



Blackjack Creek Riparian Corridor/Channel Reconstruction Review of Environmental Factors - DRAFT

January 2013



**Realising potential** 



#### Report prepared by:



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#### **Executive Summary**

This Review of Environmental Factors (REF) has been prepared by Constructive Solutions Pty Ltd (CSPL) on behalf of Gunnedah Shire Council (GSC) in order to identify, assess and provide mitigation measures for potential environmental impacts which may arise as a result of the proposed Blackjack Creek Riparian Corridor/Channel Reconstruction (the Reconstruction).

The Reconstruction is proposed as a result of the *Blackjack Floodplain Risk Management Study and Plan* (Lyall and Associates 2010), which recommended that channel realignment/reconstruction, with the aim of mitigating the impacts of flooding, be investigated. This resulted in the Blackjack Creek Riparian Corridor/Channel Reconstruction Concept Design and Feasibility Assessment undertaken by Constructive Solutions, which comprises of the following:

- Stage 1 Channel Options Study;
- Stage 2 Concept Design; and
- Stage 3 Technical Review and Detailed Design.

The Reconstruction will realign/reconstruct Blackjack Creek for approximately 1.9km stretching from approximately 200m south of the Oxley Highway Bridge in Wandobah Reserve to approximately 200m north of Lincoln Street.

This REF comprises one component of Stage 3 - Technical Review and Detailed Design and has examined the environmental components and potential impacts of the Reconstruction. This REF determines that, with the exception of impact to Core Koala Habitat, the potential negative environmental impacts of the Reconstruction can be mitigated through the recommended measures.

As the Koala is a Commonwealth and State listed threatened species under the *Environment Protection and Biodiversity Conservation Act 1999* and the *Threatened Species Conservation Act 19995* respectively, the impact to Core Koala Habitat will be assessed in a Species Impact Statement and referred to the Commonwealth Minister for the Environment through the Department of Sustainability, Environment, Water, Population and Communities.



## **1. Introduction**

# **1.1 Locality**

The Reconstruction spans a length of 1.9km of Blackjack Creek in Gunnedah NSW, from approximately 200m south of the Oxley Highway to approximately 200m north of Lincoln Street and traverses Wandobah Reserve and the private properties of 'Fermanagh' and 'Balmoral'. The Reconstruction traverses Lot 7053 DP 1116141 (Wandobah Reserve), Lot 78 DP 755503 ('Fermanagh'), Lot 77 DP 755503 ('Balmoral') and Lot 2 DP 542293 ('Balmoral'). The location of the Reconstruction in relation to Gunnedah is illustrated in Figure 1.



Figure 1 – Location of Reconstruction in relation to Gunnedah (Google Earth 2012)

# **1.2 Existing Environment**

Blackjack Creek is an ephemeral stream with a relatively small catchment covering an area of 24km<sup>2</sup>. The headwaters of Blackjack Creek are quite steep, with an average gradient of 7% over the 5.5km from the catchment boundary to Lincoln Street; however from Lincoln Street Blackjack Creek flattens, with an average gradient of 0.78% for the remaining 2.5km to the Oxley Highway Bridge (Lyall and Associates 2005).



Blackjack Creek has a historical record of floods exceeding the 20 year ARI magnitude, including those in 1984, 2008 and 2010. During these events, flooding of the residential area north of High Street to the east of Wandobah Road has occurred.

Modelling completed by Lyall and Associates in 2005, and subsequently verified by Constructive Solutions in 2012, determined that flows up to the 5 year ARI magnitude would be conveyed within the existing Blackjack Creek channel and its immediate vicinity under current conditions. However, at flows equal and greater than the 20 year ARI magnitude, floodwaters would extend to a width greater than 400m over the floodplain downstream of High Street, break the right bank of the creek upstream of McAndrew park, and enter the residential area north of High Street.

It was determined that 104 properties would be subject to above-floor flooding of up to 0.9m during a flood at the 100 year ARI magnitude, with flood damages predicted to be \$3.45 million (Lyall and Associates 2010).

Blackjack Creek traverses Wandobah Reserve and the private properties of 'Fermanagh' and 'Balmoral' in Gunnedah NSW. Wandobah Reserve is a GSC recreational area which has been heavily modified by previous vegetation clearing, flood events, flood mitigation works, and revegetation activities. Blackjack Creek consists of a grassed channel for the majority of Wandobah Reserve, with a deeper, narrower channel present at the upstream section in the southern section of Wandobah Reserve. Figures 2 to 4 illustrate the current condition of Blackjack Creek within Wandobah Reserve.



Figure 2 – Blackjack Creek in northern section of Wandobah Reserve looking south





Figure 3 – Blackjack Creek in middle section of Wandobah Reserve looking south



Figure 4 – Blackjack Creek in southern section of Wandobah Reserve looking south

'Fermanagh' and 'Balmoral' are agricultural properties which have been heavily modified for cropping and grazing purposes, with extensive vegetation clearing surrounding Blackjack Creek. The riparian zone is unfenced for both properties. Cropping and grazing, on 'Fermanagh' and 'Balmoral' respectively, occur right up



to the banks of Blackjack Creek. The creek itself is poorly defined and very shallow throughout these properties. Figures 5 to 7 illustrate the current condition of Blackjack Creek within 'Fermanagh' and 'Balmoral'.



Figure 5 – Trees lining northern extent of Blackjack Creek on 'Fermanagh' looking west from Wandobah Road with crop in foreground



Figure 6 – Limited vegetation lining southern extent of Blackjack Creek on 'Fermanagh' looking west from Wandobah Road with crop throughout paddock





Figure 7 – Extensive grassy vegetation, with a lack of trees, lining Blackjack Creek on 'Balmoral' looking south towards Lincoln Street. 'Balmoral' farm dam can be seen in left foreground, with Memorial Park buildings in left background.

The condition and composition of existing vegetation at the site is discussed in Section 6.6.

#### **1.2.1 Landforms and geology**

The Reconstruction site falls within the Brigalow Belt South Bioregion. The bedrock of the Brigalow Belt South Bioregion comprises of horizontally bedded Jurassic and Triassic quart sandstone and shale, with limited areas of conglomerate or basalts. The landscapes of the Brigalow Belt South Bioregion are derived from extensive basalt flows and quartz sandstones and, subsequently, soils and vegetation are very variable depending on local rock type and/or sediment source (Office of Environment and Heritage 2011).

Blackjack Creek has a relatively small catchment covering an area of 24km<sup>2</sup>. The headwaters of Blackjack Creek are quite steep, with an average gradient of 7% over the 5.5km from the catchment boundary to Lincoln Street; however from Lincoln Street Blackjack Creek flattens, with an average gradient of 0.78% for the remaining 2.5km to the Oxley Highway Bridge (Lyall and Associates 2005).

Soil profiles completed in 2012 for the length of Blackjack Creek from Lincoln Street to the Oxley Highway crossing determined that the soil profile mostly comprises of medium to heavy red brown clays with some calcite, sand and gravel throughout. These soil profiles are discussed in greater detail in Section 6.3.





#### 1.2.2 Climate

Climate observations for Gunnedah have been recorded at several sites, including the Pool, Resource Centre and Airport. The long-term climate averages observed at these locations are very similar and, as such, only one site has been used to provide climate information for this REF. Figure 8 illustrates the average annual temperatures and rainfall observed at the Gunnedah Pool, which is located approximately 1.5km east of Wandobah Reserve.



#### Figure 8 – Annual Temperatures and Rainfall (Weatherzone 2012)



## **2. Description of Activity**

The Reconstruction will realign/reconstruct Blackjack Creek for approximately 2km stretching from approximately 200m south of the Oxley Highway Bridge in Wandobah Reserve to approximately 200m north of Lincoln Street. The following activities will occur as part of the Reconstruction:

- Site establishment, including establishment of works compounds and installation of sediment and erosion controls;
- Clear and grub the existing floodplain for the length and width of the reconstruction;
- Strip and store topsoil from the reconstruction area;
- Excavate channel for the length and width of the reconstruction, in accordance with design;
- Construct mitre drains and stormwater inlets in accordance with design;
- Install any necessary protective materials at stormwater inlets and along Reconstruction length to prevent scour, in accordance with design;
- Spread excavated spoil on floodplain;
- Spread stored topsoil over excavated surfaces;
- Revegetate reconstruction in accordance with a Vegetation Management Plan to form a Vegetated Riparian Zone (VRZ);
- Maintain revegetation to ensure establishment (e.g. watering);
- Remove all works compounds and stockpiles;
- Monitor revegetation and sediment and erosion controls; and
- Removal of sediment and erosion controls when monitoring determines that site is stable.

The Reconstruction may also require the closure of Wandobah Road for short periods of time to facilitate construction and community access to the reconstruction site will be restricted for the duration of reconstruction.

A schematic of the Reconstruction and typical cross sections are provided in Figures 9 to 11. Greater detail regarding the construction of the Reconstruction can be found in the *Blackjack Creek Riparian Corridor/Channel Reconstruction Detailed Design*, which is provided in **APPENDIX A**.





#### Figure 9 – Schematic of the Reconstruction showing channel and Vegetated Riparian Zone (NSW Office of Water 2012)



Figure 10 – Typical cross section of upper reach of Reconstruction



Figure 11 – Typical cross section of lower reach of Reconstruction



## **3. Evaluation of Alternatives**

Following the 1984 flood, GSC commissioned the design of a channel improvement scheme with the aim of containing floods up to the 100 year ARI. The resultant scheme involved the construction of a grassed floodway with a trapezoidal cross-section, with a low-flow concrete invert. This was not constructed. Since this time, there have been significant changes in legislation and 'best practice' management of waterways, with current practice being to consider creeks as functioning riparian zones that provide a variety of environmental benefits in addition to flood conveyance. As such, any designs similar to the one previously proposed would not be considered acceptable by current standards.

The *Blackjack Creek Floodplain Risk Management Study and Plan* (Lyall and Associates 2010) investigated flood management measures under three broad categories – flood modification (e.g. structural measures such as levees and channel reconstructions), property modification (e.g. house raising, voluntary purchase, and development controls) and response modification (e.g. community awareness and flash flood warning system).

The following flood management measures were considered:

- Riparian corridor/channel reconstruction hydraulic modelling showed that, in order to achieve flood mitigation to the desired level, the hydraulic capacity of Blackjack Creek would need to be increased substantially. Although economic analysis concluded that the reconstruction would have a benefit/cost ratio of less than one, the social benefits of mitigating flooding in properties currently affected by flooding from Blackjack Creek were considered to improve the benefit/cost ratio;
- Management of vegetation and stream clearing modelling showed that stream clearing would not result in a reduction in flood levels greater than approximately 200mm and would therefore not be a viable mitigation measure for major floods of Blackjack Creek. Additionally, the cost associated with ongoing maintenance of vegetation was considered economically unfeasible;
- Detention basins 'offline' basins (located away from main stream) were considered not to be viable for Blackjack Creek due to the limited extent of the floodplain and the nature of existing landuse. A basin constructed across the creek would require a very large storage area, with investigated storage downstream of Lincoln Street having less than one third of the required storage capacity. As such, detention basins were not considered viable flood management measures for Blackjack Creek;
- Levees hydraulic modelling showed that 100 year ARI flood levels would be increased by up to 330mm due to the constricting effects of a levee spanning a distance of 1,650m from Bando Street to 200m upstream of the Oxley Highway Bridge. Additionally, the levee would require facilities for temporary detention and subsequent release of approximately 40,000m<sup>3</sup> of stored runoff from protected areas. As there are no suitable



sites available throughout the eastern residential area to achieve this storage and the levee would increase flood levels, it was not considered a viable flood management measure for Blackjack Creek;

- Voluntary purchase of residential property the residential properties affected by flooding of Blackjack Creek are technically not located in high hazard areas, flooding is relatively shallow and of short duration, there is ready access eastwards to higher ground, voluntary purchase is not favoured by residents, and voluntary purchase of affected properties is not considered economically viable. As such, this is not considered a viable flood management measure for Blackjack Creek;
- House raising raising of all residential properties potentially affected by 100 year ARI flooding is not considered economically viable, and raising properties of brick construction is considered technically difficult. These factors, combined with relatively shallow flooding of short duration and easy access eastwards to higher ground, resulted in the conclusion that house raising is not a viable flood management measure for Blackjack Creek;
- Planning controls the implementation of appropriate flood planning levels and flood policy by GSC was investigated and it was concluded that existing levels and policy should be updated to reflect current understanding and information regarding flooding in Blackjack Creek. This has been completed to ensure any future development will be protected from flooding, however this does not represent a viable flood management measure for existing properties subject to flooding from Blackjack Creek;
- Flash flood warning system the implementation of a flash flood warning system for the Blackjack Creek catchment was considered economically unviable, with the ephemeral nature of Blackjack Creek, the relatively short duration and shallow depth of flooding, and the difficulties associated with forecasting a flash flood inducing rainfall event contributing to this conclusion. Although favoured by residents, the ongoing operation of such a system should structural mitigation be implemented was also considered economically unviable; and
- Flood awareness programs it was ascertained that, as the community already has a high awareness of flooding, additional awareness programs would not have a significant impact. It was determined that notification of flood affectation on Section 149 Certificates for flood affected properties were an appropriate method of communicating flood potential. Additionally, the preparation of a FloodSafe brochure by GSC and the SES was recommended.

Full details of each measure, including economic analysis, can be found in the *Blackjack Creek Floodplain Risk Management Study and Plan* (Lyall and Assocaites 2010) which concluded that planning controls and revision of flood policy for Blackjack Creek should occur, and that the riparian corridor/channel reconstruction warranted further consideration, with the *Blackjack Creek* 



*Riparian Corridor/Channel Reconstruction Concept Design and Feasibility Study* considered the appropriate next step.

A Concept Design was prepared by Constructive Solutions in 2012, based on the recommendations of the report *Use of Geophysical Methods to Delineate Salt Affected Areas for Channel Reconstruction in Wandobah Reserve, Gunnedah* (Department of Infrastructure, Planning and Natural Resources 2003), the report *Blackjack Creek Floodplain Risk Management Study and Plan* (Lyall and Associates 2010), and field survey. The recommendations drawn from these reports, including the channel alignment recommended, were combined to provide a channel alignment and width that would be capable of containing a 1 in 100 ARI rainfall event whilst not intercepting areas of high salinity.

As part of the detailed design process, and as a result of recommendations arising from specialist ecological assessment of the site, alternatives such as retention of current channel alignment, excavation to greater depths, enhancement of the existing levee, and variation of channel width, depth and alignment to retain established trees were considered. As a result of these considerations it was determined that:

- Retention of the current channel alignment will not allow for containment of a 1 in 100 ARI rainfall event and will therefore result in the continuation of flooding of residential properties east of Wandobah Road;
- Retention of the current channel alignment allows for ongoing scour to occur at stormwater outlets, with Wandobah Road being susceptible to undercutting near its intersection with George Street;
- Excavation to greater depths is not considered optimal, as there is potential to intercept groundwater;
- Enhancement of the existing levee will not allow for containment of a 1 in 100 ARI rainfall event and will therefore result in the continuation of flooding of residential properties east of Wandobah Road, with potential for an increase in flood heights as a result of the constricting effect of a levee; and
- Variation of the channel width, depth and alignment to retain established trees is not feasible due to the above considerations, with additional construction and maintenance issues associated with retention of large trees within the excavated creek channel.

As such, it was considered that the channel alignment, width and depth proposed in the Detailed Design provides the most favourable outcome with regards to balancing flood mitigation requirements with environmental considerations such as groundwater, salinity and vegetation.



## 4. Planning Context

## 4.1 Statutory Planning

The *Environmental Planning and Assessment Act 1979* and its Regulations provide the framework for the assessment of environmental impact of activities in New South Wales. This REF is prepared in accordance with Part 5 of the *Environmental Planning and Assessment Act 1979*. Section 6 provides consideration of the factors listed in Clause 228 of the *Environmental Planning and Assessment Regulation 2000*.

As GSC is a public authority, the Reconstruction is permissible without consent under the auspices of the *State Environmental Planning Policy (Infrastructure)* 2007, with Part 3, Division 7, Clause 50(1) stating:

"Development for the purpose of flood mitigation work may be carried out by or on behalf of a public authority without consent on any land."

As GSC is a public authority, the Reconstruction is exempt from requirements relating to Controlled Activity Approvals under the *Water Management (General) Regulation 2011*, with Part 3, Division 2, Subdivision 4, Clause 38 stating:

"A public authority is exempt from section 91E (1) of the Act in relation to all controlled activities that it carries out, on or under waterfront land."

Provisions of the *Native Vegetation Act 2003* with regards to the clearing of native vegetation do not apply to the Reconstruction, with Part 3, Division 4, Clause 25 stating:

"This Act does not apply to the following types of clearing of native vegetation:

(g) any clearing that is, or is part of, an activity carried out by a determining authority within the meaning of Part 5 of the EPA Act if the determining authority has complied with that Part."

# 4.2 Local Planning Approval

The Reconstruction site is zoned RE1 – Public Recreation under the *Gunnedah Local Environmental Plan 2012*. Environmental protection works are permitted without consent under the provisions of this zone.

# 4.3 Licences and Approvals Required

As discussed in Section 4.1, the Reconstruction is exempt from requiring any Controlled Activity Approval under the *Water Management (General) Regulation 2011* and is exempt from the provisions of the *Native Vegetation Act 2003* with regards to the clearing of native vegetation.



## **5. Stakeholder Consultation**

Letters were sent to various stakeholders as part of Stage 1 – Channel Options Study, with additional letters sent to interested stakeholders as part of this REF for Stage 3 – Technical Review and Detailed Design. Table 1 provides additional details of correspondence with stakeholders. Copies of all letters sent and responses received are provided in **APPENDIX B**.

Stakeholder	Stage 1 Letter Issued	Response Received	Stage 3 Letter Issued	Response Received
Bureau of Meteorology	14/02/2012	No	n/a	n/a
Department of Planning	14/02/2012	No	10/09/2012	No
Department of Primary Industries – Aquaculture, Conservation and Marine Parks	14/02/2012	24/02/2012 - letter	10/09/2012	No
Namoi Catchment Management Authority	14/02/2012	28/02/2012 - letter	10/09/2012	08/10/2012
NSW Office of Water	14/02/2012	02/03/2012 - letter	07/09/2012	11/10/2012
Office of Environment and Heritage	f t and 14/02/2012 09/03/20 - letter		10/09/2012	13/09/2012 - email
RailCorp	14/02/2012	03/03/2012 - email	n/a	n/a
Roads and Maritime Services – Northern Region	14/02/2012	No	n/a	n/a
State Emergency Service – Namoi Region	14/02/2012	21/02/2012 - phone call	10/09/2012	No

#### Table 1 – Stakeholder Consultation

In addition to the consultation letters sent and responses received, the Namoi Catchment Management Authority (CMA) requested a meeting during which



greater detail regarding the Reconstruction could be provided to Namoi CMA staff members in order to inform their response. This meeting was held on 19 September 2012.

Extensive community consultation was undertaken as part of the *Blackjack Creek Flood Management Study and Plan* (Lyall and Associates 2010). A website has been in operation throughout the preparation of the Blackjack Creek Riparian Corridor/Channel Reconstruction Concept Design and Feasibility Study, with details of the Reconstruction provided for public access. Upon completion of the draft REF, a community information forum will be held and the draft REF will be placed on public exhibition to allow the community to review and comment. These comments will then be considered during the finalisation of the REF.



## 6. Potential Environmental Impacts and Mitigation Measures

## 6.1 Air

The generation of dust at the site as a result of soil disturbance has the potential to impact on air quality during construction of the Reconstruction. Upon completion of construction and appropriate revegetation, it is not anticipated that the site will generate any significant volumes of dust.

Recommended dust mitigation measures include:

- Staged vegetation clearing ahead of channel reconstruction in order to minimise area of exposed soil at any one time. The area of disturbance should not exceed more than half the length or width of the Reconstruction at any one time;
- Regular watering of areas of active construction and exposed soil;
- Establishing appropriate vegetative cover over disturbed areas following channel reconstruction, in accordance with the Reconstruction Vegetation Management Plan (VMP); and
- Assessment of daily meteorological conditions to ensure that any dust generating activities are halted during unfavourable conditions (e.g. high speed winds).

Heavy vehicles and machinery will be used on site for the duration of construction of the Reconstruction. Emissions from these vehicles represent a significant potential source of air quality contaminants. As such, the following mitigation measures are recommended:

- Regular servicing of vehicles in accordance with manufacturer specifications; and
- Ensuring vehicles are not left idling for long periods of time.

# 6.2 Water

Any activity which occurs on waterfront land must be carefully considered in order to limit the impacts that activity will have. Impacts to the groundwater table and surface water quality, including mobilisation of salt, as well as impacts associated with stormwater management on site, are of concern for this Reconstruction.



#### **6.2.1** Groundwater

Three piezometers were installed in Wandobah Reserve in 1999 and monitored up until 2003, with the results forming a component of the report *Use of Geophysical Methods to Delineate Salt Affected Areas for Channel Reconstruction in Wandobah Reserve, Gunnedah* (Department of Infrastructure, Planning and Natural Resources 2003). Monitoring of these piezometers determined that groundwater levels fluctuate throughout Wandobah Reserve, with levels generally rising during winter and spring when the soil moisture coefficient and evapotranspiration are at their minimums and recharge is at a maximum. During this monitoring, groundwater levels fluctuated between 0m and 5.5m in depth. These piezometers have not been consistently monitored since 2003.

Geomorphological investigations were undertaken as part of the Reconstruction project, which included the drilling of bores holes for soil testing and to ascertain groundwater depths. A total of 19 bore holes were drilled for the length of the Reconstruction. The locations of these bore holes can be found in the detailed design provided in **APPENDIX A**. Piezometers were installed for 5 of the 19 bore holes. These 5 piezometers will facilitate ongoing monitoring of the Reconstruction site throughout construction and once the site is stabilised. The location of these piezometers is illustrated in Figure 12.



Figure 12 – Location of piezometers for length of Reconstruction (Google Earth 2012)



When drilling occurred in May 2012, groundwater depths ranged across the Reconstruction site from 1.5m to over 8.5m. Subsequent monitoring of the 5 piezometers in September 2012 provided standing water levels, with these ranging from 0.087m to 1.814m in depth from the top of the piezometers. The piezometers were surveyed to allow comparison to design heights.

These groundwater depths informed the design of the Reconstruction, with the channel depths designed in order to avoid interception of the groundwater table where possible. Table 2 details the groundwater depths observed in May 2012, the standing water levels observed in September 2012 at the piezometers and the proposed excavation depths.

		Groundwater depth (m)			Depth from proposed	Depth from proposed
Bore	Design Chainage	Drilled depth May 2012	Observed Water Level Sept 2012	Proposed Excavation depth (m)	excavation to observed water depth May 2012 (m)	excavation to observed Standing Water Level Sept 2012 (m)
1	1650	6	n/a	1.307	4.693	n/a
2	1850	4.3	n/a	0.693	3.607	n/a
3	1425	3	n/a	1.123	1.877	n/a
4	1450	1.5	n/a	0.878	0.622	n/a
5	1700	7.7	1.8	1.713	5.987	0.087
6	1925	3.2	2.2	0.581	2.619	1.619
7	1984	No water @ 8.5	n/a	0.731	No water @ 7.769	n/a
8	625	2	2.44	1.39	0.61	1.05
9	325	4.5	2.26	1.387	3.113	0.873
10	0	7	2.32	0.506	6.494	1.814
11	100	3.3	n/a	0.308	2.992	n/a
12	225	4.2	n/a	1.424	2.776	n/a
13	325	4.2	n/a	1.064	3.136	n/a
14	600	2.5	n/a	1.495	1.005	n/a
15	700	1.8	n/a	1.265	0.535	n/a
16	50	3.5	n/a	0.461	3.039	n/a
17	425	3.5	n/a	1.409	2.091	n/a

#### Table 2 – Groundwater depths and proposed excavation depths



18	825	3.5	n/a	1.18	2.32	n/a
19	1125	3.5	n/a	1.833	1.667	n/a

\* Excavation depth and depth to observed water have been taken from the greatest existing surface height and greatest excavation depth proposed for each chainage in order to provide conservative figures.

The above comparison results in the consideration that the Reconstruction should not intercept groundwater tables as they stand. However, it should be noted that, as the water table beneath Blackjack Creek is subject to fluctuation, it is possible that the water table may be intercepted during construction.

A radius search for groundwater bores in the vicinity of the Reconstruction was completed and is provided in **APPENDIX C**. The works summaries provided as part of this search demonstrate that:

- 10 of the 18 identified groundwater bores are those drilled as part of geotechnical investigations for the Reconstruction. 3 of these have been equipped with piezometers for ongoing monitoring and the remainder have been backfilled and recorded as having abandoned status;
- 3 of the 18 identified groundwater bores are those drilled as part of the report Use of Geophysical Methods to Delineate Salt Affected Areas for Channel Reconstruction in Wandobah Reserve Gunnedah, NSW (Department of Infrastructure, Planning and Natural Resources 2003). No information, including drillers details, construction method, working status or drillers logs are on record with NOW for these bores;
- 2 of the 18 identified groundwater bores were drilled for monitoring in 2000, with slotted screens installed at 8.5-10m depth. However, the status of these bores is unknown;
- 1 of the 18 identified groundwater bores was drilled for monitoring in 2000, with slotted screens installed at 14.5-15.5m deep. However, the status of this bore is unknown;
- 1 of the 18 identified groundwater bores was drilled for monitoring in 2000, with slotted screens installed at 7-8 and 21-22m deep. This bore has an abandoned status; and
- 1 of the 18 identified groundwater bores was drilled in 1941 for unknown purposes, with water bearing zone identified at 15.2m. The status of this bore is unknown.

Based on the above, the majority of groundwater bores within the Reconstruction vicinity are for monitoring purposes and intercept the shallow water table between 2-8m deep. The installation of slotted screens at depths of 14.5, 15.2 and 21m for some of these bores indicates the presence of a deeper water table. Given that the majority of groundwater bores within the Reconstruction vicinity are for monitoring purposes and there are no stock and domestic or irrigation bores recorded as utilising groundwater within the vicinity



of the Reconstruction, it is considered that the Reconstruction is unlikely to have any negative impact on groundwater usage.

In order to ensure that the Reconstruction does not have a negative impact on the groundwater in the area, a groundwater monitoring program will be established during and post-construction in order to ascertain the long-term effects of the Reconstruction on groundwater. This groundwater monitoring program will consist of quarterly monitoring of the 5 piezometers installed in 2012 during construction and site stabilisation and annual monitoring once the site is stabilised.

Ongoing monitoring of these parameters will allow for comparison to testing completed in September 2012. Details of the testing completed in September 2012 are provided in **APPENDIX D** and indicate that groundwater quality in the vicinity of the Reconstruction is considered to be suitable for agricultural and irrigation purposes, with sodium absorption rates (SAR) ranging from 1.8 to 13.5. The vast majority of crops will not experience foliar damage as a result of such low SAR values.

#### 6.2.2 Surface Water

Erosion and sediment control in waterways such as Blackjack Creek is important to prevent erosion of creek banks and deposition of sediment downstream. As part of the design process, hydraulic calculations were completed for the length of the Reconstruction in order to determine at which points the design should incorporate protective materials. These calculations are provided in **APPENDIX E**.

Permissible velocities were determined using the 'Blue Book' *Managing Urban Stormwater: Soil and Construction* (Landcom 2004). Table 3 provides the steps undertaken to determine the permissible velocities for the Reconstruction.

Item	Value	Source
Soil landscape	Curlewis – Black Jack	Table C7, pg. C-35
USCS Class	СН	Soil testing results and OEH 2012 DSNR USCS: Field Method
K-factor	0.015-0.020	Table C7, pg. C-35
Erodibility (K)	Low	Table 5.2, pg. 5-24
Critical velocity – Couch, Carpet	2.0 m/s	Table 5.2, pg. 5-24

# Table 3 – Determination of maximum design flow velocities using the 'BlueBook'



Item	Value	Source
grass, Rhodes grass, etc		
Critical velocity – Jute or coir mesh	2.3 m/s	Table 5.2, pg. 5-24
Critical velocity – gabions and reno mattresses (0.17m thickness and 70-100mm aggregate size)	3.5 m/s	Table 5.2, pg. 5-24

As a result of hydraulic calculations, it has been determined that the reconstructed Blackjack Creek will be subject to velocities above the maximum design flow velocity for grasses at certain chainages. Protective materials have been incorporated into the detailed design to ensure that erosion is prevented at chainages where vegetation alone will not sufficiently stabilise the channel. The location of the varying protective materials is provided in the detailed design in **APPENDIX A** and are summarised in Table 4.

Design Chainages	Velocities (m/s)	Protective Material
0 - 775	<2.0	Grasses
800 - 1025	>2.0 and <2.3	Jute or coir mesh
1050	>2.3 and <3.5	Reno mattress
1075 - 1825	>2.0 and <2.3	Jute or coir mesh
1850 - 1875	>2.3 and <3.5	Reno mattress
1900 - 1950	>2.0 and <2.3	Jute or coir mesh

#### Table 4 – Location of protective materials for length of Reconstruction

Incorporation of such protective materials into the Reconstruction, combined with revegetation in accordance with the VMP, will result in the provision of a stable channel which should not experience occurrences of scour and erosion.

During and upon completion of construction of the Reconstruction, suitable erosion and sediment controls shall be installed and maintained in accordance with an Erosion and Sediment Control Plan (ESCP) which should be prepared by the construction contractor following the auspices of *Managing Urban Stormwater: Soils and Construction* – the 'Blue Book' (NSW Landcom 2004). This ESCP should include the following:

• Site map clearly identifying location of work compounds and stockpiles;



- Erosion control practices including design criteria of structural measures and details of monitoring and maintenance; and
- Sediment control practices, such a temporary sediment fencing, including details of monitoring and maintenance.

The *Blackjack Creek Riparian Corridor/Channel Reconstruction Detailed Design* (Constructive Solutions 2012) provides details such as:

- Extent of vegetation clearing and site disturbance;
- Proposed final site contours;
- Existing and proposed drainage pattern; and
- VMP mapping.

The provisions of the *Detailed Design* should be carefully considered in the ESCP.

As the Reconstruction alignment will intercept landholder constructed dams on 'Balmoral' and 'Fermanagh', GSC will investigate the provision of alternative water sources for these properties, such as new dams or groundwater bores. Investigations regarding this will be made as part of the acquisition/compensation process associated with GSC's acquisition of the necessary land.

## 6.3 Soils and Geology

Wandobah Reserve has been the subject of extensive investigations to delineate salinity levels, with the report *Use of Geophysical Methods to Delineate Salt Affected Areas for Channel Reconstruction in Wandobah Reserve Gunnedah, NSW* (Department of Infrastructure, Planning and Natural Resources 2003) providing guidance as to where to locate the channel reconstruction in order to avoid mobilising salt. The results of this report were used to guide the design of the Reconstruction, with the channel alignment generally following areas determined to have lower salinities.

The 2003 report determined that salinity decreases with depth throughout the reserve. As part of a geomorphological assessment carried out in May 2012 and in order to determine current surface salinities, additional soil testing was carried out for the top 30cm of soil at the 19 boreholes which were drilled for the length of the Reconstruction. As the majority of the 1999 samples occurred on the western side of Wandobah Reserve or away from the current and proposed channel alignment, many of the boreholes drilled in 2012 do not match those sampled in 1999 for the 2003 report. However, for the purposes of a general comparison, 1999 samples which occurred nearby those that occurred in 2012 revealed that, for the majority of the samples, salinity in the top 30cm had decreased. Details of this comparison are provided in **APPENDIX F**.



Soil profiling undertaken on soil cores collected as part of the geomorphological assessment showed that the Reconstruction site is comprised of clays, with some calcite located throughout. Laboratory analysis of soil samples showed that salinities ranged from 0.50-7.30 Ece (dS/m) and 0.05-0.73 EC 1:5 (dS/m). These soils profiles and the laboratory analysis of soil samples are provided in **APPENDIX G**.

The Reconstruction will result in the disturbance of soil for the length of the Reconstruction, with the following volumes derived from the design:

- 54,000m<sup>3</sup> cut;
- 30,500m<sup>3</sup> fill; and
- 10,000m<sup>3</sup> stripped topsoil.

These volumes indicate that approximately 23,500m<sup>3</sup> of cut will remain after fill is used for construction of banks and mitre drains. This cut will be spread over the floodplain surrounding the creek to a width of approximately 100m, resulting in an approximate depth of 10cm. The stripped topsoil will be spread over a similar area to facilitate revegetation.

As discussed above, salinity has been identified as an existing issue for Wandobah Reserve and the Reconstruction may intercept saline soils as part of the excavation, with the resultant cut volume being saline. It is considered, however, that:

- Areas of high salinity will not be disturbed, with the design incorporating the recommendations of the report *Use of Geophysical Methods to Delineate Salt Affected Areas for Channel Reconstruction in Wandobah Reserve Gunnedah, NSW* (Department of Infrastructure, Planning and Natural Resources 2003) as to general channel location;
- It is likely that disturbed areas will have low salinity levels, as soil salinity has previously been shown to decrease with depth and 2012 testing indicated that surface salinity levels were generally lower than previously recorded; and
- The anticipated low salinity levels of the disturbed soil will result in the remaining cut which is to be spread over the floodplain also having low salinity levels.

As such, while there is some potential for mobilisation of salt as a result of the Reconstruction, it is considered that the Reconstruction has been designed so as to limit the risk of mobilisation.

Staging of construction will aid in mitigating the impacts of soil disturbance, with the disturbed area not to exceed an area greater than half the length and width of the Reconstruction at any one time. Staging of construction will also allow for staging of revegetation, as per the VMP, which will further aid in reducing potential erosion and sediment impacts.



During and upon completion of construction of the Reconstruction, suitable erosion and sediment controls shall be installed and maintained in accordance with an Erosion and Sediment Control Plan (ESCP) which should be prepared by the construction contractor following the auspices of *Managing Urban Stormwater: Soils and Construction* – the 'Blue Book' (NSW Landcom 2004). This ESCP should include the following:

- Site map clearly identifying location of work compounds and stockpiles;
- Erosion control practices including design criteria of structural measures and details of monitoring and maintenance; and
- Sediment control practices, such a temporary sediment fencing, including details of monitoring and maintenance.

The *Blackjack Creek Riparian Corridor/Channel Reconstruction Detailed Design* (Constructive Solutions 2012) provides details such as:

- Extent of vegetation clearing and site disturbance;
- Proposed final site contours;
- Existing and proposed drainage pattern; and
- VMP mapping.

The provisions of the *Detailed Design* should be carefully considered in the ESCP.

## 6.4 Noise and Vibration

Following the *NSW Industrial Noise Policy* (Office of Environment and Heritage 2000), the residential area adjoining Wandobah Reserve can be classified as suburban, as it is an area that has local traffic with characteristically intermittent traffic flows, or with some commerce or industry. The *NSW Industrial Noise Policy* provides the following recommended maximum noise levels from industrial sources for suburban residences:

- Day 60dB(A);
- Evening 50dB(A); and
- Night 45dB(A).

Receptor distance varies along the length of the Reconstruction site from a minimum of 100m to distances greater than 300m. Residences situated between Kilcoy Street and McAndrew Park are the closest sensitive receptors at a minimum distance of 110m, with the cemetery being located 100m from the Reconstruction site. Assuming that the daytime operation of an excavator results in the generation of 104dB(A) at the source, the inverse distance law can be



used to calculate anticipated noise levels at receptors of varying distances. Table 5 provides anticipated noise levels at various distances.

Distance	Noise Level dB(A)
100m	64
110m	63
120m	62
130m	61
150m	60
180m	58

#### Table 5 – Anticipated noise levels at varying distances

The majority of residences located along Wandobah Road are located at distances of 150m or greater from the Reconstruction site and are not considered likely to experience noise levels above the recommended maximum. However, residences located between Kilcoy Street and McAndrew Park are closer to the Reconstruction site and may experience noise at levels above the recommended maximum. The cemetery in Memorial Park may also experience exceedances.

Given the relatively short duration of construction, it is anticipated that the exceedances identified above can be mitigated by the following:

- Undertaking construction between the hours of 7am to 6pm Monday to Friday and 8am to 1pm Saturday;
- Notifying affected residences prior to undertaking any activities which produce high noise levels (e.g. channel excavation);
- Ensuring vehicles and machinery are not left idling for long periods of time;
- Fitting of residential class mufflers to all machinery; and
- Regular servicing of vehicles and machinery in accordance with manufacturer specifications.



# 6.5 Traffic and Transport

The Reconstruction is likely to result in some traffic and transport impacts as a result of the need to use Wandobah Road to access the Reconstruction site, such as movement of machinery along Wandobah Road and use of Wandobah Road for site access by construction personnel. It is anticipated that these impacts would be relatively short in duration and not affect the overall traffic flow and function of Wandobah Road.

In order to mitigate any potential impacts on traffic and transport, the following measures are recommended:

- Implementation of suitable traffic control procedures to prevent unnecessary traffic impacts and related road safety issues;
- Signage in accordance with GSC's Workplace Health and Safety requirements informing passers-by of the construction works; and
- Ensuring, where possible, that transport of heavy machinery, construction equipment, and other construction items is conducted outside of peak flow times (i.e. 8am-9.30am and 4pm-6pm).

# 6.6 Flora

A specialist ecological assessment of the site was undertaken in accordance with OEH's Environmental Impact Assessment requirements. These requirements can be found in Attachment 1 of the OEH/EPA response provided in **APPENDIX B**. The specialist ecological assessment is provided in **APPENDIX H**.

The ecological assessment concluded that:

- The Study Area has been extensively modified (vegetation clearing and levee construction), disturbed (weed encroachment, rubbish dumping, and garden clipping disposal), and cleared within the southern extent for cropped paddocks
- 111 species of vascular flora from 37 families were recorded in the Study Area during the field survey;
- Of these, 60 species are non-native, including 6 species of listed Noxious Weeds of which one species is a Weed of National Significance;
- No threatened flora, populations, or endangered ecological communities listed under the *Threatened Species Conservation* (TSC) or *Environment Protection and Biodiversity Conservation* (EPBC) Acts were recorded in the Study Area;
- The Reconstruction will result in the removal of 30-37 identified habitat trees with medium and high habitat values, which are considered to be a declining and rare resource within the landscape; and



• The Reconstruction will result in the removal of additional non-hollow bearing trees and shrubs within the impact footprint that, while planted, still provide valuable habitat and flowering resources for threatened fauna.

The following mitigation measures were recommended as a result of the ecological assessment:

- Areas of vegetation to be cleared should be clearly marked with high visibility tape to ensure that accidental clearing does not occur;
- Tree clearing should be undertaken with care, in accordance with details provided in Section 6.7;
- Best practice weed management practices should be in place to prevent the transfer of weed seeds and vegetative materials, including storage of plant in weed-free areas and appropriate wash-down and maintenance of plant, with all measures to be implemented prior to commencement of construction and maintained throughout the duration of construction and site stabilisation;
- Any herbicides used should be waterway friendly, as per Department of Primary Industries guidelines;
- An Erosion and Sediment Control Plan should be implemented and maintained for the duration of construction and site stabilisation;
- Progressive rehabilitation of the Study Area upon completion of construction of each section;
- Retention of top soil in order to maintain a viable seed bank, with topsoil to be used in rehabilitation. Soil should be respread as soon as possible after excavation in order to maximise fertility, seed viability and microbial activity;
- Exposed ground should be sprayed with native grass seeds, as per the Vegetation Management Plan (VMP); and
- Rehabilitation of the creek in accordance with the VMP, with preference given to Koala feed tree species.

A VMP for the Reconstruction can be found in **APPENDIX I**.

# 6.7 Fauna

A specialist ecological assessment of the site was undertaken in accordance with OEH's Environmental Impact Assessment requirements. These requirements can be found in Attachment 1 of the OEH/EPA response provided in **APPENDIX B**. The specialist ecological assessment is provided in **APPENDIX H**.

The ecological assessment concluded that:

• 61 species of terrestrial fauna from 31 families were recorded in the Study Area during the field survey;



- The abundance of honeyeaters recorded during the field survey is likely to be a result of the flowering resources in the Study Area at the time;
- No amphibians were heard calling or detected in Blackjack Creek. This may be an indication of unsuitable creek conditions for amphibian habitat;
- It is considered likely that further species of fauna may occur in the Study Area as a result of the habitat present, however they were not detected during the field surveys;
- Three species of threatened fauna were recorded in the Study Area, including the Koala (TSC and EPBC Acts), Little Lorikeet (TSC Act) and Grey-headed Flying Fox (TSC and EPBC Acts);
- Hollow dependent threatened microbats and threatened owls (Masked Owl and Barking Owl) are assumed to be present in the Study Area based on the variety and number of suitable hollows present;
- The Study Area is considered to be a 'High Use Activity' area for Koalas (TSC and EPBC Acts) with evidence of Koala use at 22 of the 37 trees within the impact footprint of the Reconstruction. This is a density of 59% as per the Spot Assessment Technique, with one mature male Koala recorded in the Cemetery adjacent to the Study Area;
- The Reconstruction will result in the removal of 30-37 identified habitat trees with medium and high habitat values, which are considered to be a declining and rare resource within the landscape;
- The Reconstruction will result in the removal of additional non-hollow bearing trees and shrubs within the impact footprint that, while planted, still provide valuable habitat and flowering resources for threatened fauna;
- The Koala would be significantly affected by the Reconstruction as it will have a significant impact on Core Koala Habitat; and
- No other threatened fauna species will be significantly affected by the Reconstruction.

As the Reconstruction will significantly affect Core Koala Habitat, a Species Impact Statement is being prepared and the Reconstruction will be referred to the Federal Environment Minister through the Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC).

The following mitigation measures were recommended as a result of the ecological assessment:

• A Koala Plan of Management should be prepared and rehabilitation should include proposals to enhance and expand Core Koala Habitat, with direction on successful revegetation for the Koala in the Gunnedah area to be drawn from Crowther *et al.* 2010;



- Prior to any tree clearing, care should be taken to identify nests and/or roosting sites and/or threatened species, including:
  - A pre-clearing check of hollow bearing trees in the impact footprint to identify breeding sites of threatened species;
  - Inspection of trees prior to pushing or felling to ensure nests are vacant, with pushing or felling to occur immediately after inspection;
  - If a bird is present in a nest, trees surrounding it should be cleared first to encourage dispersement. If the bird is nestling, all feasible measures should be taken to collect the bird and remove it to a safe location, including contacting local WIRES representatives; and
  - Thorough inspection of all trees to be trimmed or removed for the presence of Koalas or other fauna immediately prior to clearance;
  - Felled trees should be left on site overnight to allow any remaining fauna to disperse;
  - Logs with hollows from felled trees may be scattered throughout the Reconstruction site to provide additional habitat;
- Construction works should occur outside the spring breeding period for most hollow dependent fauna and outside the Rainbow Bee-eater breeding season between November and January;
- All food scraps and rubbish are to be appropriately disposed of in sealed receptacles to prevent the provision of forage habitat for foxes, rats, dogs and cats;
- Any herbicides used should be waterway friendly, as per Department of Primary Industries guidelines;
- An Erosion and Sediment Control Plan should be implemented and maintained for the duration of construction and site stabilisation;
- Replication of a natural riparian system in the restored areas through implementation of creek meandering, varying widths, and pool and riffle sequences should be implemented throughout the Reconstruction; and
- The following Biodiversity Offsets should be implemented:
  - Habitat values of hollow bearing trees are to be replaced at a 1:1 ratio with nest boxes suitable for large owls, rosella/grass parrots, Brown Treecreepers and microbats. These nest boxes:



- Are to be maintained until plantings reach a suitable size;
- Should be placed in adjacent appropriate habitat as identified in consultation with the National Parks and Wildlife Service;
- Primary feed trees for Koala in the Gunnedah locality should be planted at a ratio of 1:10, with plantings aimed at linking existing remnant vegetation through the use of corridors, in partnership with existing recovery plans and Namoi revegetation programs;
- Impacted vegetation of the Poplar Box grassy woodland or Box-Gum Woodland communities should be offset with plantings at a 1:1 ratio; and
- Rehabilitation of disturbed areas within the Study Area in accordance with the VMP, with preference to be given to Koala feed tree species.

The Reconstruction will be referred to the DSEWPAC as a result of the significant impact to Core Koala Habitat, with DSEWPAC determination and recommendations to be incorporated into the final REF.

# 6.8 Heritage

A search of the *Aboriginal Heritage Information Management System* (AHIMS) dated 23 April 2012 showed that there are no Aboriginal sites or places located in or near the Reconstruction site. A copy of the AHIMS search can be found in **APPENDIX J**. Several site features result in the consideration that it is highly unlikely that any Aboriginal objects or places would be found within the Reconstruction site. These include:

- The highly modified nature of the Reconstruction site, particularly through the southern extent where cultivation and grazing has previously disturbed the soil;
- The highly disturbed nature of the Reconstruction site, with historical flooding events previously disturbing the soil; and
- The presence of a permanent water source (the Namoi River) to the north of the Reconstruction site, with the ephemeral nature of Blackjack Creek being less suitable for utilisation.

Although the due diligence process has been followed, there is still some potential for objects of Aboriginal cultural heritage significance to be found during construction. In order to mitigate this, the following measures are recommended:

• Establishment of `no-go' areas for all non-essential construction areas, with no excavation to occur outside the proposed reconstruction;



- Ensure construction staff are made aware of the potential for objects of Aboriginal cultural heritage significance to occur on site as part of the site induction process;
- Minimise, where possible, vehicle access to the site, with works compounds, parking areas, and stockpiling areas to be clearly designated; and
- If any objects of potential Aboriginal cultural heritage significance are found during the disturbance of soil, work must cease immediately and OEH should be notified. The relevant Aboriginal Heritage Planning Officer for Gunnedah is located in Dubbo. Contact details can be found at http://www.environment.nsw.gov.au/contact/Dubbo.htm.

With regards to European heritage, a search of the New South Wales heritage register identified one heritage item for the Gunnedah Shire Council Local Government Area (LGA). This item is the Gunnedah Railway Station Group, which is not located within the Reconstruction site and will not be impacted by the Reconstruction. It is noted that, given the historical patterns of European settlement within the Gunnedah region, there is some potential for remnants of original farm houses, watering points such as windmills, or other agriculturally-related artefacts to occur which could potentially be disturbed by construction of the Reconstruction. However, it is considered that, given the well-represented nature of such artefacts throughout Gunnedah and other LGAs, any disturbance of such items as a result of the Reconstruction will not result in a significant negative impact to European heritage values in Gunnedah.

## 6.9 Chemical and Hazardous Substance Management

Although it is anticipated that the majority of materials used in the construction of the Reconstruction will be benign in nature (such as soil and vegetation), there is some potential for the use of chemicals or hazardous substances on site (such as herbicides for weed control). As such, the following mitigation measures should be implemented:

- Using any chemicals or hazardous substances on site in accordance with safe handling practices, including provisions of any relevant Safety Data Sheets;
- Storage of any chemicals or hazardous substances on site in accordance with safe handling practices, including being stored in a bunded area and being removed from site when not in use;
- Ensuring that a chemical spill kit is kept on site at all times; and
- Locating any works compound for the purpose of chemical or hazardous substance storage, refuelling, parking of machinery, and stockpiling construction materials at least 40m from any drainage lines including Blackjack Creek.



# 6.10 Contaminated Land

No contamination issues were identified during site inspections, and groundwater and soil testing, nor were any records of contamination located in GSC records. However, there is some anecdotal evidence that car bodies were buried in 'Balmoral' as a stabilisation measure in the 1990's. If the proposed reconstruction encounters these car bodies, appropriate soil testing should be undertaken to ascertain the presence of any contamination and, if present, appropriate remediation should be undertaken.

Monitoring of the piezometers, as outlined in Section 6.2, will facilitate in the detection and remediation of any contamination should it occur.

# 6.11 Visual Impacts

It is considered likely that there will be some negative impacts on visual amenity of the Reconstruction site during construction, as materials for construction, works compounds and vehicles and machinery will be present on the site during construction.

Visual amenity impact will be experienced by people travelling along the Oxley Highway, residents living or driving along Wandobah Road, and any persons visiting the Gunnedah Cemetery. People travelling along the Oxley Highway will be subject to visual amenity impact for a short period of time only as they pass by. People living and/or travelling along Wandobah Road will be subject to a higher level of visual amenity impact; however those living at the northern end of Wandobah Road will be mitigated slightly by the extensive nature of the vegetation present at the northern end of Wandobah Reserve.

People visiting the cemetery will be subject to visual amenity impacts, with very little vegetation present to act as a screen from visual impacts.

While negative impacts will occur as a result of construction, it is considered that the completed reconstruction will provide for positive visual amenity impacts, with the improved channel and associated revegetation being more visually pleasing than the current degraded stream. It is hoped that by improving the visual amenity of Wandobah Reserve, the ongoing dumping of waste in the Reserve by local residents will cease, thus providing additional amenity improvements.

In order to mitigate any negative visual impacts the Reconstruction may have, the following measures are recommended:

 Locating stockpiles and works compounds, where possible, in areas away from roads and out of the line of sight of any nearby residents or passersby. This could include the utilisation of the nearby GSC depot as a works compound and stockpiling area in order to limit the storage of items on the Reconstruction site;


- Removing vehicles and machinery from site when not in use, with the nearby GSC depot to act as a base for these;
- Implementing and maintaining appropriate erosion and sediment control in accordance with the ESCP; and
- Carrying out revegetation in accordance with the PVP.

# **6.12 Social Impacts**

The Reconstruction may have some negative impacts on social values during construction, with limited access to Wandobah Reserve, visual impacts as described in Section 6.11, and some traffic and transport impacts as described in Section 6.5. It is anticipated that the mitigation measures provided in the relevant sections will address these impacts.

The Reconstruction will have some significant positive impacts on social values. By providing adequate flood mitigation, the negative impacts of flooding on currently flood-liable properties and their residents will be significantly improved. The extensive revegetation of the Reconstruction length, as provided for in the Vegetation Management Plan, will improve the visual amenity of the Reconstruction site. Additionally, there is potential for the community to be involved in site revegetation, thus contributing to community values and increasing community 'ownership' of the site.

Wandobah Reserve is currently utilised by some members of the community as a waste dumping zone, with a broad array of wastes (including household waste, used nappies, broken equipment such as strollers, used tyres, and dead animals) frequently encountered by GSC staff during routine maintenance activities. It is anticipated that the limiting of access to the site during construction, combined with the improved visual amenity of the site once revegetation is successfully established, will result in decreased instances of waste dumping as community 'ownership' of Wandobah Reserve increases. However, this cannot be guaranteed and GSC should continue to educate residents as to the appropriate methods of waste disposal.

The impact upon the landholders of 'Balmoral' and 'Fermanagh' can be considered to be negative, in that a portion of land which may previously have been used for agricultural purposes will no longer be available for such activities; however GSC will be required to adequately compensate the landholders for the acquisition of any required land. This will include the provision of suitable replacement water sources for the farm dams which are intercepted by the Reconstruction alignment, as previously discussed.

The New South Wales government, through agencies such as the Namoi CMA, have been encouraging landholders to improve riparian areas on private land for some time in order to combat environmental issues such as erosion, salinity and loss of biodiversity. The Reconstruction may provide further benefits for the remaining surrounding private land as a result of the improved environmental



function of the riparian corridor, such as improved soil structure and increased organic matter content. This represents a significant positive benefit for the landholders, with no requirement for any direct capital contribution from these landholders.

In order to minimise the social impact that the Reconstruction will have, the following measures are recommended:

- Provision of notification to residents of anticipated commencement and completion dates for the Reconstruction, via a letterbox drop and/or advertising in the local newspaper;
- Maintaining a project webpage linked to the GSC website in order to provide the community with ongoing progress updates for the Reconstruction;
- Ensuring that GSC administration staff are aware that any queries or concerns relating to the Reconstruction should be directed to the GSC project manager; and
- Ensuring that the GSC project manager, or their representative, respond to any such queries or concerns appropriately and within a reasonable timeframe.

# 6.13 Safety

There is some potential for safety issues to arise during the construction of the Reconstruction, particularly with regards to the operation of heavy machinery and the felling of trees. GSC is required to consider the safety of any members of staff, contractors, or the public who may come into contact with any activities associated with the Reconstruction.

In order to mitigate any safety issues, the following measures should be implemented:

- Inducting all site staff and contractors, with a site induction to cover all relevant aspects of Workplace Health and Safety, including emergency procedures;
- Ensuring all staff and contractors are appropriately trained, with heavy vehicles and machinery only to be operated by qualified personnel; and
- Installing and maintaining adequate safety measures, for the duration of the construction, in accordance with Workplace Health and Safety laws and regulations.



# 6.14 Electricity Use and Greenhouse Gas Emissions

The ongoing operation of the Reconstruction, once constructed, will not use electricity nor generate Greenhouse Gas (GHG) emissions as it will be an entirely natural environmental system. While GSC is under no obligation to offset the small volume of Greenhouse Gas (GHG) emissions that will be generated by the Reconstruction, comparing the potential GHG emissions to those of an average car provides an indicator of the potential impact the Reconstruction will have with regards to GHG generation.

The average car generates 5.2 tonnes of carbon dioxide equivalent ( $CO_2$ -e) per annum. Operation of a diesel powered excavator (or similar equipment such as front-end loader or back-hoe) using 20L per hour for 8 hours per day for three weeks for channel excavation would generate 6.967 tonnes of carbon dioxide equivalent ( $CO_2$ -e). Operation of a tip truck for the movement of soil from cut areas to fill areas using 10L per hour for 4 hours per day for three weeks would generate 1.36 tonnes  $CO_2$ -e (Carbon Neutral 2012).

These figures will vary based on machinery used and total construction time; however, from the above preliminary calculations, the construction of the Reconstruction is anticipated to generate slightly more GHG emissions than one average car.

While it is considered that the extensive revegetation proposed will adequately offset any emissions generated, the following additional measures are recommended:

- Regular servicing of vehicles and machinery in accordance with manufacturer specifications; and
- Ensuring vehicles and machinery are not left idling for extended periods of time.

# 6.15 Resource and Waste Management

The Reconstruction will not use materials or resource which are, or are likely to become, short in supply with the majority of materials required for construction being benign in nature and readily available.

All disturbed soil will be used on site, with stripped topsoil to be stockpiled for revegetation, and excavated soils from cut areas to be used as fill where required. Any additional soil will be evenly distributed across the Reconstruction site.

Rock for channel stabilisation is readily available from commercial suppliers, with quarries in the New England-North West region having the capability to supply appropriate materials for this purpose.



Seeds and/or plants for revegetation purposes will be sourced locally, where possible, to ensure provenance. Species listed in the VMP are considered to be common and readily available.

Any other additional wastes which may be generated by the Reconstruction will be disposed of at the nearest Waste Management Facility, with recycling to be utilised where possible.

# **6.16 Cumulative Impacts**

Currently there are no developments proposed which will generate or contribute additional water volumes for Blackjack Creek to convey. However, the area is zoned to allow for future residential development, with residential development such as the Mornington Heights subdivision having occurred recently. As Wandobah Reserve is zoned for public recreation and environmental protection, it is anticipated that the revegetation which will occur as part of the Reconstruction will contribute to mitigating the cumulative impacts of vegetation clearing in the surrounding area.

Should any future residential or other development be proposed which will generate or contribute additional storm water volumes for Blackjack Creek to convey, careful consideration should be given by the proponent to volumetric run-off calculations and appropriate on-site stormwater management to ensure that any such contributions arising from the development do not significantly impact on the carrying capacity of Blackjack Creek during flood conditions.

Category	Mitigation Measure			
Air	<ul> <li>Staged clearing of vegetation ahead of construction to minimise area of exposed soil;</li> </ul>			
	<ul> <li>Regular watering of areas of active construction and exposed soil;</li> </ul>			
	• Establishing appropriate vegetative cover over disturbed areas following channel reconstruction in accordance with Reconstruction Vegetation Plan;			
	<ul> <li>Assessment of daily meteorological conditions to ensure that any dust generating activities are halted during unfavourable conditions;</li> </ul>			
	<ul> <li>Regular servicing of vehicles and machinery in accordance with manufacturer specifications; and</li> </ul>			
	• Ensuring vehicles are not left idling for extended periods of time.			
Water	Construction according to design;			

# 6.17 Summary of Mitigation Measures



Category	Mitigation Measure			
	Groundwater Monitoring Plan;			
	<ul> <li>Installation of protective materials according to design; and</li> </ul>			
	Erosion and Sediment Control Plan.			
Soils and Geology	Erosion and Sediment Control Plan; and			
	Vegetation Management Plan.			
Noise and Vibration	<ul> <li>Undertaking construction between the hours of 7am-6pm Monday to Friday and 8am-1pm on Saturday;</li> </ul>			
	<ul> <li>Notifying affected residents prior to undertaking any activities which produce high noise levels;</li> </ul>			
	<ul> <li>Ensuring vehicles are not left idling for extended periods of time;</li> </ul>			
	<ul> <li>Fitting of residential class mufflers to all vehicles and machinery, where possible; and</li> </ul>			
	• Regular servicing of vehicles and machinery in accordance with manufacturer specifications.			
Traffic and Transport	<ul> <li>Implementation of suitable traffic control procedures to prevent unnecessary traffic impacts and related road safety issues;</li> </ul>			
	• Signage in accordance with GSC Workplace Health and Safety requirements informing passers-by of the construction works; and			
	• Ensuring, where possible, that transport of heavy machinery, construction equipment and other construction items is conducted outside of peak flow times.			
Flora	<ul> <li>Areas of vegetation to be cleared should be clearly marked with high visibility tape to ensure that accidental clearing does not occur;</li> </ul>			
	• Tree clearing should be undertaken with care, in accordance with details provided in Section 6.7;			
	• Best practice weed management practices should be in place to prevent the transfer of weed seeds and vegetative materials, with all measures to be implemented prior to commencement of construction and maintained throughout the duration of construction and site stabilisation;			
	<ul> <li>Any herbicides used should be waterway friendly, as per Department of Primary Industries guidelines;</li> </ul>			
	• An Erosion and Sediment Control Plan should be implemented and maintained for the duration of construction and site stabilisation;			
	<ul> <li>Progressive rehabilitation of the Study Area upon completion of construction of each section;</li> </ul>			
	• Retention of top soil in order to maintain a viable seed bank,			



Category	Mitigation Measure			
	with topsoil to be used in rehabilitation. Soil should be respread as soon as possible after excavation in order to maximise fertility, seed viability and microbial activity;			
	<ul> <li>Exposed ground should be sprayed with native grass seeds, as per the Vegetation Management Plan; and</li> </ul>			
	<ul> <li>Rehabilitation of the creek in accordance with the Vegetation Management Plan, with preference to be given to Koala feed tree species.</li> </ul>			
Fauna	• A Koala Plan of Management should be prepared and rehabilitation should include proposals to enhance and expand Core Koala Habitat, with direction on successful revegetation for the Koala in the Gunnedah area to be drawn from Crowther <i>et al.</i> 2010;			
	<ul> <li>Prior to any tree clearing, care should be taken to identify nests and/or roosting sites and/or threatened species, including:</li> </ul>			
	<ul> <li>A pre-clearing check of hollow bearing trees in the impact footprint to identify breeding sites of threatened species;</li> </ul>			
	<ul> <li>Inspection of trees prior to pushing or felling to ensure nests are vacant, with pushing or felling to occur immediately after inspection;</li> </ul>			
	<ul> <li>If a bird is present in a nest, trees surrounding it should be cleared first to encourage dispersement. If the bird is nestling, all feasible measures should be taken to collect the bird and remove it to a safe location, including contacting local WIRES representatives; and</li> </ul>			
	<ul> <li>Thorough inspection of all trees to be trimmed or removed for the presence of Koalas or other fauna immediately prior to clearance;</li> </ul>			
	<ul> <li>Logs with hollows from felled trees may be scattered throughout the Reconstruction site to provide additional habitat;</li> </ul>			
	• Construction works should occur outside the spring breeding period for most hollow dependent fauna and outside the Rainbow Bee-eater breeding season between November and January;			
	<ul> <li>All food scraps and rubbish are to be appropriately disposed of in sealed receptacles to prevent the provision of forage habitat for foxes, rats, dogs and cats;</li> </ul>			
	<ul> <li>Any herbicides used should be waterway friendly, as per Department of Primary Industries guidelines;</li> </ul>			
	An Erosion and Sediment Control Plan should be implemented and maintained for the duration of construction			



Category	Mitigation Measure			
	and site stabilisation;			
	• Replication of a natural riparian system in the restored areas through implementation of creek meandering, varying widths, and pool and riffle sequences should be implemented throughout the Reconstruction; and			
	The following Biodiversity Offsets should be implemented:			
	<ul> <li>Habitat values of hollow bearing trees are to be replaced at a 1:1 ratio with nest boxes suitable for large owls, rosella/grass parrots, Brown Treecreepers and microbats. These nest boxes:</li> </ul>			
	<ul> <li>Are to be maintained until plantings reach a suitable size;</li> </ul>			
	<ul> <li>Should be placed in adjacent appropriate habitat as identified in consultation with the National Parks and Wildlife Service;</li> </ul>			
	<ul> <li>Primary feed trees for Koala in the Gunnedah locality should be planted at a ratio of 1:10, with plantings aimed at linking existing remnant vegetation through the use of corridors, in partnership with existing recovery plans and Namoi revegetation programs;</li> </ul>			
	<ul> <li>Impacted vegetation of the Poplar Box grassy woodland or Box-Gum Woodland communities should be offset with plantings at a 1:1 ratio; and</li> </ul>			
	• Rehabilitation of disturbed areas within the Study Area in accordance with the VMP, with preference to be given to Koala feed tree species.			
Heritage	<ul> <li>Establishment of 'no go' areas for all non-essential construction areas, with no excavation to occur outside the propped reconstruction;</li> </ul>			
	• Ensuring construction staff or contractors are made aware of potential for objects of Aboriginal cultural heritage significance to occur on site as part of the site induction process;			
	• Minimise, where possible, vehicle access to the site, with works compound, parking areas and stockpiling areas to be clearly designated; and			
	• If any objects of potential Aboriginal cultural heritage significance are found during soil disturbance, work must cease immediately and the OEH Aboriginal Heritage Planning Officer at Dubbo must be contacted.			
Chemical and Hazardous Substance	<ul> <li>Using any chemical or hazardous substance on site in accordance with safe handling practices, including provisions of any relevant Material Safety Data Sheets;</li> </ul>			
Management	<ul> <li>Storage of any chemicals or hazardous substances in accordance with safe handling practices, including being</li> </ul>			



Category	Mitigation Measure			
	stored in a bunded area and removed from site when not in use;			
	<ul> <li>Ensuring that a chemical spill kit is kept on site at all times; and</li> </ul>			
	<ul> <li>Locating any works compound at least 40m from any drainage line, including Blackjack Creek.</li> </ul>			
Contaminated Land	• If potential contamination is encountered during construction, undertake appropriate testing and remediation, as necessary			
Visual Impacts	<ul> <li>Locating stockpiles and works compounds, where possible, in areas away from roads and out of the line of sight of any nearby residents or passers-by;</li> </ul>			
	• Removing vehicles and machinery from site when not in use;			
	• Implementing and maintaining appropriate erosion and sediment control in accordance with Erosion and Sediment Control Plan; and			
	Carrying out revegetation in accordance with Vegetation Management Plan.			
Social Impacts	<ul> <li>Provision of notification to residents of anticipated commencement and completion dates for the Reconstruction, via a letterbox drop and/or advertising in the local newspaper;</li> </ul>			
	• Maintaining a project webpage linked to the GSC website in order to provide the community with ongoing progress updates for the Reconstruction;			
	• Ensuring that GSC administration staff are aware that any queries or concerns relating to the Reconstruction should be directed to the GSC project manager; and			
	• Ensuring that the GSC project manager, or their representative, respond to any such queries or concerns appropriately and within a reasonable timeframe.			
Safety	• Inducting all site staff and contractors, with site induction to cover all relevant aspects of Workplace Health and Safety, including emergency procedures;			
	• Ensuring all staff and contractors are appropriately trained, with heavy vehicles and machinery only to be operated by qualified personnel; and			
	• Installing and maintaining adequate safety measures for the duration of the construction, in accordance with Workplace Health and Safety laws and regulations.			
Electricity Usage and Greenhouse	<ul> <li>Regular servicing of vehicles and machinery in accordance with manufacturer specifications;</li> </ul>			



Category	Mitigation Measure				
Gas Emissions	<ul> <li>Ensuring vehicles are not left idling for extended periods of time; and</li> </ul>				
	<ul> <li>Undertaking revegetation in accordance with Vegetation Management Plan.</li> </ul>				
Resource and Waste Management	<ul> <li>All disturbed soil is to be used on site, with stripped topsoil to be stockpiled for revegetation and excavated soil used as fill where required. Any additional soil will be evenly distributed across the site;</li> </ul>				
	<ul> <li>Seeds and/or plants for revegetation will be sourced locally, where possible, to ensure provenance; and</li> </ul>				
	<ul> <li>Any additional wastes generated will be disposed of at the nearest Waste Management Facility, with recycling to occur if possible.</li> </ul>				
Cumulative Impacts	<ul> <li>Any future developments should consider the contribution of the development to stormwater volumes being handled by Blackjack Creek, with provision of adequate management measures to prevent any reduction in the carrying capacity of Blackjack Creek</li> </ul>				



# 7. New South Wales EP&A Act 1979 – Part 5 Considerations

As part of its obligations under Section 111 of the *Environmental Planning and Assessment Act 1979* GSC is required to take into account, to the fullest extent possible, all matters likely to affect the environment as listed in Clause 228 of the *Environmental Planning and Assessment Regulation 2000*. The Clause 228 factors are listed in items **A to P** below.

For the purpose of this report the following abbreviations shall apply:

- na not applicable
- nil no impact
- -ve negative impact

## +ve – positive impact

For each of the descriptive factors that follow, the most appropriate of the aforementioned abbreviations shall be highlighted.

## A) Any environmental impact on a community?



Comments:

The Reconstruction will have a positive environmental impact on the Gunnedah community, particularly residents along and near Wandobah Road, as it will provide for improved flood mitigation, improved visual amenity for Wandobah Reserve and the private properties, improved utilisation of the riparian corridor by local fauna and, potentially, improved community ownership of the site.

The short-term construction impacts identified in this REF can be addressed through application of the mitigation measures proposed, with the long-term benefits considered to outweigh the short-term impacts.

## B) Any transformation of a locality?



comments.

The Reconstruction will transform the locality in a positive manner by providing for a fully vegetated riparian corridor which will improve fauna utilisation of the site, reduce flooding impacts on adjacent properties, and improve the visual



amenity of the site. This will include the establishment of vegetation in accordance with the Vegetation Management Plan that will enhance the natural nature of the site and complement revegetation works undertaken to date in Wandobah Reserve.

Additionally, it is anticipated that associated increases in community ownership of the site may assist in reducing instances of waste dumping.

## C) Any environmental impact on the ecosystems of the locality?



Comments:

Several large hollow-bearing trees will be removed as part of the Reconstruction, thus impacting negatively on the terrestrial ecosystem in the short-term; however the provision of nesting boxes and extensive revegetation of the site will result in improved habitat outcomes in the long-term. Revegetation using appropriate local species will facilitate future utilisation of the site by fauna species which may be experiencing habitat decline.

Due to the ephemeral nature of Blackjack Creek, the groundwater investigations which were incorporated into the design, and the proposed mitigation measures, it is considered that the Reconstruction will not have any negative impacts on ground or surface water ecosystems in the locality.

# D) Any reduction of the aesthetic, recreational, scientific, or other environmental quality or value of a locality?

	na	nil	-ve	+ve	
Com	ments	:			-

comments.

The Reconstruction will have a positive impact on the aesthetic and recreational qualities of Wandobah Reserve and the upstream private properties by providing a fully functioning riparian corridor which is far more visually pleasing than the current degraded channel.

The installation of the piezometers and the proposed groundwater monitoring program will enhance scientific knowledge regarding groundwater tables and salinity levels in the Wandobah Reserve area.

## *E)* Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historic, scientific, or social significance or other special value for present or future generations?



na	nil	-ve	+ve		
 a ma ma a maka a					

Comments:

The Reconstruction will significantly improve the aesthetic and social values of the locality by providing a fully vegetated riparian corridor and by reducing the impacts of flooding on adjacent properties. The Reconstruction site does not have any archaeological, architectural, cultural, historic or scientific significance.

## F) Any impact on the habitat of protected fauna?



Comments:

The Reconstruction will result in the removal of trees which are considered to be Core Koala Habitat. Koalas are a threatened species which is protected under both the State TSC Act and the Commonwealth EPBC Act. As this impact is considered significant, a Species Impact Statement is being prepared and the Reconstruction is being referred to DSEWPAC.

Mitigation measures are proposed in Section 6.7 of this REF.

# *G)* Any endangering of any species of animal or plant or other forms of life, whether living on land, in water, or in the air?

na nil	-ve	+ve
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Comments:

No species of animal or plant or other forms of life will be significantly endangered by the Reconstruction, with appropriate mitigation measures proposed to ensure that terrestrial fauna vacate vegetation prior to felling and that the Reconstruction site is revegetated with locally common species.

The protective measures proposed for installation as part of the Reconstruction to ensure that scouring and erosion do not occur will mitigate the impact that sediment loads are currently having on Blackjack Creek, potentially improving the habitat potential of the creek for aquatic flora and fauna.

## H) Any long term effects on the environment?



**Revision C** 



The Reconstruction will result in a long-term positive improvement to the environment, with the establishment of a stable channel with a vegetated riparian corridor providing for a greater range of habitat for local fauna, greater connectivity of Wandobah Reserve with nearby bushland, improvements in soil salinity and erosion, and potential improvements in community ownership of the site, thus reducing the prevalence of illegal rubbish dumping within the Reserve.

These improvements will be in addition to the positive impact of mitigating the flood impacts for the Blackjack Creek catchment.

# *I)* Any degradation of the quality of the environment?

na nil -ve +ve
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Comments:

There will be some negative impacts to the quality of the environment during construction, with many of being addressed through the proposed mitigation measures. However once the Reconstruction is finished, including site stabilisation and establishment of revegetation, the improved riparian corridor will provide for a positive improvement in the quality of the environment, with a greater range of habitat for local fauna, greater connectivity of Wandobah Reserve to nearby bushland, and improvements with regards to salinity and erosion.

# J) Any risk to the safety of the environment?

	na	nil	-ve	+ve	
-					

Comments:

There is some potential for negative impacts to the safety of the environment as a result of construction, with salt mobilisation within the creek and erosion and sedimentation issues being the main concerns. The current condition of Blackjack Creek is subject to erosion and it is considered that the measures provided in the REF and design will provide for the stabilisation of this, thus negating any scour and erosion impacts.

While salinity may be mobilised in the short-term during construction, provision of an improved channel may assist in lowering site salinities as water will no longer pool throughout Wandobah Reserve following rainfall events, and revegetation may assist in reducing salinities, with deep-rooted plants assisting in drawing the water table, and thus the salt layer, deeper.



## *K)* Any reduction in the range of beneficial uses of the environment?

	na	nil	-ve	+ve	
_	mmente				

Comments:

There will be no reduction in the range of beneficial uses of the environment, with Wandobah Reserve still acting as a recreational reserve for community use. Although the riparian corridor will reclaim land through the two private properties which have been used for agricultural production, the environmental benefits provided by the riparian corridor are anticipated to improve the environmental quality of the adjacent land.

## L) Any pollution of the environment?



Comments:

While salinity may be mobilised in the short-term during construction, provision of an improved channel may assist in lowering site salinities as water will no longer pool throughout Wandobah Reserve following rainfall events, and revegetation may assist in reducing salinities, with deep-rooted plants assisting in drawing the water table, and thus the salt layer, deeper.

In addition, it is hoped that the Reconstruction will improve community ownership of the site, potentially through community involvement in the revegetation process, and result in less occurrences of waste dumping within Wandobah Reserve.

## M) Any environmental problems associated with the disposal of waste?



comments.

The Reconstruction will not result in the generation of large volumes of waste which will require disposal, with excess soil to be spread over the site and any additional site wastes to be disposed of accordingly at the nearest Waste Management Facility, as per Section 6.15.

# *N)* Any increased demands on resources (natural or otherwise) that are, or are likely to become, short in supply?

na	nil	-ve	+ve
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## Comments:

The Reconstruction does not utilise resources that are, or are considered likely to become, short in supply.

# *O)* Any cumulative environmental effect with other existing or likely future activities?

	na	nil	-ve	+ve	
Сс	mmen	ts:			

There are no proposed or current developments which will result in cumulative impacts when considered with the Reconstruction. However as noted in Section 6.16, should any further development be proposed, careful consideration should be given to the carrying capacity of Blackjack Creek. GSC has guidelines in place to ensure that developers manage stormwater accordingly.

# P) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?

	na	nil	-ve	+ve
Сс	mmen	ts:		

The Reconstruction site is not located within a coastal zone and, as such, does not experience coastal processes nor is it subject to coastal hazards. Climate change conditions have been considered for the Reconstruction, with the design incorporating a freeboard which is anticipated to accommodate predicted changes in climate conditions for the Blackjack Creek catchment.



# 8. Commonwealth EPBC Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) requires that the following matters of National Environment Significance be considered. Under the provisions of the EPBC Act, any action that has, or is likely to have, a significant impact on these matters or on Commonwealth Land requires referral to the Commonwealth Minister for the environment for approval.

An EPBC Protected Matters Report for the Reconstruction site can be found in **APPENDIX D**.

	Matter of NES		Im	oact	
(a)	Any environmental impact on a World Heritage property?	na	-ve	nil	+ve
<b>(b)</b>	Any environmental impact on wetlands of international importance?	na	-ve	nil	+ve
(c)	Any environmental impact on Commonwealth listed threatened species or ecological communities?	na	-ve	nil	+ve

Comments:

As per Section 6.7 and the specialist ecological assessment provided in **APPENDIX H** the Reconstruction will have an environmental impact on Core Koala Habitat. Koala is a Commonwealth listed threatened species. As such, a Species Impact Statement is being prepared and the Reconstruction will be referred to the Commonwealth Minister for the Environment through DSEWPAC.

No Commonwealth listed threatened ecological communities will be significantly impacted by the Reconstruction.

(d) Any environmental impact on Commonwealth listed migratory species?	-ve	nil	+ve	

Comments:

As per the specialist ecological assessment provided in **APPENDIX H** the Reconstruction will not have any significant environmental impact on Commonwealth listed migratory species.

(e)	Does any part of the Proposal involve a nuclear action?	na	-ve	nil	+ve
(f)	Any environmental impact on a	na	-ve	nil	+ve



	Commonwealth marine area?				
<b>(g)</b>	Any direct or indirect effect on Commonwealth land?	na	-ve	nil	+ve

Comments:

An area of Commonwealth land – Australian Telecommunications Commission – is identified as being near the Reconstruction site. However, extensive Dial Before You Dig searches have confirmed that there are no telecommunication or electrical wires within the Reconstruction site. As such, it is anticipated that there will be no direct or indirect effect on Commonwealth land.

\_\_\_\_\_

From the table above, it can be determined that the Reconstruction requires referral to the Commonwealth Minister for the Environment through DSEWPAC as the Reconstruction will have a significant negative environmental impact on Core Koala Habitat, with Koala being a listed threatened species in the EPBC Act.



# 9. Conclusion

This REF has detailed the activities, potential environmental impacts, and suitable mitigation measures associated with the proposed Blackjack Creek Riparian Corridor/Channel Reconstruction.

The REF determines that while there is some potential for short-term construction impacts to occur and the Reconstruction will require the removal of some established trees within Wandobah Reserve, these short-term impacts are outweighed by the positive benefits associated with the improved Blackjack Creek riparian corridor, such as flood mitigation, provision of a fully vegetated riparian corridor for the length of the Reconstruction, improved habitat, and improved social and aesthetic values.

However, the Reconstruction will have a significant impact on Core Koala Habitat and, as such, requires preparation of a Species Impact Statement and referral to the Commonwealth Minister for the Environment through DSEWPAC.

This REF has considered the potential environmental impacts of the Reconstruction and has determined that the impacts arising from the construction of the Blackjack Creek Riparian Corridor/Channel Reconstruction will be adequately mitigated if all recommended mitigation measures are implemented.

## Declaration

This REF provides a true and fair review of the proposed activity in relation to its likely effects on the environment. It addresses to the fullest extent possible all matters affecting, or likely to affect, the environmental as a result of the proposed activity.

Name:	Sarah Horne
Signed:	
Designation:	Environmental Scientist/Project Officer
Date:	18 January 2012



# **10.** References

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# APPENDIX A Detailed Design

# GUNNEDAH SHIRE COUNCIL BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION



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# LOCALITY PLAN

# Client: GUNNEDAH SHIRE COUNCIL

COVERSHEET

**BLACKJACK CREEK RIPARIAN CORRIDOR &** CHANNEL RECONSTRUCTION

esign Completed:	Designed:	Status:	
03.12.2012	DB		PR



SHEET NUMBER	DESCRIPTION
201201-001	COVER SHEET
201201-002	SHEET INDEX
201201-003	OVERALL SITE PLAN
201201-004	EXISTING CONDITIONS & TEST BORE PLAN SHEET 1
201201-005	EXISTING CONDITIONS & TEST BORE PLAN SHEET 2
201201-006	EXISTING CONDITIONS & TEST BORE PLAN SHEET 3
201201-007	EXISTING CHANNEL LONGITUDINAL SECTION & TYPICAL SECTIONS
201201-008	PLAN & LONGITUDINAL SECTION CH 0.000 - CH 675.000
201201-009	PLAN & LONGITUDINAL SECTION CH 675.000 - CH 1350
201201-010	PLAN & LONGITUDINAL SECTION CH 1350.000 - CH 1984.870
201201-011	MITRE DRAIN LONGITUDINAL SECTIONS
201201-012	STORMWATER DRAINS 1 & 2 PLAN & LONGITUDINAL SECTIONS
201201-013	CROSS SECTIONS CH 0.000 - CH 75.000
201201-014	CROSS SECTIONS CH 100.000 - CH 175.000
201201-015	CROSS SECTIONS CH 200.00 - CH 275.000
201201-016	CROSS SECTIONS CH 296.868 - CH 375.000
201201-017	CROSS SECTIONS CH 391.789 - CH 475.000
201201-018	CROSS SECTIONS CH 500.000 - CH 558.536
201201-019	CROSS SECTIONS CH 571.143 - CH 649.161
201201-020	CROSS SECTIONS CH 654.059 - CH 725.530
201201-021	CROSS SECTIONS CH 750.000 - CH 825.000
201201-022	CROSS SECTIONS CH 850.000 - CH 916.384
201201-023	CROSS SECTIONS CH 950.000 - CH 1000.000
201201-024	CROSS SECTIONS CH 1015.366 - CH 1050.000
201201-025	CROSS SECTIONS CH 1075.000 - CH 1150.000
201201-026	CROSS SECTIONS CH 1174.042 - CH 1250.000
201201-027	CROSS SECTIONS CH 1275.000 - CH 1350.000
201201-028	CROSS SECTIONS CH 1379.411 - CH 1448.564
201201-029	CROSS SECTIONS CH 1475.000 - CH 1544.836
201201-030	CROSS SECTIONS CH 1575.000 - CH 1625.000
201201-031	CROSS SECTIONS CH 1650.000 - CH 1700.000
201201-032	CROSS SECTIONS CH 1725.000 - CH 1775.000
201201-033	CROSS SECTIONS CH 1800.000 - CH 1850.000
201201-034	CROSS SECTIONS CH 1875.000 - CH 1925.000
201201-035	CROSS SECTIONS CH 1946.078 - CH 1961.796
201201-036	PLAN & LONGITUDINAL SECTION FOR RE-ALIGNED 'BALMORAL' ACCESS ROAD
201201-037	VEGETATED RIPARIAN ZONE EXTENTS PLAN - BLACKJACK CREEK
201201-038	RIPARIAN RESTORATION ZONE - SHEET 1
201201-039	RIPARIAN RESTORATION ZONE - SHEET 2
201201-040	RIPARIAN RESTORATION ZONE - SHEET 3

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SHEET INDEX		BLACKJACK CREEK RIPARIAN CORRIDO

CHANNEL RECONSTRUCTION						
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- $_{}$   $_{}$  TELSTRA LINE
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**EXISTING CONDITIONS & TEST BORE PLAN** SHEET 1

# **GUNNEDAH SHIRE COUNC**

**BLACKJACK CREEK RIPARIAN CORRIDO** CHANNEL RECONSTRUCTION

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	12	236409.360	6569195.250	4.2m	
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			ISTRUCTIVI	E SOLUTIONS	PTY. LTD. 40 Australia
OR &			(02) 6762 19	969 Fax: (02) (	6762 1969
		Email:	: admin@co www.constru	nstructivesolutions.c	ons.com.au com.au
	Plan Size		Drawing No:	201201	
NK Y		<b>A</b> 1		201201	-004



	TELEPHONE POLE					
$\bigcirc$	SEWER MANHOLE					
$\textcircled{\textcircled{0}}$	PC	WER POLE				
$\oslash$	ST	AY POLE				
	MC	ONITORING BORE				
$\bigcirc$	TR	EE				
/ / /	FE	NCE				
=======	ST	ORMWATER PIPE				
s s	SE	WER MAIN				
T T	ΤE	LSTRA LINE				
— е — е —	O∖	ERHEAD POWERLINE				

А	03.12.2012	DB	ISSUED FOR REVIEW		
REV.	DATE	BY	DESCRIPTION	CHK.	



Client:

**EXISTING CONDITIONS & TEST BORE PLAN** SHEET 2

GUNNEDAH SHIRE COUNCIL CONSTRUCTIVE SOLUTIONS PTY. LTD. PO Box 1498 Tamworth NSW 2340 Australia Tel: (02) 6762 1969 Fax: (02) 6762 1969 Email: admin@constructivesolutions.com.au **BLACKJACK CREEK RIPARIAN CORRIDOR &** CHANNEL RECONSTRUCTION www.constructivesolutions.com.au Plan Size: Drawing No: 201201-005 **JARY A1** 

Design Completed:	Designed:	Status:	
03.12.2012	DB		PRELIMIN

WANDOBAH ROAD LOT 78 1 DP 755503 GROUNDWATER MONITORING BORE SCHEDULE WATER DEPTH FROM SURFACE EASTING NORTHING 236220.590 6568841.060 2m 236204.660 6568905.390 2.5m 236151.450 6568802.360 1.8m 236119.780 6568666.580 3.5m 235981.090 6568413.480 3.5m



Λ	02 42 2042	סח		
A	03.12.2012	ЪВ	1350ED FOR REVIEW	
REV.	DATE	BY	DESCRIPTION	CHK.

Design Completed:	Designed:	Status:
03.12.2012	DB	PRELIMINA



Design Completed:	Designed:	Status:	DDELIM
03.12.2012	DB		PRELIMI



Design Completed:	Designed:	Status:	
03.12.2012	DB		PRELIMIN



%										0.6%			
275.153	275.348	275.543	275.663	275.732 275.764	275.894	276.052	276.209 276.251	276.367	276.524	276.676	276.839	276.997	277.154
276.47	276.69	275.84	275.40	275.19 275.62	276.73	277.52	277.60 277.66	277.68	277.76	277.96	278.17	278.36	278.51
950.000	975.000	000.000	1015.366	024.190 029.288	050.000	075.000	1100.000 1106.706	1125.000	1150.000	174.042	200.000	225.000	250.000

Design Completed:	Designed:	Status:	
03.12.2012	DB		PRELIMINA



CHAN	NEL RECONSTRUCTION
BLACKJACK	CREEK RIPARIAN CORR

Design Completed: Designed: Status:				
03.12.2012 DB PRELIMIN	Design Completed: 03.12.2012	Designed:	Status:	PRELIMINA

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280.852	281.073	281.100	281.285	281.329	281.497	281.709	281.920	282.132	282.344	282.555	282.767	282.902	282.960	283.120	283.279
280.91	281.51	281.68	282.01	282.00	282.14	282.38	282.45	282.60	282.36	282.54	282.78	282.89	282.99	283.20	283.30
\$25.000	50.000	653.168	575.000	680.169	100.000	125.000	750.000	175.000	300.000	325.000	350.000	365.928	375.000	000.006	925.000



Design Completed: 03.12.2012	Designed:	Status:	PRELIMINA

				0.7	1%							•
279.671	279.707	279.742	279.778	279.813	279.849	279.885	279.920	279.956	279.991	280.027	280.063	280.086
279.68	279.69	279.70	279.69	279.77	279.80	279.80	279.79	279.75	279.72	279.85	280.00	280.09
55.000	60.000	65.000	70.000	75.000	80.000	85.000	90.000	95.000	100.000	105.000	110.000	113.289



		1.	0%									**	
NCN.17	279.100	279.150	279.200	279.250	279.300	279.350	279.400	279.450	279.500	279.550	279.600	279.647	
217.02	279.04	279.17	279.27	279.32	279.34	279.35	279.42	279.52	279.62	279.71	279.81	279.87	
0.000	75.000	30.000	35.000	90.000	95.000	000.00	)5.000	10.000	15.000	20.000	25.000	29.726	

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271.746	271.780	271.815	271.849	271.883	271.917	271.952	271.986					
271.78	271.82	271.86	271.89	271.91	271.94	271.96	271.99	272.02	272.13	272.30	272.46	272.46
100.000	105.000	110.000	115.000	120.000	125.000	130.000	135.000	14.0.000	145.000	150.000	155.000	155.037



			1 in 9.0		1 in 9.0			IN 4.0	
R.L. 267.000									
	268.563 268.676	268.676	268.115	268.115	268.115	268.676	268.676	268.274	
	268.53 268.56 268.57 268.57	268.57	268.55	268.08	268.63	268.29	268.28	268.27	268.26
	-24.485 -22.485 -22.031	-20.031	- 15.000	0.000	15.000	20.031	22.031	23.643	25.643

R.L. 266.900										
	268.184	268.439	268.439	267.939	267.939	267.939	268.439	268.439	268.244	e to
268.20	268.18	268.29	268.38	268.40	267.95	268.48	268.35	268.30	268.24	268.20
-26.544	-24.544	-22.000	-20.000	- 15.000	0.00	15.000	20.000	22.000	23.947	25.947

DI 266 50											
N.E. 200.30		268.159	268.262	268.262	267.762	267.762	267 762	268.262	() () () () () () () () () () () () () (	200.202 768 108	700.100
	268.14	268.16	268.17	268.19	268.21	267.58	15 8.4C	268.22		200.LI	268.05
	-25.028	-23.028	-22.000	-20.000	- 15.000	0.00	1 000 000	20.000		אטט.22 אטט.22	25.534

			0.0	%	10.0%	0.097	0.08/		10.0%	0.0%	-10.0%	
R.L. 266.400						0.0%	0.0%					
DESIGN SURFACE		267.996	268.124	268.124	267.624	267.624		267.624	268.124	268.124	267.965	
EXISTING SURFACE	267.93	268.00	268.03	268.07	268.13	267.54		268.23	268.03	267.99	267.97	267.93
OFFSET	-25.276	-23.276	-22.000	-20.000	- 15.000	0.000		15.000	20.000	22.000	23.587	25.587

6					
SIONS					
REVI					
	А	03.12.2012	DB	ISSUED FOR REVIEW	
	REV.	DATE	BY	DESCRIPTION	CHK.

Ch 75.000

Ch 50.000

Ch 25.000

Ch 0.000

SCALE <u>1 2 3 4 5m</u> HORIZ: 1:100 VERT: 1 0 1 2 3 4 5m 1:100

# Client: **GUNNEDAH SHIRE COUNCIL**

# BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

**CROSS SECTIONS** CH 0.000 - CH 75.000

Design Completed:	Designed:	Status:	
03.12.2012	DB		PRE





				1 in 6.9			1 in 6.9			
R.L. 267.600	)									
		269.283 269.390	269.390	268.645	268.645	רע אלג אר	269.390	269.390	268.674	
	269.26	269.28 269.29	269.31	269.35	269.05	78 87 268 87	268.66	268.66	268.67	268.68
	-24.554	-22.554	-20.125	- 15.000	0.000	ער 000 000	20.125	22.125	24.988	26.988

		_			1 in 7.5			1 in 7.5			
R.L. 267.4(	00										
		268.611	269.152	269.152	268.469	708.409	0 768 469 268	269.152	269.152	268.581	
	268.64	268.61	268.59	268.65	268.78	268.62	268 75	268.61	268.60	268.58	268.57
	-26.259	-24.259	-22.094	-20.094	- 15.000	0.000	ער 1000 1000 1000	20.094	22.094	24.379	26.379

		11	in 4.0	0.0%	1 in 8.1	0.0%	0.0%	1 in 8.	1	).0% 1	in 4.0	
R.L. 267.200	0											
DESIGN SURFACE		268.520	268.914	268.914	268.292		268.292	268.292	268.914	268.914	268.479	
EXISTING SURFACE	268.56	268.52	268.56	268.60	268.60		268.32	268.66	268.51	268.49	268.48	268.46
OFFSET	-25.638	-23.638	-22.063	-20.063	- 15.000		0.000	15.000	20.063	22.063	23.805	25.805

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	А	03.12.2012	DB	ISSUED FOR REVIEW		
	REV.	DATE	BY	DESCRIPTION	CHK.	

1 ir	6.4			
268.822	269.628	269.628	269.106	
269.25	269.17	269.14	269.11	269.08
15.000	20.156	22.156	24.241	26.241

Ch 175.000

Ch 150.000

Ch 125.000

Ch 100.000



# Client: GUNNEDAH SHIRE COUNCIL

# BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

CROSS SECTIONS	
CH 100 000 - CH 175 000	
	Design C

ign Completed: 03.12.2012	Designed: DB	Status:	PRELIMI





				1 in 5.8				
R.L. 268.100								
	270.246	269.107	269.107	269.107	270.011	270.011	269.715	
	270.24	270.48	269.42	269.88	269.77	269.73	269.72	269.69
	-21.554 -19.554	- 15.000	0.000	15.000	20.207	22.207	23.391	25.391

			1 in 4.0	0.0%	0.0%	1 in 6.0	0.0%		
R.L. 267.90	0								
DESIGN SURFACE		270.209	268.999	268.999	600 890	269.865	269.865	269.566	
EXISTING SURFACE	270.20	270.21	270.25	269.40	8 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	269.60	269.58	269.57	269.55
OFFSET	-21.839	-19.839	- 15.000	0.00	1 000 000	20.188	22.188	23.385	25.385

VERT:

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	А	03.12.2012	DB	ISSUED FOR REVIEW		
	REV.	DATE	BY	DESCRIPTION	CHK.	

		1 in 4.0	
269.529	269.529	270.681	
269.82	270.67	270.68	270.67
0.000	15.000	19.610	21.610

		1 in 5.3			
265.902	269.352	270.341	270.341	270.143	
269.69	270.21	270.17	270.15	270.14	270.13
000.0	15.000	20.250	22.250	23.043	25.043

Ch 250.000

Ch TP215.347

Ch 200.000



## Client: **GUNNEDAH SHIRE COUNCIL**

# BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

CROSS SECTIONS	
CH 200.000 - CH 275.000	

Design Completed:	Designed:	Status:	
03.12.2012	DB		PREL





	1 in 4.2			
270.236	270.236	271.530	271.191	
271.05	271.29	271.19	271.19	271.19
0.000	15.000	22.407	23.763	25.763

			0.0%		
		1 in 4.4			
270.037		271.262	271.262	271.188	
270.40	1 1 1	271.22	271.19	271.19	271.16
0.000		20.372	22.372	22.668	24.668

_			
269.883	269.883	271.215	
270.16	271.30	271.22	271.20
0.000	15.000	20.330	22.330

	0.0%	1 in 4.0	
269.684	269.684	270.901	
270.05	270.87	270.90	270.88
0.000	15.000	19.868	21.868

	Client: GUN	INEDA	H S	HIRE COUNCIL
CROSS SECTIONS CH 296 868 - CH 375 000	BLAC	CKJACK C & CHANN	REE	K RIPARIAN CORRIDOR ECONSTRUCTION
	Design Completed: 03.12.2012	Designed: DB	Status:	PRELIMINARY




270.956	270.956	272.492	272.492	272.219	
271.58	272.65	272.33	272.24	272.22	272.19
0.000	15.000	20.990	22.990	24.081	26.081

270.774	272.249	272.249	271.975	
271.47	272.10	272.00	271.97	271.97
000.0	20.756	22.756	23.854	25.854

	1 in 3.9			
270.576	270.576	271.987 271.987	271.560	
271.49	271.97	271.60 271.58	271.56	271.54
0.000	15.000	20.504	24.214	26.214

		1 in 4.1	0.0%	-	
	0.0%				
270.355	רי קדר 10 קדר 10	271.690	271.690	271.408	
271.15	۳ ۲ ۲ ۲ ۲	271.40	271.41	271.41	271.41
0.00.0	۲ 000	20.428	22.428	23.553	25.553

**CROSS SECTIONS** CH 391.789 - CH 475.000

### Client: **GUNNEDAH SHIRE COUNCIL**

## **BLACKJACK CREEK RIPARIAN CORRIDOR** & CHANNEL RECONSTRUCTION

Design Completed:	Designed:	Status:	
03.12.2012	DB		PRELIM







				0.0%	1 in 3.9	0.0%
R.L. 269.900	)					
DESIGN SURFACE		272.399	272.734	272.734	271.139	
EXISTING SURFACE	272.32	272.40	272.48	272.63	272.55	
OFFSET	-26.562	-24.562	-23.223	-21.223	- 15.000	

SIONS						
REVIS						
	А	03.12.2012	DB	ISSUED FOR REVIEW		
	REV.	DATE	BY	DESCRIPTION	СНК.	

## CROSS SECTIONS CH 500.000 - CH 558.536

## Client: GUNNEDAH SHIRE COUNCIL

## BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

0.0%

	& CHANN	IEL R	ECONSTRUCTION
esign Completed: 03.12.2012	Designed:	Status:	PRELIMINARY



SCALE

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1:100

HORIZ: 1 0 1 2 3 4 5m

VERT: 1 0 1 2 3 4 5m



Ch 525.000

271.321	271.321	272.976	272.704	
272.24	272.74	272.66	272.70	272.76
0.00.0	15.000	23.456	24.546	26.546

Ch TP558.536

271.566	271.566	273.301	273.301	273.082	
273.20	273.31	273.02	273.06	273.08	273.11
0.000	15.000	21.769	23.769	24.646	26.646





		29
		1 in 2.2
272.386	272.386	
273.72	273.62	
0.00.0	15.000	

		1 in 3.9	
272.150	272.150	274.014 274.014	777 66
273.71	273.54	273.46	C 77 ELC
000.0	15.000	22.306	26 586

		. 29			
		1 in 3.2			
271.905	271.905	273.728	273.728	273.320	
273.12	273.40	273.27	273.30	273.32	273.34
0.000	15.000	22.125	24.125	25.756	27.756

Design Completed: 03.12.2012	Designed: DB	Status:	PRELIMI	
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272.86	274.87	
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0.000	15.000 22.849 24.849 29.884	
Ch 700.000		
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0 4 0	287 587 797	
0 272.6	0 274.5 0 274.5 0 273.1	
273.9	273.8 273.8 273.8 273.8	
0000	22.668 21.824 29.824	
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	0.0% 1 in 4.0	
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272.45	274.31 274.31 273.6(	
273.78	273.65 273.60 273.57 273.57	
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Ch 654.059		
HORIZ: 1 0 1 2 3 4 5m		
VERT: 1 0 1 2 3 4 5m 1 : 100		
	Client: GUNNEDAH SHIRE COUNCIL CONSTRUCTIVE SOLUTIONS PT	Y. LTD.
	BLACK.IACK CREEK RIPARIAN CORRIDOR PO Box 1498 Tamworth NSW 2340 / Tel: (02) 6762 1969 Fax: (02) 6762	Australia 2 1969
	& CHANNEL RECONSTRUCTION Email: admin@constructivesolutions.com	.com.au .au

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Ch 725.530						
		1 in 3.9				
2.885	2.885	4.873	4.873	14.114		
4.07 27	4.03 27	4.09 27	4.10 27	4.11 27	4.12	
00 27,	00 27,	49 271	49 27	84 27	84 27	
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Ch 700.000						
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272.64	272.64	274.58	274.58	273.79		
273.90	273.80	273.80	273.80	273.80	273.80	
0.000.0	5.000	2.668	4.668	7.824	9.824	
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273.7		273.6		273.6	273.6	273.5
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Ch 654.059						
HORIZ: 1 0 1 2 3 4 5m 1 : 100						
VERT: 1 0 1 2 3 4 5m 1 : 100						
	Client: GUNNEDA	H SHIRE COL	JNCI	L		CONSTR
CROSS SECTIONS	BLACKJACK C	REEK RIPARIAN CO	ORRIDO	R 🚄	P(	O Box 14 Tel: (02)
	& CHANN	NEL RECONSTRUCT	ION			WWW.

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274.0	274.0	274.09	274.10	274.1	274.12
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273.9	273.8	273.8	273.8(	273.8(	273.8
0000	15.000	22.668	24.668	27.824	29.824
ՐԵ 675 000					
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Lh 654.059					
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CROSS SECTIONS	BLACKJACH & CHA	NNEL RECONSTRUCT	) KRIDC ION	)K	
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273.13	273.13	275.16	275.16	274.49		
4.50	4.36	4.40	4.44	4.49 2 4.54		
0 27	0 27	3 27	3 27	4 27 4 27		
00.00	15.00	23.03	25.03	27.71 29.71		
Ch 725.530						
	1 in	3.9				
2.885	2.885	4.873	4.873	4.114		
07 27	03 27	09 27	.10 27	.11 27		
274.	274.	274.4	274	274. 274.		
0000	15.000	2.849	4.849	7.884 9.884		
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272.43	272.43		274.34	274.34	273.60	
3.78	13.65		13.62	73.61 2	73.60	
.2	2.2		16 27	16 2	)4 2 <sup>-</sup> )4 2 <sup>-</sup>	
0.0	15.00		22.5	24.5	27.5(29.5(	
Ch 654.059				1		
SCALE						
1:100						
1:100				1		
	Client: GUNNEDAH SH	IRE COU	NCIL		CONSTRUCTIVE	E SOLUTIO
CROSS SECTIONS	BLACKJACK CREEK F		RRIDOR		Tel: (02) 6762 19	)69 Fax: (0
	& CHANNEL REC	ONSTRUCTIO	ON		www.construc	ctivesolutior



Drawing No: 201201-020

Plan Size:

Desiç	ign Completed:	Designed:	Status:	
(	03.12.2012	DB		PRELIMINARY

CH 654.059 - CH 725.530



1 in L	÷.0		
274.110	76.303	75.479	
275.29 2	275.47 2 <sup>-</sup> 275.48 2 <sup>-</sup>	275.48 27	275.48
000 12	23.753 2 25.753 2	29.052 2	31.052 2
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273.375	273.375	:75.445	15.445	274.806	
274.69	274.75	274.81 2	274.812	274.812	274.81
0.00.0	15.000	23.210	25.210	27.768	29.768

Design Completed: 03.12.2012	Designed:	Status:	PRELIMIN

276.017	275.283	
275.26	275.28	275.29
25.572	28.507	30.507

080.C/7	275.686	275.044	
20.612	275.04	275.04	275.05
23.302	25.362	27.931	29.931



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274.89	274.89	277.14	277.14	276.439
276.03	276.47	276.54	276.48	276.44
000	15.000	24.000	26.000	28.805 30.805

E9L 7L	E9L 7L2	277.013	277.013	276.600	
00 JC	276 46	276.60	276.60	276.60	276.60
	21 000 21	24.000	26.000	27.652	29.652

Design Completed: 03.12.2012	Designed: DB	Status:	PRELIMINA

276.724	276.724	275.846	
275.87	275.87	275.85	275.83
24.000	26.000	29.510	31.510







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275.348	275.348	277.598 277.598	277.158	
276.69	276.93	277.12 277.15	277.16	
0.000	15.000	24.000 26.000	27.760	

Ch 975.000

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275.153	275.153	277.403	277.403	276.824		
276.47	276.69	276.79	276.80	276.82	276.84	
0.00	15.000	24.000	26.000	28.317	30.317	

Ch 950.000



## Client: GUNNEDAH SHIRE COUNCIL

### BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

Design Completed:	Designed:	Status:
03.12.2012	DB	PRELII

CROSS SECTIONS CH 950.000 - CH 1000.000







R.L. 274.000						
DESIGN SURFACE		277.566	277.913	277.913	275.663	
EXISTING SURFACE	277.92	277.57	277.32	277.16	277.89	
OFFSET	-29.386	-27.386	-26.000	-24.000	- 15.000	

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## Client: GUNNEDAH SHIRE COUNCIL

### BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

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277.53	277.79	278.08
25.997	26.875	28.875

278.140	278.140	277.703	
276.79	277.28	277.70	277.80
23.983	25.983	27.730	29.730



276.524	276.524	
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276.251	276.251	
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277.154	277.154	
278.51	278.79	
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276.9	276.9	
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### Client: GUNNEDAH SHIRE COUNCIL

## BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

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277.892	277.892	280.109	280.109 270 517	110.617
279.08	279.61	279.57	279.55 279.57	279.50
0000	14.585	23.451	25.451 27 816	29.816

279.827	279.827	279.294	
279.23	279.26	279.29	279.33
23.801	25.801	27.935	29.935

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78 976	278.976	281.264	281.264
06 622	279.82	279.96	280.00 280.00 280.00 280.01
0000	12.800	21.952	23.952 29.009 31.009

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	22.310	24.31	28.41	30.41

278.442	278.442	280.695	280.695	279.803	1
279.41	279.36	279.88	279.88	279.80	279.78
00000	13.679	22.691	24.691	28.258	30.258

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CH 1379.411	- CH 1448.564

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280.453	280.453	279.732	
279.69	279.71	279.73	279.71
23.004	25.004	27.891	29.891



280.035	280.035	282.393	282.393
280.76	280.80	281.23	281.37
0.000	11.056	20.487	22.487

Client: GUN	INEDA	HS	HIRE COUNCIL			/E SOLUTIONS PTY. LTD.
BLAC	CKJACK C & CHANN	REE	K RIPARIAN CORRIDOR RECONSTRUCTION	Tel: Email	(02) 6762 1 : admin@co www.constr	1969 Fax: (02) 6762 1969 onstructivesolutions.com.au ructivesolutions.com.au
Design Completed: 03.12.2012	Designed: DB	Status:	PRELIMINARY	Plan Size:	Drawing No:	201201-029

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281.867	280.87	
280.82	280.87	280.91
23.169	27.153	29.153

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281.574	280.449	
280.39	280.45	280.48
23.550	28.052	30.052







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### Client: **GUNNEDAH SHIRE COUNCIL**

### **BLACKJACK CREEK RIPARIAN CORRIDOR** & CHANNEL RECONSTRUCTION

**CROSS SECTIONS** CH 1575.000 - CH 1625.000

Design Completed: Designed: Status: PRELIMINARY 03.12.2012 DB









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701.4.21	281.4.97	281.497	284.139
07.707	282.14	283.21	284.14
-	0.000	10.000	20.568

Ch 1700.000

281.329 281.329 283.905 283.905 283.905 283.905 283.905	
283.30 283.37 283.37 283.37	283.53
0.000 20.303 22.303 24.151	26.151

Ch TP1680.169

Ch 1650.000

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CROSS SECTIONS CH 1650.000 - CH 1700.000

## Client: GUNNEDAH SHIRE COUNCIL

### BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

Design Completed: 03.12.2012	Designed:	Status:	PRELIMINA





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282.132	282,132	282.132	284.924	284.924		1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1
282.02	282.60	282.96	283.87	284.01		284.36
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281.920	281.920	281.920	284.656	284.656	283.795	
282.36	282.45	282.65	283.37	283.52	283.80	283.97
-10.000	0.000	10.000	20.941	22.941	26.383	28.383

Ch 1750.000

Ch 1725.000



CROSS SECTIONS CH 1725.000 - CH 1775.000

## Client: GUNNEDAH SHIRE COUNCIL

### BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

Design Completed: 03.12.2012	Designed:	Status:	PRELIMINA



284.387	284.387	284.318	
284.19	284.30	284.32 284.44	
20.713	22.713	22.987 24.987	

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282.767	282.767	282 767	285.731	285.731	285.034	
282.60	282.78	385 AA	284.57	284.76	285.03	285.20
- 11.243	0000	10 000	21.855	23.855	26.642	28.642

Ch 1850.000







### **GUNNEDAH SHIRE COUNCIL**

### BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

Design Completed:	Designed:	Status:	
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285.462	285.462	284.833	
284.39	284.59	284.83	285.03
21.626	23.626	26.143	28.143

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285.193	285.193	284.55	
284.15	284.32	284.55	284.73
21.398	23.398	25.966	27.966







Ch 1900.000



Ch 1875.000

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### 1 in 5.0 285.663 285.663 285.212 285.21 285.36 284.94 285.09 285. 35.860 37.860 39.663 41.663



### Client: **GUNNEDAH SHIRE COUNCIL**

### BLACKJACK CREEK RIPARIAN CORRIDOR NEL RECONSTRUCTION

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R.L. 280.800						
	284.247	285.514 285.514	283.514	283.514	283.514	285.514 285.514 285.514 285.139
	284.25 284.25	284.21 284.20	283.52	283.51	284.20	284.98 285.07 285.14 285.14
	-63.235 -61.235	-56.166 -54.166	-42.166	0.000	55.953	67.953 69.953 71.451

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R.L. 280.30	0				
DESIGN SURFACE	284.036	285.578	285.578	283.414	
EXISTING SURFACE	284.04 284.04	284.02	284.02	283.62	
OFFSET	-56.206 -54.206	-48.038	-46.038	-34.038	

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### Client: **GUNNEDAH SHIRE COUNCIL**

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51.696	53.696	54.792	56.792

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## **GUNNEDAH SHIRE COUNCIL**

**BLACKJACK CREEK RIPARIAN CORRIDOR &** CHANNEL RECONSTRUCTION

Design Completed: 03-12-2012	Designed: DB	Status:	PRELIMIN







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## **RIPARIAN RESTORATION ZONE** SHEET 1

PO Box 1498 Tamworth NSW 2340 Australia Tel: (02) 6762 1969 Fax: (02) 6762 1969 Email: admin@constructivesolutions.com.au www.constructivesolutions.com.au **BLACKJACK CREEK RIPARIAN CORRIDOR &** CHANNEL RECONSTRUCTION Plan Size: Drawing No: Status: 201201-038 PRELIMINARY **A1** 

Design Completed:	Designed:
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### **APPENDIX B** Stakeholder Consultation





14 February 2012

### Northern Region – Tamworth Office Manager Department of Planning and Infrastructure PO Box 550 Tamworth NSW 2340

To the Northern Region – Tamworth Office Manager,

### Re: Gunnedah Shire Council Blackjack Creek Riparian Corridor/Channel Reconstruction Feasibility Study and Concept Design

Gunnedah Shire Council (GSC) has engaged Constructive Solutions Pty Ltd (CSPL) to prepare a Feasibility Study and Concept Design for the proposed Blackjack Creek Riparian Corridor/Channel Reconstruction.

Blackjack Creek is an intermittent watercourse that drains the catchment to the south of Gunnedah, passing along the western side of the urban area of the town and through the Wandobah Reserve. The stream crosses the Oxley Highway, the North West Railway Line, and the Kamilaroi Highway, before discharging to the floodplain of the Namoi River. Please refer to the attached figure for a plan of Blackjack Creek and its location.

GSC has recently completed the Blackjack Creek Floodplain Risk Management Study and Plan. The plan identifies that flood modification measures are the preferred option to alleviate the threat of flooding within the section of the Blackjack Creek catchment subject to the plan. The riparian corridor/channel reconstruction was considered to be the most favourable mitigation measure.

Following the adoption of the Floodplain Risk Management Plan the next step, as outlined NSW Government Floodplain Development Manual 2005, is the implementation of that plan. As such, a Concept Design and Feasibility Study of the riparian corridor /channel reconstruction for Blackjack Creek is to be prepared, including the preparation of documentation for approval under Part 5 of the Environmental Planning & Assessment Act 1979 and the Water Management Act 2000.

PROFESSIONAL PROJECT, VALUE & ENVIRONMENTAL MANAGEMENT SERVICES

Constructive Solutions Pty Ltd	
ACN 070 324 640	
ABN 72 070 324 640	V



The preparation of the study will be undertaken in three (3) stages:

- Stage 1 Feasibility Study
- Stage 2 Concept Design
- Stage 3 Technical review and final detailed design and tender documentation, including a Review of Environmental Factors

CSPL would like to extend an invitation to the Department of Planning and Infrastructure to comment on the preparation of the Blackjack Creek Riparian Corridor/Channel Reconstruction Feasibility Study and Concept Design.

It should be noted that CSPL will be seeking further consultation with the Department of Planning and Infrastructure throughout the preparation of the Blackjack Creek Riparian Corridor/Channel Reconstruction Feasibility Study and Concept Design, including seeking commentary on the preparation of a Review of Environmental Factors.

It would be appreciated if comments could be forwarded to Sarah Horne at Constructive Solutions by **5pm Friday 2 March 2012** using the following:

**Mail:** PO Box 1498

Tamworth NSW 2340

**Email:** sarah@constructivesolutions.com.au

I thank you for your time and look forward to receiving any input the Department of Planning and Infrastructure may have. If you have any queries, please do not hesitate to contact me on (02) 6762 1969.

Yours faithfully,

Sarah Horne Environmental Scientist/Project Officer

PROFESSIONAL PROJECT, VALUE AND ENVIRONMENTAL MANAGEMENT SERVICES



TRIM V12/1069 OUT12/3968

24 February 2012 Sarah Horne Constructive Solutions PO Box 1498 Tamworth NSW 2340

Dear Sarah

### RE: Gunnedah Shire Council Blackjack Creek Riparian Corridor/Channel Reconstruction Feasibility Study and Concept design

Thank you for giving NSW Department of Primary Industries Aquaculture, Conservation & Marine Parks Branch (AC&MP) the opportunity to provide comments on the a feasibility study & concept design.

DPI AC&MP is responsible for managing fish (including aquatic invertebrates), and fish habitat throughout NSW. The Department's goals encompass protecting the aquatic environment and promoting the rehabilitation of degraded aquatic environments. This includes protecting rare and threatened species and maintaining aquatic biodiversity.

This response reflects the policy and legislative role of NSW DPI AC&MP in relation to aquatic habitats and floodplains. Further policy information can be found in *NSW DPI Policy and Guidelines for Aquatic Habitat Management and Fish Conservation 1999* www.fisheries.nsw.gov.au/publications/aquahab.htm.

### Legislation Section - Fisheries Management Act (1994)

Under Part 7 (s198-203) of the *Fisheries Management Act* 1994, *water land* (land that may be permanently or intermittently submerged by water) is protected. It is an offence to perform unauthorised *dredging and reclamation* works in *water land*. These works include construction of drains, roads, creek diversions, geotechnical investigations and excavating or reclaiming the bed or banks of any waterways.

Also contained within Part 7 (s218-220) of the Act, the passage of fish must not be blocked. A person who creates an obstruction without a permit, which could cause fish to be stranded or the destruction of immature fish or obstructs the free passage of fish, is guilty of an offence with heavy penalties.

Part 7A of the *Fisheries Management Act* 1994 also ensures that threatened species of fish are taken into consideration during the planning process and in decision-making by authorities.

### General Principles which our department believes should be taken on board as part of the planning process;

-DPI AC&MP believe that the flood study should aim to define a system of floodways that conforms to the natural drainage pattern and thereby ensures that fish passage and access to spawning and feeding locations is maintained by minimising significant alterations to the natural flow distribution and velocity.

www.industry.nsw.gov.au

-DPI AC&MP generally supports enlargement of bridges and culverts to enhance the hydraulic capacity of these structures. All such structures should be built in accordance to the Policy and Guideline document *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings.* The department has a legislative role issuing permits for the construction of bridges, culverts, causeways, etc.

- DPI AC&MP do not support creek widening/and or dredging. NSW DPI AC&MP have a "No Net Habitat Loss" policy as outlined in the document *Policy and Guidelines for Aquatic Habitat Management and Fish Conservation 1999*. Incorporated into this policy to compensate for adverse environmental effects is DPI's policy of habitat compensation calculated on a 2:1 basis, whereby the creation of new (or remediating existing) habitat is calculated to "offset" the loss of existing habitat.

-DPI AC&MP do not support clearing creeks of debris. Riparian vegetation and snags are critical to the health of streams. Riparian vegetation is a key component of fish habitat and directly interacts with the stream by providing nutrients, shading, temperature control, water quality control, and stream stability. Snags (large woody debris) consist of whole trees, limbs or root masses that have fallen or been washed into a waterway and have become partly or wholly submerged by water. The "removal of large woody debris" and the "degradation of riparian vegetation along NSW Watercourses" have been listed as Key Threatening Processes under Schedule 6 Of the Fisheries Management Act 1994 and the department has a responsibility to limit these impacts where possible.

- DPI AC&MP believe that flood mitigation structures such as permanent levees should only be constructed where there is a compelling need such as around a town or a dwelling.

If you require any further information please contact me on (02) 6763 1255. Yours sincerely,

D. Ward.

DAVID WARD FISHERIES CONSERVATION MANAGER (GREATER DARLING) From: feedback@railcorp.nsw.gov.au
Sent: Saturday, 3 March 2012 9:36 AM
To: sarah@constructivesolutions.com.au
Subject:Your RailCorp feedback

Dear Ms Horne,

I refer to your correspondence regarding the Blackjack Creek Riparian Corridor/Channel Reconstruction Feasibility Study.

Rail Corporation New South Wales (RailCorp) aims to deliver safe, clean and reliable passenger services. RailCorp provides metropolitan passenger rail services via CityRail and long distance services via CountryLink.

RailCorp is responsible for the safe operation, crewing and maintenance of passenger trains and stations. We also own and maintain the metropolitan rail network (bounded by Islington Junction in the north, Macarthur in the South West, Bowenfels in the West) and provide access to freight operators in the metropolitan area.

I am advised by our Property Division that we have no property interests in the area you refer to in your correspondence.

I trust this information is of assistance.

Yours sincerely,

### Zak

Senior Customer Relations Officer

RailCorp

Please do not respond to this email as the inbox for this email address is unattended. Should you wish to respond to this email please use our contact form at www.cityrail.info or www.countrylink.info and you will receive a response within 5 working days.

From:	<u>Admin</u>
То:	sarah@constructivesolutions.com.au
Subject:	FW: Gunnedah - Blackjack Creek
Date:	Friday, 2 March 2012 2:32:35 PM
Attachments:	DOC290212.pdf

From: Paul Purcell [mailto:PPurcell@ARTC.com.au] Sent: Friday, 2 March 2012 11:00 AM To: admin@constructivesolutions.com.au Subject: Gunnedah - Blackjack Creek

Attention: Sarah Horne

I refer to the attached correspondence forwarded to Railcorp.

The rail corridor through Gunnedah forms part of the ARTC Lease of rail lines in NSW. As such ARTC is responsible for all issues associated with land and infrastructure associated with the rail corridor.

ARTC will provide comment on the proposal next week.

Any further correspondence concerning this matter should be directed in the first instance to:

Teena Renes Property Manager ARTC Locked Bag 1 BROADMEADOW NSW 2292

Regards,

Paul Purcell Manager Property Services

P - 02 4941 9610
F - 02 4941 9738
M - 0409 320 228
E - ppurcell@artc.com.au

Australian Rail Track Corporation Ltd. Locked Bag 1, Broadmeadow NSW 2292

The information in this email and any attachments to it is confidential to the intended recipient and may be privileged. Receipt by a person other than the intended recipient does not waive confidentiality or privilege. Unless you are the intended recipient, you are not authorised to disseminate, copy, retain or rely on the whole or any part of this communication. If you have received this communication in error please notify ARTC on +61 8 8217 4366. While we have taken various steps to alert us to the presence of computer viruses we do not guarantee that this communication is virus free.

----Original Message----From: Andrews, Sue [mailto:SUZANNE.ANDREWS@railcorp.nsw.gov.au] Sent: Wednesday, 29 February 2012 1:26 PM To: Paul Purcell Subject: Correspondence

Hi Greg

The attached was received in our office today.

Regards

Sue Andrews

Administration Officer

RailCorp Property Division

T 8922 0309 | E sue.andrews@railcorp.nsw.gov.au Level 21, 477 Pitt Street, Haymarket NSW 2000

Add our trip planner to your website...find out how at www.131500.com.au

----Original Message-----From: 477PT21TOSO1 [mailto:477PT21TOSO1@railcorp.nsw.gov.au] Sent: Wednesday, 29 February 2012 1:20 PM To: Andrews, Sue Subject: Send data from 477PT21TOSO1 29/02/2012 13:20 Scanned from 477PT21TOSO1. Date: 29/02/2012 13:20 Pages:3 Resolution:200x200 DPI



28<sup>th</sup> February 2012

Sarah Horne Constructive Solutions Pty Ltd PO Box 1498 Tamworth NSW 2340

Dear Ms Horne,

### Re: Gunnedah Shire Council Blackjack Creek Riparian Corridor/Channel Reconstruction Feasibility Study and Concept Design

Thank you for including Namoi Catchment Management Authority (Namoi CMA) in the consultation process in the development of the Blackjack Creek Riparian Corridor/Channel Reconstruction Feasibility Study and Concept Design.

Namoi CMA has reviewed the Blackjack Creek Floodplain Risk Management Study and Plan (2010) developed by Constructive Solutions Pty Ltd (CSPL) as part of this consultation and review process.

We have examined the main issues of concern to Namoi CMA including the ecology, surface water, rehabilitation and final landform, and socio-economics.

At this stage of the process we would like to note that within the riparian corridor/channel construction area there is a significant area of protected native vegetation including White Box (*Eucalyptus albens*) and Yellow Box (*Callitris glaucophylla*) amongst other native canopy, shrub and ground cover species.

This protected native vegetation (*Native Vegetation Act 2003*) lies predominantly within land owned by the State Government of New South Wales (NSW) but may also be found on private land along the area of interest. As it is protected native vegetation permission for any clearing would need to be sought from the relevant authorities.

In addition, the feasibility study needs to identify any significant natural features including threatened species, geological features and Aboriginal

cultural heritage issues. Potential impacts need to be identified and mitigation measures and safeguards addressed.

Any terrestrial and aquatic impacts within Blackjack Creek need to be assessed and mitigation measures and safeguards addressed.

The Blackjack Creek Floodplain Risk Management Study and Plan states in Table 3.9 that there are environmental benefits to the riparian corridor/channel reconstruction. We would be interested to know the details of these environmental benefits (as distinct from the economic, social and flood mitigation benefits).

Namoi CMA recognises the social and economic benefits of the Blackjack Creek riparian corridor/channel reconstruction as outlined in the study. We would like to see more balance in retaining the ecological value of the site while also achieving the flood mitigation benefits that the community is seeking.

Namoi CMA looks forward to being part of the consultative process and also reviewing the Blackjack Creek Riparian Corridor/Channel Reconstruction Feasibility Study and Concept Design when it is available.

If you need to discuss this matter further, please do not hesitate to contact Glenn Bailey on (02) 6742 9204 or email <u>glenn.bailey@cma.nsw.gov.au</u>.

Yours Sincerely

Simon Turpin Acting Catchment Co-ordinator (West Namoi) Namoi Catchment Management Authority





Our reference: Contact: DOC12\9541 Liz Mazzer 02 68835325

Sarah Horne Constructive Solutions PO Box 1498 TAMWORTH NSW 2340

Dear Ms Horne

Thank you for your letter dated 14 February 2012 to the Office of Environment and Heritage (OEH) seeking comment in relation to the preparation of a feasibility study and concept design for the reconstruction works proposed for Blackjack Creek Riparian Corridor. I apologise for the delay in responding to your request. The following information also includes general requirements of the Environment Protection Authority (EPA).

The OEH and EPA can provide advice on the feasibility study, concept design and Review of Environmental Factors (REF) where they deal with natural and cultural heritage conservation issues, air and water pollution, noise emission and waste management. The OEH and EPA may also comment on the legitimacy of the conclusions reached regarding the significance of impacts by the proposed development to these components of the environment.

The *Environmental Planning and Assessment Act* 1979 (EP&A Act) requires that the REF should fully describe the proposal, the existing environment and impacts of the proposal.

### Flora, Fauna, Threatened Species and Aboriginal Cultural Heritage (OEH)

The OEH has responsibilities under the:

- National Parks and Wildlife Act 1974 namely the protection and care of Aboriginal objects and places, the protection and care of native flora and fauna and the protection and management of reserves.
- Threatened Species Conservation Act 1995 which aims to conserve threatened species of flora and fauna, populations and ecological communities to promote their recovery and manage processes that threaten them.
- Native Vegetation Conservation Act 2003 ensuring compliance with the requirements of this legislation.

Attachment 1 provides guidance for flora and fauna assessment. For cultural heritage guidance, please refer to OEH guidelines, particularly the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales,* which can be accessed on the OEH website at <u>http://www.environment.nsw.gov.au/conservation/aboriginalculture.htm</u>

PO Box 2111 Dubbo NSW 2830 Level 1 48-52 Wingewarra Street Dubbo NSW Tel: (02) 6883 5312 Fax: (02) 6884 8675 ABN 30 841 387 271 www.environment.nsw.gov.au
#### Pollution Control and Environmental Management (EPA)

Statutory functions and powers, including those in the *Protection of the Environment Operations Act 1997* (POEO Act), are exercised by the EPA, a statutory body created by the *Protection of the Environment Administration Act 1991*.

We wish to advise that at this stage, that based on the information provided the proposed development does not require licensing by the EPA under the POEO Act. Hence, for the purposes of the EPA the development application will not be subject to the integrated development assessment process.

Information and guidelines relevant to air and water pollution, noise emission and waste management are available at <u>http://www.environment.nsw.gov.au/environmentalissues.htm</u>

It should be noted that these are only guidelines and it is up to the proponent (and later the determining authority after appropriate consultation) to determine the detail and comprehensiveness of the surveys and level of assessment required to form legally defensible conclusions regarding the impact of the proposal. The scale and intensity of the proposed development should dictate the level of investigation. It is important that all conclusions are supported by adequate data.

If you have any questions, or wish to discuss this matter further please contact Liz Mazzer in the Dubbo OEH office on 02 6883 5325 or at liz.mazzer@environment.nsw.gov.au.

Yours sincerely,

R. Jaylor

ROBERT TAYLOR Manager, Environment & Conservation Programs Office of Environment & Heritage

# ATTACHMENT 1: EIA REQUIREMENTS - FLORA AND FAUNA

## INTRODUCTION

The Environmental Planning and Assessment Act (1979) (EP&A Act) requires that proponents of a development/activity and the Consent/Determining Authorities adequately assess the impact of a development or activity in any Environmental Impact Assessment (EIA) documents. These EIA documents include:

- · Statement of Environmental Effects (SoEE), or
- · Review of Environmental Factors (REF), or
- · Environmental Impact Statement (EIS).

These are introductory, generic specifications of the Office of Environment and Heritage (OEH) for an adequate assessment of the impacts of a development proposal on native flora and fauna (ie including protected and threatened species). However, OEH recognises that the scale and complexity of the project will to some extent, dictate the level of information that is required to address the questions posed below. Consequently, flora and fauna assessments need to be tailored to suit the proposal. For example, a development which is proposed on land which has already been totally (or substantially) cleared should address the issues raised below but the amount of work required to address these issues may be substantially less than if the area comprised undisturbed bushland and, therefore, of more significant wildlife habitat value. A preliminary assessment, including a desktop investigation and a preliminary site inspection, may indicate the need for a detailed survey of the site.

It is up to the proponent (and later the consent and/or determining authorities after appropriate consultation) to determine the detail and comprehensiveness of assessment required to form legally defensible conclusions regarding the impact of the proposal. The scale and intensity of the proposed development should dictate the detail of investigation.

It is important that all conclusions are supported by adequate data and that these data are clearly presented in EIA documentation.

OEH will consider the following issues when reviewing an EIA document:

- Concerns What are OEH's concerns regarding the conservation of natural and cultural heritage in accordance with the relevant legislation? Is the proposal likely to affect natural and cultural heritage? How?
- 2. **Provision of Information** Is adequate information provided for a valid assessment of the impacts?
- 3. Validity of Conclusions Has the proponent arrived at valid conclusions as a result of the assessment of impacts?
- 4. **Recommended Conditions to Consent** Should Consent or Approval be granted, what conditions (if any) are required to ensure that the project is developed, and thereafter managed in accordance with natural and cultural heritage conservation and the provisions of legislation administered by OEH?

Thus the EIA document should fully describe the existing environment including flora and fauna, so that future impacts can be properly assessed and then reviewed (eg during the public participation phase).

## FLORA

### Background

The Australian flora comprises many endemic taxa and is therefore unique in the world.

OEH is concerned at the extent to which vegetation has been cleared and otherwise modified in north-western NSW. This high level of modification has been highlighted in the National State of the Environment Reports (1996 and 2001). Evidence strongly suggests that many plant species and communities are threatened with extinction.

Although the proposed site may be disturbed by various landuses, any remnants of native vegetation are of significant natural heritage value, including riparian and wetland areas. The area of vegetation and habitat at the proposed site may provide an area of high biological diversity, high conservation value or may not be well represented or protected elsewhere. It may also act as a corridor or migratory route for wildlife, drought refuge habitat or have other important values.

The NSW community places a high value on those areas of native vegetation that remain. OEH is committed to the protection, appropriate management, and where necessary, rehabilitation of native vegetation. For these reasons, OEH considers that careful planning should precede any development that involves further vegetation clearance or other significant impact within areas of remnant vegetation.

Negative impacts to native vegetation (eg clearing) should be avoided where possible. Where impacts cannot be avoided, the EIA should detail how a "maintain or improve" outcome for biodiversity will be achieved. Biobanking provides a voluntary mechanism through which this can be achieved. The Biobanking assessment methodology allows quantification of impacts and assessment of the value of offset areas and associated management regimes for those areas. The biobanking scheme provides an alternative path for proponents to the current threatened species assessment of significance process.

Information about Biobanking is located on OEH's website at <a href="http://www.environment.nsw.gov.au/biobanking/">http://www.environment.nsw.gov.au/biobanking/</a>

#### **Report Requirements**

The EIA documentation should include a report on the flora that includes the following:

- detailed location map and identification of the area surveyed (including the location of photographs, transects, areas of significance etc),
- at least one of the following: a land satellite image, vegetation communities map, aerial photograph, or a remnant vegetation map,
- A map identifying the vegetation communities located in the study area and the areas of each vegetation community to be impacted.
- a complete plant list (including scientific names of those plants) of all tree, shrub, ground cover and aquatic species, categorised according to country of origin (ie., native versus exotic),
- a detailed description of vegetation structure (in terms of a scientifically accepted classification system) and spatial distribution (i.e. plant densities and patterning) on the site, including a vegetation map,
- describe the condition and integrity of the vegetation including a description of any past disturbance,
- an account of the likely original vegetation communities (pre-, or at early settlement), and an assessment of the likely regional distribution of the original communities,

- an assessment of whether the plant communities are adequately represented in conservation reserves or otherwise protected,
- an account of the hydrology of the area and how this relates to the dynamics of the vegetation communities,
- a list of known and likely threatened species as listed under Schedules 1 & 2 (*Threatened Species Conservation Act 1995*) which might occur at the site. The OEH database needs to be accessed and the likelihood of occurrence of threatened flora species determined,
- an assessment of the impacts of the proposal on flora, on-site and off-site (eg siltation, water availability or drainage changes) and measures to mitigate these impacts,
- an assessment of the significance of the impact of the development at both the site and at the regional scale,
- a detailed rehabilitation/management plan including a list of the plant species to be used during rehabilitation (if required),
- detail methodologies used and a list of the reference literature cited, and
- any other issues that may be considered relevant.

The above guidelines will provide some of the information necessary to conduct an Assessment of Significance required for threatened flora and fauna under Section 5a of the *EP&A Act*, should threatened species be likely or known to occur in the locality of the subject development proposal. Similarly, it will provide some of the information required if an application is found to be necessary under the *Native Vegetation Act (2003)*. However the above relates mostly to the specific environmental assessment processes under the *EP&A Act* and does not constitute an Assessment of Significance.

Similarly, the above guidelines will provide some of the information required for Biobanking, but may not be sufficient for Biobanking offset calculations. Please refer to the Biobanking website or contact OEH for specific information relating to Biobanking assessment requirements. The Biobanking scheme provides an alternative path for proponents to the current threatened species assessment of significance process.

## FAUNA

### Background

Evidence suggests that Western NSW has suffered the highest extinction rate for indigenous mammals of any region in the world. Many other vertebrate species are currently threatened. One of the major reasons for such a high level of extinction has been the destruction of habitat. Native vegetation including wetland, riparian and remnant environments are very significant areas of fauna habitat. Therefore any development in such areas should fully consider the impact on fauna and its habitat.

#### **Report Requirements**

The EIA document should include a report on the fauna (including protected and threatened species), that includes the following:

 detailed location map and identification of the area surveyed (including the location of photographs, transects, areas of significance etc),

- at least one of the following: a land satellite image, vegetation communities map, aerial photograph, or a remnant vegetation map,
- a complete list of all known and likely terrestrial and aquatic species (eg birds, mammals, reptiles and amphibians including scientific names). It is suggested that invertebrates also be considered as they form part of the food chain for many fauna species,
- those species which are protected, threatened or listed under any international agreements, as well as introduced species,
- those species known or likely to breed in the area,
- any species which have specific habitat requirements found within the project area,
- those species or populations which may be near the limit of their geographic range or are a disjunct/isolated population,
- assessment of the importance or otherwise of the location as a corridor, migratory route or drought refuge, in relation to other remnant vegetation, riparian and wetland areas or habitat in the region,
- assessment of the impacts of the proposal on all fauna and its habitat, at both the site and at the regional scale,
- identification of any mitigation measures proposed to limit or ameliorate the impact of the proposal,
- detailed methodologies used and a list of the reference literature cited, and,
- any other issues that may be considered relevant.

Again, the above guidelines will provide some of the information required for the Threatened Species component of Biobanking, but may not be sufficient for Biobanking offset calculations. Please refer to the Biobanking website or contact OEH for specific information relating to Biobanking assessment requirements

### SEPP No. 44 - Koala Habitat Protection

The Shire may be listed in Schedule 1 of SEPP No. 44 - Koala Habitat Protection. If so, the requirements of the SEPP regarding Koala habitat protection should be considered by the proponents.

## THREATENED SPECIES OF FAUNA AND FLORA

#### Background

Apart from the need to consider the impact on protected species, the proponent will need to address the requirements of legislation that currently governs threatened species protection and impact assessment in NSW.

The *Threatened Species Conservation Act (1995) (TSC Act)* protects all threatened flora and fauna native to NSW (excluding fish and marine plants). The proponent will need to consider the provisions of this Act.

The *TSC Act* contains lists of threatened species, which are divided into a number of categories – those presumed extinct, endangered species, critically endangered species and vulnerable species. It also contains lists of endangered populations, endangered ecological communities, critically endangered ecological communities. This Act also allows for the declaration of critical habitat, key threatening processes and the preparation of both Recovery Plans and Threat Abatement Plans. These listings and plans must be considered as part of the EIA process.

If an activity or development is proposed in a locality likely or known to be occupied by a threatened species, population, ecological community or critical habitat, any potential impact to that threatened species must be taken into account during the development assessment process. However under the *EP&A Act*, some types of development are not required to go through approval processes. Please note that a licence may still be required under the *TSC Act* if such a development/activity is likely to harm a threatened species, population or ecological community.

Proponents can voluntarily use BioBanking to minimise and offset their impacts on biodiversity. The scheme provides an alternative path for proponents to the current threatened species assessment of significance process.

#### Assessment of Significance & Species Impact Statements

If during the flora or fauna assessment or survey, threatened species are **found** or are **likely** to occur in the area, the proponents must undertake an Assessment of Significance as outlined in section 5A of the *EP&A Act* to determine whether or not the development would be likely to have a significant impact upon threatened species.

The Assessment of Significance is a statutory mechanism which allows decision makers to assess whether a proposed development or activity is likely to have a significant effect on threatened species, populations or ecological communities, or their habitats.

The Assessment of Significance is contained within section 5A of the *EP&A Act* and consists of seven factors which need to be addressed for informed decisions to be made regarding the effect of a proposed development or activity on threatened species, populations or ecological communities, or their habitats. A copy of OEH's *Threatened species assessment guidelines: The assessment of significance* can be obtained from the OEH website at:

#### http://www.environment.nsw.gov.au/resources/threatenedspecies/tsaguide07393.pdf

Following threatened species assessment via the Assessment of Significance, it may be necessary to prepare a Species Impact Statement (SIS). The proponent will need to prepare a SIS in the following circumstances:

- If (after having addressed Section 5A) the flora/fauna assessment concludes that there
  is likely to be a significant impact to threatened species, or
- The proposed development is likely to affect critical habitat declared under the TSC Act.

If a SIS is required, the proponent (not the consultant) must write to OEH for any formal requirements for the SIS that he might deem appropriate. The SIS must then be prepared in accordance with these requirements and provided to the OEH. In some instances the Minister for the Environment will also need to be consulted for approval.

Methods to reduce the impact on the protected and threatened species should be considered fully, and are considered an integral requirement within any SIS document.

The OEH advises that conducting an Assessment of Significance or an SIS according to the provisions of the *EP&A Act* and the *TSC Act* is a complex task and should be undertaken by suitably qualified person(s).

## AVAILABLE DATA

OEH can supply, at the standard cost, fauna prediction data and recorded fauna sightings data (Wildlife Atlas of NSW) to help in the investigation. The following information on site recordings of Flora and Fauna is available from OEH:

 A general search for flora and fauna records can be conducted through the Atlas of NSW Wildlife at: <u>http://www.bionet.nsw.gov.au/</u>

Please note that not all the information associated with the individual records is available on this website. You can apply to the Office of Environment and Heritage for more detailed information about individual sightings (terms and conditions apply). Contact the Wildlife Data Unit for more information on (02) 9995 5000.

 Detailed information relating to threatened species, populations, ecological communities and their habitats can be obtained from the OEH Threatened Species website at:

http://www.threatenedspecies.environment.nsw.gov.au/index.aspx

Other reference literature may be available for the subject locality/region. The proponent should explore this possibility thoroughly.



Constructive Solutions c/- Sarah Horne PO Box 1498 Tamworth NSW 2340. Contact Chris Binks Phone 02 6701 9633 Fax 02 6701 9692 Email chris.binks@water.nsw.gov.au

Our ref Our file: Your ref:

Attention: Sarah

2nd March 2012

Dear Sarah,

# **Re:** Gunnedah Shire Council Blackjack Creek riparian corridor/channel reconstruction feasibility study and concept design.

The NSW Office of Water has reviewed the correspondence and supporting information dated 14<sup>th</sup> February 2012.

Please note that pursuant to cl 38 of the Water Management (General) Regulation 2011, Gunnedah Shire Council, as a public authority, is exempt from s 91E(1) of the Water Management Act 2000 and are therefore not required to obtain a Controlled activity before commencing works.

However, cl 37 provides that this exemption is subject to a condition requiring the person by whom the relevant controlled activity is carried out to comply with any direction that the Minister may give to the person for the protection of:

- (a) the waterfront land on which the activity is carried out, or
- (b) any river, lake or estuary to which that land has frontage.

The NSW Office of Water does not encourage the use of wire mesh structures, concrete, spray concrete, concrete grouting, crib walling, masonry, car bodies or tyres for bank stabilisation.

Yours sincerely



Chris Binks Licensing Officer Namoi/Gwydir/Border Rivers



## CONTROLLED ACTIVITIES ON WATERFRONT LAND

# Controlled activity exemptions on waterfront land

Under the *Water Management Act 2000* (WM Act) an approval is required to undertake controlled activities on waterfront land, unless that activity is otherwise exempt (section 91E).

Controlled activities include the carrying out of building work, such as erecting buildings and other structures, and the installation of infrastructure. They also include excavaling or depositing material.

Waterfront land is the bed of any river, lake or estuary and any land within 40 metres of the highest bank of the river, the lake shore or the mean high water mark of the estuary.

The Water Management (General) Regulation 2011 sets out a number of exemptions in relation to controlled activities. Please refer to the Water Management (General) Regulation 2011 Part 3, Division 2, Subdivision 4 and Schedule 5, Part 2 for full details.

## Exempt controlled activities

#### Public authorities

A public authority does not need to obtain a controlled activity approval for any controlled activities that it carries out in, on or under waterfront land.

The WM Act defines a public authority as:

- a minister of the Crown
- a government department or administrative office
- a statutory body representing the Crown
- a statutory state owned corporation (or any of its subsidiaries) within the meaning of the State Owned Corporation Act 1989
- a council or county council within the meaning of the Local Government Act 1993.

Landcom is not a public authority for the purposes of this exemption (clause 30 of the Water Management (General) Regulation 2011).

#### Third parties undertaking controlled activities on behalf of public authorities

Under the WM Act a public authority is exempt from the need to obtain a controlled activity approval for any controlled activities that it carries out in, on or under waterfront land.

In some cases a third party, such as a contractor, may carry out works on behalf of a public authority. When this happens, the third party will usually benefit from the exemption in favour of the public authority.

Factors used to determine if a third party is acting for and on behalf of a public authority will include the nature of the contractual relationship between the parties and the level of control that the public authority retains over the works, both during and after construction.

Examples of exempt controlled activities undertaken by third parties on behalf of a public authority include:

- · a contractor desilting drains for a council
- · a contractor maintaining or installing water mains for Sydney Water.

A third party will not benefit from the exemption in favour of a public authority when undertaking controlled activities on their own behalf. This includes works undertaken under a development application or other approval, even when the works will be handed over to a public authority after completion.

Examples of controlled activities that are not considered to be exempt include:

- a developer constructing drainage and detention basin works to be transferred to council ownership after completion
- a developer constructing sewerage and water supply infrastructure to be transferred to Sydney Water ownership after completion.

## Private dwellings

A controlled activity approval is not required for erecting or demolishing, or the alteration or addition to, or the provision of ancillary facilities for a dwelling house or dual occupancy building, so long as the activity:

- is exempt development for the purposes of Environmental Planning and Assessment Act 1979 or is subject to a development consent or complying development certificate in force under the Environmental Planning and Assessment Act 1979
- is not constructed on or in the bed or bank of a river, the bed or shore of a lake, or the bed or land lying between the high water mark of any estuary.

## Other exemptions

A controlled activity approval is not required if:

- the waterfront land relates to a river channel that is fully concrete lined or is a fully enclosed pipe channel
- the construction or use of fencing, a vehicular crossing or an access track on waterfront land does not impound water and relates to a minor stream in a rural zone
- · the activity is nothing more than removal of vegetation in circumstances that would otherwise be lawful
- the controlled activity is to be undertaken:
  - o in accordance with a WM Act water supply works approval
  - o in accordance with a WM Act harvestable rights order
  - o in accordance with section 52 (domestic and stock rights) of the WM Act in certain circumstances.
  - o in accordance with an approval under Part 2 of the former Water Act 1912
  - by a network operator or pipeline licensee to construct, modify, repair, maintain, or complete emergency work on water or gas infrastructure or licensed pipelines
  - o during an emergency under the direction of a relevant act
  - in accordance with any mining, crown lands or western lands lease, licence, permit
  - o in accordance with any lease, licence, permit or other right in force in respect of land under the ownership or control of the maritime authority or a port corporation.

## Harm to waterfront land

The Minister may, if necessary, require a person to take measures to protect the waterfront land, or any river, lake or estuary to which that land has frontage, when carrying out an exempt controlled activity.

#### Where do I go for additional information?

Find out more about controlled activities at the Office of Water website www.water.nsw.gov.au

#### Contact us

Contact a water regulatory officer as listed on the Office of Water website www.water.nsw.gov.au free call the licensing information on 1800 353 104 or email information@water.nsw.gov.au.

Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (June 2012). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of the Department of Primary Industries or the user's independent adviser.

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10 September 2012

Northern Region – Tamworth Office Manager Department of Planning and Infrastructure PO Box 550 Tamworth NSW 2340

To the Northern Region – Tamworth Office Manager,

## Re: Review of Environmental Factors for Gunnedah Shire Council Blackjack Creek Riparian Corridor/Channel Reconstruction

A letter was issued to the DP&I on 14 February 2012 regarding the Gunnedah Shire Council (GSC) Blackjack Creek Riparian Corridor/Channel Reconstruction Concept Design and Feasibility Study. A formal response to this letter was not received.

As part of Stage 3 – Technical Review and Detailed Design, Constructive Solutions Pty Ltd (CSPL) is preparing a Review of Environmental Factors (REF) for the proposed Blackjack Creek Riparian Corridor/Channel Reconstruction, with the REF and detailed design to be based upon the recommendations of the Stage 2 – Concept Design report prepared by CSPL for GSC.

The Blackjack Creek Riparian Corridor/Channel Reconstruction Concept Design Plans have been attached to this letter for your reference and comment.

The design methodologies for the Concept Design were as follows:

- Design a riparian corridor/channel reconstruction for Blackjack Creek which utilises existing data to determine a channel alignment and capacity which is capable of mitigating the impact of a 1% AEP flood on the local community;
- Design a riparian corridor/channel with a total width of 120m, as per the *Guidelines for riparian corridors*, to encompass the Core Riparian Zone and a vegetated buffer;

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ABN 72 070 324 640	www



- Consider the full width of the riparian corridor and its functions;
- Accommodate fully structured native vegetation in the Core Riparian Zone;
- Minimise the design and construction footprint and proposed extent of disturbances to soil and vegetation;
- Maintain or mimic existing or natural hydraulic, hydrologic, geomorphic and ecological functions;
- Maintain natural geomorphic processes;
- Maintain natural hydrological regimes;
- Protect against scour; and
- Stabilise and rehabilitate all disturbed areas.

The design assumptions for the Concept Design were as follows:

- The flood modelling completed to date for Blackjack Creek is an accurate and reliable indicator of flood conditions in the catchment (as confirmed by the *Channel Options Study*);
- All design for in-stream and riparian zone works must be developed in accordance with NSW Office of Water guidelines in order to obtain a Controlled Activity Approval;
- GSC require a channel width of a minimum 30m for the majority of the length of the proposed reconstruction to cater for increased flows from the residential area to the east of Blackjack Creek, with a short length of channel being a minimum 20m in width at the start of the reconstruction in order to minimise impact on the Gunnedah cemetery and private property;
- A total channel length of 1.9 km, spanning from approximately 200m downstream of Lincoln Street to approximately 200m upstream of the Oxley Highway is to be reconstructed, with channel levels to tail out to existing levels at each end;

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- A Core Riparian Zone of 35-40m, depending on stream width, with an additional 10m vegetated buffer is sufficient to meet requirements to obtain a Controlled Activity Approval;
- The 120m wide riparian corridor is required to encompass the creek, Core Riparian Zone and vegetated buffer. Based on the proposed alignment, this corridor is located on both GSC land and/or private land, with GSC proposing to acquire the area required for the reconstruction; and
- GSC intends to revegetate and maintain the proposed riparian corridor in accordance with a Vegetation Management Plan.

The geomorphologic assessment concluded that:

- The concept design provided in this report is not likely to intercept groundwater;
- Salinity levels throughout Wandobah Reserve have lowered significantly since the 2003 report, with the extensive planting undertaken by the local Landcare group likely contributing to this;
- The concept design provided in this report is not likely to encounter any high salinity hazard areas nor mobilise significant volumes of salt to Blackjack Creek;
- The installed piezometers will allow for ongoing monitoring of groundwater levels and quality during and post-construction; and
- The proposed revegetation of the site to provide a Core Riparian Zone may further assist in lowering salinity levels for the length of the reconstruction.

The environmental justifications for the Project are as follows:

 Provision of a channel with the capacity to contain flows up to a 1% AEP flood event will mitigate the adverse impact of flooding on the areas surrounding the channel, including protection of infrastructure such as Wandobah Road which has previously been subject to scour and undercutting by Blackjack Creek during high flow events;

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- Provision of a Core Riparian Zone in accordance with the NSW Office of Water 2011 Controlled activities – Guidelines for riparian corridors will introduce appropriate native flora species to Wandobah Reserve in addition to the vegetation already present on site and increase the distribution and density of native flora at the site, as well as provide additional habitat for aquatic and terrestrial fauna;
- Provision of a Core Riparian Zone for the length of Blackjack Creek which traverses private property will introduce appropriate native flora species to the site, thus replacing and/or repairing the riparian zone vegetation that has been previously modified on these properties;
- Provision of a stabilised, appropriately vegetated channel will mitigate the ongoing occurrence of scour for the length of the reconstruction and where required at stormwater inlets, thus mitigating the sediment load being introduced into Blackjack Creek and, subsequently, the Namoi River;
- Provision of additional appropriate native flora species may assist in ongoing control of salinity at the site;
- Provision of adequate drainage may assist in controlling salinity at the site;
- Installation of piezometers for water table depth and water quality monitoring will facilitate ongoing management of water quality issues for Blackjack Creek;
- Provision of a stabilised and appropriately vegetated site will improve the visual amenity of the site, which is currently utilised for recreational purposes; and
- Revegetation of the site will provide opportunities for community engagement in the process, with potential for community 'ownership' of the site to increase.

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**Realising potential** 

CSPL would like to extend an invitation to the DP&I to comment on the Concept Design Plans and provide any further commentary they may have regarding the preparation of a REF.

It would be appreciated if comments could be forwarded to Sarah Horne at Constructive Solutions by **5pm Friday 21 September 2012** either at the address listed at the bottom of this page, or via email on sarah@constructivesolutions.com.au

I thank you for your time and look forward to receiving any input the DP&I may have. If you have any queries, please do not hesitate to contact me.

Yours faithfully,

Sarah Horne

Environmental Scientist/Project Officer

PROFESSIONAL PROJECT, VALUE AND ENVIRONMENTAL MANAGEMENT SERVICES

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Constructive Solutions PO Box 1498 Tamworth NSW 2340 ContactDavid ThomasPhone02 6701 9620Fax02 6701 9692Emaildavid.thomas@water.nsw.gov.au

Our ref Our file: Your ref:

Attention: Sarah Horne

11 October 2012

Dear Sarah,

## Re: Review of Environmental Factors for Gunnedah Shire Council Blackjack Creek riparian corridor/channel reconstruction.

I enclose a copy of the NSW Office of Water response to your correspondence and supporting information dated 14<sup>th</sup> February 2012. As stated in that letter under clause 38 of the Water Management (General) Regulation 2011, Gunnedah Shire Council, as a public authority, is exempt from section 91E(1) of the Water Management Act 2000 and are therefore not required to obtain a Controlled activity before commencing works. Please see enclosed a copy of Department of Primary Industries NSW Office of Water Controlled activity exemptions on waterfront land.

Please note that on 1 July 2012 new riparian corridor guidelines commenced. Please see attached link;

http://www.water.nsw.gov.au/Water-Licensing/Approvals/Controlled-activities/default.aspx

The REF should address the following potential impacts of the proposal during construction and operation, and describe what measures would be implemented to avoid, minimise, mitigate, offset, manage and/or monitor these potential impacts.

## Key Issues;

- Impacts on surface or groundwater.
- Management of storm water on site including methods of disposal off site.
- Flora and fauna assessment.
- Vegetation to be cleared, and the management of remaining native vegetation.
- Proposed monitoring of water quality impacts.
- Threatened Species Impact Report Species Impact Statement, if relevant.
- Aboriginal Cultural Heritage An Aboriginal Heritage Information Management System Report is required, as a minimum.
- Consultation with the Local Aboriginal Community and an archaeological survey, if required.
- Geomorphology Where proposals are within or within the zone likely to affect a watercourse, river, lake or estuary or coastal zone. This includes:

Detailed design drawings which include a surveyed plan, cross sections (across the watercourse) and a long section of the watercourse, showing the proposed works relative to existing and proposed bed and bank profiles and water levels. The cross section should extend to the landward limit of the identified riparian corridor. All plans must include a scale bar.

Detailed report of pre and post construction hydraulic conditions. The report should address bank full discharge, velocity, tractive force or sheer stress, afflux (Modified RTA method is acceptable), Froude and Manning's 'n' roughness values, relative to the proposed structure.

Detailed plans of permanent bed and bank stabilisation works for scour protection.

Photographs of the site. To assist with future monitoring and reporting, all photo points should be identified by GPS coordinates or by survey - particularly for large scale earthworks or extractive industries.

A vegetation management plan prepared in accordance with NSW Office of Water guidelines for vegetation management plans.

Sediment and erosion control plan.

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A site management plan incorporating a works schedule, sequence and duration of works, contingencies (in case of flood or similar), erosion and sediment controls and proposed monitoring and reporting periods.

## Comments specific to hydrogeology

- 1. Information should be provided that can be used to assess impacts on groundwater.
- 2. Without presenting any evidence, the correspondence (page 3, dot point 4) states that the concept design provided in a geomorphologic assessment report is not likely to intercept groundwater. If evident in the geomorphologic assessment report, then the relevant contents of that report should be included in the REF.
- 3. Piezometers should be surveyed to the same datum as the proposed channel.
- 4. Geotechnical data should be included on the mechanical stability of the proposed channel lining under flood conditions.

I trust the information is helpful, however, if you have any queries please do not hesitate to contact the Tamworth office on telephone 0267 019620.

Yours sincerely

David Thomas Senior Licensing Officer Namoi/Gwydir/Border Rivers



Constructive Solutions c/- Sarah Horne PO Box 1498 Tamworth NSW 2340. Contact Chris Binks Phone 02 6701 9633 Fax 02 6701 9692 Email chris.binks@water.nsw.gov.au

Our ref Our file: Your ref:

Attention: Sarah

2nd March 2012

Dear Sarah,

# **Re:** Gunnedah Shire Council Blackjack Creek riparian corridor/channel reconstruction feasibility study and concept design.

The NSW Office of Water has reviewed the correspondence and supporting information dated 14<sup>th</sup> February 2012.

Please note that pursuant to cl 38 of the Water Management (General) Regulation 2011, Gunnedah Shire Council, as a public authority, is exempt from s 91E(1) of the Water Management Act 2000 and are therefore not required to obtain a Controlled activity before commencing works.

However, cl 37 provides that this exemption is subject to a condition requiring the person by whom the relevant controlled activity is carried out to comply with any direction that the Minister may give to the person for the protection of:

- (a) the waterfront land on which the activity is carried out, or
- (b) any river, lake or estuary to which that land has frontage.

The NSW Office of Water does not encourage the use of wire mesh structures, concrete, spray concrete, concrete grouting, crib walling, masonry, car bodies or tyres for bank stabilisation.

Yours sincerely



Chris Binks Licensing Officer Namoi/Gwydir/Border Rivers



## CONTROLLED ACTIVITIES ON WATERFRONT LAND

# Controlled activity exemptions on waterfront land

Under the *Water Management Act 2000* (WM Act) an approval is required to undertake controlled activities on waterfront land, unless that activity is otherwise exempt (section 91E).

Controlled activities include the carrying out of building work, such as erecting buildings and other structures, and the installation of infrastructure. They also include excavaling or depositing material.

Waterfront land is the bed of any river, lake or estuary and any land within 40 metres of the highest bank of the river, the lake shore or the mean high water mark of the estuary.

The Water Management (General) Regulation 2011 sets out a number of exemptions in relation to controlled activities. Please refer to the Water Management (General) Regulation 2011 Part 3, Division 2, Subdivision 4 and Schedule 5, Part 2 for full details.

## Exempt controlled activities

#### Public authorities

A public authority does not need to obtain a controlled activity approval for any controlled activities that it carries out in, on or under waterfront land.

The WM Act defines a public authority as:

- a minister of the Crown
- a government department or administrative office
- a statutory body representing the Crown
- a statutory state owned corporation (or any of its subsidiaries) within the meaning of the State Owned Corporation Act 1989
- a council or county council within the meaning of the Local Government Act 1993.

Landcom is not a public authority for the purposes of this exemption (clause 30 of the Water Management (General) Regulation 2011).

#### Third parties undertaking controlled activities on behalf of public authorities

Under the WM Act a public authority is exempt from the need to obtain a controlled activity approval for any controlled activities that it carries out in, on or under waterfront land.

In some cases a third party, such as a contractor, may carry out works on behalf of a public authority. When this happens, the third party will usually benefit from the exemption in favour of the public authority.

Factors used to determine if a third party is acting for and on behalf of a public authority will include the nature of the contractual relationship between the parties and the level of control that the public authority retains over the works, both during and after construction.

Examples of exempt controlled activities undertaken by third parties on behalf of a public authority include:

- · a contractor desilting drains for a council
- · a contractor maintaining or installing water mains for Sydney Water.

A third party will not benefit from the exemption in favour of a public authority when undertaking controlled activities on their own behalf. This includes works undertaken under a development application or other approval, even when the works will be handed over to a public authority after completion.

Examples of controlled activities that are not considered to be exempt include:

- a developer constructing drainage and detention basin works to be transferred to council ownership after completion
- a developer constructing sewerage and water supply infrastructure to be transferred to Sydney Water ownership after completion.

## Private dwellings

A controlled activity approval is not required for erecting or demolishing, or the alteration or addition to, or the provision of ancillary facilities for a dwelling house or dual occupancy building, so long as the activity:

- is exempt development for the purposes of Environmental Planning and Assessment Act 1979 or is subject to a development consent or complying development certificate in force under the Environmental Planning and Assessment Act 1979
- is not constructed on or in the bed or bank of a river, the bed or shore of a lake, or the bed or land lying between the high water mark of any estuary.

## Other exemptions

A controlled activity approval is not required if:

- the waterfront land relates to a river channel that is fully concrete lined or is a fully enclosed pipe channel
- the construction or use of fencing, a vehicular crossing or an access track on waterfront land does not impound water and relates to a minor stream in a rural zone
- · the activity is nothing more than removal of vegetation in circumstances that would otherwise be lawful
- the controlled activity is to be undertaken:
  - o in accordance with a WM Act water supply works approval
  - o in accordance with a WM Act harvestable rights order
  - o in accordance with section 52 (domestic and stock rights) of the WM Act in certain circumstances.
  - o in accordance with an approval under Part 2 of the former Water Act 1912
  - by a network operator or pipeline licensee to construct, modify, repair, maintain, or complete emergency work on water or gas infrastructure or licensed pipelines
  - o during an emergency under the direction of a relevant act
  - in accordance with any mining, crown lands or western lands lease, licence, permit
  - o in accordance with any lease, licence, permit or other right in force in respect of land under the ownership or control of the maritime authority or a port corporation.

## Harm to waterfront land

The Minister may, if necessary, require a person to take measures to protect the waterfront land, or any river, lake or estuary to which that land has frontage, when carrying out an exempt controlled activity.

#### Where do I go for additional information?

Find out more about controlled activities at the Office of Water website www.water.nsw.gov.au

#### Contact us

Contact a water regulatory officer as listed on the Office of Water website www.water.nsw.gov.au free call the licensing information on 1800 353 104 or email information@water.nsw.gov.au.

Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (June 2012). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of the Department of Primary Industries or the user's independent adviser.

Published by the Department of Primary Industries, a division of NSW Department of Trade and Investment, Regional Infrastructure and Services.

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From:	Admin
To:	sarah@constructivesolutions.com.au
Subject:	FW: Blackjack Creek reconstruction
Date:	Thursday, 13 September 2012 9:50:24 AM

From: Robert Taylor [mailto:Robert.Taylor@environment.nsw.gov.au]
Sent: Thursday, 13 September 2012 9:15 AM
To: admin@constructivesolutions.com.au
Subject: Blackjack Creek reconstruction

Sarah

Re your letter of 10 September outlining the concept design plans for Blackjack Creek. At this stage OEH has no comments additional to those provided in our letter date 9 March 2012.

Rob

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Dr Robert Taylor Manager, Environment and Conservation Programs Office of Environment and Heritage PO Box 2111, Dubbo, NSW 2830 Ph 68835354, 0427423422

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Any views expressed in this email are those of the individual sender except where the sender expressly and with authority states them to be the views of the Office of Environment and Heritage, NSW Department of Premier and Cabinet.

PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL



8<sup>th</sup> October 2012

Constructive Solutions Pty Ltd PO Box 1498 TAMWORTH NSW 2340

Attention Ms Sarah Horne

Dear Sarah

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## RE: REF for Blackjack Creek Riparian Corridor / Channel Reconstruction – Gunnedah

Thank you for your letter dated 10<sup>th</sup> September 2012 requesting input and comment for inclusion in the draft Review of Environmental Factors (REF) for the proposed Blackjack Creek Riparian Corridor / Channel Reconstruction project on the outskirts of Gunnedah.

Furthermore, thank you for your visit on the 19<sup>th</sup> September 2012 and the opportunity to discuss the proposal with you and with a number of Namoi CMA staff. The discussions and the additional material have helped to formulate the following comments.

Namoi CMA has concerns with the following issues:

- Catchment hydrology and channel design
- Salinity and Groundwater management
- Rehabilitation and Revegetation.

Namoi CMA believes that these issues need to addressed in detail within the Review of Environmental Factors and that safeguards are specified that will mitigate the potential impacts for the proposed Blackjack Creek Riparian Corridor / Channel Reconstruction.

Namoi CMA understands that an approval will be sought under the Water Management Act 2000 for a controlled activity for the channel reconstruction. Consequently, approval under the Native Vegetation Act 2003 is not required for any clearing of native vegetation as the incidental clearing is considered to be 'Excluded Clearing' under s25 of the NVAct. However, Namoi CMA recommends that Gunnedah Shire Council consider the channel location is respect to minimising the amount and type of clearing, especially regarding the recently planted vegetation and the existing old box trees that provide numerous environmental services.

## Catchment hydrology and channel design

As per the 'Channel Options Study' April 2012, the adopted design peak discharge for a 100 year ARI rainfall is estimated to be 127m<sup>3</sup>/sec. Based on this peak discharge, the concept

design plans and some rudimentary hydraulics it is believed that there maybe a few issues that need to be examined further in the REF including:

- It appears that the capacity of the lower reaches of the channel near the Oxley Highway will be exceeded during a 100 year ARI event. This maybe intentional and desirable, however the flood behaviour at this end of the channel during a 100 year ARI needs to be explained,
- It appears that for the whole channel length, non scouring velocities will be exceeded during a 100 year ARI event even under thick and high grass cover. Again erosion damage during a 100 year ARI event maybe acceptable, repairable and manageable, however, this needs to be examined and justified in the REF,
- The 'Concept Design Report' June 2012 mentions the inclusion of rock revetment or similar to manage soil erosion, however it is believed that these type of structures provide little protection against erosion especially when subjected to high velocity flows such as a 100 year ARI. The inclusion of these structures needs to be justified in the REF,
- The 'Concept Design Plans' detail the expected depths of excavation to allow the channel reconstruction. The average depths range from zero through to over 2m with a resultant excavated volume of soil of 75,405m<sup>3</sup>. The REF needs to thoroughly detail how this soil will be handled and disposed.

Namoi CMA understands the reasoning for the channel and its proposed location; however Namoi CMA would prefer greater replication of natural riparian systems through increased meandering, varying widths, and pools and riffle sequences. These options need to be examined within the REF.

## Salinity and Groundwater Management

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It is well known that dryland salinity and high water tables are issues within the Wandobah reserve along Blackjack Creek. It has been investigated thoroughly and reported in 'Use of Geophysical Methods to Delineate Salt Affected Areas for Channel Reconstruction in Wandobah Reserve Gunnedah, NSW' DIPNR 2003. This report highlighted that:

- soil salinity is high near the surface decreasing with soil depth,
- soil salinity is high enough to affect plant growth,
- the water tables are impacted by seasons but can range from 0 to 5.5m below ground level,
- saline water discharges are likely to occur during wet periods, and
- the lack of drainage exacerbates salinity levels.

It appears from the 'Concept Design Report' June 2012 that soil tests were only undertaken on soil samples from 0 to 30cm deep and that soil salinities ranged from  $0.50EC_e$  to  $7.30EC_e$ . As channel excavation depths will range from 0 to over 2m at various locations, it would be expected that soil salinity and groundwater testing would be undertaken to depths at least equal to the depth of excavation at the respective locations. It is preferred that soil salinity and groundwater testing be undertaken to depths at 0.2m below the expected excavation depth to test for the presence of salts and rising water tables.

Namoi CMA believes that the REF will need to detail whether the excavated channel will expose soils with high salt levels and whether shallow groundwater tables will be intercepted. If these occur, the REF will need to detail how these mitigated and managed to prevent environmental impacts.

Furthermore, Namoi CMA believes that the excavated spoil will have elevated soil salinity levels. Consequently, how it will be handled, managed and disposed will need to be thoroughly explained in the REF.

#### **Rehabilitation and Revegetation**

It appears from the 'Concept Design Report' June 2012 that the channel, batters and banks will occupy an area of 9.25hectares and that topsoil to a depth of 0.1m will be stripped from this area and stockpiled for later re-use.

Namoi CMA believes that REF should examine salvaging subsoil for use in the rehabilitation process to rebuild soil profiles and ensure rehabilitation. Namoi CMA is concerned that the proposed excavation depths will intercept inhospitable soil types, soil salinities and high water tables. The replacement of additional, more favourable soils will possibly seal off and cap the inhospitable soil types, soil salinities and high water tables. The REF needs to address the concerns of inhospitable soil types, soil salinities and high water tables that will occur with the great depths of excavation.

As mentioned above, the REF will need to address how the excavated spoil will be handled, managed and disposed. If it is to be disposed of on the adjacent floodplain, the REF needs to detail how it will be encapsulated, rehabilitated and revegetated.

Namoi CMA is concerned with the proposed riparian restoration and the selection of vegetation species. Blackjack Creek is mainly an ephemeral creek with intermittent flows mainly from urban stormwater. Namoi CMA believes that the indicative wetland species specified in the 'Concept Design Plans' are inappropriate for revegetation within Blackjack Creek. The REF needs to examine various suitable species for rehabilitation taking into account the hydraulic requirements, soil stabilisation, predicted moisture presence, likely soil salinity, ease of maintenance, habitat values, establishment requirements and aesthetic qualities.

## Conclusion -

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Namoi CMA appreciates the opportunity to provide comment and input into the preparation of the REF. Namoi CMA looks forward to reviewing the REF when it is on exhibition.

If you would like to like to discuss any of these issues further please do not hesitate to contact me on 6742 9204.

Yours Sincerely

Glenn Bailey, Catchment Coordinator Namoi Catchment Management Authority

# APPENDIX C Groundwater Bores Radius Search



# **GROUNDWATER BORES IN THE AREA**



Date/Time :21-Nov-2012 10:54 AM User :VMARTIN Report :RMGW001D.QRP Executable :S:\G5\PROD32\Ground.exe Exe Date :25-Nov-2011 System :Groundwater Database :Edbp

Licence :



Converted From HYDSYS

Intended Purpose(s)

## NSW OFFICE OF WATER Work Summary

Licence Status Authorised Purpose(s)

#### GW024734

Work Type :Bore NOT KNOWN Work Status :Supply Obtained Construct. Method :Cable Tool **Owner Type :**Private **Commenced Date :** Final Depth : 32.30 m 0.00 Completion Date :01-Jan-1941 **Drilled Depth : Contractor Name :** Driller : Assistant Driller's Name : **Property** : **Standing Water Level :** GWMA: -Salinity : (Unknown) GW Zone : -Yield : Site Details Site Chosen By County Parish Portion/Lot DP Form A :POTTINGER GUNNEDAH 189 Licensed : Region :90 - BARWON CMA Map :8936-3S EMERALD HILL River Basin :419 - NAMOI RIVER Grid Zone :56/1 Scale :1:25,000 Area / District : **Elevation :** Northing :6569351 Latitude (S) :30° 58' 47" Elevation Source :(Unknown) Easting :235829 Longitude (E) :150° 14' 2" GS Map :0028A4 MGA Zone:56 **Coordinate Source :** Construction Negative depths indicate Above Ground Level; H-Hole; P-Pipe; OD-Outside Diameter; ID-Inside Diameter; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers H P Component Type From (m) To (m) OD (mm) ID (mm) Interval Details (No Construction Details Found) Water Bearing Zones To (m) Thickness (m) WBZ Type 15.20 0.00 (Unknown) From (m) 15.20 S.W.L. (m) D.D.L. (m) Yield (L/s) Hole Depth (m) Duration (hr) Salinity (mg/L) (Unknown) **Drillers Log** From (m) To (m) Thickness(m) Drillers Description **Geological Material** Comments

Remarks

\*\*\* End of GW024734 \*\*\*

## GW965532

Licence :			Licence Status	Intended Purpose	
Work Type :Bore Work Status : Construct. Method :Auger Owner Type :			Autorised Fulpose(s)	MONITORING B	ORE
Commenced Date : Completion Date :10-Feb-2000	Final Depth : Drilled Depth :	10.00 m 10.00 m			
Contractor Name :DLWC Ground Driller : Assistant Driller's Name :	water Drilling - Proline				
Property : GWMA : - GW Zone : -		S	Standing Water Level : Salinity : Yield :		
Site Details					
Site Chosen By	Form A : Licensed :	County	Parish	Portion/Lot DP	
<b>Region :</b> 90 - BARWO <b>River Basin :</b> <b>Area / District :</b>	J		CMA Map : Grid Zone :	Scale :	
Elevation : Elevation Source :			Northing :6569501 Easting :236699	<b>Latitude (S) :</b> 30° <b>Longitude (E) :</b> 150°	58' 43" ° 14' 35"
GS Map :	MGA Zone :56	С	oordinate Source :GPS - Gl	obal Positioning System	
Negative depths int           H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside	licate Above Ground Level; iameter;C-Cemented;SL-Slot Le irom (m) To (m) OD (mm) 0.00 10.00 150 -1.06 10.00 50 8.50 10.00 50 8.40 10.00	ngth;A-Aperture;GS-Gri ID (mm) Interval Deta Auge Seata PVC Grad	ain Size;Q-Quantity;PL-Placement ils r d on Bottom : Mechanically Slotted ed	of Gravel Pack;PC-Pressure Cemented;S-	Sump;CE-Centralisers
Water Bearing Zones	/BZ Type	S.W.L. (m)	D.D.L. (m) Yield (I	L/s) Hole Depth (m) Duration (hr)	Salinity (mg/L)
	(Ne	Water Bearing Zoi	ne Details Found)		5
Drillers         LOG           From (m)         To (m)         Thickness(m) Drillers Dec           0.00         1.00         1.00 clay/loa           1.00         2.00         1.00 clay/sit           2.00         10.00         8.00 silty/cl	<b>cription</b> m/silty dark brown ly with sand and gravel ay	dark brown	Geological Mater Clay Clay Invalid Code	rial Comments	

## Remarks

Form A Remarks: ECI-5 (ds/m) 1m .11, 2m .14, 3m .76, 4m .52, 5m .34, 6m .31, 7m .46, 8m .82, 9m .99,10m 1.02 ECe (ds/m) 1m 1.10, 2m 1.4, 3m 5.32, 4m 4.42, 5m 2.89, 6m 2.62, 7m 3.91, 8m 6.97, 9m 8.42, 10m 8.67 SP1 Maintenance Data: Pipe =,contractor=Dubbo Drilling,maintained=,blocked=,recovered=,SWL below MP=4.13,Height of MP/Cas=,Depth below MP=5.02,Bore Protector Painted=Yes,New Lid on Bore Protector=,LD. added=yes,Lock=yes,New Bore Protector Required= ,New Bore Protector Added=,Cement Around Bore Protector=,camera=,airlift=,airlift success=,logger repaired=,logger installed or replaced=,narrative=OK

#### \*\*\* End of GW965532 \*\*\*

## GW965543

Licence :			Licence Status	(c)	Intended Purpose	
Work Type :Bore Work Status : Construct. Method :Auger Owner Type :			Autoriseu r ur pose	8)	MONITORING BO	DRE
Commenced Date : Completion Date :10-Feb-2000	Final Depth : Drilled Depth :	10.00 m 10.00 m				
Contractor Name :DLWC Groun Driller : Assistant Driller's Name :	ndwater Drilling - Proline					
Property : GWMA : - GW Zone : -			Standing Water Level Salinity Yield	:		
Site Details						
Site Chosen By	Co Form A : Licensed :	unty	Parish		Portion/Lot DP	
<b>Region :</b> 90 - BARW <b>River Basin :</b> Area / District :	ON		CMA Map : Grid Zone :	So	cale :	
Elevation : Elevation Source :			Northing :656 Easting :236	59501 5699	Latitude (S) :30° 5 Longitude (E) :150°	58' 43" 14' 35"
GS Map :	MGA Zone :56	(	Coordinate Source :			
Construction Negative depths H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside H P Component Type 1 Hole Hole 1 I Casing P.V.C. 1 I Opening Slots 1 Annulus (Unknown)	indicate Above Ground Level; a Diameter;C-Cemented;SL-Slot Lengt From (m) To (m) OD (mm) ID 0.00 10.00 150 -1.08 10.00 50 8.50 10.00 50 8.40 10.00	h;A-Aperture;GS-G (mm) Interval Det: Aug PV( Grad	rain Size;Q-Quantity;PL-Plac ails rer C; Mechanically Slotted ded	ement of Gravel Pa	ck;PC-Pressure Cemented;S-S	Sump;CE-Centralisers
Water Bearing ZonesFrom (m)To (m)Thickness (m)	) WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s) Hole	Depth (m) Duration (hr)	Salinity (mg/L)
	(No W	Vater Bearing Zo	one Details Found)			
Torillers         Log           From (m)         To (m)         Thickness(m)         Drillers           0.00         1.00         1.00 gravel           1.00         2.00         1.00 sandy/           2.00         3.00         1.00 slty/           3.00         4.00         1.00 clay/gr           4.00         6.00         2.00 silty/           6.00         7.00         1.00 clay/gr           7.00         8.00         1.00 silty/	Description ly/sandy clay clay dark brown clay with sand ravel/sand dark brown clay with rhyolite chips ravel with some quatz clay light clay with gravel		Geologica Gravel Invalid Invalid Clay Invalid Clay Invalid Invalid	I Material Code Code Code Code	Comments	

#### Remarks

pipe name SP15 Maintenance Data: Pipe =,contractor=Dubbo Drilling,maintained=,blocked=,recovered=,SWL below MP=,Height of MP/Cas=,Depth below MP=9.9,Bore Protector Painted=Yes,New Lid on Bore Protector=,LD. added=yes,Lock=yes,New Bore Protector Required=,New Bore Protector Added=,Cement Around Bore Protector=,camera=,airlift=,airlift success=,logger repaired=,logger installed or replaced=,narrative=Aquifer dry

#### \*\*\* End of GW965543 \*\*\*

#### GW965567

Licence :		Li	icence Status	Letandad Durmaaa(a)
Work Type :Bore Work Status :Abandoned - ( Construct. Method :Rot. Rev. Circ Owner Type :	Collapsed ⊳ Mud	A	unioriseu r'urpose(s)	MONITORING BORE
Commenced Date : Completion Date :18-May-2002	Final Depth : Drilled Depth :	24.00 m 24.00 m		
Contractor Name :Arfrac Drilling Driller :1662 Assistant Driller's Name :	g Pty Ltd CROWLEY, Warren James			
Property : GWMA : - GW Zone : -		Sta	nding Water Level : Salinity : Yield :	
Site Details				
Site Chosen By Hydrogeologist	Cou Form A : Licensed :	inty	Parish	Portion/Lot DP
<b>Region :</b> 90 - BARWO <b>River Basin :</b> Area / District :	N		CMA Map : Grid Zone :	Scale :
Elevation : Elevation Source :			Northing :6568655 Easting :235833	Latitude (S) :30° 59' 10" Longitude (E) :150° 14' 2"
GS Map :	MGA Zone :56	Cool	rdinate Source :	
Negative depths i           H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside           H         P         Component         Type           1         Hole         Hole         1           2         Casing         P.V.C.         1           1         Opening         Slots - Horizontal         1           2         Opening         Slots - Horizontal         1           1         Annulus         Crushed Aggregate	ndicate Above Ground Level; Diameter;C-Cemented;SL-Slot Length From (m) To (m) OD (mm) ID ( 0.00 24.00 154 -0.97 8.00 50 -0.97 8.00 50 7.00 8.00 50 21.00 22.00 50 0.00 24.00 154	;A-Aperture;GS-Grain 1; mm) Interval Details Rot. Rev. Glued; Sr Glued; Sr Glued; Sr PVC; Me PVC; Me 50 Graded	Size;Q-Quantity;PL-Placement of . Circ Mud eated on Bottom eated on Bottom schanically Slotted; A: .5mm schanically Slotted; A: .5mm	Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centralisers
Water Bearing ZonesFrom (m)To (m)Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m) Yield (L/s	) Hole Depth (m) Duration (hr) Salinity (mg/L)
	(No We	ater Bearing Zone I	Details Found)	
From (m)         To (m)         Thickness(m)         Drillers ID           0.00         1.00         1.00 clay/re           1.00         2.00         1.00 clay/re           2.00         5.00         3.00 salty clay           5.00         8.00         3.00 sandstc           8.00         9.00         1.00 conglom           9.00         12.00         3.00 conglom           12.00         13.00         1.00 mudstor           13.00         16.00         3.00 shale/s           16.00         24.00         8.00 shale	Description d silty sandy d silty sandy more clay tlay ne/lithic/siltstone weathere merate/interbeds of mudstone merate with rock fragments si ne/weathered siltstone dark grey weathered	d and siltstone ze increases with	Geological Material Clay Clay Invalid Code Sandstone Conglomerate Mudstone Shale Shale	Comments

## Remarks

Form A Remarks:

Form A Remarks. bentonite plugs at .4m to .5m and 18.7m to 19.1m. shallow pipe = 1 deeper pipe=2. A steel monument is in place for protection. bore identity P18 Maintenance Data: Pipe =,contractor=Dubbo Drilling,maintained=,blocked=,recovered=,SWL below MP=,Height of MP/Cas=,Depth below MP=,Bore Protector Painted=,New Lid on Bore Protector=,1.D. added=,Lock=,New Bore Protector Required=yes ,New Bore Protector Added=,Cement Around Bore Protector=,camera=,airlift=,airlift success=,logger repaired=,logger installed or replaced=,narrative=Bore protector needs replacing

\*\*\* End of GW965567 \*\*\*

## GW965573

Licence :			Licence Status Authorised Purpos	se(s)	Inte	ended Purpose	(s)
Work Type :Bore Work Status : Construct. Method :Rot. Rev. Circ Owner Type :	Mud				МО	NITORING BO	DRE
Commenced Date : Completion Date :06-May-2000	Final Depth : Drilled Depth :	16.00 m 16.00 m					
Contractor Name :Arfrac Drilling Driller :1662 Assistant Driller's Name :	g Pty Ltd CROWLEY, Warren Jame	es					
Property : GWMA : - GW Zone : -			Standing Water Lev Salini Yie	vel : ty : ld :			
Site Details							
Site Chosen By Hydrogeologist	C Form A : Licensed :	ounty	Parish		Portion	n/Lot DP	
<b>Region :</b> 90 - BARWO <b>River Basin :</b> Area / District :	N		CMA Map : Grid Zone :		Scale :		
Elevation : Elevation Source :			Northing :6 Easting :2	569501 36699	Lati Longi	itude (S) :30° 5 itude (E) :150°	8' 43" 14' 35"
GS Map :	MGA Zone :56	(	Coordinate Source :C	GPS - Global	Positioning Sys	tem	
H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside           H         P         Component         Type           H         Hole         Hole         Hole           1         1         Casing         P.V.C.           1         1         Opening         Slots - Horizontal	ndicate Above Ground Level; Diameter;C-Cemented;SL-Slot Len; From (m) To (m) D (mm) I 0.00 16.00 154 -0.89 16.00 50 14.50 15.50 50	gth;A-Aperture;GS-G D (mm) Interval Det Rot Glu PVC	rain Size;Q-Quantity;PL-P ails . Rev. Circ Mud ed; Seated on Bottom C; Mechanically Slotted; A: .	lacement of Gra 5mm	avel Pack;PC-Press	sure Cemented;S-S	Sump;CE-Centralisers
Water Bearing Zones From (m) To (m) Thickness (m)	WBZ Type	S.W.L. (m)	) D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
	(No	Water Bearing Zo	one Details Found)				
From (m)         To (m)         Thickness(m)         Drillers         D           0.00         1.00         1.00 silty of         1.00 silty of         2.00         10.00 silty of           10.00         1.00         1.00 silty of         1.00 silty of         1.00 silty of         1.00 silty of           10.00         11.00         1.00 silty of         1.00 silt	escription lay loam dark brown lay loam dark brown with so lay e/weathered with quatz gra. e with basalt fragments e	ome gravel ins about 2mm	Geolog Inval Inval Inval Inval Inval Rhyol	ical Material id Code id Code id Code id Code id Code ite	Comme	ents	

## Remarks

bentonite plug in place at 9.7m-10m. Local identification P17. A steel monument is in place for protection Maintenance Data: Pipe =,contractor=Dubbo Drilling,maintained=,blocked=,recovered=,SWL below MP=4.91,Height of MP/Cas=,Depth below MP=16.11,Bore Protector Painted=Yes,New Lid on Bore Protector=,I.D. added=yes,Lock=,New Bore Protector Required= ,New Bore Protector Added=,Cement Around Bore Protector=,camera=,airlift=,airlift success=,logger repaired=,logger installed or replaced=,narrative=OK

#### \*\*\* End of GW965573 \*\*\*

#### GW966959

Licence :		1	Licence Status	0(6)	Into	ndad Purpasa	s)
Work Type :Bore Work Status :(Unknown) Construct. Method :(Unknown) Owner Type :(Unknown)		1	Authoriseu r'ui pos	e(s)	Inter	nueu i ui pose(	5)
Commenced Date : Completion Date :20-Jan-2005	Final Depth : Drilled Depth :						
Contractor Name : Driller :							
Assistant Driller's Name : Property : GWMA : - GW Zone : -		St	anding Water Leve Salinit Yiel	el : y : d :			
Site Details							
Site Chosen By	Form A Licensed	County : :	Parish		Portion	/Lot DP	
<b>Region :</b> 90 - BARW <b>River Basin :</b> Area / District :	ON		CMA Map : Grid Zone :		Scale :		
Elevation : Elevation Source :			Northing :65 Easting :23	569462 36578	Lati Longit	<b>tude (S) :</b> 30° 5 <b>tude (E) :</b> 150°	8' 44" 14' 30"
GS Map :	MGA Zone :56	Co	ordinate Source :G	PS - Global l	Positioning Syst	tem	
Construction Negative depths H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside H P Component Type	indicate Above Ground Level; e Diameter;C-Cemented;SL-Slot I From (m) To (m) OD (mm)	Length;A-Aperture;GS-Grain ID (mm) Interval Details	n Size;Q-Quantity;PL-Pla	acement of Gra	vel Pack;PC-Press	ure Cemented;S-S	ump;CE-Centralisers
		(No Construction De	tails Found)				
Water Bearing Zones	) WBZ Type	SWL (m)	D.D.L. (m)	Vield (L/s)	Hole Depth (m)	Duration (br)	Salinity (mg/L)
	(1	No Water Bearing Zone	e Details Found)	11044 (2,5)	11010 20 <b>0</b> 101 (m)		Summy (mg/2)
From (m) To (m) Thickness(m) Drillers I	Description		Geologi	cal Material	Comme	nts	
Remarks							

piezometer pipe height 1.03m--location Wandobah Reserve--P-1 Reviewed data - nothing to update.

\*\*\* End of GW966959 \*\*\*

#### GW966960

Licence :		1	Licence Status	(a)	Intended Durnese	
Work Type :Bore Work Status :(Unknown) Construct. Method :(Unknown) Owner Type :(Unknown)		1	Authoriseu Furpose(	8)	intended Furpose	(5)
Commenced Date : Completion Date :20-Jan-2005	Final Depth : Drilled Depth :					
Contractor Name : Driller : Assistant Driller's Name :						
Property : GWMA : - GW Zone : -		St	anding Water Level Salinity Yield	:		
Site Details						
Site Chosen By	Form A Licensed	County : :	Parish		Portion/Lot DP	
<b>Region :</b> 90 - BARWON <b>River Basin :</b> Area / District :	1		CMA Map : Grid Zone :	S	cale :	
Elevation : Elevation Source :			Northing :656 Easting :236	59147 5453	<b>Latitude (S) :</b> 30° 5 <b>Longitude (E) :</b> 150°	8' 54" 14' 25"
GS Map : M	IGA Zone :56	Co	ordinate Source :GP	S - Global Posit	tioning System	
Construction Negative depths ind H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside D H P Component Type F	icate Above Ground Level; iameter;C-Cemented;SL-Slot I rom (m) To (m) OD (mm)	Length;A-Aperture;GS-Grain ID (mm) Interval Details (No Construction De	n Size;Q-Quantity;PL-Plac tails Found)	ement of Gravel Pa	ack;PC-Pressure Cemented;S-S	Sump;CE-Centralisers
Water Bearing Zones						
From (m) To (m) Thickness (m) W	BZ Type	S.W.L. (m)	<b>D.D.L.</b> (m)	Yield (L/s) Ho	e Depth (m) Duration (hr)	Salinity (mg/L)
	(1	No Water Bearing Zone	e Details Found)			
Drillers Log From (m) To (m) Thickness(m) Drillers Des	cription		Geologica	l Material	Comments	
<b>Remarks</b> Form A Remarks: piezometer pipe height 1.08Wandobah Reserve-P-2	Reviewed data - nothing to upda	ıte.				

\*\*\* End of GW966960 \*\*\*

#### GW966961

Licence :		I	Licence Status		Intended Dumos	
Work Type :Bore Work Status :(Unknown) Construct. Method :(Unknown) Owner Type :(Unknown)		F	aumorisen rurpose(s	)	intended Furpose	2(8)
Commenced Date : Completion Date :20-Jan-2005	Final Depth : Drilled Depth :					
Contractor Name : Driller : Assistant Driller's Name :						
Property : GWMA : - GW Zone : -		St	anding Water Level : Salinity : Yield :			
Site Details						
Site Chosen By	Form A Licensed	County : :	Parish		Portion/Lot DP	
<b>Region :</b> 90 - BARWO <b>River Basin :</b> Area / District :	NO		CMA Map : Grid Zone :	Sc	ale :	
Elevation : Elevation Source :			Northing :6569 Easting :2361	9137 186	Latitude (S) :30° Longitude (E) :150°	58' 55" 2 14' 15"
GS Map :	MGA Zone :56	Coo	ordinate Source :GPS	- Global Positio	oning System	
Construction Negative depths i	indicate Above Ground Level;					
H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside H P Component Type	From (m) To (m) OD (mm)	Length;A-Aperture;GS-Grain ID (mm) Interval Details	Size;Q-Quantity;PL-Place	ment of Gravel Pac	k;PC-Pressure Cemented;S-	Sump;CE-Centralisers
		(No Construction De	tails Found)			
Water Bearing Zones						
From (m) To (m) Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m) Y	ield (L/s) Hole	Depth (m) Duration (hr)	Salinity (mg/L)
	(1	No water Bearing Zone	Details Found)			
Drillers         Log           From (m)         To (m)         Thickness(m)         Drillers         I	Description		Geological	Material	Comments	
Remarks						
Form A Remarks:						

piezometer pipe height 1.09--Wandobah Reserve--P-3 Reviewed data - nothing to update.

\*\*\* End of GW966961 \*\*\*

## **GW970239** - Gunnedah Shire Council - Wandobah Reserve

Licence :90BL256052			Licence Status Active	Intended Draws	2(5)
Work Type :Bore Work Status :Equippec Construct. Method :Auger - S Owner Type :Local Go	l - bore used for obs Solid Flight vvt		Authorised Purpose(s) MONITORING BORE	MONITORING B	e(s) ORE
Commenced Date : Completion Date :24-May-2	Final Depth : 2012 Drilled Depth :	2.50 m 2.50 m			
Contractor Name :Terratest Driller :1673 Assistant Driller's Name :Darryl S	TUCKER, Jason Douglas				
Property : - WAN GWMA :024 - M GW Zone : -	DOBAH RESERVE ISCELLANEOUS FRACTURED RC	OCK OF	Standing Water Level : Salinity : Yield :		
Site Details					
Site Chosen By Client	Cour Form A :POT Licensed :POT	nty TINGER TINGER	<b>Parish</b> GUNNEDAH GUNNEDAH	<b>Portion/Lot DP</b> 7053//1116141 7053 1116141	
Region :90 - BA River Basin :419 - N Area / District :	RWON AMOI RIVER		<b>CMA Map :</b> 8936-35 <b>Grid Zone :</b> 56/1	S EMERALD HILL Scale :1:25,000	
Elevation : Elevation Source :			Northing :656884 Easting :236221	Latitude (S) :30°           Longitude (E) :150	59' 4" ° 14' 16"
GS Map :	MGA Zone :56		Coordinate Source :GPS - C	Global Positioning System	
Construction         Negative definition           H-Hole;P-Pipe;OD-Outside Diameter;ID-         H           H         P         Component         Type           1         Hole         Hole         Hole           1         1         Casing         PVC Class 18           1         1         Opening         Slots - Horizontal           1         Annulus         Cement Grout           1         Annulus         Waterworn/Rounded	From (m)         To (m)         OD (mm)         ID (n)           0.00         2.50         125         0.00         1.00         60           1.00         2.50         60         0.00         2.50         125           0.00         1.00         60         0.00         2.50         125           0.00         0.20         125         0.00         0.00         125           0.20         0.70         125         0.20         125         0.70         2.50         125	A-Aperture;GS- nm) Interval D 50 Sa 50 P 60 P1 60 P1 60 G	Grain Size;Q-Quantity;PL-Placemen etails uger - Solid Flight crewed; Cemented; End cap VC Class 18; Mechanically Slotted; A: . L: Poured/Shovelled L: Poured/Shovelled raded; GS: 1-2mm; PL: Poured/Shovelle	nt of Gravel Pack;PC-Pressure Cemented;S 04mm; Screwed	-Sump;CE-Centralisers
Water BearingZonFrom (m)To (m)2.002.50	es ss (m) WBZ Type 0.50	S.W.L. (1	m) D.D.L. (m) Yield	(L/s) Hole Depth (m) Duration (hr)	Salinity (mg/L)
To (m)         To (m)         Thickness(m)         Dri           0.00         0.30         0.30 Lo         se           0.30         0.62         0.32 Lo         se           1.11         1.39         0.28 Sa         se           1.39         1.70         0.31 cl         se	illers Description am, brown orange, crumbly, clayey nt am, brown orange, dry crumbly, cal nd/Gravel, reds browns ndy Clay, increasing, brown orange avel, abrupt change, calcite, sand ay/Sand, very wet, fine texture	sandy, calc: cite present y no soil, y	Geological Mat ite, gravel pre Loam t Loam Sand Sandy Clay very wet Gravel Clay	erial Comments	

## Remarks

Form A Remarks: Nat Carling, 19-Sept-2012; GPS provided by driller. Lithology/Page 3 of the Form-A was provided by consultant at a later date. No indication of which log was associated with which bore was provided, may differ from actual log.

#### \*\*\* End of GW970239 \*\*\*

GW970240	- Gunnedah Shire Council - Wandobah Reserve
<b>UT VV 9 / UZ4U</b>	- Guilledan Shire Council - wandoban Reserve

Licence :90BL256052			Licence Status Active	Inter de l D		
Work Type :B Work Status :E Construct. Method :A Owner Type :La	ore juipped - bore used for uger - Solid Flight ocal Govt	r obs		Authorised Purpose(s) MONITORING BORE	Intended P MONITOR	urpose(s) ING BORE
Commenced Date : Completion Date :24	-May-2012 Dr	Final Depth : illed Depth :	9.80 m 9.80 m			
Contractor Name :To Driller :16 Assistant Driller's Name :D	erratest Pty Ltd 73 TUCK arryl S	ER, Jason Doug	las			
Property : - GWMA :02 GW Zone : -	WANDOBAH RESE 4 - MISCELLANEC	ERVE DUS FRACTURI	ED ROCK OF	Standing Water Level : Salinity : Yield :		
Site Details						
Site Chosen By Client		Form A Licensed	County :POTTINGER :POTTINGER	<b>Parish</b> GUNNEDAH GUNNEDAH	<b>Portion/Lot D</b> 7053//1116141 7053 1116141	P
<b>Region :</b> 90 <b>River Basin :</b> 4 Area / District :	9 - BARWON 9 - NAMOI RIVER			<b>CMA Map :</b> 8936-3 <b>Grid Zone :</b> 56/1	S EMERALD HILL Scale :1:25,000	
Elevation : Elevation Source :				<b>Northing :</b> 656942 <b>Easting :</b> 236514	23 Latitude (S 4 Longitude (E	5) :30° 58' 46" 5) :150° 14' 28"
GS Map :	MGA Zo	one :56		Coordinate Source :GPS -	Global Positioning System	
Construction         Net           H-Hole;P-Pipe;OD-Outside Diar         Here           I         PC Component Type           1         Hole         Hole           1         I Casing         PVC Class 1           1         I Opening         Slots - Horiz           1         Annulus         Cement Gro           1         Annulus         Bentonite           1         Annulus         Waterworn/D	gative depths indicate Abov neter;ID-Inside Diameter;C From (m) 0.00 8 0.00 ontal 3.80 0.00 0.20 counded 2.80	ve Ground Level; -Cemented;SL-Slot To (m) OD (mm) 9.80 125 3.80 60 9.50 60 0.20 125 2.80 125 9.80 125	Length;A-Aperture;G ID (mm) Interval 50 60 60 60 60	S-Grain Size;Q-Quantity;PL-Placeme Details Auger - Solid Flight Screwed; Cemented; End cap PVC Class 18; Mechanically Slotted; A: PL: Poured/Shovelled PL: Poured/Shovelled Graded; GS: 1-2mm; PL: Poured/Shovel	nt of Gravel Pack;PC-Pressure Ceme .04mm; Screwed	ented;S-Sump;CE-Centralisers
Water Bearing           From (m)         To (m)           7.00         7.50	Zones Thickness (m) WBZ Type 0.50		S.W.L	. (m) D.D.L. (m) Yield	d (L/s) Hole Depth (m) Duration	n (hr) Salinity (mg/L)
	(m) Deillorg Description			Contorior	torial Commente	

From (m)	To (m)	Thickness(m) Drillers Description	Geological Material	Comments
0.00	0.41	0.41 Loam; dry crumbly, brown, slight creams, slightly gravel	Loam	
0.41	1.11	0.70 Loam; texture change, moist, heavy clay, red orange, slight gr	Loam	
		ey colours		
1.11	3.30	2.19 Clay; grey colours increasing, moist, calcite throughout, red	Clay	
		oranges		
3.30	3.40	0.10 Gravel, river gravel, reds oranges, clay, very moist	Gravel	
3.40	9.50	6.10 Clay, moisture thoughout, grey colours, heavy clay, red orange	Clay	
		S		

## Remarks

Form A Remarks: Nat Carling, 19-Sept-2012; GPS provided by driller. Lithology/Page 3 of the Form-A was provided by consultant at a later date. No indication of which log was associated with which bore was provided, may differ from actual log.

#### \*\*\* End of GW970240 \*\*\*
Licence :90BL256052	2			Licence Status Active	Intended Durness(s)		
Work Type :Bore Work Status :Equipped - b Construct. Method :Auger - Solie Owner Type :Local Govt	Work Type :Bore Work Status :Equipped - bore used for obs Construct. Method :Auger - Solid Flight Owner Type :Local Govt			MONITORING BORE	MONITORING BORE		
Commenced Date : Completion Date :24-May-201	Final 1 2 Drilled 1	Depth : Depth :	5.50 m 5.00 m				
Contractor Name :Terratest Pty Driller :1673 Assistant Driller's Name :Darryl S	Ltd TUCKER, Ja	ason Douglas					
Property : - WANDOBAH RESERVE GWMA :024 - MISCELLANEOUS FRACTURED ROCK OF GW Zone : -				Standing Water Level : Salinity : Yield :			
Site Details							
Site Chosen By Client		C Form A :P Licensed :P	c <b>ounty</b> OTTINGER OTTINGER	<b>Parish</b> GUNNEDAH GUNNEDAH	<b>Portion/Lot DP</b> 7053//1116141 7053 1116141		
<b>Region :</b> 90 - BARW <b>River Basin :</b> 419 - NAM <b>Area / District :</b>	/ON OI RIVER			<b>CMA Map :</b> 8936-3S <b>Grid Zone :</b> 56/1	EMERALD HILL Scale :1:25,000		
Elevation : Elevation Source :				Northing :6569069 Easting :236398	Latitude (S) :30° 58' 57" Longitude (E) :150° 14' 23"		
GS Map :	MGA Zone :5	5		Coordinate Source : GPS - Glob	al Positioning System		
Construction Negative depths	s indicate Above Grou	nd Level;					
I-Hole;P-Pipe;OD-Outside Diameter;ID-Insid H P Component Type	de Diameter;C-Cemer From (m) To (n	ted;SL-Slot Len	igth;A-Aperture;GS ID (mm) Interval I	Grain Size;Q-Quantity;PL-Placement of C Details	Gravel Pack;PC-Pressure Cemented;S-Sump;CE-Centr		
			4	AUSTA - MORT L'HEIR			

1 1	Opening	Slots - Horizontal	2.50	5.50	60	<i>c</i> 0	PVC Class 18; Mechanically Slotted; A: .04mm; Screwed
1	Annulus	Cement Grout	0.00	1.00	125	60	PL: Poured/Shovelled
1	Annulus	Bentonite	1.00	1.50	125	60	PL: Poured/Shovelled
1	Annulus	Waterworn/Rounded	1.50	5.50	125	60	Graded; GS: 1-2mm; PL: Poured/Shovelled
Wa	ter Be	earing Zones					

From (m)	To (m) Thick	ness (m) WBZ Type	S.W.1	L. (m) D.D.L. (m	n) Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
4.50	5.00	0.50						

### **Drillers Log**

From (m)	To (m)	Thickness(m) Drillers Description	Geological Material	Comments
0.00	0.38	0.38 Clay, brown, slight red, light, dry	Clay	
0.38	1.26	0.88 Clay, texture change, heavy clay, red orange, increasing moist ure, increasing orange	Clay	
1.26	2.45	1.19 Clay, heavy, crubmly, very moist, orange slight red	Clay	
2.45	5.00	2.55 Clay, mottling increasing, gley colours increasing, calcite, o range red, very moist	Clay	

#### Remarks

Form A Remarks: Nat Carling, 19-Sept-2012; GPS provided by driller. Lithology/Page 3 of the Form-A was provided by consultant at a later date. No indication of which log was associated with which bore was provided, may differ from actual log.

\*\*\* End of GW970241 \*\*\*

GW970243	- Gunnedah Shire	Council -	Wombadah Reserve
$(\tau VV 9 / U243)$	- Guilleuan Shile	Council -	wombauan Keserve

Gillion Calification		iouuun nebe	110				
Licence :90BL256052	2		Licence Stat	us Active	Terderer	de d Desarra e e (e	``
Work Type :Bore Work Status :Abandoned - Construct. Method :Hand Auger Owner Type :Local Govt	Backfilled		Authorised F MONITORIN	JG BORE	Intended Purpose(s) MONITORING BORE		
Commenced Date : Completion Date :24-May-2012	Final Depth : 2 Drilled Depth :	4.00 m 4.00 m					
Contractor Name :Terratest Pty Driller :1673 Assistant Driller's Name :Darryl S	Ltd TUCKER, Jason Douglas						
Property : - WANDO GWMA :024 - MISC GW Zone : -	BAH RESERVE ELLANEOUS FRACTURED R	SOCK OF	tanding Wate	er Level : Salinity : Yield :			
Site Details							
Site Chosen By Client	Cor Form A :PO Licensed :PO	unty FTINGER FTINGER	<b>Par</b> GU GU	<b>ish</b> NNEDAH NNEDAH	<b>Portion/I</b> 7053//111 7053 111	Lot DP 16141 6141	
<b>Region :</b> 90 - BARW <b>River Basin :</b> 419 - NAM <b>Area / District :</b>	'ON OI RIVER		CMA N Grid Z	<b>fap :</b> 8936-3S one :56/1	EMERALD HII Scale :1:25,00	L 10	
Elevation : Elevation Source :			North East	ing :6569311 ing :236469	Latitı Longitu	ıde (S) :30° 58 ıde (E) :150° 1	' 49" 4' 26"
GS Map :	MGA Zone :56	Co	ordinate Sou	rce :GPS - Global	Positioning System	m	
Construction Negative depths H-Hole;P-Pipe;OD-Outside Diameter;ID-Insid H P Component Type 1 Hole Hole 1 1 Backfill Drilled cuttings Water Bearing Zones From (m) To (m) Thickness (m 3.30 3.50 0.2	s indicate Above Ground Level; te Diameter;C-Cemented;SL-Slot Lengti From (m) To (m) OD (mm) ID 0.00 4.00 56 0.00 4.00 56 0.00 56 0.	h;A-Aperture;GS-Grai (mm) Interval Detail Hand . S.W.L. (m)	n Size;Q-Quanti s Auger D.D.L. (m)	ty;PL-Placement of Gr Yield (L/s)	avel Pack;PC-Pressur Hole Depth (m) I	e Cemented;S-Su Duration (hr)	mp;CE-Centralisers Salinity (mg/L)
Drillers I og							
From (m)         To (m)         Thickness(m)         Drillers           0.00         0.30         0.30         Clay;           0.30         0.54         0.24         Clay;           0.54         1.00         0.46         Clay;           1.00         1.30         0.30         Clay;           1.34         1.62         0.28         Clay;           1.62         2.13         0.51         Clay;           2.20         2.26         0.06         Loar,           2.26         3.15         0.89         Clay;           3.30         4.00         0.70         Gravel	Description dark brown, heavy lighter texture, dark brown red, lighter texture, colour heavy, orange red, moist slight calcite moist, orange, red lighter, some calcite, yellow yellow orange, lighter clay lighter texture cream colours, black orange, t, river gravel, colours orang , as above, moisture increasi	change 7 orange heavy, calcite o 19 yellow blacks ng	deposits creams	Geological Material Clay Clay Clay Clay Clay Clay Clay Cl	Comment	s	

#### Remarks

Form A Remarks: Nat Carling, 19-Sept-2012; GPS provided by driller. Lithology/Page 3 of the Form-A was provided by consultant at a later date. No indication of which log was associated with which bore was provided, may differ from actual log.

#### \*\*\* End of GW970243 \*\*\*

Licence :90BL256052			Licence Status Act	ive	<b>Intended Purpose(s)</b> MONITORING BORE		
Work Type :Bore Work Status :Abandoned - Construct. Method :Hand Auger Owner Type :Local Govt	Backfilled		MONITORING BO	RE			
Commenced Date : Completion Date :24-May-2012	Final Depth : Drilled Depth :	4.00 m 4.00 m					
Contractor Name :Terratest Pty Driller :1673 Assistant Driller's Name :Darryl S	Ltd TUCKER, Jason Douglas						
Property : - WANDOI GWMA :024 - MISCI GW Zone : -	ROCK OF	Standing Water Level : Salinity : Yield :					
Site Details							
Site Chosen By Client	Chosen By County nt Form A :POTTINGER Licensed :POTTINGER		<b>Parish</b> GUNNEDAH GUNNEDAH		<b>Portion</b> 7053//1 7053 1	<b>n/Lot DP</b> 116141 116141	
<b>Region :</b> 90 - BARW <b>River Basin :</b> 419 - NAM <b>Area / District :</b>	ON DI RIVER		CMA Map :8 Grid Zone :5	936-3 <b>S</b> 6/1	EMERALD H Scale :1:25,	IILL 000	
Elevation : Flevation Source ·			Northing :6 Easting :2	569054 36293	Latitude (S) :30° 58' 57"		
GS Map :	MGA Zone :56		Coordinate Source :G	PS - Globa	l Positioning Sys	stem	14 19
Construction Negative depths H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside H P Component Type 1 Hole Hole 1 I Backfill Drilled cuttings	indicate Above Ground Level; e Diameter;C-Cemented;SL-Slot Leng From (m) To (m) OD (mm) II 0.00 4.00 56 0.00 4.00 56	pth;A-Aperture;GS- D (mm) Interval Do Ha	Grain Size;Q-Quantity;PL-Pl e <b>tails</b> and Auger	acement of G	ravel Pack;PC-Press	sure Cemented;S-S	Sump;CE-Centralisers
From (m) To (m) Thickness (m)	) WBZ Type	S.W.L. (n	n) D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
	(No	Water Bearing Z	Zone Details Found)				
Drillers Log							

From (m)	To (m)	Thickness(m) Drillers Description	Geological Material	Comments
0.00	0.30	0.30 Clay, red, slight orange	Clay	
0.30	0.45	0.15 Clay, heavier, wetter, red orange	Clay	
0.45	0.55	0.10 Clay, red orange, heavy	Clay	
0.55	0.61	0.06 Clay, calcite chunks, red orange, heavy	Clay	
0.61	1.20	0.59 Clay, black, heavy, very moist, slightly mottling black orange	Clay	
1.20	4.00	2.80 Clay, colour lighter, calcite chunks, very moist, gley colours increasing with depth	Clay	

#### Remarks

Form A Remarks: Nat Carling, 19-Sept-2012; GPS provided by driller. Lithology/Page 3 of the Form-A was provided by consultant at a later date. No indication of which log was associated with which bore was provided, may differ from actual log.

\*\*\* End of GW970244 \*\*\*

GW970245	- Gunnedah Shire Council - Wandobah Reserve
----------	---

Licence :90BL256052			Licence Status Activ	ve	Intended Durnes	a(s)
Work Type :Bore Work Status :Abandoned - Construct. Method :Hand Auger Owner Type :Local Govt	Backfilled		MONITORING BOF	RE RE	MONITORING B	ORE
Commenced Date : Completion Date :25-May-2012	Final Depth : Drilled Depth :	3.00 m 3.00 m				
Contractor Name :Terratest Driller :1673 Assistant Driller's Name :Joel Campbel	TUCKER, Jason Douglas ll & Darryl S					
Property : - WANDO GWMA :024 - MISC GW Zone : -	BAH RESERVE ELLANEOUS FRACTURED RO	S CK OF	Standing Water Leve Salinity Yield	1: y: 1:		
Site Details						
Site Chosen By Client	Cour Form A :POT Licensed :POT	nty ΓINGER ΓINGER	<b>Parish</b> GUNNEDA GUNNEDA	AH AH	<b>Portion/Lot DP</b> 7053//1116141 7053 1116141	
<b>Region :</b> 90 - BARW <b>River Basin :</b> 419 - NAM <b>Area / District :</b>	ON DI RIVER		CMA Map :89 Grid Zone :56	36-3S /1	EMERALD HILL Scale :1:25,000	
Elevation : Elevation Source :			Northing :65 Easting :23	69348 6543	Latitude (S) :30° Longitude (E) :150	58' 48" ° 14' 29"
GS Map :	MGA Zone :56	С	oordinate Source :GF	PS - Global I	Positioning System	
Construction Negative depths H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside H P Component Type 1 Hole Hole 1 I Backfill Drilled cuttings	indicate Above Ground Level; e Diameter;C-Cemented;SL-Slot Length;/ From (m) To (m) OD (mm) ID (n 0.00 3.00 56 0.00 3.00 56	A-Aperture;GS-Gra <b>nm) Interval Deta</b> i Hand	ain Size;Q-Quantity;PL-Pla I <b>ls</b> Auger	cement of Grav	vel Pack;PC-Pressure Cemented;S	Sump;CE-Centralisers
Water Bearing Zones	) WDZ Tranc	SWI (m)		Viold (L/a)	Hele Douth (m) Duration (hu)	Solinity (mg/I)
FIOR (III) IO (III) IIICKIESS (III	(No Wat	ter Bearing Zor	ne Details Found)	riciu (L/S)	now Depth (m) Duration (m)	Samity (mg/L)
Drillers         LOgy           From (m)         To (m)         Thickness(m)         Drillers           0.00         0.08         0.08         Clay,           0.08         0.30         0.22         Clay,           0.30         2.34         2.04         Clay,           2.34         2.53         0.19         Clay,	Description black, calcite chunk lighter textures, lighter clay exture, red red orange some mottle, heavie: organic matter, black mottle d slight texture changes, crumbl	, some mottles r textures, pr colours y calcite	Geologic Clay s, slightly s Clay cogressive de Clay Clay	al Material	Comments	
2.53         2.74         0.21 Clay,           2.74         2.82         0.08 Clay,           2.82         3.00         0.18 Clay,	heavy, mottling, red orange calcite chunks, crumbly heavy, mottling, very moist, re	ed orange	Clay Clay Clay Clay			

#### Remarks

Form A Remarks: Nat Carling, 19-Sept-2012; GPS provided by driller. Lithology/Page 3 of the Form-A was provided by consultant at a later date. No indication of which log was associated with which bore was provided, may differ from actual log.

#### \*\*\* End of GW970245 \*\*\*

<u>GW9702</u>	<b>46</b> - Gun	nedah Sh	ire Coun	cil - Wan	ndobah Re	eserve				
	Licence :90B	L256052				Licence Stat	tus Active			
Wa Wor Construct. Owr	Work Type :Bore Work Status :Abandoned - Backfilled Construct. Method :Hand Auger Owner Type :Local Govt				Authorised MONITORI	<b>Purpose(s)</b> NG BORE	Intended Pu MONITORII		<b>irpose(s)</b> NG BORE	
Commene Complet	ced Date : ion Date :25-M	May-2012	Final D Drilled D	)epth : )epth :	3.00 m 3.00 m					
Contracto Assistant Drillo	or Name :Terr Driller :1673 er's Name :Joel	atest Pty Ltd 3 Campbell & I	ΓUCKER, Ja Darryl S	son Douglas						
ı G	Property : - N GWMA :024 W Zone : -	VANDOBAH - MISCELLA	RESERVE ANEOUS FR	ACTURED F	ROCK OF	Standing Wat	ter Level : Salinity : Yield :			
Site Det	ails									
Site Chosen H Client	Зу			Co Form A :PC Licensed :PC	ounty OTTINGER OTTINGER	<b>Pa</b> GU GU	<b>rish</b> JNNEDAH JNNEDAH	<b>Portion</b> 7053//1 7053 11	/ <b>Lot DP</b> 116141 16141	
Riv Area /	Region :90 er Basin :419 District :	BARWON - NAMOI RI	VER			CMA Grid Z	Map :8936-3S Zone :56/1	EMERALD H Scale :1:25,0	ILL 000	
E Elevation	Clevation : n Source :					Nort Eas	hing :6568984 sting :236335	Lati Longi	itude (S) :30° 5 tude (E) :150°	78' 60" 14' 21"
	GS Map :	М	GA Zone :56	i		Coordinate So	urce :GPS - Global	Positioning Sys	tem	
Construct H-Hole;P-Pipe;O H P Component Hole 1 1 Backfill	D-Outside Diamer ent Type Hole Drilled cuttings	tive depths indica er;ID-Inside Diar From	te Above Grour neter;C-Cement n (m) To (m) 0.00 3.00 0.00 3.00	nd Level; ted;SL-Slot Leng ) OD (mm) II ) 56 ) 56	th;A-Aperture;GS D (mm) Interval I F	-Grain Size;Q-Quan Details Iand Auger	tity;PL-Placement of Gr	avel Pack;PC-Press	ure Cemented;S-	Sump;CE-Centralisers
From (m)	To (m) TI	ICTIES	2 Туре		S.W.L. (	(m) <b>D.D.L.</b> (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
				(No V	Vater Bearing	Zone Details Fo	und)			
Drillers From (m) 0.00 0.10 0.39 0.50 1.06	Log To (m) Thickness( 0.10 0.1 0.39 0.2 0.50 0.1 1.06 0.5 1.90 0.8	m) Drillers Descri 10 Soil, light 29 Loam, incra 11 Loam, light 36 Loam, mott 34 Loam, mott	<b>ption</b> c crumbly, b asing heavin c colour red ling oranges ling orange	orown less, brown l brown, ligh greys grey black,	ter texture, calcite chunk	crumbly s, heavy textur	Geological Material Soil Loam Loam Loam	Comme	ents	
1.90 2.23 2.43 2.55	2.23       0.3         2.43       0.2         2.55       0.1         3.00       0.4	es, moist 3 Clay, heavy 20 Soil, black 2 Clay, heavy 5 Clay, calc	7, some mois 7, mottles r ite chunks,	eture ed orange, c gley colours	alcite, wet		Clay Soil Clay Clay			

#### Remarks

Form A Remarks: Nat Carling, 19-Sept-2012; GPS provided by driller. Lithology/Page 3 of the Form-A was provided by consultant at a later date. No indication of which log was associated with which bore was provided, may differ from actual log.

#### \*\*\* End of GW970246 \*\*\*

GW970247 - Gunnedah S	Shire Council - Won	nbadah Res	erve				
Licence :90BL256052 Work Type :Bore Work Status :Abandoned - B: Construct. Method :Hand Auger Owner Type :Local Govt		Licence Status Authorised Pur MONITORING	Active rpose(s) BORE	<b>Intended Purpose(s)</b> MONITORING BORE			
Commenced Date : Completion Date :24-May-2012	Final Depth : Drilled Depth :	3.00 m 3.00 m					
Contractor Name :Terratest Pty Lt Driller :1673 Assistant Driller's Name :Joel Campbell &	d TUCKER, Jason Douglas & Darryl S						
Property : - WANDOBA GWMA :024 - MISCEI GW Zone : -	AH RESERVE LANEOUS FRACTURED R	OCK OF	Standing Water I Sa	Level : linity : Yield :			
Site Details							
Site Chosen By County Client Form A :POTTING Licensed :POTTING			<b>Parish</b> GUNN GUNN	n NEDAH NEDAH	<b>Portion/Lot DP</b> 7053//1116141 7053 1116141		
Region :90 - BARWO River Basin :419 - NAMOI Area / District :	N RIVER		CMA Maj Grid Zon	<b>p :</b> 8936-3S <b>e :</b> 56/1	EMERALD H Scale :1:25,0	ILL 000	
Elevation : Elevation Source :			Northing Easting	g :6568905 g :236205	Lati Longi	itude (S) :30° 5 tude (E) :150°	9' 2" 14' 16"
GS Map :	MGA Zone :56	C	oordinate Sourc	e :GPS - Global	Positioning Syst	tem	
Negative depths inc         H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside D         H       P       Component Type       H         I       Hole       Hole       H         1       1       Backfill       Drilled cuttings	licate Above Ground Level; hiameter;C-Cemented;SL-Slot Lengt from (m) To (m) OD (mm) ID 0.00 3.00 56 0.00 3.00 56	h;A-Aperture;GS-Gr (mm) Interval Deta Hand	ain Size;Q-Quantity;F i <b>ls</b> I Auger	PL-Placement of Gr	avel Pack;PC-Press	ure Cemented;S-S	ump;CE-Centralisers
Water Bearing ZonesFrom (m)To (m)Thickness (m)2.503.000.50	VBZ Type	S.W.L. (m)	<b>D.D.L.</b> ( <b>m</b> )	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
Drillers Log							
From (m)         To (m)         Thickness(m) Drillers Decomposition           0.00         0.30         0.30 Topsoil,           0.30         0.80         0.50 Clay, he           0.80         1.10         0.30 Clay, he           1.10         1.25         1.55           1.55         1.50         0.25 Clay, ve           1.55         1.90         0.35 Clay, st	<pre>scription loamy, black avier, small calcite, red h tter, sandier texture, red sandy texture, crumbly, cre ry wet layer, red brown ry wet, free water, red brow ill moist, red brown orange</pre>	prown, slight m brown, slight eam reds, some own e black mottles	Ge To ottling Cl mottling Cl calcite Gr Cl , water at 1. Cl	eological Material popsoil .ay .ay cavel .ay .ay .ay	Comme	ents	

### Remarks

1.90 2.06 2.20

2.06 2.20 3.00

8m

8m 0.16 Sandy Clay, moist, brown 0.14 Clay, brown, heavier, moist 0.80 Clay, mottles, grey orange red, heavy, moist

Form A Remarks Nat Carling, 19-Sept-2012; GPS provided by driller. Lithology/Page 3 of the Form-A was provided by consultant at a later date. No indication of which log was associated with which bore was provided, may differ from actual log.

Sandy Clay Clay Clay

#### \*\*\* End of GW970247 \*\*\*

GW970248	- Gunnedah Shire Council - Wombadah Reserve
GW970248	- Gunnedah Shire Council - Wombadah Reserve

			5 mi • •								
	Licence :	90BL256052					Licence Stat	tus Active	<b>.</b> .		
Wo Wo Construct Ow	ork Type : rk Status : . Method : ner Type :	Bore Abandoned - I Hand Auger Local Govt	Backfilled				Authorised MONITORI	<b>Purpose(s)</b> NG BORE	Inte MO	ended Purpose( NITORING BC	s) DRE
Commen Complet	iced Date : tion Date :	24-May-2012	F Dri	inal Depth lled Depth	:	3.00 m 3.00 m					
Contract Assistant Drill	tor Name : Driller : ler's Name :	Terratest Pty l 1673 Joel Campbel	Ltd TUCKI & Darryl S	ER, Jason D S	ouglas						
(	Property : GWMA : GW Zone :	- WANDOE 024 - MISCE -	AH RESE	RVE US FRACT	URED RO	OCK OF	Standing Wat	er Level : Salinity : Yield :			
Site Det	tails										
Site Chosen I Client	Ву			For Lice	Cou m A :POT nsed :POT	nty TINGER TINGER	<b>Pa</b> GU GU	<b>rish</b> INNEDAH INNEDAH	<b>Portion</b> 7053//1 7053 11	<b>/Lot DP</b> 116141 16141	
Riv Area	Region : ver Basin : / District :	90 - BARWO 419 - NAMO	ON DI RIVER				CMA 1 Grid 2	Map :8936-3S Zone :56/1	EMERALD H Scale :1:25,0	ILL 000	
l Elevatio	Elevation : on Source :						North Eas	hing :6568802 iting :236151	Lati Longi	itude (S) :30° 5 tude (E) :150°	9' 5" 14' 14"
	GS Map :		MGA Zo	ne :56			Coordinate So	urce :GPS - Global	Positioning Sys	tem	
Constru H-Hole;P-Pipe;C H P Compor 1 Hole 1 1 Backfill	DD-Outside D nent Type Hole Drilled cu	Negative depths i iameter;ID-Inside ttings	ndicate Abov Diameter;C- From (m) 0.00 0.00	e Ground Lev Cemented;SL To (m) OD ( 3.00 3.00	el; -Slot Length; ( <b>mm) ID</b> (1 56 56	;A-Aperture;GS- mm) Interval D H	Grain Size;Q-Quant etails and Auger	ity;PL-Placement of Gr	avel Pack;PC-Press	ure Cemented;S-S	ump;CE-Centralisers
	Bearing	<b>y Zones</b>	WBZ Type			S.W.L. ()	m) <b>D.D.L</b> . (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
2.50	3.0	00 0.50				2		()	<b></b>		2
Drillers From (m) 0.00 0.42 0.85 1.00 1.03 1.12 2.05 2.20 2.36 2.45 2.55	Log To (m) Thic 0.42 0.85 1.00 1.03 1.12 2.05 2.20 2.36 2.45 2.55 3.00	<pre>kness(m) Drillers I 0.42 Gravel 0.43 Clay, t 0.15 Clay, s 0.03 Clay, t 0.93 Clay, s 0.93 Clay, s 0.15 Clay, c 0.16 Clay, c 0.09 Clay, n 0.10 Gravel 0.45 Clay/Gr</pre>	Description white, la exture cha- some calcii orange re some calcii grubmly, no oisture, no clay, rec avel, red	arge gravel ange, heavi ee, organic y, light t ad ee, moist, y, red brown, t brown, wo brown, moi	, red bro er, red c exture, re mottling, m, slight red brown heavier ater at 2. st, mottl	own, very cr prange cream red orange, red orange , red orange = mottling .5m ling, greys o	umbly colours more crumbly pranges	Geological Material Gravel Clay Clay Gravel Clay Clay Clay Clay Gravel Clay Gravel Clay	Comme	ents	

#### Remarks

Form A Remarks: Nat Carling, 19-Sept-2012; GPS provided by driller. Lithology/Page 3 of the Form-A was provided by consultant at a later date. No indication of which log was associated with which bore was provided, may differ from actual log.

#### \*\*\* End of GW970248 \*\*\*

GW970252 - Gunnedah	Shire Council - Wando	bah Road	Reserve			
Licence :90BL256055 Work Type :Bore Work Status :Abandoned - E Construct. Method :Auger - Solid Owner Type :Local Govt	Backfilled Flight		Licence Statu Authorised P MONITORIN	<b>is</b> Abandoned <b>urpose(s)</b> G BORE	<b>Intended Purpos</b> MONITORING B	e(s) ORE
Commenced Date : Completion Date :24-May-2012	Final Depth : Drilled Depth :	3.00 m 3.00 m				
Contractor Name :Terratest Pty L Driller :1673 Assistant Driller's Name :Joel Campbell	td TUCKER, Jason Douglas & Darryl S					
Property : - WANDOB GWMA :024 - MISCE GW Zone : -	AH ROAD RESERVE LLANEOUS FRACTURED ROC	S CK OF	tanding Wate	r Level : Salinity : Yield :		
Site Details						
Site Chosen By Client	Count Form A :POTTI Licensed :POTTI	<b>y</b> INGER INGER	<b>Pari</b> GUN GUN	s <b>h</b> NNEDAH NNEDAH	<b>Portion/Lot DP</b> Rd Adj 7053//111614 78 755503	-1
<b>Region :</b> 90 - BARWC <b>River Basin :</b> 419 - NAMO <b>Area / District :</b>	DN I RIVER		CMA M Grid Zo	lap :8936-3S one :56/1	EMERALD HILL Scale :1:25,000	
Elevation : Elevation Source :			North East	ing :6568667 ing :236120	Latitude (S) :30° Longitude (E) :150	59' 10" ° 14' 12"
GS Map :	MGA Zone :56	Co	oordinate Sou	rce :GPS - Global	Positioning System	
Negative depths in         H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside         H       P       Component Type         1       Hole       Hole         1       1       Backfill       Drilled cuttings	Indicate Above Ground Level;           Diameter;C-Cemented;SL-Slot Length;A-           From (m)         To (m)         ID (mn)           0.00         3.00         56           0.00         3.00         56	Aperture;GS-Gra n) Interval Detail Auger	in Size;Q-Quantit Is · - Solid Flight	y;PL-Placement of Gra	avel Pack;PC-Pressure Cemented;S	-Sump;CE-Centralisers
Water Bearing ZonesFrom (m)To (m)Thickness (m)	WBZ Type	S.W.L. (m)	<b>D.D.L.</b> (m)	Yield (L/s)	Hole Depth (m) Duration (hr)	Salinity (mg/L)
	(No Wate	r Bearing Zon	e Details Four	nd)		
Drillers Log						
From (m)         To (m)         Thickness(m)         Drillers D           0.00         0.20         0.20 Clay, r           0.20         0.30         0.10 Clay, i           0.30         0.70         0.40 Clay, t           0.70         0.90         0.20 Clay, r           1.15         1.35         0.20 Clay, r           1.35         2.00         0.65 Clay, t           2.00         2.28         0.28 Clay, r           2.30         2.41         0.11 Clay, r           2.41         3.00         0.59 Clay, m	escription ed ncreased white grey mottles exture change: ligth clay, red, alcite chunks, carbonates, mott hite grey red orange ed orange exture change: more gravel ed orange ncreasing mottles cream black c ed, heavy ottles increasing, lighter colc yellow black	, no mottles les, gley co prange, very n purs, gley co	lours moist lours cream	Geological Material Clay Clay Clay Clay Clay Clay Clay Cl	Comments	

#### Remarks

Form A Remarks: Nat Carling, 19-Sept-2012; GPS provided by driller. Lithology/Page 3 of the Form-A was provided by consultant at a later date. No indication of which log was associated with which bore was provided, may differ from actual log.

> \*\*\* End of GW970252 \*\*\* \*\*\* End of Report \*\*\*

# APPENDIX D Groundwater Quality Testing September 2012



82 Plain Street Tamworth NSW 2340 Ph 02 6762 1733 Fx 02 6765 9109 admin@ewenviroag.com.au www.ewenviroag.com.au

### ANALYSIS REPORT WATER

Projec	et No: EW120639	Date of Issue:	28/09/2012
Client:	Gunnedah Shire Council	Report No:	1
Address	PO Box 63	Date Received:	20/09/2012
	Gunnedah NSW 2380	Matrix:	WATER
Phone:	02 6740 2126	Source:	GWMP
Fax:	02 67 40 2129	Location:	Blackjack Creek Gunnedah
email:	lachlanjohnson@infogunnedah.com.au	Sampler ID:	AM
		Date of Sampling	20/09/2012

Comments: \*Analysis performed under sub-contract by ALS (Ref ES1222710) - NATA 825.

Signed: Anne Michie Laboratory Manager



East West is certified by the Australian-Asian Soil & Plant Analysis Council to perform various soil and plant tissue analysis. The tests reported herein have been performed in accordance with our terms of accreditation. This report must not be reproduced except in full and EWEA takes no responsibility of the end use of the results within this report. This analysis relates to the sample submitted and it is the client's responsibility to make certain the sample is representative of the matrix to be tested. Samples will be discarded one month after the date of this report. Please advise if you wish to have your sample/s returned.

\*NATA CERTIFIED LABORATORY \* INDEPENDENT SAMPLING \*ENVIRONMENTAL & AGRICULTURAL CONSULTING

### **Project No:**

### EW120639

Location:

Blackjack Creek Gunnedah

		Source	GWMP	GWMP	GWMP	GWMP
	Sa	mple ID	#1 Horse paddock	#2 Corner Cemetry	#3 Top End Reserve	# 4 Middle Reserve
			30°59' 615''	30° 59' 515''	30° 59' 070''	30° 58' 949''
			150° 13' 806''	150° 13' 854''	150º 14' 273''	150° 14' 388''
ANALYTE	METHOD	UNITS	120639-1	120639-2	120639-3	120639-4
Chloride	ED045G	mg/L	53	811	354	626
pH Value	EA005P:	pH Unit	7.84	7.42	7.71	7.90
Conductivity	EA010P	µS/cm	875	4160	1870	3010
TDS Salinity	EA016	mg/L	569	2700	1220	1960
Total Hardness as CaCO3	EA065	mg/L	342	1560	606	999
Hydroxide Alkalinity as CaCO3	ED037P	mg/L	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	ED037P	mg/L	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	ED037P	mg/L	302	300.0	240	516
Total Alkalinity as CaCO3	ED037P	mg/L	302	300	240	516
Sulfate	ED041G	mg/L	77	817	240	244
Calcium	ED093F	mg/L	94	367	134	67
Magnesium	ED093F	mg/L	26	156	66	202
Sodium	ED093F	mg/L	40	325	133	253
Potassium	ED093F	mg/L	19	10.0	10	14
Sodium Absorption Ratio	EA006	-	0.94	3.58	2.35	3.48
Standing Water Level	dip	m	2.20	1.80	2.44	2.26



Report Date: 28/09/2012

### **Project No:**

### EW120639

				Location:	Blackjack Creek Gunnedah
		Source	GWMP		
	Sa	mple ID	Far Bank Near Bridge		
			30° 58' 759''		
			150° 14' 466''		
ANALYTE	METHOD	UNITS	120639-5		
Chloride	ED045G	mg/L	564		
pH Value	EA005P:	pH Unit	8.12		
Conductivity	EA010P	µS/cm	3760		
TDS Salinity	EA016	mg/L	2440		
Total Hardness as CaCO3	EA065	mg/L	501		
Hydroxide Alkalinity as CaCO3	ED037P	mg/L	<1		
Carbonate Alkalinity as CaCO3	ED037P	mg/L	<1		
Bicarbonate Alkalinity as CaCO3	ED037P	mg/L	1010		
Total Alkalinity as CaCO3	ED037P	mg/L	1010		
Sulfate	ED041G	mg/L	272		
Calcium	ED093F	mg/L	26		
Magnesium	ED093F	mg/L	106		
Sodium	ED093F	mg/L	693		
Potassium	ED093F	mg/L	8		
Sodium Absorption Ratio	EA006	_	13.5		
Standing Water Level	dip	m	2.32		

This Analysis Report shall not be reproduced except in full without the written approval of the laboratory.

DOCUMENT END



Report Date: 28/09/2012

# **APPENDIX E Hydraulic Calculations**

			Wetted	Average							Maximum
Design	Depth	Area	Perimeter	Slope		Discharge Q	Velocity	Hydraulic		Shear	Permissible
chainage	(m)	(m2)	(m)	(m/m)	Manning's n	(m3/s)	(m/s)	Radius (m)	Froude	(N/m3)	Shear Stress
0	0.500	17.50	40.06	0.007	0.06	14.05	0.80	0.44	0.36	34.32	29.99
25	0.500	17.50	40.06	0.007	0.06	14.05	0.80	0.44	0.36	34.32	29.99
75	0.561	19.65	40.12	0.007	0.06	17.03	0.87	0.49	0.37	38.51	33.62
100	0.622	21.82	40.20	0.007	0.06	20.25	0.93	0.54	0.38	42.70	37.26
125	0.683	23.97	40.28	0.007	0.06	23.65	0.99	0.60	0.38	46.88	40.85
150	0.744	26.14	40.36	0.007	0.06	27.29	1.04	0.65	0.39	51.07	44.46
175	0.894	43.31	40.10	0.007	0.06	63.57	1.47	1.08	0.50	61.37	74.14
200	1.031	36.05	40.19	0.007	0.06	46.75	1.30	0.90	0.40	70.77	61.57
225	1.083	37.96	40.40	0.007	0.06	50.78	1.34	0.94	0.41	74.34	64.50
250	1.169	41.32	40.89	0.007	0.06	58.02	1.40	1.01	0.41	80.24	69.36
275	1.292	45.52	40.65	0.007	0.06	68.45	1.50	1.12	0.42	88.69	76.87
300	1.336	47.26	41.01	0.007	0.06	72.44	1.53	1.15	0.42	91.71	79.10
325	1.329	47.22	41.33	0.007	0.06	71.96	1.52	1.14	0.42	91.23	78.42
350	1.403	50.34	41.99	0.007	0.06	79.22	1.57	1.20	0.42	96.31	82.29
375	1.441	51.67	41.99	0.007	0.06	82.74	1.60	1.23	0.43	98.91	84.47
400	1.589	58.01	43.12	0.007	0.06	98.58	1.70	1.35	0.43	109.07	92.35
425	1.625	59.39	43.26	0.007	0.06	102.30	1.72	1.37	0.43	111.54	94.24
450	1.475	52.75	41.88	0.007	0.06	85.79	1.63	1.26	0.43	101.25	86.46
475	1.536	56.82	47.32	0.007	0.06	89.51	1.58	1.20	0.41	105.43	82.42
500	1.595	57.79	42.84	0.007	0.06	98.38	1.70	1.35	0.43	109.48	92.60
525	1.655	60.33	43.32	0.007	0.06	104.91	1.74	1.39	0.43	113.60	95.59
550	1.754	64.79	44.29	0.007	0.06	116.42	1.80	1.46	0.43	120.40	100.41
575	1.775	59.39	44.30	0.007	0.06	100.69	1.70	1.34	0.41	121.84	92.02
600	1.886	70.67	45.39	0.007	0.06	132.38	1.87	1.56	0.44	129.46	106.87
625	1.894	69.54	45.08	0.007	0.06	129.46	1.86	1.54	0.43	130.01	105.89
650	1.905	71.41	45.44	0.007	0.06	134.60	1.88	1.57	0.44	130.76	107.87
675	1.947	73.33	45.82	0.007	0.06	139.90	1.91	1.60	0.44	133.65	109.85
700	1.988	75.24	46.20	0.007	0.06	145.23	1.93	1.63	0.44	136.46	111.79
725	2.029	77.15	46.56	0.007	0.06	150.64	1.95	1.66	0.44	139.28	113.74

Hydraulic calculations for Blackjack Creek reconstructed channel

			Wetted	Average							Maximum
Design	Depth	Area	Perimeter	Slope		Discharge Q	Velocity	Hydraulic		Shear	Permissible
chainage	(m)	(m2)	(m)	(m/m)	Manning's n	(m3/s)	(m/s)	Radius (m)	Froude	(N/m3)	Shear Stress
750	2.070	79.08	46.94	0.007	0.06	156.13	1.97	1.68	0.44	142.09	115.64
775	2.111	81.05	47.30	0.007	0.06	161.84	2.00	1.71	0.44	144.90	117.62
800	2.152	83.00	47.68	0.007	0.06	167.48	2.02	1.74	0.44	147.72	119.49
825	2.193	84.95	48.04	0.007	0.06	173.22	2.04	1.77	0.44	150.53	121.38
850	2.234	86.98	48.42	0.007	0.06	179.23	2.06	1.80	0.44	153.35	123.31
875	2.250	87.75	48.56	0.007	0.06	181.53	2.07	1.81	0.44	154.44	124.04
900	2.250	87.75	48.56	0.007	0.06	181.53	2.07	1.81	0.44	154.44	124.04
925	2.250	87.75	48.56	0.007	0.06	181.53	2.07	1.81	0.44	154.44	124.04
950	2.250	87.75	48.56	0.007	0.06	181.53	2.07	1.81	0.44	154.44	124.04
975	2.250	87.75	48.56	0.007	0.06	181.54	2.07	1.81	0.44	154.44	124.04
1000	2.434	96.85	50.07	0.007	0.06	209.66	2.16	1.93	0.44	167.08	132.77
1025	2.250	87.75	48.56	0.007	0.06	181.54	2.07	1.81	0.44	154.44	124.04
1050	3.063	131.39	35.26	0.007	0.06	440.37	3.35	3.73	0.61	210.25	255.78
1075	2.241	87.39	48.54	0.007	0.06	180.34	2.06	1.80	0.44	153.83	123.58
1100	2.238	87.16	48.46	0.007	0.06	179.75	2.06	1.80	0.44	153.62	123.46
1125	2.233	86.93	48.42	0.007	0.06	179.06	2.06	1.80	0.44	153.28	123.24
1150	2.229	86.75	48.38	0.007	0.06	178.54	2.06	1.79	0.44	153.00	123.08
1175	2.225	86.55	48.34	0.007	0.06	177.95	2.06	1.79	0.44	152.73	122.90
1200	2.221	86.37	48.32	0.007	0.06	177.39	2.05	1.79	0.44	152.45	122.69
1225	2.217	86.17	48.28	0.007	0.06	176.80	2.05	1.78	0.44	152.18	122.51
1250	2.213	85.97	48.24	0.007	0.06	176.21	2.05	1.78	0.44	151.91	122.33
1275	2.208	85.74	48.20	0.007	0.06	175.52	2.05	1.78	0.44	151.56	122.10
1300	2.205	85.59	48.18	0.007	0.06	175.06	2.05	1.78	0.44	151.36	121.94
1325	2.200	85.36	48.14	0.007	0.06	174.38	2.04	1.77	0.44	151.01	121.71
1350	2.217	82.32	46.54	0.007	0.06	167.89	2.04	1.77	0.44	154.40	121.41
1375	2.235	83.15	46.68	0.007	0.06	170.38	2.05	1.78	0.44	153.42	122.27
1400	2.253	81.94	45.94	0.007	0.06	168.05	2.05	1.78	0.44	154.65	122.43
1425	2.271	80.69	45.17	0.007	0.06	165.65	2.05	1.79	0.43	155.89	122.62
1450	2.289	79.44	44.42	0.007	0.06	163.21	2.05	1.79	0.43	157.12	122.75
1475	2.307	78.15	43.66	0.007	0.06	160.65	2.06	1.79	0.43	158.36	122.87

			Wetted	Average							Maximum
Design	Depth	Area	Perimeter	Slope		Discharge Q	Velocity	Hydraulic		Shear	Permissible
chainage	(m)	(m2)	(m)	(m/m)	Manning's n	(m3/s)	(m/s)	Radius (m)	Froude	(N/m3)	Shear Stress
1500	2.145	70.85	42.82	0.007	0.06	138.21	1.95	1.65	0.43	147.24	113.58
1525	2.343	75.45	42.15	0.007	0.06	155.11	2.06	1.79	0.43	160.83	122.87
1550	2.362	74.11	41.41	0.007	0.06	152.33	2.06	1.79	0.43	162.13	122.85
1575	2.380	72.69	40.64	0.007	0.06	149.35	2.05	1.79	0.43	163.37	122.78
1600	2.398	71.21	39.89	0.007	0.06	146.12	2.05	1.79	0.42	164.60	122.54
1625	2.450	73.00	40.20	0.007	0.06	151.51	2.08	1.82	0.42	168.17	124.65
1650	2.507	75.28	40.68	0.007	0.06	158.23	2.10	1.85	0.42	172.09	127.02
1675	2.564	77.58	41.14	0.007	0.06	165.12	2.13	1.89	0.42	176.00	129.44
1700	2.630	80.30	41.70	0.007	0.06	173.31	2.16	1.93	0.42	180.53	132.18
1725	2.678	82.24	42.08	0.007	0.06	179.26	2.18	1.95	0.43	183.82	134.15
1750	2.736	84.66	42.56	0.007	0.06	186.72	2.21	1.99	0.43	187.80	136.54
1775	2.792	87.02	43.02	0.007	0.06	194.08	2.23	2.02	0.43	191.65	138.85
1800	2.849	89.46	43.50	0.007	0.06	201.74	2.26	2.06	0.43	195.56	141.17
1825	2.907	91.92	43.96	0.007	0.06	209.59	2.28	2.09	0.43	199.54	143.53
1850	2.964	98.10	45.68	0.007	0.06	227.70	2.32	2.15	0.43	203.46	147.41
1875	2.905	105.23	48.92	0.007	0.06	244.52	2.32	2.15	0.44	199.41	147.65
1900	2.644	117.53	57.04	0.007	0.06	265.37	2.26	2.06	0.44	181.49	141.44
1925	2.384	147.21	74.21	0.007	0.06	324.08	2.20	1.98	0.46	163.64	136.16
1950	2.123	193.75	103.64	0.007	0.06	410.00	2.12	1.87	0.46	145.73	128.32

# APPENDIX F Salinity Comparison

						ECEC	Ex Mg	Ex Na	Ex K	Ex Ca	
			EC5	Ece	pH(CaCl2	(meq/100	(meq/1	(meq/100g	(meq/100g	(meq/100g	Ex Na
ID	Easting	Northing	(dS/m)	(dS/m)	)	g)	00g)	)	)	)	%
WAND4	236468	6569264	2.38	21.42	5.6	33.7	15.4	9.9	0.7	7.7	29.3
B11	236468.62	6569311.37	0.73	7.3	7.03	19.8	7.48	2.94	1.19	8.14	14.9
WAND6	236145	6568733	0.24	2.16	6.7	21.1	5.4	1.4	1.7	12.5	6.63
B15 (nearby)	236151.45	6568802.36	0.05	0.55	6	12	2.81	0.19	0.78	8.25	1.55
B18 (nearby)	236119.78	6568666.58	0.14	1.54	7.16	21.4	3.23	0.22	1.56	16.42	1.01
WAND7	236371	6569022	0.06	0.6	5.3	9.5	3.6	0.6	1.1	4.2	6.31
B17	236334.93	6568984.44	0.1	1.1	6.18	8.22	2.53	0.33	0.77	4.59	3.98

Comparison of A3 (soil cores) to 2012 testing

\* WAND1-3 and WAND5 were all located away from current and proposed channel alignment

#### Comparison of A4 (soil pits) to 2012 testing

			EC5	Ece	pH(CaCl2	Organic	(meq/1	(meq/100g	(meq/100g	(meq/100g	Ex Na	
ID	Easting	Northing	(dS/m)	(dS/m)	)	Carbon %	00g)	)	)	)	%	Ca:Mg
PIT3	236422	6569288	0.92	6.44	7.4	0.8	10.4	0.9	1.1	7.3	4.5	0.7
B11	236468.62	6569311.37	0.73	7.3	7.03	1.11	7.48	2.94	1.19	8.14	14.9	1.09
PIT5	236255	6568850	0.14	1.54	6.6	1.98	3.8	0.1	2.1	10.1	0.3	2.7
B8	236220.59	6568841.06	0.05	0.55	6.33	0.98	2.42	0.13	1.02	8.19	1.09	3.39
PIT6	236323	6568906	0.08	0.8	6.2	0.32	2.3	n/a	0.9	7.3	n/a	3.1
B14	236204.66	6568905.39	0.11	1.21	6.77	1.39	3.01	0.19	1.09	10.3	1.28	3.43
B17	236334.93	6568984.44	0.1	1.1	6.18	0.81	2.53	0.33	0.77	4.59	3.98	1.81

\* PIT 1 & 2 located away from current and proposed channel alignment, coordinates for PIT 7 are incorrect (Leard Forest location) and PIT 4 is located on 'Fermanagh'

Comparison of A7 (soil cores for resistivity) to 2012 testing

			EC5	Ece
ID	Easting	Northing	(dS/m)	(dS/m)
Wandobah 2	236433	6569260	0.49	n/a

B11	236468.62	6569311.37	0.73	7.3
B12	236409.36	6569195.25	0.11	1.1
Wandobah 3	236517	6569260	1.22	n/a
B11	236468.62	6569311.37	0.73	7.3
B12	236409.36	6569195.25	0.11	1.1
Wandobah 5	236196	6568936	0.11	n/a
B14	236204.66	6568905.39	0.11	1.21
Wandobah 8	236364	6569116	0.7	n/a
B9 approx.	236398.15	6569069.23	0.06	0.54
Wandobah 9	236442	6569103	0.03	n/a
B9 approx.	236398.15	6569069.23	0.06	0.54
Wandobah 10	236438	6569203	0.32	n/a
B12	236409.36	6569195.25	0.11	1.1
Wandobah 12	236163	6568774	0.38	n/a
B15	236151.45	6568802.36	0.05	0.55
Wandobah 15	236512	6569345	3.05	n/a
B16	236542.58	6569348.34	0.09	0.99

\* Wandobah 1, 4, 6, 7, 11 & 14 are located away from current and proposed channel alignment, 13 is located on 'Fermanagh'

# APPENDIX G Soil Profiles and Laboratory Analysis



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# ANALYSIS REPORT SOIL

# Project No:EW120441Customer:Constructive Solutions

Address: PO Box 1498 Tamworth NSW 2340 Phone: 02 67 621969 Fax: email: <u>sarah@constructivesolutions.com.au</u>

### Date of Issue: 14/06/2012

Report No:
Date Received:
Matrix:
Location:
Sampler ID:
Date of Sampling:
Sample Condition:

1 25/05/2012 SOIL Blackjack Creek Client Supplied 23/24&25/5/2012 acceptable

Comments:

Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

Signed: Anne Michie Laboratory Manager

NATA Accredited Laboratory 15708

This document is issued in accordance with NATA's accreditation requirements.

Accredited for complience with ISO/IEC 17025

This analysis relates to the sample submitted and it is the client's responsibility to make certain the sample is representative of the matrix to be tested. Samples will be discarded one month after the date of this report. Please advise if you wish to have your sample/s returned.

### Project No: EW120441

Location: Blackjack Creek

		Sa	mple ID	В	H1	В	H2	В	H3	B	H4
Test Parameter	Method Description	Method Reference	Depth Units	0-3 1204	0cm 441-1	0-30cm 120441-2		0-30cm 120441-3		0-30cm 120441-4	
Chlorides	Probe	R&H 5A1	mg/kg	7	25	10	6.0	37	7.0	66.0	
Electrical Conductivity	Soil:Water (1:5)	R&H 3A1	dS/m	0.	59	0.	24	0.	12	0.13	
pH (CaCl <sub>2</sub> )	Electrode	R&H 4A2	pH units	7.	04	7.	34	6.	67	6.64	
NO <sub>3</sub> -Nitrogen Ex	Aqueous Buffer	In House	mg/kg	1	1.3	8.	40	8.	08	6.	61
Phosphorus Ex	Colwell	R&H 9B1	mg/kg	53	3.3	32	2.7	75	5.1	33	3.9
Sulphur Ex	KCI-40	Chinoim, LeFroy & Blair	mg/kg	72	2.1	4.	50	17	7.7	28	3.5
Organic Carbon	LECO	In House	%	1.	39	1.	79	2.	50	2.	23
Copper Ex	DTPA	R&H 12A1	mg/kg	1.	96	1.14		3.63		1.68	
Zinc Ex	DTPA	R&H 12A1	mg/kg	3.	66	1.01		10.5		4.20	
Manganese Ex	DTPA	R&H 12A1	mg/kg	22.9		83.0		65.2		81.7	
Iron Ex	DTPA	R&H 12A1	mg/kg	7	1.4	128		412		99.9	
Texture	-	PSR-1999	-	L	.C	CL		L			L
Ece	-	-	dS/m	5.	31	2.16		1.20		1.	30
				mg/kg	meq/100g	mg/kg	meq/100g	mg/kg	meq/100g	mg/kg	meq/100g
Potassium Ex	NH₄CI	R&H 15A1	-	754	1.93	784	2.01	518	1.33	588	1.51
Calcium Ex	NH₄CI	R&H 15A1	-	3105	15.5	6997	35.0	1696	8.48	2390	12.0
Magnesium Ex	NH₄CI	R&H 15A1	-	833	6.94	750	6.25	1350	11.3	663	5.53
Sodium Ex	NH₄CI	R&H 15A1	-	294	1.28	38.3	0.17	111.0	0.48	98.5	0.43
Aluminium Ex	KCL	R&H 15G1	-	0.33	0.00	0.3	0.00	0.3	0.00	0.6	0.01
Ex Potassium %	Calc	Calc	%	7.	53	4.	63	6.	17	7.	76
Ex Calcium %	Calc	Calc	%	60	0.5	8	0.6	39	9.4	61	1.5
Ex Magnesium %	Calc	Calc	%	27	7.0	14	4.4	52	2.2	28	3.5
Ex Sodium %	Calc	Calc	%	4.	98	0.	38	2.24		2.	21
Ex Aluminium %	Calc	Calc	%	0.	01	0.	01	0.01		0.04	
ECEC	Calc	Calc	meq/100g	2	5.7	43	43.4 21.5		1.5	19.4	
Ca/Mg Ratio	Calc	Calc	meq/100g	2.	24	5.60		0.75		2.16	



### Project No: EW120441

Location: Blackjack Creek

		Sa	mple ID	В	H5	В	H6	В	H7	В	H8
Test Parameter	Method Description	Method Reference	Depth Units	Depth 0-30cm Units 120441-5		0-30cm 120441-6		0-30cm 120441-7		0-30cm 120441-8	
Chlorides	Probe	R&H 5A1	mg/kg	1	34	8.	60	225		11.4	
Electrical Conductivity	Soil:Water (1:5)	R&H 3A1	dS/m	0.	20	0.	05	0.	.23	0.05	
pH (CaCl <sub>2</sub> )	Electrode	R&H 4A2	pH units	6.	76	6.	12	6.	.41	6.33	
NO <sub>3</sub> -Nitrogen Ex	Aqueous Buffer	In House	mg/kg	6.	15	7.	11	7.	.20	6.	67
Phosphorus Ex	Colwell	R&H 9B1	mg/kg	44	4.6	98	3.8	73	3.8	22	2.1
Sulphur Ex	KCI-40	Chinoim, LeFroy & Blair	mg/kg	19	9.8	4.	97	10	0.0	8.	84
Organic Carbon	LECO	In House	%	1.	05	1.	98	1.	.38	0.	98
Copper Ex	DTPA	R&H 12A1	mg/kg	1.	26	2.	44	1.	.63	1.15	
Zinc Ex	DTPA	R&H 12A1	mg/kg	3.17		3.99		2.54		0.91	
Manganese Ex	DTPA	R&H 12A1	mg/kg	39.0		163		60.9		53.0	
Iron Ex	DTPA	R&H 12A1	mg/kg	1	14	242		117		96	5.9
Texture	-	PSR-1999	-	l	_	FSL		FSL			L
Ece	-	-	dS/m	2.	00	0.	55	2.	.53	0.	50
				mg/kg	meq/100g	mg/kg	meq/100g	mg/kg	meq/100g	mg/kg	meq/100g
Potassium Ex	NH₄CI	R&H 15A1	-	570	1.46	613	1.57	835	2.14	396	1.02
Calcium Ex	NH₄CI	R&H 15A1	-	2145	10.7	2968	14.8	1764	8.82	1637	8.19
Magnesium Ex	NH₄CI	R&H 15A1	-	540	4.50	320	2.67	234	1.95	290	2.42
Sodium Ex	NH₄CI	R&H 15A1	-	64.2	0.28	31.1	0.14	49.4	0.21	29.5	0.13
Aluminium Ex	KCL	R&H 15G1	-	0.2	0.00	0.5	0.01	0.2	0.00	0.4	0.00
Ex Potassium %	Calc	Calc	%	8.	61	8.	18	16	5.31	8.	64
Ex Calcium %	Calc	Calc	%	63	3.2	7	7.2	6	7.2	69	9.7
Ex Magnesium %	Calc	Calc	%	26	6.5	1:	3.9	14	4.9	20	0.6
Ex Sodium %	Calc	Calc	%	1.	65	0.	70	1.64		1.	09
Ex Aluminium %	Calc	Calc	%	0.	01	0.03 0.02		.02	0.04		
ECEC	Calc	Calc	meq/100g	17	7.0	19	19.2 13.1		3.1	11.7	
Ca/Mg Ratio	Calc	Calc	meq/100g	2.	38	5.57		4.52		3.39	



### Project No: EW120441

Location: Blackjack Creek

		Sa	mple ID	В	H9	Bł	110	BH	111	Bŀ	112
Test Parameter	Method Description	Method Reference	Depth Units	0-3 1204	0cm 441-9	0-30cm 120441-10		0-30cm 120441-11		0-30cm 120441-12	
Chlorides	Probe	R&H 5A1	mg/kg	23	3.6	2	5.5	600		57.5	
Electrical Conductivity	Soil:Water (1:5)	R&H 3A1	dS/m	0.	.06	0.	08	0.	73	0.	11
pH (CaCl <sub>2</sub> )	Electrode	R&H 4A2	pH units	6.	20	6.	35	7.	03	6.	61
NO <sub>3</sub> -Nitrogen Ex	Aqueous Buffer	In House	mg/kg	6.	.99	6.	20	7.	87	7.	29
Phosphorus Ex	Colwell	R&H 9B1	mg/kg	4	1.0	36	6.8	50	).6	43	3.0
Sulphur Ex	KCI-40	Chinoim, LeFroy & Blair	mg/kg	12	2.2	9.	03	2	35	12	2.5
Organic Carbon	LECO	In House	%	1.	.81	1.	09	1.	11	1.	65
Copper Ex	DTPA	R&H 12A1	mg/kg	1.	42	2.	10	1.	51	2.55	
Zinc Ex	DTPA	R&H 12A1	mg/kg	1.91		1.38		4.06		21.10	
Manganese Ex	DTPA	R&H 12A1	mg/kg	93.4		22.8		24.6		55.0	
Iron Ex	DTPA	R&H 12A1	mg/kg	8	5.6	78.7		70	).7	158	
Texture	-	PSR-1999	-	C	CL	CL		L		I	L
Ece	-	-	dS/m	0.	54	0.	72	7.	30	1.	10
				mg/kg	meq/100g	mg/kg	meq/100g	mg/kg	meq/100g	mg/kg	meq/100g
Potassium Ex	NH <sub>4</sub> CI	R&H 15A1	-	481	1.23	568	1.46	465	1.19	557	1.43
Calcium Ex	NH <sub>4</sub> CI	R&H 15A1	-	2138	10.7	1914	9.57	1627	8.14	2039	10.2
Magnesium Ex	NH₄CI	R&H 15A1	-	376	3.13	1004	8.37	898	7.48	632	5.27
Sodium Ex	NH₄CI	R&H 15A1	-	28.7	0.12	119.0	0.52	677.0	2.94	68.2	0.30
Aluminium Ex	KCL	R&H 15G1	-	0.6	0.01	0.3	0.00	0.5	0.01	0.2	0.00
Ex Potassium %	Calc	Calc	%	8.	12	7.	31	6.	03	8.	31
Ex Calcium %	Calc	Calc	%	7(	0.4	48	3.1	41	1.2	59	9.3
Ex Magnesium %	Calc	Calc	%	20	0.6	42	2.0	37	7.9	30	).6
Ex Sodium %	Calc	Calc	%	0.	.82	2.	60	14.90		1.	73
Ex Aluminium %	Calc	Calc	%	0.	.05	0.	02	0.03		0.01	
ECEC	Calc	Calc	meq/100g	1:	5.2	19	9.9	19.8		17.2	
Ca/Mg Ratio	Calc	Calc	meq/100g	3.	.41	1.	14	1.	09	1.	94



### Project No: EW120441

Location: Blackjack Creek

		Sa	mple ID	Bł	113	B	114	Bł	115	Bł	116
Test Parameter	Method Description	Method Reference	Depth Units	0-30cm 120441-13		0-30cm 120441-14		0-30cm 120441-15		0-30cm 120441-16	
Chlorides	Probe	R&H 5A1	mg/kg	2	0.7	2	9.0	18	8.0	31.5	
Electrical Conductivity	Soil:Water (1:5)	R&H 3A1	dS/m	0.	.07	0	.11	0.	.05	0.09	
pH (CaCl <sub>2</sub> )	Electrode	R&H 4A2	pH units	6	.49	6	.77	6.00		6.	07
NO <sub>3</sub> -Nitrogen Ex	Aqueous Buffer	In House	mg/kg	6	.82	5	56	6.	.03	8.	37
Phosphorus Ex	Colwell	R&H 9B1	mg/kg	4	0.0	4	1.5	34	4.1	32	2.9
Sulphur Ex	KCI-40	Chinoim, LeFroy & Blair	mg/kg	1:	2.0	1	5.5	8.	.67	10	0.5
Organic Carbon	LECO	In House	%	1.	.93	1.	.39	1.	.70	1.	77
Copper Ex	DTPA	R&H 12A1	mg/kg	2	.33	1.	.33	1.	.22	2.01	
Zinc Ex	DTPA	R&H 12A1	mg/kg	8	.32	3.20		4.53		4.79	
Manganese Ex	DTPA	R&H 12A1	mg/kg	65.7		198		78.5		84.8	
Iron Ex	DTPA	R&H 12A1	mg/kg	1	19	341		153		189	
Texture	-	PSR-1999	-	F	SL	FSL		FSL		F	SL
Ece	-	-	dS/m	0.	.77	1.21		0.55		0.99	
				mg/kg	meq/100g	mg/kg	meq/100g	mg/kg	meq/100g	mg/kg	meq/100g
Potassium Ex	NH₄CI	R&H 15A1	-	393	1.01	426	1.09	305	0.78	389	1.00
Calcium Ex	NH₄CI	R&H 15A1	-	2297	11.5	2066	10.3	1649	8.25	1312	6.56
Magnesium Ex	NH₄CI	R&H 15A1	-	667	5.56	361	3.01	337	2.81	663	5.53
Sodium Ex	NH₄CI	R&H 15A1	-	60.6	0.26	43.1	0.19	43.0	0.19	54.8	0.24
Aluminium Ex	KCL	R&H 15G1	-	0.3	0.00	0.3	0.00	0.2	0.00	0.3	0.00
Ex Potassium %	Calc	Calc	%	5.	.50	7.	.47	6.	.50	7.	49
Ex Calcium %	Calc	Calc	%	62	2.7	7	0.7	6	8.6	49	9.2
Ex Magnesium %	Calc	Calc	%	3	0.3	2	0.6	2	3.4	41	1.5
Ex Sodium %	Calc	Calc	%	1.	.44	1.	.28	1.55		1.	79
Ex Aluminium %	Calc	Calc	%	0.	.02	0	.02	0.02		0.02	
ECEC	Calc	Calc	meq/100g	18	8.3	1	4.6	12.0		13.3	
Ca/Mg Ratio	Calc	Calc	meq/100g	2	.07	3.43		2.94		1.19	



### Project No: EW120441

Location: Blackjack Creek

		Sa	mple ID	Bł	117	Bł	H18	Bł	119	
Test Parameter	Method	Method	Depth	0-3	0cm	0-3	0cm	0-3	0cm	
			Units	1204	41-17	1204	41-18	1204	41-19	
Chlorides	Probe	R&H 5A1	mg/kg	30	5.8	24	4.8	64	4.5	
Electrical Conductivity	Soil:Water (1:5)	R&H 3A1	dS/m	0.	.10	0.	14	0.	.09	
pH (CaCl <sub>2</sub> )	Electrode	R&H 4A2	pH units	6.	.18	7.	16	7.	.10	
NO <sub>3</sub> -Nitrogen Ex	Aqueous Buffer	In House	mg/kg	6.	.47	6.	18	5.	.16	
Phosphorus Ex	Colwell	R&H 9B1	mg/kg	64	4.5	94	4.7	24	4.5	
Sulphur Ex	KCI-40	Chinoim, LeFroy & Blair	mg/kg	1	7.6	12	2.1	3.	.39	
Organic Carbon	LECO	In House	%	0.	.81	1.	40	0.	.39	
Copper Ex	DTPA	R&H 12A1	mg/kg	1.	.02	1.	33	1.	.19	
Zinc Ex	DTPA	R&H 12A1	mg/kg	2.	.01	1(	0.3	0.	.69	
Manganese Ex	DTPA	R&H 12A1	mg/kg	2	27	1	69	18	8.5	
Iron Ex	DTPA	R&H 12A1	mg/kg	4	33	2	96	5	3.1	
Texture	-	PSR-1999	-	F	SL	F	SL	C	CL	
Ece	-	-	dS/m	1.	10	1.	54	0.	.81	
				mg/kg	meq/100g	mg/kg	meq/100g	mg/kg	meq/100g	
Potassium Ex	NH₄CI	R&H 15A1	-	300	0.77	607	1.56	346	0.89	
Calcium Ex	NH₄CI	R&H 15A1	-	917	4.59	3283	16.42	1741	8.71	
Magnesium Ex	NH₄CI	R&H 15A1	-	304	2.53	387	3.23	619	5.16	
Sodium Ex	NH₄CI	R&H 15A1	-	75.2	0.33	49.7	0.22	55.7	0.24	
Aluminium Ex	KCL	R&H 15G1	-	0.1	0.00	0.3	0.00	0.2	0.00	
Ex Potassium %	Calc	Calc	%	9.	36	7.	27	5.	.92	
Ex Calcium %	Calc	Calc	%	5	5.8	76	5.6	5	8.1	
Ex Magnesium %	Calc	Calc	%	30	<b>3.</b> 8	1:	5.1	34	4.4	
Ex Sodium %	Calc	Calc	%	3.	.98	1.	01	1.	.62	
Ex Aluminium %	Calc	Calc	%	0.	.02	0.	02	0.	.02	
ECEC	Calc	Calc	meq/100g	8.	22	2	1.4	1	5.0	
Ca/Mg Ratio	Calc	Calc	meq/100g	1.	.81	5.	09	1.	.69	

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#### DOCUMENT END



	Blackjack Creek Soil Investigation							
Project Numbe	Project Number: FW120//1 Drill Big: Geoprobe							
Date Collected:	25/05/12	Hole Number: 19						
Northing: 30° 5	9" 298'	Total Depth of Test pit: 3.47m						
Easting: 150° 1	4" 116'							
Graphic Log	Description							
	0.00-20.00cm Red clay							
	20.00-30.00cm Increased white gr	ey mottles						
	30.00-70.00cm Texture change: light clay red no mottles							
	70.00-90.00cm Calcite chunks, carbonates, mottles, gley colours							
	90.00-115.00cm white grey red orange							
	115.00-135.00cm Back to clay red orange							
	135.00-200.00cm Texture change:	more gravel						
	200.00-228.00cm Red orange clay							
	228.00-230.00cm Start to see mot	tles cream black orange, still clay, very moist						
	230.00-241.00cm Red heavy clay							
	241.00-347.00cm Mottles increasing, lighter colours, gley colours, cream, orange, yellow, black							
	3.47m Core Sample terminated No free water observed.2.3m very wet layer.							
Contact: 02 676	WEST VIROAG 52 1733 admin@ewenviroag.com.a	u						

Blackjack Creek Soil Investigation							
Project Numbe	er: FW120441	Drill Rig: Geoprobe					
Date Collected	: 25/05/12	Hole Number: 18					
Northing: 30° 5	59″ 163′	Total Depth of Test pit: 3.28m					
Easting: 150° 1	4" 207′						
Graphic Log	Description						
	0.00-36.00cm Dark brown loam						
	36.00-50.00cm Texture change, light texture, light colour, red brown, very crumbly						
	50.00-95.00cm Heavy clay						
	95.00-144.00cm texture change, lighter colours, lighter texture, crumbly, yellow red						
	144.00-151.00cm Large calcite chunks, full spectrum of gley colours						
	151.00-209.00cm Red brown, light clay						
	209.00-222.00cm Gley colours, bl	ack, clay					
	222.00-250.00cm Calcite chunks i	n clay					
	250.00-262.00cm Clay, gley colou	rs					
	262.00-328.00cm Wet layer						
	Free water not observed						
EAST	east west enviroag						
Contact: 02 67	Contact: 02 6762 1733 admin@ewenviroag.com.au						

# **Blackjack Creek Soil Investigation** Project Number: EW120441 Drill Rig: Geoprobe Date Collected: 25/05/12 Hole Number: 17 Northing: 30° 59" 994' Total Depth of Test pit: 3.34m Easting: 150° 14" 347' Graphic Log Description 0.00-8.00cm Clay, black, calcite chunk at 8cm 8.00-30.00cm Lighter textures, lighter clay, some mottles, slightly sandy, texture red 30.00-234.00cm Red orange some mottle, heavier texture, progressive decaying organic matter, black, mottle colours 234.00-253.00cm Slight texture changes, crumbly calcite 253.00-274.00cm heavy clay mottling, red orange 274.00-282.00cm Calcite chunks crumbly 282.00-334.00cm heavy clay mottling, very moist, red orange 3.34m Core Sample terminated Free water not observed. 2.9m Wet layer observed . EAST WEST enviroag Contact: 02 6762 1733 admin@ewenviroag.com.au

	Blackjack Creek Soil Investigation						
Proiect Numbe	r: EW120441	Drill Rig: Geoprobe					
Date Collected	: 25/05/12	Hole Number: 16					
Northing: 30° 5	9″ 800′	Total Depth of Test pit: 3.47m					
Easting: 150° 1	4" 483'						
Graphic Log	Description						
	0.00-10.00cm Light crumbly, brown						
	10.00-39.00cm Loam, increasing heaviness, brown						
	39.00-50.00cm Light colour red brown, lighter texture, crumbly						
	50.00-106.00cm Mottling oranges greys						
	106.00-190.00cm Mottling orange grey black, calcite chunks, heavy texture, moist						
	190.00-223.00cm Heavy clay, water						
	223.00-243.00cm Black soil						
	243.00-255.00cm Heavy clay, mot	ttles reg orange, calcite, wet clay					
	255.00-300.00cm Calcite chunks, gley colours, wet clay						
	300.00-347.00cm Calcite deposits at several points, gley colour, wet clay						
	Free water not observed. Wet layers from 1.9	to 3.5					
Contact: 02 67	Free water not observed. Wet layers from 1.9 to 3.5						

	Blackjack Creek Soil Investigation						
Project Numbe	er: EW120441	Drill Rig: Geoprobe					
Date Collected	: 24/05/12	Hole Number: 15					
Northing: 30° 5	59" 035'	Total Depth of Test pit: 3.0m					
Easting: 150° 1	4" 264'						
Graphic Log	Description						
	0.00-30.00cm Loamy top soil, black						
	30.00-80.00cm Heavier clay, small calcite, red brown slight mottling						
	80.00-110.00cm Wetter clay, sandier texture, red brown slight mottling						
	110.00-125.00cm Gravely sandy texture, crumbly, cream reds, some calcite						
	125.00-150.00cm very wet layer, clay, red brown						
	150.00-155.00cm Very wet clay, free water, red brown clay						
	155.00-190.00cm Still moist, red brown orange black mottles 1.8m water						
	190.00-206.00cm Sandy clay, moist, brown						
	206.00-220.00cm Brown heavier clay, moist						
	220.00-300.00cm Mottles, grey orange red heavy clay, moist						
	3.00m Core Sample terminated						
Contact: 02 67	Contact: 02 6762 1722 admin@awanviroag.com au						

Blackjack Creek Soil Investigation							
Proiect Numbe	r: EW120441	Drill Rig: Geoprobe					
Date Collected:	24/05/12	Hole Number: 14					
Northing: 30° 5	9" 035'	Total Depth of Test pit: 3.35m					
Easting: 150° 14	4″ 264′						
ohic							
Gra <sub>l</sub> Log	Description						
	0.00-42.00cm Gravel, white, large gravel, red brown, very crumbly						
	42.00-85.00cm Texture change: heavier clay, red orange cream colours						
	85.00-100.00cm Some calcite, organic matter, red orange, more crumbly						
	100.00-103.00cm Very crumbly, light texture, red orange						
	103.00-112.00cm Gravel, orange red						
	112.00-205.00cm Some calcite, moist clay, mottling, red, orange						
	205.00-220.00cm Quite moist, red brown clay, slight mottling						
	220.00-236.00cm Crumbly, not mo	bist, red brown					
	236.00-245.00cm Moisture, red br	own, heavier clay					
	245.00-255.00cm Gravel, clay, red brown 2.5m water						
	255.00-300.00cm Red brown, moist, mottling, gravel, greys oranges						
	300.00-335.00cm Red brown white	e mottling, heavy clay					
	3.35m Core Sample terminated	/					
EAST C	viroag						
Contact: 02 6762 1733 admin@ewenviroag.com.au							

Blackjack Creek Soil Investigation					
Project Number: EW120441		Drill Rig: Geoprobe			
Date Collected: 24/05/12		Hole Number: 13			
Northing: 30° 58″ 956'		Total Depth of Test pit: 4.2m			
Easting: 150° 14" 322'					
Graphic Log	Description				
	0.00-30.00cm Dark brown heavy clay				
	30.00-54.00cm Lighter texture, dark brown				
	54.00-100.00cm Red, lighter texture, colour change				
	100.00-130.00cm Heavy clay, orange, red, moist				
	130.00-134.00cm Slight calcite clay				
	134.00-162.00cm Clay, moist, ora	ange, red			
	162.00-213.00cm Lighter clay, some calcite, yellow orange				
	213.00-220.00cm Clay yellow orange, lighter clay				
	220.00-226.00cm Lighter texture, loam				
	226.00-315.00cm Cream colours, black orange, heavy, calcite deposits				
	315.00-330.00cm River gravel, co	plours orange yellow blacks creams			
	4.2m water				
enviroag					
Contact: 02 6762 1733 admin@ewenviroag.com.au					

Blackjack Creek Soil Investigation				
Project Number: EW120441		Drill Rig: Geoprobe		
Date Collected: 24/05/12		Hole Number: 12		
Northing: 30° 58" 881'		Total Depth of Test pit: 4.2m		
Easting: 150° 14" 397'				
Graphic Log	Description			
	0.00-56.00cm Red brown loamy c	ay, red black mottles, light calcite		
	56.00-336.00 Heavy clay, black gro through the profile, calcite chunks	ey mottles, very moist, gley colours increasing		
	2.55m Core Sample terminated 4.2m:Free water			
Contact: 02 6762 1733 admin@ewenviroag.com.au				

L

Blackjack Creek Soil Investigation						
Project Number: EW120441		Drill Rig: Geoprobe				
Date Collected: 24/05/12		Hole Number: 11				
Northing: 30° 58" 819'		Total Depth of Test pit: 3.5m				
Easting: 150° 14" 436'						
Graphic Log	Description					
	0.00-30.00cm Red cl	ay, slight orange				
	30.00-45.00cm Heavi	er clay, wetter, red orange				
	45.00-55.00cm Red c	range, wetter, heavy clay				
	55.00-61.00cm Calcite chunks, red orange, heavy clay					
	61.00-120.00cm Colour change: black, heavy clay, very moist, slightly mottling					
	120.00cm-255.00cm Colour lighter, calcite chunks, very moist, gley colours					
	More gley colours increasing to the end, calcite present throughout, very moist					
	2.55m Core Sample terminated 3.3m:Free water	I				
Contact: 02 6762 1733 admin@ewenviroag.com.au						

Blackjack Creek Soil Investigation Ground Water Monitoring Point				
Ducie et Nume				
Project Number: EW120441		Drill Rig: Geoprobe		
Date Collected: 24/05/12		Hole Number. 10		
Northing: 30° 58″ 949′		Total Depth of Test pit: 9.5m		
Easting: 150° 14" 388'				
Graphic Log	Description			
	0.00-41.00cm Dry crumbly, brown, slight crams, slightly gravel			
41.00-111.00cm Texture change. Moist, heavy clay, red orange, slight gley colou				
111.00-330.00cm Gley colours increasing, moist, calcite throughout, red ora				
	330.00-340.00cm River gravel, reds oranges, clay, very moist			
	3.40m Core Sample terminated 9.5m:Free water, bore casing /locked monun	nent.		
east west enviroag				
Contact: 02 6762 1733 admin@ewenviroag.com.au				
	Blackjack Creek Ground Water	Soil Investigation Monitoring Point		
---	--	--	--	
Project Numbe	r: EW120441	Drill Rig: Geoprobe		
Date Collected	: 24/05/12	Hole Number: 9		
Northing: 30° 58″ 949′		Total Depth of Test pit: 4.5m		
Easting: 150° 14″ 388′				
Description				
	0.00-38.00cm Brown slight red, light clay, dry 38.00-126.00cm Texture change. Heavy clay, red orange, increasing moisture, increasing orange			
	126.00-245.00cm Heavy clay, crun	nbly, very moist, orange slight red		
	245.00-340.00cm Mottling increas very moist	sing, gley colours increasing, calcite, orange red clay,		
	3.40m Core Sample terminated 4.5m:Free water, bore casing /locked monume	nt.		
EAST WEST. ENVIROAD				
Contact: 02 6762 1733 admin@ewenviroag.com.au		u		

	Blackjack Creek Ground Water	Soil Investigation Monitoring Point	
Project Numbe	er: EW120441	Drill Rig: Geoprobe	
Date Collected	: 24/05/12	Hole Number: 8	
Northing: 30° 5	59" 070'	Total Depth of Test pit: 1.98m	
Easting: 150° 1	4" 273'		
Graphic Log	Description		
	0.00-30.00cm Brown orange crum	ibly clay sandy loam, calcite, gravel present	
	30.00-62.00cm Brown orange, dry	crumbly, calcite present	
	62.00-111.00cm Sand gravel, reds	browns	
	111.00-139.00cm Sandy clay incre	asing, brown orange	
	139.00-170.00cm Abrupt change,	gravel, calcite, sandy no soil, very wet.	
	170.00-198.00cm Very wet, clay s	and, fine texture	
	1.98m Core Sample terminated 2.0m:Free water, bore casing /locked monume	ent.	
EAST	viroag		
Contact: 02 6762 1733 admin@ewenviroag.com.au		iu	

	Blackjack Creek	Soil Investigation
Project Numbe	r: EW120441	Drill Rig: Geoprobe
Date Collected	: 24/05/12	Hole Number: 7
Northing: 30° 5	9" 664'	Total Depth of Test pit: 8.5m
Easting: 150° 13" 796'		
Graphic Log	Description	
	0.00-40.00cm Very crumbly, dr	y, red brown, light clay loam
	40.00-136.00cm Heavier clay, bro gritty, increasing moisture.	wn red orange mottles, calcite present, slightly
	136.00-298.00cm Gravel/calcite lo increasing, heavy clay, wet, light c	ens at 149cm, increasing moisture, gley colours colours greys oranges
	298.00-335.00cm Darker colour, k	olack browns, heavy clay, wet
	3.35m Core Sample terminated Auger to 8.5m no water	
EAST	WEST	
Contact: 02 670	62 1733 admin@ewenviroag.com.a	au

	Blackjack Creek Soil Investigation Ground Water Monitoring Point		
Project Number	: EW120441	Drill Rig: Geoprobe	
Date Collected:	24/05/12	Hole Number: 6	
Northing: 30° 59	9" 613'	Total Depth of Test pit: 4.50m	
Easting: 150° 13	3″ 810'		
Graphic Log	Description		
	0.00-30.00cm Brown black, clay loa	my, crumbly	
	30.00-54.00cm brown black, heavie	r clay, dry	
	54.00-106.00cm Calcite present, he moisture.	avier clay, reds oranges colours, brown black, slight	
	106.00-116.00cm Gley colours incre	easing	
	116.00-142.00cm Gley colours strong		
	142.00-154.00cm Gravel lens, reds	oranges	
	154.00-166.00cm Heavy clay, red br	rowns, moist, gritty	
	166.00-182.00cm Gravel, sand, wet	, no soil, purple red cream.	
	182.00-210.00cm Gravel, increase s	oil, sandy, gley colours, lighter colours, wet clay	
	210.00-380.00cm Heavy clay, gley c	olours, wet, increasing wet	
	380.00-440.00cm Slightly sandy clay	γ, gley colours, very wet.	
	4.40m Core Sample terminated		
		-	
Contact: 02 676	2 1733 admin@ewenviroag.com.au		

	Blackjack Creek Soil Investigation			
	Ground Water Monitoring Point			
Project Nur	nber: EW120441	Drill Rig: Geoprobe		
Date Collec	ted: 23/05/12	Hole Number: 5		
Fasting: 15	0° 13″ 854′	Total Depth of Test pit: 7.7m		
Graphic Log	Description			
	0.00-30.00cm Dry crumbly	y gravel, calcite present, light brown orange blacks		
	30.00-55.00cm Dark brow	n, some reds, crumbly gritty, dry		
	55.00-94.00cm Dark brow	n oranges, increasing wet, gritty, dry		
	94.00-110.00cm Clay incre	easing wet crumbly, brown grey, slight gley colours		
	110.00-172.00cm Clay inc calcite present, slight moi	reasing wet crumbly, gritty, gley colours, greys oranges, sture		
	172.00-254.00cm Heavier	clay, grey, increasing oranges reds, moist		
	254.00-271.00cm Clay wit	h sand, orange red gley colours, moist		
	271.00-312.00cm More gr	ravel and sand cream gley colours moist		
	312.00-404.00cm Clay inc	reasing dark greys gley colours, grey orange		
	404.00-440.00cm heavy cl moist, slight gravel.	lay, calcite deposits, gley colours, grey orange creams,		
	4.40m Core Sample terminated 7.6m:Free water, bore casing /locke	d ed monument.		
	. 0702 1755 aumin@ewenv	n oag.com.au		

	Blackjack Creek	Soil Investigation
Project Numbe	r: EW120441	Drill Rig: Geoprobe
Date Collected:	23/05/12	Hole Number: 4
Northing: 30° 5	9" 394'	Total Depth of Test pit: 1.90m
Easting: 150° 13	3" 936'	
Graphic Log	Description	
	0.00-50.00cm Dark brown crum	bly dry slight reds
	50.00-107.00cm Calcite chunks, gr	avel, gley colours, crumbly sandy
	107.00-117.00cm Heavy clay sandy	r, gley colours light grey reds
	117.00-160.00cm Sandy clay very v	vet gley colours
	160.00-190.00cm Heavy clay less n	noisture gley colours grey orange
	1.90 Core Sample terminated	
Contact: 02 676	VIROAG 52 1733 admin@ewenviroag.com.au	1

	Blackjack Creek	Soil Investigation
Project Number	r: EW120441	Drill Rig: Geoprobe
Date Collected:	23/05/12	Hole Number: 3
Northing: 30° 59	9″ 337′	Total Depth of Test pit: 3.76m
Easting: 150° 13	3″ 911′	
Graphic Log	Description	
	0.00-66.00cm Clay, black brown,	dry, increasing moisture
	66.00-163.00cm Heavy clay, quite	wet, black brown
	163.00-180.00cm Red slightly sandy, wet gravel. Slight gley colours, orange grey, calcite present.	
	180.00-205.00cm Heavy clay black brown, very wet	
	205.00-270.00cm Red clay slightly I	ess wet, slightly sandy, gley colours, grey orange
	270.00-367.00cm Sandy increasing 3.5m water.	gley colours, orange grey colours. Very wet, sand,
	3.67 Core Sample terminated	
Contact: 02 6762 1733 admin@ewenviroag.com.au		

	Blackjack Creek Soil Investigation		
Project Numbe	er: FW120441	Drill Rig: Geoprobe	
Date Collected	: 23/05/12	Hole Number: 2	
Northing: 30° 59″ 555′		Total Depth of Test pit: 5.20m	
Easting: 150° 1	.3" 745'		
Graphic Log	Description		
	0.00-30.00cm Red brown clay, rocks present, light clay		
	30.00-428.00cm Calcite present, very dry, light brown orange, mottling creams, cla		
	428.00-520.00cm Gravel wet, fre colours	e water, calcite chunks, red brown soil some gley	
	5.2m Core Sample terminated		
EAST	viroag		
Contact: 02 67	62 1733 admin@ewenviroag.com	au	

Blackjack Creek Soil Investigation		
Project Number	r: EW120441	Drill Rig: Geoprobe
Date Collected:	23/05/12	Hole Number: 1
Northing: 30° 5	9" 466'	Total Depth of Test pit: 6.5m
Easting: 150° 13	3" 819'	
Graphic Log	Description	
	0.00-30.00cm Clay red brown, dry	
	30.00-50.00cm Clay brown	
	50.00-90.00cm Red brown moist h	eavier clay
	90.00-200.00cm Red clay, some cal	cite, cream orange red mottles down profile
	200.00-426.00cm heavy clay colour	change down profile, light red, dark red, orange red
	4.26m Core Sample terminated	
Contact: 02 6762 1733 admin@ewenviroag.com.au		

## APPENDIX H Ecological Assessment



Koala in the Cemetary adjacent to the Study Area.

## ECOLOGICAL ASSESSMENT: BLACKJACK CREEK RESTORATION IN GUNNEDAH, NSW.

**Gunnedah Local Government Area** 

November 2012

Report Prepared by

OzArk Environmental & Heritage Management Pty Ltd

For Constructive Solutions



Environmental and Heritage Management P/L

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## EXECUTIVE SUMMARY

OzArk Environmental Heritage & Management (OzArk) was commissioned by Constructive Solutions (CS) on behalf of Gunnedah Shire Council (GSC) to undertake an ecological assessment for the proposed impacts associated with the reconstruction and realignment of Blackjack Creek in the town of Gunnedah, NSW (**Figure 1**).

The project will be assessed under Part 5 of the *Environmental Protection* & Assessment Act 1979 (EP&A Act).

In the Study Area, Blackjack Creek flows on a north-easterly alignment within Wandobah Reserve and private property Lot 78 DP 755583, Lot 77 DP 755583, Lot 2 DP 542293. The Study Area starts within Wandobah Reserve on the corner of View Street and the Oxley Highway and finishes behind the Gunnedah Cemetery (**Figure 2**). Blackjack Creek is generally an ephemeral creek with intermittent flows mainly from urban stormwater. It is well known that dryland salinity and high water tables are issues within Wandobah Reserve along Blackjack Creek.

The proposed Impact Footprint incorporates an area of Blackjack Creek 1.9 kilometres in length. The entire length will be rehabilitated to form a Vegetated Riparian Zone as identified in the Concept Design (**Figure 2**) to a total width of approximately 70 metres. However, only portions of the creek within Wandobah Reserve (the first 941 metres) will be realigned up to 50 metres from the existing creek alignment.

The Study Area has been extensively modified (vegetation clearing, levee construction), disturbed (weed encroachment, rubbish dumping, garden clipping disposal) and cleared to the south for cropped paddocks. Remnant vegetation in the Study Area is consistent with Biometric vegetation ID NA185 '*Poplar Box grassy woodland on alluvial heavy clay soils in the Brigalow Belt South Bioregion (Benson 101)*'. This is consistent with the RVC 80 '*Poplar Box grassy woodland on alluvial clay soils, Brigalow Belt South and Nandewar*'. A complete species list for the Study Area can be found in **Table 4**. In total 111 species of vascular flora from 37 families were recorded in the Study Area during the field survey (**Table 4**). Of these 60 species are non-native (54 %) including six species of listed Noxious Weed of which one species is a Weed of National Significance.

No threatened species of flora, populations or endangered ecological communities listed under the *Threatened Species Conservation Act 1995 TSC* Act (TSC Act) or *Environment Protection and Biodiversity Conservation Act 1999* Act (EPBC Act) were recorded in the Study Area.

61 species of terrestrial fauna from 31 families were recorded in the Study Area during the field survey (**Table 5**). The abundance of honeyeaters recorded is likely a result of the flowering resources in the Study Area at the time of the assessment. Interestingly, no amphibians were heard calling or detected in the creek. This may be an indication of the unsuitable creek conditions including known high salinity levels.

It is likely that further species of fauna occur in the Study Area however due to the inopportune night-time weather conditions and malfunction of the echolocation device were not detected.

Three species of threatened fauna were recorded in the Study Area including the Koala (TSC and EPBC Act), Little Lorikeet (TSC Act) and Grey-headed Flying Fox (TSC and EPBC Act) (**Table 5**). Hollow dependent threatened microbats and threatened owls (Masked Owl and Barking Owl) are assumed to be present in the Study Area. This is based on habitat present including the variety and number of suitable hollows.

The Study Area is considered to be a 'High Use Activity' area for Koalas (TSC and EPBC Act) with evidence of Koala-use at 22 of the 37 trees within Wandobah Reserve in the Impact Footprint. This is density of 59 per cent as per the Spot Assessment Technique (SAT) technique. One mature male Koala was recorded within the Cemetery adjacent to the Study Area (**Plate 5**).

The Proposal will result in the removal of approximately 30-37 identified habitat trees with medium and high habitat values (a declining and rare resource within the landscape) (**Table 6**). In addition to those habitat trees identified in **Table 6** additional non-hollow bearing trees / shrubs within the Impact Footprint are listed in **Table 7**. Despite the fact that most of the species listed in **Table 7** are planted, they still provide valuable habitat and flowering resources for threatened fauna and combat dryland salinity in the Study Area.

State Environmental Planning Policy- 44 (SEPP 44) – Koala habitat is not relevant to proposals assessed under Part 5 of the EPA Act, however has been considered in the preparation of this document. Koalas are a threatened species and have been assessed appropriately as part of the impact assessment processes established under the TSC Act and the EPBC Act.

Consideration of the type and scale of habitat to be removed has resulted in the conclusion that the Koala would be significantly affected by the Proposal. In its current state, the Proposal is considered to have a significant impact on 'Core Koala Habitat' and will require an SIS and Referral of the Project to the Environment Minister of DSEWPaC. The Proposal would not have a significant impact on any other item listed in **Table 8**.

Consideration has been given as to how the proposed impacts accord with ecologically sustainable development (ESD) principles throughout the assessment, particularly with regard to the environmental constraints posed in the Study Area. It is summarised that the proposed direct and indirect impact to Koalas are not justifiable under ESD as:

- Koala habitat trees within' Core Koala Habitat' will be impacted;
- Koala habitat trees to be impacted provide connectivity between the Namoi River and forested areas around Gunnedah;
- Impacts will occur within a town which considers itself to be the 'Koala Capitol of the World';
- Being a vulnerable species at both state and federal level, the proposed impacts do not consider the economic and non-biological values of koalas to the Gunnedah community or reflect the recovery strategies for the Koala outlined in the Draft National Koala Recovery Plan.

Additionally large hollow bearing trees in the Study Area are considered to have high ecological values that have not been adequately avoided in the design stage of the Proposal.

As such it is considered that ecological values present / or having potential to occur are not adequately avoided or mitigated against by the Proposal, and will not be protected or managed for future generations.

As such it is recommended that GSC do not impact large hollow bearing trees adjacent to the creek and consider redesigning the Proposal to avoid hollow bearing trees and minimise the amount and type of clearing. Maintaining the existing alignment of Blackjack Creek appears the most ecologically sensible. Further recommendations in regards to the Proposal can be found in **Section 8** of this report.

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## 1. INTRODUCTION

## 1.1 **PROPOSAL IDENTIFICATION**

OzArk Environmental Heritage & Management (OzArk) was commissioned by Constructive Solutions (CS) on behalf of Gunnedah Shire Council (GSC) to undertake an ecological assessment for the proposed impacts associated with the reconstruction and realignment of Blackjack Creek in the town of Gunnedah, NSW (**Figure 1**).

The project will be assessed under Part 5 of the *Environmental Protection & Assessment Act 1979* (EP&A Act).

## 1.2 LOCATION

The proposed reconstruction of Blackjack Creek falls entirely within the Gunnedah Local Government Area (LGA) (**Figure 1**). Blackjack Creek flows on a north-easterly alignment within Wandobah Reserve and private property Lot 78 DP 755583, Lot 77 DP 755583, Lot 2 DP 542293. The Study Area starts within Wandobah Reserve on the corner of View Street and the Oxley Highway and finishes behind the Gunnedah Cemetery (**Figure 2**). Only portions of the creek within Wandobah Reserve are proposed for realignment and reconstruction.



#### Figure 1: Locality Map.



Figure 2: Arial view of the Study Area showing realignment.

#### 1.3 DEFINITIONS USED IN THIS REPORT

**Activity** - has the same meaning as in the EP&A Act. The nature of the proposed activity is described in Section 2.1.

**EEC** - Endangered Ecological Community

*Locality* - means the area within a 50 km radius of the Study Area described in Section 1.2.

**Study Area** – The area ecologically assessed where the proposed activity outlined in Section 2.1 will be undertaken (**Figure 2**).

*Impact Footprint* – An area within the Study Area that will be mechanically destroyed or altered to construct infrastructure associated with the activity.

*Threatened Species* – A species specified in Schedule 1 Part 1 (endangered species), Part 4 (presumed extinct) and Schedule 2 (vulnerable species) of the *Threatened Species Conservation Act 1995* (TSC Act 1995), within the schedules of the *Fisheries Management Act 1991 (*FM Act 1991*)* or within the Schedules of the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act 1999).

## 1.4 PURPOSE OF THE REPORT

The investigation and report included the following aspects:

- A review of current legislation including the *NSW National Parks and Wildlife Act 1974* (NP&W Act), TSC Act 1995, EPBC Act 1999, FM Act 1991 *and the* EPA Act 1979;
- A search of the Office of Environment and Heritage (OEH), Primary Industries (Fishing and Aquaculture), Department of Sustainability Environment, Water, Population and Community (DSEWPaC) online databases and NSW Wildlife Atlas to identify species within the Local Government Area (LGA) of Catchment Management Authority (CMA) that are protected within the schedules of the TSC Act 1995, FM Act 1991 and EPBC Act 1999;
- A review of relevant literature including previous consulting reports, academic theses, articles and available works on the ecology, flora, fauna, of the Gunnedah region;
- Consultation with OEH Threatened Species Unit if required or the Royal Botanic Gardens Botanical Information Service of New South Wales;
- Pedestrian field survey to identify and record all species of flora and fauna within the Study Area for the proposed works;
- Seven-part Tests / Assessments of Significance to determine the significance of impacts to listed species, populations and communities and the formulation of appropriate management strategies; and,
- Completion of documentary evidence (e.g. updates for the OEH Wildlife Atlas) for any species located during the survey for the notification of the relevant authorities.

## 1.5 DATE OF AND WEATHER CONDITIONS DURING THE ASSESSMENT

The field assessment for this project was undertaken on the 22<sup>nd</sup> and 23<sup>rd</sup> of October 2012. Weather was warm 27.4°C and 24.9°C respectively. Nocturnal assessments were undertaken on the night of the 22<sup>nd</sup> of October. Weather was extremely windy with a peak wind gust of 69 km/h.

## 1.6 OZARK EHM INVOLVEMENT

The ecological assessment was undertaken by Heidi Kolkert (BA, BSc Hons) of OzArk under NSW Department of Primary Industries (DPI) Ethics Approval No 07/1601 & NSW Scientific Research License 11194. Phillip Cameron (BSc, Ass Dip App Sc) reviewed this report. The flora and fauna assessment has been completed in accordance with Section 5a of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environment* 

Protection and Biodiversity Conservation Act 1999 (EPBC Act), for threatened species populations and ecological communities that could be affected by the Project.

## 2. PROPOSAL

## 2.1 PROJECT SCOPE AND OBJECTIVES

CS has been engaged by GSC to prepare a Concept Design and Feasibility Study for the proposed riparian corridor and channel reconstruction of Blackjack Creek.

In accordance with the New South Wales Government's Flood Policy, GSC has completed a Flood Study, Floodplain Management Study, and Floodplain Management Plan for Blackjack Creek. It was determined that riparian corridor/channel reconstruction was the most favourable mitigation measure to alleviate the threat of flooding of houses on Wandobah Road from Blackjack Creek during inundation.

The Concept Design in **Appendix 3** shows the riparian corridor/channel reconstruction of Blackjack Creek is capable of conveying the 1% Annual Exceedance Probability (AEP) flood event including freeboard provisions as per the requirements of the Department of Planning & Infrastructure.

The proposed Impact Footprint incorporates an area of Blackjack Creek 1.9 kilometres in length. The entire length will be rehabilitated along the riparian zone as identified in the Concept Design (**Figure 2**) to a width of approximately 70 metres. However, only portions of the creek within Wandobah Reserve (the first 941 metres) will be realigned up to 50 metres from the existing creek alignment. The Impact Footprint for the works is approximately ten hectares in total. The average depth range of proposed soil excavation is from zero through to over two metres.

## 3. STATUTORY AND PLANNING FRAMEWORK

#### 3.1 KEY LEGISLATION

#### 3.1.1 Environmental Planning and Assessment Act 1979

The *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal planning legislation for the state, providing a framework for the overall environmental planning and assessment of development proposals. Under the EP&A Act there are three distinctive processes, which are:

- Part 5.1 (Previously Part 3A) 'State Significant Infrastructure, which regulates specific types of 'Infrastructure' and requires an Environmental Assessment report to be prepared and submitted to the Department of Planning for the Minister's approval;
- Part 4, which regulates 'development' requires a development application to be accompanied by an Environmental Impact Statement 'prepared by or on behalf of the applicant in the form prescribed by the regulations.'
- Part 5, which regulates 'activities' and requires a REF for determination by a state self-determining authority.

The proposal is to be undertaken by the GSC, a self-determining authority under Part 5 of the Act. All relevant statutory planning instruments have been examined for the Proposal. ISEPP operates to remove the development consent requirements, thereby permitting assessment of the Proposal under Part 5 of the EP&A Act.

#### 3.1.2 Environment Protection and Biodiversity Conservation Act 1999

Under the EPBC Act a referral is required to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) for proposed 'actions that have the potential to significantly impact on matters of national environmental significance (**Table 1**) or the environment of Commonwealth land.

Relevance to the current project: In relation to this Act, items of national environmental significance are detailed in this report. The assessment of the Proposal's impact on matters of national environmental significance and the environment of Commonwealth land found that there is likely to be a significant impact on relevant matters of national environmental significance (**Section 7.4**). Accordingly, the Proposal is recommended for Referral to DSEWPC.

	Issue	Impact
a)	Any environmental impact on a World Heritage property	No
b)	Any impacts on wetlands of international importance	No
c)	Any environmental impact on Commonwealth listed threatened species or ecological communities	Yes –Core Koala Habitat.
d)	Any environmental impact on Commonwealth listed migratory species	No
e)	Does the project affect any national heritage places	No
f)	Does any part of the proposal involve a nuclear action?	No
g)	Any environmental impact on Commonwealth marine area?	No
h)	Any direct or indirect effect on Commonwealth land?	No

#### Table 1: Matters of National Environmental Significance

#### 3.2 STATE LEGISLATION

#### 3.2.1 Environmental Planning and Assessment Act, 1979 (EP&A Act)

Relevance to the current proposal: This assessment has considered critical habitat, threatened species, populations or ecological communities, or their habitats which occur in the Study Area.

#### 3.2.2 Ecologically Sustainable Development (ESD)

Relevance to the current proposal: Consideration has been given to how the proposed modifications accord with ESD principles throughout the assessment, particularly with regard to the environmental constraints posed in the Study Area. It is summarised that the proposed direct and indirect impact to Koalas are not justifiable under ESD as:

- Koala habitat trees within' Core Koala Habitat' will be impacted;
- Koala habitat trees to be impacted provide connectivity between the Namoi River and forested areas around Gunnedah;
- Impacts will occur within a town which considers itself to be the 'Koala Capitol of the World'; and
- Being a threatened species at both state and federal level, the proposed impacts do not consider the economic and non-biological values of Koalas to the Gunnedah community or reflect the recovery strategies for the Koala outlined in the Draft National Koala Recovery Plan.

Additionally large hollow bearing trees in the Study Area are considered to have high ecological values that have not been adequately avoided in the design stage of the

Proposal.

As such it is considered that ecological values present / or having potential to occur are not adequately avoided or mitigated against by the Proposal, and will not be protected or managed for future generations.

#### 3.2.3 Protection of the Environment Operations Act, 1997 (PoEO Act)

Management of environmental impacts in relation to air, noise and water quality falls under the provisions of the *Protection of the Environment Operations Act 1997*.

#### 3.2.4 The Native Vegetation Act 2003 (NV Act)

Relevance to the current proposal: This project will be assessed under Part 5 of the EP&A Act where clearing of native vegetation is exempt from the NVA Act under point 'f': any clearing that is, or that is part of, designated development within the meaning of the EPA Act and for which development consent has been granted under that Act.

#### 3.2.5 The Noxious Weeds Act 1993 (NW Act)

This Act provides for a coordinated approach to the removal and control of scheduled noxious weeds across the State.

Relevance to the current proposal: No permits or approvals are required under this Act, but it is the responsibility of the proponent to provide for the removal and proper disposal of any listed weeds found within the Study Area.

#### 3.2.6 Water Act 1912

There are still some provisions in the *Water Act 1912* that are yet to be incorporated into the WM Act. Under Part 8 of the Act, approval is required for a "controlled work". A "controlled work" is defined as an earthwork, embankment or levee or any work proposed to be constructed, on land that forms part of a bank of a river or is within a designated floodplain and that is declared by order of the Ministerial Corporation published in the Gazette to be a controlled work.

Relevance to the current proposal: Under Part 5 of the EPA Act, GCS is exempt from having to submit a Controlled Works Application to NOW.

#### 3.2.7 The Water Management Act 2000 (WM Act).

The *Water Management Act 2000* (WM Act) provides for the protection of river and lakeside land in NSW and aims to provide for the sustainable management of the water sources throughout NSW.

All controlled development on or under waterfront land is regulated by the *Water Management Act 2000* (WM). The NSW Office of Water (NOW) administers the WM and is required to assess the impact of any proposed controlled activity to ensure that no more

than minimal harm will be done to waterfront land as a consequence of carrying out the controlled activity. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary.

Relevance to the current proposal: Clause 39A(1) Water Management (General) Regulations *2004,* provides for all public authorities (other than Landcom and councils) to be exempt from the need to hold Controlled Activity Approval. Thus GSC will require approval under the Water Management Act 2000 for a controlled activity for the channel reconstruction.

#### 3.2.8 Threatened Species Conservation Act 1995 (TSC Act)

Items within the TSC Act relevant to the current proposal include:

- Threatened species, populations and ecological communities.
  - Relevance to the current proposal: In relation to the Study Area, desktop and field investigations have occurred to identify if any threatened species, populations and ecological communities occur in the Study Area.
- Key threatening processes
  - Relevance to the current proposal: In terms of the threatening processes as listed in Schedule 3 of the TSC Act, the project would involve clearing of native vegetation within an already cleared and disturbed area.
- The NSW planning and licensing system (the EP&A Act) and its relationship to threatened species, populations or ecological communities, or their habitats.
  - Relevance to the current proposal: Assessments of significance are required and can be found in **Appendix 2** of this report.

# 3.2.9 Threatened Species Conservation Amendment (Biodiversity Banking) Act 2006.

Relevance to the current proposal: This project has not been assessed using the BioBanking scheme. Offsets and rehabilitation will however be recommended as part of onsite habitat restoration plan.

#### 3.3 STATE ENVIRONMENTAL PLANNING POLICIES

#### 3.3.1 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State.

As the Proposal is being assessed under Part 5 of the *Environmental Planning and Assessment Act 1979,* development consent from Council is not required.

The Proposal is not located on land reserved under the National Parks and Wildlife Act 1974 and does not affect land or development regulated by State Environmental Planning Policy No. 14 – Coastal Wetlands, State Environmental Planning Policy No. 26 – Littoral Rainforests or State Environmental Planning Policy (Major Projects) 2005.

#### 3.3.2 State Environmental Planning Policy No. 44 (SEPP 44)

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) aims "to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline".

Although SEPP 44 does not apply in relation to the assessment of development under Part 5 of the EP&A Act, it has still requires a degree of consideration. SEPP 44 requires that before granting development consent under Part 4 of the EP&A Act for development on land over 1 hectare in area, a consent authority must form a view as to whether the land is "potential" or "core" Koala habitat. Potential koala habitat is defined as: *areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15 per cent of the total number of trees in the upper or lower strata of the tree component.* 

Schedule 1 of SEPP 44, which lists the LGAs to which SEPP 44 applies, includes the Gunnedah LGA. SEPP 44 applies to local councils determining development applications under Part 4 of the EP&A Act.

Core Koala habitat is defined as: an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

Where core Koala habitat is found to occur, SEPP 44 requires that a site-specific Koala plan of management (KPoM) be prepared.

The Gunnedah LGA is listed under Schedule 1 – Local Government Areas of *State Environmental Planning Policy No 44 (SEPP 44) – Koala Habitat Protection* and as such it is defined as 'potential Koala habitat'.

Gunnedah is known to support a population of Koalas.

One Koala was observed adjacent to the Study Area during field surveys undertaken as part of the ecological assessment. Evidence of Koalas, including multiple database records in the locality, scats and scratches on tree trunks was observed on the majority of trees in the Study Area. It has thus been determined that the Study Area provides suitable core breeding habitat for the Koala, and therefore constitutes Core Koala Habitat. Accordingly it is recommended that KPoM be developed.

#### 1.1.1.1 Local Environment Plans (LEP)

As the Proposal is being assessed under Part 5 of the EP&A Act Approval from council in relation to LEPs is not required.

*Gunnedah Local Environmental Plan 2012.* Under Section 8b (2a) the development will be non-complying development as the Proposal will not be consistent with SEPP 44.

(2) Development is complying development only if:

(e) it is consistent with any plan of management prepared under <u>State</u> <u>Environmental Planning Policy No 44—Koala Habitat Protection</u>, and

- (f) it is not integrated development.
- Zone E1 National Parks and Nature Reserves

*Gunnedah Local Environmental Plan 1998 - Reg 28*. This regulation related to tree preservation in the LGA.

#### 1.1.1.2 Development Control Plans (DCP)

**Development Control Plan (South Gunnedah).** Council is required to take into account the provisions of this Development Control Plan when assessing applications for development in the Study Area, as required by section 79C of the *Environmental Planning and Assessment Act 1979.* Under Section 2.19 Landscaping of this DCP: *Replanting of native trees and continuation of Koala corridor throughout development.* 

## 4. ENVIRONMENTAL CONTEXT OF THE STUDY AREA

#### 4.1 HYDROLOGY OF THE STUDY AREA

The Study Area is situated within the Namoi Catchment Management Authority (CMA). The Study Area specifically falls within the Liverpool Plains (Part B) subregion (**Figure 3**).

The Study Area forms part of the western slopes of the southern hills of the town of Gunnedah. The land drains via the Lincoln Street Catchment toward Wandobah Road and Blackjack Creek. The Blackjack Creek catchment comprises an area of 24km<sup>2</sup>. The area will drain in two separate directions. Part of the area drains to the north through a reserve to Blackjack Creek while the other drains to the west to Wandobah Road to Blackjack Creek.

The remaining or western part of the site will discharge to Wandobah Road and conveyed by a culvert under the road by open channel to Blackjack Creek. The open channel will be formed to a profile with concrete invert similar to that 350 metres north.

Blackjack Creek is mainly an ephemeral creek with intermittent flows mainly from urban stormwater. Small pools of water were evident in the Study Area possible as a result of recent rain. However the presence of Cumbungi (Typha sp.) an emergent monoecious aquatic perennial in a small portion of creek, indicates a high water table.

It is well known that dryland salinity and high water tables are issues within the Wandobah Reserve along Blackjack Creek.

## 4.2 TOPOGRAPHY OF THE STUDY AREA

The Study Area is situated in the Liverpool Plains within the Brigalow Belt South Bioregion (BBSB) in New South Wales. Gunnedah is 264 metres above sea level in the heart of the Liverpool Plains region of the Upper Namoi River valley. The predominant topographical features are the flood plains of the Namoi and Mooki Rivers and Cox's Creek, with 85 per cent of the Shire having a land slope of less than 3 degrees. The Study Area is generally flat to very gently undulating with a gradual fall from the east to west situated within the Blackjack Creek floodplain

## 4.3 CLIMATE OF THE STUDY AREA

According to the Köppen climate classification the Study Area falls within a climate zone characterised by a temperate climate with a moderately dry winter and a warm to hot summer. The nearest official Australian Bureau of Meteorology (BOM) recoding station is located at Gunnedah Resource Centre. The Gunnedah region experiences warm to hot summers with an average annual rainfall of 642.1 millimetres. Rainfall peaks during the

summer in January and is lowest on average at the end of winter. The hottest month is January with a mean temperature range of 18.8 °Celsius to 31.9 °Celsius. The mean temperature range in coldest month (July) is 4.7 °C to 16.1 °Celsius (BOM, 2012).

#### 4.4 GEOLOGY AND SOILS OF THE STUDY AREA

The Study Area is situated on the 'Liverpool Alluvial Plains' (Mitchell 2002). This landscape is based upon quaternary alluvial plains and outwash fans derived from Tertiary basalts; Permian and Triassic quartz sandstones with minor basalt caps with deep black and brown cracking clays, alluvial soils and red or brown texture-contrast soils on slopes below sandstone.

Soils of the area have been characterised as dark grey to brown sandy loam. Loam dominates A horizon, grading into a reddish brown clay in the B horizon. Gravel is present throughout the soil profile.

The soils vary depending on proximity to the ridge forming sandstone and conglomerate outcrops which occupy part of the 7(d) Environment Protection Scenic zone.

#### 4.5 VEGETATION OF THE STUDY AREA

On the 'Liverpool Alluvial Plains' landscape vegetation can be expected to be comprised of open grasslands of Plains Grass (*Austrostipa aristiglumis*), *Panicum* sp., Windmill Grass (*Chloris truncata*) and Blue Grass (*Dichanthium sericeum*) on black earths with occasional Myall (*Acacia pendula*), White Box (*Eucalyptus albens*), Yellow Box (*Eucalyptus melliodora*), Bimble Box (*Eucalyptus populnea*) and Wilga (*Geijera parviflora*). River Red Rum (*Eucalyptus camaldulensis*) occurs along the Namoi River.

Blackjack Creek is known to be an established waterway lined with large native eucalypts.

#### 4.6 WILDLIFE CORRIDORS AND HABITAT CONNECTIVITY

Fauna wildlife corridors are usually associated with waterways, wetlands and riverine environments or specific continuous habitats (for example escarpments, woodlands). Blackjack Creek provides connectivity with the Namoi River along Blackjack Creek north through Pensioners Hill Reserve. The Oxley Highway and Kamilaroi Highway is the most notable habitat interruption to this corridor between the river and vegetated hills to the south. However, Koalas are known to cross roads and vehicle related injury or mortality does occur.

The Study Area also has connectivity to a more vegetated pathway to the Namoi River immediately west of the Study Area. Other nearby remnants that could be used as habitat stepping stones include Wolseley Park and Namoi Flats.

Connectivity across the Study Area also occurs south-east to the more densely vegetated hills and ridgelines associated with Porcupine Reserve. Wildlife corridors and connectivity in the Study Area are shown in **Figure 3**.

#### 4.6.1 Existing Levels of Disturbance

The majority of the Study Area has been heavily impacted by dispersed urban development (roads, bridges and flood protection), rubbish dumping, agricultural activities, road-base stockpiling, BMX track/jump creation, clearing and feral animals. Land use changes have resulted in extensive areas of native vegetation being highly modified and fragmented, resulting in minimal remnants remaining in a near natural state.

Land within Wandobah Reserve has been revegetated by Landcare approximately 10 to 15 year ago. Locally native and non-native species were planted in-between remnant large eucalypts. The Study Area is predominately covered by exotic grasses that are regularly mown. Mowing was also noted as occurring within the creek bed.

Natural drainage patterns within the Study Area and elsewhere on surrounding land have been previously modified through the installation of levee banks, contour/diversion banks and sediment retention structures, although the overall drainage pattern remains the same.



Figure 3: Wildlife Corridors and connectivity between remnants indicated by the yellow arrow (Base map source: © Google Earth).

## 5. ASSESSMENT METHODOLOGY

#### 5.1 PRELIMINARY DESKTOP ASSESSMENTS

#### 5.1.1 Information Sources

Preliminary assessments drew on a number of information sources including previous preliminary reporting and information held on government databases and archives. Data gathered during preliminary assessments was used to assist in identifying distributions, suitable habitats and known records of threatened species so that field investigations could more efficiently focus survey effort. Preliminary assessment utilised a number of information sources as follows:

- Aerial Photograph Interpretation (API) of the landscape and previous vegetation maps;
- Literature reviews to determine vegetation and species habitat(s) within the Study Area and environs;
- Review of flora records contained in the OEH Threatened Species Database and EPBC Protected Matters Search;
- NSW Wildlife Atlas / Bionet GIS data request and website search;
- Australia Museum records;
- Royal Botanical Gardens (Plantnet NSW Flora Online);
- NSW Atlas of Living Australia records;
- Birds Australia Atlas.

The background searches enabled a predictive model of threatened flora and fauna occurrence to be developed for the Study Area.

#### 5.1.2 Predictive Model for Threatened Species Detection

The concepts of the modelling formed the basis of the methodology designed for the current assessment. These reflect the predominant patterns of threatened species distribution as elicited from prior survey work and from applying habitat preference for those species within a transport corridor.

Remnant patch size is the primary factor appearing to determine the location of threatened plants and animals in the region and to a lesser degree in disturbed habitats proximity to a permanent water supply. Predictive modelling for endangered ecological communities (EEC) in the locality is fairly straight forward as it can be summarised as likely to be any
native vegetation left in the valley floor and on the undulating hills. The likelihood of occurrence of threatened flora, fauna and EECs are discussed in Table 2.

#### Table 2: Likelihood of Occurrence of Threatened Flora, Fauna and EECs.

Key to Table 2. E (Endangered), V (Vulnerable), CE (Critically Endangered).

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Litoria booroolongensis	Booroolong Frog	Animal > Amphibian	E	E		Species or species habitat may occur within area	Unlikely. Suitable habitat for the Booroolong Frog does not occur in the Study Area. Lives along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins. Shelter under rocks or amongst vegetation near the ground on the stream edge. Sometimes bask in the sun on exposed rocks near flowing water during summer. Breeding occurs in spring and early summer and tadpoles metamorphose in late summer to early autumn. Eggs are laid in submerged rock crevices and tadpoles grow in slow- flowing connected or isolated pools.	Will not be affected by the Proposal.
Chalinolobus dwyeri	Large-eared Pied Bat	Animal > Bats	V	V	Known	Species or species habitat may to occur.	Unlikely. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle- shaped mud nests of the Fairy Martin (Petrochelidon ariel), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Potential foraging habitat near the creek is present.	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Mormopterus norfolkensis	Eastern Freetail-bat	Animal > Bats	V		Known		Likely. Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. Usually solitary but also recorded roosting communally, probably insectivorous.	Potential breeding/ roosting and foraging habitat suitable for this species will be impacted.
Nyctophilus corbeni	Corben's Long-eared Bat	Animal > Bats	V	V	Known	Species or species habitat may occur within area	Likely Inhabits a variety of vegetation types, including mallee, bulloke Allocasuarina luehmannii and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland.	Potential breeding/ roosting and foraging habitat suitable for this species will be impacted.
Pteropus poliocephalus	Grey-headed Flying-fox	Animal > Bats	V	V	Known		Potential. Large eucalyptus fringing a waterway suitable to support a colony are not present in the Study Area. Unlikely to support a breeding population, however feeding resources occur in the Study Area.	Potential foraging habitat suitable for this species will be impacted.
Saccolaimus flaviventris	Yellow- bellied Sheathtail- bat	Animal > Bats	V		Known		Likely. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and	Feeding habitat and potential breeding habitat (hollow bearing trees) will be impacted.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
							autumn.	
Saccolaimus flaviventris	Yellow- bellied Sheathtail- bat	Animal > Bats	V		Known		Likely. This species is known to inhabit a number of habitats including the box- gum woodland, cleared grasslands and timbered water courses. Tree hollows and buildings provide potential roosting habitat in the Study Area. An abundance of insects are also available for foraging.	Potential breeding and foraging habitat suitable for this species will be impacted.
Vespadelus troughtoni	Eastern Cave Bat	Animal > Bats	V		Known		Unlikely. Very little is known about the biology of this uncommon species. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally found along cliff-lines in wet eucalypt forest and rainforest. Potential foraging habitat near the creek is present.	Will not be affected by the Proposal.
Chalinolobus picatus	Little Pied Bat	Animal > Bats	V		Known		Likely. Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest and mallee and Bimbil box woodlands. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. Can tolerate high temperatures and dryness but need access to nearby open water. Feeds on moths and possibly other flying invertebrates.	Potential breeding and foraging habitat suitable for this species will be impacted.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Geophaps scripta scripta	Squatter Pigeon (southern)	Animal > Bats	V	V		Species or species habitat may occur within area	Potential. Disturbance and regular mowing most likely precludes this species from breeding in the Study Area. Found from north Queensland to the North West Slopes of NSW and extending down to the Liverpool Plains and Dubbo. Today they are very rare in the southern parts of their range. Grassy woodlands and plains, preferring sandy areas and usually close to water. Feed on the ground, on seeds of grasses, herbs and shrubs, as well as insects. Nest on the ground.	Not recorded. Will not be affected by the Proposal.
Alectura lathami - E population	Australian Brush-turkey population in the Nandewar and Brigalow Belt South Bioregions	Animal > Birds	EP		Known		Unlikely. Usually prefers dry rainforest that is found within the Semi-evergreen Vine Thicket Birds build nesting mounds in areas of dense vegetation. This provides ample litter for the mound building and decomposition process, as well as shade to reduce moisture loss from the mound Tall trees such as eucalypts are used for nocturnal and diurnal roosting (15 - 20m above the ground). Feeds on a variety of food types including seeds, fruits, grain, insects, earthworms, and occasionally reptiles and carrion Mound building and maintenance continues for most of the year but little detail is known of breeding, egg laying, and incubation seasons in the inland Nandewar and Brigalow Belt population	Will not be affected by the Proposal.
Anseranas semipalmata	Magpie Goose	Animal > Birds	V		Predicted		Unlikely. The lack of marsh habitat, protective cover in and adjacent to the stream precludes this species of bird from occurring. Has potential to occur during periods of flooding when the Study Area is inundated.	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Anthochaera phrygia	Regent Honeyeater	Animal > Birds	CE	E	Known	Species or species habitat may occur in the Study Area	Potential. This species may utilise flowering resources in the Study Area during migration. However the lack of quality flowering habitat and mobile / vagrant nature of this honeyeater, means that it is more likely to seek out favourable habitat elsewhere.	Unlikely to be affected by the Proposal. Due to the mobile nature of this species and lack of breeding habitat, removal of a small area of potential foraging habitat is unlikely to affect this species.
Botaurus poiciloptilus	Australasian Bittern	Animal > Birds	E		Predicted		Unlikely. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (Typha spp.) and spikerushes (Eleocharis spp.).	Will not be affected by the Proposal.
Burhinus grallarius	Bush Stone- curlew	Animal > Birds	E		Known		Unlikely. The lack of woody debris and protective cover precludes this species of bird from occurring.	Will not be affected by the Proposal.
Calyptorhynchus lathami	Glossy Black- Cockatoo	Animal > Birds	V		Known		Potential. Casuarina does occur in the Study Area. However this species prefers <i>Allocasuarina diminuata</i> and <i>gymotheca</i> and as such is likely to feed in areas that contain these species.	Potential feed trees will be impacted. Due to the species mobile nature, removal of a small area of potential foraging habitat is unlikely to affect this species.
Certhionyx variegatus	Pied Honeyeater	Animal > Birds	V		Known		Likely. Inhabits wattle shrub (primarily Mulga, <i>Acacia aneura</i> ), mallee, spinifex and eucalypt woodlands, usually when shrubs are flowering; feeds on nectar, predominantly from various species of emu-bushes (Eremophila spp.); also from mistletoes and various other shrubs (e.g. Grevillea spp.); also eats saltbush fruit, berries, seed, flowers and insects.	Not recorded. Will not be affected by the Proposal. Due to the species mobile nature, removal of a small area of potential foraging habitat is unlikely to affect this species.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Chthonicola sagittata	Speckled Warbler	Animal > Birds	V		Known		Unlikely. The species appears to need a structurally diverse open woodland community with a healthy tussock understorey. This sort of habitat is expected to occur in Box-Gum woodlands. Foraging resources such as seeding grasses and insects is likely to be available. The extent of clearing and lack of suitable habitat in the Study Area precludes this species from occurring.	Not recorded. Will not be affected by the Proposal.
Circus assimilis	Spotted Harrier	Animal > Birds	V		Known		Potential to forage over open habitats including edges of inland wetlands. However trees and habitat suitable for breeding do not occur in the Study Area.	Potential to be affected by the Proposal. Potential foraging habitat suitable for this species may be affected. However given the mobile nature of this species, removal of a small area of potential foraging habitat is unlikely to affect this species.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Animal > Birds	V		Known		Likely. Requires large remnant patch of vegetation and is tree hollow dependant. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (Eucalyptus camaldulensis) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat	Not recorded. Potential breeding and foraging habitat suitable for this species will be impacted.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
							component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Sedentary, considered to be resident in many locations throughout its range; present in all seasons or year- round at many sites; territorial year- round, though some birds may disperse locally after breeding.	
Daphoenositta chrysoptera	Varied Sittella	Animal > Birds	V		Known		Potential. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.	Not recorded. Will not be affected by the Proposal. Due to the mobile nature of this species habitat in the Study Area cannot be considered critical to this species survival.
Ephippiorhynchus asiaticus	Black- necked Stork	Animal > Birds	E		Known		Unlikely. Black-necked Storks are mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sandflats, and mangrove vegetation. NSW, Storks usually nest in a tall, live and isolated paddock tree, but also in other trees, including dead trees and paperbarks, or even lower shrubs within wetlands. The nest is a large platform, 1-2 m in	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
							diameter, made in a live or dead tree, in or near a freshwater swamp.	
Epthianura albifrons	White- fronted Chat	Animal > Birds	V		Known		Unlikely. Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground.	Will not be affected by the Proposal
Falco hypoleucos	Grey Falcon	Animal > Birds	E		Known		Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey. Preys primarily on birds, especially parrots and pigeons, using high-speed chases and stoops; reptiles and mammals are also taken.	Potential foraging habitat suitable for this species may be affected. However given the mobile nature of this species, removal of a small area of potential foraging habitat is unlikely to affect this species.
Glossopsitta pusilla	Little Lorikeet	Animal > Birds	V		Known		Likely Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.	Feeding habitat and potential breeding habitat (hollow bearing trees) will be impacted.
Grantiella picta	Painted Honeyeater	Animal > Birds	V		Known		Likely. The Painted Honeyeater is a specialist feeder, feeding on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema. Insects and nectar from mistletoe or eucalypts are occasionally eaten.	Potential to be affected by the Proposal. Due to the mobile nature of this species habitat in the Study Area cannot be considered critical to this species survival.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Grus rubicunda	Brolga	Animal > Birds	V		Predicted		Unlikely. The lack of marsh habitat, protective cover in and adjacent to the stream precludes this species of bird from occurring. Has potential to occur during periods of flooding when the floodplain is inundated.	Will not be affected by the Proposal. Due to the mobile nature of this species the small area of impact along with the species large range, habitat in the Study Area cannot be considered critical to this species survival.
Hamirostra melanosternon	Black- breasted Buzzard	Animal > Birds	V		Known		Lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands. Not a powerful hunter, despite its size, mostly taking reptiles, small mammals, birds, including nestlings, and carrion. Also specialises in feeding on large eggs, including those of emus, which it cracks on a rock.	Potential breeding/ roosting and foraging habitat suitable for this species will be impacted.
Hieraaetus morphnoides	Little Eagle	Animal > Birds	V		Known		Possible. Feeding resources (including an abundance of rodents associated with the urbanised environment) are likely to occur in the Study Area. However trees and habitat suitable for breeding do not occur in the Study Area.	Potential to be affected by the Proposal. However given the mobile nature of this species, removal of a small area of potential foraging habitat is unlikely to affect this species.
Lathamus discolor	Swift Parrot	Animal > Birds	E	E	Known	Species or Species Habitat may occur in the Study Area.	Likely. Potential foraging habitat such as eucalypt nectar and pollen, as well as sugary lerps is readily available within the Study Area. As the species is known to use a variety of habitats, migrate across large distances between breeding and foraging territories and to follow the flowering patterns of feed trees, it is likely	Unlikely to be affected by the Proposal. Due to the mobile nature of this species and lack of breeding habitat, removal of a small area of potential foraging habitat is unlikely to affect this

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
							that the species would use the habitat resources in the Study Area. Breeding would occur within the area (breeds on the east coast of Tasmania)	species.
Leipoa ocellata	Malleefowl	Animal > Birds	E	V	Known		Unlikely. Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300 - 450 mm mean annual rainfall) areas. Utilises mallee with a spinifex understorey, but usually at lower densities than in areas with a shrub understorey. Less frequently found in other eucalypt woodlands, such as Inland Grey Box, Ironbark or Bimble Box Woodlands with thick understorey, or in other woodlands such dominated by Mulga or native Cypress Pine species. Prefers areas of light sandy to sandy loam soils and habitats with a dense but discontinuous canopy and dense and diverse shrub and herb layers.	Will not be affected by the Proposal.
Limosa limosa	Black-tailed Godwit	Animal > Birds	V	Listed	Predicted		Unlikely. Inland muddy lakes or swamps do not occur in the Study Area. Has potential to occur during periods of flooding when the floodplain is inundated.	Will not be affected by the Proposal.
Lophoictinia isura	Square- tailed Kite	Animal > Birds	V		Known		Potential. Potential to forage over open habitats including edges of inland wetlands. However trees and habitat suitable for breeding do not occur in the Study Area.	Potential to be affected by the Proposal. However given the mobile nature of this species, removal of a small area of potential foraging habitat is unlikely to affect this species.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Melanodryas cucullata cucullata	Hooded Robin (south- eastern form)	Animal > Birds	V		Known		Potential. Woodland and hollow bearing trees occur in the Study Area. However requires large patch size of remnant. The extent of clearing and degraded state of the remnant precludes this species from occurring.	Will not be affected by the Proposal.
Melithreptus gularis gularis	Black- chinned Honeyeater (eastern subspecies)	Animal > Birds	V		Known		Unlikely. Associated woodlands dominated by box and ironbark eucalypts, especially E. sideroxylon, E. albens, E. microcarpa, and E. melliodora do not occur within the Study Area.	Potential to be affected by the Proposal. However given the mobile nature of this species, removal of a small area of potential foraging habitat is unlikely to affect this species.
Neophema pulchella	Turquoise Parrot	Animal > Birds	V		Known		Potential Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Breeding habitat for this species is not present in the Study Area. Forages quietly and may be quite tolerant of disturbance. However, if flushed it will fly to a nearby tree and then return to the ground to browse as soon as the danger has passed. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	Potential foraging habitat suitable for this species will be impacted. However given the mobile nature of this species, removal of a small area of potential foraging habitat is unlikely to affect this species.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Ninox connivens	Barking Owl	Animal > Birds	V		Known		Likely. Potential roosting habitat is available is not present in the Study Area. This species often uses ecotones for hunting, thus the edges of cleared floodplain may form potential foraging habitat. Prey species such as rodents and rabbits are also likely to use the Study Area.	Potential to be affected by the Proposal. Due to the mobile nature of this species habitat in the Study Area cannot be considered critical to this species survival.
Ninox strenua	Powerful Owl	Animal > Birds	V		Known		Likely. The species is known to inhabit a variety of habitats including open woodlands in fragmented areas and has particularly large home ranges. Potential prey species such as birds and rodents are also prevalent in the local area.	Potential to be affected by the Proposal. Due to the mobile nature of this species habitat in the Study Area cannot be considered critical to this species survival.
Oxyura australis	Blue-billed Duck	Animal > Birds	V		Known		Unlikely. The lack of marsh habitat, protective cover in and adjacent to the stream precludes this species of bird from occurring. Has potential to occur during periods of flooding when the floodplain is inundated.	Potential to be affected by the Proposal. Due to the mobile nature of this species habitat in the Study Area cannot be considered critical to this species survival.
Pachycephala olivacea	Olive Whistler	Animal > Birds	V		Known		Unlikely. No habitat present. Associated habitat such as box-ironbark woodlands, cypress pine and river red gum forests.	Potential to be affected by the Proposal. Due to the mobile nature of this species habitat in the Study Area cannot be considered critical to this species survival.
Petroica boodang	Scarlet Robin	Animal > Birds	V		Known		Unlikely. Requires shrubby vegetation of a large patch size.	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Petroica phoenicea	Flame Robin	Animal > Birds	V		Predicted		Unlikely. Requires shrubby vegetation of a large patch size.	Will not be affected by the Proposal.
Polytelis swainsonii	Superb Parrot	Animal > Birds	V	V	Known		Likely. Inhabit Box-Gum, Box-Cypress- pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Breeding habitat for this species does not occur in the Study Area. Nest in small colonies, often with more than one nest in a single tree.	Potential foraging habitat suitable for this species will be impacted. However given the mobile nature of this species, removal of a small area of potential foraging habitat is unlikely to affect this species.
Pomatostomus temporalis temporalis	Grey- crowned Babbler (eastern subspecies)	Animal > Birds	V		Known		Potential. Inhabits open Box-Gum Woodlands on the slopes, and Box- Cypress-pine and open Box Woodlands on alluvial plains.	Will not be affected by the Proposal. However given the mobile nature of this species, removal of a small area of potential foraging habitat is unlikely to affect this species.
Stagonopleura guttata	Diamond Firetail	Animal > Birds	V		Known		Likely. Associated habitats such as box- gum woodland, lightly wooded farmland, riparian vegetation occur within the Study Area. Food resources such as seeding grasses, insects and leaves are also available on site.	Potential to be affected by the Proposal. Due to the mobile nature of this species habitat in the Study Area cannot be considered critical to this species survival.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Stictonetta naevosa	Freckled Duck	Animal > Birds	V		Known		Unlikely. The lack of marsh habitat, protective cover in and adjacent to the stream precludes this species of bird from occurring.	Potential to be affected by the Proposal. Due to the mobile nature of this species habitat in the Study Area cannot be considered critical to this species survival.
Tyto longimembris	Eastern Grass Owl	Animal > Birds	V		Known		Unlikely. Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. They rest by day in a 'form' - a trampled platform in a large tussock or other heavy vegetative growth. If disturbed they burst out of cover, flying low and slowly, before dropping straight down again into cover. Always breeds on the ground. Nests are found in trodden grass, and often accessed by tunnels through vegetation. Breeding season is highly variable and dependent on environmental conditions, but in NSW nesting most typically occurs in autumn or winter. Unlikely to have breeding habitat in the Study Area due to the disturbed nature of the ground and regular mowing regime.	Potential foraging habitat suitable for this species will be impacted. However given the mobile nature of this species, removal of a small area of potential foraging habitat is unlikely to affect this species.
Tyto novaehollandiae	Masked Owl	Animal > Birds	V		Known		Likely. Forest and large hollow bearing trees to support an owl population are present in the Study Area. Likely to have feeding habitat in an area that supports resting or perching opportunities.	Potential to be affected by the Proposal. Due to the mobile nature of this species habitat in the Study Area cannot be considered critical to this species survival.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Apus pacificus	Fork-tailed Swift	Animal > Birds > Migratory > Listed Marine		Listed		Species or species habitat may occur within area	Likely to occur during October to March. Breeding habitat occurs outside of Australia.	Will not be affected by the Proposal.
Ardea alba	Great Egret, White Egret	Animal > Birds > Migratory > Migratory Wetland > Listed Marine		Listed		Species or species habitat may occur within area	Potential to occur.	Will not be affected by the Proposal.
Ardea ibis	Cattle Egret	Animal > Birds > Migratory > Migratory Wetland > Listed Marine		Listed		Species or species habitat may occur within area	Potential to occur.	Will not be affected by the Proposal.
Ardeotis australis	Australian Bustard	Animal > Birds > Migratory Terrestrial	E	V	Known		Unlikely. Mainly inhabits tussock and hummock grasslands, though prefers tussock grasses to hummock grasses; also occurs in low shrublands and low open grassy woodlands; occasionally seen in pastoral and cropping country, golf courses and near dams.	Will not be affected by the Proposal.
Hirundapus caudacutus	White- throated Needletail	Animal > Birds > Migratory Terrestrial		Listed		Species or species habitat may occur within area	Potential, mainly coastal and aerial. White-throated Needletails arrive in Australia from their breeding grounds in the northern hemisphere in about October each year and leave somewhere between May and August.	Will not be affected by the Proposal.
Myiagra cyanoleuc	Satin Flycatcher	Animal > Birds > Migratory Terrestrial		Listed		Species or species habitat may occur within the area.	Unlikely. The Satin Flycatcher is found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Haliaeetus leucogaster	White-bellied Sea-Eagle	Animal > Birds > Migratory Terrestrial > Listed Marine Species		Listed		Species or species habitat likely to occur within area	Unlikely, mainly coastal.	Will not be affected by the Proposal.
Gallinago hardwickii	Lathams Snipe	Animal > Birds > Migratory Wetland Species > Listed Marine Species		Listed		Species or species habitat may to occur within area	Unlikely shallow inland wetland areas associated with the Creek do occur in the Study Area.	Potential to be affected by the proposal.
Merops ornatus	Rainbow Bee-eater	Animal > Birds > Migratory Wetland Species > Listed Marine Species		Listed		Species or species habitat may to occur within area	Potential breeding habitat occurs in the sandy creek (eroded) banks of the creek in the Study Area.	Will not be affected by the Proposal.
Rostratula benghalensis s. lat	Snipe	Animal > Birds > Migratory Wetland Species > Listed Marine Species		V		Species or species habitat may to occur within area	No. Suitable habitat does not exist in the Study Area.	Will not be affected by the Proposal.
Maccullochella peelii peelii	Murray Cod, Cod, Goodoo	Animal > Fish	V FM Act	V		Species or species habitat may to occur within area	Unlikely. The creek is ephemeral at best and relies on stormwater and heavy rains to flow. The lack of water, snags and root systems in the Creek preclude this species from occurring.	Will not be affected by the Proposal.
Bettongia penicillata penicillata	Brush-tailed Bettong (South-East Mainland)	Animal > Marsupials	Extinct	Extinct	Known		Unlikely. The Brush-tailed Bettong (south-east mainland) was associated with grassland, heath and sclerophyll woodland. Other accounts record the subspecies from open eucalypt forest with low woody scrub, tussock grass and occasional bare patches.	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Bridled Nailtail Wallaby		Animal > Marsupials	Extinct	Extinct	Known		Unlikely. The Bridled Nail-tail Wallaby previously occupied Acacia shrubland and grassy woodland in semi-arid regions of eastern Australia.	Will not be affected by the Proposal.
Cercartetus nanus	Eastern Pygmy- possum	Animal > Marsupials	V		Known		No. Suitable habitat of a large patch size does not occur in the Study Area.	Will not be affected by the Proposal.
Dasyurus geoffroii	Western Quoll	Animal > Marsupials	Extinct	V	Known		Unlikely. The Western Quoll previously occupied habitat in a variety of climatic zones across Australia but are now restricted to the south-west of Western Australia. The former range of the Western Quoll suggests that the species utilised a wide variety of habitats including dry sclerophyll forests, beaches and deserts. The Western Quoll currently inhabit most kinds of wooded habitat within its current range including eucalypt forest (especially Jarrah, Eucalyptus marginata), dry woodland and mallee shrublands. In Jarrah forest, populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest. The densest populations of the western quoll have been found in riparian forest. They have never been recorded in pure Karri (Eucalyptus diversicolor) forest.	Will not be affected by the Proposal.
Dasyurus maculatus	Spotted- tailed Quoll	Animal > Marsupials	V	E	Known		Potential. Recorded in proximity to the Study Area. The lack of suitable habitat precludes the Spotted -tailed Quoll from establishing a permanent population in the Study Area.	Potential habitat will be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Eastern Hare- wallaby		Animal > Marsupials	Extinct	Extinct	Known		Unlikely. The Eastern Hare-wallaby preferred habitat that consisted of open plains and grasslands.	Will not be affected by the Proposal.
Lagorchestes leporides	Eastern Hare-wallaby	Animal > Marsupials	Extinct	Extinct	Known		Unlikely. The Eastern Hare-wallaby preferred habitat that consisted of open plains and grasslands.	Will not be affected by the Proposal.
Macropus dorsalis	Black-striped Wallaby	Animal > Marsupials	E		Known		Unlikely. Preferred habitat is characterised by dense woody or shrubby vegetation within three metres of the ground. This dense vegetation must occur near a more open, grassy area to provide suitable feeding habitat. Black- striped Wallaby populations are associated with open forest with thick regrowth brigalow, Acacia harpophylla or other shrub understory woodland, closed forest margins and dense wet sclerophyll forests with a vine understorey (Gilmore & Parnaby 1994; Kirkpatrick 1995).	Will not be affected by the Proposal.
Petaurus australis	Yellow- bellied Glider	Animal > Marsupials	V		Predicted		No. Suitable habitat with a large patch size does not occur in the Study Area.	Will not be affected by the Proposal.
Petaurus norfolcensis	Squirrel Glider	Animal > Marsupials	V		Known		Potential. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Petrogale penicillata	Brush-tailed Rock- wallaby	Animal > Marsupials	E	V	Known	Species or species habitat may occur within area.	No. Suitable rocky escarpments do not occur in the Study Area.	Will not be affected by the Proposal.
Phascogale tapoatafa	Brush-tailed Phascogale	Animal > Marsupials	V		Known		Potential. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter.	Will not be affected by the Proposal.
Phascolarctos cinereus	Koala	Animal > Marsupials	V	V	Known	Species or species habitat known to occur.	Known.	Core koala habitat will be impacted.
	Rufous Bettong	Animal > Marsupials	V		Predicted		Unlikely. Suitable habitat does not occur in the Study Area. Rufous Bettongs inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter. They sleep during the day in cone-shaped nests constructed of grass in a shallow depression at the base of a tussock or fallen log. At night they feed on grasses, herbs, seeds, flowers, roots, tubers, fungi and occasionally insects.	Will not be affected by the Proposal.
Sminthopsis macroura	Stripe-faced Dunnart	Animal > Marsupials	V		Predicted		Unlikely. However more suitable habitat south of the Study Area has connectivity to the Study Area. Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (Themeda australis).	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
	Western Barred Bandicoot (mainland)	Animal > Marsupials	Extinct	Extinct	Known		Unlikely. The Western Barred Bandicoot formerly inhabited a variety of landscapes and vegetation types. These included the saltbush covered Nullarbor Plain, sand ridges with woodlands, bluebush plains, desert Acacia, shrublands and heath.	Will not be affected by the Proposal.
Aprasia parapulchella	Pink-tailed Legless Lizard	Animal > Reptiles	V	V	Known	Species or species habitat may occur within area.	No. Suitable habitat for this species does not occur in the Study Area. Associated with trachite hills and scattered pieces of basalt within grassland.	Will not be affected by the Proposal.
Hoplocephalus bitorquatus	Pale-headed Snake	Animal > Reptiles	V		Known		Unlikely. Suitable habitat for this species does not occur in the Study Area. Found mainly in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest.	Will not be affected by the Proposal.
Underwoodisaurus sphyrurus	Border Thick-tailed Gecko	Animal > Reptiles	V	V	Known		Unlikely. Suitable habitat for this species does not occur in the Study Area. As implied by another of its common names (Granite Thick-tailed Gecko), this species often occurs on steep rocky or scree slopes, especially granite. Recent records from basalt and metasediment slopes and flats indicate its habitat selection is broader than formerly thought and may have extended into areas that were cleared for agriculture Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy that helps create a sparse understorey. These Geckos are active at night and shelter by day under rock slabs, in or under logs, and under the bark of standing trees.	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Conilurus albipes	White-footed Tree-rat	Animal > Rodents	Extinct	Extinct	Known		The White-footed Tree-rat was known to inhabit open forest woodlands and grassy ecosystems in Victoria. Habitat information is not known for other states in which the species occurred. The species was nocturnal had been observed sleeping in the hollow limbs of prostrate trees, or in hollow branches of large Eucalypts near the ground. There is very little information on the life cycle of the White-footed Tree-rat. One report recorded a female with several young in a hollow log, which they had stuffed, to a depth of about 60 cm, with nesting material made of leaves and possibly grass. The mother carried her young attached to her teats.	Will not be affected by the Proposal.
Plains Rat		Animal > Rodents	Extinct	V	Known		Unlikely. Disturbance and regular mowing most likely preclude this species from occurring. The Plains Rat is primarily found in gibber (stone-covered) plains and mid slopes with boulders, small stones and gilgais (water soaks, depressions). In years of very good rainfall, this species occur on adjoining sandy plains. During poor conditions, core refuge areas may occur on low-lying gilgais and watercourses of gibber plains.	Will not be affected by the Proposal.
Pseudomys gouldii	Gould's Mouse	Animal > Rodents	Extinct	Extinct	Known		Unlikely. Disturbance and regular mowing most likely preclude this species from occurring. The species is reported to have preferred sandhills and plains, and to make burrows under bushes in loose soil.	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Rattus villosissimus	Long-haired Rat	Animal > Rodents	V		Known		Unlikely. Disturbance and regular mowing most likely preclude this species from occurring. Eats roots, stems and leaves of grasses and herbs, especially the more succulent species. Seeds, flowers and insects (e.g. locust) which become available in better seasons stimulate reproduction.	Will not be affected by the Proposal.
Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South bioregion"		Community > Threatened Ecological Communities	EEC		Known		Potential. Usually occurs on undulating terrain on a variety of soil types, between 300-450 m altitude.	Will not be affected by the Proposal.
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions		Community > Threatened Ecological Communities	EEC		Predicted		Potential. Community occurs on brown loam or clay, alluvial or colluvial soils on prior streams and abandoned channels or slight depressions on undulating plains or flats of the western slopes.	Will not be affected by the Proposal.
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions		Community > Threatened Ecological Communities	EEC	Е	Known	Community may occur within area	Potential. Inland Grey Box Woodland occurs on fertile soils of the western slopes and plains of NSW. The community generally occurs where average rainfall is 375- 800 mm pa and the mean maximum annual temperature is 22- 26°C. There is a correlation between the distribution of Eucalyptus microcarpa communities and soils of Tertiary and Quaternary alluvial origin, largely corresponding with the Red Brown Earths.	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions		Community > Threatened Ecological Communities	EEC	E	Known	Community may occur within area	Potential. The Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions is known or predicted to occur in the Liverpool Plains (Part B) sub-region of the Namoi Catchment Management Region.	Will not be affected by the Proposal.
Native Vegetation on Cracking Clay Soils of the Liverpool Plains	South- eastern Australia Natural grasslands on basalt and fine- textured alluvial plains of northern New South Wales and southern Queensland	Community > Threatened Ecological Communities	EEC	CE	Known	Community likely to occur within area	Potential. Occurs on the highly fertile cracking clay soils of the Liverpool Plains. Native Vegetation on Cracking Clay Soils of the Liverpool Plains is mainly a native grassland community which includes a range of small forb and herb species. The main grass species include Plains Grass (Austrostipa aristiglumis), Queensland Bluegrass (Dichanthium sericeum) and Coolibah Grass (Panicum queenslandicum). It also contains scattered and patchy shrubs and trees, including Boree (Acacia pendula), Rough-barked Apple (Angophora floribunda), Fuzzy Box (Eucalyptus conica), Bimble Box (E. populnea) and Yellow Box (E. melliodora). In wetter locations rushes and sedges are common.	Will not be affected by the Proposal.
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions		Community > Threatened Ecological Communities	EEC		Known		Unlikely. This community often occurs on rocky hills, in deep, loam, high nutrient soils derived from basalt or other volcanic rocks, in areas which are sheltered from frequent fire.	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
White Box Yellow Box Blakely's Red Gum Woodland		Community > Threatened Ecological Communities	EEC	CE	Known	Community likely to occur within the area.	Box – Gum Grassy Woodlands and Derived Grasslands are characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance, of White Box, Yellow Box or Blakely's Red Gum trees. Known to be distributed widely within the Gunnedah LGA	Will not be affected by the Proposal.
Tylophora linearis	Tylophora linearis	Plant > Epiphytes and Climbers	V	E	Known		Unlikely. Disturbance, clearing and mixing most likely precludes this species from occurring. Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla and Allocasuarina luehmannii.	Will not be affected by the Proposal.
Bothriochloa biloba	Lobed Bluegrass	Plant > Grass		V			Potential as species has been recorded nearby. Disturbance, clearing and mixing most likely precludes this species from occurring. Lobed Blue-grass grows in cleared eucalypt forests and relict grassland, often dominated by Purple Wiregrass (Aristida ramosa), Red-leg Grass (Bothriochloa macra), Red Grass (B. decipiens), Queensland Bluegrass (Dichanthium sericeum) or Austrostipa aristiglumis	Will not be affected by the Proposal.
Digitaria porrecta	Finger Panic Grass	Plant > Grass	E	E		Species or species habitat likely to occur within area	Unlikely. Ground surface disturbance precludes this species from occurring. In NSW, the most frequently recorded associated tree species are Eucalyptus albens and Acacia pendula. Common associated grasses and forbs in NSW sites include Austrostipa aristiglumis, Enteropogon acicularis, Cyperus bifax, Hibiscus trionum and Neptunia gracilis.	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
							Flowering season is summer or late summer from mid-January to late February, with seeds maturing and falling from the plant soon after.	
Cyperus conicus	Cyperus conicus	Plant > Herbs and Forbs	E		Predicted		Unlikely. Unsuitable habitat. Disturbance, clearing and mixing most likely precludes this species from occurring. Grows in open woodland on sandy soil. In central Australia, the species grows near waterholes and on the banks of streams in sandy soils. In Qld the species usually found on heavy soils.	Will not be affected by the Proposal.
Dichanthium setosum	Bluegrass	Plant > Herbs and Forbs	V	V	Known		Unlikely. Disturbance, clearing and mixing most likely precludes this species from occurring. Lobed Blue-grass grows in cleared eucalypt forests and relict grassland, often dominated by Purple Wiregrass (Aristida ramosa), Red-leg Grass (Bothriochloa macra), Red Grass (B. decipiens), Queensland Bluegrass (Dichanthium sericeum) or Austrostipa aristiglumis	Will not be affected by the Proposal.
Digitaria porrecta	Finger Panic Grass	Plant > Herbs and Forbs	E	E	Known		Unlikely. Disturbance, clearing and mixing most likely precludes this species from occurring. In NSW, the most frequently recorded associated tree species are Eucalyptus albens and Acacia pendula. Common associated grasses and forbs in NSW sites include Austrostipa aristiglumis, Enteropogon acicularis, Cyperus bifax, Hibiscus trionum and Neptunia gracilis.	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Homopholis belsonii	Belson's Panic	Plant > Herbs and Forbs	E	V	Known		Unlikely. Disturbance, clearing and mixing most likely precludes this species from occurring. Grows in dry woodland (e.g. Belah) often on poor soils, although sometimes found in basalt-enriched sites north of Warialda and in alluvial clay soils. It occurs on the northwest slopes and plains of NSW, north of Warialda between Wee Waa, Goondiwindi and Glen Innes. It also occurs in Queensland, mainly in the Brigalow Belt South bioregion.	Will not be affected by the Proposal.
Lepidium aschersonii	Spiny Peppercress	Plant > Herbs and Forbs	V	V	Known		Found on ridges of gilgai clays dominated by Brigalow (Acacia harpophylla), Belah (Casuarina cristata), Bulloke (Allocasuarina luehmannii) and Grey Box (Eucalyptus microcarpa). Often the understorey is dominated by introduced plants. The species grows as a component of the ground flora, in grey loamy clays. Vegetation structure varies from open to dense, with sparse grassy understorey and occasional heavy litter.	Will not be affected by the Proposal.
Swainsona murrayana	Slender Darling Pea	Plant > Herbs and Forbs	V	V	Known		The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with Maireana species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated. Plants produce winter-spring growth, flower in spring to early summer and then die back after flowering. They re-shoot	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
							readily and often carpet the landscape after good cool-season rains. The species may require some disturbance and has been known to occur in paddocks that have been moderately grazed or occasionally cultivated.	
Thesium australe	Austral Toadflax	Plant > Herbs and Forbs	V	V	Known		Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (Themeda australis). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	Will not be affected by the Proposal.
Prasophyllum sp. Wybong (C.Phelps ORG 5269)	A leek-orchid	Plant > Orchid		CE		Species or species habitat likely to occur within area	Unlikely. Ground surface disturbance precludes this species from occurring. Endemic to NSW, it is known from near llford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. Most populations are small, although the Wybong population contains by far the largest number of individuals.	Will not be affected by the Proposal.
Pterostylis cobarensis	Cobar Greenhood Orchid	Plant > Orchid	V	V		Species or species habitat likely to occur within area	Unlikely. Ground surface disturbance precludes this species from occurring. Habitats are eucalypt woodlands, open mallee or Callitris shrublands on low stony ridges and slopes in skeletal sandy-loam soils. Associated species include Eucalyptus morrisii, E. viridis, E. intertexta, E. vicina, Callitris glaucophylla, Geijera parviflora, Casuarina cristata, Acacia doratoxylon, Senna spp. and Eremophila spp. Flowers from September to November.	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
Philotheca ericifolia		Plant > Shrubs		V		Species or species habitat likely to occur within area	This species is known to occur chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies (Weston & Harden, 1991). It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. It is a moisture-loving plant (DEC, 2005b). The distribution of this species overlaps with the following EPBC Act-listed threatened ecological communities: • Brigalow (Acacia harpophylla dominant and co-dominant), and • White Box–Yellow Box–Blakely's Red Gum Grassy Woodland and Derived Native Grassland.	Will not be affected by the Proposal.
Pomaderris queenslandica	Scant Pomaderris	Plant > Shrubs	E		Known		Unlikely. Disturbance, clearing and mixing most likely precludes this species from occurring. Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks. Widely scattered but not common in north-east NSW and in Queensland. It is known from several locations on the NSW north coast and a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolata.	Will not be affected by the Proposal.
Cadellia pentastylis	Ooline	Plant > Trees	V	V	Known		Unlikely. Suitable habitat for this species does not occur in the Study Area. Appears to flower spasmodically, during a general flowering period of October to January. Dispersal of fruit and seed is probably by "passive fall" or by birds. Seeds showed a high rate of infertility at all sites, although they have been successfully germinated and established after heat application. Forms a closed or	Will not be affected by the Proposal.

Scientific name	Common name	Type of species	NSW status	National Status	NSW Occurrence (TSC Act)	National Occurrence (DSEWPaC Search)	Likelihood.	Impact
							open canopy mixing with eucalypt and cypress pine species. There appears to be a strong correlation between the presence of Ooline and low- to medium-nutrient soils of sandy clay or clayey consistencies, with a typical soil profile having a sandy loam surface layer, grading from a light clay to a medium clay with depth. as the capacity to resprout from rootstock and coppice vigorously from stumps, a feature which may be critical for the species survival in a fire-prone environment. Populations display a variety of age classes including large mature trees, suckering regrowth and seedlings. The total area occupied by Ooline is only about 1200 hectares, with remaining populations in NSW still threatened to various degrees by clearing for agriculture and grazing pressures.	

# 5.2 GENERAL ASSESSMENT METHODOLOGY

The assessment was undertaken following the general auspices of the OEH<sup>1</sup> *Biodiversity Survey Guidelines Working Draft* (DEC 2004), *Threatened Species Assessment Guidelines: The Part 5A of the EP&A Act 7-part Assessment of Significance* (DECC 2007) *and OEH Field Survey Methods* (DECCW 2009). Notable constraints have been included in Section 5.5 of this report. To predict the likely effect of the Proposal on species generally detected through this type of survey effort, the precautionary principle has been applied.

The OEH Biodiversity Survey Guidelines (DEC 2004: 30–34) state '*It is advised that where adequate surveys have not been conducted within the Study Area due to time limitations* (you can also infer season timing etc.), *the precautionary principle should always be adopted. This involves assuming that threatened biodiversity which are likely to occur in the Study Area (based upon the presence of suitable habitat and recent records) inhabit the whole of the Study Area. The Assessment of Significance (7-part tests) would then be conducted on this basis'.* 

# 5.3 FLORA SURVEY METHODOLOGY

Survey of the Study Area was conducted according to the Random Meander Method described by Cropper (1993: 30) following the proposed alignment. Detailed botanical survey for native plants was carried out and the observed species composition within the community was aligned to OEH *Plant Community Types* (PCT) list. Plant identification was made according to recent nomenclature in Harden 1990–2002, Cunningham *et al.* 1992, Royal Botanic Gardens (RBG 2011), and PlantNet NSW Flora Online (RBG 2011a). The national conservation significance of flora was determined by referencing *Rare or Threatened Australian Plants* (ROTAP) (Briggs and Leigh 2006) and the Schedules associated with the TSC Act or the EPBC Act.

Special consideration was given to locating rare or threatened plants identified in the NSW Wildlife Atlas database (OEH 2012a) or those being predicted to occur by OEH (OEH 2012b) or DSEWPaC (DSEWPaC 2012) for the Study Area (**Appendix I**).

Where areas had a combination of key habitat elements which were more likely to provide an environment in which a threatened plant would be recorded, it was given closer inspection.

Community composition, health, age status, habitat value for fauna and flora species, overall conservation significance and structural or habitat importance of the vegetation

<sup>1</sup> The departments formally known as the NSW DEC, DECC and DECCW are now a division in the Department of Premier and Cabinet (DPC) known as The Office of Environment and Heritage (OEH).

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present was examined. The extent/distribution of the vegetation communities was mapped in the field.

## 5.3.1 Habitat Values

Habitat values were allocated to individual tress and or groups of trees as required. Not all could be inspected at close range (due to access issues) and where this occurred, binoculars were employed. The majority of trees were inspected at close range.

Trees were assigned a constraint class relating to the type of management required for its removal:

- Low Habitat Value (LHV). A tree with a 'frequent' key habitat element that one and very rarely more of the regions threatened species could use, i.e. in the Gunnedah LGA it would be a tree with no hollows suitable for tree roosting microbats and / or substantive volumes of decorating bark. This category also includes trees with negligible habitat value, i.e. a tree that is unlikely to provide key habitat elements for roosting or breeding for any of the regions threatened species.
- <u>Moderate Habitat Value</u> (MHV). An older tree with an 'infrequent' key habitat element that one and possibly (but less likely) more of the region's threatened species could use, i.e. Gunnedah LGA it would be a tree with good quality small hollows / fissures for microbats, a moderate sized hollow(s) for parrots / gliders but too small to be suitable for a large forest owl breeding. With time, a tree with MHV would become a HHV tree.
- High Habitat Value (HHV). An old growth tree with a 'rare' key habitat element that one or more of the regions threatened species could use, i.e. in the Gunnedah LGA a tree with a large hollow suited for a large forest owl, western quoll or is known breeding habitat for a threatened species. It may also be a tree or a shrub with a nest of a non-hollow dependant threatened species (i.e. Hooded Robin, Greycrowned Babbler). This type of tree has the most difficult key habitat elements to naturally replace and may also have moderate and small hollows and / or decorating bark for other of the regions threatened species. In essence it is a tree that proves a range of hollows and or habitat types for the largest number of threatened species in that region.

Individual variances in the habitat value of the tree are used when determining the habitat value and subsequent constraint class. Values noted above are subjective and do not take into account SEPP 44 trees, the tree being a component of and Endangered Ecological Community (EEC) or habitat for commonly occurring species. The above criteria were

developed purely to address impacts to those species listed in the OEH and DSEWPaC database search results.

# 5.4 FAUNA SURVEY METHODOLOGY

The survey methods employed during the field investigations were generally based on the descriptions provided in the following publications and any relevant recovery plans and threat abatement plans for ecological assessment. To this end these documents have formed the core basis for ecological assessment over the Study Area:

- OEH Threatened species survey and assessment: Guidelines for developments and activities. Working Draft, November DEC 2004;
- OEH Field Survey Methods, DECCW 2009;
- Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2010a);
- Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the EPBC Act (DEWHA 2010b);
- Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals as threatened under the EPBC Act. (DEWHA 2010c);
- Survey guidelines for Australia's threatened frogs Guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999 (DEWHA 2010).

Fauna surveys included general habitat searches and targeted surveys for threatened species. Tailored searches for species identified as likely to occur (based upon the habitat present) but not previously recorded were undertaken.

Identification of the species present, and their diversity, can indicate the type of habitat that is present within the Study Area. Further, an assessment of the habitat present within the Study Area will also dictate which identified threatened species, although they remained unobserved during the current survey, may utilise it (the basis of the precautionary principle). The likely impacts of development can be addressed through this process.

Fauna identification was achieved via:

- Identification of scats, diggings, tracks and other traces;
- Direct observation: i.e. bird watching;
- Ground, leaf litter and other refuge searches;

- Call identification; and
- Searches for indirect evidence of mammals (vocalisation, tracks, scats, burrows etc.).
- Echolocation;
- Call playback;
- Koala Spot Assessment Technique (SAT)

These methods are described in further detail in the following subsections where required.

#### 5.4.1 Echolocation

An Anabat SDITM echolocation detector was used to identify the possible presence of any microchiropterans that may be present. The echolocation sites selected were those that corresponded to the habitats likely to be used by microchiropterans during their foraging and dispersal periods (i.e. woodlands and habitat ecotones) or as roosting sites (i.e. hollow-bearing trees where present).

The detector was set prior to dusk and left in place for the entire duration of the evening.

Calls were analysed by Lesryk Environmental Pty Ltd consultants using Anabat 6.3 computer software. The echolocation device was set up near chainage 633.00.

#### 5.4.2 Call Playback

Nocturnal birds were surveyed through call playback and spotlighting. Call playback followed the methods described by Kavanagh and Peake (1993) and Debus (1995). This method requires an initial listening period of 10 to 15 minutes after playing the respective call, followed by a spotlight search for ten minutes to detect any animals in the immediate vicinity, followed by intermittently playing the call for another five minutes and a ten minute listening period. A general search of the immediate environs was then undertaken to see if any non-vocalising birds were present.

Nocturnal birds and marsupials were surveyed through call playback and spotlighting. Use of the playback of pre-recorded CDs (Nature Sound) for the detection of the following threatened species:

- Koala (*Phascolarctos cinereus*, TSC Act, EPBC Act)
- Powerful Owl (*Ninox strenua*, TSC Act)
- Masked Owl (Tyto novaehollandiae, TSC Act)
- Barking Owl (*Ninox connivens*, TSC Act)
- Eastern Grass Owl (*Tyto longimembris*, TSC Act).

The playback sessions involved broadcasting characteristic calls through a loud hailer that was connected to an iPod<sup>TM</sup>. Prior to conducting the call playbacks, a ten minute listening period was undertaken to determine if any of these species were present. The calls were then broadcast for five minutes per species. The sequence of the calls broadcast was as noted above, a short listening period occurring between the Koala and owl calls. To detect any responses to the call playbacks, a ten minute listening period was undertaken at the completion of the playback session.

To minimise stressing and disturbing the species targeted, if an animal responded to the call playbacks, calls of this species were not broadcast during subsequent playback sessions (unless those playbacks were proposed to be conducted beyond the limits of the documented habitat range of the target species). In some instances, calls of non-threatened species were broadcast (such as the Owlet Nightjar and Sugar Glider). The purpose of this was to determine the suitability of habitat for associated threatened species.

Call playback was undertaken at chainage 633.00 and at McCalls Road south of the Study Area.

## 5.4.3 Koala Spot Assessment Technique (SAT)

The Spot Assessment Technique (SAT) was used to determine the presence/absence of faecal pellets within a prescribed search area around the base of known koala feed trees. In the case of multi-stemmed trees, at least one of the live stems must have a diameter at breast height (dbh) of 100 mm or greater. Each tree was searched for up to two minutes or until a faecal pellet was detected. Disturbance of the leaf litter and ground cover was involved if faecal pellets were not immediately obvious. A result of absent was recorded if no pellets were detected within two minutes. SAT is based around a technique from the Australian Koala Foundation (Phillips & Callaghan, 1995).

# 5.5 SURVEY EFFORT

The Study Area was assessed entirely on foot. All trees, native planted or non-native were assessed for evidence of Koala use. Fallen logs and ground debris were inspected for arboreal fauna and reptiles.

## 5.6 SURVEY CONSTRAINTS

Not all animals and plants can be fully accounted for within any given Study Area. The presence of threatened species is not static. It changes over time, often in response to longer term natural forces that can, at any time, be dramatically influenced by man-made disturbance.

Slashing of grass in the Study Area occurred during the assessment on both days. This made it difficult to identify some species of grass with no flowering material. Likewise the lack of grassy understorey limited areas of potential refuge for small species of bird and reptiles. Species sensitive to noise (from the slasher) may also have avoided the Study Area, however the impact of this is reduced as most species in the Study Area would be acclimatised to road noise.

Owls are unlikely to hunt during windy weather and instead will starve and shelter for the night. Thus, it is possible that call playback was not successful due to the windy conditions.

This report is based upon data acquired from recent and current surveys, however, it should be recognised that the data gathered is indicative of the environmental conditions of the site at the time the report was prepared.

In order to overcome some of these limitations, database searches were conducted for threatened species, populations and ecological communities known to occur within the region as well as consultation with landowners. As such, the 'precautionary approach' for species occurrence has been adopted where required.
## 6. **RESULTS**

### 6.1 DESKTOP AND BACKGROUND DATABASE SEARCH RESULTS

### 6.1.1 Preliminary Database Search Results

**Table 3** presents a summary of databases searches indicated for TSC and EPBC listed species, ecological communities and populations. Copies of the OEH threatened species database search (TSC Act), DPI records viewer (FM Act) and DSEWPaC Protected Matters (EPBC Act) threatened species database searches have been provided as **Appendix 1**.

**Table 4** provide lists of threatened flora, fauna and ecological communities identified through the background searches and annotated with the potential to be recorded in the Study Area. A map displaying threatened Flora and Fauna records for the Study Area can be seen in **Figure 4** on the following page.

Name of database searched	Date of search	Type of search	Comment
DSEWPaC Register of Critical Habitat <u>http://www.environment.gov.au/</u> <u>cgi-</u> <u>bin/sprat/public/publicregisterofc</u> <u>riticalhabitat.pl</u>	24.10.12	National search: Register of Critical Habitat	Critical Habitat as classified by DSEWPaC does not occur in the Study Area.
Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) Protected Matters (EPBC Act) Database; <u>http://www.environment.gov.au/</u> <u>erin/ert/epbc/index.html</u>	5.11.12	A polygon search of Wabodah Reserve with a 1 km buffer.	Listed Threatened Ecological Communities:5 Listed Migratory Species:13 Listed Threatened Species:20 Listed Marine Species: 10 Commonwealth Land:1 Place on the RNE:2 Invasive Species:10
Office of Environment and Heritage (OEH) Threatened Species online database: <u>http://www.environment.nsw.go</u> <u>v.au/threatenedspecies/</u>	24.10.12	Namoi CMA (Liverpool Plains Part B)	51 species of threatened fauna 7 Endangered Ecological Communities 10 species of threatened flora 33 Key threatening processes
NSW Wildlife Atlas 2012. Data License agreement	25.10.12	Search criteria : Public Report of all Valid Records of Threatened (listed on TSC Act 1995) ,Commonwealth listed ,CAMBA listed ,JAMBA listed or ROKAMBA listed Entities in GUNNEDAH LGA	Search returned a total of 1,089 records of 147 species. The Koala, Blue-lobed Grass and the Spotted-tailed Quoll have been recorded within a 1 km radius of the Study Area. Due to the number of koala records it is likely that the Study Area will be core koala habitat.

#### Table 3: Desktop Database Search Results

Department of Primary Industries Noxious Weeds Database <u>http://www.dpi.nsw.gov.au/agric</u> <u>ulture/pests-</u> <u>weeds/weeds/noxweed</u>	24.10.12	Gunnedah LGA	
NSW Legislation website: SEPP 44: Koala Habitat Protection <u>http://www.legislation.nsw.gov.a</u> <u>u/fragview/inforce/epi%2B5%2B</u> <u>1995%2Bcd%2B0%2BN</u> ?	24.10.12	Schedule 1: LGAs listed and Schedule 2: Feed Trees listed	SEPP 44 applies. Gunnedah LGA is listed within Schedule 1 of this SEPP. Listed feed trees are known to occur in the Study Area.
Office of Environment and Heritage (OEH) Key Threatening Processes. <u>http://www.environment.nsw.go</u> <u>v.au/threatenedspecies/aboutK</u> <u>TPSinNSW.htm</u>	24.10.12	NSW Key Threatening processes website search	There are currently 36 key threatening processes listed under the Threatened Species Conservation Act 1995. Those relevant to the project proposal have been listed in this report along with appropriate management suggestions where required.
Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) Key Threatened Processes <u>http://www.environment.gov.au/</u> <u>biodiversity/threatened/ktp.html</u>	24.10.12	EPBC Key Threatening processes website search	There are currently 19 key threatening processes listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Those relevant to the project proposal have been listed in this report along with appropriate management suggestions where required.
Bird Life Australia (Important Bird Areas) <u>http://www.birdlife.org/datazone/</u> <u>site/search</u>	11.11.12	Map search of IBA regions for Australia	No IBAs occur in or are nearby to the Study Area.
Atlas of Living Australia http://biocache.ala.org.au/explor e/your-area#- 33.11077814509428 148.41198 754282232 12 Amphibians	24.10.12	Centred on the Study Area with a 1 km radius	Two threatened species are listed as occurring: Bothriochloa biloba: Lobed Bluegrass 1 Phascolarctos cinereus : Koala 40



Figure 4: Bionet/Wildlife Atlas Recorded Flora & Fauna, Namoi CMA Liverpool Plains (Part B) subregion (Base map source: © Google Earth).

### 6.1.2 Previous Ecological Assessments

Many ecological assessments have occurred recently across the Liverpool Plains and Gunnedah Basin area, mainly due to mining and coal-seam gas exploration.

Although these ecological assessments took place within the region; the areas assessed, the temporal difference, and the relevance of the proposals were unrelated sufficiently that all data and values contained within this report were assessed anew.

### 6.1.3 Available Vegetation Mapping / Descriptions

Vegetation descriptions and general mapping within the BBSB has been undertaken by Morgan and Terrey (1992), Thackaway & Cresswell (1995), Beckers and Binns (2000), Environment Australia (2000), NSW NPWS (2000). Keith (2004), OEH (DEC NSW 2006, 2006a), Benson *et al.* (2006) and Benson (2008). Regionally, a vegetation map for the Namoi CMA has been produced (ELA 2009a). This mapping product is underpinned by a Regional Vegetation Community (RVC) classification which is linked to the vegetation type classification in the Biometric Vegetation Types Database. RVC's within the Study Area are shown in **Figure 5**.

Most recently the vegetation in proximity to the Study Area has been remapped to align with the Biometric Vegetation types preferred by the OEH (ELA 2010b), which correlate with threatened ecological communities listed under the EPBC and TSC Acts. Biometric Vegetation Types are also the base units used in the Biobanking Tool, which has been used to guide offset requirements for impacts to native vegetation at the Study Area.



Figure 5: Regional Vegetation Communities (RVC) mapped in the Study Area

## 6.2 SURVEY RESULTS

### 6.2.1 General Description / Vegetation Communities

The northern portion of the Study Area near the Oxley Highway is characterised by cleared exotic grassland within a slightly concave overflow channel that forms part of Blackjack Creek (**Plate 1**).



Plate 1: View from northern most post of the Study Area from the Oxley Highway. Photo showing recently mowed grass within an overflow channel that forms part of Blackjack Creek.

Isolated large hollow bearing trees are common (**Plate 2**). Where present, Poplar Box (*Eucalyptus populnea subs. populnea*) is the main remnant eucalypt. Other occasional native trees include Yellow Box (*Eucalyptus melliodora*) and Blakely's Red Gum (*E. blakelyi*) close to Blackjack Creek with scattered River Oak (*Casuarina cunninghamia*). Exotics including Pepper Trees and White Cedar are also common (**Plate 3**). The Study Area is strewn with planted trees mainly from the *Myrtaceae* and *Fabaceae* family with medium height acacias and melaleucas across the site. Understory vegetation in the Study Area where present is predominately exotic. The Study Area has been extensively modified (vegetation clearing, levee construction), disturbed (weed encroachment, rubbish dumping, garden clipping disposal) and cleared for cropped paddocks (to the south).

The southern portion of the Study Area consisted of wheat paddocks with the odd Pepper Tree and White Cypress Pine (**Plate 4**).

Remnant vegetation in the Study Area is consistent with Biometric vegetation ID NA185 '*Poplar* Box grassy woodland on alluvial heavy clay soils in the Brigalow Belt South Bioregion (Benson 101)' and is in a degraded state. This is consistent with the RVC 80 '*Poplar Box grassy* 

woodland on alluvial clay soils, Brigalow Belt South and Nandewar'. A complete species list for the Study Area can be found in **Table 4**.



Plate 2: Typical view of isolated Poplar Box with hollows in the Study Area.



Plate 3: Built up levee adjacent to Blackjack Creek. Showing scattered Pepper Trees, White Cedar, Yellow Box and Poplar Box.



Plate 4: Oat and Wheat paddocks dominate the southern half of the Study Area.

#### 6.2.2 Ecological Communities

No ecological communities listed under the TSC Act, FM Act or EPBC Act were identified in the Study Area. Areas of White Box grassy woodland outside the Study Area are likely to form part of the State listed White Box – Yellow Box – Blackley's Red Gum Endangered Ecological Community.



Figure 6: Location of threatened flora and fauna recorded during the assessment.

### 6.2.3 Flora Species Recorded

In total 111 species of vascular flora from 37 families were recorded in the Study Area during the field survey (**Table 4**). Of these 60 species are non-native (54 %) including six species of listed Noxious Weed of which one species is a Weed of National Significance.

Family	Common Name	Scientific Name	Presence	Status
Aizoaceae	New Zealand Spinach	Tetragonia tetragonioides	х	*
Alliaceae	Fragrant False Garlic	Nothoscordum inodorum	Х	*
Anacardiaceae	Pepper Tree	Schinus areira	х	*
Apiaceae	Bishop's Weed	Ammi majus	х	*
Apiaceae	Fennel	Foeniculum vulgare	х	*
Asteraceae	Capeweed	Arctotheca calendula	х	*
Asteraceae	Cobbler's Pegs	Bidens pilosa	х	*
Asteraceae	Yellow Burr-daisy	Calotis lappulacea	х	
Asteraceae	Cough Bush	Cassinia quinquefaria	х	
Asteraceae	Chicory	Cichorium intybus	х	*
Asteraceae	Spear Thistle	Cirsium vulgare	х	*
Asteraceae	Flaxleaf Fleabane	Conyza bonariensis	Х	*
Asteraceae	Tall fleabane	Conyza sumatrensis	х	*
Asteraceae	Cretan Weed	Hedypnois rhagadioloides	х	*
Asteraceae	Catsear	Hypochaeris radicata	х	*
Asteraceae	Prickly Lettuce	Lactuca serriola	х	*
Asteraceae	Cotton Fireweed	Senecio quadridentatus	Х	
Asteraceae	Prickly Sowthistle	Sonchus asper subsp. asper	х	*
Asteraceae	Common Sowthistle	Sonchus oleraceus	Х	*
Asteraceae	Dandelion	Taraxacum officinale	х	*
Asteraceae	Common Sunray	Triptilodiscus pygmaeus	Х	
Asteraceae	A Fuzzweed	Vittadinia cervicularis var. cervicularis	x	
Asteraceae	A Fuzzweed	Vittadinia cuneata var. cuneata	Х	
Asteraceae	Golden Everlasting	Xerochrysum bracteatum	Х	
Boraginaceae	Patterson's Curse	Echium plantagineum	Х	<b>‡</b> *
Boraginaceae	Viper's Bugloss	Echium vulgare	Х	<b>‡</b> *
Boraginaceae	Blue Heliotrope	Heliotropium amplexicaule	Х	<b>‡</b> *
Brassicaceae	Common Peppercress	Lepidium africanum	Х	*
Brassicaceae	Turnip Weed	Rapistrum rugosum	Х	*
Brassicaceae	Charlock	Sinapis arvensis	Х	*
Brassicaceae	Indian Hedge Mustard	Sisymbrium orientale	Х	*
Cactaceae	Common Prickly Pear	Opuntia stricta var. stricta	Х	*
Campanulaceae	Tufted Bluebell	Wahlenbergia communis	Х	*
Caryophyllaceae	Mouse-ear Chickweed	Cerastium glomeratum	Х	*
Caryophyllaceae	Proliferous Pink	Petrorhagia nanteuilii	Х	*
Caryophyllaceae	Common Chickweed	Stellaria media	Х	*
Casuarinaceae	River Oak	Casuarina cunninghamiana	P/ X	

subsp. cunninghamiana         Chenopodiaceae      Old Man Salt Bush      Atriplex nummularia      X         Chenopodiaceae      Climbing Saltbush      Einadia nutans subsp. nutans      X         Convolvulaceae      A Bindweed      Convolvulars spp.      X         Convolvulaceae      Kidney Weed      Dichondra repens      X         Convolvulaceae      White Cypress Prine      Callitris glaucophylla      X         Fabaceae (Faboideae)      Burr Medic      Medicago polymorpha      X         Fabaceae (Faboideae)      Harestoct Clover      Trifolium arvense      X         Fabaceae (Faboideae)      Harestoct Clover      Trifolium arvense      X         Fabaceae (Faboideae)      Hop Clover      Trifolium arvense      X         Fabaceae (Immosoideae)      Cooba      Acacia salicina      P/ X         Fabaceae (Mimosoideae)      Ocoba      Acacia salicina      P/ X         Fabaceae (Mimosoideae)      River Cooba      Acacia salicina      P/ X         Fabaceae (Mimosoideae) <t< th=""><th>Family</th><th>Common Name</th><th>Scientific Name</th><th>Presence</th><th>Status</th></t<>	Family	Common Name	Scientific Name	Presence	Status
Chenopodiaceae      Old Man Salt Bush      Atriplex nummularia      X      ·        Chenopodiaceae      Climbing Sattbush      Einadia nutans subsp. nutans      X      ·        Convolvulaceae      A Bindweed      Convolvulus spp.      X      ·        Convolvulaceae      Kidney Weed      Dichondra repers      X      ·        Cupressaceae      White Cypress Pine      Callitris glaucophylla      X      ·        Fabaceae (Faboideae)      Burr Medic      Medicago polymorpha      X      ·        Fabaceae (Faboideae)      Haresfoot Clover      Trifolum repens      X      ·        Fabaceae (Faboideae)      White Clover      Trifolum repens      X      ·        Fabaceae (faboideae)      Watte Clover      Trifolum repens      X      ·        Fabaceae (Mimosoideae)      Cooba      Acacia saligna      P/ X      Fabaceae (Mimosoideae)      Veia Watte      Acacia saligna      P/ X      Fabaceae (Mimosoideae)      River Cooba      Acacia saligna      P/ X      Fabaceae (Mimosoideae)      River Cooba      Acacia saligna      P/ X      Fabaceae (Mimosoideae)      River Cooba      Acacia salifore invitinum			subsp. cunninghamiana		
Chenopodiaceae      Climbing Saltbush      Einadia nutans subsp. nutans      X      •        Convolvulaceae      A Bindweed      Convolvulus spp.      X      •        Convolvulaceae      Kidney Weed      Dichondra repens      X      •        Convolvulaceae      Kidney Weed      Dichondra repens      X      •        Fabaceae (Faboideae)      Emu-toot      Cullen tenax      X      •        Fabaceae (Faboideae)      Haresfoot Clover      Trifolium avense      X      •        Fabaceae (Faboideae)      Hop Clover      Trifolium campestre      X      •        Fabaceae (Faboideae)      White Clover      Trifolium repens      X      •        Fabaceae (fimosoideae)      Green Watte      Acacia salicina      P/X      •        Fabaceae (Mimosoideae)      Cooba      Acacia saligna      P/X      •        Fabaceae (Mimosoideae)      River Cooba      Acacia saliona      X      •        Fabaceae (Mimosoideae)      River Cooba      Acacia saliona      X      •        Geraniaceae      Common Growdot      Erodium cicutarium      X      •	Chenopodiaceae	Old Man Salt Bush	Atriplex nummularia	Х	*
Convolvulaceae      A Bindweed      Convolvulus spp.      X      *        Convolvulaceae      Kidney Weed      Dichondra repens      X         Cupressaceae      White Cypress Pine      Callitris glaucophylla      X         Fabaceae (Faboideae)      Burr Medic      Medicago polymorpha      X      *        Fabaceae (Faboideae)      Harestout Clover      Tritolium avense      X      *        Fabaceae (Faboideae)      Harestout Clover      Tritolium repens      X      *        Fabaceae (Faboideae)      White Clover      Tritolium repens      X      *        Fabaceae (Faboideae)      Russian vetch      Vicia villosa subs. glaucescens      X      *        Fabaceae (Mimosoideae)      Gooba      Acacia saligna      P/ X      Fabaceae (Mimosoideae)      Acacia saligna      P/ X        Fabaceae (Mimosoideae)      River Cooba      Acacia sp.      X      *        Fabaceae (Mimosoideae)      River Cooba      Acacia sp.      X      *        Gearaniaceae      Common Crowtoot      Erodium crinium      X      *        Gearaniaceae      Common Crowtoot <td>Chenopodiaceae</td> <td>Climbing Saltbush</td> <td>Einadia nutans subsp. nutans</td> <td>Х</td> <td>*</td>	Chenopodiaceae	Climbing Saltbush	Einadia nutans subsp. nutans	Х	*
Convolvulaceae      Kidney Weed      Dichondra repens      X        Cupressaceae      White Cypress Pine      Califitis glaucophylla      X        Fabaceae (Faboideae)      Ernu-toot      Cullen tenax      X        Fabaceae (Faboideae)      Burr Medic      Medicago polymorpha      X      *        Fabaceae (Faboideae)      Harestoot Clover      Trifolium arvense      X      *        Fabaceae (Faboideae)      Hop Clover      Trifolium arvense      X      *        Fabaceae (Faboideae)      Russian vetch      Vicia villosa subs. glaucescens      X      *        Fabaceae (Mimosoideae)      Green Watte      Acacia saligna      P/ X      Fabaceae (Mimosoideae)      For VX        Fabaceae (Mimosoideae)      River Cooba      Acacia sp.      X      *        Fabaceae (Mimosoideae)      River Cooba      Acacia sp.      X      *        Geraniaceae      Blue Crowtoot      Erodium cicutarium      X      *        Geraniaceae      Blue Crowtoot      Erodium cicutarium      X      *        Geraniaceae      Dead Nettle      Lamim amplexicaule      X      * <t< td=""><td>Convolvulaceae</td><td>A Bindweed</td><td>Convolvulus spp.</td><td>х</td><td>*</td></t<>	Convolvulaceae	A Bindweed	Convolvulus spp.	х	*
Cupressaceae      White Cypress Pine      Califiris glaucophylla      X        Fabaceae (Faboideae)      Emu-foot      Cullen tenax      X        Fabaceae (Faboideae)      Burr Medic      Medicago polymorpha      X      *        Fabaceae (Faboideae)      Haresfoot Clover      Trifolium arvense      X      *        Fabaceae (Faboideae)      Hop Clover      Trifolium repens      X      *        Fabaceae (Faboideae)      Russian vetch      Vicia villosa subs. glaucescens      X      *        Fabaceae (Mimosoideae)      Green Wattle      Acacia salicina      P/ X      Fabaceae (Mimosoideae)      P/ X        Fabaceae (Mimosoideae)      Olden Wreath Wattle      Acacia salicina      P/ X      Fabaceae (Mimosoideae)      P/ X        Fabaceae (Mimosoideae)      River Cooba      Acacia sitenophylla      P/ X      *        Fumariaceae      Narrow-leaved Fumitory      Fumaria densifiora      X      *        Geraniaceae      Common Crowfoot      Erodium cicutarium      X      *        Geodeniaceae      Dead Nettle      Lamiaceae      X      *        Lamiaceae      Vervain	Convolvulaceae	Kidney Weed	Dichondra repens	Х	
Fabaceae (Faboideae)    Emu-loot    Cullen tenax    X      Fabaceae (Faboideae)    Burt Medic    Medicago polymorpha    X    •      Fabaceae (Faboideae)    Harestoot Clover    Tritolium arvense    X    •      Fabaceae (Faboideae)    Hop Clover    Tritolium repens    X    •      Fabaceae (Faboideae)    Russian vetch    Vicia villosa subs. glaucescens    X    •      Fabaceae (Mimosoideae)    Goen Wattle    Acacia saligna    P/ X    •      Fabaceae (Mimosoideae)    Cooba    Acacia saligna    P/ X    •      Fabaceae (Mimosoideae)    River Cooba    Acacia saligna    P/ X    •      Fabaceae (Mimosoideae)    River Cooba    Acacia saligna    P/ X    •      Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylia    P/ X    •      Geraniaceae    Cormon Crowfoot    Erodium cintum    X    •    •      Geraniaceae    Scrambles Eggs    Goodenia pinnatifida    X    •    •      Lamiaceae    Vervian    Marubium vulgare    X    •    •      Lamiaceae    White Horehound	Cupressaceae	White Cypress Pine	Callitris glaucophylla	х	
Fabaceae (Faboideae)    Burr Medic    Medicago polymorpha    X    •      Fabaceae (Faboideae)    Haresfoot Clover    Trifolum arvense    X    •      Fabaceae (Faboideae)    Hop Clover    Trifolum campestre    X    •      Fabaceae (Faboideae)    White Clover    Trifolum regens    X    •      Fabaceae (Faboideae)    Russian vetch    Vicia villosa subs. glaucescens    X    •      Fabaceae (Mimosoideae)    Green Wattle    Acacia saligna    P/ X    •      Fabaceae (Mimosoideae)    olden Wreath Wattle    Acacia saligna    P/ X    •      Fabaceae (Mimosoideae)    River Cooba    Acacia saligna    P/ X    •      Fumariaceae    Narrow-leaved Fumitory    Fumaria densiltora    X    •      Geraniaceae    Common Crowfoot    Erodium cinitum    X    •      Goodeniaceae    Blue Crowfoot    Erodium cinitum    X    •      Lamiaceae    Vervain    Salvia verbanaca    X    •      Lamiaceae    Vervain    Salvia verbanaca    X    •      Lamiaceae    Vervain    Salvia verbanaca    X	Fabaceae (Faboideae)	Emu-foot	Cullen tenax	х	
Fabaceae (Faboideae)    Haresfoot Clover    Trifolium arpense    X    *      Fabaceae (Faboideae)    Hop Clover    Trifolium campestre    X    *      Fabaceae (Faboideae)    White Clover    Trifolium repens    X    *      Fabaceae (Faboideae)    Russian vetch    Vicia viliosa subs. glaucescens    X    *      Fabaceae (Mimosoideae)    Green Wattle    Acacia salicina    P/ X    Fabaceae (Mimosoideae)    P/ X      Fabaceae (Mimosoideae)    oden Wreath Wattle    Acacia saligna    P/ X    Fabaceae (Mimosoideae)    X    *      Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylla    P/ X    *    *      Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylla    P/ X    *    *      Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylla    P/ X    *    *      Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylla    P/ X    *    *      Fabaceae    Narrow-leaved Fumitory    Fumariaceantifica    X    *    *    *    *    *    *    *    *    *    *    *    * </td <td>Fabaceae (Faboideae)</td> <td>Burr Medic</td> <td>Medicago polymorpha</td> <td>х</td> <td>*</td>	Fabaceae (Faboideae)	Burr Medic	Medicago polymorpha	х	*
Fabaceae (Faboideae)    Hop Clover    Trifolium campestre    X    *      Fabaceae (Faboideae)    White Clover    Trifolium repens    X    *      Fabaceae (Faboideae)    Russian vetch    Vicia villosa subs. glaucescens    X    *      Fabaceae (Mimosoideae)    Green Wattle    Acacia salicina    P/ X    *      Fabaceae (Mimosoideae)    Oden Wreath Wattle    Acacia saligna    P/ X    *      Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylla    P/ X    *      Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylla    P/ X    *      Fumariaceae    Narrow-leaved Fumitory    Fumaria densifiora    X    *      Geraniaceae    Blue Crowfoot    Erodium crinitum    X    *      Goodeniaceae    Blue Crowfoot    Erodium crinitum    X    *      Lamiaceae    White Horehound    Marrubim wulgare    X    *      Lamiaceae    Vervain    Salvia verbenaca    X    *      Lamiaceae    Grey Mistletoe    quandang var.    *    *      Loranthaceae    Grey Mistletoe    Alvara privifiora	Fabaceae (Faboideae)	Haresfoot Clover	Trifolium arvense	х	*
Fabaceae (Faboideae)    White Clover    Trifolium repens    X    *      Fabaceae (Faboideae)    Russian vetch    Vicia villosa subs. glaucescens    X    *      Fabaceae (Mimosoideae)    Green Wattle    Acacia deanei    X    *      Fabaceae (Mimosoideae)    Ocoba    Acacia salicina    P/ X    Fabaceae (Mimosoideae)    N      Fabaceae (Mimosoideae)    Olden Wreath Wattle    Acacia saligna    P/ X    Fabaceae (Mimosoideae)    X    *      Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylla    P/ X    *      Fumariaceae    Narrow-leaved Fumitory    Fumaria densifiora    X    *      Geraniaceae    Biue Crowfoot    Erodium cicutarium    X    *      Goodeniaceae    Scrambles Eggs    Goodenia pinnatifida    X    *      Lamiaceae    White Horehound    Marrubium vulgare    X    *      Lamiaceae    Vervain    Salvia verbanca    X    *      Malvaceae    Sinal-Howered Mallow    Malva parvillora    X    *      Malvaceae    Fianelweed    Abuilion oxycarpum    X    *	Fabaceae (Faboideae)	Hop Clover	Trifolium campestre	х	*
Fabaceae (Faboideae)      Russian vetch      Vicia villosa subs. glaucescens      X      •        Fabaceae (Mimosoideae)      Green Wattle      Acacia deanei      X         Fabaceae (Mimosoideae)      Cooba      Acacia saligna      P/ X         Fabaceae (Mimosoideae)      Oiden Wreath Wattle      Acacia saligna      P/ X         Fabaceae (Mimosoideae)      River Cooba      Acacia stemophylla      P/ X         Fabaceae (Mimosoideae)      River Cooba      Acacia stemophylla      P/ X         Fumariaceae      Narrow-leaved Fumitory      Fumaria densiflora      X      *        Geraniaceae      Common Crowfoot      Erodium crinitum      X      *        Goodeniaceae      Scrambles Eggs      Goodenia pinnatifida      X      *        Lamiaceae      Dead Nettle      Lamium amplexicaule      X      *        Lamiaceae      Vervain      Salvia verbenaca      X      *        Lamiaceae      Vervain      Salvia verbenaca      X      *        Malvaceae      Small-flowered Mallow      Malva parviflora      X      * <td>Fabaceae (Faboideae)</td> <td>White Clover</td> <td>Trifolium repens</td> <td>Х</td> <td>*</td>	Fabaceae (Faboideae)	White Clover	Trifolium repens	Х	*
Fabaceae (Mimosoideae)    Green Wattle    Acacia deanei    X      Fabaceae (Mimosoideae)    Cooba    Acacia salicina    P/X      Fabaceae (Mimosoideae)    Olden Wreath Wattle    Acacia salicina    P/X      Fabaceae (Mimosoideae)    River Cooba    Acacia sp.    X      Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylla    P/X      Fumariaceae    Narrow-leaved Fumitory    Fumaria densifiora    X    *      Geraniaceae    Common Crowfoot    Erodium cicutarium    X    *      Geraniaceae    Scrambles Eggs    Goodenia pinnatifida    X    *      Lamiaceae    Dead Nettle    Lamium amplexicaule    X    *      Lamiaceae    Vervain    Salvia verbenaca    X    *      Lamiaceae    Grey Mistletoe    quandang var.    X    *      Malvaceae    Small-flowered Mallow    Malva parvifiora    X    *      Malvaceae    Pink Pavonia    Pavonia hastata    X    *      Malvaceae    Pink Pavonia    Pavonia hastata    X    *      Myrtaceae    Scarlet Pimpermel    Anagallis arvensis	Fabaceae (Faboideae)	Russian vetch	Vicia villosa subs. glaucescens	Х	*
Fabaceae (Mimosoideae)    Cooba    Acacia salicina    P/X      Fabaceae (Mimosoideae)    olden Wreath Wattle    Acacia saligna    P/X      Fabaceae (Mimosoideae)    River Cooba    Acacia senophylla    P/X      Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylla    P/X      Fumariaceae    Narrow-leaved Fumitory    Fumaria densifiora    X    *      Geraniaceae    Common Crowfoot    Erodium cicutarium    X    *      Geodeniaceae    Blue Crowfoot    Erodium cinitum    X    *      Goodeniaceae    Dead Nettle    Lamium amplexicaule    X    *      Lamiaceae    Vervain    Salvia verbenaca    X    *      Lamiaceae    Vervain    Salvia verbenaca    X    *      Malvaceae    Grey Mistletoe    quandang var.    *    *      Loranthaceae    Pink Pavonia    Pavonia hastata    X    *      Malvaceae    Flannelweed    Abutilon oxycarpum    X    *      Malvaceae    Point Jackson Fig    Ficus rubiginosa f. rubiginosa ??    X    *      Myrtaceae    Roiver Red Gum	Fabaceae (Mimosoideae)	Green Wattle	Acacia deanei	х	
Fabaceae (Mimosoideae)    olden Wreath Wattle    Acacia saligna    P/ X      Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylla    P/ X      Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylla    P/ X      Fumariaceae    Narrow-leaved Fumilory    Fumaria densifiora    X    *      Geraniaceae    Common Crowfoot    Erodium cicutarium    X    *      Geraniaceae    Blue Crowfoot    Erodium cicutarium    X    *      Goodeniaceae    Scrambles Eggs    Goodenia pinnatifida    X    *      Lamiaceae    Dead Nettle    Lamium amplexicaule    X    *      Lamiaceae    Wrevain    Salvia verbenaca    X    *      Maivaceae    Grey Mistletoe    quandang    X    *      Malvaceae    Small-flowered Mallow    Malva parvillora    X    *      Malvaceae    Flannelweed    Abution oxycarpum    X    *      Meliaceae    White Cedar    Melia azedarach    X    *      Myrtaceae    Scarlet Pimpernel    Anagallis arvensis    X    *      Myrtaceae    Crimon Bottleb	Fabaceae (Mimosoideae)	Cooba	Acacia salicina	P/ X	
Fabaceae (Mimosoideae)    River Cooba    Acacia sp.    X      Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylla    P/ X      Fumariaceae    Narrow-leaved Fumitory    Fumaria densifiora    X    *      Geraniaceae    Common Crowfoot    Erodium cicutarium    X    *      Geraniaceae    Blue Crowfoot    Erodium cinitum    X    *      Goodeniaceae    Scrambles Eggs    Goodenia pinnatifida    X    *      Lamiaceae    Dead Nettle    Lamium amplexicaule    X    *      Lamiaceae    White Horehound    Marrubium vulgare    X    *      Lamiaceae    Vervain    Salvia verbenaca    X    *      Malvaceae    Grey Mistletoe    quandang    X    *      Malvaceae    Pink Pavonia    Pavonia hastata    X    *      Malvaceae    Pink Pavonia    Pavonia hastata    X    *      Meliaceae    White Cedar    Melia azedarach    X    *      Moraceae    Port Jackson Fig    Ficus rubiginosa f. rubiginosa ??    X    *      Myrtaceae    Crimson Bottlebrush	Fabaceae (Mimosoideae)	olden Wreath Wattle	Acacia saligna	P/ X	
Fabaceae (Mimosoideae)    River Cooba    Acacia stenophylla    P/X      Fumariaceae    Narrow-leaved Fumitory    Fumaria densiflora    X    *      Geraniaceae    Common Crowfoot    Erodium cicutarium    X    *      Geraniaceae    Blue Crowfoot    Erodium cicutarium    X    *      Goodeniaceae    Scrambles Eggs    Goodenia pinnatifida    X    *      Lamiaceae    Dead Nettle    Lamium amplexicaule    X    *      Lamiaceae    White Horehound    Marrubium vulgare    X    *      Lamiaceae    Vervain    Salvia verbenaca    X    *      Lamiaceae    Grey Mistletoe    quandang    X    *      Malvaceae    Grey Mistletoe    quandang    X    *      Malvaceae    Pink Pavonia    Pavonia hastata    X    *      Malvaceae    Flannelweed    Abution oxycarpum    X    *      Meliaceae    White Cedar    Melia azedarach    X    *      Myrsinaceae    Scarlet Pimpernel    Anagallis arvensis    X    *      Myrtaceae    Crimson Bottlebrush	Fabaceae (Mimosoideae)		Acacia sp.	х	
Fumariaceae    Narrow-leaved Fumitory    Fumaria densiflora    X    *      Geraniaceae    Common Crowfoot    Erodium cicutarium    X    *      Geraniaceae    Blue Crowfoot    Erodium cicutarium    X    *      Goodeniaceae    Scrambles Eggs    Goodenia pinnatifida    X    *      Lamiaceae    Dead Nettle    Lamium amplexicaule    X    *      Lamiaceae    White Horehound    Marrubium vulgare    X    *      Lamiaceae    Vervain    Salvia verbenaca    X    *      Loranthaceae    Grey Mistletoe    quandang var.    *    *      Loranthaceae    Grey Mistletoe    Anyema quandang var.    *    *      Malvaceae    Small-flowered Mallow    Malva parvitlora    X    *      Malvaceae    Pink Pavonia    Pavonia hastata    X    *      Malvaceae    Flannelweed    Abution oxycarpum    X    *      Meliaceae    White Cedar    Melia azedarach    X    *      Moraceae    Port Jackson Fig    Ficus rubiginosa f. rubiginosa ??    X    *      Myrtaceae<	Fabaceae (Mimosoideae)	River Cooba	Acacia stenophylla	P/ X	
Geraniaceae    Common Crowfoot    Erodium cicutarium    X    *      Geraniaceae    Blue Crowfoot    Erodium crinitum    X       Goodeniaceae    Scrambles Eggs    Goodenia pinnatifida    X    *      Lamiaceae    Dead Nettle    Lamium amplexicaule    X    *      Lamiaceae    White Horehound    Marrubium vulgare    X    *      Lamiaceae    Vervain    Salvia verbenaca    X    *      Lamiaceae    Vervain    Salvia verbenaca    X    *      Lamiaceae    Vervain    Salvia verbenaca    X    *      Loranthaceae    Grey Mistletoe    quandang var.	Fumariaceae	Narrow-leaved Fumitory	Fumaria densiflora	Х	*
Geraniaceae    Blue Crowfoot    Erodium crinitum    X      Goodeniaceae    Scrambles Eggs    Goodenia pinnatifida    X      Lamiaceae    Dead Nettle    Lamium amplexicaule    X    *      Lamiaceae    White Horehound    Marrubium vulgare    X    *      Lamiaceae    Vervain    Salvia verbenaca    X    *      Loranthaceae    Grey Mistletoe    quandang var.    X    *      Malvaceae    Small-flowered Mallow    Malva parviflora    X    *      Malvaceae    Pink Pavonia    Pavonia hastata    X    *      Malvaceae    Flannelweed    Abutilon oxycarpum    X    *      Meliaceae    White Cedar    Melia azedarach    X    *      Moraceae    Port Jackson Fig    Ficus rubiginosa f. rubiginosa ??    X      Myrtaceae    Scarlet Pimpernel    Anagallis arvensis    X    *      Myrtaceae    White Box    Eucalyptus albens    X    *      Myrtaceae    Blakely's Red Gum    Eucalyptus camalculensis    P    *      Myrtaceae    Dirty Gum    Eucalyptus chloroclada </td <td>Geraniaceae</td> <td>Common Crowfoot</td> <td>Erodium cicutarium</td> <td>Х</td> <td>*</td>	Geraniaceae	Common Crowfoot	Erodium cicutarium	Х	*
Goodeniaceae    Scrambles Eggs    Goodenia pinnatifida    X      Lamiaceae    Dead Nettle    Lamium amplexicaule    X    *      Lamiaceae    White Horehound    Marrubium vulgare    X    *      Lamiaceae    Wervain    Salvia verbenaca    X    *      Loranthaceae    Grey Mistletoe    quandang var.    X    *      Malvaceae    Small-flowered Mallow    Malva parviflora    X    *      Malvaceae    Small-flowered Mallow    Malva parviflora    X    *      Malvaceae    Pink Pavonia    Pavonia hastata    X    *      Malvaceae    Flannelweed    Abutilon oxycarpum    X    *      Meliaceae    White Cedar    Melia azedarach    X    *      Moraceae    Port Jackson Fig    Ficus rubiginosa f. rubiginosa ??    X    *      Myrtaceae    Scarlet Pimpernel    Anagallis arvensis    X    *      Myrtaceae    White Box    Eucalyptus albens    X    *      Myrtaceae    Blakely's Red Gum    Eucalyptus camaldulensis    P    *      Myrtaceae    Dirty Gum	Geraniaceae	Blue Crowfoot	Erodium crinitum	Х	
LamiaceaeDead NettleLamium amplexicauleX*LamiaceaeWhite HorehoundMarrubium vulgareX*LamiaceaeVervainSalvia verbenacaX*LoranthaceaeGrey Mistletoequandang var.X*MalvaceaeGrey Mistletoequandang var.X*MalvaceaeSmall-flowered MallowMalva parvifloraX*MalvaceaePink PavoniaPavonia hastataX*MalvaceaeFlannelweedAbution oxycarpumX*MeliaceaeWhite CedarMelia azedarachX*MoraceaePort Jackson FigFicus rubiginosa f. rubiginosa ??X*MyrsinaceaeScarlet PimpernelAnagallis arvensisX*MyrtaceaeCrimson BottlebrushCallistemon citrinusP*MyrtaceaeBlakely's Red GumEucalyptus blakelyiP / X*MyrtaceaeDirty GumEucalyptus chorocladaP*MyrtaceaePilow BoxEucalyptus melliodoraP / X*MyrtaceaeBimble BoxbimbilX**MyrtaceaeCoastal MoortEucalyptus utilisP*MyrtaceaeMallee Honey-mytrleAcuminataP*MyrtaceaePirkly-leaved TeatreeMelaleuca aricfoliaP*MyrtaceaePickly-leaved TeatreeMelaleuca stypheliodesP	Goodeniaceae	Scrambles Eggs	Goodenia pinnatifida	Х	
LamiaceaeWhite HorehoundMarrubium vulgareX*LamiaceaeVervainSalvia verbenacaX*LoranthaceaeGrey Mistletoequandang var.X*MalvaceaeSmall-flowered MallowMalva parvifloraX*MalvaceaePink PavoniaPavonia hastataX*MalvaceaeFlannelweedAbutilon oxycarpumX*MeliaceaeWhite CedarMelia azedarachX*MoraceaePort Jackson FigFicus rubiginosa f. rubiginosa ??X*MyrsinaceaeScarlet PimpernelAnagallis arvensisX*MyrtaceaeCrimson BottlebrushCallistemon citrinusP*MyrtaceaeBlakely's Red GumEucalyptus albensX*MyrtaceaeDirty GumEucalyptus canadulensisP*MyrtaceaeDirty GumEucalyptus utilisP*MyrtaceaeBimble BoxbimbilX*MyrtaceaeBimble BoxbimbilX*MyrtaceaeCoastal MoortEucalyptus utilisP*MyrtaceaeMallee Honey-mytrleAcuminataP*MyrtaceaeSwamp Paperbarkmelaleuca ericifoliaP*MyrtaceaeSwamp Paperbarkmelaleuca stypheliodesP*MyrtaceaeSwamp Paperbarkmelaleuca stypheliodesP*MyrtaceaePrickly-leaved TeatreeMelaleuca stypheliodesP*My	Lamiaceae	Dead Nettle	Lamium amplexicaule	х	*
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	Myrtaceae	Prickly-leaved Teatree	Melaleuca stypheliodes	Р	

Family	Common Name	Scientific Name	Presence	Status
Myoporaceae		Eremophila sp.	Х	
Oxalidaceae	Oxalis	Oxalis perennans	х	
Plantaginaceae	Lamb's Tongue	Plantago lanceolata	Х	
Poaceae	Purple Wiregrass	Aristida personata	Х	
Poaceae	Plains Grass	Austrostipa aristiglumis	Х	
Poaceae	Speargrass	Austrostipa scabra	Х	
Poaceae	Slender Bamboo Grass	Austrostipa verticillata	Х	
Poaceae	Red Grass	Bothriochloa macra	Х	
Poaceae	Sand Brome	Bromus arenarius	Х	
Poaceae	Prairie Grass	Bromus catharticus	Х	*
Poaceae	Soft Brome	Bromus molliformis	Х	*
Poaceae	Rhodes Grass	Chloris gayana	Х	
Poaceae	Windmill Grass	Chloris truncata	Х	
Poaceae	Tall Chloris	Chloris ventricosa	Х	
Poaceae	Common Couch	Cynodon dactylon	Х	
Poaceae	Queensland Bluegrass	Dichanthium sericeum	Х	
Poaceae	Stinkgrass	Eragrostis cilianensis	Х	*
Poaceae	African Lovegrass	Eragrostis curvula	Х	*
Poaceae		Eragrostis sp.	Х	
Poaceae	Wimmera Ryegrass	Lolium rigidum	Х	*
Poaceae	Water Couch	Paspalum distichum	Х	
Poaceae	Johnson Grass	Sorghum halepense	Х	*‡
Poaceae	Rat's Tail Fescue	Vulpia myuros	Х	*
Polygonaceae	Curled Dock	Rumex crispus	Х	*
Rosaceae (Amygdaloideae)	English Laurel	Prunis lauroceras	Х	*
Rosaceae (Amygdaloideae)		Prunis sp*	Х	*
Rubiaceae	Cleavers	Galium asperine	Х	
Rutaceae	Wilga	Geijera parviflora	Х	
Sapindaceae	Western Rosewood	Alectryon oleifolius	Х	
Solanaceae	Green Cestrum	Cestrum parqui	Х	*‡
Solanaceae	African Box thorn		Х	*‡
Sterculiaceae	Kurrajong	Brachychiton populneus subsp. Populneus	x	*
Typhaceae	Cumbungi	Typha sp.	Х	
Verbenaceae	Purpletop	Verbena bonariensis	Х	*

Key to Table 4: \* not native, ‡ Listed noxious P planted, X present

### 6.2.4 Threatened Flora

No threatened species of flora or potential habitat for threatened cryptic species (Swainsona and orchids) as identified under the TSC or EPBC Act were recorded in the Study Area. It is highly unlikely that habitat for these species occurs within the Study Area due to current and historical disturbance.

### 6.2.5 Noxious Weeds

Six declared Noxious Weeds were recorded in the Study Area. Blue Heliotrope, Paterson's curse, Vipers bugloss, Prickly pear, Johnson Grass and African Boxthorn are all Class 4 listed Noxious Weeds. The growth of the Class 4 Noxious Weeds must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed. African Boxthorn is also a Weed of National Significance. One Class 3 noxious weed Green Cestrum was recorded in the Study Area. This plant must be fully and continuously suppressed and destroyed.

### 6.2.6 Fauna Species Recorded

In total, 61 species of terrestrial fauna from 31 families were recorded in the Study Area during the field survey (**Table 5**). The abundance of honeyeaters recorded is likely a result of the flowering resources in the Study Area at the time of the assessment. Interestingly, no amphibians were heard calling or detected in the creek. This may be an indication of the unsuitable creek conditions including known high salinity levels.

It is likely that further species of fauna occur in the Study Area however due to the inopportune nigh-time weather conditions and malfunction of the echolocation device were not detected.

Family	Common Name	Scientific Name	Status	Number
Acanthizidae	Yellow-rumped Thornbill	Acanthiza chrysorrhoa		
Acanthizidae	Striated Thornbill	Acanthiza lineata		
Acanthizidae	Yellow Thornbill	Acanthiza nana		
Acanthizidae	Buff-rumped Thornbill	Acanthiza reguloides		
Acrocephalus	Australian Reed Warbler,	Acrocephalus australis		
Agamidae	Bearded Dragon	Pogona barbata		
Alcedinidae	Laughing Kookaburra	Dacelo novaeguineae		
Alcedinidae	Sacred Kingfisher	Todiramphus sanctus		
Ardeidae	White-necked Heron	Ardea pacifica		
Artamidae	Pied Butcherbird	Cracticus nigrogularis		
Artamidae	Australian Magpie	Cracticus tibicen		
Artamidae	Pied Currawong	Strepera graculina		
Cacatuidae	Sulphur-crested Cockatoo	Cacatua galerita		
Cacatuidae	Little Corella	Cacatua sanguinea		
Cacatuidae	Galah	Eolophus roseicapillus		
Cacatuidae	Cockatiel	Nymphicus hollandicus		
Campephagidae	Black-faced Cuckoo-shrike	Coracina novaehollandiae		
Campephagidae	White-winged Triller	Lalage sueurii		
Columbidae	Bar-shouldered Dove	Geopelia humeralis		
Columbidae	Crested Pigeon	Ocyphaps lophotes		
Columbidae	Common Bronzewing	Phaps chalcoptera		
Columbidae	Spotted Dove	treptopelia chinensis		

Table 5: Terrestrial Fauna Records in the Study Area.

Corvidae	Australian Raven	Corvus coronoides		
Elapidae	Eastern Brown Snake	Pseudonaja textilis		
Estrildidae	Double-barred Finch	Taeniopygia bichenovii		
Hirundinidae	Welcome Swallow	Hirundo neoxena		
Leporidae	Brown Hare	Lepus capensis*	Introduced	
Macropodidae	Eastern Grey Kangaroo	Macropus giganteus		
Maluridae	Variegated Fairy-wren	Malurus lamberti		
Meliphagidae	Spiny-cheeked Honeyeater	Acanthagenys rufogularis		
Meliphagidae	Blue-faced Honeyeater	Entomyzon cyanotis		
Meliphagidae	Yellow-faced Honeyeater	Lichenostomus chrysops		
Meliphagidae	Fuscous Honeyeater	Lichenostomus fuscus		
Meliphagidae	White-plumed Honeyeater	Lichenostomus penicillatus		
Meliphagidae	Noisy Miner	Manorina melanocephala		
Meliphagidae	Little Friarbird	Philemon citreogularis		
Meliphagidae	Noisy Friarbird	Philemon corniculatus		
Molossidae	Mastiff-bat	Mormopterus sp.		
Molossidae	White-striped Freetail-bat	Tadarida australis		
Monarchidae	Magpie-lark	Grallina cyanoleuca		
Muridae	House Mouse	Mus musculus	Introduced	
Pachycephalidae	Grey Shrike-thrush	Colluricincla harmonica		
Pachycephalidae	Rufous Whistler	Pachycephala rufiventris		
Pardalotidae	Striated Pardalote	Pardalotus striatus		
Passeridae	House Sparrow	Passer domesticus	Introduced	
Phalangeridae	Common Brushtail Possum	Trichosurus vulpecula		
Phascolarctidae	Koala	Phascolarctos cinereus	V TSC Act	1 Male
Psittacidae	Australian King-Parrot	Alisterus scanularis		1 Maio
Psittacidae	Little Lorikeet	Glossonsitta nusilla	V TSC Act	50+
Psittacidae	Musk Lorikeet	Glossopsitta concinn		001
Psittacidae	Fastern Rosella	Platycercus eximius		
Psittacidae	Red-rumped Parrot	Psenhotus haematonotus		
			V TSC Act	
Pteropodidae	Grey-headed Flying Fox	Pteropus poliocephalus	V EPBC Act	~ 20
Rhipiduridae	Grey Fantail	Rhipidura albiscapa		
Rhipiduridae	Willie Wagtail	Rhipidura leucophrys		
Scincidae	Robust Ctenotus	Ctenotus robustus		
Scincidae	Dark-flecked Garden Sunskink	Lampropholis delicata		
Sturnidae	Common Myna	Sturnus tristis	Introduced	
Sturnidae	Common Starling	Sturnus vulgaris	Introduced	
Sturnidae	Black Bird	Turdis merula		
Vespertilionidae	Gould's Wattled Bat	Chalinolobus gouldii		

### 6.2.7 Threatened Fauna

Three species of threatened fauna were recorded in the Study Area (Table 5).

The Study Area is considered to be a 'High Use Activity' area for Koalas (TSC and EPBC Act) with evidence of Koala use at 22 of the 37 trees within Wandobah Reserve in the Study Area. This is density of 59 per cent as per the SAT technique. One mature male Koala was recorded within the Cemetery adjacent to the Study Area (**Plate 7**). According to locals, Koalas have recently moved away from the town area. Whether this is a seasonal or local movement has not yet been ascertained, however many of the scats found in the Study Area appeared to be within a week to fortnight old with no fresh scats located (**Plates 4** and **5**).

Several flocks of Little Lorikeets (TSC Act) were observed feeding on flowering plants in the Study Area and crop feeding young. Traditional nest-sites occur in mature and old-growth stands of smooth-barked gums Eucalyptus spp., within 2 km of stands of their key food trees (flowering White Box and Yellow Box) (Courtney and Debus 2006). Thus, there is potential that breeding occurred outside the Study Area.

Approximately 20 Grey-headed Flying Fox were recorded drinking from pooled water in Blackjack Creek during the nocturnal assessment. It is possible that the nectar and pollen of Eucalyptus, Melaleuca and Banksia recorded in the Study Area are also used for feeding.

Hollow dependant threatened microbats and threatened owls (Masked Owl and Barking Owl) are assumed to be present in the Study Area. This is based on habitat present including the variety and number of suitable hollows.



Plate 5: Example of older Koala scat.



Plate 6: Example of Koala scratches (and others) on bark of Blakely's Red Gum, indicating the high traffic of Koala in the Study Area.



Plate 7: Male Koala in the Cemetery adjacent to the Study Area

#### 6.2.8 Terrestrial Fauna Habitat

Vegetation in the Study Area is considered to have high habitat values, as it provides connectivity within a largely cleared landscape, connectivity to the Namoi River and has many large hollow bearing trees. The numerous mature hollow bearing Poplar Box provide important habitat for hollow dependent fauna. More specifically the habitat values in the Study Area include:

• Medium and High Habitat Value trees provide roosting habitat for medium-sized parrots,

marsupials and owls. Large old trees on more fertile sites have been observed to produce more significant nectar flows for fauna than nearby trees on poorer sites such as hillsides;

- The grasslands provide opportunities for a range of common native plants and animals but limited key habitat elements for threatened plant species. Impacts from slashing, clearing, wood removal and the presence of exotic species reduce any opportunities for the regions rare plants;
- Stags, cracks and fissures in dead trees and limbs provided a degree of habitat complexity for microbats and arboreal reptiles;
- Foliage that is fodder for Koalas.

The Study Area provides frog habitat, however is unlikely to support migratory wetland birds aside from common herons and egrets under normal conditions.

## 7. IMPACTS

### 7.1 FLORA

The Proposal will result in the removal of approximately 30 to 37 identified habitat trees with medium and high habitat values (a declining and rare resource within the landscape) (**Table 6**).

In addition to those habitat trees identified in **Table 6** additional non-hollow bearing trees / shrubs within the Impact Footprint are listed in **Table 7**. Despite the fact that most of the species listed in **Table 7** are planted, they still provide valuable habitat and flowering resources and combat dryland salinity in the Study Area.

Table 6: Habitat	values in the S	udy Area incluc	ling evidence of	Koala activity in t	he Study Area.

Tree Number	Species	Easting	Northing	Habitat/ Hollows	Koala Evidence	Habitat notes
T1	E. populnea	236477	6569325	HHV, 1M, 4M- S, 2S		Dead. Nest
T2	E. populnea	236397	6569163	HHV, 4M, 5S	Yes. Scat	Stag, dieback
Т3	E. populnea	236391	6569157	HHV, 1 M-L, 1S		
T4	E. populnea	236376	6569144	MHV, 3M, 2S		
T5	E. blakelyi	236333	6569100	LHV	Yes. Scratch, Scat	Advanced regeneration
Т6	E. blakelyi	236333	6569950	LHV	Yes. Scratch, Scat	Advanced regeneration
T7	E. populnea	236292	6569051	MHV, 3M, 3S		Half dead.
Т8	E. populnea	236256	6569000	LHV		Advanced regeneration
Т9	E. populnea	236209	6568390	HHV		Large tree
T10	E. albens	236206	6568904	MHV		
T11	E. populnea	236217	6568876	MHV		
T12	E. blakelyi	236203	6568873	HHV	Yes. Scratch	
T13	E. melliodora	236211	6568859	MHV	Yes. Scratch	
T14	E. populnea	236240	6568851	MHV	Yes. Scats	
T15	E. populnea	236178	6568823	MHV	Yes. Scats	
T16	E. populnea	236179	6568815	MHV	Yes. Scratch	
T17	E. populnea	236176	6568815	MHV	Yes. Scratch	
T18	E. populnea	236169	6568801	MHV		
T19	E. populnea	236169	6568186	MHV		
T20	E. populnea	236129	6568797	HHV		
T21	E. populnea	236130	6568783	HHV	Yes. Scratch, Scats	
T22	E. populnea	236125	6568780	MHV	Yes. Scratch, Scats	
T23	E. melliodora	236112	6568726	LHV	Yes. Scratch, Scats	Advanced

Tree Number	Species	Easting	Northing	Habitat/ Hollows	Koala Evidence	Habitat notes
						regeneration
T24	E. populnea	236097	6568726	LHV	Yes. Scats	Advanced regeneration
T25	E. populnea	236100	6568719	LHV	Yes. Scratch, Scats	Advanced regeneration
T26	E. populnea	236107	6568708	HHV	Yes. Scratch, Scats	
T27	E. Blakelyi	236099	6568694	MHV	Yes. Scats	
T28	E. populnea	236156	6568853	HHV, 2M, 4S	Yes. Scats	Large Tree
T29	E. Blakelyi	236164	6568854	LHV	Yes. Scratch	No hollows
T30	E. populnea	236143	6568848	HHV, 3M, 2S		
T31	E. populnea	236124	6568838	HHV, 4M, XS	Yes. Scratch, Scats	
T32	E. melliodora	236072	6568760	LHV	Yes. Scratch, Scats	Advanced regeneration
T33	E. Blakelyi	236064	6568763	LHV	Yes. Scratch	Advanced regeneration
T34	E. populnea	236174	6568903	HHV, 1L, 1M and XS		Large Tree
T35		235661	6567977		Yes. 1 male Koala.	Tree located in Cemetery
Т36	E. populnea	236338	6569124	MHV, 3M		
T37	E. populnea	236345	6569169	MHV,2M,3S	Yes. Scratch, Scats	Possible Aboriginal Scarred Tree

Species (Common Name)	Advance regeneration 5 – 10m height	Sapling or shrub 2 - 4m height
River Oak	8	22
Acacia (all)	9	5
Blakely's Red Gum	5	2
Dirty Gum	0	2
Poplar Box	11	11
Wilga	2	0
Pepper Tree	4	0
Eremophila	0	4
White Cedar	2	2
Mallee Honey Myrtle	0	1
Prickly Leaved Paperbark	0	7
Swamp Paper Bark	0	3
Yellow Box	3	3
Coastal Moort	9	0

Table 7: Additional trees / shrubs advanced regrowth in the Impact Footprint.

### 7.2 WILDLIFE CORRIDORS AND CONNECTIVITY

Connectivity associated with Blackjack Creek in the Study Area is already restricted by land clearing and houses along Wandobah Road.

Although the Study Area is weedy and lacks mid-storey diversity or an overstorey, the general coverage of grasses may provide a movement corridor or stepping stone habitat for some native fauna. The Proposal may therefore remove a north south aligned vegetation fragment reducing connectivity to and from the Namoi River.

In the context of koala habitat connectivity, Wandobah Reserve is considered to have interconnecting habitat with other 'Core Koala Habitat' within the locality. Removing these trees within the creek will reduce koala habitat and may increase periods of exposure on the ground (potentially indirectly increasing Koala mortality) between remnants or isolated trees.

Any removal of native vegetation within the Study Area would directly reduce the remnant patch size of vegetation within the Study Area and its associated habitat values (particularly those key habitat elements required for hollow dependent fauna).

It is likely that habitat remediation along the riparian corridor will increase the value of this corridor as a movement pathway. However, the benefits of revegetation are not immediate and may take ten plus years.

## 7.3 KEY THREATENING PROCESSES

A number of Key Threatening Processes (KTP) which are listed on the schedules of the TSC Act and Fisheries Management Act 1994 (FM Act) are likely to be relevant to the Study Area and may be exacerbated by the Proposal. These KTP's include:

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands (TSC Act);
- Removal of hollow bearing trees (TSC Act);
- Clearing of native vegetation (TSC Act);
- Invasion of native plant communities by exotic perennial grasses (TSC Act);
- Degradation of native riparian vegetation along New South Wales watercourses (FM Act);

The Proposal will exacerbate the KTP 'Alteration of natural flow regimes of rivers and streams and their floodplains and wetlands'. Proposed widening of the creek to promote uniform flow for flood-mitigation will remove the limited aquatic habitat provided by the pooled water of the creek.

Degradation of native riparian vegetation along New South Wales watercourses has already occurred in the Study Area. Rehabilitation and revegetation of the Study Area would result in an improvement to the Blackjack Creek habitat.

The clearing of native vegetation and loss of hollow bearing trees is a major contributor to the loss of biodiversity. In the determination, the NSW Scientific Committee found that 'clearing of any area of native vegetation, including areas less than two hectares in extent, may have significant impacts on biological diversity'. The proposal is considered to contribute significantly to the operation of clearing and the removal of hollows as a threatening process.

The Proposal would also contribute to this key threatening process *'removal of dead wood and dead trees*' that includes the removal of fallen branches and litter as general tidying up and the removal of standing dead trees.

## 7.4 SIGNIFICANCE ASSESSMENTS

The appropriate management of ecological items is usually determined on the basis of their assessed significance as well as the likely impacts of any Proposal. Significance of a species, population or community is determined by appointed NSW and National Scientific Committees, cultural and public significance are considerations within the significance determination process. Within the framework of an impact assessment impacts to listed significant item must be assessed at a State (under the TSC Act) or National (under the EPBC Act) level – even if it is

the same species. The following sections identify State or nationally listed threatened (significant) species then determines if impacts are 'significant'.

### 7.4.1 Affected Species

It should be noted that in the *Threatened species assessment guidelines: The assessment of significance* (DECC 2007), a species does not have to be considered as part of the assessment of significance if adequate surveys or studies have been carried out that clearly show that the species:

- does not occur in the Study Area, or
- will not use on-site habitats on occasion, or
- Will not be influenced by off-site impacts of the proposal.

Otherwise all species likely to occur in the Study Area (based on general species distribution information) and known to use that type of habitat, should be considered in the rationale that determines the list of threatened species, populations and ecological communities for the assessment of significance.

### 7.4.2 Significant Communities, Populations Or Species Within The Study Area

Consideration of the type and scale of habitat to be removed has resulted in the conclusion that the Koala would be significantly affected by the Proposal. In its current state, the Proposal is considered to have a significant impact on 'Core Koala Habitat' and will require an SIS and Referral of the Project to the Environment Minister of DSEWPaC. The Proposal would not have a significant impact on any other item listed in **Table 8**.

Common Name	Scientific Name	TSC Act	FM Act	EPBC Act
Little Pied Bat	Chalinolobus picatus	7- Part Test		
Corben's Long-eared Bat	Nyctophilus corbeni	7- Part Test		Assessment of Significance
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	7- Part Test		
Eastern Freetail-bat	Mormopterus norfolkensis	7- Part Test		
Koala	Phascolarctos cinereus	7- Part Test		Assessment of Significance
Little Lorikeet	Glossopsitta pusilla	7- Part Test		
Grey-headed Flying-fox	Pteropus poliocephalus	7- Part Test		Assessment of Significance
Barking Owl	Ninox connivens	7- Part Test		
Powerful Owl	Ninox strenua	7- Part Test		

Table 8: Species Requiring	Significance Assessments Unde	r The TSC, FM And EPBC Act
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# 8. BIODIVERSITY AND HABITAT OFFSETS

Ultimately offsets within the project should be able to demonstrate a 'improve or maintain' outcome for impacts in the Study Area. Offsets are best directed at generally improving the riparian habitat for all threatened species and connectivity to remnants. Plants used for revegetation should be consistent with those locally occurring and would provide improvements to the creek bank stability address erosion and assist in managing salinity.

## 8.1 NAMOI CMA BIODIVERSITY OFFSETS POLICY 2011

Namoi CMA has recently ratified a 'Biodiversity Offset Policy' for the Namoi Catchment. The policy provides guidance for developers to enable achievement of beneficial biodiversity offsets. Any predicted impacts on biodiversity need to be offset. Offsets need to:

- compensate for the predicted impacts,
- ensure that there is no net loss of native vegetation,
- ensure that the development does not cross any critical ecological thresholds,
  - a) 30% (in cleared sub-catchments) woody native vegetation extent threshold
  - b) 70% (in intact sub-catchments) woody native vegetation extent threshold
  - c) 30% of Regional Vegetation Communities threshold within the Catchment
- be consistent with the existing NSW Government and Commonwealth legislative biodiversity offset requirements, as the minimum standard.

As the Proposal will impact native vegetation that has been cleared by more than 70% in the Namoi CMA it is thus inconsistent with this Policy and crosses a critical threshold identified in the Namoi Catchment Action Plan.

### 8.2 **PROPOSED OFFSETS**

The following requires offsetting:

- Hollow bearing trees will require offsetting. Replace habitat values at a ratio of 1:1 with nest boxes suitable for large owls, rosellas/grass parrots, Brown Treecreepers and microbats. GSC will be required to install and maintain the bat and bird nest boxes over the life period of the Offset Plantings to reach suitable size. DECCW does not typically consider nest boxes to be an adequate offset or compensatory measure for habitat destruction, in part because of the high level of maintenance needed over centuries before the hollows being destroyed are replaced.
  - d) Nest boxes should be placed in adjacent appropriate habitat as identified in consultation with NPWS.

- Koala Habitat will require offsetting in the Study Area. It is recommended that primary feed trees known for the Gunnedah locality be planted at a ratio of 1:10. Tree species may include River Red Gum, White Box, Poplar Box along with Yellow Box, Dirty Gum and Blakely's Red Gum.
  - e) Plantings should be aimed at linking existing remnant vegetation through the use of corridors, in partnership with existing recovery plans and Namoi revegetation programs
- 3. *Biometric* vegetation ID NA185 recorded in the Study Area is considered a 'red flag' area under the BBAM (as over 75 per cent has been cleared). As such it is recommended that impact is first avoided to this community. Any impacted vegetation should be offset at a ratio of 1:1 with those species consistent with this community and locally occurring Box-Gum Woodland.
- 4. The following principles must be applied when considering using biodiversity offsets:
  - a) Offsets will be used as a last resort, after consideration of alternatives to avoid and/or mitigate impacts
  - b) Offset areas be kept within the Namoi Catchment boundaries (either wholly or in part as a contiguous area of native vegetation)
  - c) Offsets must be of the same vegetation type and be at least the size, equivalent biodiversity value & configuration of the vegetation lost through development and additional to existing native vegetation areas
  - d) Offsetting must achieve biodiversity benefits in perpetuity and be registered on title
  - e) Offset conditions must be monitored, enforceable, clearly mapped, recorded and publicly available.
  - f) An offset area, once designated, cannot be used for further offseting of subsequent developments in future.
- 5. Rehabilitation of disturbed areas is also required in the Study Area.

## 9. RECOMMENDATIONS AND MITIGATION OF IMPACTS

The following ameliorative measures are based on a three tier hierarchy of:

- Avoid impact;
- Minimise impact; and
- Mitigate against impact.

The following mitigation measures have been made in regards to the Proposal.

- It is recommended that GSC do not impact large hollow bearing trees adjacent to the creek and consider redesigning the Proposal to avoid hollow bearing trees and minimise the amount and type of clearing. Maintaining the existing alignment of Blackjack Creek appears the most ecologically sensible. Other methods could involve:
  - a) Widen the creek where possible, avoiding large hollow bearing trees and their root systems.
  - b) Increase the existing levee height either side of the creek.
  - c) Deepen the creek in areas where possible, keeping in mind the high water table and salinity issues.
- 2. Areas to be cleared should be clearly marked with high visibility nightline prior to construction, to ensure that accidental clearing does not occur.
- 3. A Koala Plan of Management should be prepared and rehabilitation would include proposals to enhance and expand 'Core Koala Habitat'.
  - a) Crowther *et al* 2010 provides direction on successful revegetation for the koala in the Gunnedah area.
- In its current state, the Proposal is considered to impact habitat critical to the survival of the Koala and thus requires a Species Impact Statement to be prepared and Referral to the DSEWPaC
- 5. Prior to any tree clearing, care should be taken to identify nests and /or roosting sites and / or threatened species.
  - a) A Pre clearing check of hollow bearing trees in the impact footprint should be undertaken to identify breeding sites of threatened species.
  - b) Prior to lopping or clearing, inspect trees with bird nests before pushing or felling to ensure the nests are vacant (no nests were observed during the assessment).
     Inspection should occur immediately before pushing or felling. If a bird is in the nest, clear the trees around it first to see if the animal will disperse. If the bird is a

nestling all measures should be taken to collect the bird and remove to a safe location;

- c) All trees to be trimmed or removed should be thoroughly checked for the presence of Koalas or other fauna immediately prior to clearance.
- d) It is recommended that the construction works occur outside of the spring breeding period for most hollow dependant fauna. It is particularly advisable that the construction works occur outside the Rainbow Bee-eater breeding season (breeding season is between November and January - this is a burrowing species, not hollow dependant).
- 6. All food scraps and rubbish are to be appropriately disposed of in sealed receptacles to prevent providing forage habitats for foxes, rats, dogs and cats.
- 7. Best practice weed management practices should be in place to prevent transfer of weed seeds and vegetative materials, including washdown of vehicles entering or leaving the worksite. To achieve this, weed control measures would need to be established prior to the commencement of construction.
- 8. Ensure all sprays are waterway friendly as per NSW DPI guidelines.
- 9. Ongoing weed control should be undertaken in disturbed areas.
- 10. An Erosion and Sediment Control Plan (ESCP), shall be prepared for the works and would be in line with Landcom's Managing Urban Stormwater, Soils & Construction Guidelines (The Blue Book) (Landcom 2004).
- 11. Progressive rehabilitation of the Study Area would be staged after the completion of each installation stage.
- 12. Retention of top soil should occur where possible to maintain a viable seed bank and respread after channel construction,
- 13. Soil should be respread as soon as possible after trenching in order to maximise its fertility, seed viability and microbial activity.
- 14. Exposed grounds should be sprayed with native grass seeds (those species characteristic for Box-Gum Woodland). Species could include:
  - Plains Grass (Austrostipa aristiglumis), Bothriochloa decipiens, Slender Bamboo Grass (Austrostipa verticillata), Aristida ramosa, Queensland Bluegrass (Dichanthium sericeum subsp. sericeum), Austrodanthonia bipartita, Windmill Grass (Chloris truncata), Austrodanthonia caespitosa, Speargrass (Austrostipa scabra subsp. scabra), Kangaroo Grass (Themeda australis), Eulalia aurea, Einadia nutans subsp. nutans, Oxalis

perennans, Vittadinia cuneata, Solanum parvifolium, Abutilon oxycarpum, Wahlenbergia stricta subsp. stricta.

- 15. Rehabilitation of the creek may require the use of saline tolerant plant including:
  - Paspalum (Paspalum diatatum), Spike Rush (Juncus acutus) Black Roly Poly (Sclerolaena muricata), Common Couch (Cynodon dactylon), Native Panic (Panicum buncei), Cumbungi (Typha sp.)
- 16. Replicating a natural riparian system in the restored areas of creek through implementation of creek meandering, varying widths and pools and riffle sequences is recommended in the Study Area to enhance the riparian habitat.
- 17. Implement the proposed biodiversity offset for the Study Area as described in Section 8.2.

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# APPENDIX 1: DATABASE SEARCH RESULTS

	Type of	NSW	
Common name	species	status	Occurrence
Large-eared Pied Bat	Animal > Bats	Vulnerable	Known
Little Pied Bat	Animal > Bats	Vulnerable	Known
Corben's Long-eared Bat	Animal > Bats	Vulnerable	Known
Yellow-bellied Sheathtail-bat	Animal > Bats	Vulnerable	Known
Eastern Freetail-bat	Animal > Bats	Vulnerable	Known
Eastern Cave Bat	Animal > Bats	Vulnerable	Known
Magpie Goose	Animal > Birds	Vulnerable	Predicted
Australian Bustard	Animal > Birds	Endangered	Known
Australasian Bittern	Animal > Birds	Endangered	Predicted
Bush Stone-curlew	Animal > Birds	Endangered	Known
Glossy Black-Cockatoo	Animal > Birds	Vulnerable	Known
Pied Honeyeater	Animal > Birds	Vulnerable	Known
Brown Treecreeper (eastern subspecies)	Animal > Birds	Vulnerable	Known
Black-necked Stork	Animal > Birds	Endangered	Known
Grey Falcon	Animal > Birds	Endangered	Known
Brolga	Animal > Birds	Vulnerable	Predicted
Black-breasted Buzzard	Animal > Birds	Vulnerable	Known
Black-tailed Godwit	Animal > Birds	Vulnerable	Predicted
Hooded Robin (south- eastern form)	Animal > Birds	Vulnerable	Known
Powerful Owl	Animal > Birds	Vulnerable	Predicted
Superb Parrot	Animal > Birds	Vulnerable	Known
Grey-crowned Babbler	Animal > Birds	Vulnerable	Known
Eastern Grass Owl	Animal > Birds	Vulnerable	Known
Painted Honeveater	Animal > Birds	Vulnerable	Known
Swift Parrot	Animal > Birds	Endangered	Known
	-		
	Common nameLarge-eared Pied BatLittle Pied BatCorben's Long-eared BatYellow-bellied Sheathtail-batEastern Freetail-batEastern Cave BatMagpie GooseAustralian BustardAustralasian BitternBush Stone-curlewGlossy Black-CockatooPied HoneyeaterBrown Treecreeper (eastern subspecies)Black-necked StorkGrey FalconBrolgaBlack-breasted BuzzardBlack-tailed GodwitHooded Robin (south- eastern form)Powerful OwlSuperb ParrotGrey-crowned Babbler (eastern subspecies)Eastern Grass OwlPainted HoneyeaterSwift Parrot	Common nameType of speciesLarge-eared Pied BatAnimal > BatsLittle Pied BatAnimal > BatsCorben's Long-eared BatAnimal > BatsYellow-bellied Sheathtail-batBatsEastern Freetail-batBatsEastern Cave BatAnimal > BatsMagpie GooseAnimal > BirdsAustralian BustardBirdsAustralian BustardAnimal > BirdsBush Stone-curlewBirdsGlossy Black-CockatooBirdsPied HoneyeaterBirdsBlack-necked StorkAnimal > BirdsBlack-necked StorkAnimal > BirdsBlack-hreasted BuzzardBirdsBlack-hreasted BuzzardAnimal > BirdsBlack-tailed GodwitAnimal > BirdsBlack-tailed GodwitAnimal > BirdsBlack-tailed GodwitAnimal > BirdsBlack-tailed GodwitAnimal > BirdsBlack-tailed GodwitAnimal > BirdsBlack-tailed GodwitAnimal > BirdsPowerful OwlBirdsSuperb ParrotBirdsAnimal > BirdsBirdsPainted HoneyeaterAnimal > BirdsPainted HoneyeaterBirdsAnimal > BirdsBirdsAnimal > BirdsBirdsAnimal > BirdsBirdsAnimal > BirdsBirdsAnimal > BirdsBirdsAnimal > BirdsBirdsAnimal > BirdsBirdsAnimal > BirdsBirdsAnimal > <b< td=""><td>Type of SpeciesNSW statusLarge-eared Pied BatAnimal &gt; BatsVulnerableLittle Pied BatAnimal &gt; BatsVulnerableCorben's Long-eared BatAnimal &gt; BatsVulnerableYellow-bellied Sheathtail-batAnimal &gt; BatsVulnerableEastern Freetail-batAnimal &gt; BatsVulnerableEastern Cave BatAnimal &gt; BatsVulnerableMagpie GooseAnimal &gt; BirdsVulnerableAustralian BustardAnimal &gt; BirdsEndangeredBush Stone-curlewAnimal &gt; BirdsVulnerableBirdsVulnerableEndangeredBirdsVulnerableEndangeredBirdsStone-curlewAnimal &gt; BirdsVulnerableBirdsVulnerableEndangeredBirdsVulnerableEndangeredBirdsVulnerableEndangeredBirdsVulnerableEndangeredBirdsVulnerableBirdsBosy Black-CockatooAnimal &gt; BirdsVulnerableBirdsVulnerableEndangeredBirdsVulnerableBirdsBlack-necked StorkAnimal &gt; BirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerable</td></b<>	Type of SpeciesNSW statusLarge-eared Pied BatAnimal > BatsVulnerableLittle Pied BatAnimal > BatsVulnerableCorben's Long-eared BatAnimal > BatsVulnerableYellow-bellied Sheathtail-batAnimal > BatsVulnerableEastern Freetail-batAnimal > BatsVulnerableEastern Cave BatAnimal > BatsVulnerableMagpie GooseAnimal > BirdsVulnerableAustralian BustardAnimal > BirdsEndangeredBush Stone-curlewAnimal > BirdsVulnerableBirdsVulnerableEndangeredBirdsVulnerableEndangeredBirdsStone-curlewAnimal > BirdsVulnerableBirdsVulnerableEndangeredBirdsVulnerableEndangeredBirdsVulnerableEndangeredBirdsVulnerableEndangeredBirdsVulnerableBirdsBosy Black-CockatooAnimal > BirdsVulnerableBirdsVulnerableEndangeredBirdsVulnerableBirdsBlack-necked StorkAnimal > BirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerableBirdsVulnerable

OEH Threatened Species Database Results for Namoi (Liverpool Plains Part B) CMA

Lophoictinia isura	Square-tailed Kite	Animal > Birds	Vulnerable	Known
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Animal > Birds	Vulnerable	Known
Neophema pulchella	Turquoise Parrot	Animal > Birds	Vulnerable	Known
Ninox connivens	Barking Owl	Animal > Birds	Vulnerable	Known
Oxyura australis	Blue-billed Duck	Animal > Birds	Vulnerable	Known
Chthonicola sagittata	Speckled Warbler	Animal > Birds	Vulnerable	Known
Rostratula australis	Australian Painted Snipe	Animal > Birds	Endangered	Known
Stagonopleura guttata	Diamond Firetail	Animal > Birds	Vulnerable	Known
Stictonetta naevosa	Freckled Duck	Animal > Birds	Vulnerable	Known
Tyto novaehollandiae	Masked Owl	Animal > Birds	Vulnerable	Known
Anthochaera phrygia	Regent Honeyeater	Animal > Birds	Critically Endangered	Known
Glossopsitta pusilla	Little Lorikeet	Animal > Birds	Vulnerable	Known
Petroica phoenicea	Flame Robin	Animal > Birds	Vulnerable	Predicted
Petroica boodang	Scarlet Robin	Animal > Birds	Vulnerable	Known
Alectura lathami - endangered population	Australian Brush-turkey population in the Nandewar and Brigalow Belt South Bioregions	Animal > Birds	Endangered Population	Known
Hieraaetus morphnoides	Little Eagle	Animal > Birds	Vulnerable	Known
Circus assimilis	Spotted Harrier	Animal > Birds	Vulnerable	Known
Daphoenositta chrysoptera	Varied Sittella	Animal > Birds	Vulnerable	Known
Epthianura albifrons	White-fronted Chat	Animal > Birds	Vulnerable	Known
Cercartetus nanus	Eastern Pygmy-possum	Animal > Marsupials	Vulnerable	Known
Macropus dorsalis	Black-striped Wallaby	Animal > Marsupials	Endangered	Known
Petaurus norfolcensis	Squirrel Glider	Animal > Marsupials	Vulnerable	Known
Phascogale tapoatafa	Brush-tailed Phascogale	Animal > Marsupials	Vulnerable	Known
Phascolarctos cinereus	Koala	Animal > Marsupials	Vulnerable	Known

Sminthopsis macroura	Stripe-faced Dunnart	Animal > Marsupials	Vulnerable	Predicted
Aepyprymnus rufescens	Rufous Bettong	Animal > Marsupials	Vulnerable	Predicted
Dasyurus maculatus	Spotted-tailed Quoll	Animal > Marsupials	Vulnerable	Known
Petaurus australis	Yellow-bellied Glider	Animal > Marsupials	Vulnerable	Predicted
Petrogale penicillata	Brush-tailed Rock-wallaby	Animal > Marsupials	Endangered	Known
Perameles bougainville fasciata	Western Barred Bandicoot (mainland)	Animal > Marsupials	Extinct	Known
Lagorchestes leporides	Eastern Hare-wallaby	Animal > Marsupials	Extinct	Known
Onychogalea fraenata	Bridled Nailtail Wallaby	Animal > Marsupials	Extinct	Known
Dasyurus geoffroii	Western Quoll	Animal > Marsupials	Extinct	Known
Bettongia penicillata penicillata	Brush-tailed Bettong (South- East Mainland)	Animal > Marsupials	Extinct	Known
Aprasia parapulchella	Pink-tailed Legless Lizard	Animal > Reptiles	Vulnerable	Known
Hoplocephalus bitorquatus	Pale-headed Snake	Animal > Reptiles	Vulnerable	Known
Underwoodisaurus sphyrurus	Border Thick-tailed Gecko	Animal > Reptiles	Vulnerable	Known
Rattus villosissimus	Long-haired Rat	Animal > Rodents	Vulnerable	Known
Pseudomys pilligaensis	Pilliga Mouse	Animal > Rodents	Vulnerable	Predicted
Pseudomys australis	Plains Rat	Animal > Rodents	Extinct	Known
Conilurus albipes	White-footed Tree-rat	Animal > Rodents	Extinct	Known
Pseudomys gouldii	Gould's Mouse	Animal > Rodents	Extinct	Known
Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South Bioregions	Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South bioregion	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Native Vegetation on Cracking Clay Soils of the Liverpool Plains	Native Vegetation on Cracking Clay Soils of the Liverpool Plains	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
--	--	---	---------------------------------------	-----------
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Predicted
White Box Yellow Box Blakely's Red Gum Woodland	White Box Yellow Box Blakely's Red Gum Woodland	Community > Threatened Ecological Communities	Endangered Ecological Community	Predicted
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Tylophora linearis	Tylophora linearis	Plant > Epiphytes and Climbers	Vulnerable	Known
Dichanthium setosum	Bluegrass	Plant > Herbs and Forbs	Vulnerable	Known
Lepidium aschersonii	Spiny Peppercress	Plant > Herbs and Forbs	Vulnerable	Known
Thesium australe	Austral Toadflax	Plant > Herbs and Forbs	Vulnerable	Known

Homopholis belsonii	Belson's Panic	Plant > Herbs and Forbs	Endangered	Known
Cyperus conicus	Cyperus conicus	Plant > Herbs and Forbs	Endangered	Predicted
Digitaria porrecta	Finger Panic Grass	Plant > Herbs and Forbs	Endangered	Known
Swainsona murrayana	Slender Darling Pea	Plant > Herbs and Forbs	Vulnerable	Known
Pomaderris queenslandica	Scant Pomaderris	Plant > Shrubs	Endangered	Known
Cadellia pentastylis	Ooline	Plant > Trees	Vulnerable	Known
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	Threat > Disease	Key Threatening Process	Predicted
Infection of native plants by Phytophthora cinnamomi	Infection of native plants by Phytophthora cinnamomi	Threat > Disease	Key Threatening Process	Predicted
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	Threat > Disease	Key Threatening Process	Predicted
Alteration of habitat following subsidence due to longwall mining	Alteration of habitat following subsidence due to longwall mining	Threat > Habitat Loss/Change	Key Threatening Process	Predicted
Bushrock removal	Bushrock Removal	Threat > Habitat Loss/Change	Key Threatening Process	Predicted
Clearing of native vegetation	Clearing of native vegetation	Threat > Habitat Loss/Change	Key Threatening Process	Predicted
Anthropogenic Climate Change	Human-caused Climate Change	Threat > Habitat Loss/Change	Key Threatening Process	Predicted
Loss of Hollow-bearing Trees	Loss of Hollow-bearing Trees	Threat > Habitat Loss/Change	Key Threatening Process	Predicted
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands.	Threat > Habitat Loss/Change	Key Threatening Process	Predicted
Loss or degradation (or both) of sites used for hill-topping by butterflies	Loss and/or degradation of sites used for hill-topping by butterflies	Threat > Habitat Loss/Change	Key Threatening Process	Predicted

Removal of dead wood and dead trees	Removal of dead wood and dead trees	Threat > Habitat Loss/Change	Key Threatening Process	Predicted
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	Ecological consequences of high frequency fires	Threat > Habitat Loss/Change	Key Threatening Process	Predicted
Forest eucalypt dieback associated with over- abundant psyllids and Bell Miners	Forest eucalypt dieback associated with over- abundant psyllids and Bell Miners	Threat > Other Threat	Key Threatening Process	Predicted
Competition from feral honey bees, Apis mellifera L.	Competition from feral honeybees	Threat > Pest Animal	Key Threatening Process	Predicted
Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	Invasion of the yellow crazy ant (Anoplolepis gracilipes) into NSW	Threat > Pest Animal	Key Threatening Process	Predicted
Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Threat > Pest Animal	Key Threatening Process	Predicted
Invasion and establishment of the Cane Toad (Bufo marinus)	Invasion and establishment of the Cane Toad	Threat > Pest Animal	Key Threatening Process	Predicted
Predation and hybridisation by Feral Dogs, Canis lupus familiaris	Predation and hybridisation by Feral Dogs, Canis lupus familiaris	Threat > Pest Animal	Key Threatening Process	Predicted
Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	Introduction of the large earth bumblebee (Bombus terrestris)	Threat > Pest Animal	Key Threatening Process	Predicted
Predation by the Feral Cat Felis catus (Linnaeus, 1758)	Predation by feral cats	Threat > Pest Animal	Key Threatening Process	Predicted
Herbivory and environmental degradation caused by feral deer	Herbivory and environmental degradation caused by feral deer	Threat > Pest Animal	Key Threatening Process	Predicted
Predation by the European Red Fox Vulpes Vulpes (Linnaeus, 1758)	Predation by the European Red Fox	Threat > Pest Animal	Key Threatening Process	Predicted
Predation by Gambusia holbrooki Girard, 1859 (Plague Minnow or Mosquito Fish)	Predation by the Plague Minnow (Gambusia holbrooki)	Threat > Pest Animal	Key Threatening Process	Predicted
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 )	Threat > Pest Animal	Key Threatening Process	Predicted

Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Importation of red imported fire ants into NSW	Threat > Pest Animal	Key Threatening Process	Predicted
Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Competition and grazing by the feral European rabbit	Threat > Pest Animal	Key Threatening Process	Predicted
Invasion of native plant communities by exotic perennial grasses	Invasion of native plant communities by exotic perennial grasses	Threat > Weed	Key Threatening Process	Predicted
Invasion of native plant communities by Chrysanthemoides monilifera	Invasion of native plant communities by bitou bush & boneseed	Threat > Weed	Key Threatening Process	Predicted
Invasion, establishment and spread of Lantana (Lantana camara L. sens. Lat)	Invasion, establishment and spread of Lantana (Lantana camara L. sens. lat)	Threat > Weed	Key Threatening Process	Predicted
Invasion and establishment of exotic vines and scramblers	Invasion and establishment of exotic vines and scramblers	Threat > Weed	Key Threatening Process	Predicted
Invasion of native plant communities by African Olive Olea europaea L. subsp. cuspidata (Wall ex G. Don Cirferri)	Invasion of native plant communities by African Olive Olea europaea L. subsp. cuspidata (Wall ex G. Don Cirferri)	Threat > Weed	Key Threatening Process	Predicted
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	Threat > Weed	Key Threatening Process	Predicted
Invasion and establishment of Scotch Broom (Cytisus scoparius)	Invasion and establishment of Scotch Broom (Cytisus scoparius)	Threat > Weed	Key Threatening Process	Predicted

# Bionet/ Wildlife Atlas Licensed Search Results

	17.04.04		2	
snowing records for:	17-21 Alfor	a Ka	, Gunnedan NSW 2380, Australia 🐚	
Display records in a	1 <b>•</b> km	radiu	s <u>View all occurrence records</u> Dow	nload
Group	Species		Species : Common Name	Records
All Species	7	1.	Bothriochloa biloba : Lobed Bluegrass	1
Animals	5	2.	Ficus rubiginosa f. rubiginosa	1
Mammals	4	3.	Phascolarctos cinereus : Koala	4(
Birds	1	4.	Tachyglossus aculeatus : Short-beaked Echidna	4
Reptiles	0	5.	Threskiomis spinicollis : Straw-necked Ibis	1
Amphibians	0	6.	Vombatus ursinus : Bare-nosed Wombat	1
Fish	0	7.	Vulpes vulpes : Fox	7
Molluscs	0			
Arthropods	0			
Crustaceans	0			
Insects	0			
Plants	2			
Bryophytes	0			
Gymnosperms	0			
FernsAndAllies	0			
Angiosperms	2			
Monocots	1			
Dicots	1			
Fungi	0			
Chromista	0			
Protozoa	0			
Bacteria	0			
Algoe	0			



Tip: you can fine-tune the location of the area by dragging the red marker icon

# **EPBC** Protected Matters Search Results

Australian Government Department of Sustainability, Environment, Water, Population and Communities

# 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 <u>Environment Assessments</u> and the EPBC Act including significance guidelines, forms and application process details.

Report created: 05/11/12 11:49:17

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: 1.0Km



#### 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 <u>Administrative Guidelines on Significance</u>.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	20
Listed Migratory Species:	13

#### 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 <u>heritage values</u> of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

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.

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:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	10
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

#### Extra Information

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

Place on the RNE:	2
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	10
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

## Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities 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.

Name	Status	Type of Presence
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of	Endangered	Community may occur within area
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and	Critically Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area
Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anthochaera phrygia		
Regent Honeyeater [82338]	Endangered	Species or species habitat may occur within area
Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor		
Swift Parrot [744]	Endangered	Species or species habitat may occur within area
Leipoa oceiiata		
Malleefowi [934]	Vulnerable	Species or species habitat may occur within area
Superb Parrot [738]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Rostratula australis		.,,
Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
Fish		
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Frogs		
Litoria booroolongensis		
Booroolong Frog [1844]	Endangered	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Nyctophilus corbeni South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within
		area
Phascolarctos cinereus (combined populations of Qld, 1	NSW and the ACT)	
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Plants		
Digitaria porrecta		
Finger Panic Grass [12768]	Endangered	Species or species habitat likely to occur within area
[64942]	Vulnerable	Species or species habitat likely to occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269)		
a leek-orchid (81964)	Critically Endangered	Species or species habitat may occur within area
Cobar Greenhood Orchid [12993]	Vulnerable	Species or species
		within area
Swainsona murrayana Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]	Vulnerable	Species or species habitat likely to occur within area
Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area
Reptiles		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat known to occur within area
Listed Migratory Species		[Resource Information ]
* Species is listed under a different scientific name on th	e EPBC Act - Threatened	Species list.
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species

Name	Threatened	Type of Presence
		habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Mhite bellied See Eagle (242)		Species of species
white-bellied Sea-Eagle [943]		habitat likely to occur within area
Hirundapus caudacutus		Creation or ornation
vvnite-throated iveedietali [662]		habitat may occur within area
Leipoa oceilata	Vulnerable	
Malleerowi (934)	vuinerable	habitat may occur within area
Merops ornatus		Creation of creation
Rainbow Bee-eater [6/0]		Species or species habitat may occur within area
Myiagra cyanoleuca		<b>6</b>
Satin Flycatcher [612]		Species or species habitat may occur within area
Xanthomyza phrygia		
Regent Honeyeater [430]	Endangered*	Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba		
Great Egret, white Egret [59541]		habitat may occur within area
Cattle Earct (59542)		Spacing of enoring
Cattle Eğler [39342]		habitat may occur within area
Gallinago hardwickii		Creation of the second second
Latnam's Snipe, Japanese Snipe (863)		area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area
Other Matters Protected by the EPBC Act		
Commonwealth Land		[Resource Information
The Commonwealth area listed below may indicate to vicinity. Due to the unreliability of the data source, all impacts on a Commonwealth area, before making a government land department for further information.	te presence of Commo proposals should be c definitive decision. Con	onwealth land in this hecked as to whether it tact the State or Territory
Name		
Commonwealth Land - Australian Telecommunication	ns Commission	
Listed Marine Species		[ Resource Information
* Species is listed under a different scientific name or	the EPBC Act - Three	atened Species list.
Name	Threatened	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species

		_
Name	Threatened	Type of Presence
		habitat likely to occur
Ardea alba		within area
Great Earst White Earst (59541)		Species or species
Great Egret, White Egret [38541]		babitat may occur within
		area
Ardea ibis		
Cattle Egret [59542]		Species or species
		habitat may occur within
		area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species
		habitat may occur within
Heller sheet have a sector		area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species
		habitat likely to occur
Hinundanus caudacutus		within area
White threated Needlatail [682]		Spacing or epocing
White-throated Needletan [002]		habitat may occur within
		area
Lathamus discolor		
Swift Parrot [744]	Endangered	Species or species
	-	habitat may occur within
		area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species
		habitat may occur within
		area
Mylagra cyanoleuca		
Satin Flycatcher [612]		Species or species
		nabitat may occur within
Rostratula honghalonsis (sonsu lato)		area
Painted Spine (889)	Vulnerable*	Species or species
anned onlye [ooa]	vunerable	habitat may occur within
		area

#### Extra Information

Places on the RNE			[Resource Information]
Note that not all Indigenous sites	may be listed.		
Name		State	Status
Historic			
Gunnedah General Cemetery		NSW	Indicative Place
Gunnedah Railway Station		NSW	Registered
Invasive Species			[Resource Information]
Weeds reported here are the 20 plants that are considered by the biodiversity. The following feral a and Cane Toad. Maps from Land 2001.	species of national significance States and Territories to pose a nimals are reported: Goat, Red Iscape Health Project, National	(WoNS), along particularly si Fox, Cat, Rabit and and Wate	with other introduced gnificant threat to oit, Pig, Water Buffalo er Resouces Audit,
Name	Status		Type of Presence
Mammals			
Capra hircus			
Goat [2]			Species or species

habitat likely to occur within area

## Name

Felis catus Cat, House Cat, Domestic Cat [19]

Oryctolagus cuniculus Rabbit, European Rabbit [128]

#### Sus scrofa Pig [6]

Vulpes vulpes Red Fox, Fox [18]

#### Plants

Lycium ferocissimum African Boxthorn, Boxthorn [19235]

#### Pinus radiata

Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]

Rubus fruticosus aggregate Blackberry, European Blackberry [68406]

Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]

#### Tamarix aphylla

Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018] Type of Presence

Status

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat may occur within area

Species or species habitat may occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

#### Coordinates

-30.978334 150.242773,-30.978257 150.242926,-30.980465 150.242697,-30.9861 150.236834, -30.991963 150.233332,-30.995389 150.23257,-30.994933 150.228459,-30.980542 150.234931,-30.978334 150.242773

#### 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 Heritage and Register of National Estate properties, Wetlands of International 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.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

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.

#### 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:

-Department of Environment, Climate Change and Water, New South Wales -Department of Sustainability and Environment, Victoria -Department of Primary Industries, Parks, Water and Environment, Tasmania -Department of Environment and Natural Resources, South Australia -Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts -Environmental and Resource Management, Queensland -Department of Environment and Conservation, Western Australia -Department of the Environment, Climate Change, Energy and Water -Birds Australia -Australian Bird and Bat Banding Scheme -Australian National Wildlife Collection -Natural history museums of Australia -Museum Victoria -Australian Museum -SA 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, Atherton and Canberra -University of New England -Ocean Biogeographic Information System -Australian Government, Department of Defence -State Forests of NSW -Geoscience Australia -CSIRO -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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# APPENDIX 2: ASSESSMENT OF SIGNIFICANCE

7-Part Test Criteria	Koala Phascolarctos cinereus	Powerful Owl, Barking Owl
1) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.	<ul> <li>Local Population: In New South Wales, koala populations generally occur along the central and northern coasts, with some populations occurring in the western region, including to the west of Gunnedah.</li> <li>The Gunnedah koala population was the subject of a study conducted by the National Parks and Wildlife Service (Smith, 1992). The study identified that healthy, Chlamydia free populations of koalas occurs in the region, with strong fecundity. The study identified that while koala numbers had increased over the previous 30 years diminishing availability of habitat, increased vehicle strikes, and increasing distances between feed trees was resulting in stress and illness to the local population. A recent study also identified a significant increase in the Gunnedah Koala population in 2006, compared with Koala populations in 1986 (Lunney 2009). Additional key points outlined in the Smith study were: White Box (E. albens) is a preferred feed tree in the region, while Blakely's Red Gum (Eucalyptus blakelyi), Tumbledown Red Gum (E. dealbata), White Cypress Pine (Callitris glaucophylla), Bimble Box, and Narrow-leaved Grey Box (E. microcarpa-pilligaensis) are also important and favoured food trees; A significant number of koalas utilise roadside vegetation as movement passages, and are vulnerable to car-induced injuries and/or mortality; Koalas favour hills and mountains in the region, due to the generally heavily-wooded condition; and Koalas show a strong propensity to locate on better quality soils. A more recent study (Crowther and Lunney 2006) found that koalas are not restricted to using old-growth eucalypts and will frequently use 10- to 20-year-old tree plantings, often moving several kilometres between patches to find the right food and shelter. In 2010 the Koala population in Gunnedah region due to revegetation was inferred to increase by 3000.</li> <li>A viable local population is considered to occur in the Study Area due to the abundance of evidence (scats and scratches) in addition</li></ul>	<ul> <li>Local Population: None identified. Due to the abundance of large hollow bearing trees near Blackjack Creek and in proximity to the Namoi River, both species are assumed to be present in the Study Area. Having said this no wildlife Atlas records exist for these species in proximity to the Study Area.</li> <li>A viable local population may occur in the Study Area due to the abundance of suitable hollow bearing trees.</li> <li>The Proposal is unlikely to affect the life cycle of the species such that a viable local population is likely to be placed at risk of extinction.</li> </ul>

# 7-part tests (TSC Act) for the Koala, Powerful Owl and Barking Owl.

7-Part Test Criteria	Koala Phascolarctos cinereus	Powerful Owl, Barking Owl
	species putting it at risk of extinction. The trees in the impact footprint are also considered to form part of a movement corridor connecting with habitat along the Namoi River and vegetated hills and ridgelines south of Gunnedah.	
2) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.	Not relevant	Not relevant
<ul> <li>3) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</li> <li>(i) is likely to have an adverse effect on the extent of the ecological community such that its occurrence is likely to be placed at risk of extinction, or</li> <li>(ii) is likely to substantially and adversely modify the composition of the ecological occurrence is likely to be placed at risk of extinction, or</li> </ul>	Not relevant	Not relevant
<ul> <li>4) in relation to habitat of a threatened species, population or ecological community:</li> <li>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and</li> <li>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</li> <li>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the</li> </ul>	<ul> <li>Core Koala Habitat would be impacted. Impacts are detailed in Section 7 of this report.</li> <li>Habitat is already extremely fragmented would not become further fragmented or isolated.</li> <li>Koalas will have more appropriate habitat outside of the Study Area that will remain untouched by the Proposal.</li> </ul>	<ul> <li>Impacts are detailed in Section 7 of this report.</li> <li>Impacts would occur to several large hollow bearing trees with suitable owl nesting/roosting hollows.</li> <li>Habitat is already extremely fragmented would not become further fragmented or isolated.</li> </ul>

7-Part Test Criteria	Koala Phascolarctos cinereus	Powerful Owl, Barking Owl
species, population or ecological community in the locality.		
5) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).	<ul> <li>Critical habitat for this species has not been declared. However due to its speciality feeding requirements, any feed trees in core Koala breeding habitat are likely to be considered as critical habitat. Using this analogy, critical habitat for the Koala occurs in the Study Area as it has been assessed that the habitat in the Study Area is Core Koala Habitat.</li> </ul>	Critical habitat for these species has not been declared.
6) whether the actions proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.	<ul> <li>A Koala Recovery Plan (DECC 2008) and National Koala Conservation and Management Strategy 2009–2014 (DEWHA 209) exist for the koala. As an iconic Australian species there is much interest in the conservation of the Koala. Habitat removal is not consistent with these plans. The Proposal is not consistent with the Koala Recovery Plan.</li> </ul>	<ul> <li>No recovery plan exists for these species. There is no threat abatement plan.</li> </ul>
7) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	<ul> <li>Schedule 4 of the TSC Act currently lists 36 key threatening processes.</li> <li>KTPs such as clearing of native vegetation, and loss of hollow bearing trees, will be exacerbated by the Proposal. Predation by the European red fox (Vulpes vulpes) and Predation by the feral cat (Felis catus), have or are currently occurring with Study Area. The removal of trees is likely to increase the koalas vulnerability to foxes during periods of movement along the ground.</li> </ul>	As per the left hand column.
Conclusion	• The Proposal is considered likely to cause an impact to a locally occurring population of this species such that it is placed at risk of local extinction. A SIS is should be prepared to further characterise the impact to this species.	• The proposal is likely to directly remove breeding habitat. The proposal is unlikely to cause impact to a locally occurring population of this species such that it is placed at risk of local extinction. A SIS is not required.

7-Part Test Criteria	Microbats	Little Lorikeet
1) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.	<ul> <li>Local population: No positive identification. All species of hollow dependent microbat have the potential to utilise hollow-bearing trees within the Study Area as roosting habitat.</li> <li>No local populations of microbats are known to occur in or adjacent to the Study Area</li> <li>The Study Area contains foraging and roosting resources for bats within the Study Area and Blackjack Creek that attract insects and nearby Grassy White Box Woodland EEC</li> <li>Due to the small scale of the Proposal it is unlikely to temporarily affect the dynamics of the local population.</li> <li>A local population being placed at risk of extinction is unlikely due to the minimal number of habitat to be affected and adjacent Poplar Box Woodland and Box-Gum Woodland (which provides analogous habitat) adjoining the Study Area).</li> </ul>	Definition of 'local population': Several small flocks of Little Lorikeets were observed in the Study Area. Birds were observed crop feeding young in the Study Area. Over 50 birds were identified utilising habitat in the Study Area.
2) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.	Not relevant	Not relevant
<ul> <li>3) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</li> <li>(i) is likely to have an adverse effect on the extent of the ecological community such that its occurrence is likely to be placed at risk of extinction, or</li> <li>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its</li> </ul>	Not relevant	Not relevant

7-part tests (TSC Act) for Hollow Dependant Microbats and the Little Lorikeet.

7-Part Test Criteria	Microbats	Little Lorikeet
local occurrence is likely to be placed at risk of extinction,		
<ul> <li>4) in relation to habitat of a threatened species, population or ecological community:</li> <li>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and</li> <li>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</li> <li>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</li> </ul>	<ul> <li>Impacts are detailed in Section 7 of this report.</li> <li>Impacts would occur to several hollow bearing trees with suitable small nesting/roosting hollows.</li> <li>Habitat is already extremely fragmented would not become further fragmented or isolated.</li> </ul>	<ul> <li>The habitat to be removed is feeding and potential breeding habitat. As this species is highly mobile it has the ability to utilise feeding and breeding resources outside the Study Area. As such removal of a small area of habitat cannot be considered critical to the survival of this species.</li> </ul>
5) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).	Critical Habitats do not occur in the locality.	Critical habitat for this species has not been declared.
6) whether the actions proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.	There are no recovery or threat abatement plans for these species. The only relevant document is the "Action Plan for Australian Bats (Environment Australia 1999).	No recovery plan exists for this species. There is no threat abatement plan.
7) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	<ul> <li>Schedule 4 of the TSC Act currently lists 36 key threatening processes.</li> <li>KTPs such as: Clearing of native vegetation and removal of hollow bearing trees will be exacerbated by the Proposal. Predation by the European red fox (Vulpes vulpes) and Predation by the feral cat (Felis catus), have or are currently occurring with Study Area.</li> </ul>	As per left hand column
Conclusion	• The affect to environs to which threatened microbats are dependant would not be significant such that a viable local population is placed at risk of local extinction.	• The affect to environs to which threatened the Little Lorikeet are dependant would not be significant such that a viable local population is placed at risk of local extinction.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it would:	Koala	Greater Long-eared Bat (V) EPBC Act 1999.
<ul> <li>lead to a long-term decrease in the size of an important population, or</li> </ul>	<ul> <li>The population of Koalas in the Study Area is considered an important population. A viable local population is considered to occur in the Study Area due to the abundance of evidence (scats and scratches) in addition to recording a Koala.</li> <li>A viable local population is considered to occur in the Study Area due to the abundance of evidence (scats and scratches) in addition to recording a Koala. Aviable local population is considered to occur in the Study Area due to the abundance of evidence (scats and scratches) in addition to recording a Koala. Removal of feed trees including large trees that are preferred by the koala is considered likely to disrupt a viable local population of the species putting it at risk of extinction. The trees in the impact footprint are also considered to form part of a movement corridor connecting with habitat along the Namoi River and vegetated hills and ridgelines south of Gunnedah. Thus removal of this vegetation may reduce or sever the exchange of individuals within sub-populations or restrict movement along the Namoi River.</li> </ul>	<ul> <li>Important population: No positive identification. The Greater Long-eared Bat has the potential to utilise Poplar Box habitat in the Study Area and adjacent Box-Gum Woodland.</li> <li>A long-term decrease in the size of an important population is unlikely given the spatial extent of quality habitat outside the Study Area. and adjacent Box-Gum Woodland (which provides analogous habitat) adjoining the Study Area).</li> <li>The removal of foraging and potential roosting habitat is not considered to be a significant amount in relation to the amount of similar habitat that will remain unaffected in the Study Area.</li> </ul>
<ul> <li>reduce the area of occupancy of an important population, or</li> </ul>	The Proposal will not reduce an area of occupancy.	The potential population of Greater Long-eared Bat in the Study Area is not considered an important population.
<ul> <li>fragment an existing important population into two or more populations, or</li> </ul>	<ul> <li>The proposal will not fragment an existing important population into two or more populations.</li> </ul>	<ul> <li>The population of Greater Long-eared Bat in the Study Area is not considered an important population.</li> <li>The nature of clearing for the proposed development action will not isolate habitat for the Greater Long-eared Bat and will not fragment an existing population into two or more populations due to the species' large foraging range.</li> </ul>
<ul> <li>adversely affect habitat critical<sup>2</sup> to the survival of a species, or</li> </ul>	• The Proposal is situated within Core Koala Habitat. Core Koala Habitat is considered critical to the survival of the species.	<ul> <li>The mobile nature of the species allows the Greater Long- eared Bat to occupy foraging and roosting resources outside the Study Area that are adequate for the species survival.</li> </ul>

# DSEWPaC Assessment of significance the Koala and Greater Long-eared Bat

habitat identified in a recovery plan for the species as habitat critical for those species or communities; and/or i) habitat listed on the Register of Critical Habitat maintained by the Minister under the Act; and/or

- for activities such as foraging, breeding, roosting, or dispersal;
- for succession;
- to maintain genetic diversity and long term evolutionary development; or
- for the reintroduction of populations or recovery of the species.

<sup>&</sup>lt;sup>2</sup> Habitat critical to the survival of a species refers to:

areas that are necessary: ii)

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it would:	Koala	Greater Long-eared Bat (V) EPBC Act 1999.
		<ul> <li>Relatively small areas of foraging and roosting cannot be considered critical to the survival of the species in context with the broader landscape.</li> <li>It is unlikely that the action will adversely affect habitat critical to the survival of the species.</li> </ul>
disrupt the breeding cycle of a population, or	<ul> <li>As the works will occur in Core Koala Habitat, the works have the potential to disrupt a locally occurring breeding population.</li> </ul>	<ul> <li>Little is known about the breeding biology and reproduction of this species.</li> <li>The population of Greater Long-eared Bat in the Study Area is not considered an important population.</li> </ul>
<ul> <li>modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or</li> </ul>	<ul> <li>The Proposal will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that it is possible the species is likely to decline. Any identified Core Koala Habitat is considered critical to the survival of the species.</li> </ul>	<ul> <li>Habitat to be removed is a relatively small area in relation to similar habitat remaining adjacent to the Study Area.</li> <li>The removal of habitat is unlikely to decrease the availability of habitat or result in the decline habitat condition for this species. The large home range of the species allows offsite foraging resources to be used and isolation of habitat will not result from the proposal.</li> <li>It is unlikely that the Proposal would isolate and decrease the availability of quality habitat to the extent that the species is likely to decline.</li> </ul>
<ul> <li>result in invasive species that are harmful to a vulnerable species becoming established in the species habitat, or</li> </ul>	• Invasive species are already established in the Study Area. Rehabilitation post the works is likely to assist in removing invasive species from the Study Area. However the removal of trees is likely to increase the koala vulnerability to foxes during periods of movement along the ground.	<ul> <li>It is unlikely that further invasive species that are harmful to the Greater Long-eared Bat would become established.</li> </ul>
<ul> <li>interferes substantially with the recovery of the species.</li> </ul>	The Proposal has the potential to interfere with the recovery of the species.	• The Action Plan for Australian Bats (Duncan et al. 1999) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific roosting requirements. However, based on the potential ecological impacts of the proposal on the species as discussed above, it is unlikely that the Proposal would interfere with the recovery of this species.
Conclusion	<ul> <li>Koala habitat trees within' Core Koala Habitat' will be impacted;</li> <li>Koala habitat trees to be impacted provide connectivity between the Namoi River and forested areas around Gunnedah</li> <li>Impacts will occur within a town which considers itself to be the 'Koala Capitol of the World'</li> </ul>	<ul> <li>It is unlikely that this species would be significantly impacted by the Project. Referral to the Commonwealth Minister of the Environment is not required.</li> </ul>

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it would:	Koala	Greater Long-eared Bat (V) EPBC Act 1999.
	<ul> <li>Being an endangered species at both state and federal level, the proposed impacts do not consider the economic and non-biological values of koalas to the Gunnedah community or reflect the recovery strategies for the Koala outlined in the Draft National Koala Recovery Plan.</li> <li>Referral to the Commonwealth Minister of the Environment is required.</li> </ul>	

**APPENDIX 3: DESIGN DETAIL** 

			Shire of Gunnedah Land of Opportunity					
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Securit ons			COVERSHEET	BLACKJA	CK CREEK CHA	ANNEL RECONSTRUCTION		Icx 1498 Tamworth NSW 2340 Australia (02) 6762 1969 Fax: (02) 6762 1969 I: admin@constructivesolutions.com.au www.constructivesolutions.com.au
A 31.05.2012 DB REV. DATE BY	ISSUED FOR REVIEW	ik.		Destan Completed 29.05.2012	Designed: Status: DB	DRAFT	Plan Size: A1	Drewling No: 201201-002









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# APPENDIX I Vegetation Management Plan





Blackjack Creek Riparian Corridor/Channel Reconstruction Vegetation Management Plan

January 2013



**Realising** potential



# Report prepared by:



Realising potential

PO Box 1498 TAMWORTH NSW 2340 Phone: 02 6762 1969 Fax: 02 6762 1969

# Director: Steve O'Rourke

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Issue	Rev	Issued To	Qty	Date	Reviewed	Approved
1	А	S. O'Rourke	1	20/12/12	S. <b>O'Rourke</b>	S. <b>O'Rourke</b>
1	В	Gunnedah Shire Council	1	08/01/13	L. Johnson	M. Silver
1	1	Gunnedah Shire Council	1	11/01/13		

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APPE	NDIX C Planting Guide	
APPE	NDIX D Monitoring and Maintenance Checklists	


#### 1. Introduction

Gunnedah Shire Council (GSC) is proposing to reconstruct the Blackjack Creek riparian corridor/channel in order to provide for flood mitigation. GSC has completed extensive investigations to date, culminating in the preparation of the Blackjack Creek Riparian Corridor/Channel Reconstruction Concept Design and Feasibility Study (Constructive Solutions 2012).

As part of Stage 3 – Technical Review and Detailed Design – of the Blackjack Creek Riparian Corridor/Channel Reconstruction Concept Design and Feasibility Study, a Review of Environmental Factors (REF) has been prepared. This REF recommends that a Vegetation Management Plan (VMP) be prepared for the Blackjack Creek Riparian Corridor/Channel Reconstruction in accordance with the NSW Office of Water (NOW) *Guidelines for vegetation management plans on waterfront land* (2012).

Although GSC is exempt from requiring a Controlled Activity Approval (CAA) under the *Water Management Act 2000* (WM Act) through the provisions of the *Water Management (General) Regulation 2011*, this VMP has been prepared to meet the NOW requirements for the preparation of a VMP where a Controlled Activity Approval for disturbance to waterfront land is required.

The VMP addresses the NOW criteria for the preparation of a VMP in the following sections:

- Locality details of the location of the bed and banks, riparian corridor width, maps, site photographs, and access arrangements;
- Species selection and application details of vegetation species composition, planting layout, planting densities, and sources of seed;
- Revegetation methods rehabilitation methods, staging and schedule;
- Maintenance and monitoring provisions for monitoring and maintenance during and post-construction; and
- Costs details of the costs associated with revegetation and maintenance.



### 2. Locality

The Blackjack Creek Riparian Corridor/Channel Reconstruction (the Reconstruction) traverses Wandobah Reserve and the agricultural properties 'Fermanagh' and 'Balmoral' in Gunnedah.

Using the Land and Property Information Spatial Information Exchange SIX Viewer it was identified that Blackjack Creek is a 2<sup>nd</sup> order stream, as per the Strahler classification system. The NOW *Guidelines for riparian corridors on waterfront land* (2012) recommends that the Vegetated Riparian Zone (VRZ) width for 2<sup>nd</sup> order streams should be 20m on each side of the watercourse from the highest point of the bank.

The Reconstruction will result in a 30m channel width for the majority of the **Reconstruction length, with a 20m width spanning 'Balmoral'. As such, the** Riparian Corridor (RC) for the Reconstruction will be approximately 100m encompassing 30m of channel, additional area to the top of the channel banks at an average 1 in 4 slope, and 20m of VRZ on either side of the channel. Figure 1 illustrates a typical VRZ.





The Reconstruction location, current conditions, channel width, bank width, and VRZ width of the Reconstruction are illustrated in the *Blackjack Creek Riparian Corridor/Channel Reconstruction Detailed Design* (Constructive Solutions 2012).

Access to Wandobah Reserve can be obtained from Wandobah Road to the east or from unformed tracks off Alford Road to the west. Access to the **Reconstruction for 'Fermanagh' and 'Balmoral' can be obtained from the private** access tracks within those properties. No long-term measures for preventing access or encroachment to the Reconstruction site for Wandobah Reserve are proposed, however the RC may be fenced within the private properties.

Photographs of the Reconstruction site in its current condition, including coordinates to facilitate ongoing monitoring, are provided in **APPENDIX A**.



### 3. Species Selection and Application

Revegetation of the Reconstruction is to be carried out in accordance with the NOW *Guidelines for vegetation management plans on waterfront land* (2012) which delineates the RC into 4 zones – the stream, toe, middle and upper. These are illustrated in Figure 2. As per the guidelines, the main objective is to provide a stable watercourse and riparian zone which will emulate local native vegetation communities.

As the Reconstruction site has been identified as Core Koala Habitat, it is proposed to give preference to Koala feed tree species during revegetation in order to provide for an increase in Koala habitat at the Reconstruction site and to facilitate the use of the Reconstruction as a wildlife corridor for fauna species travelling from habitat located to the south towards the Namoi River to the north.



Figure 1 – Typical riparian cross section (NOW 2012)

For the Reconstruction, the widths of the 4 RC zones will generally be:

- Stream 30m;
- Toe 10m (5m on either side of the stream on the inner bank);
- Middle 20m (10m on either side of the stream on the inner bank); and



• Upper - 40m (20m on either side of the stream from the top of the bank).

In order to emulate local native vegetation communities the species to be used in revegetation of the Reconstruction have been derived from the Namoi Catchment Management Authority guide *Native Plants for Creek and Rivers in the Namoi* (2012). Blackjack Creek is located in the Alluvial Plains of Area C in the Namoi Catchment and is classified as a riparian area. **APPENDIX B** provides the recommended planting list for the Reconstruction, including the name, description, propagation method and riparian zone for each species.

The recommended planting list will be adhered to a closely as possible, with the potential for some species exclusions to occur based on seed and/or seedling availability. Anticipated planting densities are provided in Table 1.

Planting layout and density will be dictated by the riparian zone location, with all planting to occur in an irregular fashion in order to mimic the natural growth of plants rather than in lines.

Zone	Area	Vegetation Type	Density	Total to be Planted
Upper	80,000m <sup>2</sup>	Trees	1 per 80m <sup>2</sup>	1,000
		Shrubs	1 per 50m <sup>2</sup>	1,600
Middle	40,000m <sup>2</sup>	Shrubs	1 per 25m <sup>2</sup>	1,600
		Herbs	1 per 10m <sup>2</sup>	4,000
Тое	20,000m <sup>2</sup>	Sedges and Rushes	5 per 1m <sup>2</sup>	100,000
Entire RC	200,000m <sup>2</sup>	Grasses	15kg per ha	300kg

#### Table 1 – Anticipated planting densities

It should be noted that the above anticipated planting densities are based on open space with no existing vegetation. As there is extensive existing vegetation within Wandobah Reserve, the overall densities will be significantly higher than those indicated in the table. These higher densities will contribute to the overall function of the Reconstruction as a riparian corridor.

GSC currently sources seed and seedlings from Gunnedah Forestry Nursery and Fields Native Nursery in Uralla. The volumes required for the Reconstruction may result in the need to source additional volumes elsewhere. GSC will endeavour to ensure that seed and tubestock sources are located as close to Gunnedah as possible in order to provide for seed provenance.



### 4. Revegetation Methods

Revegetation will be undertaken utilising various methods, including hydromulching, conventional planting, and long-stem planting, depending on the species, location and establishment requirements. Examples of these are provided in Table 2.

Vegetation Type	<b>Revegetation Method</b>	Common Zones
Sedges and Rushes	Conventional planting	Toe; in rip rap surrounding stormwater outlets
Grasses	Hydromulching	Stream, toe, middle and upper
Herbs	Conventional planting	Middle and upper
Wattles	Long-stem planting	Middle and upper
Shrubs	Long-stem planting	Middle and upper
Trees	Long-stem planting	Upper

#### Table 2 - Revegetation methods

Appropriate site preparation, including eradication of noxious weeds, is to be undertaken prior to commencement of revegetation.

## 4.1 **Conventional Planting**

Conventional planting of seedlings is used in many revegetation projects. The benefits of seedlings include:

- Higher, more guaranteed survival rates;
- The ability to select species; and
- The ability to plan final spacing and densities of planting.

The use of seedlings as opposed to direct seeding is appropriate where rapid growth is required, with seedlings achieving faster growth rates in the first year after establishment than germinants from direct seeding (Schirmer and Field 2000).

The use of seedlings for conventional planting in the Reconstruction instead of seeds will facilitate quicker establishment of soil stablising sedges, rushes and herbs, with quick establishment of these essential in order to mitigate potential



erosion. This is particularly important in areas surrounding stormwater outlets and where high erosive potential occurs. Conventional planting of seedlings, in conjunction with the stablilisation measures proposed in the Reconstruction design, such as reno mattresses and jute mesh, will ensure that the Reconstruction is stablised quickly following construction.

The use of 'Hiko' or multi-cell seedlings has increased in revegetation projects, as they are easy to propagate and plant and have a smaller cost when compared to standard and advanced seedlings (Schirmer and Field 2000). As such, it is proposed to source multi-cell seedlings for the herb, sedge and rush species to be used in the revegetation of the Reconstruction.

# 4.2 Long-stem Planting

Long-stem planting requires the planting of seedlings which have been matured for longer than conventional seedlings to three-quarters of their length below the soil surface, with the buried stem and leaf nodes developing roots. The benefits of long-stem planting include:

- The creation of an older, stronger seedling for planting due to the consistent nutrients and water provided in the longer nursery period;
- Insulation of the deeply planted root ball from changes in soil temperature and moisture;
- Increased chance of survival in hotter and drier environments, with the root ball located further away from these influences;
- Greater stability of newly planted seedlings in comparison to conventional planting;
- Greater ability to withstand the effects of moving water such as flood conditions in riparian zones;
- Limited watering during planting, with no further watering required postplanting; and
- Reduced loss from vandalism as it is harder to pull up a deeply planted root ball.

Long-stem planting for the Reconstruction will generally follow the auspices of *The Long-stem Planting Guide* (The Australian Plants Society NSW 2010). This is provided in **APPENDIX C**.



# 4.3 Hydromulching

Hydromulching is a one-step process where seed, fertilizer, mulch and a binder are combined in water, with the resulting slurry sprayed onto the soil surface providing a wood fibre, interlocked mat which provides moisture and protection for seed gernmination. Hydromulching is more expensive than other forms of direct seeding, however it provides for greater soil stability and protection of seed. Hydromulching with native seed has been used successfully in the rehabilitation of mine overburden (Spraygrass 2009).



Figure 2 – Hydromulch application (Spraygrass 2009)

A hydromulch mix will be applied to the whole RC as part of the revegetation of the Reconstruction. In preparation for the hydromulch mix the RC should be ripped, up to 200mm deep, and topsoiled. Where possible, weed growth, large stones and other debris should be removed. The application of the hydromulching native seed should commence immediately after surface preaparations have been completed. Table 3 provides the recommended hydromulch mix for the Reconstruction.

Zone	Area	Item	Application Rate	Total to be Applied
Entire	20 ha	Native Seed Mix	15kg per ha	300kg
RC	20 na	Cover Crop Seed (Couch)	35kg per ha	700kg

Table 3 – Hydromulching application rates for native grass s	eed
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Fertiliser*	150kg per ha	3,000kg
Wood Fibre Mulch	2.5t per ha	50t
Binder	250L per ha	5,000L

# \* Fertilizer rates and type are to be determined by soil testing during the preparation stage.

The above items shall be thoroughly mixed together to form a slurry then applied under pressure onto the RC by means of hydromulching equipment specifically designed for the purpose by operators trained in the use of this equipment.

Watering of the RC should be carried out in order to keep the wood-fibre moist until satisfactory germination occurs. Post-germination, limited watering should be carried out as necessary to ensure to native grasses reach a stage where they are self-sufficient.

## 4.4 Staging and Scheduling

Revegetation of the Reconstruction will occur immediately following construction of the Blackjack Creek Reconstruction, with staging of construction allowing for staging of revegetation. This staging shall be undertaken in a manner so as to ensure that an area no greater than half the length and width of the Reconstruction is to be disturbed at any one time.

All earthworks activities within the Reconstruction will be scheduled so as to facilitate the preparation of the Reconstruction site for revegetation immediately following the placement of topsoil.

### 5. Maintenance and Monitoring

The following maintenance and monitoring measures will be utilised by GSC to ensure the establishment and ongoing efficacy of revegetation at the Reconstruction site:

- Site inspections during construction to ensure that site preparation and topsoiling occurs in accordance with revegetation requirements;
- Employment/engagement of suitably qualified employees/contractors to undertake the revegetation, particularly with regards to hydromulching;
- Site inspections during planting/hydromulching to ensure that revegetation is occurring in accordance with the reference documents provided in this VMP;



- Regular watering of plantings/hydromulch post-planting to ensure establishment/germination;
- Regular monitoring of climatic conditions and soil surface moisture at the Reconstruction site post-establishment of revegetation, with watering to be provided should it be needed;
- Regular site inspections post-construction to ensure that any dead/damaged plants are replaced, including following a flood event in Blackjack Creek; and
- Regular mowing and pruning of vegetation as necessary.

**APPENDIX D** provides the monitoring and maintenance checklists for the revegetation of the Reconstruction.

Mowing will not be undertaken if grasses are lower than 10cm, and mowing debris will not be allowed to enter the waterway.

No burning of the riparian zone will be undertaken by GSC.



#### 6. Costs

Table 4 provides the anticipated revegetation costs for the Reconstruction. The unit costs have been derived from *The cost of revegetation* (Schirmer and Field 2000), with unit costs checked against current supplier prices to ensure accuracy.

Item	Volume	Unit Cost	Total Cost
Tree seedlings (tubestock)	1000	\$2.50	\$2,500.00
Shrub seedlings (tubestock)	3,200	\$2.50	\$8,000.00
Herb seedlings (multi-cell)	4,000	\$1.00	\$4,000.00
Sedge and rush seedlings (multi-cell)	100,000	\$1.00	\$100,000.00
Plastic sleeve guards, stakes and weed matting for trees and shrubs	4,200	\$1.50	\$6,300.00
Contractor cost to plant tree and shrub seedlings, including placement of plastic sleeves, stakes, and weed matting	4,200	\$5.00	\$21,000.00
Contractor cost to plant herb, sedge and rush seedlings	104,000	\$1.00	\$104,000.00
Hydromulch native grass	20ha	\$11,500/ha	\$230,000.00
Το	tal reveg	etation cost	\$475,800.00

#### Table 4 - Anticipated revegetation costs

While it is likely that contractors will be used to undertake the revegetation, as per the table above, there is some potential for GSC to reduce rehabilitation costs through the involvement of volunteers in the planting of the seedlings; however this will result in a cost resulting from the need to provide supervision, equipment and refreshments to any such volunteers. *The cost of revegetation* (Schirmer and Field 2000) estimates that an inexperienced volunteer would need 43 hours to plant 1000 seedlings with tree guards and that refreshment for volunteers would cost \$20 per hectare. If 20 volunteers were utilised, with GSC supervision at a cost of \$50 per hour and provision of refreshments, the planting component of the revegetation of Blackjack Creek would take approximately 233 hours, at a cost of \$11,650 for supervision and \$304 for refreshments.

This represents a significant saving over the use of contractors for planting; however it is unlikely that volunteers will be utilised to plant such large volumes as:



- At the above calculated rate, and working for 8 hours each day, revegetation of the Reconstruction would take approximately 29 days;
- Recruiting sufficient volunteers with adequate amount of available time may not be possible due to volunteers having other commitments; and
- Difficulties relating to maintaining volunteer interest over such a long period may be experienced

Ongoing maintenance costs have been derived from *The cost of revegetation* (Schirmer and Field 2000), with GSC labor and plant hire rates incorporated into this. Table 5 provides the anticipated maintenance costs for revegetation of the Reconstruction.

Item	Volume	Unit Cost	Total Cost
Monitoring (2 hours, 12 times per annum)	24hrs	\$60 per hour	\$1,440.00
Refill/infill planting*	n/a	10% of original cost	\$24,580.00
Watering (16 hours, 2 times per month, 3 months per annum)	96hrs	\$85 per hour	\$8,160.00
Mowing (16 hours, 6 times per annum)	96hrs	\$135 per hour	\$12,960.00
т	\$47,140.00		

#### Table 5 – Anticipated annual maintenance costs

\* Refill/infill planting costs will decrease over time and only apply to trees, shrubs, herbs, sedges and rushes. Figures are exclusive of corporate recharge costs.



### 7. References

- Constructive Solutions 2012, *Blackjack Creek Riparian Corridor/Channel Reconstruction Concept Design and Feasibility Study*
- Constructive Solutions 2012, *Blackjack Creek Riparian Corridor/Channel Reconstruction Detailed Design*
- Land and Property Information 2012, SIX Maps. Retrieved from http://maps.six.nsw.gov.au/
- Namoi Catchment Management Authority 2012, *Native Plants for Creeks* and Rivers in the Namoi
- NSW Office of Water 2012, *Guidelines for riparian corridors on waterfront land*
- NSW Office of Water 2012, *Guidelines for vegetation management plans* on waterfront land
- Schirmer, J. and Field, J. 2000, *The cost of revegetation*. Prepared by ANU Forestry, FORTECH and the Natural Heritage Trust
- Spraygrass 2009, *Hydromulching*. Retrieved from http://www.spraygrass.com.au/hydromulching.html
- The Australian Plants Society NSW 2010, *The Long-stem planting guide*. Prepared in conjunction with Gosford City Council and the NSW Environmental Trust
- Water Management Act 2000
- Water Management (General) Regulation 2011

# APPENDIX A Site Photographs

# Blackjack Creek Riparian Corridor/Channel Reconstruction – Photos and Coordinates



Photo 1 – 'Balmoral' looking north. Coordinates -30.991591 150.230782



Photo 2 - 'Balmoral' looking south. Coordinates -30.990991 150.230179



Photo 3 – Wandobah Reserve looking north. Coordinates -30.979584 150.241286



Figure 4 – Wandobah Reserve looking south. Coordinates -30.980736 150.240330



Figure 5 – Wandobah Reserve looking south. Coordinates -30.983114 150.238288

# APPENDIX B Recommended Planting List

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# APPENDIX C Long-stem Planting Guide



Return to viewing and printing instructions.



# The Long-stem Planting Guide





Australian Plants Society NSW Ltd. Central Coast Group www.oustralionplants.org



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NSW Environmental Truet Level 2, 1 Fitzmiliam Street, Perramatta NSW 2150 www.environment.nsw.gov.au envirotrust@environment.nsw.gov.au 02 8837 6093

This guide has been compiled by members of The Australian Plants Bociety Central Doest Group and Coatord City Council and is funded by NSW Environments: Trust. Acknowledgements: Thanks to Hunter-Central Rivers Catchment Management Authority and Bit Hizles for their contributions, Copyright is held by The Australian Plants Bociety NSW Ltd ACH d02 880 408 Photo copyright page 24 Blave Eccles, NRMMA, page 14 (top right) and 22 Gooff Bakewolf. Design by Marjo Pateri, Gestard City Council. Photos on front cover: long-stem planted, Back cover: coastal area, Patongs Beach; riperian area, Umina; soline area, Yamana; rainformat area, Katandra Reserve, Holgsto. Printed on recycled paper, April 2010



long-stem planting an introduction



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long-stem planting - an introduction

# Long-stem planting ...

Development of the long-stem planting method in Australia has seen an increase in the survival rates of seedlings planted in many different environments. The advantages of this method, such as no post-planting watering, increased growth rates and higher survival rates, have made a positive contribution to many rehabilitation projects and seen individuals and groups obtain successful outcomes in areas that were considered a challenge.

Within Katandra Reserve (Holgate, NSW) the long-stem planting method has been trialled on rainforest species, resulting in significantly greater growth rates in seedlings of some species planted using the technique (Chalmers et al. 2007). Furthermore, native riparian species planted using this method in the Hunter Valley (NSW) showed greater survival rates (20-50 per cent better, depending on the species) compared with standard planting methods on river banks and demonstrated that native plants could indeed be reintroduced on to river banks where previous efforts had been unsuccessful (Hicks et al. 1999). Within saline environments survival and growth rates of long-stem planting has been exceptional (Hicks 2003) and, recently, the long-stem planting method has been used in a sand dune environment with great success for both survival and growth rates (Bakewell et al. 2009).

ong-stem planting method - an introduction

# What is long-stem planting?

The long-stem planting method is an innovative way of planting that can result in higher survival and growth rates with minimal post-planting care. Using the long-stem method, seedlings are grown in pots for 10-18 months, so that they develop long woody stems. These seedlings are then planted with about threequarters of their length below the soll surface, approximately 1 metre deep, which results in much of the woody stem being covered with soil.

The deep planting protects the roots from substantial changes in soil temperature, allows the plant access to deeper soil moisture and reduces competition from weeds. Once planted, the seedling develops roots from the buried stem and leaf nodes. This promotes the development of a robust root network which gives the seedling a greater chance of survival.

#### The long-stem planting method has challenged two long-held horticultural principles:

 Large plants should not be grown in small containers as they will become root bound, thereby hindering the future growth of the plant.

The long-stem method uses plants that are relatively tall for the size of the pot they are grown in. This is achieved through the use of standard pots. In addition, slow-release fertilisers are placed in the centre of the pot so that the plant does not need to grow extended roots in search of further nutrients. This prevents the plant from becoming root bound in the pot and allows for the development of healthy roots when planted in the ground.

#### long-stem planting method - what is it

2. Stems of seedlings should not be planted below the surface of the soll as this subjects them to fungal attack and disease.

The long-stem planting method appears to challenge this long-held horticultural belief since most of the seedling's woody stem is planted underground, yet aurvival rates of these seedlings have been higher than that of those planted using traditional methods. While this has been observed during both scientific and field trials, further research is needed to determine why the stems of longstem plants are not prone to disease and fungal attack.

Field trials using the long-atem method have included a variety of native species to demonstrate that seedlings can not only be grown successfully when these two traditional principles are not followed, but can have survival and growth rates that exceed those planted using traditional planting methods. It would appear that most, if not all, hard tissue plants are suitable for use in long-stem planting (Hicks 2010, pers. com.,nd).

Geneties descelutanza

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ongstem planting method - what is it?

# How the long-stem method was developed

The long-stem planting method was pioneered by Bill Hicks for use on river banks in the Hunter Valley. Bill wanted to establish native species on river banks instead of willows (Sallx spp) as was the recommended practice at the time. The spread of willows had become an environmental problem, impacting on the ecology of river systems and wetlands in much of temperate Australia. Willows affect the flow of water and reduce biodiversity. Willow species are now listed by the Australian Government as Weeds of National Significance (1998), and are no longer recommended for planting.

The riparian environment presents challenges for the planting of natives using traditional planting methods as the seadlings are continuously affected by changes in water levels, river flow, and processes of erosion and sedimentation. Once the long-stem planting method had been developed and tested, Bill conducted workshops throughout New South Wales, Victoria and South Australia to educate communities about the use of the method and its value in revegetating cleared, disturbed and hostile natural areas. Individuals and groups have since conducted scientific field experiments to examine the effectiveness of the method in a range of habitats, including rainforest, sand duries and saline sites. The Australian Plants Society Central Coast Group have used the method for a number of years at their Bushcare site in Katandra Reserve. With assistance from Bill Hicks the method was altered singhtly to suit:

- the local rainforest conditions at Katandra;
- the number of plants required each year; and
- · the tools and materials available to the Bushcare group.

The long-stem method has now been used throughout Australia and overseas, including revegetation projects in New Mexico.

long-stem planting method - developmen



# Step-by-step guide to long-stem planting

The long-stem planting technique contains a number of steps which are considered to be important to the overall success of the method. However, once you have tried the technique you may be able to make changes in order to suit your site's particular needs.

Tools and materials suggested/required for plantings are:

- seedlings or seeds for revegetation projects, local provenance seeds or seedlings are recommended as they will provide a range of ecological benefits including providing habitat for local fauna, and maintaining local genetic Integrity.
- pots use standard 50 mm square-cornered pots.
- potting mix use a good quality mix for natives. Large places can be sleved from the mix and used at the bottom of the pot to stop the mix from escaping.
- trace elements for native plants (e.g. Micromax<sup>6</sup>).
- slow-release fertilisers suitable for native plants. Two types are required: a 5-6 month slow-release fertiliser; and an 8-9 month slowrelease fertiliser.
- potting racks to hold the pots off the ground or bench while the seedlings are growing in your 'nursery'.
- seaweed solution use half-strength seaweed solution in a bucket of water to fully immerse the potted seedlings. This is recommended just before planting.
- tools for planting shovel, post hole digger or auger, or water lance.
- water for planting if a water supply is not available and the water needs to be carried to the site, the use of as little as 2 litres per plant has been successful, but more can be used if the sub-soil is dry.

long-stem step-by-step guide - materials needed



#### How to grow the long-stem seedlings

- 1. Use seedlings that have been grown in seed-raising trays using conventional methods, or collect the seedlings from a suitable location. Within Katandra Reserve, for example, small seedlings were collected from pathways and fallen logs in the rainforest, where there was little chance the seedlings would survive to become adult trees. Collecting seedlings from the natural environment ensures that you have the strongest seedlings which have survived where others have died. These stronger seedlings transplant more successfully. Collecting seedlings from the natural environment also allows you to choose from a greater variety of species which may be representative of all layers of the forest canopy. Conditions apply to the collection of plant material in reserves and national parks. Please check with your local authorities prior to collecting seedlings.
- Thoroughly mix the trace elements through the potting mix (5 ml of trace elements per 7.6 litres of potting mix).
- Half fill the pots with the prepared potting mix, placing the larger sleved pieces at the bottom.
- 4. Create a depression deep enough to hold the slow-release fertiliser. This depression can be made with a pen or stick with a diameter of approximately 1.5 cm. Place the fertilisers in the well (half a teospoon of 8-9 month slow-release fertiliser, then quarter of a teospoon of 5-6 month slow-release fertiliser). Gently place the seedling in the pot, taking care not to damage the fine hair roots. Carefully fill with potting mix and tep the bottom of the pot to settle the potting mix and improve contact between the potting mix and the roots. Top up the rest of the pot with potting mix. Water the seedling thoroughly and add more potting mix if necessary.
- 5. Place the pots on 'potting racks' so that they do not have direct contect with the ground or table. The potting racks provide a space between the bottom of the pots and the ground/table that result in the roots being 'air pruned'. This means that when the roots reach the outside of the pot they dry off (aerial pruning) and stop growing. This allows the roots to spread out into the surrounding soil and form a strong network when the seedling is planted.

long-stem step-by-step guide - how to grow seedlings - potting up 11



- Select a suitable place for the seedlings to grow in your nursery. Choose the location to suit the species you are growing. Generally a sunlit position is recommended to encourage strong stem and leaf growth.
- Water seedlings regularly and rotate the pots periodically to ensure all plants get an equal amount of water and sunlight.
- Seedlings can take between 10 and 18 months to reach a suitable height for long stem planting. Seedlings should reach 1 metre during this time, however this would depend on the plant species' natural growth habit.
- Soak the seedlings (still in their pols) the night before planting in a halfstrength seaweed solution to ensure the root ball is thoroughly wet. This saturates the potting mix and assists in stimulating root development once planted.

#### How to plant using the long-stem method

- Dig holes that are deep enough to allow three-quarters of the plant to be buried. The use of power tools such as a soll auger in heavy clay may result in smooth walls in the hole, these may need to be roughened slightly to allow the roots to penetrate the smooth walls more easily.
- 2. Pour approximately 1 litre of water into the hole and allow it to soak in.
- Prune side branches or large leaves from the lower portion of the stem that impede placement of the seedling in the hole when planting.
- Place the plant in the hole and backfill carefully using soil and water alternately to ensure that no air pockets are left. This is important to prevent the roots from drying out.
- Create a dish-shaped depression around the stem of the plant and add the remaining water. The depression will assist in catching any rain.
- Generally no further maintenance is required. Since the root ball will be below the root zone of most weeds, competition from weed roots will be minimal. In moist environments, vine growth may need to be controlled.

long stem step by step guide - how to plant seedings



The original Bill Hicks method of long-stem planting differs slightly from the step-by-step method described above as he had a supply of water at his planting sites. The original method sourced water from the nearby stream using a water pump and then a water lance was used to dig the hole and thoroughly wet the soil. In soils prone to collapse, such as sand, a tube was used to support the hole around the lance. The plant was then placed into the tube and the plastic tube carefully removed. Water from the stream was used to water the seedlings in.

This original method of long-stem planting came out of a need to plant the seedling deep enough into the river bank so they would not be washed out during flooding in the riparian environment. While doing this Bill realised that the survival and growth rates were enhanced.

Bill grew plants from seed he collected from local sources. Shortly after germination seedlings were planted out into separate pots using the long-stem method and grown for the 10-18 month term as described above.



long-stem step-by-step guide - how to plant seedlings



# General benefits

The benefits of the long-stem planting method are significant and include advantages which are of great assistance to bush regenerators and others interested in plant survival.

Firstly, the long-stem method creates an older, stronger seedling for planting. This is due to the consistent nutrients, air pruning and longer nursery period. If the seedling is also sourced from the natural environment through collection it has the added advantage of having survived the natural culling process of its local environment. This produces a much stronger plant than an ordinary seedling and increases its survival rate.

Another notable benefit is that the deeply-planted root ball is insulated from the substantial changes in soil temperature and moisture compared with traditional plantings where the plant roots are close to the soil surface.

In drier and saline environments, planting more deeply allows the root ball to be further away from the hot, dry or damaging salt-encrusted topsoils which increases the seedling's chances of survival.

Newly planted long-stem seedlings are also more stable in the ground than those planted using traditional methods. Deeper planting means that seedlings are better able to withstand soil erosion due to wind such as on sand dunes, or the effects of moving water such as flood conditions in riparian zones. The development of a deep root system allows the plant to bind greater amounts of soil, which is also why these plants are so stable in the ground.

Another benefit is the relatively small quantities of water required when planting, and that no further watering is required post-planting. This benefit is important on sites with limited water.

An unexpected benefit of long-stem planting has been the reduced loss from vandalism as it is more difficult to pull up a deeply-planted root ball (Hicks 2010, pers. com.,nd) and seedlings can survive trampling by people walking through planted areas (Bakewell et al. 2009).

long-stem planting - general benefits in different environments


Above: A long stem seedling two months after plenting, slong a creek bank at Umina Beach.

Below: the same seedlings three years leter.



long-stem planting benefits - nparran envolonment

Finally, competition with shallow-rooted weeds is less likely to occur when seedlings are planted using the long stem method. The deeply-planted root beli accesses nutrients and soil moisture that is beyond the reach of shallow-rooted weed species. Given the reduced level of competition with shallow-rooted species, and that no follow-up watering is required, the after-planting care is minimised.

# Riparian environment

As part of the original trials in the Hunter Valley, Bill Hicks grew seedlings to a height of up to 1.5 m and then planted 70-90 per cent of the plant below the soil surface. These trials revealed that three of the four species used exhibited greater growth rates using the long stem method. Bill showed that native plants could be reintroduced into riparian environments using the long-stem planting method where previous plantings trials had not been effective.

One of the main benefits of using the long-stem method within the riparian context is that the roots of seedlings are planted more deeply into the river bank therefore, the seedling is not washed away during a flood event. Longstem planting also allows the root ball to be protected from extremes of temperature, including frosts and drying out that can damage plants which are planted using traditional methods.

Additionally, the restoration of riparian areas with native plants results in environmental benefits that cannot be achieved with exotic species. These benefits should not be overlooked. The use of native plants improves local biodiversity and does not impact negatively on the health of river systems.

long stem planting benefits - npatian environment



# Rainforest environment

Research conducted in the rainforest at Katandra Reserve has indicated that some species show significantly greater growth rates when planted as longstem seedlings (Chalmers et al. 2007). During these trials it was found that the growth of Cheese Tree, *Glochidion ferdinandi*, was significantly greater when planted using the long-stem method as opposed to traditional planting, while for Scentless Rosewood, *Synoum glandulosum*, the growth rate remained the same.

These trials at Katandra Reserve from 2002 to 2009 were conducted during an extended dry period. It is not known how long-stem planting would perform during a period of prolonged wet conditions. Field trials using a larger number of rainforest species are currently being undertaken to further study long-stem planting within rainforest environments.

Due to the great height of reinforest trees and the short seed 'shelf life' of many reinforest species it is often easier to collect seedlings from the forest floor in this environment. Collection of seedlings also provides benefits such as greater species selection and the harvesting of stronger individuals which have survived the germination process in forest conditions.

Rainforest species that are grown using the long-stem method show pronounced differences in growth habit, with some species growing to less than 1 metre in the 18-24 month period in which they are in the pots. Even though these species appear to have grown less they can still be planted using the long stem method as long as a significant portion of the woody stem is buried at planting.

Within the rainforest environment, soils are usually heavier. Therefore a shovel or a manual or petrol-driven auger can be used to dig the hole for planting.

long stem planting benefits - rainforest environment



# Coastal environment

It has been shown that in coastal areas long-stem planting of native sand dune plant species has been successful without the need for protective planting sleeves or follow-up watering. Seedlings planted in dune areas using the longstem method experienced greater survival and growth rates than tube stock planted using the traditional planting method.

At Patonga Beach (Central Coast, NSW) the long-stem planting method has been used in trials of Coastal Wattle, Acacia longifolia var. sophorae, to restore the beach dune area. Results of these trials concluded that the long-stem method produced higher survival rates compared with plants using a traditional planting method (79 per cent compared with 63 per cent). Greater growth was also recorded in the long stem seedlings (19 cm mean stem growth as compared to 8 cm for the traditional method) (Bakewell et al. 2009). Also, longstem seedlings survived trampling and breaking of stems and shoots due to human impact in the planted areas.

Long-stem plants in sand dunes benefit from having reliable soil moisture, limited root competition, and stable soil temperatures. The likelihood of the root ball being exposed in dunes as a result of sand movement is reduced when the long-stem planting method is used.

The advantages of using the long-stem planting method in this environment include the elimination of the need to build structures around the seedlings to protect them and the need for post-planting irrigation. This can significantly reduce the costs associated with regeneration work and the amount of follow-up maintenance required at the site.

In sandy environments, digging deep holes can usually be done with shovels or other hand tools.

Spellerap

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long-stem planting benefits - coastal sand dune environment



# Saline environment

There has been great success in the use of long-stem planting within saline environments. After conducting trials within salt-affected lands in the Upper Hunter, Bill Hicks concluded that survival and growth rates of long-stem plantings had been outstanding (Hicks 2003). During these trials Bill planted 2,500 salt-tolerant seedlings. The trees survived a record drought, aboveaverage temperatures and frosts as well as high salinity levels (Hicks 2003). It appears from these trials that virtually any native salt-tolerant species is suitable for long-stem planting.

The Hunter-Central Rivers Catchment Management Authority at Muswellbrook, NSW, has also used long stem planting at their saline site. Fresh water was used to water the seedlings in. At this site it was found that long-stem planting worked better on drier saline sites than wet saline ones and further research is needed to understand why.

The main benefit of this method in a saline environment is that the root system is planted below the salt-encrusted top layer of the soil. Soil salinity suppresses plant growth and creates a hot, dry and uninhabitable environment. As in other areas, deep planting places the root ball below the danger zone (Hicks 2010).

Local salt-tolerant species would be expected to establish and grow best in saline environments. The choice of shovels or power tools to dig holes will depend on the local soil conditions.

ongistem planting benefits - saline environment

## Resources required

The actual cost and resource requirements for long-stem planting in comparison with traditional methods will vary between projects and site locations. The level of maintenance will be influenced by the environment being planted. The following table lists the resources that need to be considered when making comparisons between the two methods.

While long stem seedlings are kept for a longer time in the nursery, the advantages of reduced pre-planting site preparation, reduced cost of plant protection, reduced need for post-planting weed control and improved survival and growth rates are considered to be significant.

Resource	Long-stem method	Traditional method	
Site preparation including solt preparation and ground cover weed control	Not usually needed. May be required for large plantings	Weed control and ripping may be required	
Plant sleeves or other materials to protect against wind and frost	Not usually needed. Can be useful to protect from browsing animals	Required in some locations	
Post-planting maintenance such as watering, weed control, fertilising, and mulching,	Not usually needed	Weed control and watering usually required	
Use of power tools/ equipment to dig holes	May be required in some environments	Usually not required for small scale projects, but may be used for larger projects to save time	
Length of time to dig holes	Usually longer for long stem planting	Usually shorter for traditional method	
Length of time that potted seedlings require fertiliser	Only initial slow-release fertiliser required. None required post-potting	3-6 months after potting	
Length of time that potted seedlings require watering	10-18 months	3-6 months after potting	
Length of time seedlings are in the nursery	10-18 months	6-12 months after potting	



long stem planting - traditional method resources comparisons

## Conclusion

The use of the long-stem planting method provides an opportunity to improve the survival rate of native plants in the restoration of degraded ecosystems. Long-stem planting has shown to be successful in a wide range of environments and conditions.

The long-stem planting method has been shown to be a particularly successful method to use in environments where the surface soil conditions are not generally favourable for planting. This may be due to low moisture levels, high temperatures, high salinity, or surface ground movement due to flooding or human activities such as welking. In these cases the long-stem planting method offers the advantage of planting the seeding more deeply into the ground and away from these adverse effects. It is unclear whether the method provides the same advantages in environments where subsoil moisture conditions are unfavourable during drought.

We encourage others to trial the method at their work sites and would welcome feedback on the results.

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Hicks B. (2003). Revolutionary approach to tubestock planting drops natives securely into hostile territory. Ground Cover, Issue 43, Feb 2003. Grains Research Development Corporation, Camberra.

long-stern planting conclusion reference



# For further information

Australian Plants Society Central Coast Group: www.australianplants.org/longstern.htm Hunter-Central Rivers Catchment Management Authonty. www.hcr.cma.nsw.gov.au Bill Hicks Longstern Tubestock DVD. www.norkhiltechnologies.com NSW Environmental Trust. www.environment.nsw.gov.au



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# APPENDIX D Monitoring and Maintenance Checklists

### Blackjack Creek Riparian Corridor/Channel Reconstruction

### Weekly Revegetation Monitoring and Maintenance Checklist

Issue	Yes	No	Notes/Remedial Action
Has site preparation been undertaken in accordance with the VMP?			
Are all staff and contractors adequately qualified?			
Has revegetation occurred in accordance with the VMP and appendices?			
Has watering been undertaken fortnightly, or more frequently depending on meteorological conditions?			

Name.....

Position.....

Signed.....

Date.....

### Blackjack Creek Riparian Corridor/Channel Reconstruction

### Monthly Post-Construction Revegetation Monitoring and Maintenance Checklist

Issue	Yes	No	Notes/Remedial Action
Soil moisture		-	
Is there adequate soil moisture?			
If not, has watering occurred?			
Plants		I	
Have plants died or has a flood event occurred?			
If so, have infill plants been planted?			
Mowing and Pruning			
Has any illegal burning occurred in the riparian zone?			
If so, is additional infill planting required?			
Has all mowing been undertaken only for grasses above 10cm?			
Have all large branches resulting from pruning and any rubbish encountered during mowing been prevented from entering the waterway where possible?			

Name	Position
Signed	Date

# **APPENDIX J AHIMS Search**



### AHIMS Web Services (AWS) Search Result

Date: 23 April 2012

**Constructive Solutions** 

Po Box 1498

Tamworth New South Wales 2340

Attention: Sarah Horne

Email: sarah@constructivesolutions.com.au

Dear Sir or Madam:

#### AHIMS Web Service search for the following area at Lot : 7053, DP:DP1116141 with a Buffer of 200 meters. conducted by Sarah Horne on 23 April 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0 Aboriginal sites are recorded in or near the above location.

0 Aboriginal places have been declared in or near the above location. \*

#### If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

#### Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.