



**Blackjack Creek Riparian  
Corridor/Channel  
Reconstruction  
Review of Environmental  
Factors**

**November 2013**



*Realising potential*

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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 1999* 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 quartz 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).

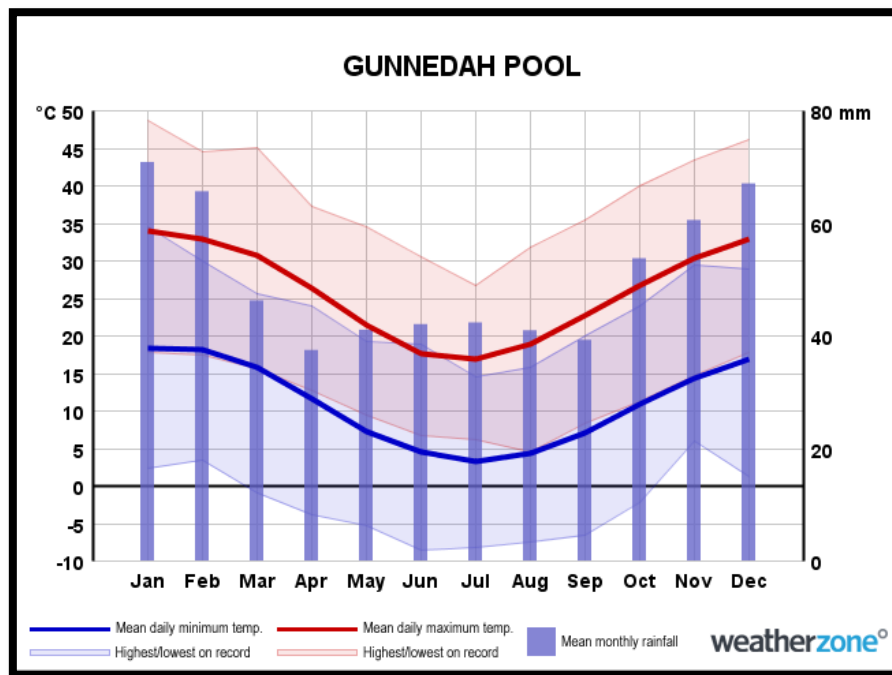
Blackjack Creek has a relatively small catchment covering an area of 24km<sup>2</sup>. The headwaters of Blackjack Creek are quite steep, with an average gradient of 7% over the 5.5km from the catchment boundary to Lincoln Street; however from Lincoln Street Blackjack Creek flattens, with an average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

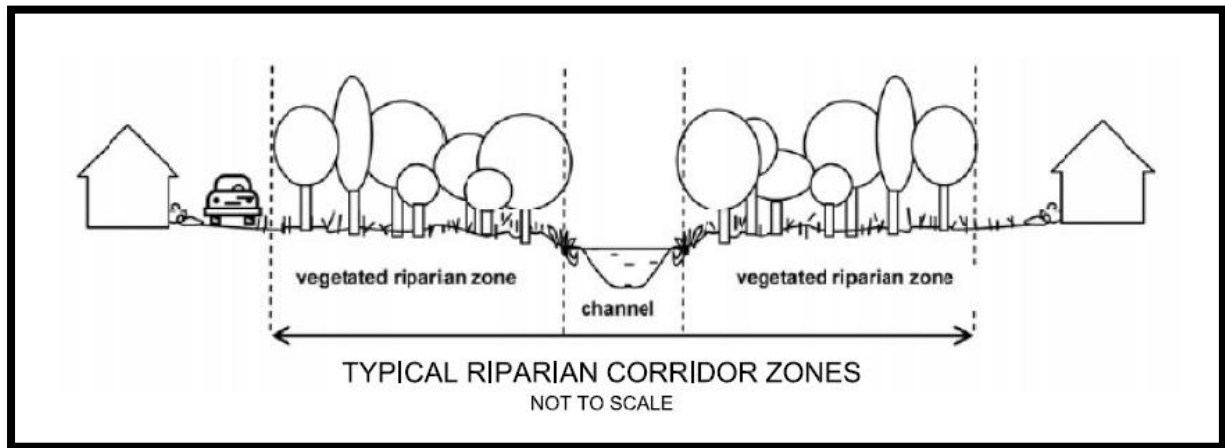
## **2. Description of Activity**

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:

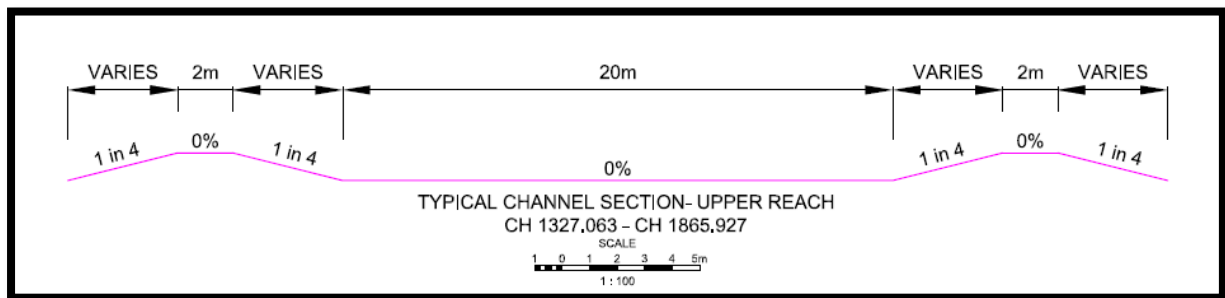
- Site establishment, including establishment of works compounds and installation of sediment and erosion controls;
- Clear and grub the existing floodplain for the length and width of the reconstruction;
- Strip and store topsoil from the reconstruction area;
- Excavate channel for the length and width 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.

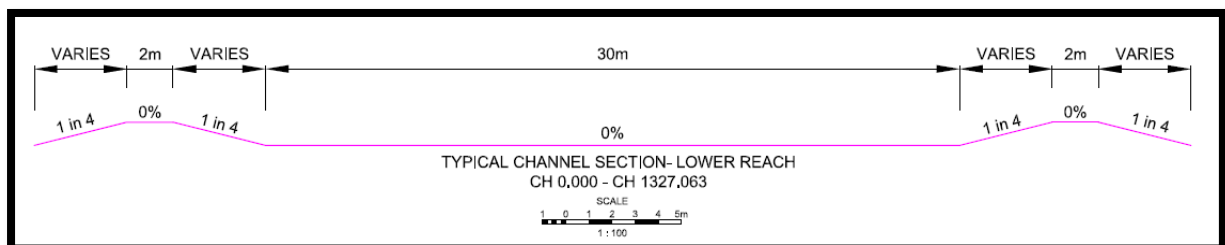
A schematic of the Reconstruction and typical cross sections are provided in Figures 9 to 11. Greater detail regarding the construction of the Reconstruction can be found in the *Blackjack Creek Riparian Corridor/Channel Reconstruction Detailed Design*, which is provided in **APPENDIX A**.



**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* (Lyll 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* (Lyll 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* (Lyll 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**.

**Table 1 – Stakeholder Consultation**

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	14/02/2012	09/03/2012 - 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

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* (Lyll 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.

## **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 bore 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.

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

Bore	Design Chainage	Groundwater depth (m)		Proposed Excavation depth (m)	Depth from proposed excavation to observed water depth May 2012 (m)	Depth from proposed excavation to observed Standing Water Level Sept 2012 (m)
		Drilled depth May 2012	Observed Water Level Sept 2012			
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
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.

**Table 3 – Determination of maximum design flow velocities using the 'Blue Book'**

<b>Item</b>	<b>Value</b>	<b>Source</b>
Soil landscape	Curlewis – Black Jack	Table C7, pg. C-35
USCS Class	CH	Soil testing results and OEH 2012 <i>DSNR USCS: Field Method</i>
K-factor	0.015-0.020	Table C7, pg. C-35
Erodibility (K)	Low	Table 5.2, pg. 5-24



Item	Value	Source
Critical velocity – Couch, Carpet grass, Rhodes grass, etc	2.0 m/s	Table 5.2, pg. 5-24
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.

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

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

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 as 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 as 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.

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

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

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;

- As part of the Koala Plan of Management a site induction of all personnel should occur to ensure that Koalas are protected in the Reconstruction site;
- 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;
  - A suitably qualified person who is able to identify Koalas will ensure that no Koalas are located in trees to be felled or pruned. Searches will be conducted prior to every tree removal and checked off by the GSC project manager. Where a Koala is present in a tree to be felled or pruned it will be allowed to move out of the tree of its own accord, generally overnight;
  - 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;
- To reduce the risk of vehicular strikes with any Koalas as a result of the increased traffic movements and heavy machinery associated with the Reconstruction all vehicles and machinery will be speed limited to a maximum of 20km/h within the Reconstruction site;
- Appropriate fire hazard reduction controls will be implemented, including the carrying of fire extinguishers on vehicles and machinery;
- 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 and riparian vegetation will occur along the length of Blackjack Creek in the Reconstruction site. Trees to be planted as part of the riparian rehabilitation will include River Red Gum (*Eucalyptus camaldulensis*).

A Species Impact Statement has been prepared for the Koala and is provided in **APPENDIX J**.

The Reconstruction will be referred to the DSEWPAC as a result of the significant impact to Core Koala Habitat, with DSEWPAC determination required.



## **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 K**. 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>.

GSC may also wish to engage with local Aboriginal stakeholders with regards to potential pre-construction site inspections.

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 an impervious 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 passers-by. 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-labile 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<sub>2</sub>-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<sub>2</sub>-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<sub>2</sub>-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.

## 6.17 Summary of Mitigation Measures

Category	Mitigation Measure
Air	<ul style="list-style-type: none"> <li>• Staged clearing of vegetation ahead of construction to minimise area of exposed soil;</li> <li>• Regular watering of areas of active construction and exposed soil;</li> <li>• Establishing appropriate vegetative cover over disturbed areas following channel reconstruction in accordance with Reconstruction Vegetation Plan;</li> <li>• Assessment of daily meteorological conditions to ensure that any dust generating activities are halted during unfavourable conditions;</li> <li>• Regular servicing of vehicles and machinery in accordance with manufacturer specifications; and</li> <li>• Ensuring vehicles are not left idling for extended periods of time.</li> </ul>
Water	<ul style="list-style-type: none"> <li>• Construction according to design;</li> <li>• Groundwater Monitoring Plan;</li> <li>• Installation of protective materials according to design; and</li> <li>• Erosion and Sediment Control Plan.</li> </ul>
Soils and Geology	<ul style="list-style-type: none"> <li>• Erosion and Sediment Control Plan; and</li> <li>• Vegetation Management Plan.</li> </ul>
Noise and Vibration	<ul style="list-style-type: none"> <li>• Undertaking construction between the hours of 7am-6pm Monday to Friday and 8am-1pm on Saturday;</li> <li>• Notifying affected residents prior to undertaking any activities which produce high noise levels;</li> <li>• Ensuring vehicles are not left idling for extended periods of time;</li> <li>• Fitting of residential class mufflers to all vehicles and machinery, where possible; and</li> <li>• Regular servicing of vehicles and machinery in accordance with manufacturer specifications.</li> </ul>
Traffic and	<ul style="list-style-type: none"> <li>• Implementation of suitable traffic control procedures to</li> </ul>

Category	Mitigation Measure
Transport	<p>prevent unnecessary traffic impacts and related road safety issues;</p> <ul style="list-style-type: none"> <li>• Signage in accordance with GSC Workplace Health and Safety requirements informing passers-by of the construction works; and</li> <li>• Ensuring, where possible, that transport of heavy machinery, construction equipment and other construction items is conducted outside of peak flow times.</li> </ul>
Flora	<ul style="list-style-type: none"> <li>• Areas of vegetation to be cleared should be clearly marked with high visibility tape to ensure that accidental clearing does not occur;</li> <li>• Tree clearing should be undertaken with care, in accordance with details provided in Section 6.7;</li> <li>• 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;</li> <li>• Any herbicides used should be waterway friendly, as per Department of Primary Industries guidelines;</li> <li>• An Erosion and Sediment Control Plan should be implemented and maintained for the duration of construction and site stabilisation;</li> <li>• Progressive rehabilitation of the Study Area upon completion of construction of each section;</li> <li>• 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;</li> <li>• Exposed ground should be sprayed with native grass seeds, as per the Vegetation Management Plan; and</li> <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	<ul style="list-style-type: none"> <li>• 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;</li> <li>• As part of the Koala Plan of Management a site induction of all site personnel should occur to ensure that Koalas are protected in the Reconstruction site;</li> <li>• Prior to any tree clearing, care should be taken to identify nests and/or roosting sites and/or threatened species, including:</li> </ul>

Category	Mitigation Measure
	<ul style="list-style-type: none"> <li>○ A pre-clearing check of hollow bearing trees in the impact footprint to identify breeding sites of threatened species;</li> <li>○ Inspection of trees prior to pushing or felling to ensure nests are vacant, with pushing or felling to occur immediately after inspection;</li> <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> <li>○ Thorough inspection of all trees to be trimmed or removed for the presence of Koalas or other fauna immediately prior to clearance;</li> <li>○ A suitably qualified person able to identify Koalas will ensure that no Koalas are located in trees to be felled or pruned. Searches will be conducted prior to every tree removal and overseen and checked off by the GSC project manager. Where a Koala is present in a tree to be felled or pruned, it will be allowed to move out of the tree of its own accord, generally overnight;</li> <li>○ Logs with hollows from felled trees may be scattered throughout the Reconstruction site to provide additional habitat;</li> </ul> <ul style="list-style-type: none"> <li>• To reduce the risk of vehicular strikes with any Koalas as a result of the increased traffic movements and heavy equipment associated with the Reconstruction all vehicles and machinery will be speed limited to a maximum of 20km/h within the Reconstruction site;</li> <li>• Appropriate fire hazard reduction controls will be implemented, including the carrying of fire extinguishers on vehicles and machinery;</li> <li>• 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;</li> <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> <li>• Any herbicides used should be waterway friendly, as per Department of Primary Industries guidelines;</li> <li>• An Erosion and Sediment Control Plan should be implemented and maintained for the duration of construction and site stabilisation;</li> <li>• Replication of a natural riparian system in the restored areas</li> </ul>

Category	Mitigation Measure
	<p>should be implemented throughout the Reconstruction; and</p> <ul style="list-style-type: none"> <li>• The following Biodiversity Offsets should be implemented: <ul style="list-style-type: none"> <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: <ul style="list-style-type: none"> <li>▪ Are to be maintained until plantings reach a suitable size;</li> <li>▪ Should be placed in adjacent appropriate habitat as identified in consultation with the National Parks and Wildlife Service;</li> </ul> </li> <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> <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> </li> <li>• Rehabilitation of disturbed areas and riparian vegetation will occur along the length of Blackjack Creek in the Reconstruction site. Trees to be planted as part of the riparian rehabilitation will include River Red Gum (<i>Eucalyptus camaldulensis</i>), a preferred Koala feed tree.</li> </ul>
Heritage	<ul style="list-style-type: none"> <li>• Establishment of 'no go' areas for all non-essential construction areas, with no excavation to occur outside the propped reconstruction;</li> <li>• 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;</li> <li>• Minimise, where possible, vehicle access to the site, with works compound, parking areas and stockpiling areas to be clearly designated; and</li> <li>• 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.</li> </ul>
Chemical and Hazardous Substance Management	<ul style="list-style-type: none"> <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> <li>• Storage of any chemicals or hazardous substances in accordance with safe handling practices, including being stored in a bunded area and removed from site when not in use;</li> </ul>



Category	Mitigation Measure
	<ul style="list-style-type: none"> <li>Ensuring that a chemical spill kit is kept on site at all times; and</li> <li>Locating any works compound at least 40m from any drainage line, including Blackjack Creek.</li> </ul>
Contaminated Land	<ul style="list-style-type: none"> <li>If potential contamination is encountered during construction, undertake appropriate testing and remediation, as necessary</li> </ul>
Visual Impacts	<ul style="list-style-type: none"> <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> <li>Removing vehicles and machinery from site when not in use;</li> <li>Implementing and maintaining appropriate erosion and sediment control in accordance with Erosion and Sediment Control Plan; and</li> <li>Carrying out revegetation in accordance with Vegetation Management Plan.</li> </ul>
Social Impacts	<ul style="list-style-type: none"> <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> <li>Maintaining a project webpage linked to the GSC website in order to provide the community with ongoing progress updates for the Reconstruction;</li> <li>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</li> <li>Ensuring that the GSC project manager, or their representative, respond to any such queries or concerns appropriately and within a reasonable timeframe.</li> </ul>
Safety	<ul style="list-style-type: none"> <li>Inducting all site staff and contractors, with site induction to cover all relevant aspects of Workplace Health and Safety, including emergency procedures;</li> <li>Ensuring all staff and contractors are appropriately trained, with heavy vehicles and machinery only to be operated by qualified personnel; and</li> <li>Installing and maintaining adequate safety measures for the duration of the construction, in accordance with Workplace Health and Safety laws and regulations.</li> </ul>
Electricity Usage and Greenhouse Gas Emissions	<ul style="list-style-type: none"> <li>Regular servicing of vehicles and machinery in accordance with manufacturer specifications;</li> <li>Ensuring vehicles are not left idling for extended periods of time; and</li> </ul>

Category	Mitigation Measure
	<ul style="list-style-type: none"> <li>• Undertaking revegetation in accordance with Vegetation Management Plan.</li> </ul>
Resource and Waste Management	<ul style="list-style-type: none"> <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> <li>• Seeds and/or plants for revegetation will be sourced locally, where possible, to ensure provenance; and</li> <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 style="list-style-type: none"> <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**

**min – minimal 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?**

na	min	-ve	+ve
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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?**

na	min	-ve	+ve
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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?**

na	min	-ve	+ve
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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	min	-ve	+ve
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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	min	-ve	+ve
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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?***

na	min	-ve	+ve
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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 has been prepared (**APPENDIX J**) 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	min	-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?***

na	min	-ve	+ve
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Comments:



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	min	-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	min	-ve	+ve
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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	min	-ve	+ve
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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?***

na	min	-ve	+ve
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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?***

na	min	-ve	+ve
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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	min	-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	min	-ve	+ve
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**Comments:**

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	min	-ve	+ve
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**Comments:**

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

<b>(d) Any environmental impact on Commonwealth listed migratory species?</b>	na	-ve	nil	+ve
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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.

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

<b>Commonwealth marine area?</b>				
<b>(g) Any direct or indirect effect on Commonwealth land?</b>	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.

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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.

## 10. Declaration

This Review of Environmental Factors has been prepared in accordance with Part 14 of the *Environmental Planning and Assessment Regulation 2000* which details the requirements for environmental assessment under Part 5 of the *Environmental Planning and Assessment Act 1979*, including consideration of the factors listed in Section 228 of the *Environmental Planning and Assessment Regulation 2000*.

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

Prepared by: Sarah Horne  
B. Marine Science and Management, M. Natural Resource.  
Constructive Solutions Pty Ltd  
PO Box 1498  
Tamworth NSW 2340

Signed: 

Date: 18 November 2013

I have examined this Review of Environmental Factors and the certification by Sarah Horne and accept the Review of Environmental Factors on behalf of Gunnedah Shire Council as the determining authority.

Name (print): ERIC GROTH

Designation: GENERAL MANAGER

Signed: 

Date: 27/11/13

## 11. References

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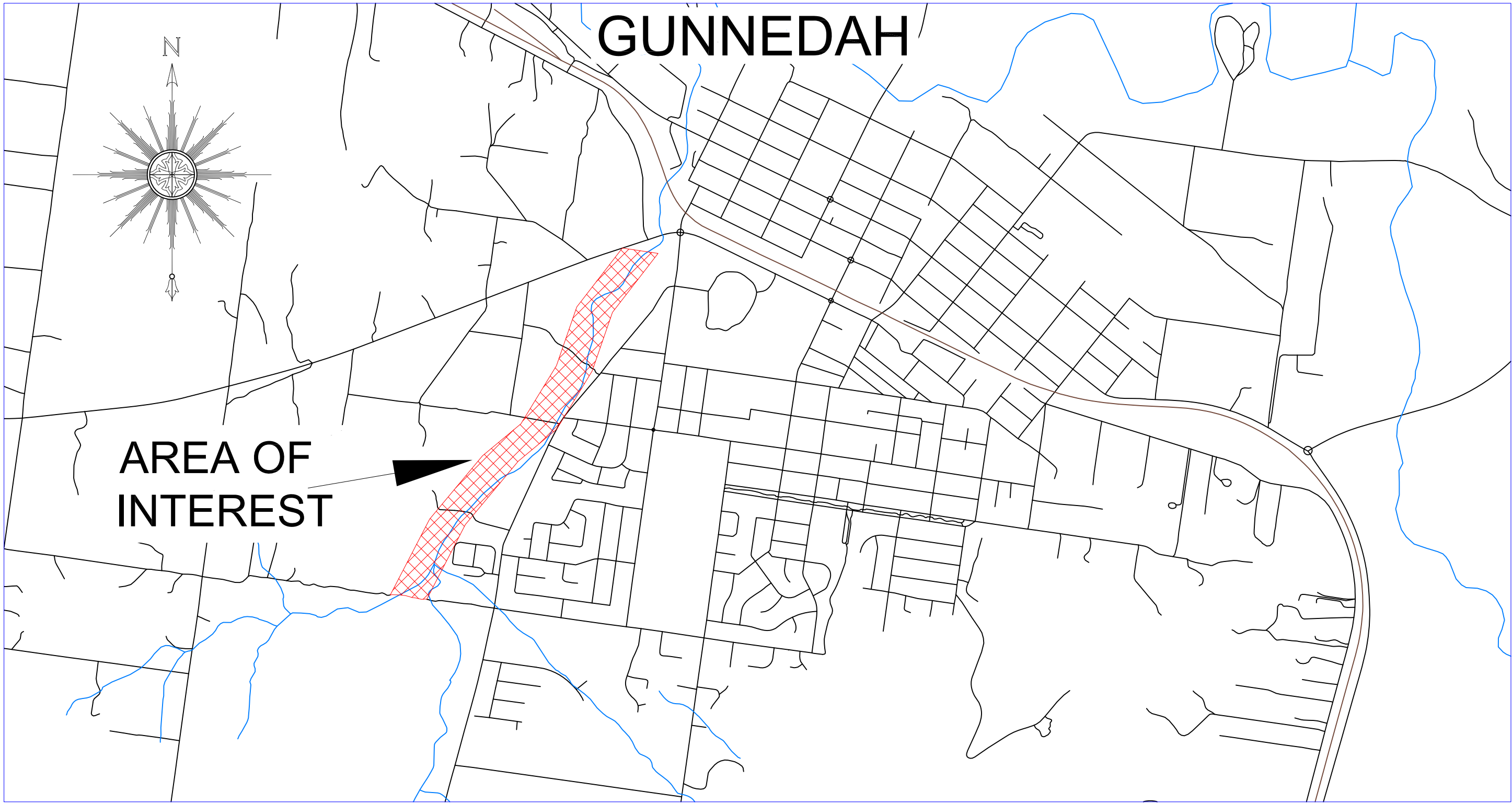
# **APPENDIX A**

## **Detailed Design**





# GUNNEDAH SHIRE COUNCIL BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION



LOCALITY PLAN

REVISIONS					
	A	03.12.2012	DB	ISSUED FOR REVIEW	--
REV.	DATE	BY	DESCRIPTION		CHK.

COVERSHEET

Client: <b>GUNNEDAH SHIRE COUNCIL</b>		
<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>

	CONSTRUCTIVE SOLUTIONS PTY. LTD. PO Box 1498 Tamworth NSW 2340 Australia Tel: (02) 6762 1969 Fax: (02) 6762 1969 Email: admin@constructivesolutions.com.au www.constructivesolutions.com.au	
	Plan Size: <b>A1</b>	Drawing No: <b>201201-001</b>

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
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201201-016	CROSS SECTIONS CH 296.868 - CH 375.000
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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
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201201-030	CROSS SECTIONS CH 1575.000 - CH 1625.000
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201201-032	CROSS SECTIONS CH 1725.000 - CH 1775.000
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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

REVISIONS					
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REV.	DATE	BY		DESCRIPTION	CHK.

SHEET INDEX	

Client: GUNNEDAH SHIRE COUNCIL		
BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION		
Design Completed: 03.12.2012	Designed: DB	Status: PRELIMINARY

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OVERALL SITE PLAN

Client: GUNNEDAH SHIRE COUNCIL

BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

Design Completed: 03.12.2012

Designed: DB

Status: PRELIMINARY



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Plan Size: A1

Drawing No: 201201-003



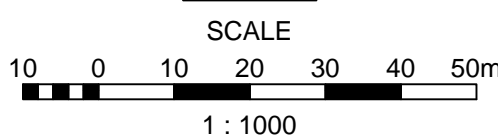


GROUNDWATER MONITORING BORE SCHEDULE			
POINT #	EASTING	NORTHING	WATER DEPTH FROM SURFACE
8	236220.590	6568841.060	2m
9	236398.150	6569069.230	4.5m
10	236513.640	6569423.440	7m
11	236468.620	6569311.370	3.3m
12	236409.360	6569195.250	4.2m
13	236293.380	6569053.680	4.2m
14	236204.660	6568905.390	2.5m
15	236151.450	6568802.360	1.8m
16	236542.580	6569348.340	3.5m
17	236334.930	6568984.440	3.5m

LEGEND

- TELEPHONE POLE
- SEWER MANHOLE
- POWER POLE
- STAY POLE
- MONITORING BORE
- TREE
- FENCE
- STORMWATER PIPE
- SEWER MAIN
- TELSTRA LINE
- OVERHEAD POWERLINE

PLAN



EXISTING CONDITIONS & TEST BORE PLAN SHEET 1

Client: GUNNEDAH SHIRE COUNCIL

BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

Design Completed: 03.12.2012

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Plan Size: A1

Drawing No: 201201-004

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LOT 78  
DP 755503

### LEGEND

- TELEPHONE POLE
- SEWER MANHOLE
- POWER POLE
- STAY POLE
- MONITORING BORE
- TREE
- FENCE
- STORMWATER PIPE
- SEWER MAIN
- TELSTRA LINE
- OVERHEAD POWERLINE

GROUNDWATER MONITORING BORE SCHEDULE			
POINT #	EASTING	NORTHING	WATER DEPTH FROM SURFACE
8	236220.590	6568841.060	2m
14	236204.660	6568905.390	2.5m
15	236151.450	6568802.360	1.8m
18	236119.780	6568666.580	3.5m
19	235981.090	6568413.480	3.5m

PLAN  
SCALE  
10 0 10 20 30 40 50m  
1 : 1000

### EXISTING CONDITIONS & TEST BORE PLAN SHEET 2

Client: GUNNEDAH SHIRE COUNCIL

BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

Design Completed: 03.12.2012

Designed: DB

Status: PRELIMINARY

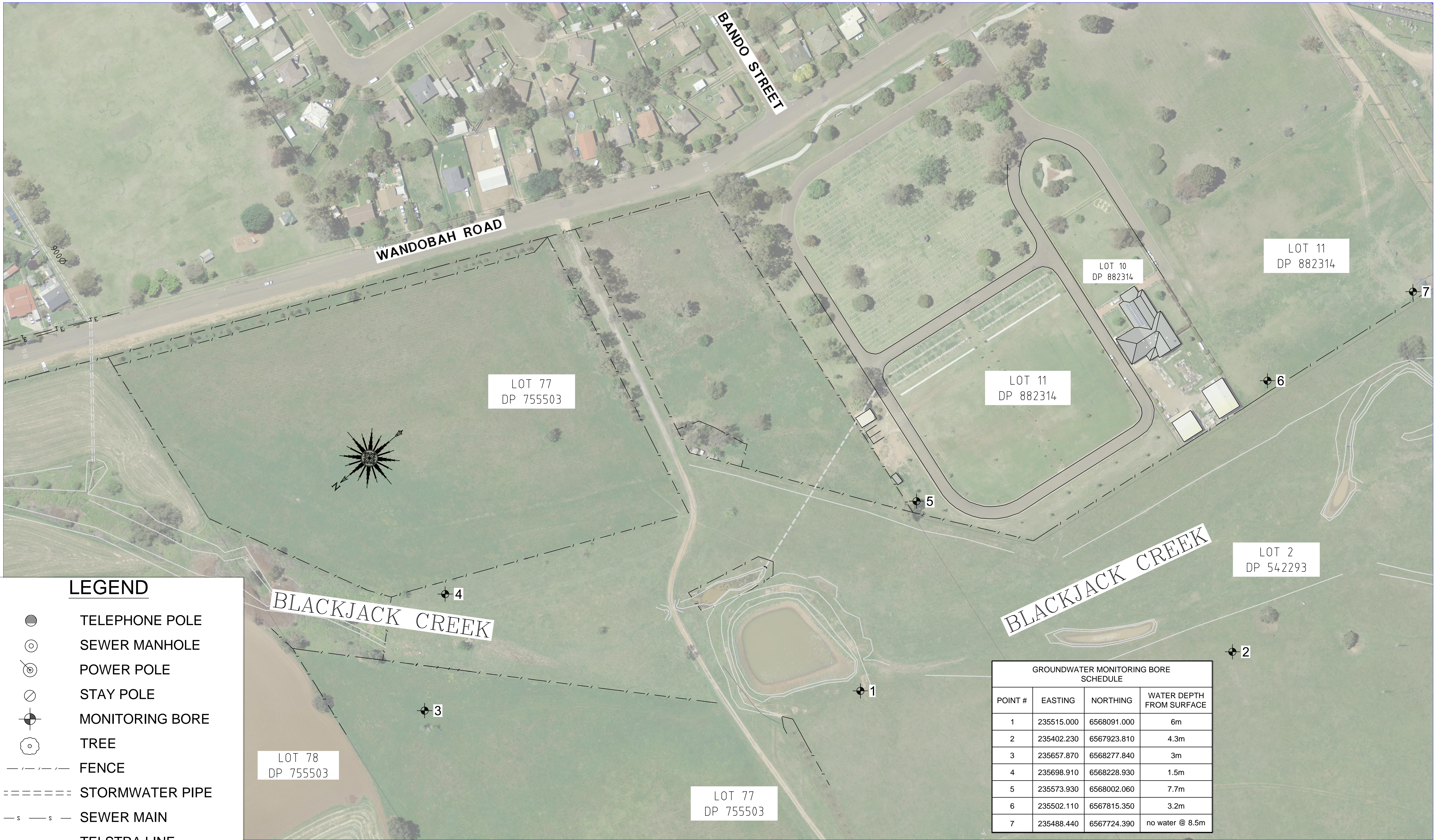
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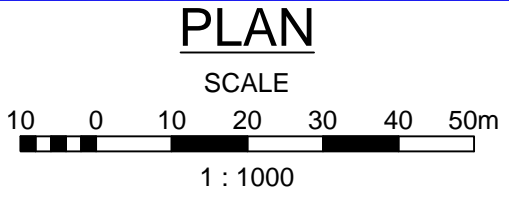




LEGEND

- TELEPHONE POLE
- SEWER MANHOLE
- ⊙ POWER POLE
- ⊘ STAY POLE
- ⊕ MONITORING BORE
- TREE
- - - - - FENCE
- ===== STORMWATER PIPE
- s - s - SEWER MAIN
- T - T - TELSTRA LINE
- E - E - OVERHEAD POWERLINE

GROUNDWATER MONITORING BORE SCHEDULE			
POINT #	EASTING	NORTHING	WATER DEPTH FROM SURFACE
1	235515.000	6568091.000	6m
2	235402.230	6567923.810	4.3m
3	235657.870	6568277.840	3m
4	235698.910	6568228.930	1.5m
5	235573.930	6568002.060	7.7m
6	235502.110	6567815.350	3.2m
7	235488.440	6567724.390	no water @ 8.5m



REVISIONS				
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A	03.12.2012	DB	ISSUED FOR REVIEW	--

EXISTING CONDITIONS &  
TEST BORE PLAN  
SHEET 3

Client:  
**GUNNEDAH SHIRE COUNCIL**

**BLACKJACK CREEK RIPARIAN CORRIDOR &  
CHANNEL RECONSTRUCTION**


Design Completed:  
03.12.2012

Designed:  
DB

Status:  
**PRELIMINARY**

Plan Size:  
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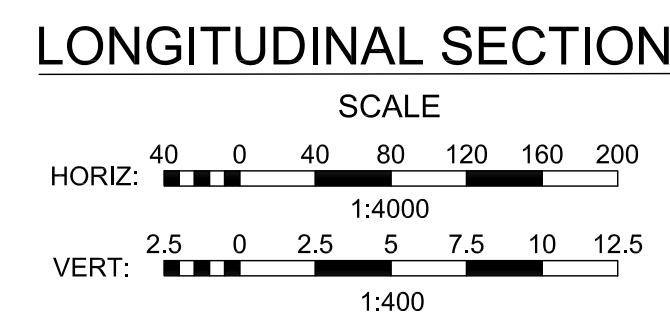
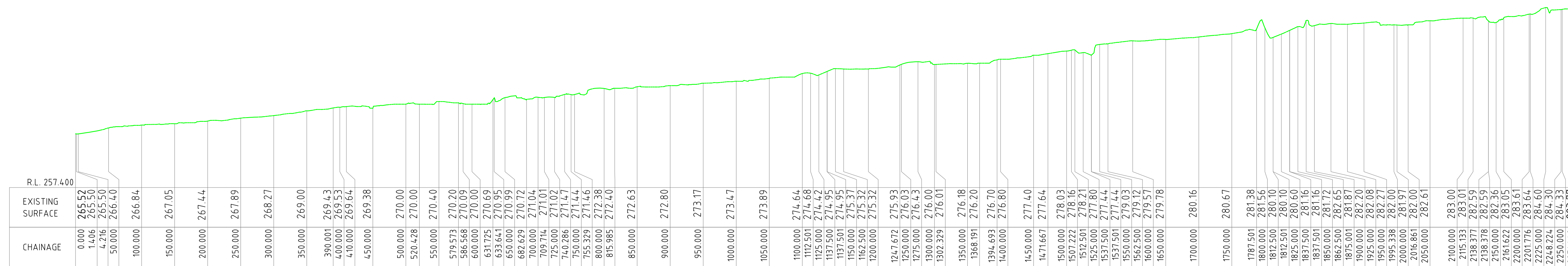
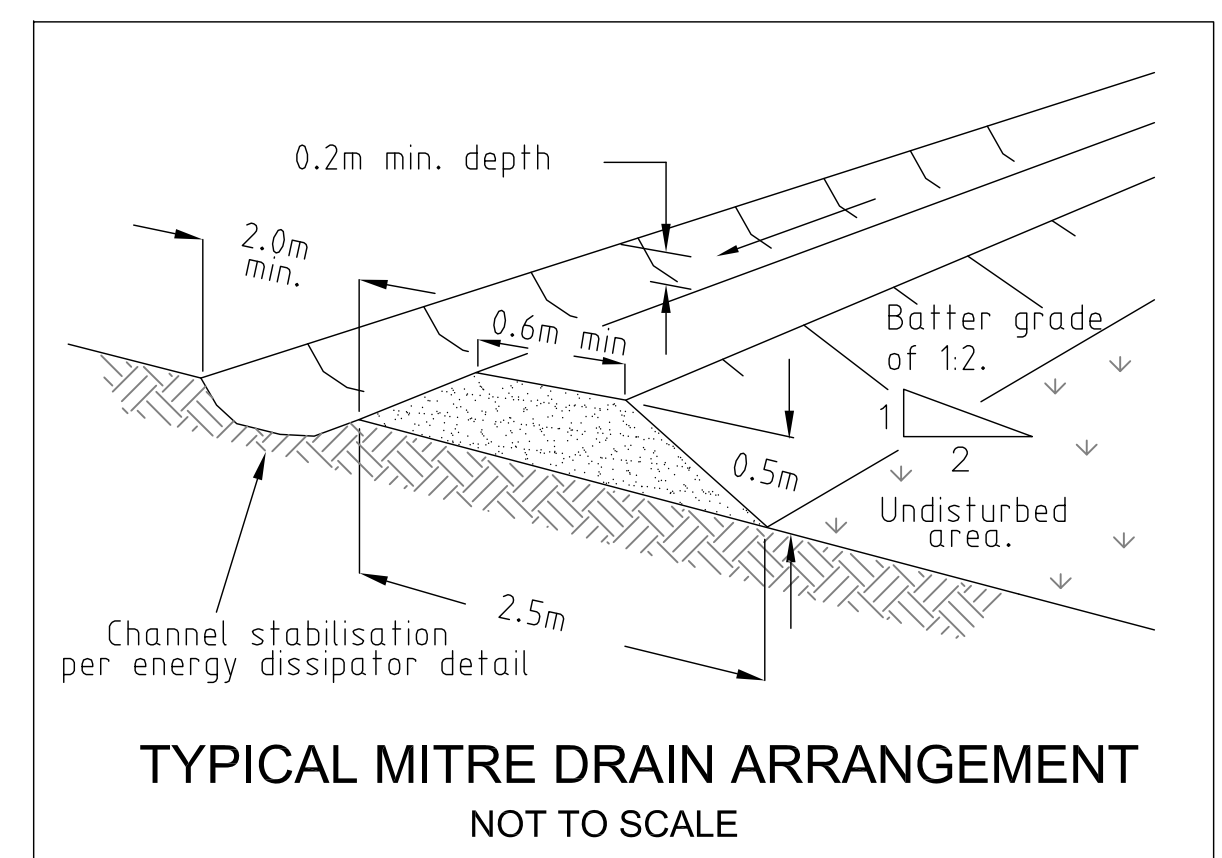
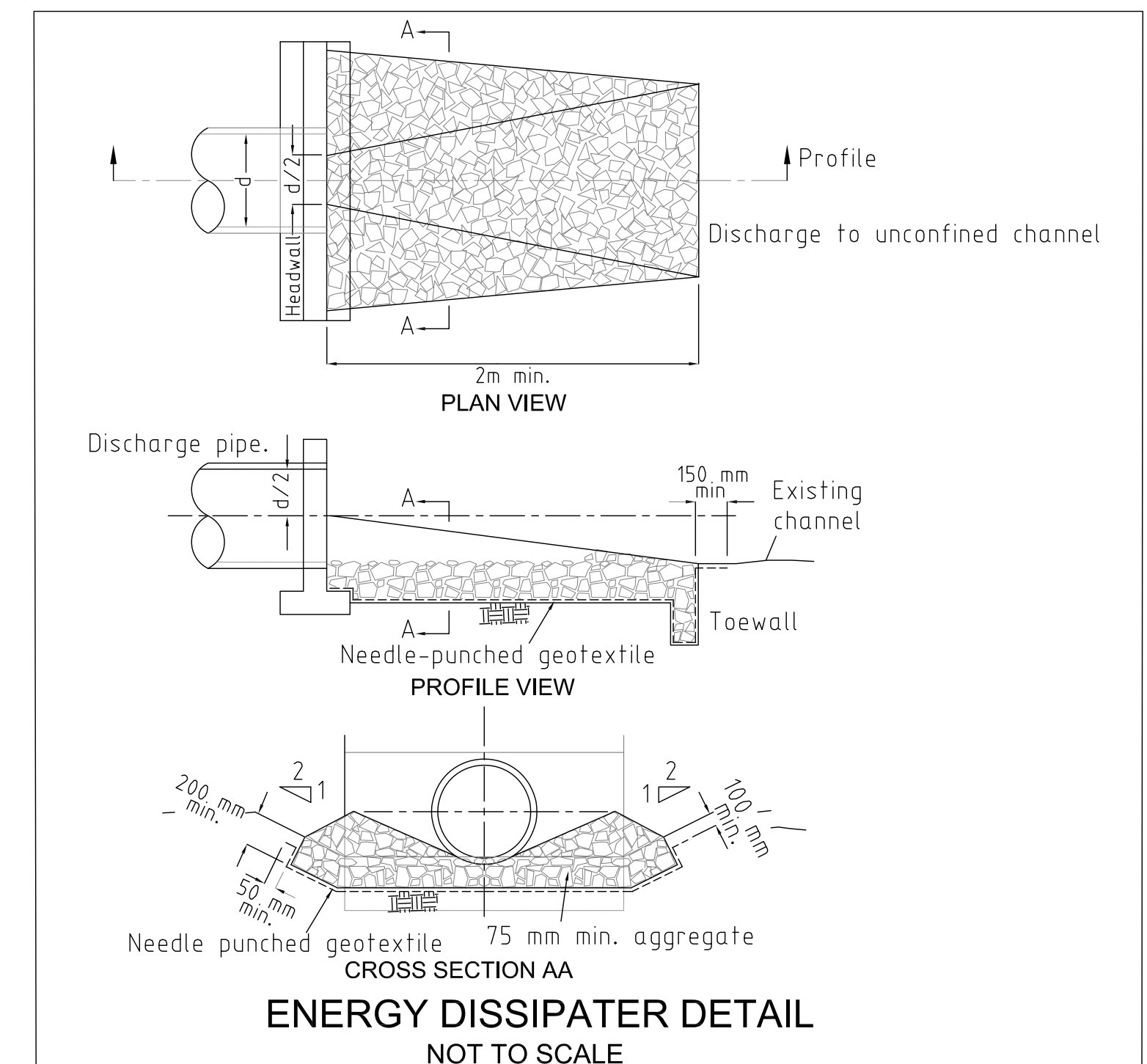
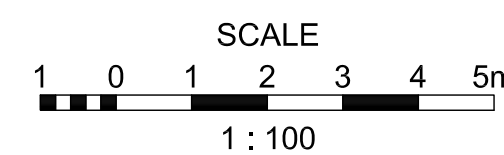
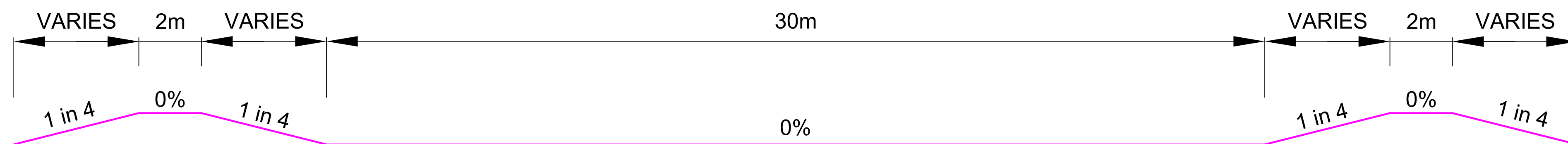
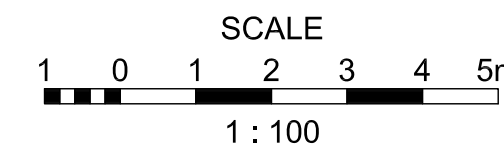
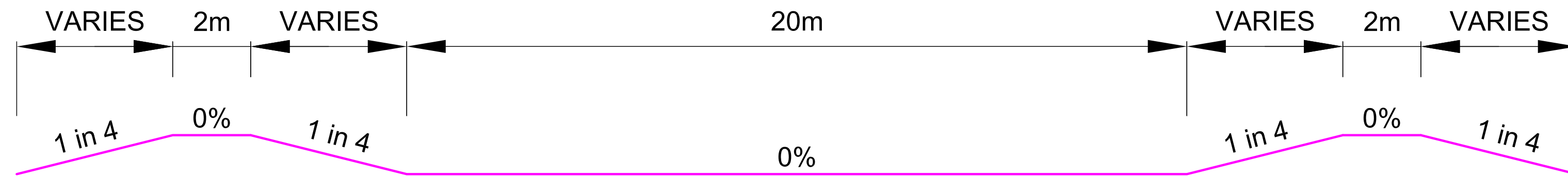
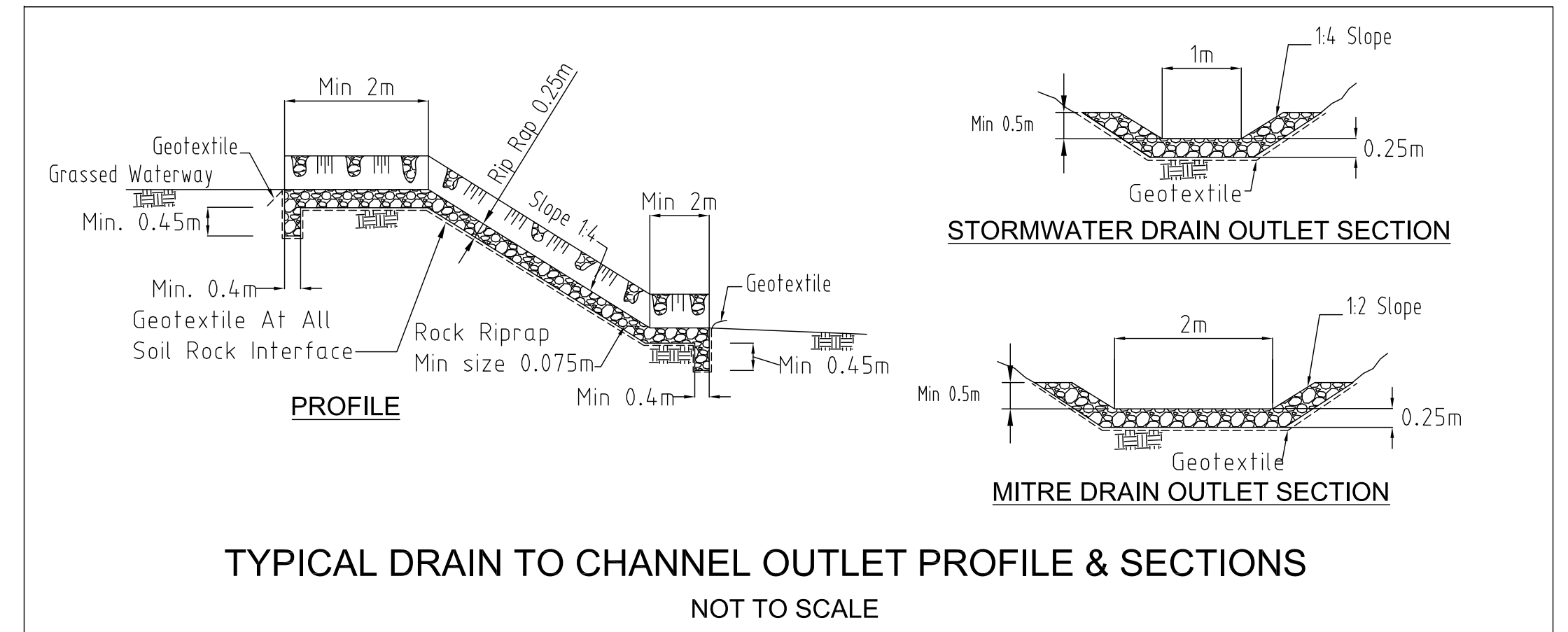
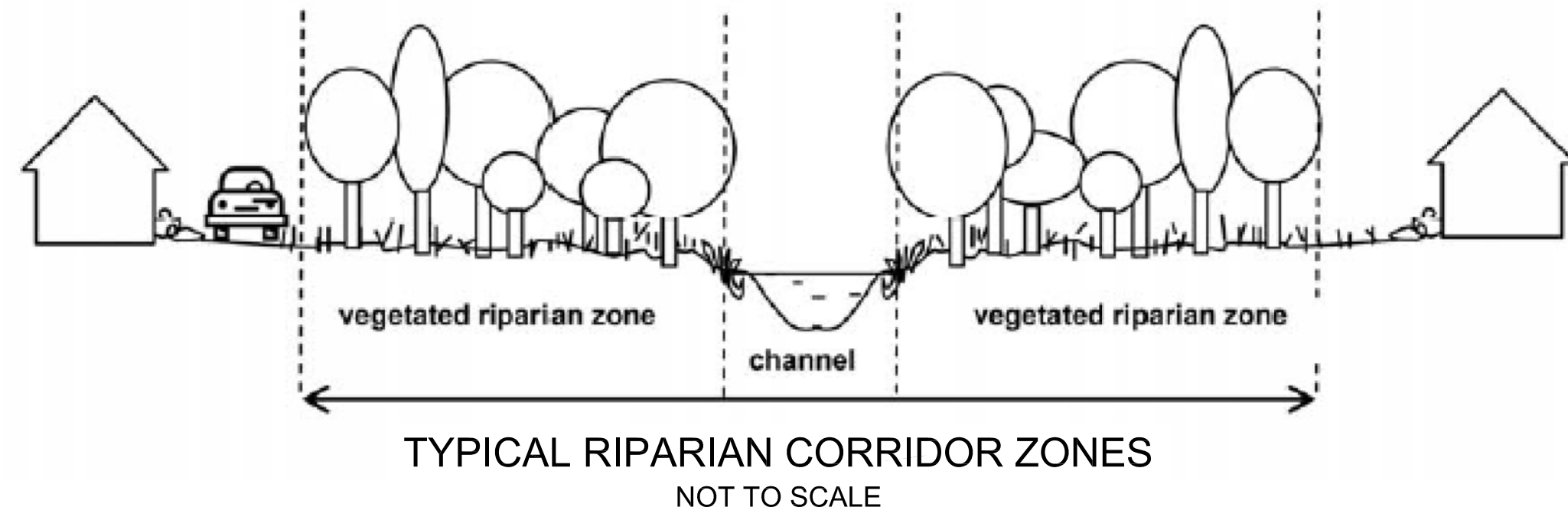
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## EXISTING CHANNEL LONGITUDINAL SECTION & TYPICAL SECTIONS

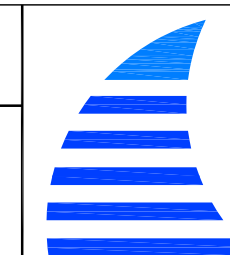
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**BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION**

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03.12.2012

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DB

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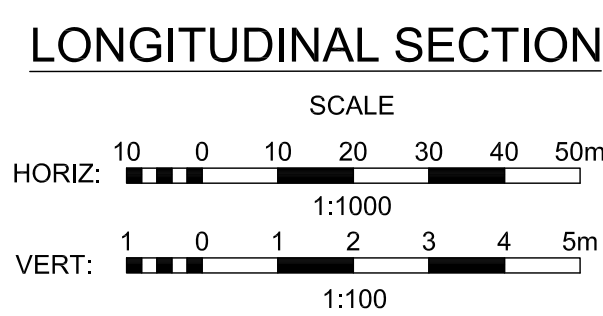
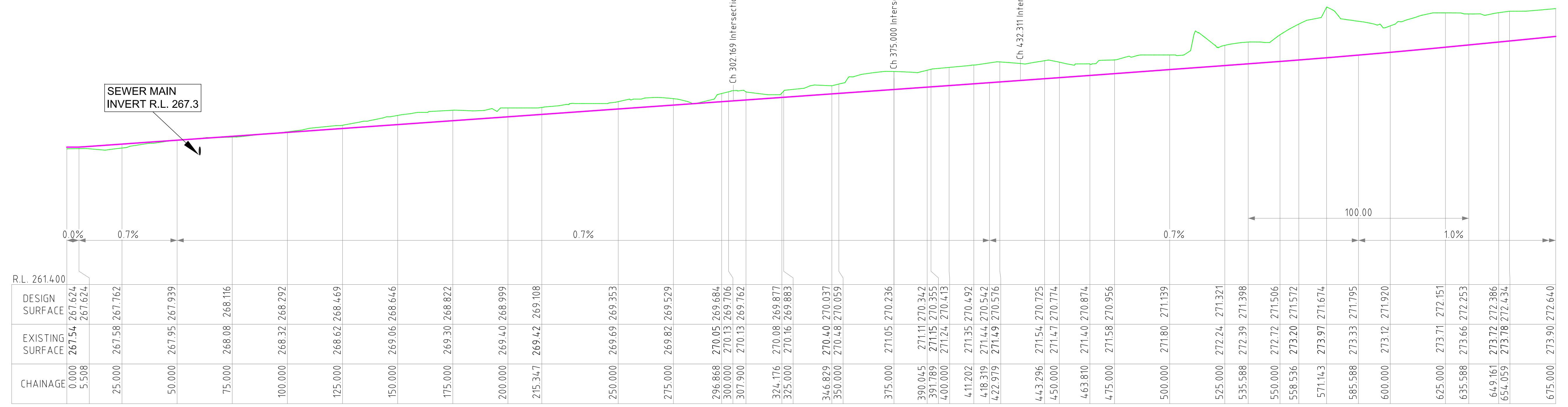
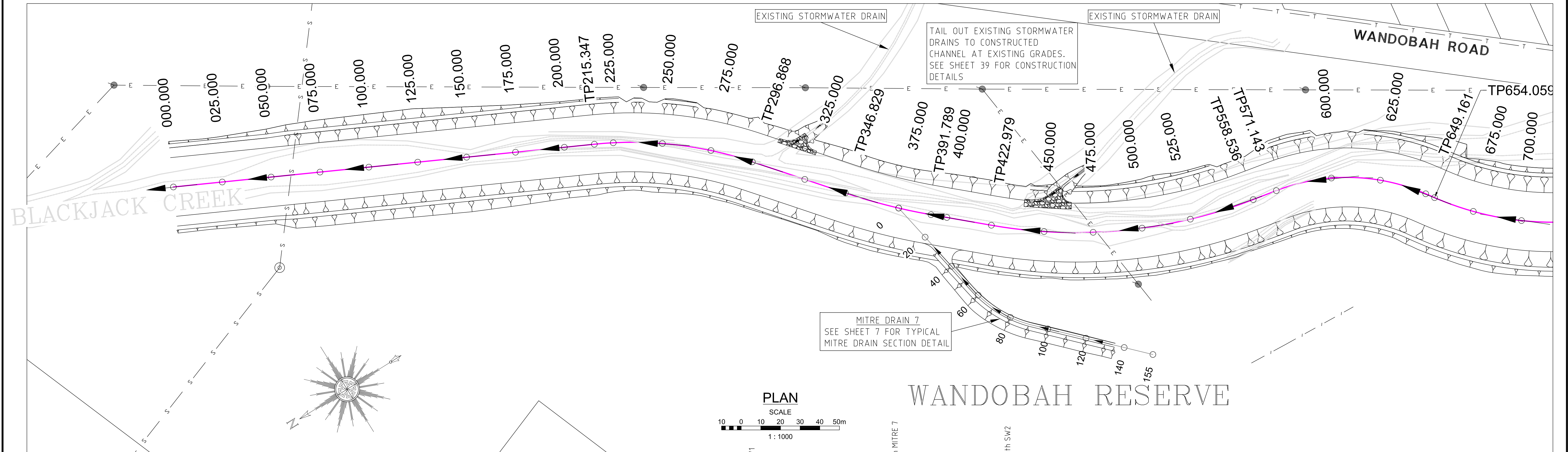
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Plan Size:  
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Drawing No:  
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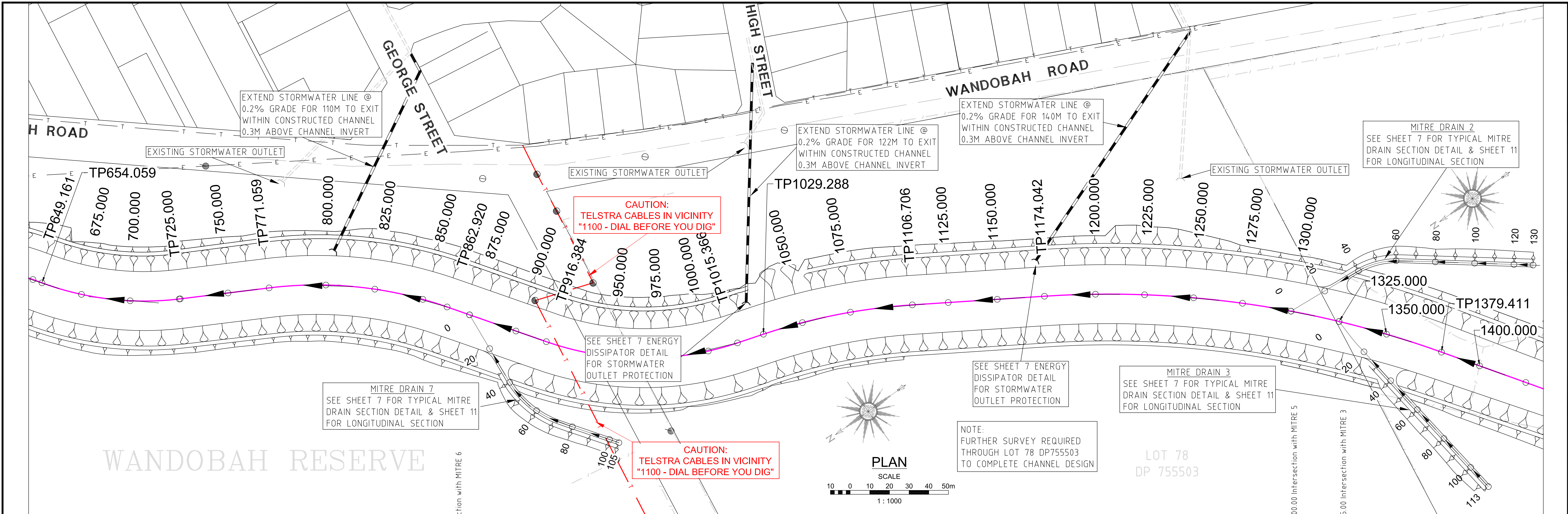
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PLAN & LONGITUDINAL SECTION  
CH 0.000 - CH 675.000

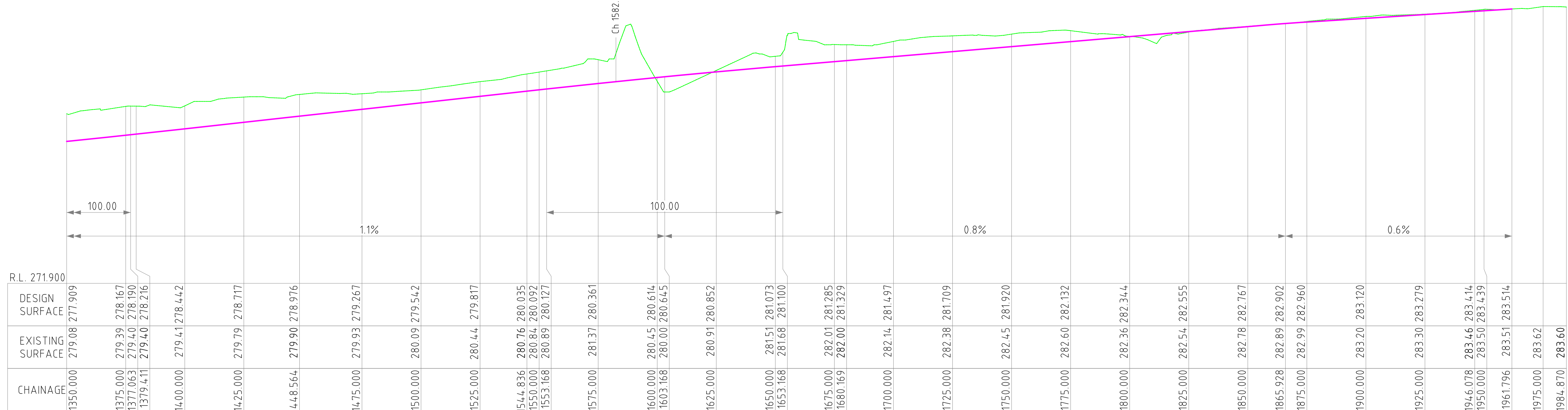
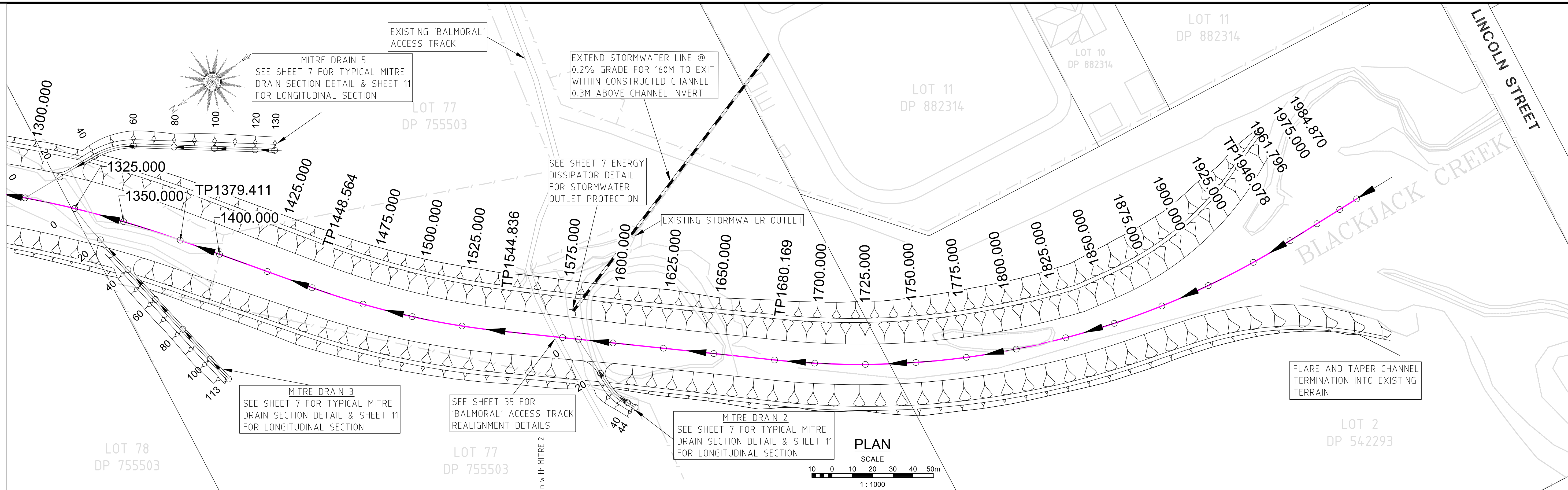
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<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
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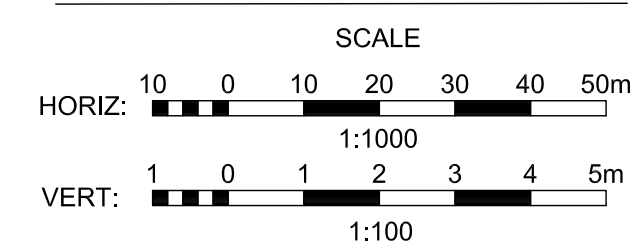









LONGITUDINAL SECTION



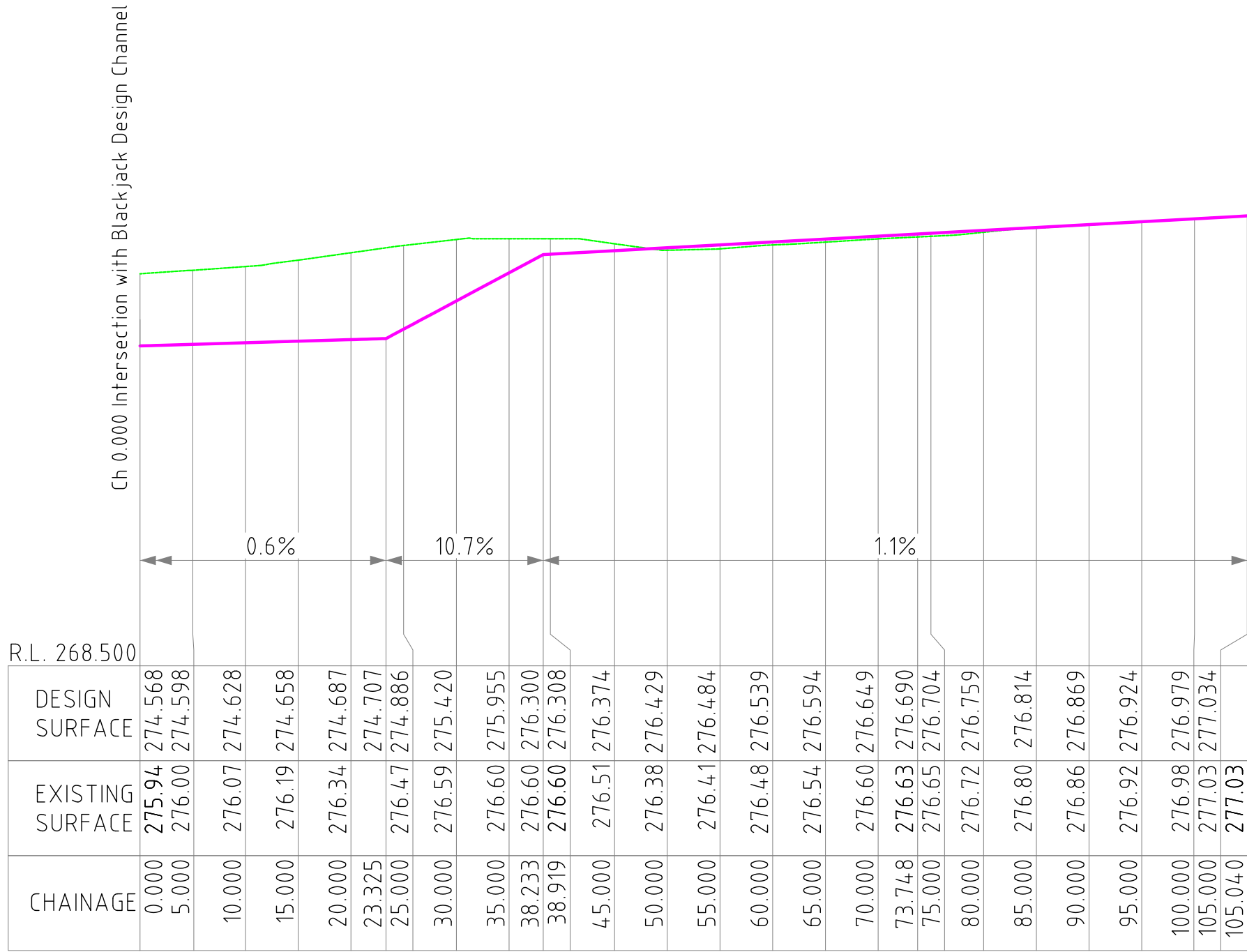
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PLAN & LONGITUDINAL SECTION  
CH 1350.000 - CH 1961.796

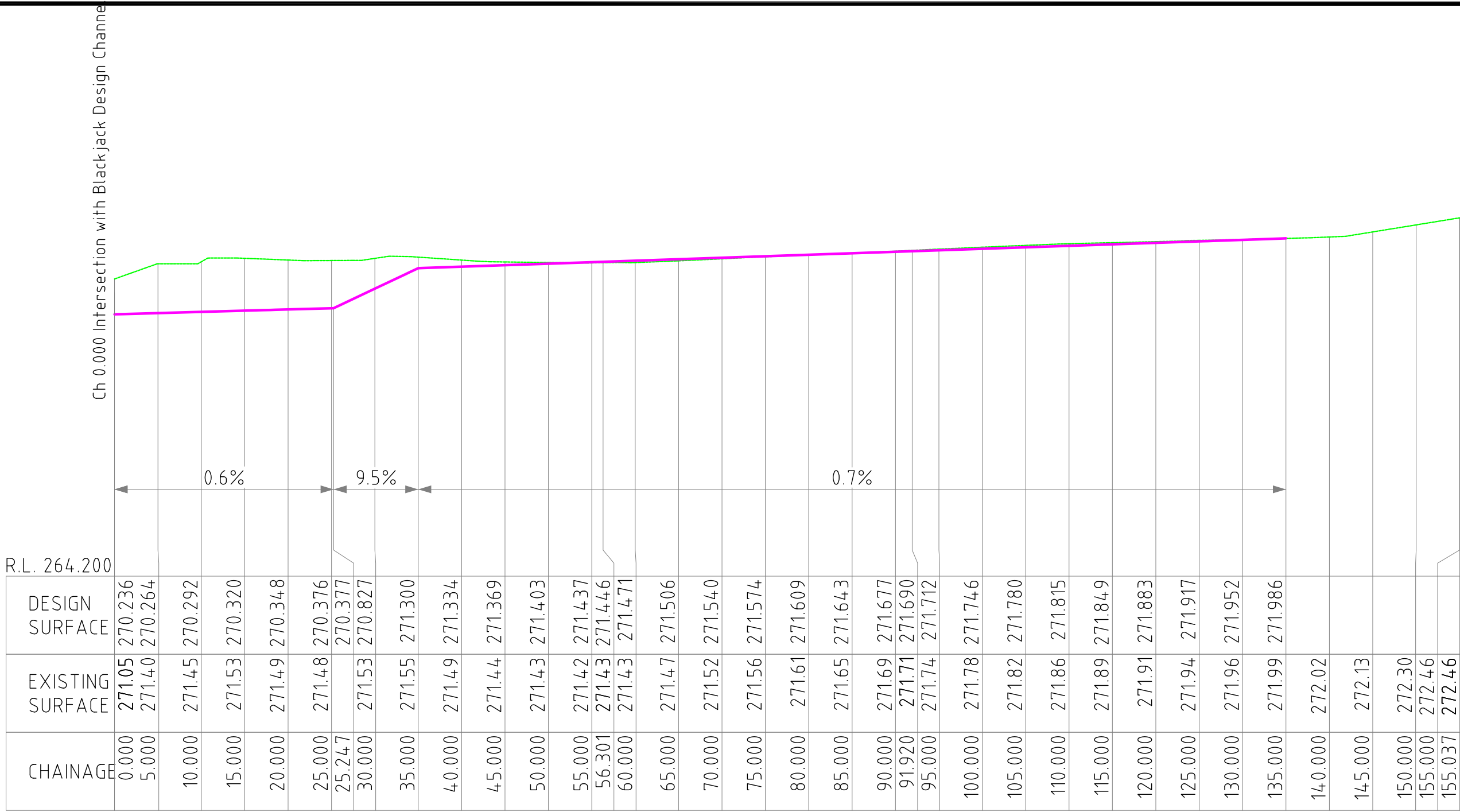
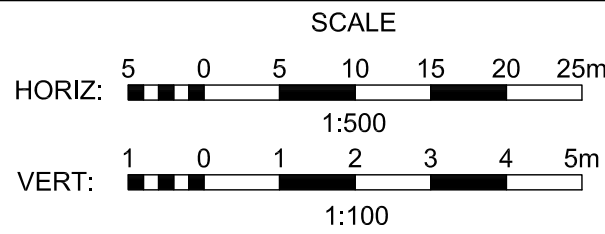
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<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>

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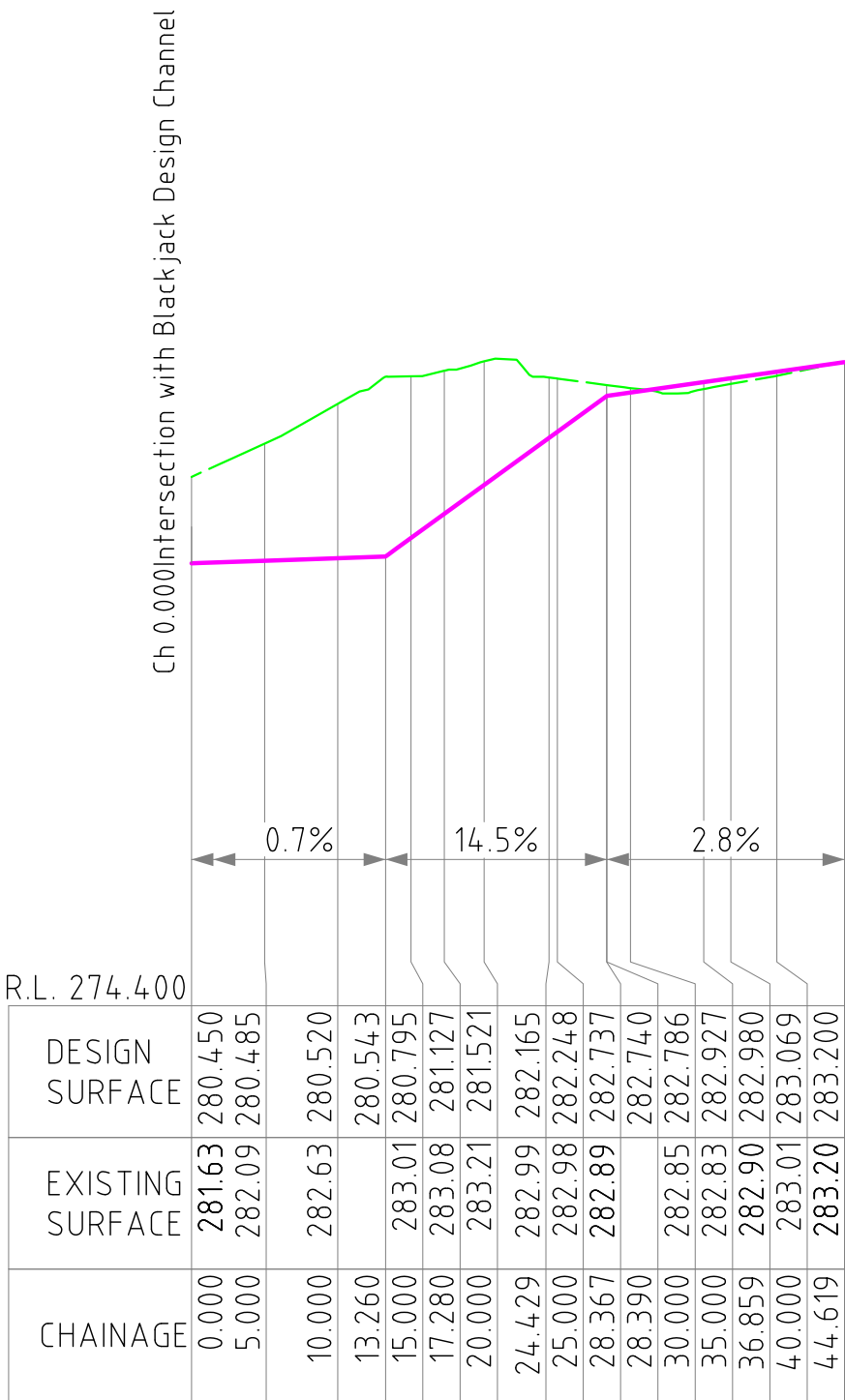
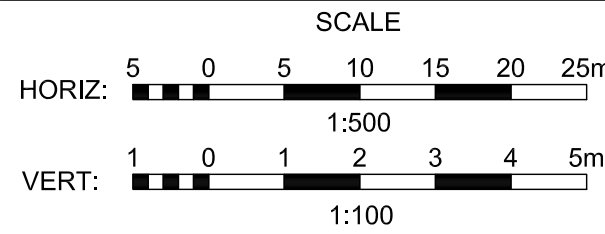




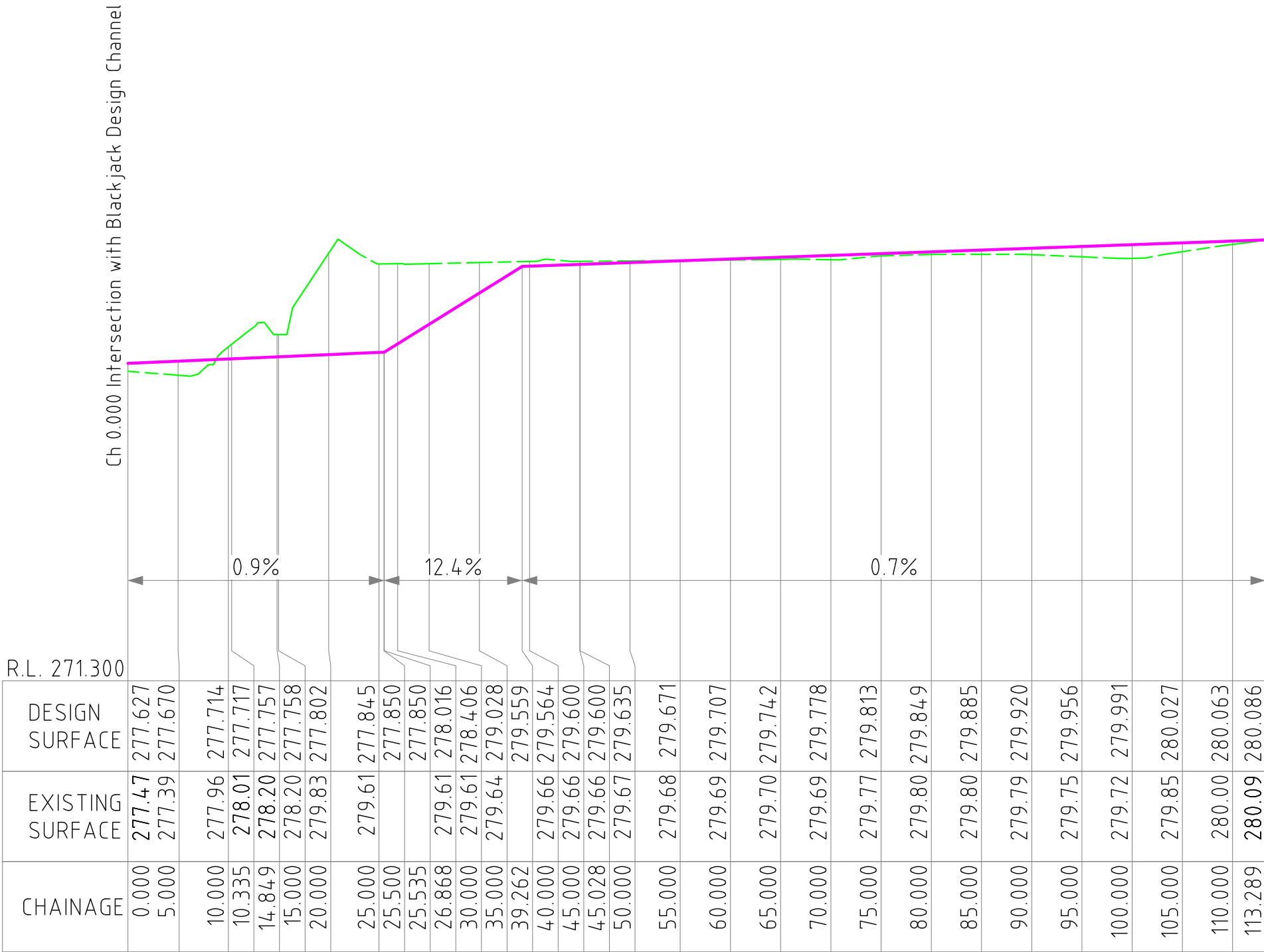
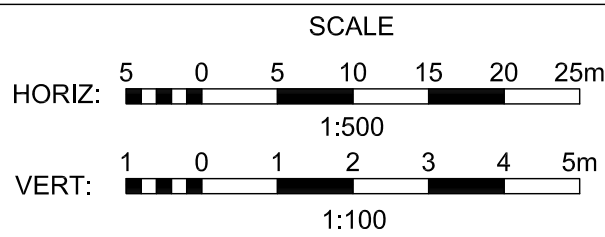
MITRE DRAIN 6  
LONGITUDINAL SECTION



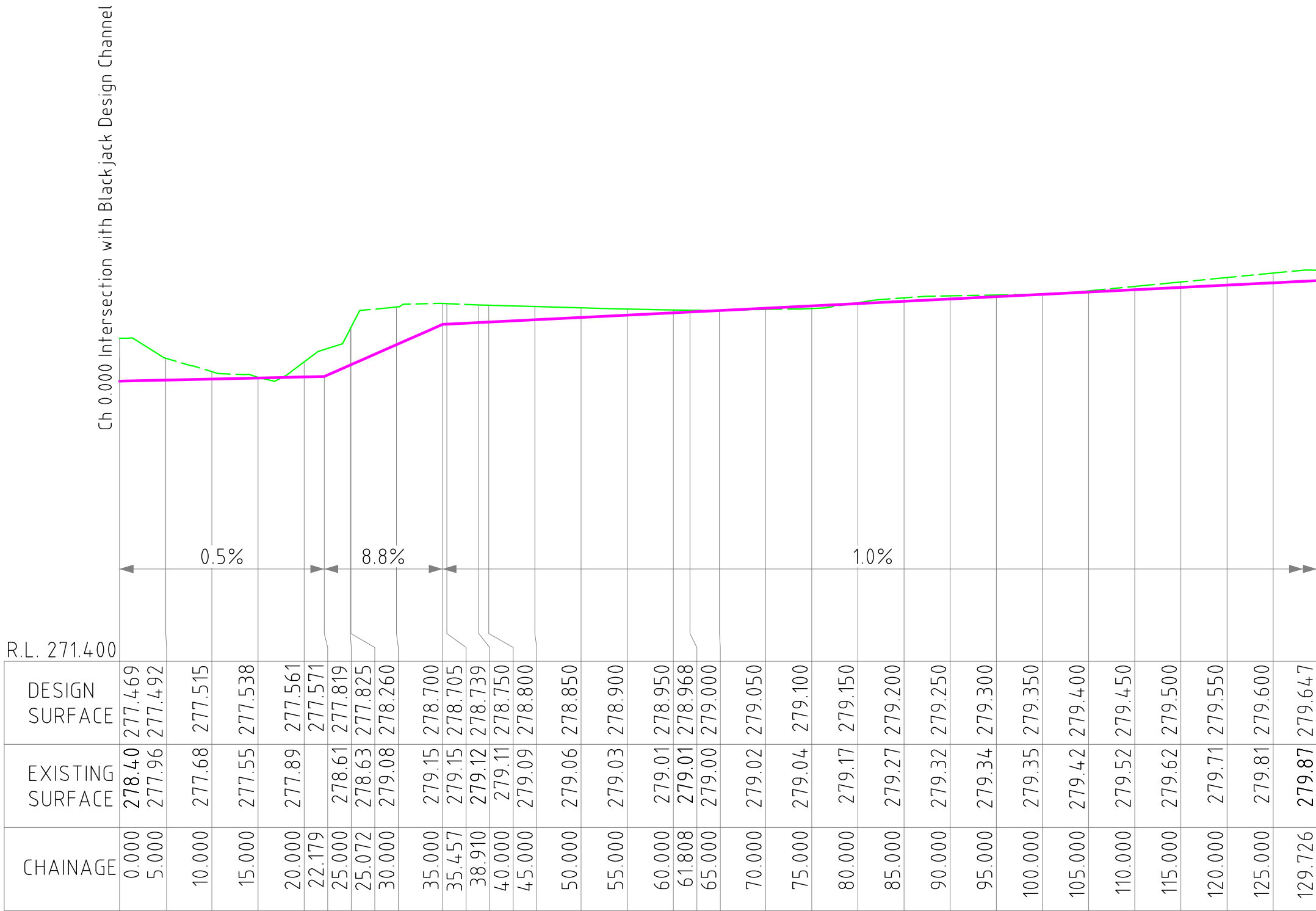
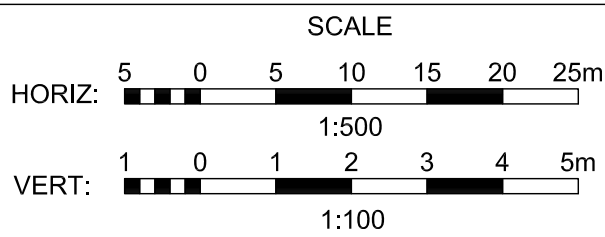
MITRE DRAIN 7  
LONGITUDINAL SECTION



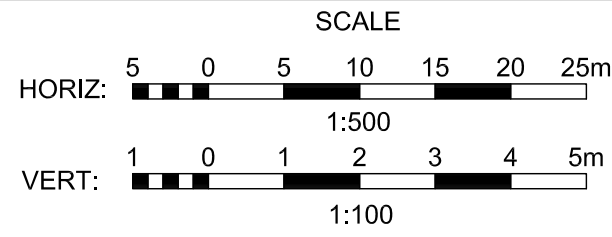
MITRE DRAIN 2  
LONGITUDINAL SECTION



MITRE DRAIN 3  
LONGITUDINAL SECTION



MITRE DRAIN 5  
LONGITUDINAL SECTION



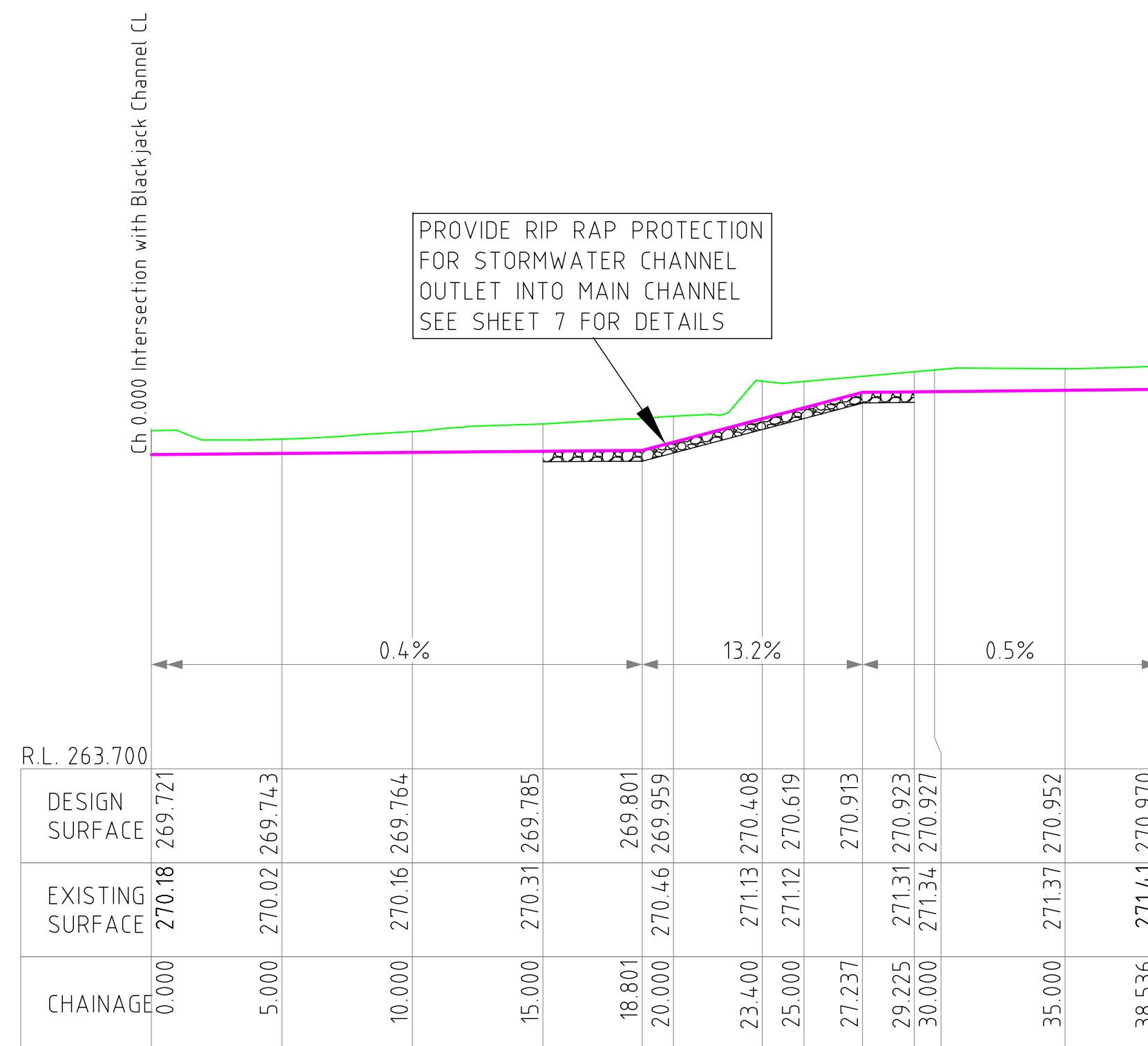
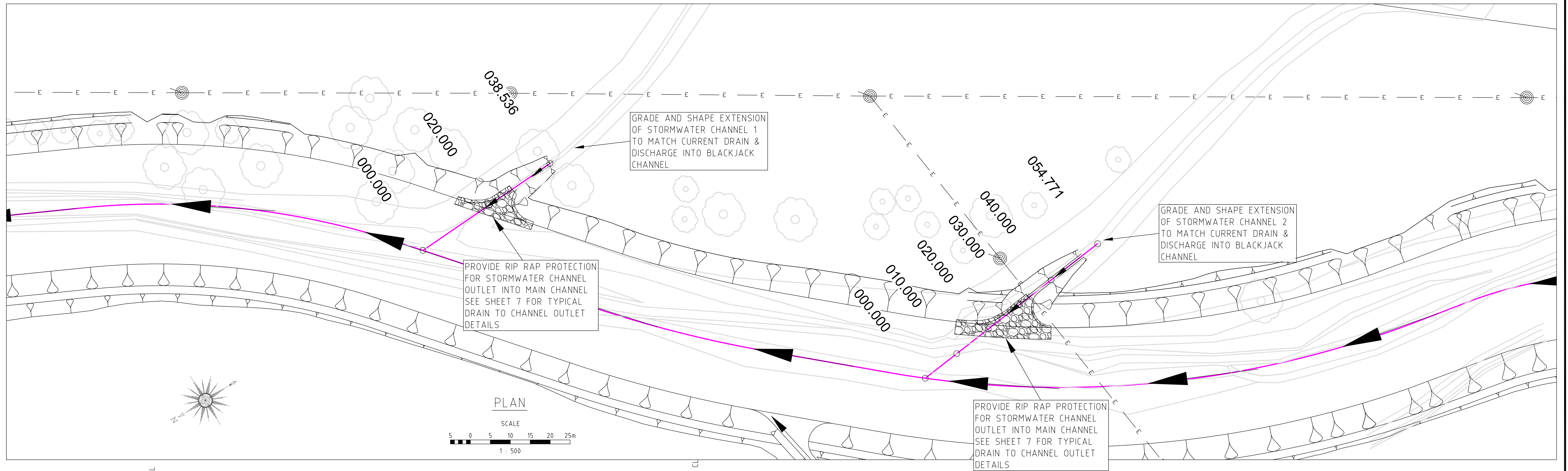
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MITRE DRAIN  
LONGITUDINAL SECTIONS

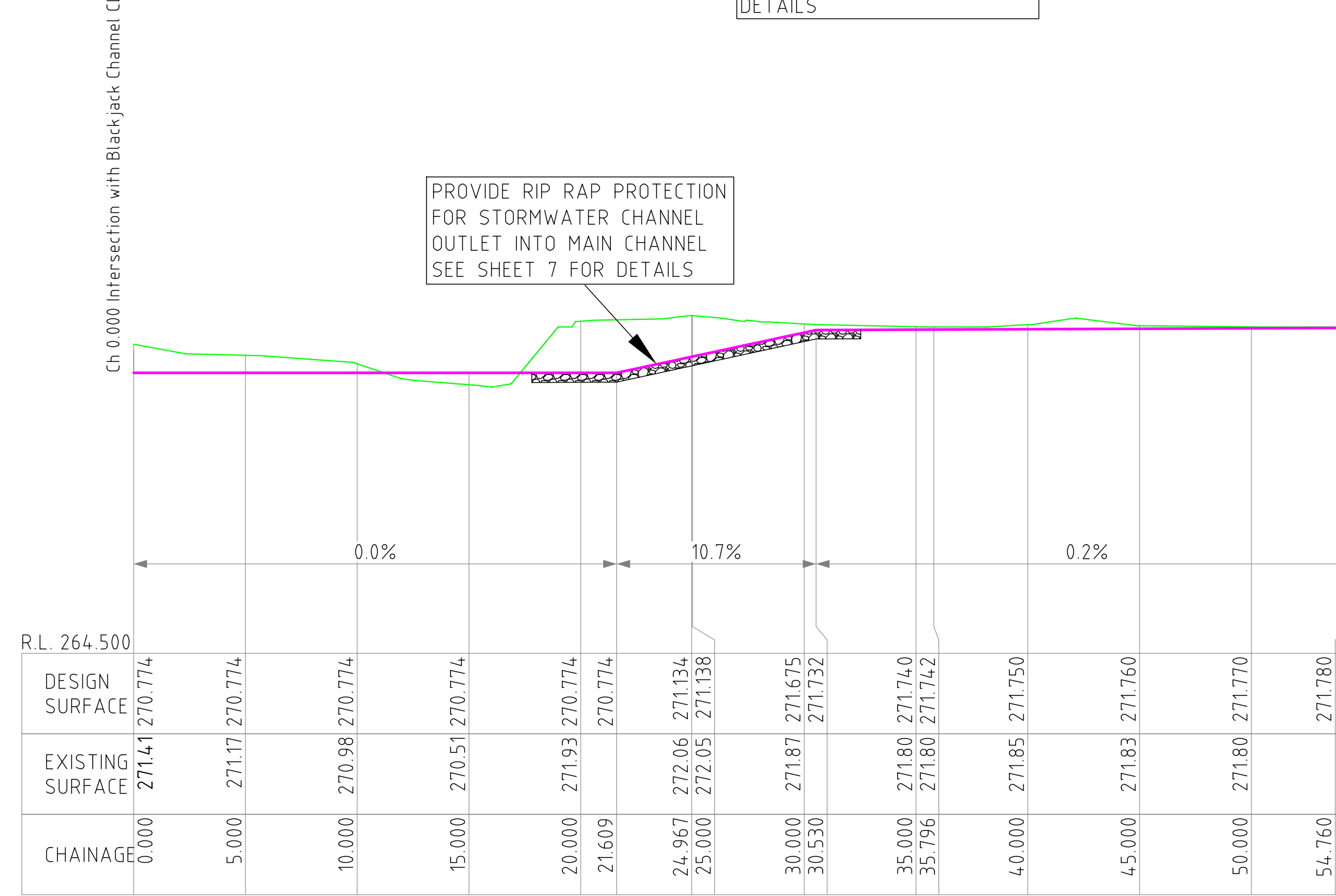
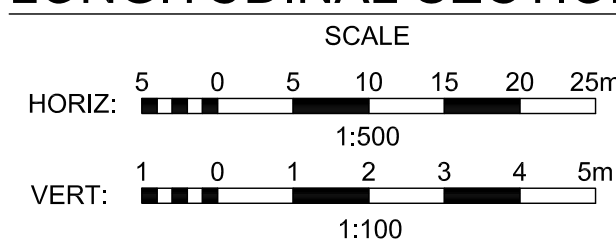
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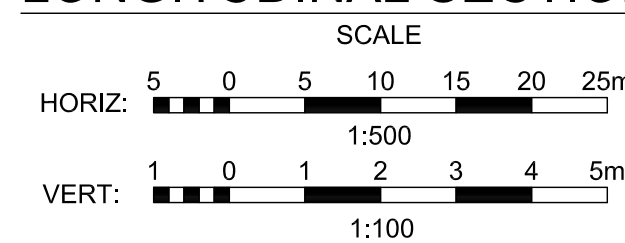




STORM WATER DRAIN 1  
LONGITUDINAL SECTION



STORM WATER DRAIN 2  
LONGITUDINAL SECTION

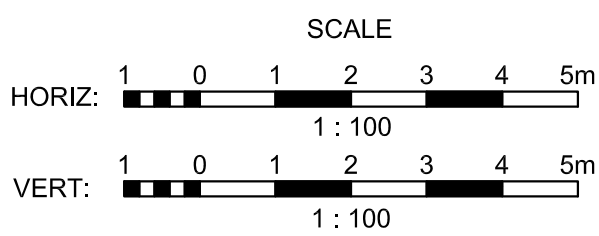
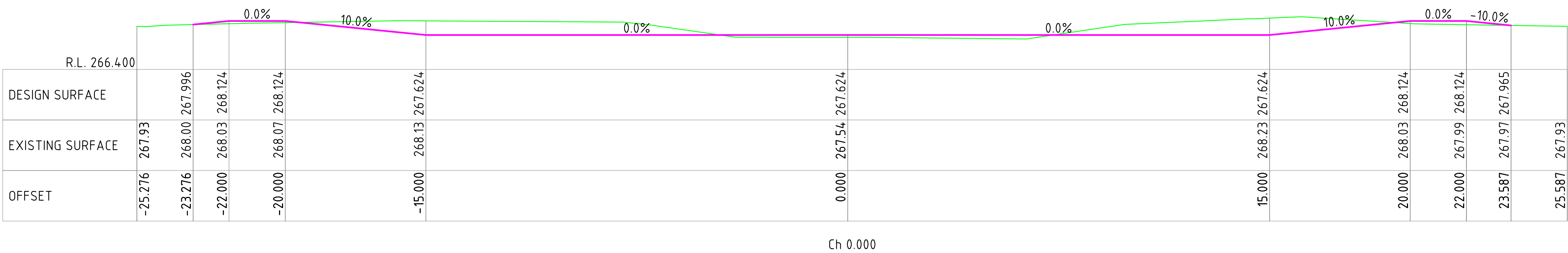
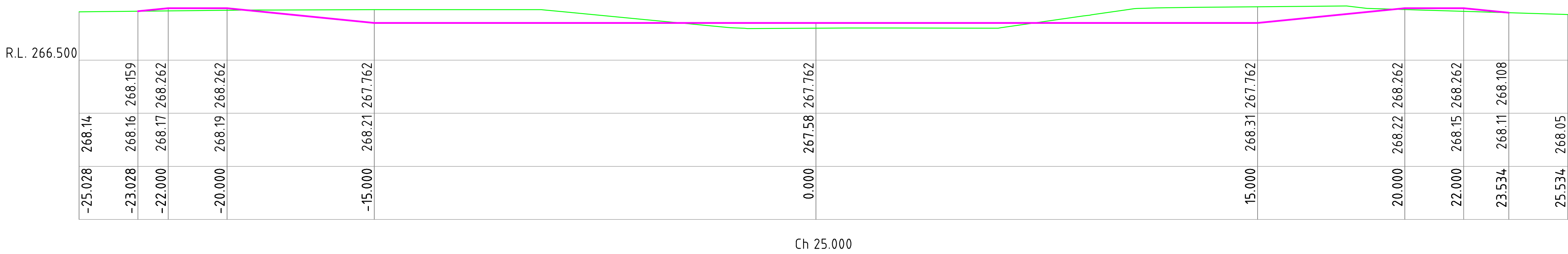
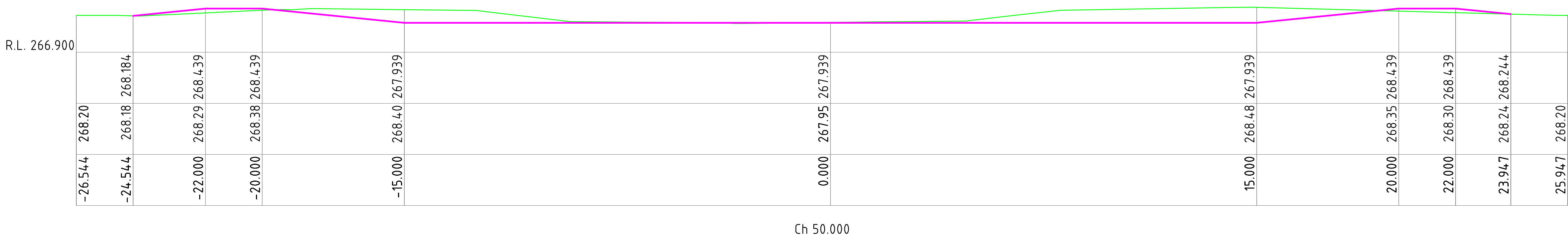
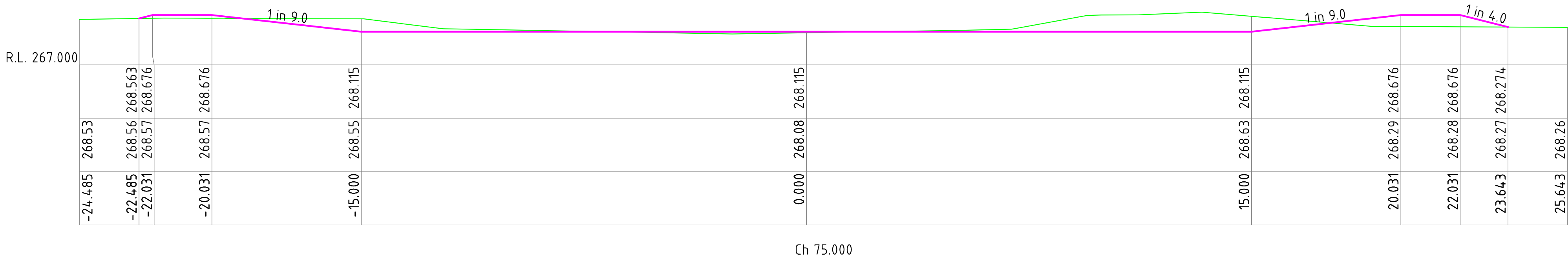


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## STORMWATER DRAINS 1 & 2 PLAN & LONGITUDINAL SECTIONS

Client: <b>GUNNEDAH SHIRE COUNCIL</b>		
<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>

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			CHK.	

CROSS SECTIONS  
CH 0.000 - CH 75.000

Client: <b>GUNNEDAH SHIRE COUNCIL</b>		
<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>

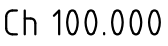
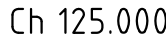
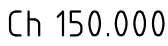
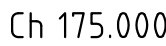


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Plan Size: **A1**

Drawing No: **201201-013**





# CROSS SECTIONS

## CH 100.000 - CH 175.000

# GUNNEDAH SHIRE COUNCIL

# BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION

ign Completed:  
03.12.2012

Designed:  
DB

Status: **PRELIMINARY**

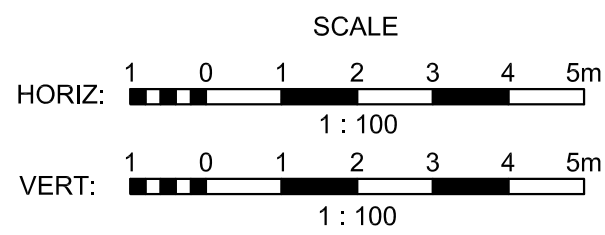
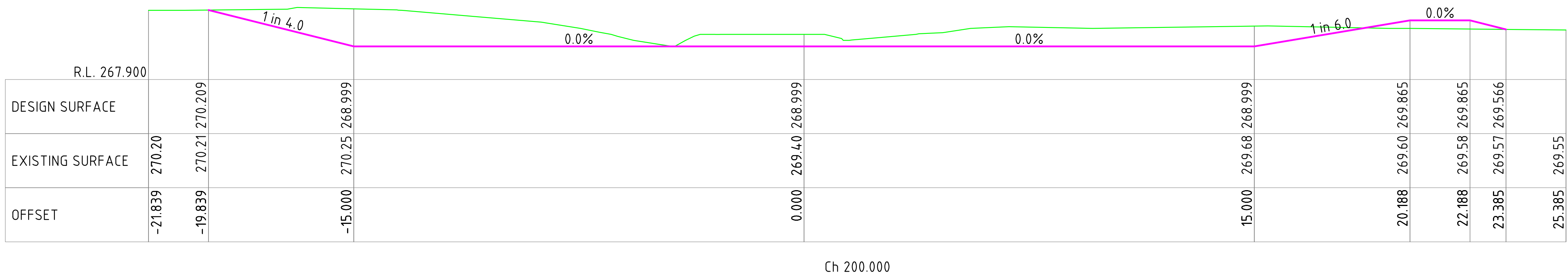
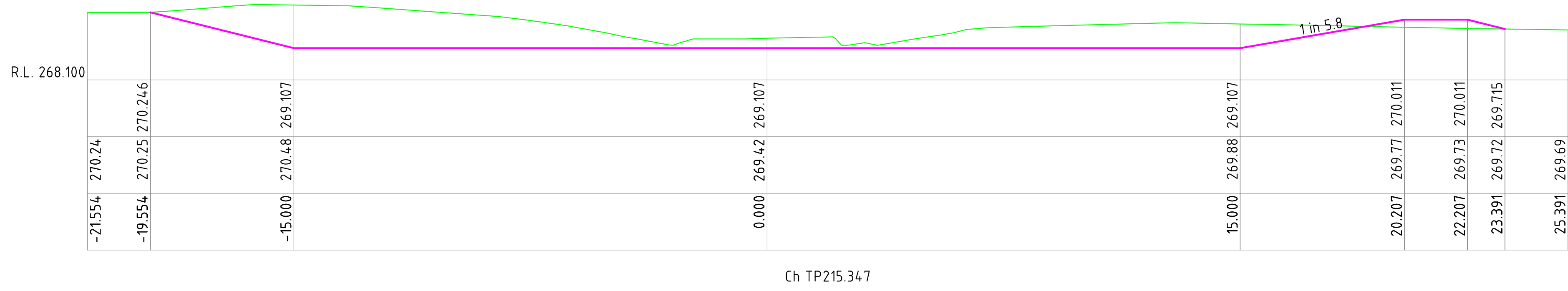
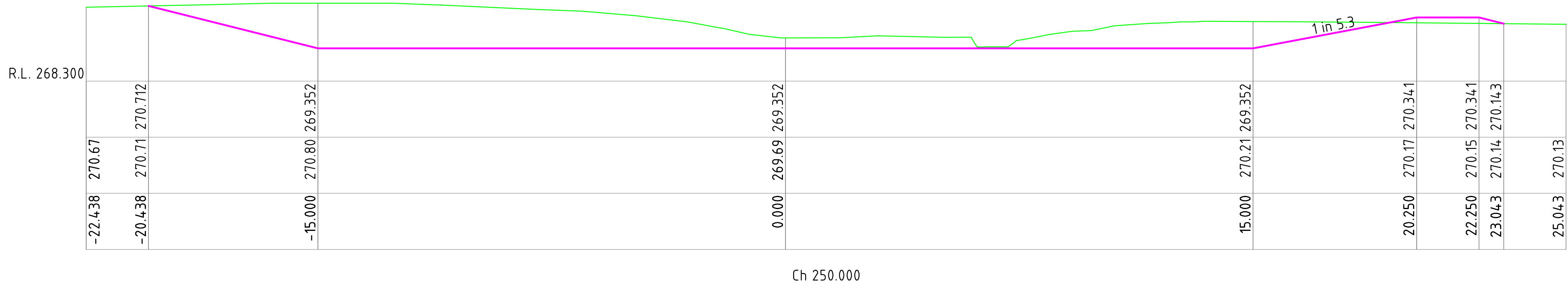
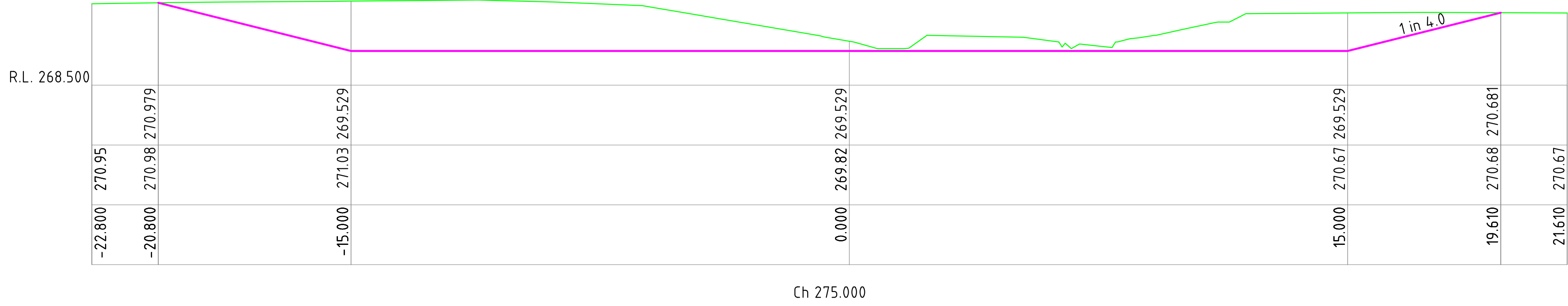


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Plan Size: **A1**

Drawing No: **201201-014**





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REV.	DATE	BY	DESCRIPTION	
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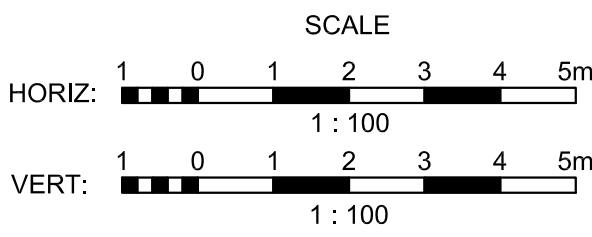
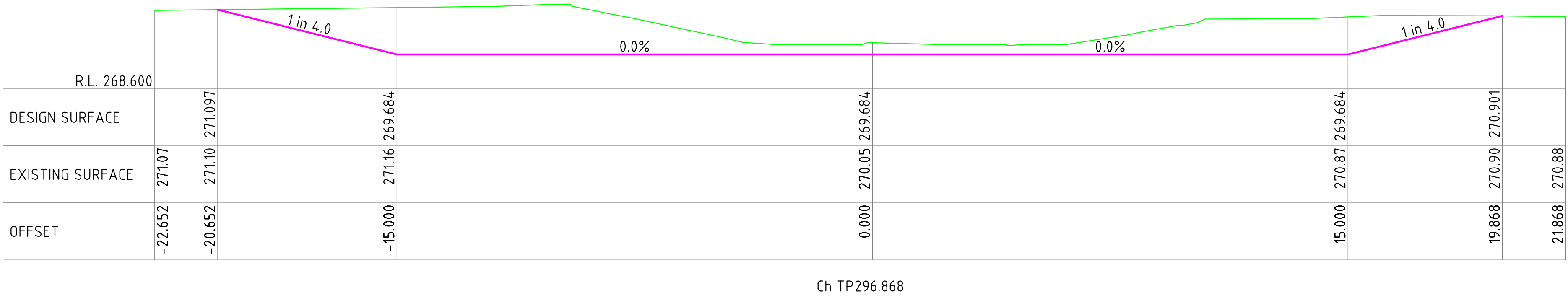
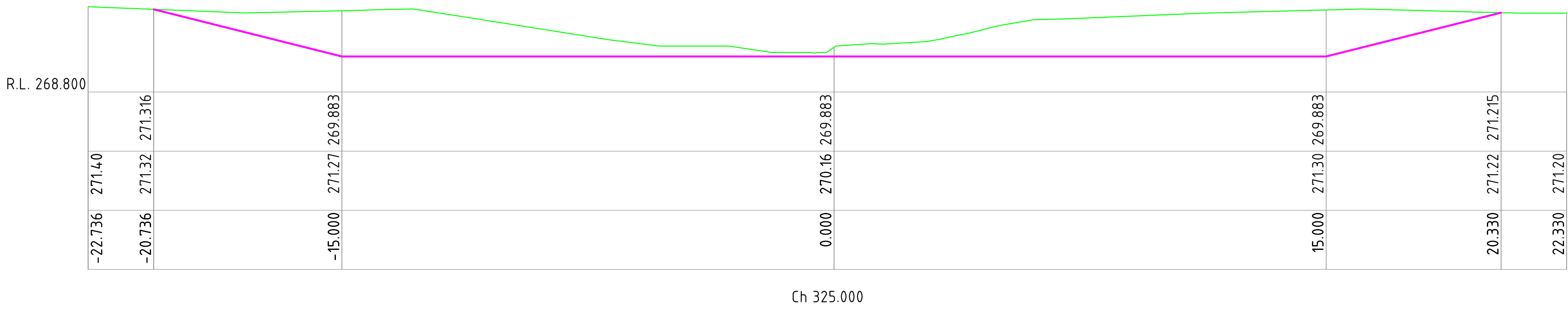
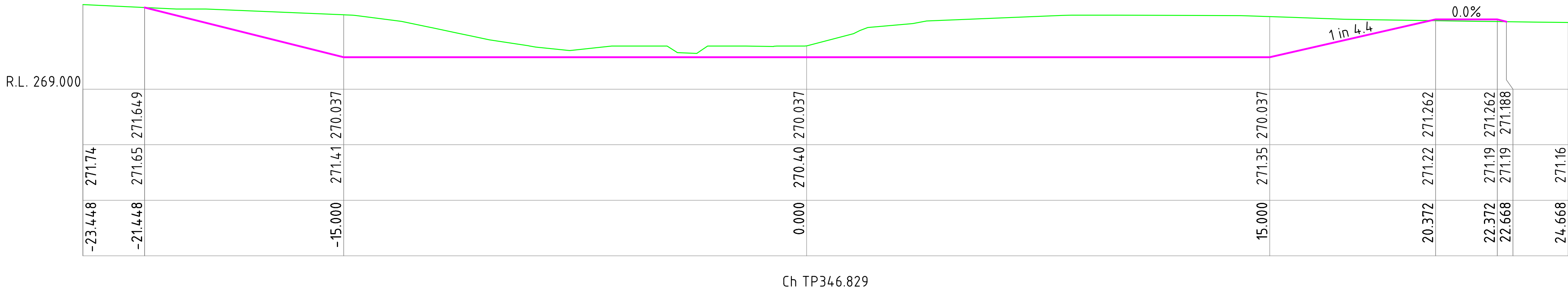
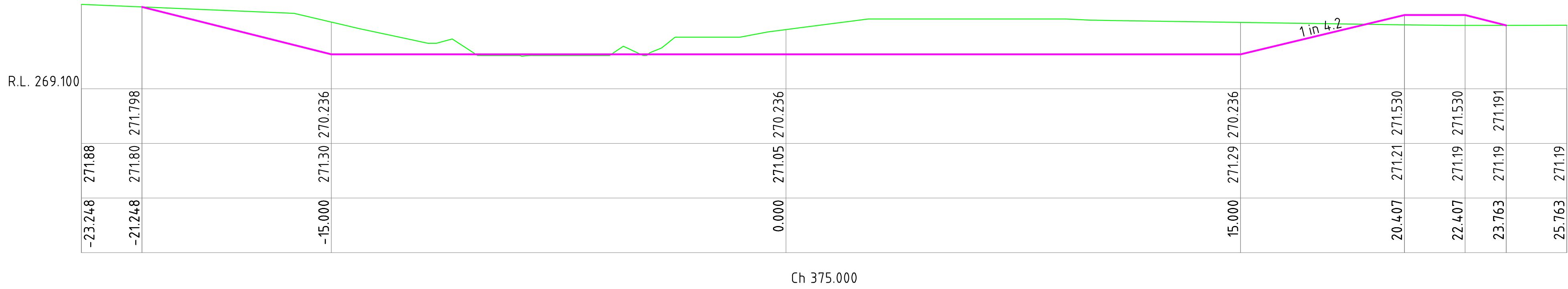
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Client: <b>GUNNEDAH SHIRE COUNCIL</b>		
<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>



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Plan Size: <b>A1</b>	Drawing No: <b>201201-015</b>
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REV.	DATE	BY	DESCRIPTION		CHK.

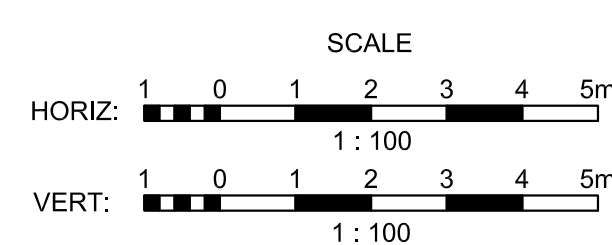
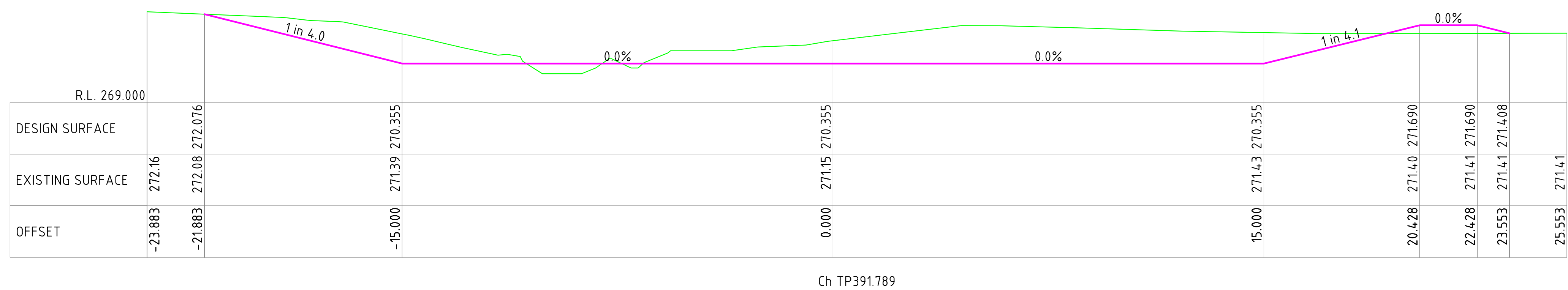
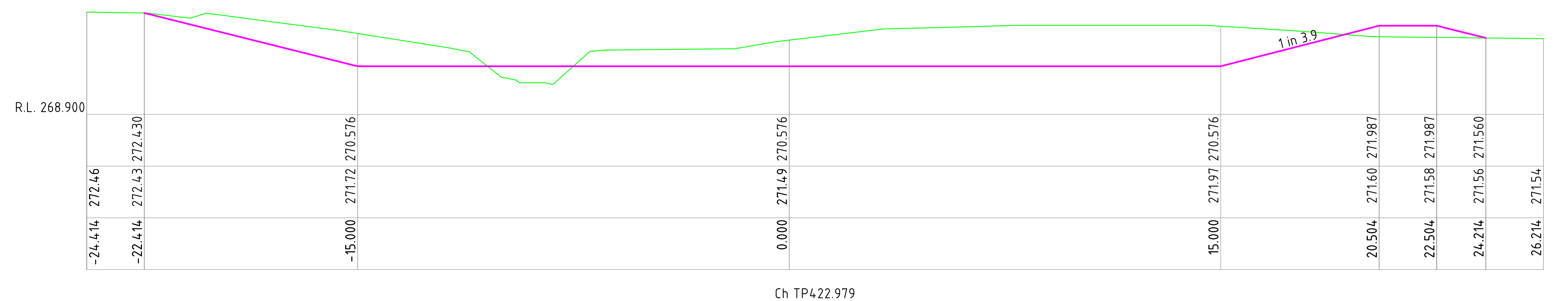
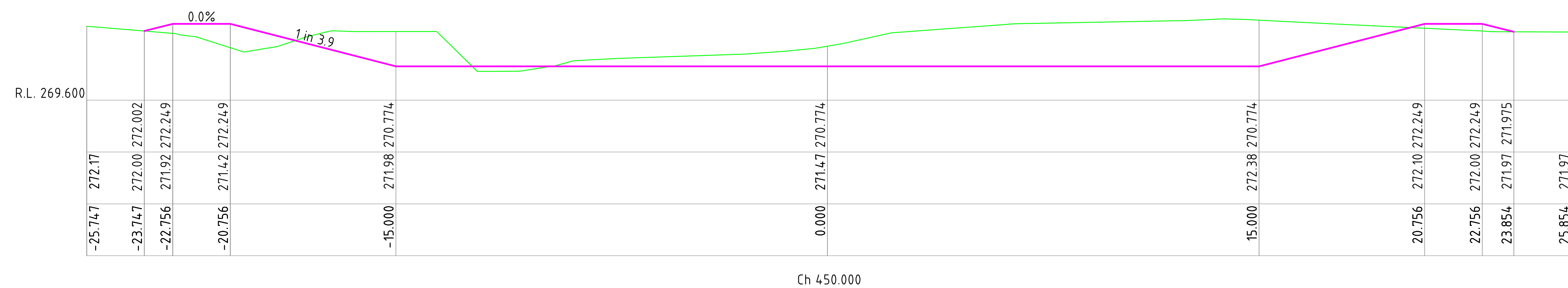
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Client: <b>GUNNEDAH SHIRE COUNCIL</b>		
<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>



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Plan Size: <b>A1</b>	Drawing No: <b>201201-016</b>
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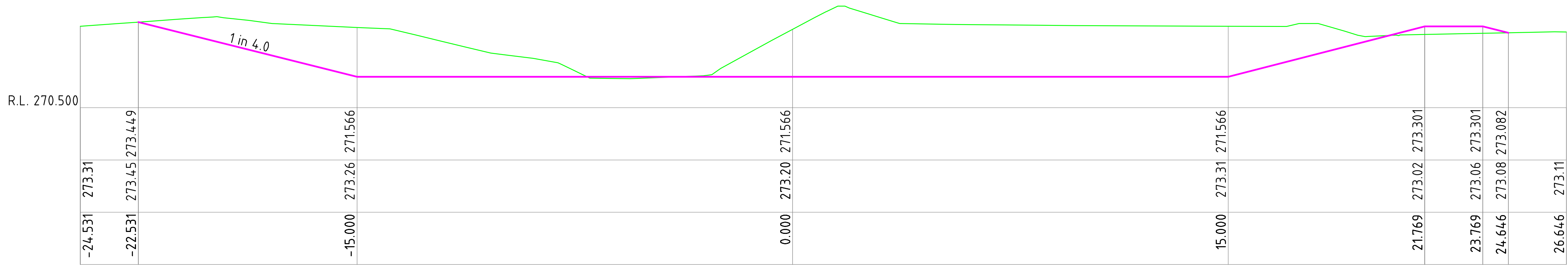


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	REV.	DATE	BY	DESCRIPTION	CHK.

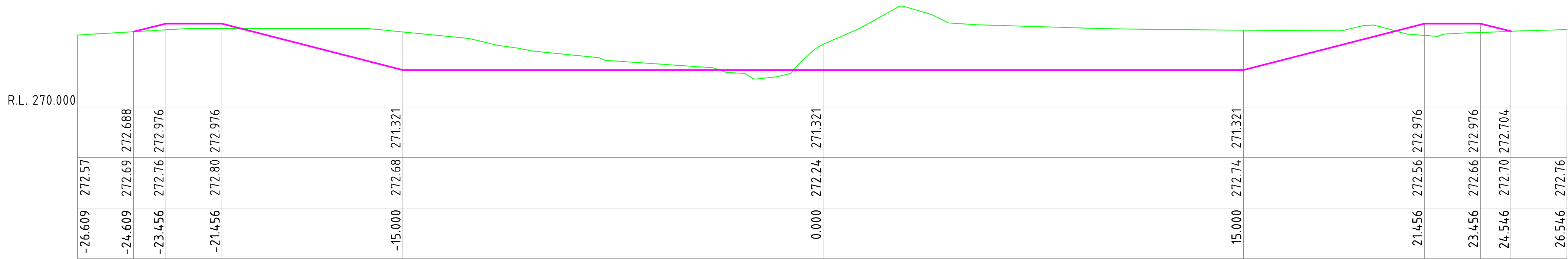
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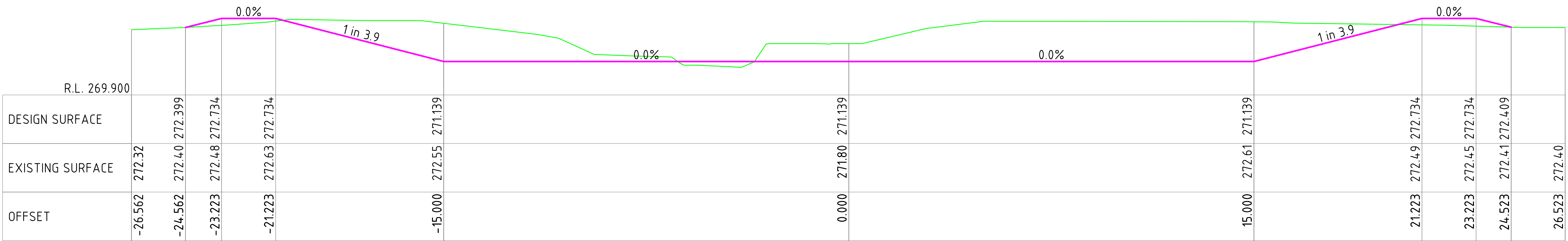
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<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>			
Design Completed: <b>03.12.2012</b>	Designed: <b>DB</b>	Status: <b>PRELIMINARY</b>	Plan Size: <b>A1</b> Drawing No: <b>201201-017</b>



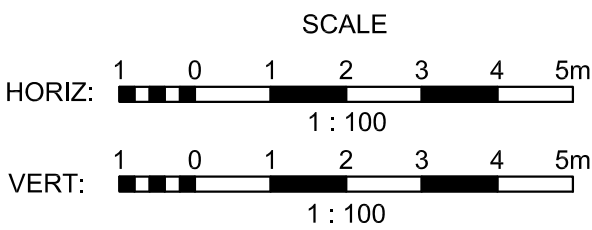
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Ch 525.000



Ch 500.000



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REV.	DATE	BY	DESCRIPTION	
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CROSS SECTIONS  
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Client: <b>GUNNEDAH SHIRE COUNCIL</b>		
<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>

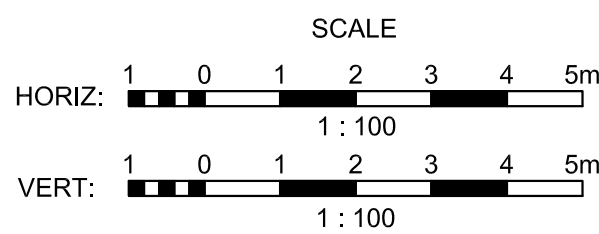
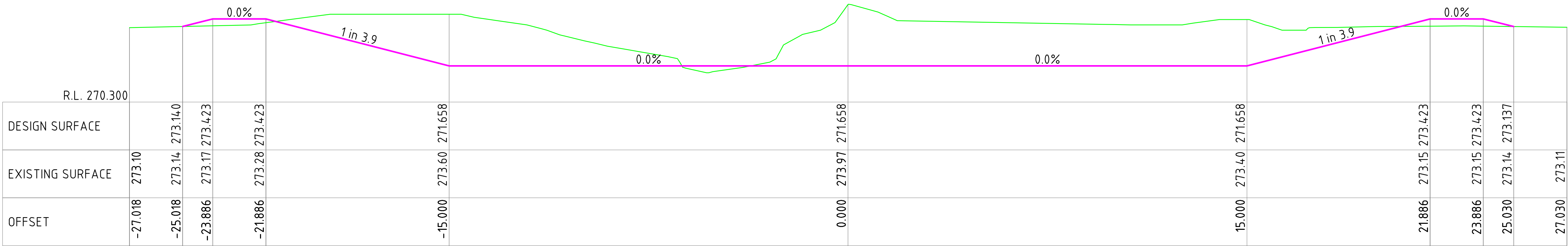
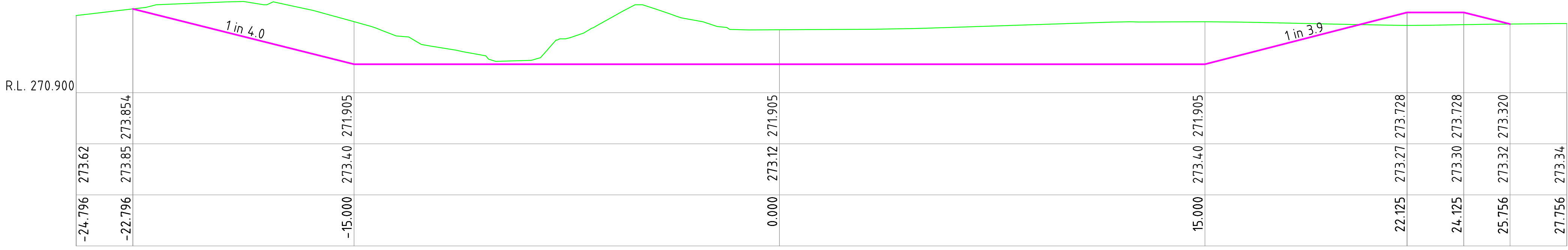
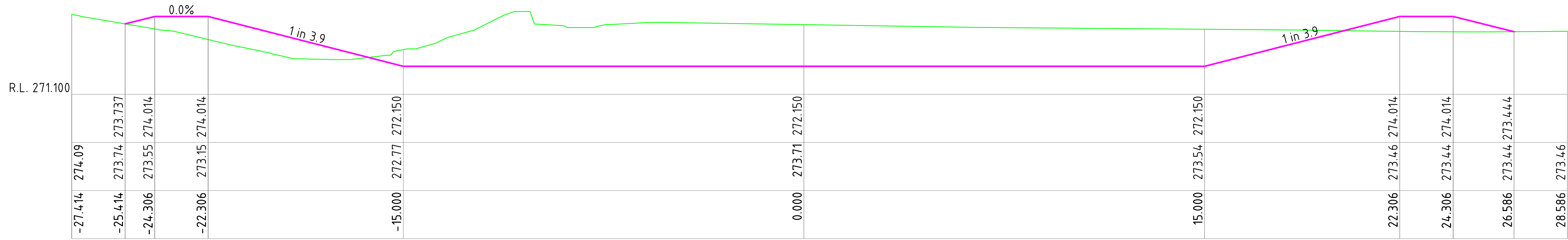
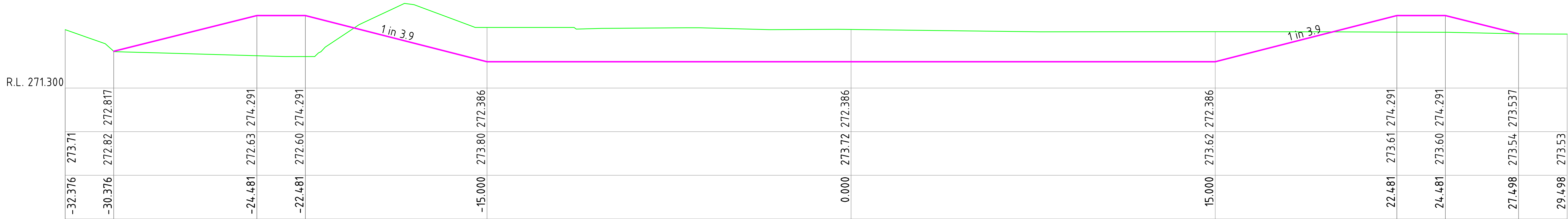


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Drawing No: **201201-018**





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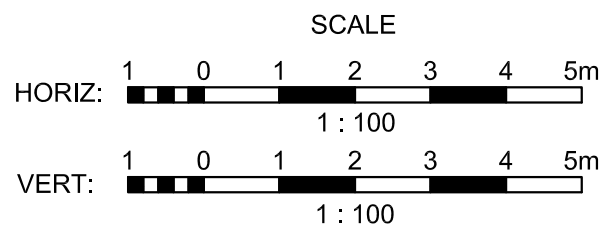
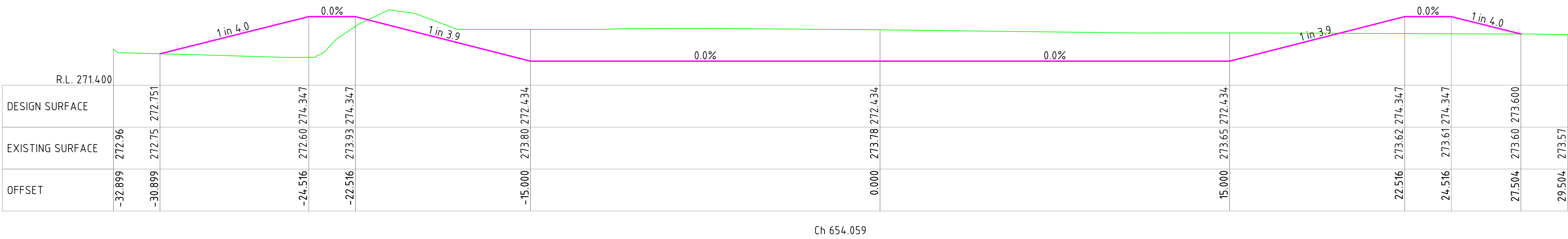
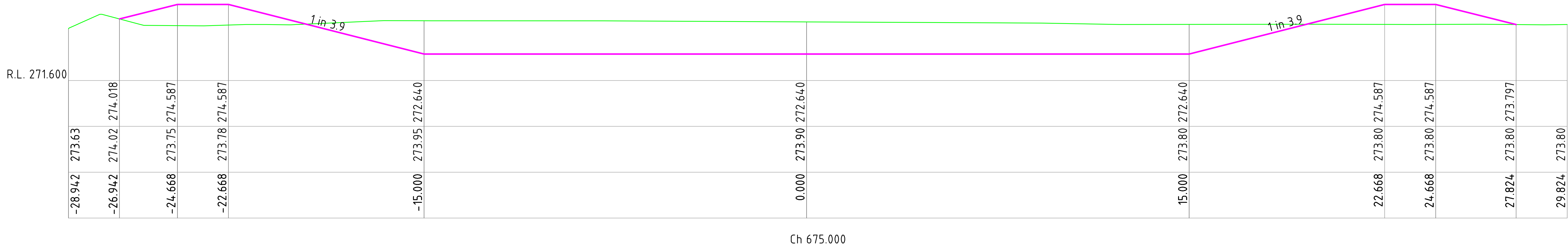
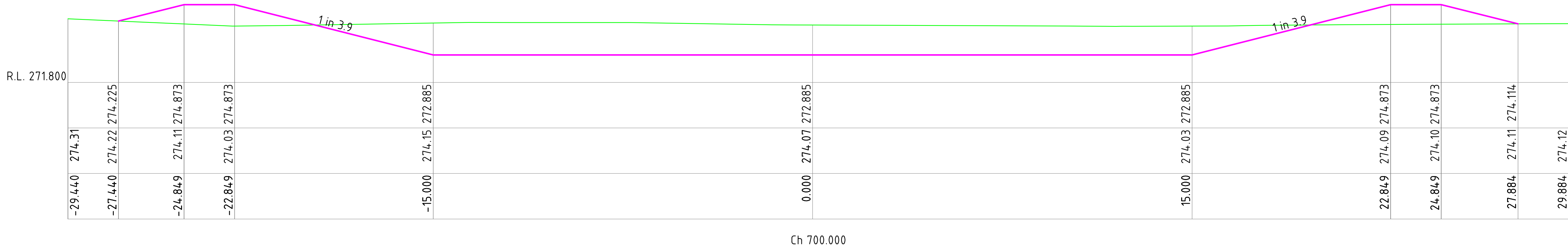
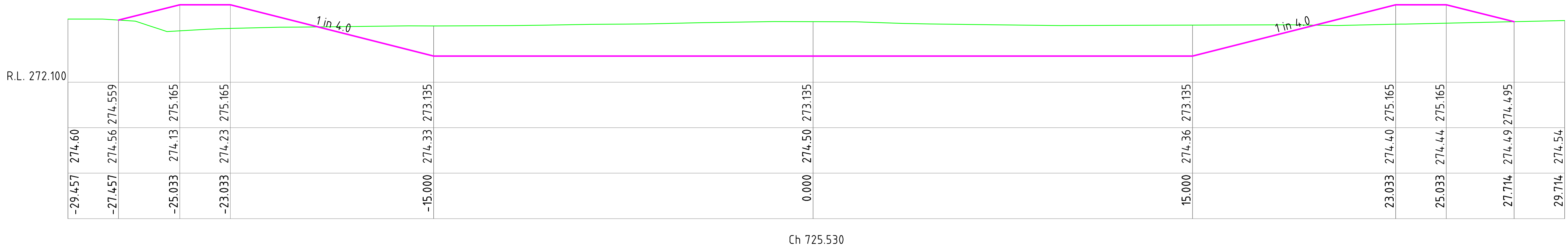
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<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
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Plan Size: **A1**

Drawing No: **201201-019**



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	A	03.12.2012	DB	ISSUED FOR REVIEW
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CROSS SECTIONS  
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Client: <b>GUNNEDAH SHIRE COUNCIL</b>		
<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>

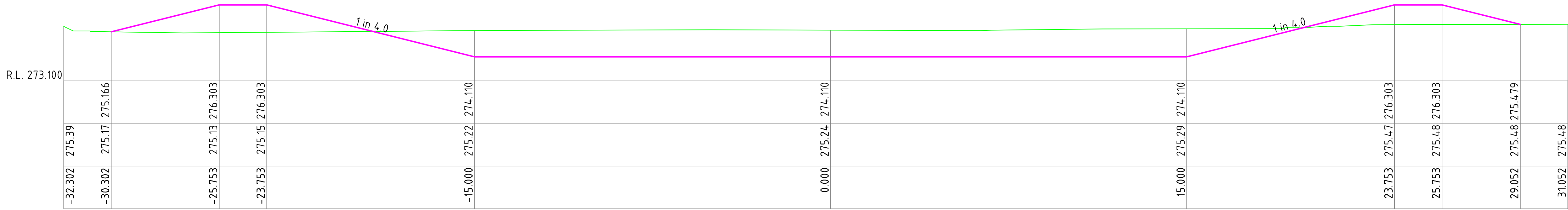


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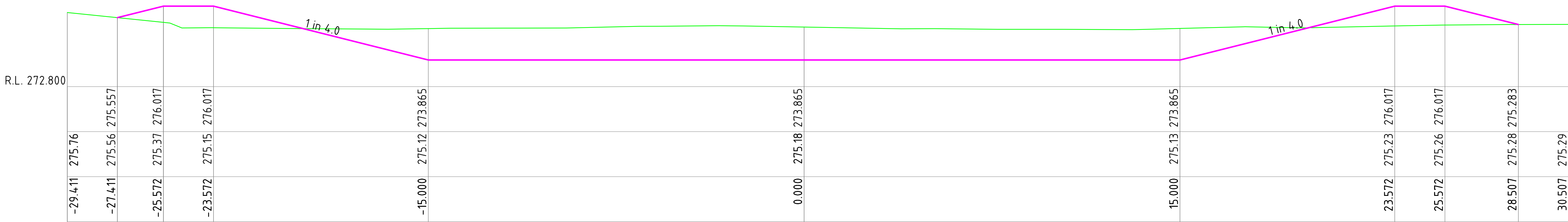
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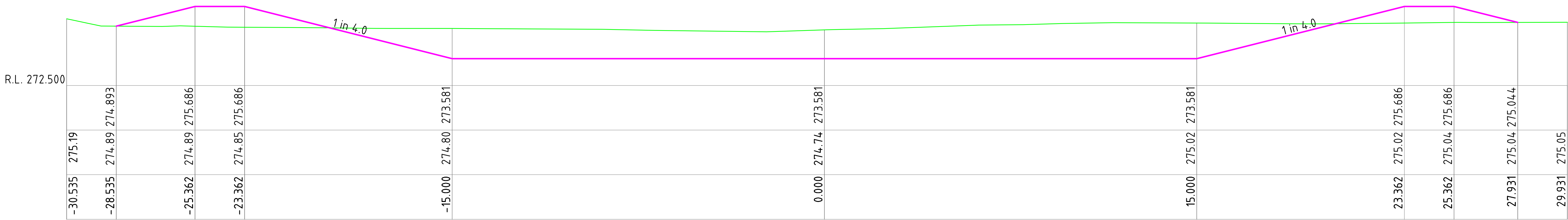




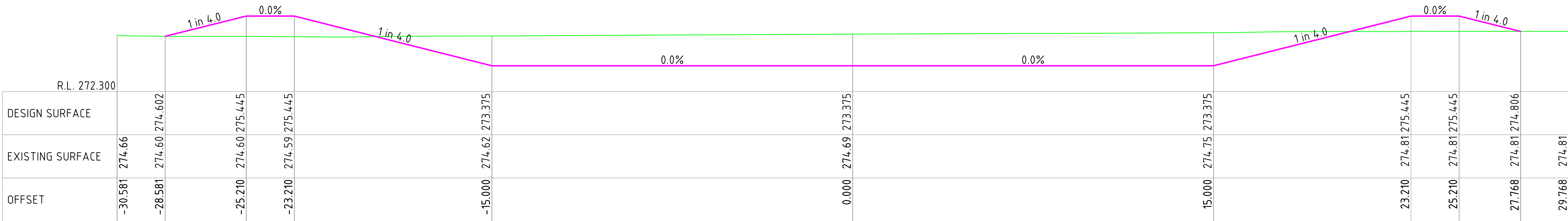
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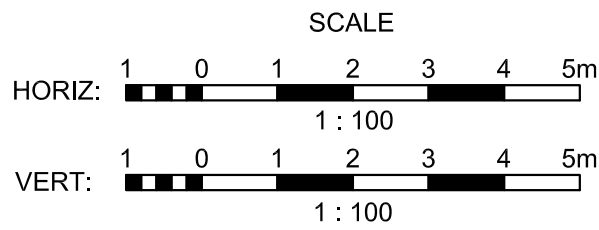
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Ch TP771.059



Ch 750.000



## CROSS SECTIONS CH 750.000 - CH 825.000

Client:

**GUNNEDAH SHIRE COUNCIL**

**BLACKJACK CREEK RIPARIAN CORRIDOR  
& CHANNEL RECONSTRUCTION**

Design Completed:

03.12.2012

Designed:

DB

Status:

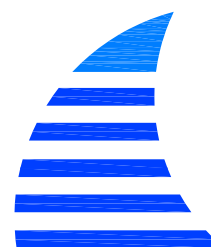
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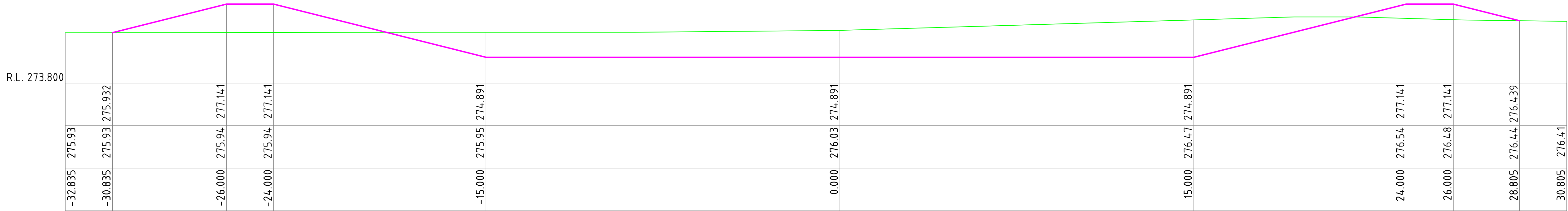
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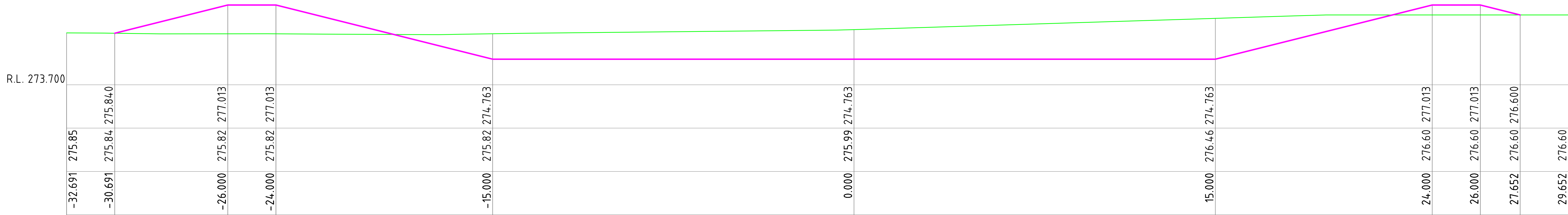
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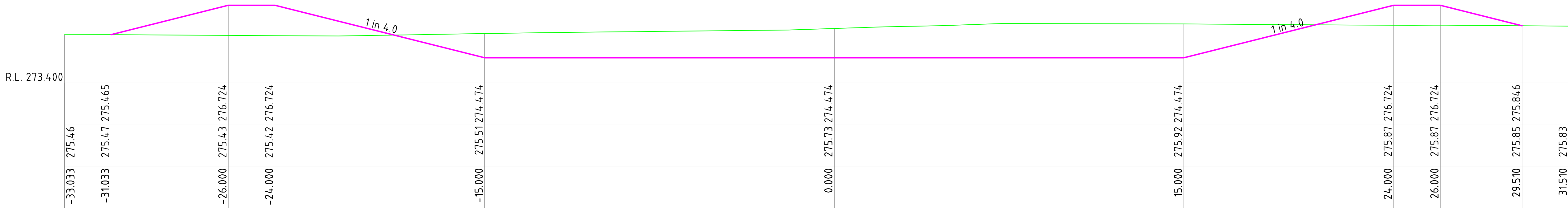
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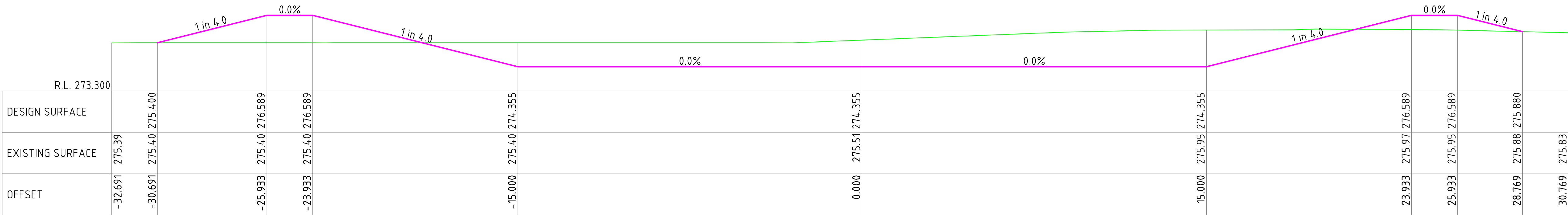
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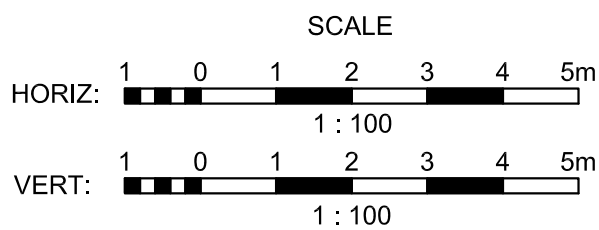
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Ch 850.000



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CROSS SECTIONS  
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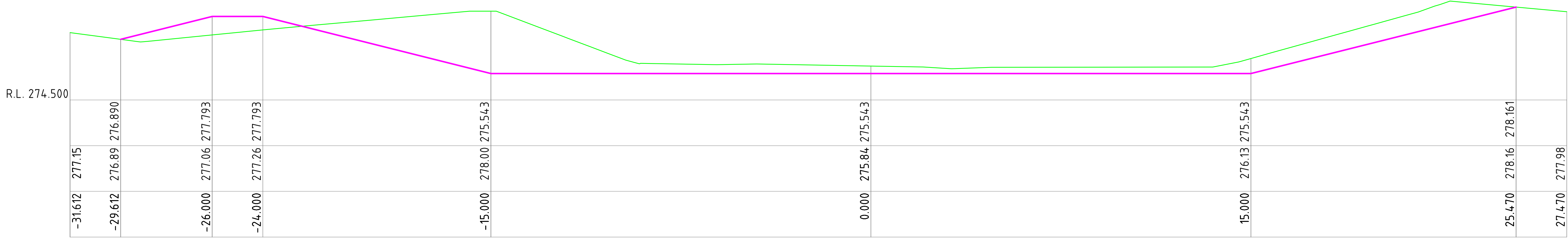
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<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
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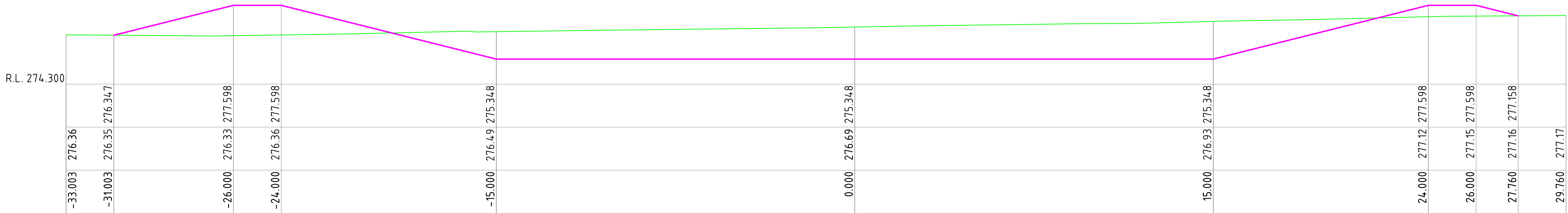
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Plan Size: **A1**

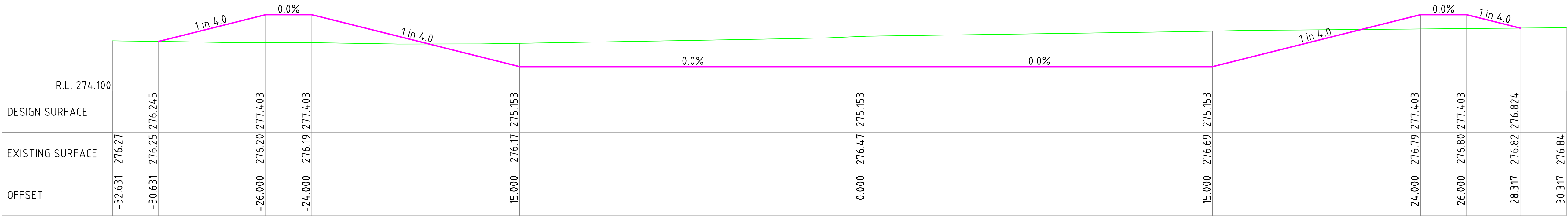
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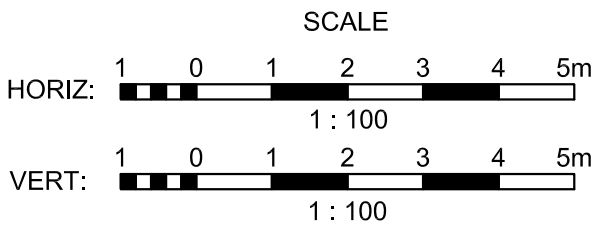
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Ch 950.000



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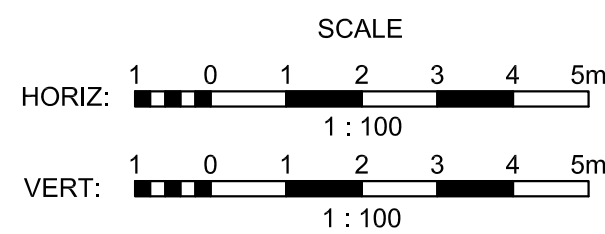
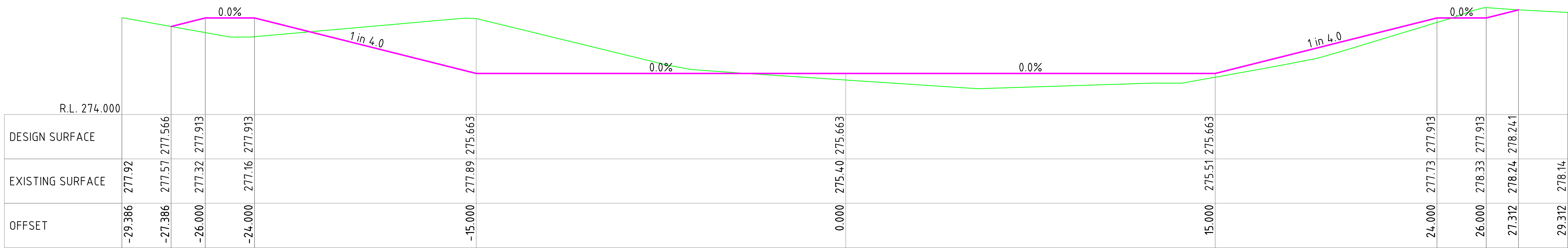
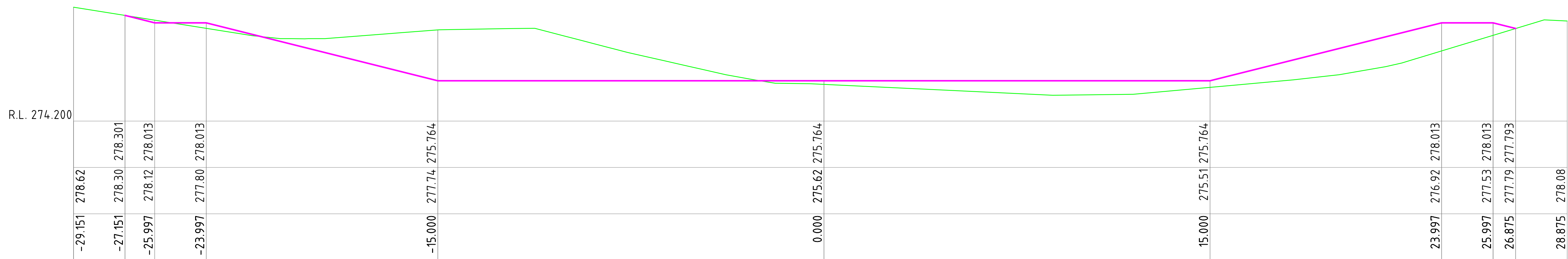
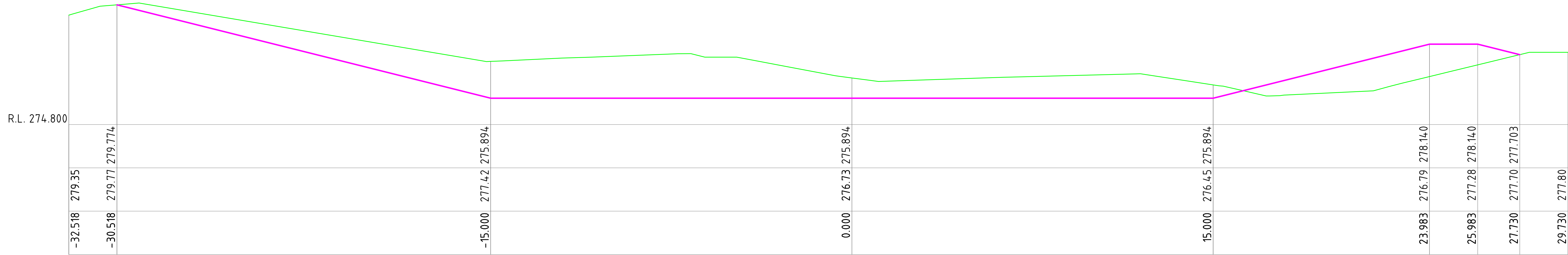
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<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>



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Plan Size: **A1**

Drawing No: **201201-023**



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CROSS SECTIONS  
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Client: <b>GUNNEDAH SHIRE COUNCIL</b>		
<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>

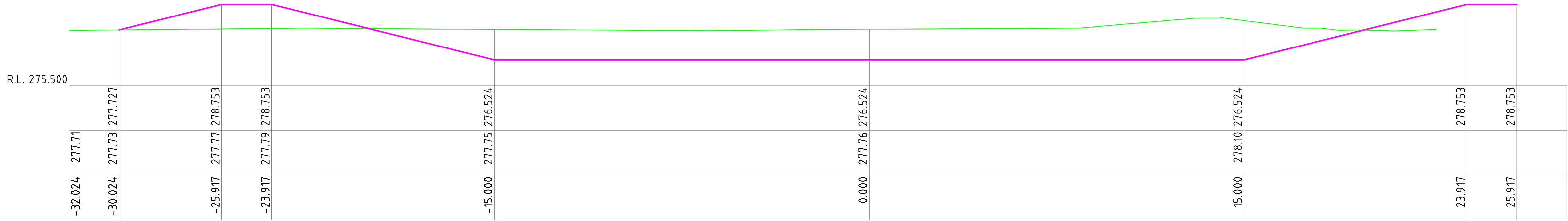


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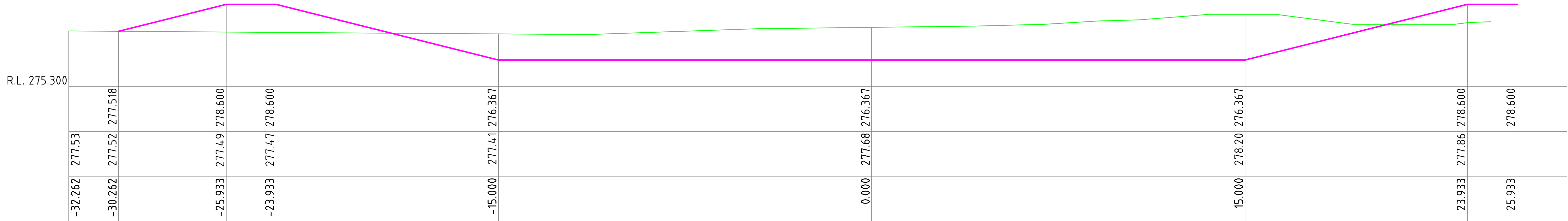
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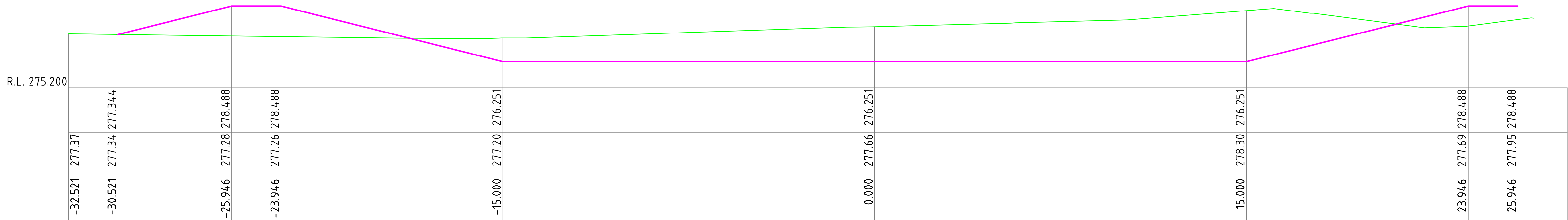




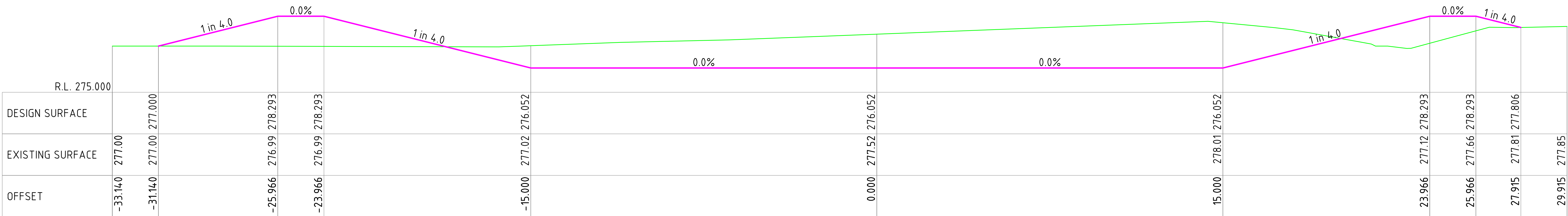
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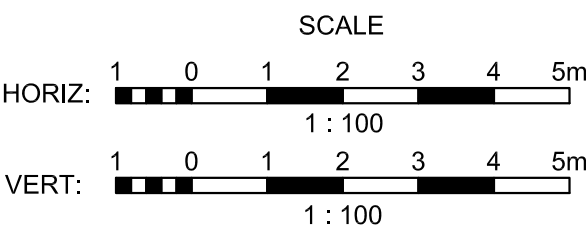
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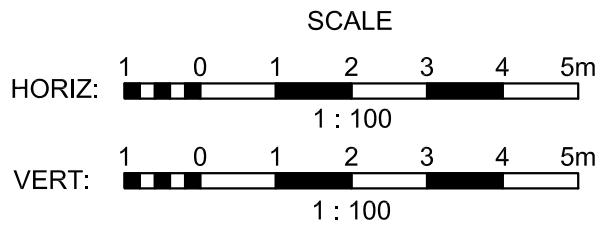
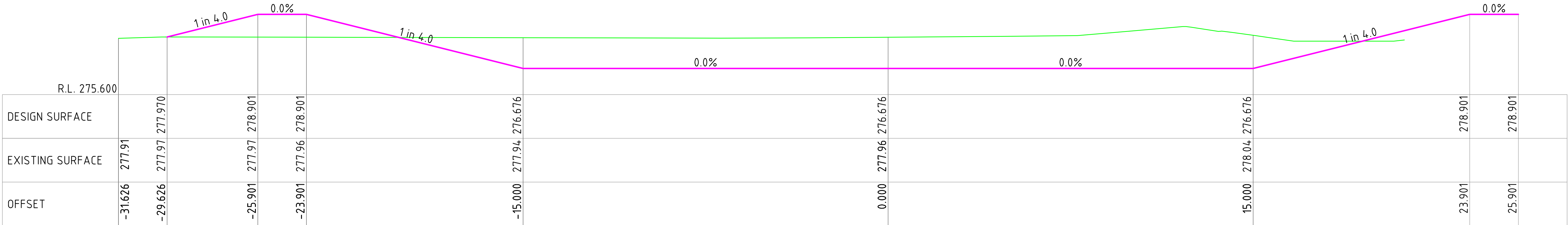
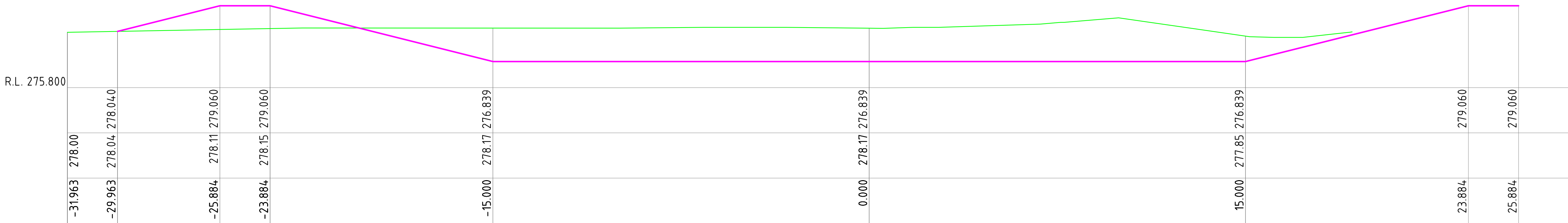
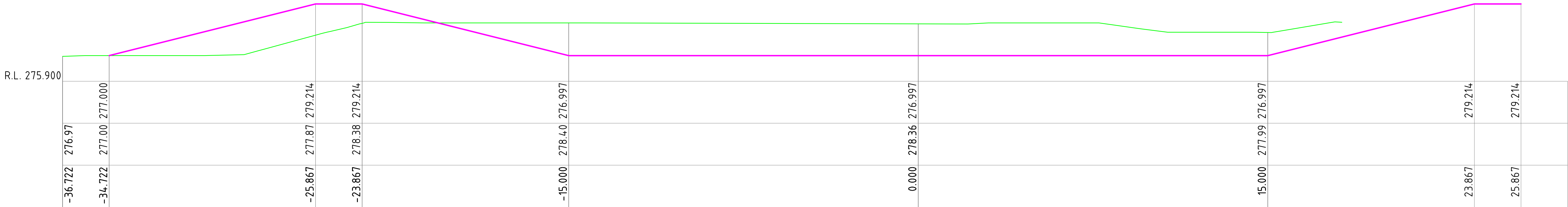
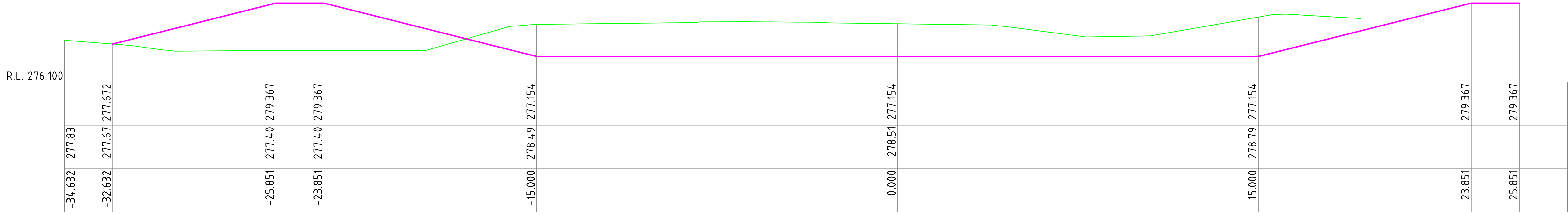
Client: GUNNEDAH SHIRE COUNCIL		
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Design Completed: 03.12.2012	Designed: DB	Status: PRELIMINARY



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Plan Size: A1

Drawing No: 201201-025



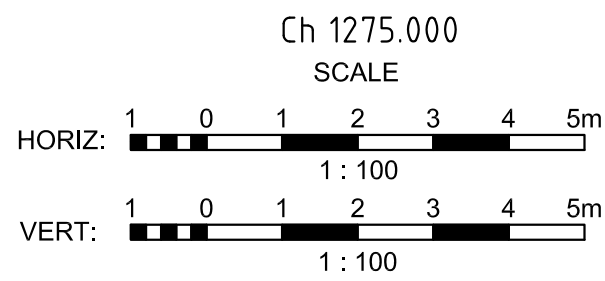
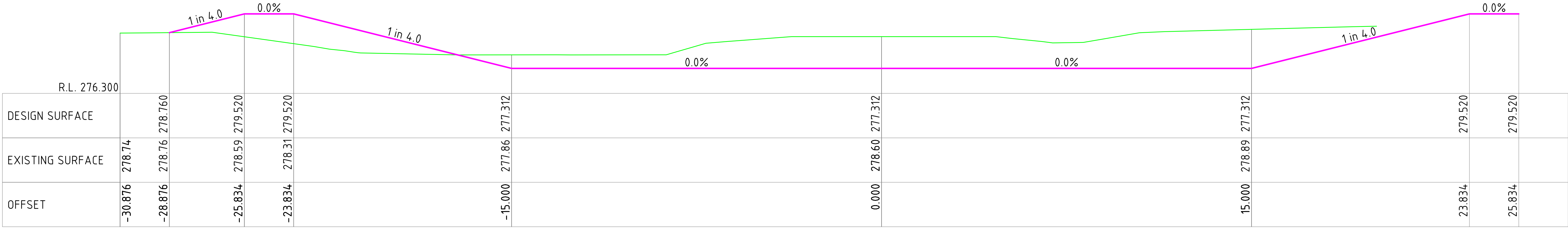
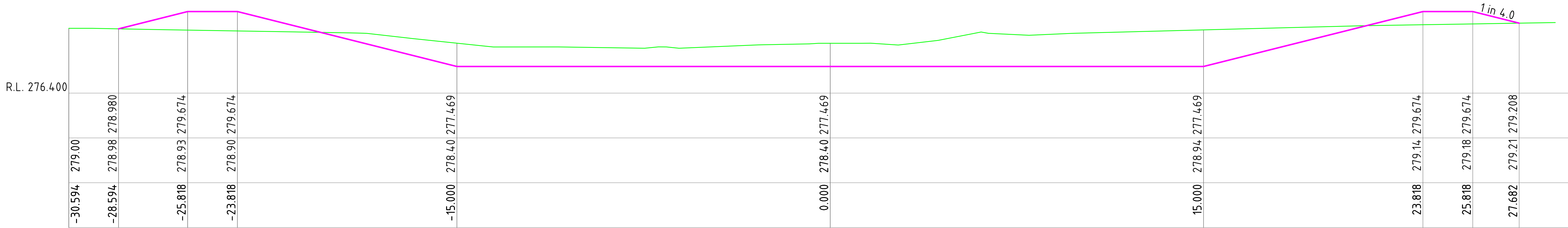
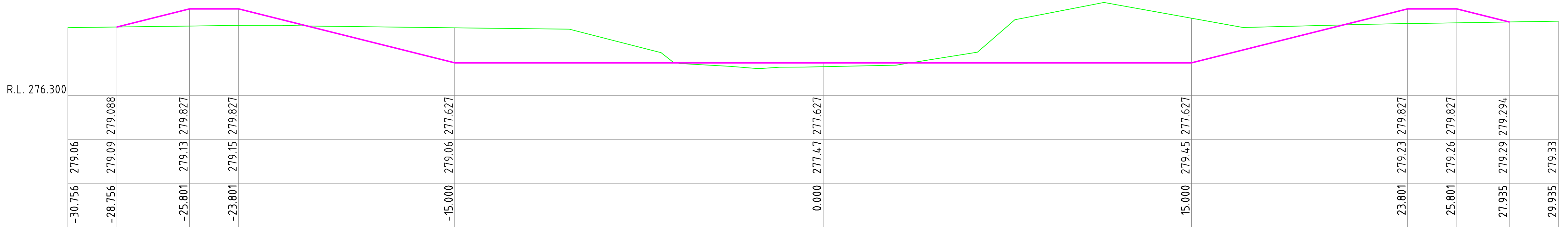
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Client: <b>GUNNEDAH SHIRE COUNCIL</b>		
<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>

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REVISIONS					
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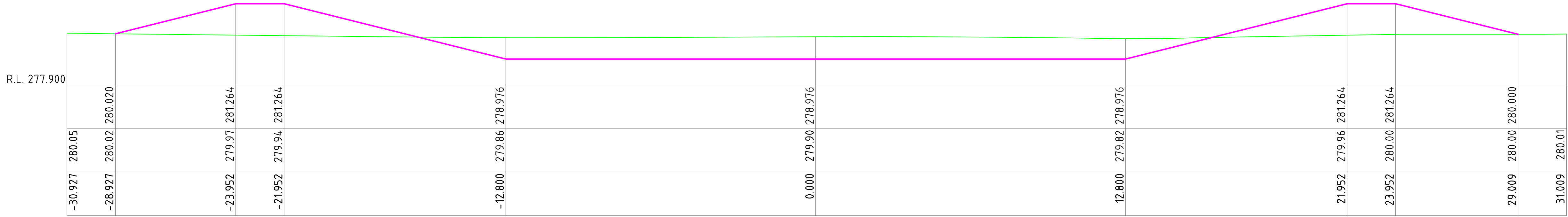
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<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
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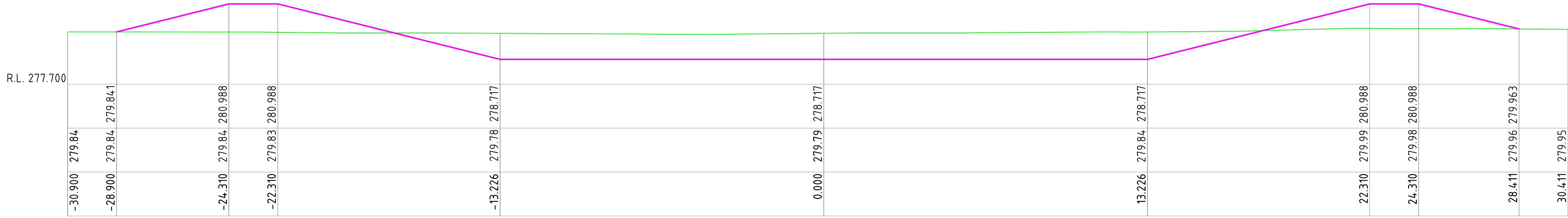
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Email: admin@constructivesolutions.com.au  
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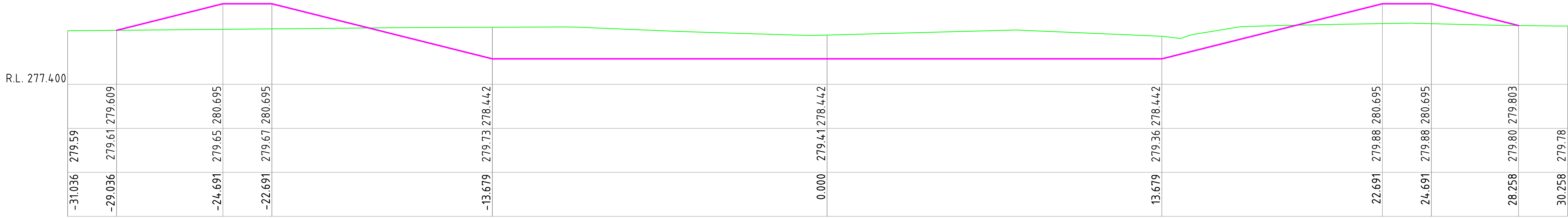
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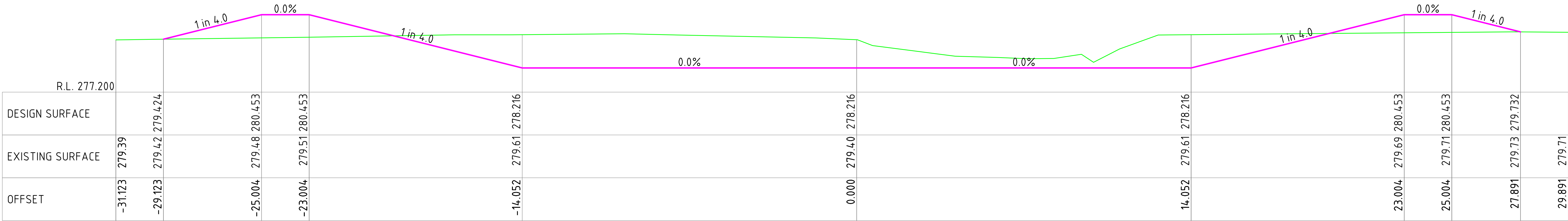
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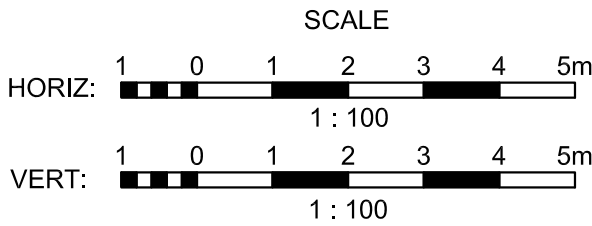
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Ch 1400.000



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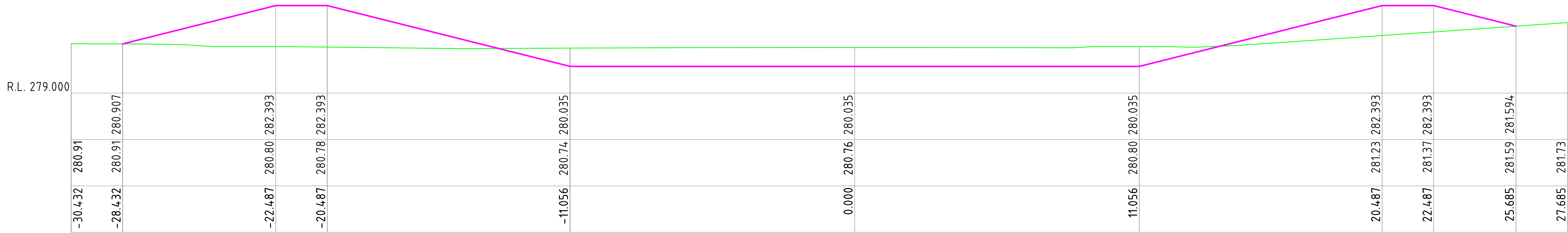


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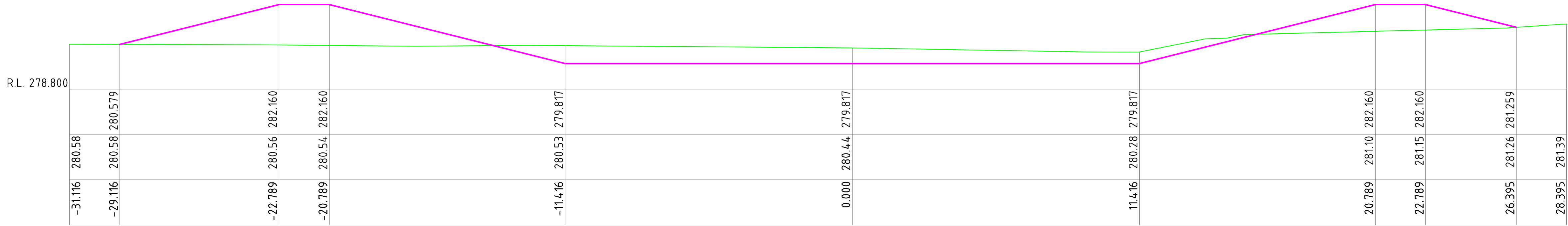
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Client: <b>GUNNEDAH SHIRE COUNCIL</b>		
<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
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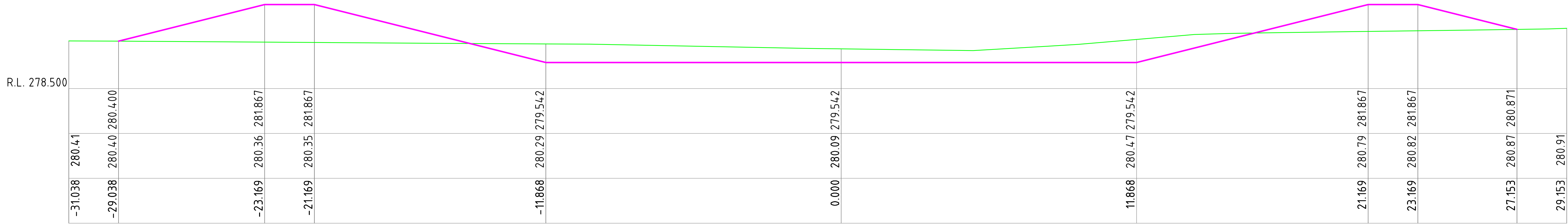
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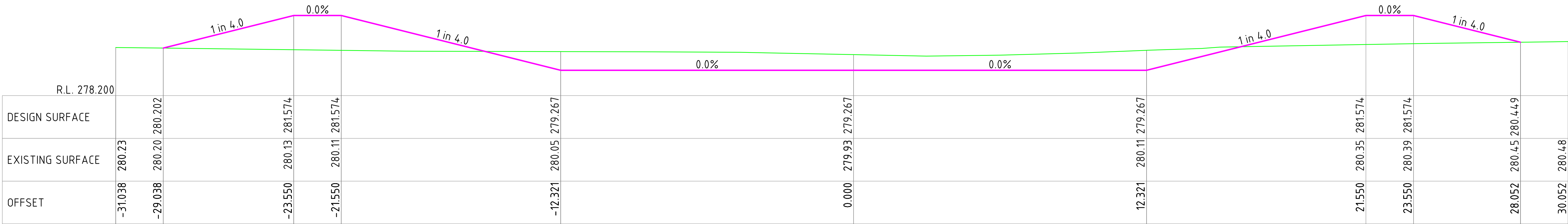
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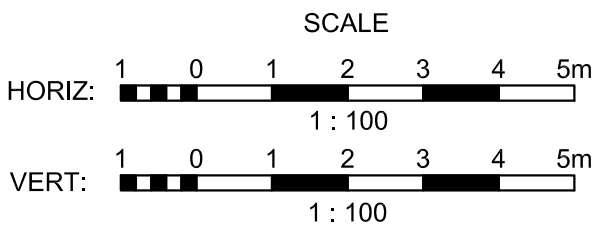
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Ch 1500.000



Ch 1475.000



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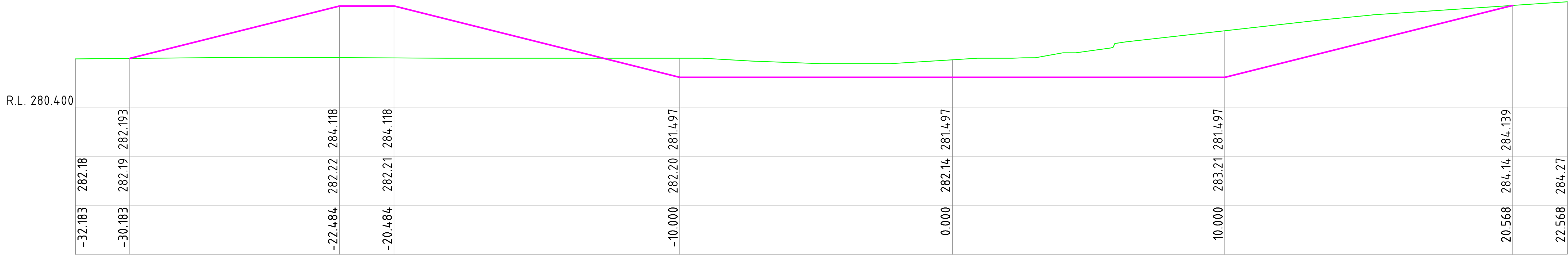
CONSTRUCTIVE SOLUTIONS PTY. LTD.  
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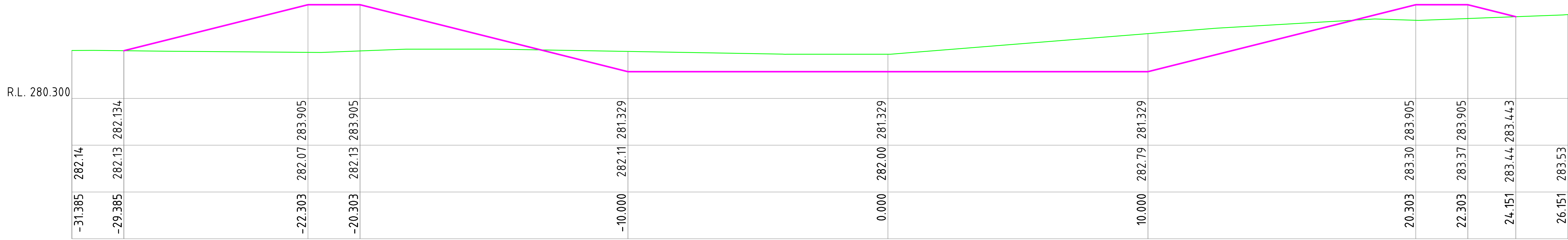
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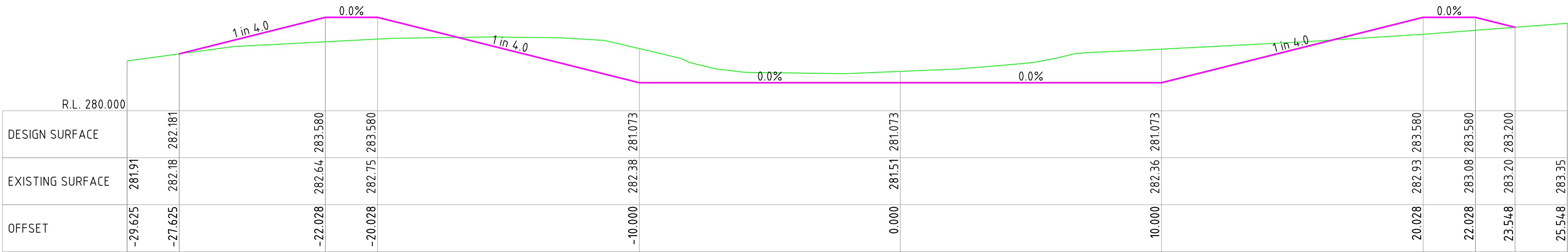




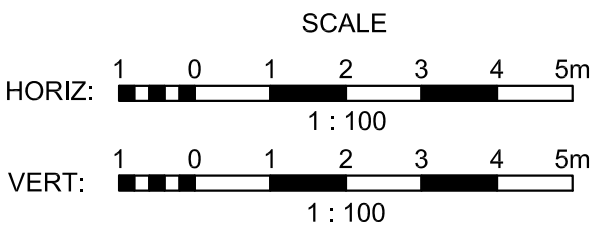
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Ch 1650.000



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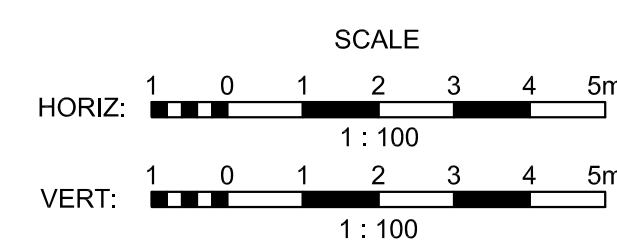
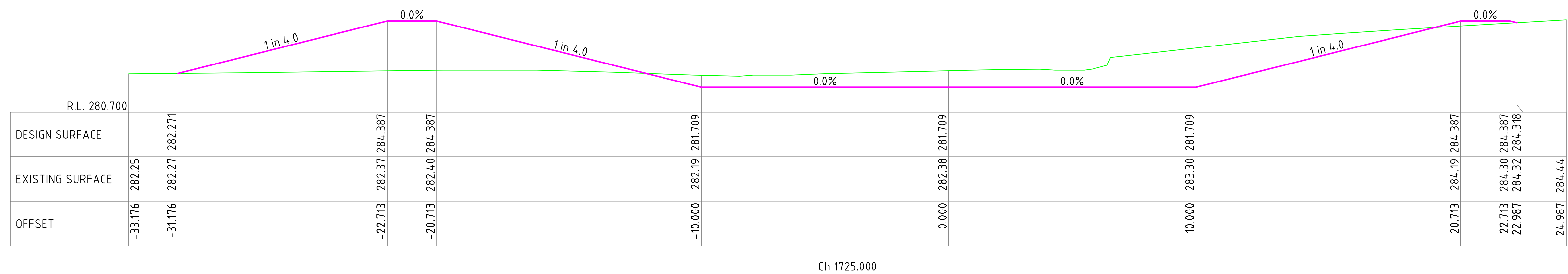
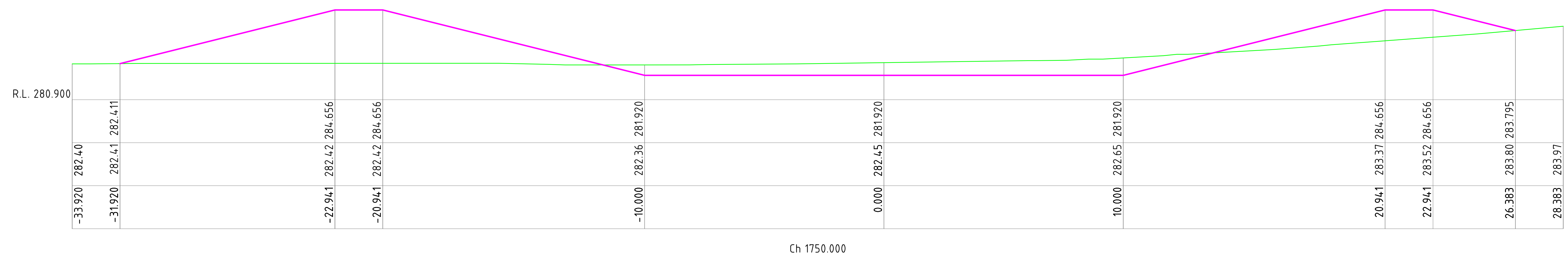
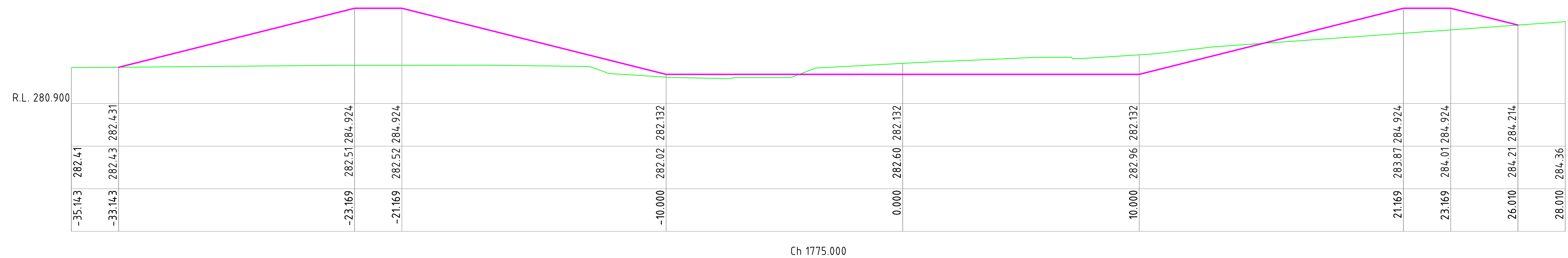
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<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>



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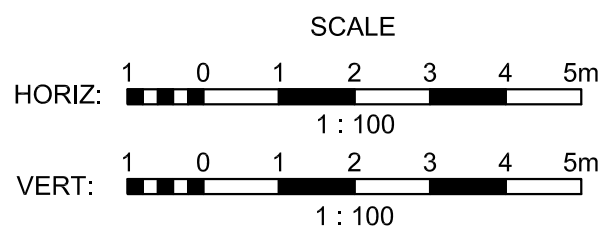
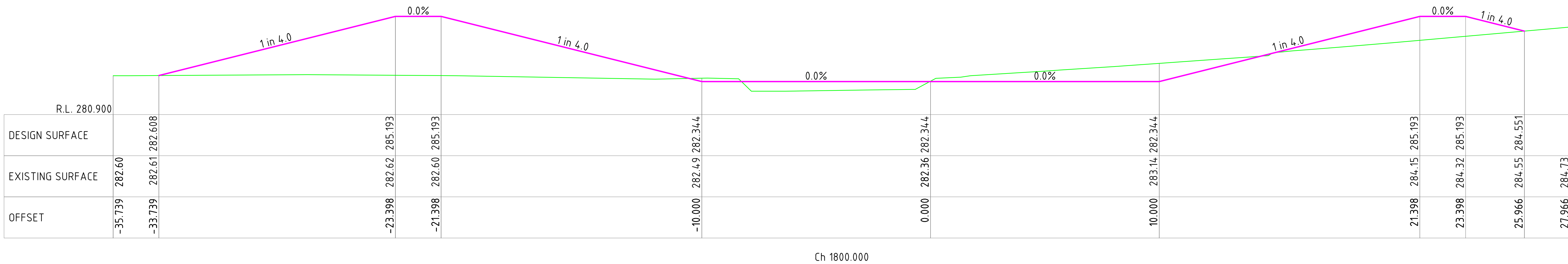
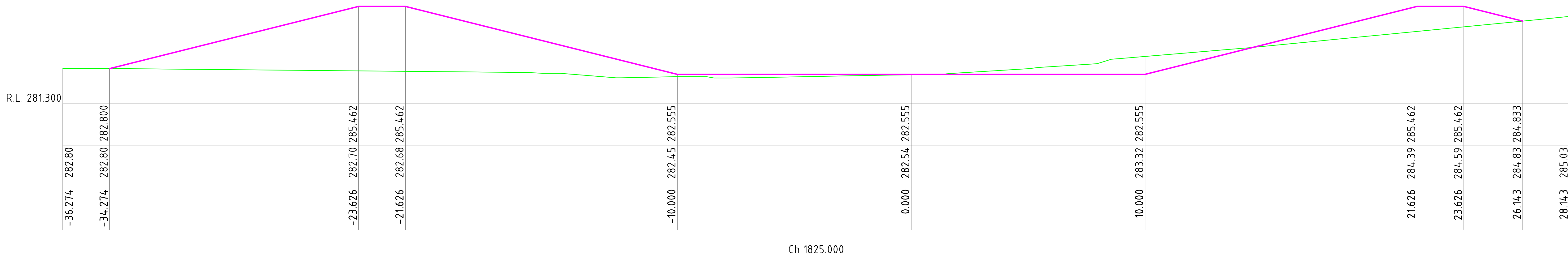
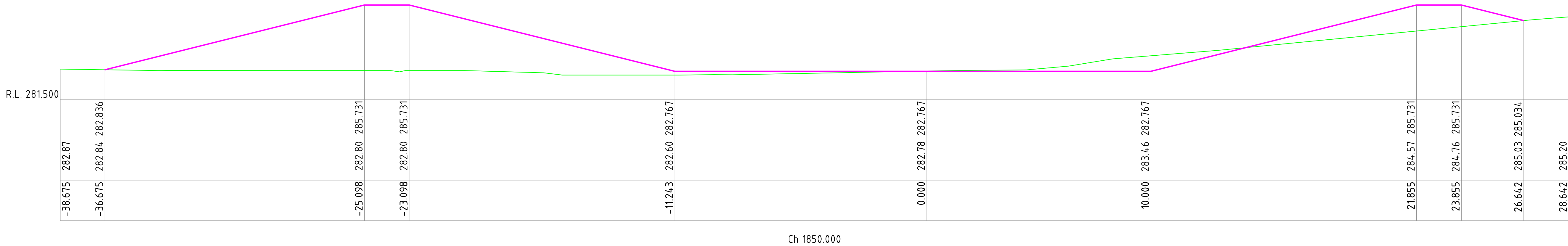
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<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
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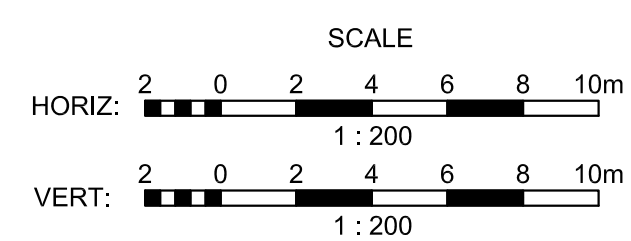
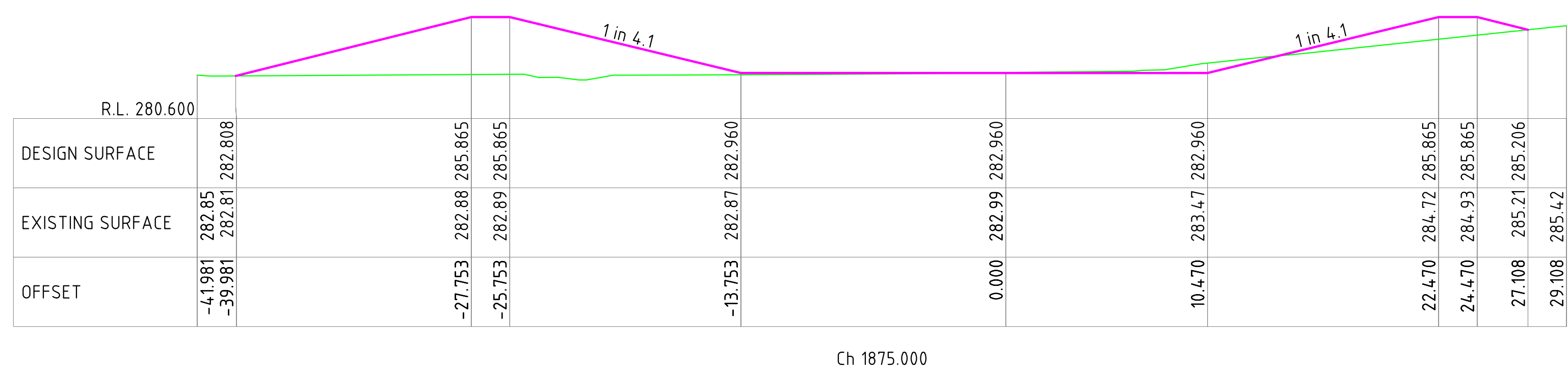
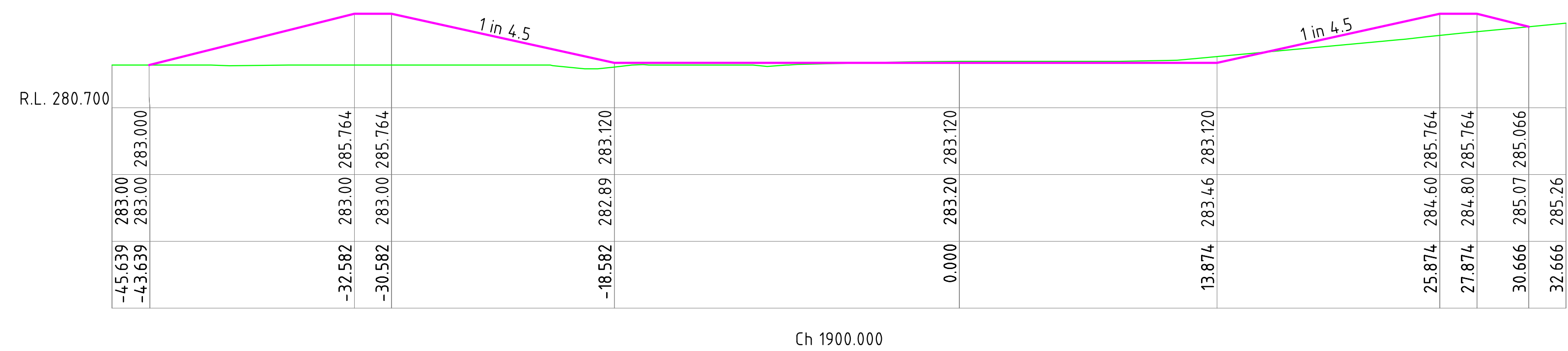
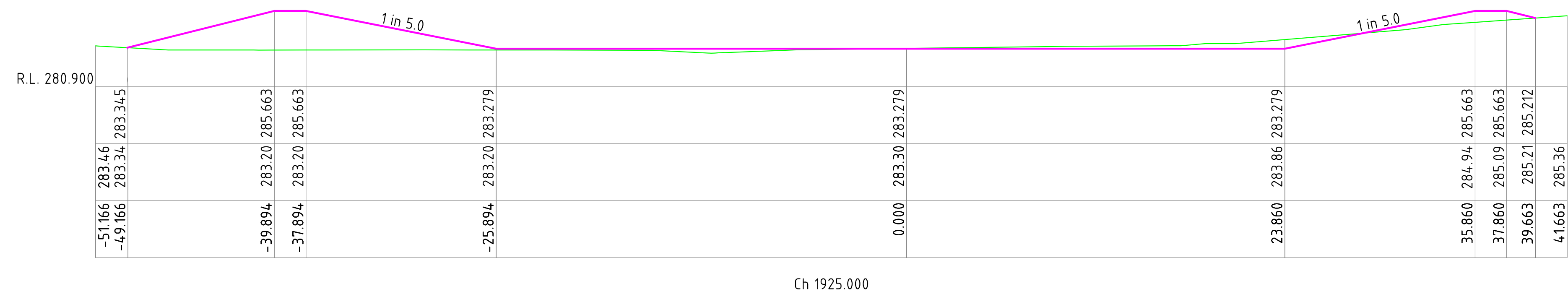
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Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>



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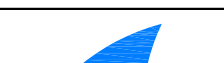
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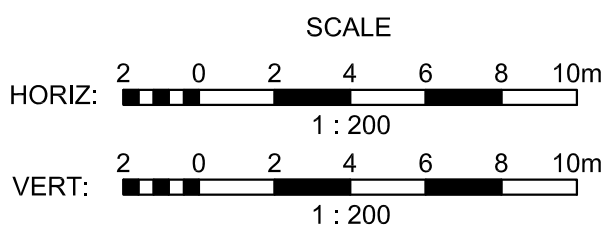
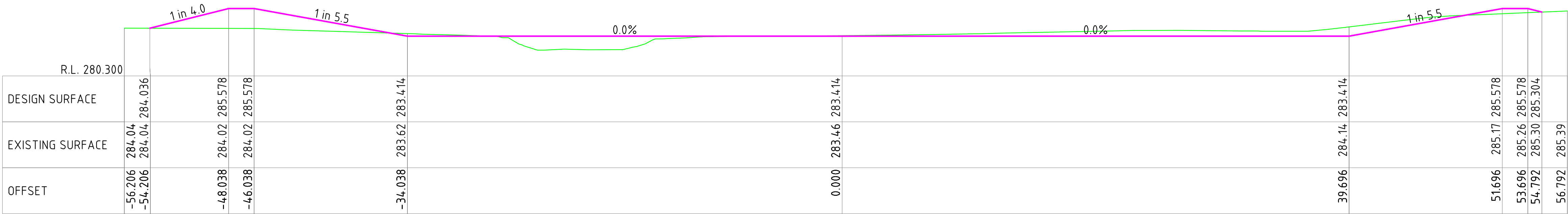
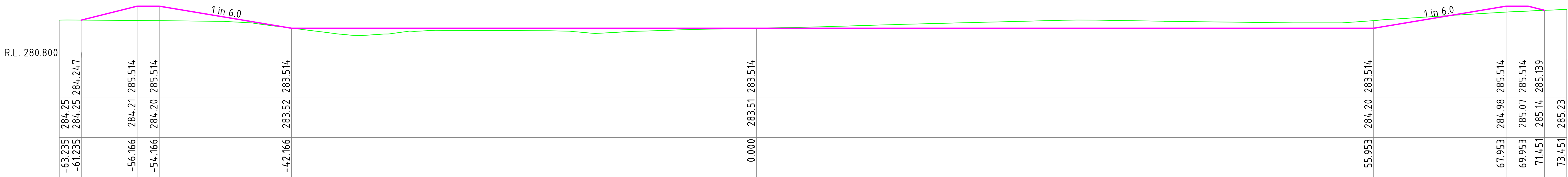


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Client: <b>GUNNEDAH SHIRE COUNCIL</b>			 <b>CONSTRUCTIVE SOLUTIONS PTY. LTD.</b> PO Box 1498 Tamworth NSW 2340 Australia Tel: (02) 6762 1969 Fax: (02) 6762 1969 Email: admin@constructivesolutions.com.au www.constructivesolutions.com.au
<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>			
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Client: <b>GUNNEDAH SHIRE COUNCIL</b>		
<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
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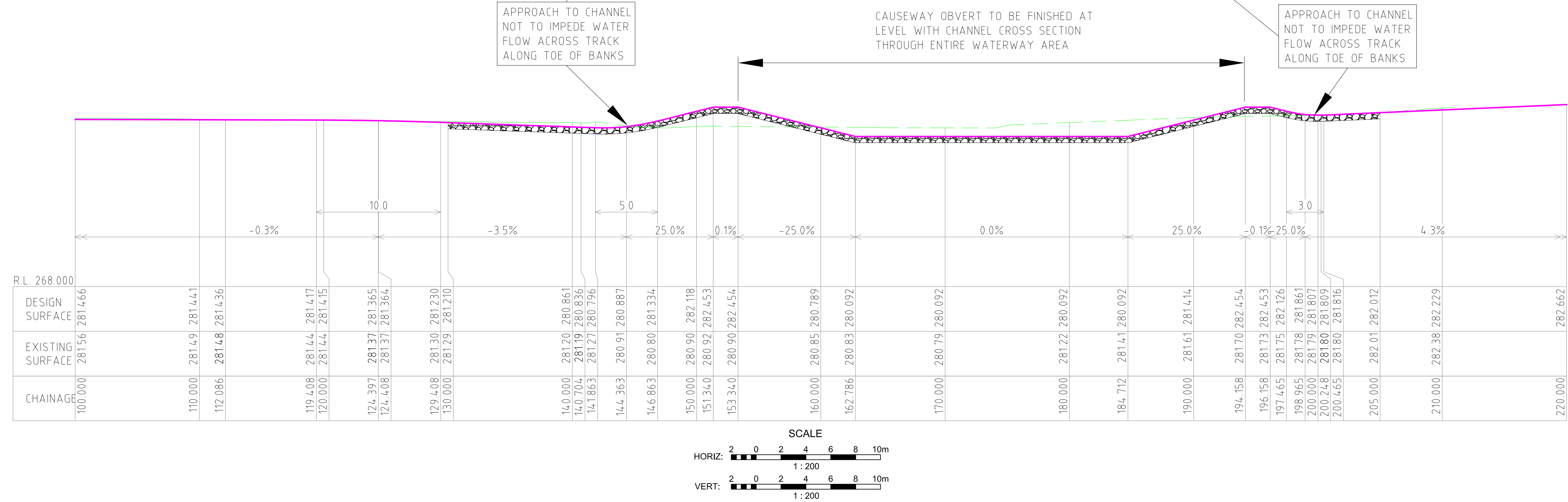
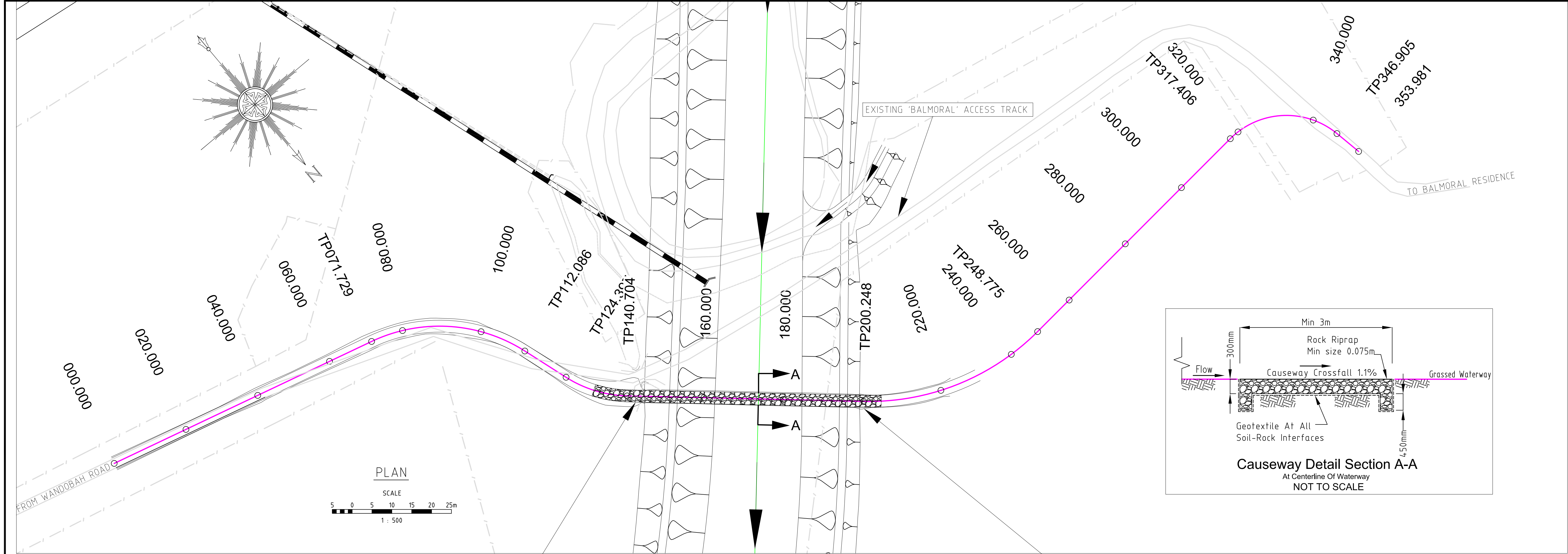


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Plan Size: <b>A1</b>	Drawing No: <b>201201-035</b>
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PLAN & LONGITUDINAL SECTION  
FOR RE-ALIGNED BALMORAL  
ACCESS ROAD

Client: <b>GUNNEDAH SHIRE COUNCIL</b>		
<b>BLACKJACK CREEK RIPARIAN CORRIDOR &amp; CHANNEL RECONSTRUCTION</b>		
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REV. NO.	REVISIONS				CHK.
	REV.	DATE	BY	DESCRIPTION	
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VEGETATED RIPARIAN ZONE EXTENTS PLAN  
- BLACKJACK CREEK

Client: GUNNEDAH SHIRE COUNCIL			 <div>CONSTRUCTIVE SOLUTIONS PTY. LTD. PO Box 1498 Tamworth NSW 2340 Australia Tel: (02) 6762 1969 Fax: (02) 6762 1969 Email: admin@constructivesolutions.com.au www.constructivesolutions.com.au</div>	
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LEGEND

VEGETATED RIPARIAN ZONE

REVISIONS					
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A	03.12.2012	DB	ISSUED FOR REVIEW		--

RIPARIAN RESTORATION ZONE  
SHEET 1

Client: GUNNEDAH SHIRE COUNCIL

BLACKJACK CREEK RIPARIAN CORRIDOR &  
CHANNEL RECONSTRUCTION

Design Completed: 03.12.2012

Designed: DB

Status: PRELIMINARY

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Email: admin@constructivesolutions.com.au  
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Plan Size: A1

Drawing No: 201201-038






PLAN  
SCALE  
10 0 10 20 30 40 50m  
1 : 1000

LEGEND  
VEGETATED  
RIPARIAN ZONE

REV.	DATE	BY	DESCRIPTION	CHK.
A	03.12.2012	DB	ISSUED FOR REVIEW	--

RIPARIAN RESTORATION ZONE  
SHEET 2

Client: 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 www.constructivesolutions.com.au	
BLACKJACK CREEK RIPARIAN CORRIDOR & CHANNEL RECONSTRUCTION				
Design Completed: 03.12.2012	Designed: DB	Status: <b>PRELIMINARY</b>	Plan Size: <b>A1</b>	Drawing No: <b>201201-039</b>





PLAN

SCALE

10

0

10

20

30

40

50m

1: 1000

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	A	03.12.2012	DB	ISSUED FOR REVIEW

RIPARIAN RESTORATION ZONE

SHEET 3

Client:

GUNNEDAH SHIRE COUNCIL

Design Completed:

03.12.2012

Designed:

DB

Status:

PRELIMINARY

Plan Size:

A1

Drawing No:

201201-040

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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.

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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:

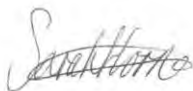
**Mail:** PO Box 1498

Tamworth NSW 2340

**Email:** [sarah@constructivesolutions.com.au](mailto: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,

A handwritten signature in dark ink, appearing to read 'Sarah Horne', is placed over a faint, light-colored rectangular stamp.

Sarah Horne  
Environmental Scientist/Project Officer

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PROFESSIONAL PROJECT, VALUE AND ENVIRONMENTAL MANAGEMENT SERVICES





## Primary Industries

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](http://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.




-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,



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](http://www.cityrail.info) or [www.countrylink.info](http://www.countrylink.info) and you will receive a response within 5 working days.



**From:** [Admin](#)  
**To:** [sarah@constructivesolutions.com.au](mailto:sarah@constructivesolutions.com.au)  
**Subject:** FW: Gunnedah - Blackjack Creek  
**Date:** Friday, 2 March 2012 2:32:35 PM  
**Attachments:** [DOC290212.pdf](#)

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**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](mailto:ppurcell@artc.com.au)

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

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-----Original Message-----

From: Andrews, Sue [mailto:[SUZANNE.ANDREWS@railcorp.nsw.gov.au](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](http://www.131500.com.au)

-----Original Message-----

From: 477PT21TOS01 [mailto:477PT21TOS01@railcorp.nsw.gov.au]  
Sent: Wednesday, 29 February 2012 1:20 PM  
To: Andrews, Sue  
Subject: Send data from 477PT21TOS01 29/02/2012 13:20

Scanned from 477PT21TOS01.  
Date: 29/02/2012 13:20  
Pages:3  
Resolution:200x200 DPI  
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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.

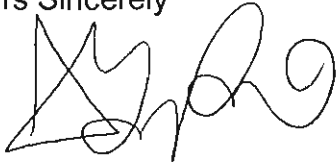
The Blackjack Creek Floodplain Risk Management Study and Plan states in Table 3.9 that there are environmental benefits to the riparian corridor/channel reconstruction. We would be interested to know the details of these environmental benefits (as distinct from the economic, social and flood mitigation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

Yours Sincerely

A handwritten signature in black ink, appearing to read 'Simon Turpin', with a stylized, cursive script.

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





Office of  
Environment  
& Heritage



Our reference: DOC12\9541  
Contact: 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 <http://www.environment.nsw.gov.au/conservation/aboriginalculture.htm>



### ***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 <http://www.environment.nsw.gov.au/environmentalissues.htm>

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](mailto:liz.mazzer@environment.nsw.gov.au).

Yours sincerely,



**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:

1. **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 <http://www.environment.nsw.gov.au/biobanking/>

### **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 and vulnerable 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: <http://www.bionet.nsw.gov.au/>

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.





Department of  
Primary Industries  
Office of Water

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](mailto: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

COPY





## 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 excavating 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:
  - in accordance with a WM Act water supply works approval
  - in accordance with a WM Act harvestable rights order
  - in accordance with section 52 (domestic and stock rights) of the WM Act in certain circumstances.
  - 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
  - during an emergency under the direction of a relevant act
  - in accordance with any mining, crown lands or western lands lease, licence, permit
  - 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](http://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](http://www.water.nsw.gov.au) free call the licensing information on 1800 353 104 or email [information@water.nsw.gov.au](mailto:information@water.nsw.gov.au).

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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.

NOW 12\_248



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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PROFESSIONAL PROJECT, VALUE & ENVIRONMENTAL MANAGEMENT SERVICES



- 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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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](mailto: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,

A handwritten signature in black ink, appearing to read "Sarah Horne", is positioned above the printed name.

Sarah Horne

Environmental Scientist/Project Officer

---

PROFESSIONAL PROJECT, VALUE AND ENVIRONMENTAL MANAGEMENT SERVICES



Constructive Solutions  
PO Box 1498  
Tamworth NSW 2340

Contact David Thomas  
Phone 02 6701 9620  
Fax 02 6701 9692  
Email david.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.


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





Department of  
Primary Industries  
Office of Water

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](mailto: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

COPY

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 excavating 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:
  - in accordance with a WM Act water supply works approval
  - in accordance with a WM Act harvestable rights order
  - in accordance with section 52 (domestic and stock rights) of the WM Act in certain circumstances.
  - 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
  - during an emergency under the direction of a relevant act
  - in accordance with any mining, crown lands or western lands lease, licence, permit
  - 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](http://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](http://www.water.nsw.gov.au) free call the licensing information on 1800 353 104 or email [information@water.nsw.gov.au](mailto:information@water.nsw.gov.au).

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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.

NOW 12\_248



**From:** [Admin](#)  
**To:** [sarah@constructivesolutions.com.au](mailto:sarah@constructivesolutions.com.au)  
**Subject:** FW: Blackjack Creek reconstruction  
**Date:** Thursday, 13 September 2012 9:50:24 AM

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**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

\*\*\*\*\*

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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Received 10/10/12



## Catchment Management Authority Namoi

8<sup>th</sup> October 2012

Constructive Solutions Pty Ltd  
PO Box 1498  
TAMWORTH NSW 2340

Attention Ms Sarah Horne

Dear Sarah

**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 be 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 in 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**

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<sub>e</sub> to 7.30EC<sub>e</sub>. 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 9.25 hectares 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**

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

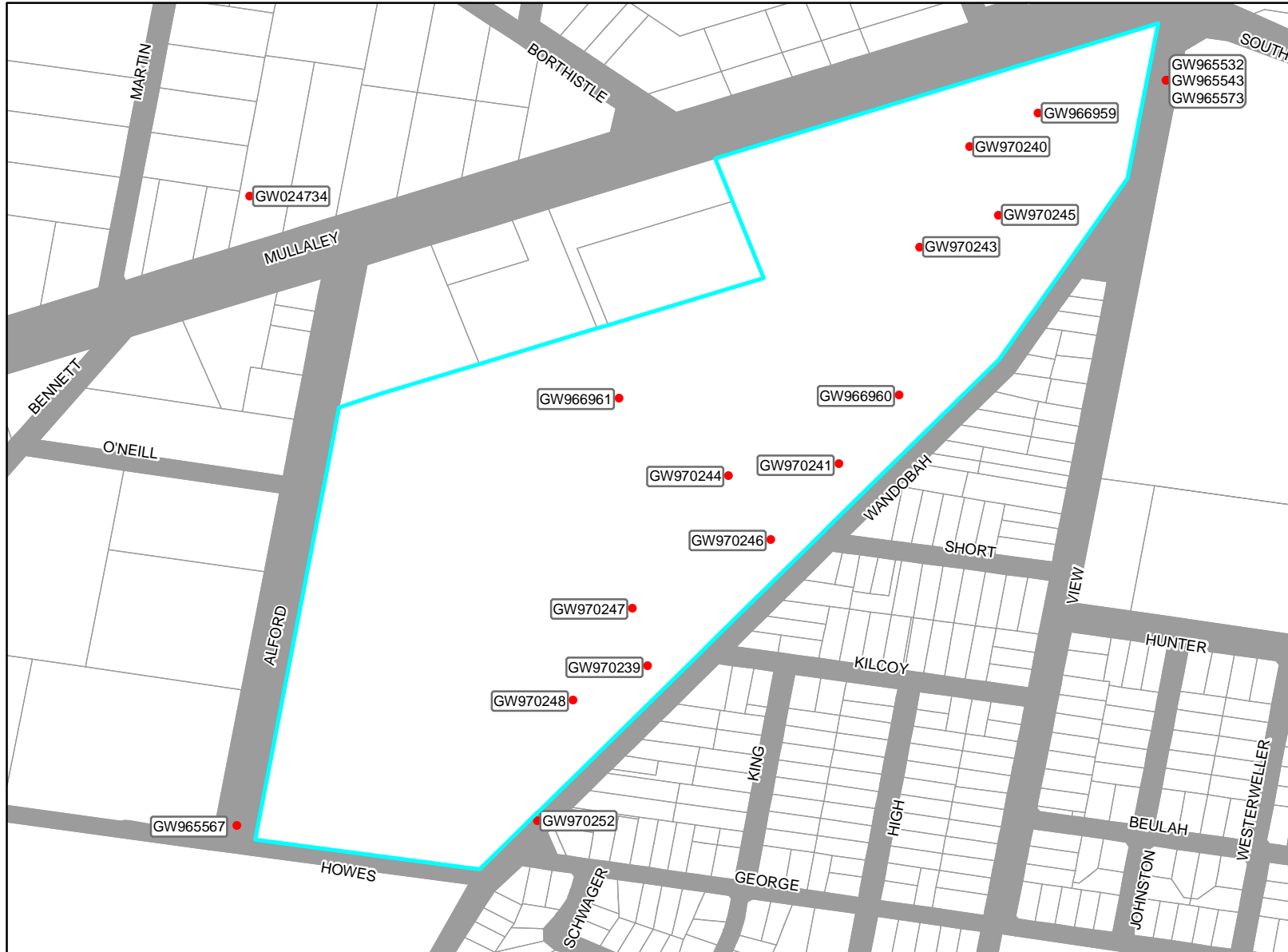


**APPENDIX C**  
**Groundwater Bores Radius**  
**Search**





# GROUNDWATER BORES IN THE AREA



## Legend

- Groundwater Bores
- Roads
- Cadastre Parcels

Produced by the NSW Office of Water

Date: November 2012 PN00799 WR2012-148  
Projection : [Geographic] Datum : [GDA94]  
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Enquiries should be directed to  
NSW Office of Water  
PO Box 53  
ORANGE NSW 2800

### SOURCES

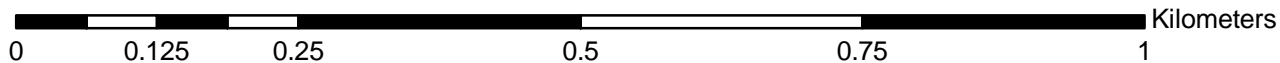
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by NSW Department of Lands  
Bore data has been supplied to the Office  
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The field information contained on this map may not be verified or complete.

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any part of this map.





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



## NSW OFFICE OF WATER Work Summary

**GW024734**

Converted From HYDSYS

<b>Licence :</b>		<b>Licence Status</b>	<b>Intended Purpose(s)</b>
<b>Work Type :</b> Bore		<b>Authorised Purpose(s)</b>	NOT KNOWN
<b>Work Status :</b> Supply Obtained			
<b>Construct. Method :</b> Cable Tool			
<b>Owner Type :</b> Private			
<b>Commenced Date :</b>	<b>Final Depth :</b>	32.30 m	
<b>Completion Date :</b> 01-Jan-1941	<b>Drilled Depth :</b>	0.00	
<b>Contractor Name :</b>			
<b>Driller :</b>			
<b>Assistant Driller's Name :</b>			
<b>Property :</b>		<b>Standing Water Level :</b>	
<b>GWMA : -</b>		<b>Salinity :</b>	(Unknown)
<b>GW Zone : -</b>		<b>Yield :</b>	

### Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
	<b>Form A :</b> POTTINGER	GUNNEDAH	189
	<b>Licensed :</b>		
<b>Region :</b> 90 - BARWON		<b>CMA Map :</b> 8936-3S	EMERALD HILL
<b>River Basin :</b> 419 - NAMOI RIVER		<b>Grid Zone :</b> 56/1	<b>Scale :</b> 1:25,000
<b>Area / District :</b>			
<b>Elevation :</b>		<b>Northing :</b> 6569351	<b>Latitude (S) :</b> 30° 58' 47"
<b>Elevation Source :</b> (Unknown)		<b>Easting :</b> 235829	<b>Longitude (E) :</b> 150° 14' 2"
<b>GS Map :</b> 0028A4	<b>MGA Zone :</b> 56	<b>Coordinate Source :</b>	

### 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

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)
15.20	15.20	0.00	(Unknown)						(Unknown)

### Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
----------	--------	--------------	----------------------	---------------------	----------

### Remarks

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



# NSW OFFICE OF WATER

## Work Summary

**GW965532**

<b>Licence :</b>	<b>Licence Status</b>	<b>Intended Purpose(s)</b>
<b>Work Type :</b> Bore	<b>Authorised Purpose(s)</b>	MONITORING BORE
<b>Work Status :</b>		
<b>Construct. Method :</b> Auger		
<b>Owner Type :</b>		
<b>Commenced Date :</b>	<b>Final Depth :</b>	10.00 m
<b>Completion Date :</b> 10-Feb-2000	<b>Drilled Depth :</b>	10.00 m
<b>Contractor Name :</b> DLWC Groundwater Drilling - Proline		
<b>Driller :</b>		
<b>Assistant Driller's Name :</b>		
<b>Property :</b>	<b>Standing Water Level :</b>	
<b>GWMA : -</b>	<b>Salinity :</b>	
<b>GW Zone : -</b>	<b>Yield :</b>	

## Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
	<b>Form A :</b>		
	<b>Licensed :</b>		
<b>Region :</b> 90 - BARWON		<b>CMA Map :</b>	
<b>River Basin :</b>		<b>Grid Zone :</b>	<b>Scale :</b>
<b>Area / District :</b>			
<b>Elevation :</b>		<b>Northing :</b> 6569501	<b>Latitude (S) :</b> 30° 58' 43"
<b>Elevation Source :</b>		<b>Easting :</b> 236699	<b>Longitude (E) :</b> 150° 14' 35"
<b>GS Map :</b>	<b>MGA Zone :</b> 56	<b>Coordinate Source :</b> GPS - Global Positioning System	

## 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
1		Hole	Hole	0.00	10.00	150			Auger
1	1	Casing	P.V.C.	-1.06	10.00	50			Seated on Bottom
1	1	Opening	Slots	8.50	10.00	50			PVC; Mechanically Slotted
1		Annulus	(Unknown)	8.40	10.00				Graded

## 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 Zone Details Found)									

## Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	1.00	1.00	clay/loam/silty dark brown	Clay	
1.00	2.00	1.00	clay/sitly with sand and gravel dark brown	Clay	
2.00	10.00	8.00	silty/clay	Invalid Code	

## Remarks

Form A Remarks:

EC1-5 (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=,I.D. 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 \*\*\*



# NSW OFFICE OF WATER

## Work Summary

**GW965543**

<b>Licence :</b>	<b>Licence Status</b>	<b>Intended Purpose(s)</b>
<b>Work Type :</b> Bore	<b>Authorised Purpose(s)</b>	MONITORING BORE
<b>Work Status :</b>		
<b>Construct. Method :</b> Auger		
<b>Owner Type :</b>		
<b>Commenced Date :</b>	<b>Final Depth :</b>	10.00 m
<b>Completion Date :</b> 10-Feb-2000	<b>Drilled Depth :</b>	10.00 m
<b>Contractor Name :</b> DLWC Groundwater Drilling - Proline		
<b>Driller :</b>		
<b>Assistant Driller's Name :</b>		
<b>Property :</b>	<b>Standing Water Level :</b>	
<b>GWMA : -</b>	<b>Salinity :</b>	
<b>GW Zone : -</b>	<b>Yield :</b>	

## Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
	<b>Form A :</b>		
	<b>Licensed :</b>		
<b>Region :</b> 90 - BARWON		<b>CMA Map :</b>	
<b>River Basin :</b>		<b>Grid Zone :</b>	<b>Scale :</b>
<b>Area / District :</b>			
<b>Elevation :</b>		<b>Northing :</b> 6569501	<b>Latitude (S) :</b> 30° 58' 43"
<b>Elevation Source :</b>		<b>Eastings :</b> 236699	<b>Longitude (E) :</b> 150° 14' 35"
<b>GS Map :</b>	<b>MGA Zone :</b> 56	<b>Coordinate Source :</b>	

## 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
1		Hole	Hole	0.00	10.00	150			Auger
1	1	Casing	P.V.C.	-1.08	10.00	50			
1	1	Opening	Slots	8.50	10.00	50			PVC; Mechanically Slotted
1		Annulus	(Unknown)	8.40	10.00				Graded

## 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 Zone Details Found)									

## Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	1.00	1.00	gravelly/sandy clay	Gravel	
1.00	2.00	1.00	sandy/clay dark brown	Invalid Code	
2.00	3.00	1.00	silty/clay with sand	Invalid Code	
3.00	4.00	1.00	clay/gravel/sand dark brown	Clay	
4.00	6.00	2.00	silty/clay with rhyolite chips	Invalid Code	
6.00	7.00	1.00	clay/gravel with some quartz	Clay	
7.00	8.00	1.00	silty/clay light	Invalid Code	
8.00	10.00	2.00	silty/clay with gravel	Invalid Code	

## 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=,I.D. 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 \*\*\*



# NSW OFFICE OF WATER

## Work Summary

**GW965567**

<b>Licence :</b>	<b>Licence Status</b>	<b>Intended Purpose(s)</b>
<b>Work Type :</b> Bore	<b>Authorised Purpose(s)</b>	MONITORING BORE
<b>Work Status :</b> Abandoned - Collapsed		
<b>Construct. Method :</b> Rot. Rev. Circ Mud		
<b>Owner Type :</b>		
<b>Commenced Date :</b>	<b>Final Depth :</b>	24.00 m
<b>Completion Date :</b> 18-May-2002	<b>Drilled Depth :</b>	24.00 m
<b>Contractor Name :</b> Arfrac Drilling Pty Ltd		
<b>Driller :</b> 1662	<b>CROWLEY, Warren James</b>	
<b>Assistant Driller's Name :</b>		
<b>Property :</b>	<b>Standing Water Level :</b>	
<b>GWMA : -</b>	<b>Salinity :</b>	
<b>GW Zone : -</b>	<b>Yield :</b>	

### Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
Hydrogeologist	<b>Form A :</b>		
	<b>Licensed :</b>		
<b>Region :</b> 90 - BARWON	<b>CMA Map :</b>		
<b>River Basin :</b>	<b>Grid Zone :</b>	<b>Scale :</b>	
<b>Area / District :</b>			
<b>Elevation :</b>	<b>Northing :</b> 6568655	<b>Latitude (S) :</b> 30° 59' 10"	
<b>Elevation Source :</b>	<b>Easting :</b> 235833	<b>Longitude (E) :</b> 150° 14' 2"	
<b>GS Map :</b>	<b>MGA Zone :</b> 56	<b>Coordinate Source :</b>	

### Construction

H	P	Component	Type	From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Hole	Hole	0.00	24.00	154			Rot. Rev. Circ Mud
1	1	Casing	P.V.C.	-0.97	8.00	50			Glued; Seated on Bottom
1	2	Casing	P.V.C.	-0.97	22.00	50			Glued; Seated on Bottom
1	1	Opening	Slots - Horizontal	7.00	8.00	50			PVC; Mechanically Slotted; A: .5mm
1	2	Opening	Slots - Horizontal	21.00	22.00	50			PVC; Mechanically Slotted; A: .5mm
1		Annulus	Crushed Aggregate	0.00	24.00	154	50		Graded

### 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 Zone Details Found)									

### Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	1.00	1.00	clay/red silty sandy	Clay	
1.00	2.00	1.00	clay/red silty sandy more clay	Clay	
2.00	5.00	3.00	silty clay	Invalid Code	
5.00	8.00	3.00	sandstone/lithic/siltstone weathered	Sandstone	
8.00	9.00	1.00	conglomerate/interbeds of mudstone and siltstone	Conglomerate	
9.00	12.00	3.00	conglomerate with rock fragments size increases with depth	Conglomerate	
12.00	13.00	1.00	mudstone/weathered	Mudstone	
13.00	16.00	3.00	shale/siltstone dark grey weathered	Shale	
16.00	24.00	8.00	shale	Shale	

### 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=,I.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 \*\*\*



# NSW OFFICE OF WATER

## Work Summary

**GW965573**

<b>Licence :</b>	<b>Licence Status</b>	<b>Intended Purpose(s)</b>
<b>Work Type :</b> Bore	<b>Authorised Purpose(s)</b>	MONITORING BORE
<b>Work Status :</b>		
<b>Construct. Method :</b> Rot. Rev. Circ Mud		
<b>Owner Type :</b>		
<b>Commenced Date :</b>	<b>Final Depth :</b>	16.00 m
<b>Completion Date :</b> 06-May-2000	<b>Drilled Depth :</b>	16.00 m
<b>Contractor Name :</b> Arfrac Drilling Pty Ltd		
<b>Driller :</b> 1662	CROWLEY, Warren James	
<b>Assistant Driller's Name :</b>		
<b>Property :</b>	<b>Standing Water Level :</b>	
<b>GWMA : -</b>	<b>Salinity :</b>	
<b>GW Zone : -</b>	<b>Yield :</b>	

### Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
Hydrogeologist	<b>Form A :</b>		
	<b>Licensed :</b>		
<b>Region :</b> 90 - BARWON	<b>CMA Map :</b>		
<b>River Basin :</b>	<b>Grid Zone :</b>	<b>Scale :</b>	
<b>Area / District :</b>			
<b>Elevation :</b>	<b>Northing :</b> 6569501	<b>Latitude (S) :</b> 30° 58' 43"	
<b>Elevation Source :</b>	<b>Easting :</b> 236699	<b>Longitude (E) :</b> 150° 14' 35"	
<b>GS Map :</b>	<b>MGA Zone :</b> 56	<b>Coordinate Source :</b> GPS - Global Positioning System	

### 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
1		Hole	Hole	0.00	16.00	154			Rot. Rev. Circ Mud
1	1	Casing	P.V.C.	-0.89	16.00	50			Glued; Seated on Bottom
1	1	Opening	Slots - Horizontal	14.50	15.50	50			PVC; Mechanically Slotted; A: .5mm

### 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 Zone Details Found)									

### Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	1.00	1.00	silty clay loam dark brown	Invalid Code	
1.00	2.00	1.00	silty clay loam dark brown with some gravel	Invalid Code	
2.00	10.00	8.00	silty clay	Invalid Code	
10.00	11.00	1.00	zhyolite/weathered with quatz grains about 2mm	Invalid Code	
11.00	12.00	1.00	as above with basalt fragments	Invalid Code	
12.00	16.00	4.00	rhyolite	Rhyolite	

### 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 \*\*\*



# NSW OFFICE OF WATER

## Work Summary

**GW966959**

<b>Licence :</b>	<b>Licence Status</b>	<b>Intended Purpose(s)</b>
<b>Work Type :</b> Bore	<b>Authorised Purpose(s)</b>	
<b>Work Status :</b> (Unknown)		
<b>Construct. Method :</b> (Unknown)		
<b>Owner Type :</b> (Unknown)		
<b>Commenced Date :</b>	<b>Final Depth :</b>	
<b>Completion Date :</b> 20-Jan-2005	<b>Drilled Depth :</b>	
<b>Contractor Name :</b>		
<b>Driller :</b>		
<b>Assistant Driller's Name :</b>		
<b>Property :</b>	<b>Standing Water Level :</b>	
<b>GWMA : -</b>	<b>Salinity :</b>	
<b>GW Zone : -</b>	<b>Yield :</b>	

### Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
	<b>Form A :</b>		
	<b>Licensed :</b>		
<b>Region :</b> 90 - BARWON		<b>CMA Map :</b>	
<b>River Basin :</b>		<b>Grid Zone :</b>	<b>Scale :</b>
<b>Area / District :</b>			
<b>Elevation :</b>		<b>Northing :</b> 6569462	<b>Latitude (S) :</b> 30° 58' 44"
<b>Elevation Source :</b>		<b>Easting :</b> 236578	<b>Longitude (E) :</b> 150° 14' 30"
<b>GS Map :</b>	<b>MGA Zone :</b> 56	<b>Coordinate Source :</b> GPS - Global Positioning System	

### 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

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 Zone Details Found)									

### Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
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### Remarks

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

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



# NSW OFFICE OF WATER

## Work Summary

**GW966960**

<b>Licence :</b>	<b>Licence Status</b>	<b>Intended Purpose(s)</b>
<b>Work Type :</b> Bore	<b>Authorised Purpose(s)</b>	
<b>Work Status :</b> (Unknown)		
<b>Construct. Method :</b> (Unknown)		
<b>Owner Type :</b> (Unknown)		
<b>Commenced Date :</b>	<b>Final Depth :</b>	
<b>Completion Date :</b> 20-Jan-2005	<b>Drilled Depth :</b>	
<b>Contractor Name :</b>		
<b>Driller :</b>		
<b>Assistant Driller's Name :</b>		
<b>Property :</b>	<b>Standing Water Level :</b>	
<b>GWMA : -</b>	<b>Salinity :</b>	
<b>GW Zone : -</b>	<b>Yield :</b>	

### Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
	<b>Form A :</b>		
	<b>Licensed :</b>		
<b>Region :</b> 90 - BARWON		<b>CMA Map :</b>	
<b>River Basin :</b>		<b>Grid Zone :</b>	<b>Scale :</b>
<b>Area / District :</b>			
<b>Elevation :</b>		<b>Northing :</b> 6569147	<b>Latitude (S) :</b> 30° 58' 54"
<b>Elevation Source :</b>		<b>Easting :</b> 236453	<b>Longitude (E) :</b> 150° 14' 25"
<b>GS Map :</b>	<b>MGA Zone :</b> 56	<b>Coordinate Source :</b> GPS - Global Positioning System	

### 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

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 Zone Details Found)

### Drillers Log

From (m) To (m) Thickness(m) Drillers Description Geological Material Comments

### Remarks

Form A Remarks:

piezometer pipe height 1.08--Wandobah Reserve--P-2 Reviewed data - nothing to update.

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



# NSW OFFICE OF WATER

## Work Summary

**GW966961**

<b>Licence :</b>	<b>Licence Status</b>	<b>Intended Purpose(s)</b>
<b>Work Type :</b> Bore	<b>Authorised Purpose(s)</b>	
<b>Work Status :</b> (Unknown)		
<b>Construct. Method :</b> (Unknown)		
<b>Owner Type :</b> (Unknown)		
<b>Commenced Date :</b>	<b>Final Depth :</b>	
<b>Completion Date :</b> 20-Jan-2005	<b>Drilled Depth :</b>	
<b>Contractor Name :</b>		
<b>Driller :</b>		
<b>Assistant Driller's Name :</b>		
<b>Property :</b>	<b>Standing Water Level :</b>	
<b>GWMA : -</b>	<b>Salinity :</b>	
<b>GW Zone : -</b>	<b>Yield :</b>	

### Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
	<b>Form A :</b>		
	<b>Licensed :</b>		
<b>Region :</b> 90 - BARWON		<b>CMA Map :</b>	
<b>River Basin :</b>		<b>Grid Zone :</b>	<b>Scale :</b>
<b>Area / District :</b>			
<b>Elevation :</b>		<b>Northing :</b> 6569137	<b>Latitude (S) :</b> 30° 58' 55"
<b>Elevation Source :</b>		<b>Easting :</b> 236186	<b>Longitude (E) :</b> 150° 14' 15"
<b>GS Map :</b>	<b>MGA Zone :</b> 56	<b>Coordinate Source :</b> GPS - Global Positioning System	

### 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

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 Zone Details Found)									

### Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
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### Remarks

Form A Remarks:

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

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



# NSW OFFICE OF WATER

## Work Summary

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

<b>Licence</b> :90BL256052		<b>Licence Status</b> :Active	<b>Intended Purpose(s)</b>
<b>Work Type</b> :Bore		<b>Authorised Purpose(s)</b>	MONITORING BORE
<b>Work Status</b> :Equipped - bore used for obs			
<b>Construct. Method</b> :Auger - Solid Flight			
<b>Owner Type</b> :Local Govt			
<b>Commenced Date</b> :	<b>Final Depth</b> :	2.50 m	
<b>Completion Date</b> :24-May-2012	<b>Drilled Depth</b> :	2.50 m	
<b>Contractor Name</b> :Terratest			
<b>Driller</b> :1673		TUCKER, Jason Douglas	
<b>Assistant Driller's Name</b> :Darryl S			
<b>Property</b> : - WANDOBAB RESERVE		<b>Standing Water Level</b> :	
<b>GWMA</b> :024 - MISCELLANEOUS FRACTURED ROCK OF		<b>Salinity</b> :	
<b>GW Zone</b> : -		<b>Yield</b> :	

## Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
Client	<b>Form A</b> :POTTINGER	GUNNEDAH	7053//1116141
	<b>Licensed</b> :POTTINGER	GUNNEDAH	7053 1116141
<b>Region</b> :90 - BARWON		<b>CMA Map</b> :8936-3S	EMERALD HILL
<b>River Basin</b> :419 - NAMOI RIVER		<b>Grid Zone</b> :56/1	<b>Scale</b> :1:25,000
<b>Area / District</b> :			
<b>Elevation</b> :		<b>Northing</b> :6568841	<b>Latitude (S)</b> :30° 59' 4"
<b>Elevation Source</b> :		<b>Easting</b> :236221	<b>Longitude (E)</b> :150° 14' 16"
<b>GS Map</b> :	<b>MGA Zone</b> :56	<b>Coordinate Source</b> :GPS - Global Positioning System	

## 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
1		Hole	Hole	0.00	2.50	125			Auger - Solid Flight
1	1	Casing	PVC Class 18	0.00	1.00	60	50		Screwed; Cemented; End cap
1	1	Opening	Slots - Horizontal	1.00	2.50	60			PVC Class 18; Mechanically Slotted; A: .04mm; Screwed
1		Annulus	Cement Grout	0.00	0.20	125	60		PL: Poured/Shovelled
1		Annulus	Bentonite	0.20	0.70	125	60		PL: Poured/Shovelled
1		Annulus	Waterworm/Rounded	0.70	2.50	125	60		Graded; GS: 1-2mm; PL: Poured/Shovelled

## 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)
2.00	2.50	0.50							

## Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.30	0.30	Loam, brown orange, crumbly, clayey sandy, calcite, gravel pre sent	Loam	
0.30	0.62	0.32	Loam, brown orange, dry crumbly, calcite present	Loam	
0.62	1.11	0.49	Sand/Gravel, reds browns	Sand	
1.11	1.39	0.28	Sandy Clay, increasing, brown orange	Sandy Clay	
1.39	1.70	0.31	Gravel, abrupt change, calcite, sandy no soil, very wet	Gravel	
1.70	2.00	0.30	Clay/Sand, very wet, fine texture	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 GW970239 \*\*\*



# NSW OFFICE OF WATER

## Work Summary

**GW970240** - Gunnedah Shire Council - Wandobah Reserve

Licence :90BL256052			Licence Status :Active	Intended Purpose(s) MONITORING BORE
Work Type :Bore			Authorised Purpose(s) MONITORING BORE	
Work Status :Equipped - bore used for obs				
Construct. Method :Auger - Solid Flight				
Owner Type :Local Govt				
Commenced Date :	Final Depth :	9.80 m		
Completion Date :24-May-2012	Drilled Depth :	9.80 m		
Contractor Name :Terratest Pty Ltd				
Driller :1673 TUCKER, Jason Douglas				
Assistant Driller's Name :Darryl S				
Property : - WANDOBAB RESERVE			Standing Water Level :	
GWMA :024 - MISCELLANEOUS FRACTURED ROCK OF			Salinity :	
GW Zone : -			Yield :	

## Site Details

Site Chosen By	County	Parish	Portion/Lot DP
Client	Form A :POTTINGER	GUNNEDAH	7053//1116141
	Licensed :POTTINGER	GUNNEDAH	7053 1116141
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 :6569423	Latitude (S) :30° 58' 46"
Elevation Source :		Easting :236514	Longitude (E) :150° 14' 28"
GS Map :	MGA Zone :56	Coordinate Source :GPS - Global Positioning System	

## 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
1		Hole	Hole	0.00	9.80	125			Auger - Solid Flight
1	1	Casing	PVC Class 18	0.00	3.80	60	50		Screwed; Cemented; End cap
1	1	Opening	Slots - Horizontal	3.80	9.50	60			PVC Class 18; Mechanically Slotted; A: .04mm; Screwed
1		Annulus	Cement Grout	0.00	0.20	125	60		PL: Poured/Shovelled
1		Annulus	Bentonite	0.20	2.80	125	60		PL: Poured/Shovelled
1		Annulus	Waterworm/Rounded	2.80	9.80	125	60		Graded; GS: 1-2mm; PL: Poured/Shovelled

## 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)
7.00	7.50	0.50							

## Drillers Log

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 grey colours	Loam	
1.11	3.30	2.19	Clay; grey colours increasing, moist, calcite throughout, red oranges	Clay	
3.30	3.40	0.10	Gravel, river gravel, reds oranges, clay, very moist	Gravel	
3.40	9.50	6.10	Clay, moisture throughout, grey colours, heavy clay, red orange s	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 GW970240 \*\*\*



# NSW OFFICE OF WATER

## Work Summary

**GW970241** - Gunnedah Shire Council - Wandobah Reserve

<b>Licence</b> :90BL256052		<b>Licence Status</b> Active	<b>Intended Purpose(s)</b>
<b>Work Type</b> :Bore		<b>Authorised Purpose(s)</b>	MONITORING BORE
<b>Work Status</b> :Equipped - bore used for obs			
<b>Construct. Method</b> :Auger - Solid Flight			
<b>Owner Type</b> :Local Govt			
<b>Commenced Date</b> :	<b>Final Depth</b> :	5.50 m	
<b>Completion Date</b> :24-May-2012	<b>Drilled Depth</b> :	5.00 m	
<b>Contractor Name</b> :Terratest Pty Ltd			
<b>Driller</b> :1673		TUCKER, Jason Douglas	
<b>Assistant Driller's Name</b> :Darryl S			
<b>Property</b> : - WANDOBAB RESERVE		<b>Standing Water Level</b> :	
<b>GWMA</b> :024 - MISCELLANEOUS FRACTURED ROCK OF		<b>Salinity</b> :	
<b>GW Zone</b> : -		<b>Yield</b> :	

## Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
Client	<b>Form A</b> :POTTINGER	GUNNEDAH	7053//1116141
	<b>Licensed</b> :POTTINGER	GUNNEDAH	7053 1116141
<b>Region</b> :90 - BARWON		<b>CMA Map</b> :8936-3S	EMERALD HILL
<b>River Basin</b> :419 - NAMOI RIVER		<b>Grid Zone</b> :56/1	<b>Scale</b> :1:25,000
<b>Area / District</b> :			
<b>Elevation</b> :		<b>Northing</b> :6569069	<b>Latitude (S)</b> :30° 58' 57"
<b>Elevation Source</b> :		<b>Easting</b> :236398	<b>Longitude (E)</b> :150° 14' 23"
<b>GS Map</b> :	<b>MGA Zone</b> :56	<b>Coordinate Source</b> :GPS - Global Positioning System	

## 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
1		Hole	Hole	0.00	5.50	125			Auger - Solid Flight
1	1	Casing	PVC Class 18	0.00	2.50	60	50		Screwed; Cemented; End cap
1	1	Opening	Slots - Horizontal	2.50	5.50	60			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	Waterworm/Rounded	1.50	5.50	125	60		Graded; GS: 1-2mm; PL: Poured/Shovelled

## 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)
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 moisture, increasing orange	Clay	
1.26	2.45	1.19	Clay, heavy, crumbly, very moist, orange slight red	Clay	
2.45	5.00	2.55	Clay, mottling increasing, gley colours increasing, calcite, orange 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 \*\*\*

# NSW OFFICE OF WATER

## Work Summary

**GW970243** - Gunnedah Shire Council - Wombadah Reserve

Licence :90BL256052		Licence Status :Active	Intended Purpose(s) MONITORING BORE
Work Type :Bore		Authorised Purpose(s) MONITORING BORE	
Work Status :Abandoned - Backfilled			
Construct. Method :Hand Auger			
Owner Type :Local Govt			
Commenced Date :	Final Depth :	4.00 m	
Completion Date :24-May-2012	Drilled Depth :	4.00 m	
Contractor Name :Terratest Pty Ltd			
Driller :1673 TUCKER, Jason Douglas			
Assistant Driller's Name :Darryl S			
Property : - WANDOBAB RESERVE		Standing Water Level :	
GWMA :024 - MISCELLANEOUS FRACTURED ROCK OF		Salinity :	
GW Zone : -		Yield :	

## Site Details

Site Chosen By	County	Parish	Portion/Lot DP
Client	Form A :POTTINGER	GUNNEDAH	7053//1116141
	Licensed :POTTINGER	GUNNEDAH	7053 1116141
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 :6569311	Latitude (S) :30° 58' 49"
Elevation Source :		Eastings :236469	Longitude (E) :150° 14' 26"
GS Map :	MGA Zone :56	Coordinate Source :GPS - Global Positioning System	

## 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
1		Hole	Hole	0.00	4.00	56			Hand Auger
1	1	Backfill	Drilled cuttings	0.00	4.00	56			

## 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)
3.30	3.50	0.20							

## Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.30	0.30	Clay; dark brown, heavy	Clay	
0.30	0.54	0.24	Clay, lighter texture, dark brown	Clay	
0.54	1.00	0.46	Clay, red, lighter texture, colour change	Clay	
1.00	1.30	0.30	Clay, heavy, orange red, moist	Clay	
1.30	1.34	0.04	Clay, slight calcite	Clay	
1.34	1.62	0.28	Clay, moist, orange, red	Clay	
1.62	2.13	0.51	Clay, lighter, some calcite, yellow orange	Clay	
2.13	2.20	0.07	Clay, yellow orange, lighter clay	Clay	
2.20	2.26	0.06	Loam, lighter texture	Loam	
2.26	3.15	0.89	Clay, cream colours, black orange, heavy, calcite deposits	Clay	
3.15	3.30	0.15	Gravel, river gravel, colours orange yellow blacks creams	Gravel	
3.30	4.00	0.70	Gravel, as above, moisture increasing	Gravel	

## 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 \*\*\*



# NSW OFFICE OF WATER

## Work Summary

**GW970244** - Gunnedah Shire Council - Wandobah Reserve

<b>Licence</b> :90BL256052		<b>Licence Status</b> Active	<b>Intended Purpose(s)</b>
<b>Work Type</b> :Bore		<b>Authorised Purpose(s)</b>	MONITORING BORE
<b>Work Status</b> :Abandoned - Backfilled			
<b>Construct. Method</b> :Hand Auger			
<b>Owner Type</b> :Local Govt			
<b>Commenced Date</b> :	<b>Final Depth</b> :	4.00 m	
<b>Completion Date</b> :24-May-2012	<b>Drilled Depth</b> :	4.00 m	
<b>Contractor Name</b> :Terratest Pty Ltd			
<b>Driller</b> :1673		TUCKER, Jason Douglas	
<b>Assistant Driller's Name</b> :Darryl S			
<b>Property</b> : - WANDOBAB RESERVE		<b>Standing Water Level</b> :	
<b>GWMA</b> :024 - MISCELLANEOUS FRACTURED ROCK OF		<b>Salinity</b> :	
<b>GW Zone</b> : -		<b>Yield</b> :	

## Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
Client	<b>Form A</b> :POTTINGER	GUNNEDAH	7053//1116141
	<b>Licensed</b> :POTTINGER	GUNNEDAH	7053 1116141
<b>Region</b> :90 - BARWON		<b>CMA Map</b> :8936-3S	EMERALD HILL
<b>River Basin</b> :419 - NAMOI RIVER		<b>Grid Zone</b> :56/1	<b>Scale</b> :1:25,000
<b>Area / District</b> :			
<b>Elevation</b> :		<b>Northing</b> :6569054	<b>Latitude (S)</b> :30° 58' 57"
<b>Elevation Source</b> :		<b>Easting</b> :236293	<b>Longitude (E)</b> :150° 14' 19"
<b>GS Map</b> :	<b>MGA Zone</b> :56	<b>Coordinate Source</b> :GPS - Global Positioning System	

## 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
1		Hole	Hole	0.00	4.00	56			Hand Auger
1	1	Backfill	Drilled cuttings	0.00	4.00	56			

## 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 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 \*\*\*

# NSW OFFICE OF WATER

## Work Summary

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

<b>Licence</b> :90BL256052	<b>Licence Status</b> :Active	<b>Intended Purpose(s)</b> :MONITORING BORE
<b>Work Type</b> :Bore	<b>Authorised Purpose(s)</b> :MONITORING BORE	
<b>Work Status</b> :Abandoned - Backfilled		
<b>Construct. Method</b> :Hand Auger		
<b>Owner Type</b> :Local Govt		
<b>Commenced Date</b> :	<b>Final Depth</b> :3.00 m	
<b>Completion Date</b> :25-May-2012	<b>Drilled Depth</b> :3.00 m	
<b>Contractor Name</b> :Terratest		
<b>Driller</b> :1673 TUCKER, Jason Douglas		
<b>Assistant Driller's Name</b> :Joel Campbell & Darryl S		
<b>Property</b> : - WANDOBAB RESERVE	<b>Standing Water Level</b> :	
<b>GWMA</b> :024 - MISCELLANEOUS FRACTURED ROCK OF	<b>Salinity</b> :	
<b>GW Zone</b> : -	<b>Yield</b> :	

## Site Details

<b>Site Chosen By</b> :Client	<b>County</b> :POTTINGER	<b>Parish</b> :GUNNEDAH	<b>Portion/Lot DP</b> :7053//1116141
	<b>Form A</b> :POTTINGER	<b>Licensed</b> :POTTINGER	<b>Portion/Lot DP</b> :7053 1116141
<b>Region</b> :90 - BARWON		<b>CMA Map</b> :8936-3S	<b>EMERALD HILL</b>
<b>River Basin</b> :419 - NAMOI RIVER		<b>Grid Zone</b> :56/1	<b>Scale</b> :1:25,000
<b>Area / District</b> :			
<b>Elevation</b> :		<b>Northing</b> :6569348	<b>Latitude (S)</b> :30° 58' 48"
<b>Elevation Source</b> :		<b>Easting</b> :236543	<b>Longitude (E)</b> :150° 14' 29"
<b>GS Map</b> :	<b>MGA Zone</b> :56	<b>Coordinate Source</b> :GPS - Global Positioning System	

## 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
1		Hole	Hole	0.00	3.00	56			Hand Auger
1	1	Backfill	Drilled cuttings	0.00	3.00	56			

## 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 Zone Details Found)									

## Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.08	0.08	Clay, black, calcite chunk	Clay	
0.08	0.30	0.22	Clay, lighter textures, lighter clay, some mottles, slightly sandy texture, red	Clay	
0.30	2.34	2.04	Clay, red orange some mottle, heavier textures, progressive decaying organic matter, black mottle colours	Clay	
2.34	2.53	0.19	Clay, slight texture changes, crumbly calcite	Clay	
2.53	2.74	0.21	Clay, heavy, mottling, red orange	Clay	
2.74	2.82	0.08	Clay, calcite chunks, crumbly	Clay	
2.82	3.00	0.18	Clay, heavy, mottling, very moist, red orange	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 \*\*\*



# NSW OFFICE OF WATER

## Work Summary

**GW970246** - Gunnedah Shire Council - Wandobah Reserve

<b>Licence</b> :90BL256052	<b>Licence Status</b> :Active	<b>Intended Purpose(s)</b>
<b>Work Type</b> :Bore	<b>Authorised Purpose(s)</b>	MONITORING BORE
<b>Work Status</b> :Abandoned - Backfilled		
<b>Construct. Method</b> :Hand Auger		
<b>Owner Type</b> :Local Govt		
<b>Commenced Date</b> :	<b>Final Depth</b> :	3.00 m
<b>Completion Date</b> :25-May-2012	<b>Drilled Depth</b> :	3.00 m
<b>Contractor Name</b> :Terratest Pty Ltd		
<b>Driller</b> :1673	TUCKER, Jason Douglas	
<b>Assistant Driller's Name</b> :Joel Campbell & Darryl S		
<b>Property</b> : - WANDOBAB RESERVE	<b>Standing Water Level</b> :	
<b>GWMA</b> :024 - MISCELLANEOUS FRACTURED ROCK OF	<b>Salinity</b> :	
<b>GW Zone</b> : -	<b>Yield</b> :	

## Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
Client	<b>Form A</b> :POTTINGER	GUNNEDAH	7053//1116141
	<b>Licensed</b> :POTTINGER	GUNNEDAH	7053 1116141
<b>Region</b> :90 - BARWON		<b>CMA Map</b> :8936-3S	EMERALD HILL
<b>River Basin</b> :419 - NAMOI RIVER		<b>Grid Zone</b> :56/1	<b>Scale</b> :1:25,000
<b>Area / District</b> :			
<b>Elevation</b> :		<b>Northing</b> :6568984	<b>Latitude (S)</b> :30° 58' 60"
<b>Elevation Source</b> :		<b>Easting</b> :236335	<b>Longitude (E)</b> :150° 14' 21"
<b>GS Map</b> :	<b>MGA Zone</b> :56	<b>Coordinate Source</b> :GPS - Global Positioning System	

## 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
1		Hole	Hole	0.00	3.00	56			Hand Auger
1	1	Backfill	Drilled cuttings	0.00	3.00	56			

## 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 Zone Details Found)									

## Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.10	0.10	Soil, light crumbly, brown	Soil	
0.10	0.39	0.29	Loam, increasing heaviness, brown	Loam	
0.39	0.50	0.11	Loam, light colour red brown, lighter texture, crumbly	Loam	
0.50	1.06	0.56	Loam, mottling oranges greys	Loam	
1.06	1.90	0.84	Loam, mottling orange grey black, calcite chunks, heavy texture, moist	Loam	
1.90	2.23	0.33	Clay, heavy, some moisture	Clay	
2.23	2.43	0.20	Soil, black	Soil	
2.43	2.55	0.12	Clay, heavy, mottles red orange, calcite, wet	Clay	
2.55	3.00	0.45	Clay, calcite chunks, grey colours, wet	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 \*\*\*

# NSW OFFICE OF WATER

## Work Summary

**GW970247** - Gunnedah Shire Council - Wombadah Reserve

<b>Licence</b> :90BL256052	<b>Licence Status</b> :Active	<b>Intended Purpose(s)</b>
<b>Work Type</b> :Bore	<b>Authorised Purpose(s)</b>	MONITORING BORE
<b>Work Status</b> :Abandoned - Backfilled		
<b>Construct. Method</b> :Hand Auger		
<b>Owner Type</b> :Local Govt		
<b>Commenced Date</b> :	<b>Final Depth</b> :	3.00 m
<b>Completion Date</b> :24-May-2012	<b>Drilled Depth</b> :	3.00 m
<b>Contractor Name</b> :Terratest Pty Ltd		
<b>Driller</b> :1673 TUCKER, Jason Douglas		
<b>Assistant Driller's Name</b> :Joel Campbell & Darryl S		
<b>Property</b> : - WANDOBAB RESERVE	<b>Standing Water Level</b> :	
<b>GWMA</b> :024 - MISCELLANEOUS FRACTURED ROCK OF	<b>Salinity</b> :	
<b>GW Zone</b> : -	<b>Yield</b> :	

## Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
Client	<b>Form A</b> :POTTINGER	GUNNEDAH	7053//1116141
	<b>Licensed</b> :POTTINGER	GUNNEDAH	7053 1116141
<b>Region</b> :90 - BARWON		<b>CMA Map</b> :8936-3S	EMERALD HILL
<b>River Basin</b> :419 - NAMOI RIVER		<b>Grid Zone</b> :56/1	<b>Scale</b> :1:25,000
<b>Area / District</b> :			
<b>Elevation</b> :		<b>Northing</b> :6568905	<b>Latitude (S)</b> :30° 59' 2"
<b>Elevation Source</b> :		<b>Easting</b> :236205	<b>Longitude (E)</b> :150° 14' 16"
<b>GS Map</b> :	<b>MGA Zone</b> :56	<b>Coordinate Source</b> :GPS - Global Positioning System	

## 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
1		Hole	Hole	0.00	3.00	56			Hand Auger
1	1	Backfill	Drilled cuttings	0.00	3.00	56			

## 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)
2.50	3.00	0.50							

## Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.30	0.30	Topsoil, loamy, black	Topsoil	
0.30	0.80	0.50	Clay, heavier, small calcite, red brown, slight mottling	Clay	
0.80	1.10	0.30	Clay, wetter, sandier texture, red brown, slight mottling	Clay	
1.10	1.25	0.15	Gravel, sandy texture, crumbly, cream reds, some calcite	Gravel	
1.25	1.50	0.25	Clay, very wet layer, red brown	Clay	
1.50	1.55	0.05	Clay, very wet, free water, red brown	Clay	
1.55	1.90	0.35	Clay, still moist, red brown orange black mottles, water at 1.8m	Clay	
1.90	2.06	0.16	Sandy Clay, moist, brown	Sandy Clay	
2.06	2.20	0.14	Clay, brown, heavier, moist	Clay	
2.20	3.00	0.80	Clay, mottles, grey orange red, heavy, 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 GW970247 \*\*\*



# NSW OFFICE OF WATER

## Work Summary

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

<b>Licence</b> :90BL256052		<b>Licence Status</b> :Active	<b>Intended Purpose(s)</b>
<b>Work Type</b> :Bore		<b>Authorised Purpose(s)</b>	MONITORING BORE
<b>Work Status</b> :Abandoned - Backfilled			
<b>Construct. Method</b> :Hand Auger			
<b>Owner Type</b> :Local Govt			
<b>Commenced Date</b> :	<b>Final Depth</b> :	3.00 m	
<b>Completion Date</b> :24-May-2012	<b>Drilled Depth</b> :	3.00 m	
<b>Contractor Name</b> :Terratest Pty Ltd			
<b>Driller</b> :1673 TUCKER, Jason Douglas			
<b>Assistant Driller's Name</b> :Joel Campbell & Darryl S			
<b>Property</b> : - WANDOBDAH RESERVE		<b>Standing Water Level</b> :	
<b>GWMA</b> :024 - MISCELLANEOUS FRACTURED ROCK OF		<b>Salinity</b> :	
<b>GW Zone</b> : -		<b>Yield</b> :	

## Site Details

<b>Site Chosen By</b>	<b>County</b>	<b>Parish</b>	<b>Portion/Lot DP</b>
Client	<b>Form A</b> :POTTINGER	GUNNEDAH	7053//1116141
	<b>Licensed</b> :POTTINGER	GUNNEDAH	7053 1116141
<b>Region</b> :90 - BARWON		<b>CMA Map</b> :8936-3S	EMERALD HILL
<b>River Basin</b> :419 - NAMOI RIVER		<b>Grid Zone</b> :56/1	<b>Scale</b> :1:25,000
<b>Area / District</b> :			
<b>Elevation</b> :		<b>Northing</b> :6568802	<b>Latitude (S)</b> :30° 59' 5"
<b>Elevation Source</b> :		<b>Easting</b> :236151	<b>Longitude (E)</b> :150° 14' 14"
<b>GS Map</b> :	<b>MGA Zone</b> :56	<b>Coordinate Source</b> :GPS - Global Positioning System	

## 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
1		Hole	Hole	0.00	3.00	56			Hand Auger
1	1	Backfill	Drilled cuttings	0.00	3.00	56			

## 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)
2.50	3.00	0.50							

## Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.42	0.42	Gravel, white, large gravel, red brown, very crumbly	Gravel	
0.42	0.85	0.43	Clay, texture change, heavier, red orange cream colours	Clay	
0.85	1.00	0.15	Clay, some calcite, organic matter, red orange, more crumbly	Clay	
1.00	1.03	0.03	clay, very crumbly, light texture, red orange	Clay	
1.03	1.12	0.09	Gravel, orange red	Gravel	
1.12	2.05	0.93	Clay, some calcite, moist, mottling, red orange	Clay	
2.05	2.20	0.15	Clay, quite moist, red brown, slight mottling	Clay	
2.20	2.36	0.16	Clay, crumbly, not moist, red brown	Clay	
2.36	2.45	0.09	Clay, moisture, red brown, heavier	Clay	
2.45	2.55	0.10	Gravel, clay, red brown, water at 2.5m	Gravel	
2.55	3.00	0.45	Clay/Gravel, red brown, moist, mottling, greys oranges	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 GW970248 \*\*\*

# NSW OFFICE OF WATER

## Work Summary

**GW970252** - Gunnedah Shire Council - Wandobah Road Reserve

<b>Licence</b> :90BL256055		<b>Licence Status</b> :Abandoned	<b>Intended Purpose(s)</b> :MONITORING BORE
<b>Work Type</b> :Bore		<b>Authorised Purpose(s)</b> :MONITORING BORE	
<b>Work Status</b> :Abandoned - Backfilled			
<b>Construct. Method</b> :Auger - Solid Flight			
<b>Owner Type</b> :Local Govt			
<b>Commenced Date</b> :	<b>Final Depth</b> :	3.00 m	
<b>Completion Date</b> :24-May-2012	<b>Drilled Depth</b> :	3.00 m	
<b>Contractor Name</b> :Terratest Pty Ltd			
<b>Driller</b> :1673 TUCKER, Jason Douglas			
<b>Assistant Driller's Name</b> :Joel Campbell & Darryl S			
<b>Property</b> : - WANDOBAB ROAD RESERVE		<b>Standing Water Level</b> :	
<b>GWMA</b> :024 - MISCELLANEOUS FRACTURED ROCK OF		<b>Salinity</b> :	
<b>GW Zone</b> : -		<b>Yield</b> :	

## Site Details

<b>Site Chosen By</b> :	<b>County</b> :	<b>Parish</b> :	<b>Portion/Lot DP</b> :
<b>Client</b> :	<b>Form A</b> :POTTINGER	GUNNEDAH	Rd Adj 7053//1116141
	<b>Licensed</b> :POTTINGER	GUNNEDAH	78 755503
<b>Region</b> :90 - BARWON		<b>CMA Map</b> :8936-3S	EMERALD HILL
<b>River Basin</b> :419 - NAMOI RIVER		<b>Grid Zone</b> :56/1	<b>Scale</b> :1:25,000
<b>Area / District</b> :			
<b>Elevation</b> :		<b>Northing</b> :6568667	<b>Latitude (S)</b> :30° 59' 10"
<b>Elevation Source</b> :		<b>Eastng</b> :236120	<b>Longitude (E)</b> :150° 14' 12"
<b>GS Map</b> :	<b>MGA Zone</b> :56	<b>Coordinate Source</b> :GPS - Global Positioning System	

## 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
1		Hole	Hole	0.00	3.00	56			Auger - Solid Flight
1	1	Backfill	Drilled cuttings	0.00	3.00	56			

## 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 Zone Details Found)									

## Drillers Log

From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	0.20	0.20	Clay, red	Clay	
0.20	0.30	0.10	Clay, increased white grey mottles	Clay	
0.30	0.70	0.40	Clay, texture change: ligh clay, red, no mottles	Clay	
0.70	0.90	0.20	Clay, calcite chunks, carbonates, mottles, gley colours	Clay	
0.90	1.15	0.25	Clay, white grey red orange	Clay	
1.15	1.35	0.20	Clay, red orange	Clay	
1.35	2.00	0.65	Clay, texture change: more gravel	Clay	
2.00	2.28	0.28	Clay, red orange	Clay	
2.28	2.30	0.02	Clay, increasing mottles cream black orange, very moist	Clay	
2.30	2.41	0.11	Clay, red, heavy	Clay	
2.41	3.00	0.59	Clay, mottles increasing, lighter colours, gley colours cream orange yellow black	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 GW970252 \*\*\*

\*\*\* End of Report \*\*\*



**APPENDIX D**  
**Groundwater Quality**  
**Testing September 2012**

## ANALYSIS REPORT      WATER

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

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

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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



# ANALYSIS REPORT

Project No:

**EW120639**

Location:

Blackjack Creek Gunnedah

Source	GWMP	GWMP	GWMP	GWMP
Sample ID	#1	#2	#3	#4
	Horse paddock	Corner Cemetery	Top End Reserve	Middle Reserve
	30°59' 615"	30° 59' 515"	30° 59' 070"	30° 58' 949"
	150° 13' 806"	150° 13' 854"	150° 14' 273"	150° 14' 388"

ANALYTE	METHOD	UNITS	120639-1	120639-2	120639-3	120639-4
Chloride	ED045G	mg/L	<b>53</b>	<b>811</b>	<b>354</b>	<b>626</b>
pH Value	EA005P:	pH Unit	<b>7.84</b>	<b>7.42</b>	<b>7.71</b>	<b>7.90</b>
Conductivity	EA010P	µS/cm	<b>875</b>	<b>4160</b>	<b>1870</b>	<b>3010</b>
TDS Salinity	EA016	mg/L	<b>569</b>	<b>2700</b>	<b>1220</b>	<b>1960</b>
Total Hardness as CaCO <sub>3</sub>	EA065	mg/L	<b>342</b>	<b>1560</b>	<b>606</b>	<b>999</b>
Hydroxide Alkalinity as CaCO <sub>3</sub>	ED037P	mg/L	<b>&lt;1</b>	<b>&lt;1</b>	<b>&lt;1</b>	<b>&lt;1</b>
Carbonate Alkalinity as CaCO <sub>3</sub>	ED037P	mg/L	<b>&lt;1</b>	<b>&lt;1</b>	<b>&lt;1</b>	<b>&lt;1</b>
Bicarbonate Alkalinity as CaCO <sub>3</sub>	ED037P	mg/L	<b>302</b>	<b>300.0</b>	<b>240</b>	<b>516</b>
Total Alkalinity as CaCO <sub>3</sub>	ED037P	mg/L	<b>302</b>	<b>300</b>	<b>240</b>	<b>516</b>
Sulfate	ED041G	mg/L	<b>77</b>	<b>817</b>	<b>240</b>	<b>244</b>
Calcium	ED093F	mg/L	<b>94</b>	<b>367</b>	<b>134</b>	<b>67</b>
Magnesium	ED093F	mg/L	<b>26</b>	<b>156</b>	<b>66</b>	<b>202</b>
Sodium	ED093F	mg/L	<b>40</b>	<b>325</b>	<b>133</b>	<b>253</b>
Potassium	ED093F	mg/L	<b>19</b>	<b>10.0</b>	<b>10</b>	<b>14</b>
Sodium Absorption Ratio	EA006	—	<b>0.94</b>	<b>3.58</b>	<b>2.35</b>	<b>3.48</b>
Standing Water Level	dip	m	<b>2.20</b>	<b>1.80</b>	<b>2.44</b>	<b>2.26</b>



Report Date:

28/09/2012

# ANALYSIS REPORT

**Project No:** EW120639

Location: Blackjack Creek Gunnedah

**Source** GWMP  
#5  
**Sample 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 CaCO <sub>3</sub>	EA065	mg/L	501
Hydroxide Alkalinity as CaCO <sub>3</sub>	ED037P	mg/L	<1
Carbonate Alkalinity as CaCO <sub>3</sub>	ED037P	mg/L	<1
Bicarbonate Alkalinity as CaCO <sub>3</sub>	ED037P	mg/L	1010
Total Alkalinity as CaCO <sub>3</sub>	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**

Hydraulic calculations for Blackjack Creek reconstructed channel

Design chainage	Depth (m)	Area (m2)	Wetted Perimeter (m)	Average Slope (m/m)	Manning's n	Discharge Q (m3/s)	Velocity (m/s)	Hydraulic Radius (m)	Froude	Shear (N/m3)	Maximum Permissible 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



Design chainage	Depth (m)	Area (m2)	Wetted Perimeter (m)	Average Slope (m/m)	Manning's n	Discharge Q (m3/s)	Velocity (m/s)	Hydraulic Radius (m)	Froude	Shear (N/m3)	Maximum Permissible 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

Design chainage	Depth (m)	Area (m2)	Wetted Perimeter (m)	Average Slope (m/m)	Manning's n	Discharge Q (m3/s)	Velocity (m/s)	Hydraulic Radius (m)	Froude	Shear (N/m3)	Maximum Permissible 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**

Comparison of A3 (soil cores) to 2012 testing

ID	Easting	Northing	EC5 (dS/m)	Ece (dS/m)	pH(CaCl2 )	ECEC (meq/100 g)	Ex Mg (meq/1 00g)	Ex Na (meq/100g )	Ex K (meq/100g )	Ex Ca (meq/100g )	Ex Na %
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

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

Comparison of A4 (soil pits) to 2012 testing

ID	Easting	Northing	EC5 (dS/m)	Ece (dS/m)	pH(CaCl2 )	Organic Carbon %	(meq/1 00g)	(meq/100g )	(meq/100g )	(meq/100g )	Ex Na %	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

ID	Easting	Northing	EC5 (dS/m)	Ece (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**



## ANALYSIS REPORT      SOIL

<b>Project No:</b>	<b>EW120441</b>	<b>Date of Issue:</b>	<b>14/06/2012</b>
Customer:	Constructive Solutions	Report No:	1
Address:	PO Box 1498 Tamworth NSW 2340	Date Received:	25/05/2012
Phone:	02 67 621969	Matrix:	SOIL
Fax:		Location:	Blackjack Creek
email:	<a href="mailto:sarah@constructivesolutions.com.au">sarah@constructivesolutions.com.au</a>	Sampler ID:	Client Supplied
		Date of Sampling:	23/24&25/5/2012
		Sample Condition:	acceptable

Comments:

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

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Signed: **Anne Michie**  
Laboratory Manager

NATA Accredited Laboratory 15708

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

Accredited for compliance 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.*

# ANALYSIS REPORT

Project No: EW120441

Location: Blackjack Creek

Test Parameter	Method Description	Method Reference	Sample ID Depth Units	BH1		BH2		BH3		BH4	
				0-30cm		0-30cm		0-30cm		0-30cm	
				120441-1		120441-2		120441-3		120441-4	
Chlorides	Probe	R&H 5A1	mg/kg	725		16.0		37.0		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	11.3		8.40		8.08		6.61	
Phosphorus Ex	Colwell	R&H 9B1	mg/kg	53.3		32.7		75.1		33.9	
Sulphur Ex	KCl-40	Chinoim, LeFroy & Blair	mg/kg	72.1		4.50		17.7		28.5	
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	71.4		128		412		99.9	
Texture	-	PSR-1999	-	LC		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	NH <sub>4</sub> Cl	R&H 15A1	-	754	1.93	784	2.01	518	1.33	588	1.51
Calcium Ex	NH <sub>4</sub> Cl	R&H 15A1	-	3105	15.5	6997	35.0	1696	8.48	2390	12.0
Magnesium Ex	NH <sub>4</sub> Cl	R&H 15A1	-	833	6.94	750	6.25	1350	11.3	663	5.53
Sodium Ex	NH <sub>4</sub> Cl	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	%	60.5		80.6		39.4		61.5	
Ex Magnesium %	Calc	Calc	%	27.0		14.4		52.2		28.5	
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	25.7		43.4		21.5		19.4	
Ca/Mg Ratio	Calc	Calc	meq/100g	2.24		5.60		0.75		2.16	



# ANALYSIS REPORT

Project No: EW120441

Location: Blackjack Creek

Sample ID				BH5		BH6		BH7		BH8	
Test Parameter	Method Description	Method Reference	Depth Units	0-30cm		0-30cm		0-30cm		0-30cm	
				120441-5		120441-6		120441-7		120441-8	
Chlorides	Probe	R&H 5A1	mg/kg	134		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	44.6		98.8		73.8		22.1	
Sulphur Ex	KCl-40	Chinoim, LeFroy & Blair	mg/kg	19.8		4.97		10.0		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	114		242		117		96.9	
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	NH <sub>4</sub> Cl	R&H 15A1	-	570	1.46	613	1.57	835	2.14	396	1.02
Calcium Ex	NH <sub>4</sub> Cl	R&H 15A1	-	2145	10.7	2968	14.8	1764	8.82	1637	8.19
Magnesium Ex	NH <sub>4</sub> Cl	R&H 15A1	-	540	4.50	320	2.67	234	1.95	290	2.42
Sodium Ex	NH <sub>4</sub> Cl	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		16.31		8.64	
Ex Calcium %	Calc	Calc	%	63.2		77.2		67.2		69.7	
Ex Magnesium %	Calc	Calc	%	26.5		13.9		14.9		20.6	
Ex Sodium %	Calc	Calc	%	1.65		0.70		1.64		1.09	
Ex Aluminium %	Calc	Calc	%	0.01		0.03		0.02		0.04	
ECEC	Calc	Calc	meq/100g	17.0		19.2		13.1		11.7	
Ca/Mg Ratio	Calc	Calc	meq/100g	2.38		5.57		4.52		3.39	

# ANALYSIS REPORT

Project No: EW120441

Location: Blackjack Creek

Test Parameter	Method Description	Method Reference	Sample ID Depth Units	BH9		BH10		BH11		BH12	
				0-30cm		0-30cm		0-30cm		0-30cm	
				120441-9		120441-10		120441-11		120441-12	
Chlorides	Probe	R&H 5A1	mg/kg	23.6		25.5		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	41.0		36.8		50.6		43.0	
Sulphur Ex	KCl-40	Chinoim, LeFroy & Blair	mg/kg	12.2		9.03		235		12.5	
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	85.6		78.7		70.7		158	
Texture	-	PSR-1999	-	CL		CL		L		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> Cl	R&H 15A1	-	481	1.23	568	1.46	465	1.19	557	1.43
Calcium Ex	NH <sub>4</sub> Cl	R&H 15A1	-	2138	10.7	1914	9.57	1627	8.14	2039	10.2
Magnesium Ex	NH <sub>4</sub> Cl	R&H 15A1	-	376	3.13	1004	8.37	898	7.48	632	5.27
Sodium Ex	NH <sub>4</sub> Cl	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	%	70.4		48.1		41.2		59.3	
Ex Magnesium %	Calc	Calc	%	20.6		42.0		37.9		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	15.2		19.9		19.8		17.2	
Ca/Mg Ratio	Calc	Calc	meq/100g	3.41		1.14		1.09		1.94	



# ANALYSIS REPORT

Project No: EW120441

Location: Blackjack Creek

Sample ID				BH13		BH14		BH15		BH16	
Test Parameter	Method Description	Method Reference	Depth Units	0-30cm		0-30cm		0-30cm		0-30cm	
				120441-13		120441-14		120441-15		120441-16	
Chlorides	Probe	R&H 5A1	mg/kg	20.7		29.0		18.0		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	40.0		41.5		34.1		32.9	
Sulphur Ex	KCl-40	Chinoim, LeFroy & Blair	mg/kg	12.0		15.5		8.67		10.5	
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	119		341		153		189	
Texture	-	PSR-1999	-	FSL		FSL		FSL		FSL	
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	NH <sub>4</sub> Cl	R&H 15A1	-	393	1.01	426	1.09	305	0.78	389	1.00
Calcium Ex	NH <sub>4</sub> Cl	R&H 15A1	-	2297	11.5	2066	10.3	1649	8.25	1312	6.56
Magnesium Ex	NH <sub>4</sub> Cl	R&H 15A1	-	667	5.56	361	3.01	337	2.81	663	5.53
Sodium Ex	NH <sub>4</sub> Cl	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	%	62.7		70.7		68.6		49.2	
Ex Magnesium %	Calc	Calc	%	30.3		20.6		23.4		41.5	
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	18.3		14.6		12.0		13.3	
Ca/Mg Ratio	Calc	Calc	meq/100g	2.07		3.43		2.94		1.19	

# ANALYSIS REPORT

Project No: EW120441

Location: Blackjack Creek

Sample ID				BH17	BH18	BH19
Test Parameter	Method Description	Method Reference	Depth Units	0-30cm	0-30cm	0-30cm
				120441-17	120441-18	120441-19
Chlorides	Probe	R&H 5A1	mg/kg	38.8	24.8	64.5
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	64.5	94.7	24.5
Sulphur Ex	KCl-40	Chinoim, LeFroy & Blair	mg/kg	17.6	12.1	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	10.3	0.69
Manganese Ex	DTPA	R&H 12A1	mg/kg	227	169	18.5
Iron Ex	DTPA	R&H 12A1	mg/kg	433	296	53.1
Texture	-	PSR-1999	-	FSL	FSL	CL
Ece	-	-	dS/m	1.10	1.54	0.81
				mg/kg meq/100g	mg/kg meq/100g	mg/kg meq/100g
Potassium Ex	NH <sub>4</sub> Cl	R&H 15A1	-	300 0.77	607 1.56	346 0.89
Calcium Ex	NH <sub>4</sub> Cl	R&H 15A1	-	917 4.59	3283 16.42	1741 8.71
Magnesium Ex	NH <sub>4</sub> Cl	R&H 15A1	-	304 2.53	387 3.23	619 5.16
Sodium Ex	NH <sub>4</sub> Cl	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	%	55.8	76.6	58.1
Ex Magnesium %	Calc	Calc	%	30.8	15.1	34.4
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	21.4	15.0
Ca/Mg Ratio	Calc	Calc	meq/100g	1.81	5.09	1.69

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

DOCUMENT END



## Blackjack Creek Soil Investigation

Project Number: EW120441

Drill Rig: Geoprobe

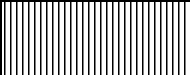

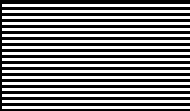

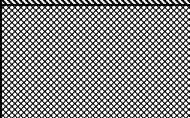
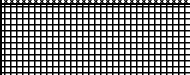
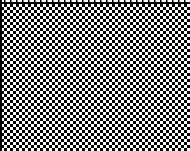


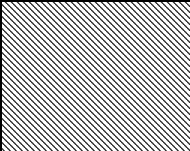
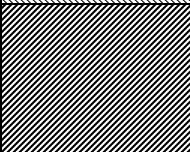
Date Collected: 25/05/12

Hole Number: 19

Northing: 30° 59" 298'

Total Depth of Test pit: 3.47m

Easting: 150° 14" 116'

Graphic Log	Description
	0.00-20.00cm Red clay
	20.00-30.00cm Increased white grey 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 mottles 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
<p>3.47m Core Sample terminated</p> <p>No free water observed. 2.3m very wet layer.</p>	



Contact: 02 6762 1733 admin@ewenviroag.com.au

## Blackjack Creek Soil Investigation

Project Number: EW120441

Drill Rig: Geoprobe

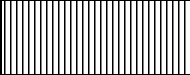
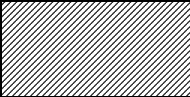

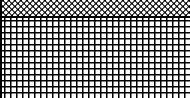
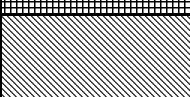
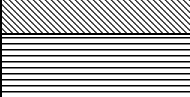
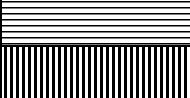
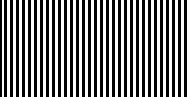


Date Collected: 25/05/12

Hole Number: 18

Northing: 30° 59" 163'

Total Depth of Test pit: 3.28m

Easting: 150° 14" 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, black, clay
	222.00-250.00cm Calcite chunks in clay
	250.00-262.00cm Clay, gley colours
	262.00-328.00cm Wet layer Free water not observed
3.28m Core Sample terminated	

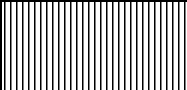
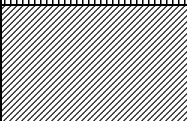
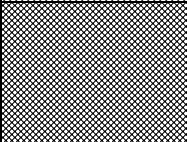
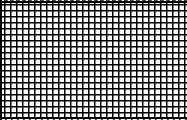
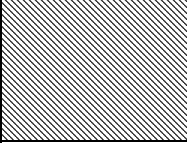
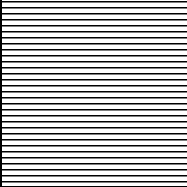
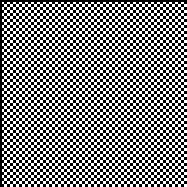


Contact: 02 6762 1733 admin@ewenviroag.com.au



## 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
	<u>3.34m Core Sample terminated</u> Free water not observed. 2.9m Wet layer observed .



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## Blackjack Creek Soil Investigation

Project Number: EW120441

Drill Rig: Geoprobe

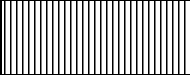
Date Collected: 25/05/12

Hole Number: 16

Northing: 30° 59" 800'

Total Depth of Test pit: 3.47m

Easting: 150° 14" 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, mottles 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
3.47m Core Sample terminated Free water not observed. Wet layers from 1.9 to 3.5	



Contact: 02 6762 1733 admin@ewenviroag.com.au



## Blackjack Creek Soil Investigation

Project Number: EW120441

Drill Rig: Geoprobe

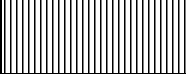
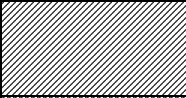
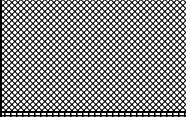
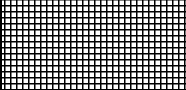
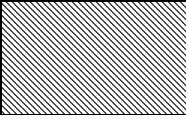
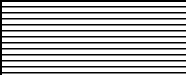
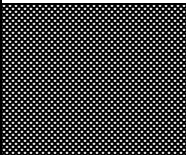
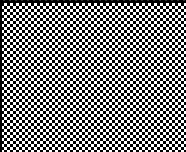
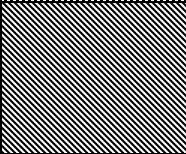
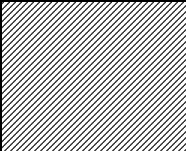
Date Collected: 24/05/12

Hole Number: 15

Northing: 30° 59" 035'

Total Depth of Test pit: 3.0m

Easting: 150° 14" 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



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## Blackjack Creek Soil Investigation

Project Number: EW120441

Drill Rig: Geoprobe

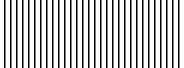
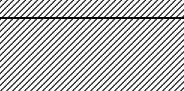
Date Collected: 24/05/12

Hole Number: 14

Northing: 30° 59" 035'

Total Depth of Test pit: 3.35m

Easting: 150° 14" 264'

Graphic 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 moist, red brown
	236.00-245.00cm Moisture, red brown, 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 mottling, heavy clay
	3.35m Core Sample terminated



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## Blackjack Creek Soil Investigation

Project Number: EW120441

Drill Rig: Geoprobe

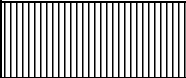

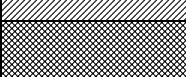
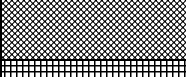
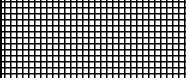


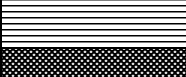

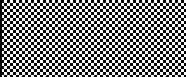

Date Collected: 24/05/12

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, orange, 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, colours orange yellow blacks creams
	3.30m Core Sample terminated 4.2m water



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## Blackjack Creek Soil Investigation

Project Number: EW120441

Drill Rig: Geoprobe

Date Collected: 24/05/12

Hole Number: 12

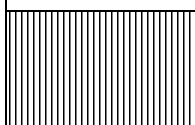
Northing: 30° 58" 881'

Total Depth of Test pit: 4.2m

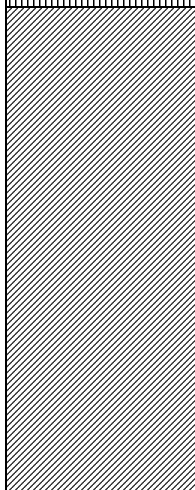
Easting: 150° 14" 397'

Graphic Log

### Description



0.00-56.00cm Red brown loamy clay, red black mottles, light calcite



56.00-336.00 Heavy clay, black grey mottles, very moist, gley colours increasing through the profile, calcite chunks throughout

2.55m Core Sample terminated  
4.2m: Free water

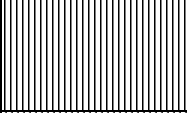
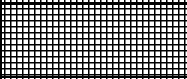


Contact: 02 6762 1733 admin@ewenviroag.com.au



## Blackjack Creek Soil Investigation

Project Number: EW120441	Drill Rig: Geoprobe
Date Collected: 24/05/12	Hole Number: 11
Northing: 30° 58" 819'	Total Depth of Test pit: 3.5m
Easting: 150° 14" 436'	

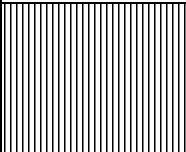
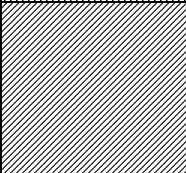
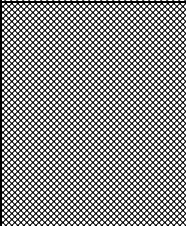
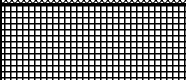
Graphic Log	Description
	0.00-30.00cm Red clay, slight orange
	30.00-45.00cm Heavier clay, wetter, red orange
	45.00-55.00cm Red orange, wetter, heavy clay
	55.00-61.00cm Calcite chunks, red orange, heavy clay
	61.00-120.00cm Colour change: black, heavy clay, very moist, slightly mottling black orange
	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



Contact: 02 6762 1733 admin@ewenviroag.com.au

## Blackjack Creek Soil Investigation Ground Water Monitoring Point

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 colours
	111.00-330.00cm Gley colours increasing, moist, calcite throughout, red oranges.
	330.00-340.00cm River gravel, reds oranges, clay, very moist
	3.40m Core Sample terminated 9.5m: Free water, bore casing /locked monument.



Contact: 02 6762 1733 [admin@ewenviroag.com.au](mailto:admin@ewenviroag.com.au)



## Blackjack Creek Soil Investigation Ground Water Monitoring Point

Project Number: EW120441

Drill Rig: Geoprobe

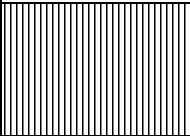
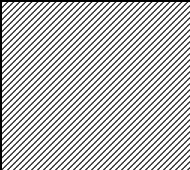
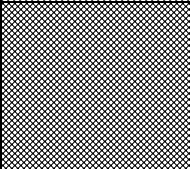
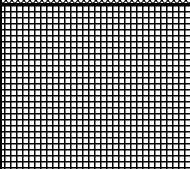
Date Collected: 24/05/12

Hole Number: 9

Northing: 30° 58" 949'

Total Depth of Test pit: 4.5m

Easting: 150° 14" 388'

Graphic Log	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, crumbly, very moist, orange slight red
	245.00-340.00cm Mottling increasing, gley colours increasing, calcite, orange red clay, very moist
	<p><u>3.40m Core Sample terminated</u></p> <p>4.5m:Free water, bore casing /locked monument.</p>



Contact: 02 6762 1733 admin@ewenviroag.com.au

## Blackjack Creek Soil Investigation Ground Water Monitoring Point

Project Number: EW120441

Drill Rig: Geoprobe

Date Collected: 24/05/12

Hole Number: 8

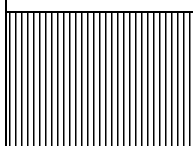
Northing: 30° 59" 070'

Total Depth of Test pit: 1.98m

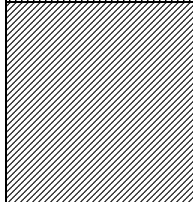
Easting: 150° 14" 273'

Graphic Log

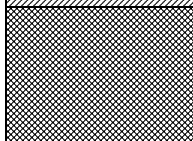
Description



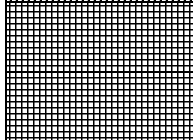
0.00-30.00cm Brown orange crumbly clay sandy loam, calcite, gravel present



30.00-62.00cm Brown orange, dry crumbly, calcite present



62.00-111.00cm Sand gravel, reds browns



111.00-139.00cm Sandy clay increasing, brown orange



139.00-170.00cm Abrupt change, gravel, calcite, sandy no soil, very wet.



170.00-198.00cm Very wet, clay sand, fine texture

1.98m Core Sample terminated  
2.0m: Free water, bore casing /locked monument.



Contact: 02 6762 1733 admin@ewenviroag.com.au



## Blackjack Creek Soil Investigation

Project Number: EW120441

Drill Rig: Geoprobe

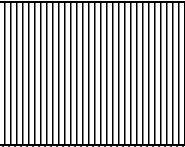
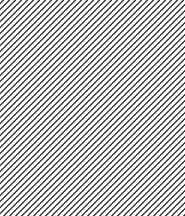
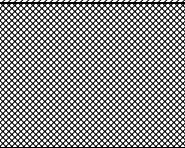
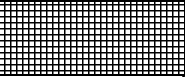
Date Collected: 24/05/12

Hole Number: 7

Northing: 30° 59" 664'

Total Depth of Test pit: 8.5m

Easting: 150° 13" 796'

Graphic Log	Description
	0.00-40.00cm Very crumbly, dry, red brown, light clay loam
	40.00-136.00cm Heavier clay, brown red orange mottles, calcite present, slightly gritty, increasing moisture.
	136.00-298.00cm Gravel/calcite lens at 149cm, increasing moisture, gley colours increasing, heavy clay, wet, light colours greys oranges
	298.00-335.00cm Darker colour, black browns, heavy clay, wet
	3.35m Core Sample terminated Auger to 8.5m no water



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## Blackjack Creek Soil Investigation Ground Water Monitoring Point

Project Number: EW120441

Drill Rig: Geoprobe

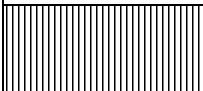
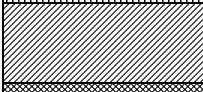

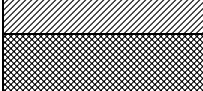
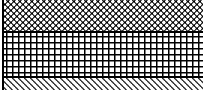

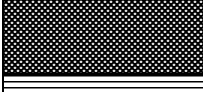
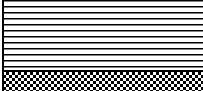
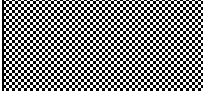
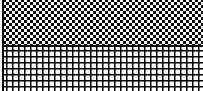
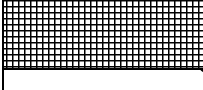
Date Collected: 24/05/12

Hole Number: 6

Northing: 30° 59" 613'

Total Depth of Test pit: 4.50m

Easting: 150° 13" 810'

Graphic Log	Description
	0.00-30.00cm Brown black, clay loamy, crumbly
	30.00-54.00cm brown black, heavier clay, dry
	54.00-106.00cm Calcite present, heavier clay, reds oranges colours, brown black, slight moisture.
	106.00-116.00cm Gley colours increasing
	116.00-142.00cm Gley colours strong
	142.00-154.00cm Gravel lens, reds oranges
	154.00-166.00cm Heavy clay, red browns, moist, gritty
	166.00-182.00cm Gravel, sand, wet, no soil, purple red cream.
	182.00-210.00cm Gravel, increase soil, sandy, gley colours, lighter colours, wet clay
	210.00-380.00cm Heavy clay, gley colours, wet, increasing wet
	380.00-440.00cm Slightly sandy clay, gley colours, very wet.
4.40m Core Sample terminated	
4.5m: Free water, bore casing /locked monument.	

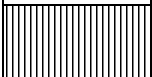
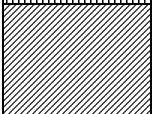
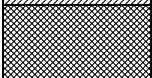
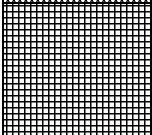
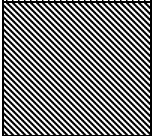
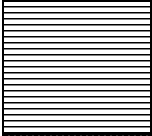
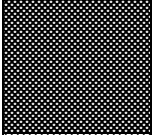
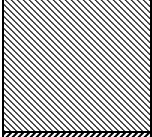
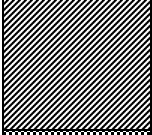
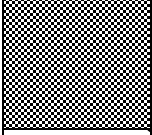


Contact: 02 6762 1733 admin@ewenviroag.com.au



## Blackjack Creek Soil Investigation Ground Water Monitoring Point

Project Number: EW120441	Drill Rig: Geoprobe
Date Collected: 23/05/12	Hole Number: 5
Northing: 30° 59" 515'	Total Depth of Test pit: 7.7m
Easting: 150° 13" 854'	

Graphic Log	Description
	0.00-30.00cm Dry crumbly gravel, calcite present, light brown orange blacks
	30.00-55.00cm Dark brown, some reds, crumbly gritty, dry
	55.00-94.00cm Dark brown oranges, increasing wet, gritty, dry
	94.00-110.00cm Clay increasing wet crumbly, brown grey, slight gley colours
	110.00-172.00cm Clay increasing wet crumbly, gritty, gley colours, greys oranges, calcite present, slight moisture
	172.00-254.00cm Heavier clay, grey, increasing oranges reds, moist
	254.00-271.00cm Clay with sand, orange red gley colours, moist
	271.00-312.00cm More gravel and sand cream gley colours moist
	312.00-404.00cm Clay increasing dark greys gley colours, grey orange
	404.00-440.00cm heavy clay, calcite deposits, gley colours, grey orange creams, moist, slight gravel.
<div>4.40m Core Sample terminated</div> <div>7.6m:Free water, bore casing /locked monument.</div>	



Contact: 02 6762 1733 admin@ewenviroag.com.au





## Blackjack Creek Soil Investigation

Project Number: EW120441

Drill Rig: Geoprobe

Date Collected: 23/05/12

Hole Number: 4

Northing: 30° 59" 394'

Total Depth of Test pit: 1.90m

Easting: 150° 13" 936'

Graphic Log	Description
	0.00-50.00cm Dark brown crumbly dry slight reds
	50.00-107.00cm Calcite chunks, gravel, gley colours, crumbly sandy
	107.00-117.00cm Heavy clay sandy, gley colours light grey reds
	117.00-160.00cm Sandy clay very wet gley colours
	160.00-190.00cm Heavy clay less moisture gley colours grey orange
1.90 Core Sample terminated	



Contact: 02 6762 1733 admin@ewenviroag.com.au

## Blackjack Creek Soil Investigation

Project Number: EW120441

Drill Rig: Geoprobe

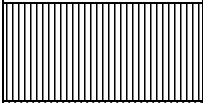
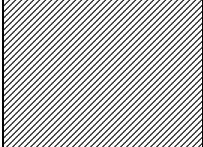
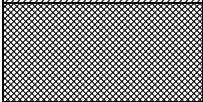
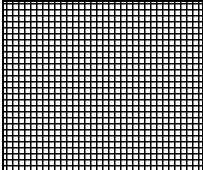
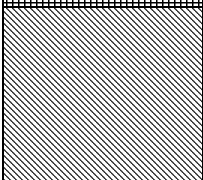
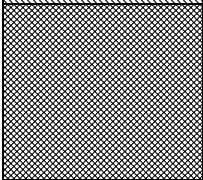
Date Collected: 23/05/12

Hole Number: 3

Northing: 30° 59" 337'

Total Depth of Test pit: 3.76m

Easting: 150° 13" 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 less wet, slightly sandy, gley colours, grey orange
	270.00-367.00cm Sandy increasing gley colours, orange grey colours. Very wet, sand, 3.5m water.
	3.67 Core Sample terminated



Contact: 02 6762 1733 admin@ewenviroag.com.au



## Blackjack Creek Soil Investigation

Project Number: EW120441

Drill Rig: Geoprobe

Date Collected: 23/05/12

Hole Number: 2

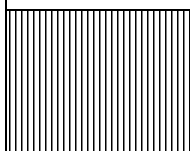
Northing: 30° 59" 555'

Total Depth of Test pit: 5.20m

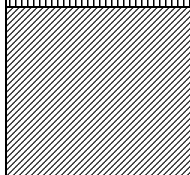
Easting: 150° 13" 745'

Graphic Log

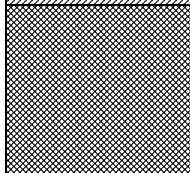
Description



0.00-30.00cm Red brown clay, rocks present, light clay



30.00-428.00cm Calcite present, very dry, light brown orange, mottling creams, clay



428.00-520.00cm Gravel wet, free water, calcite chunks, red brown soil some gley colours

5.2m Core Sample terminated



Contact: 02 6762 1733 admin@ewenviroag.com.au

## Blackjack Creek Soil Investigation

Project Number: EW120441

Drill Rig: Geoprobe

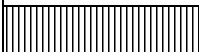

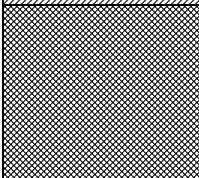
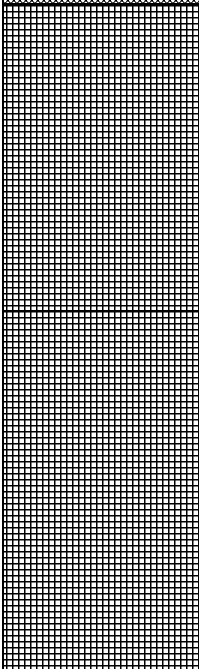

Date Collected: 23/05/12

Hole Number: 1

Northing: 30° 59" 466'

Total Depth of Test pit: 6.5m

Easting: 150° 13" 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 heavier clay
	90.00-200.00cm Red clay, some calcite, 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 6.5m free water



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.**

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**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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	V1.0	12.11.2012	HK to PJC (review)
	V1.0	12.11.2012	PJC Review
Draft V2.0 for release to client	V2.0	13.11.2012	HK to Client (SH)
	V2.1	13.11.2012	SH to OzArk (HK)
Draft V3.0 edits OzArk to client	V3.0	13.11.2012	HK amend to Client
	V3.1	17.1.2013	HK amend to Client
FINAL Approved			
<b>Prepared For</b>	<b>Prepared By</b>		
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## EXECUTIVE SUMMARY

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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 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.

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

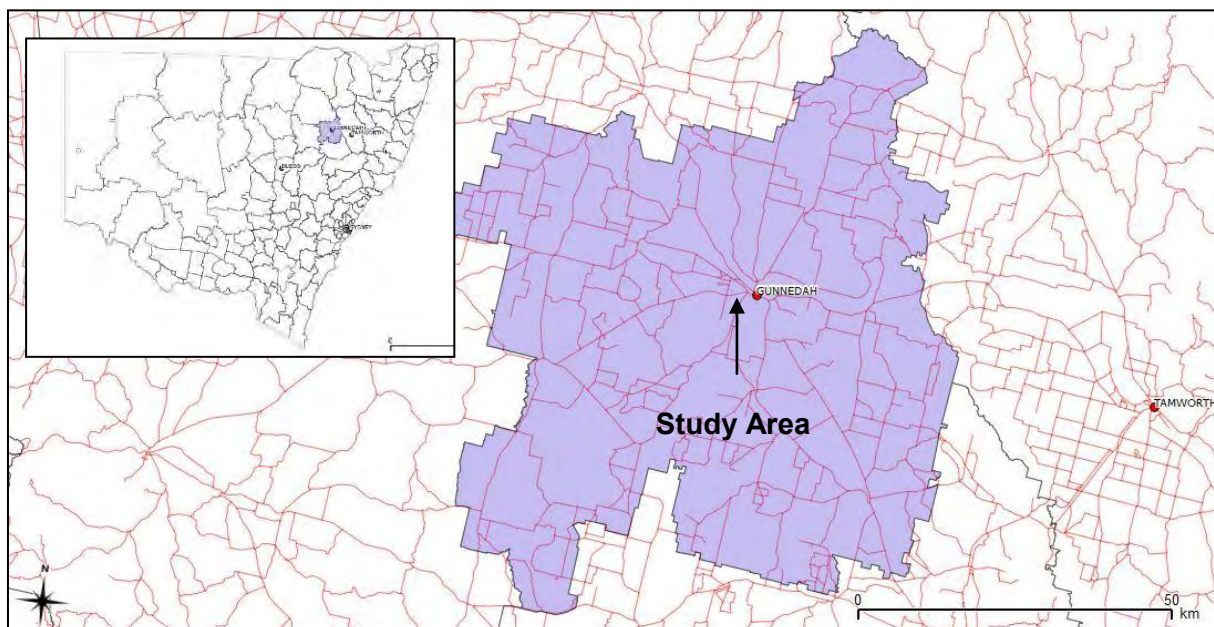
OzArk Environmental Heritage & Management (OzArk) was commissioned by Constructive Solutions (CS) on behalf of Gunnedah Shire Council (GSC) to undertake an ecological assessment for the proposed impacts associated with the reconstruction and realignment of Blackjack Creek in the town of Gunnedah, NSW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

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### 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

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#### 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.



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

<b>Issue</b>	<b>Impact</b>
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

## **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 on-site 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 [State Environmental Planning Policy No 44—Koala Habitat Protection](#), 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) recording 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 Gum (*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 are 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**

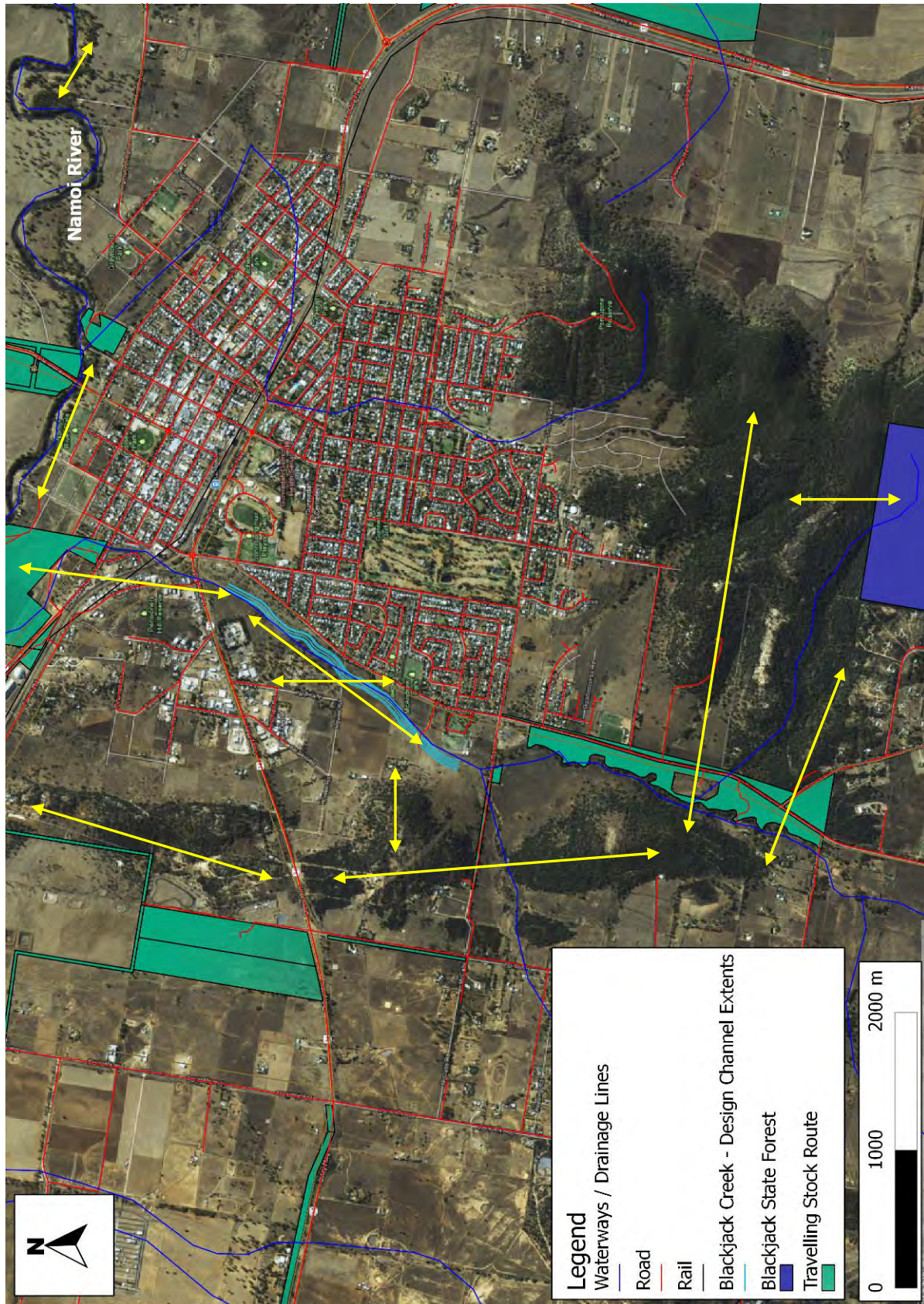
The majority of the Study Area has been heavily impacted by dispersed urban development (roads, bridges and flood protection), rubbish dumping, agricultural activities, road-base stockpiling, BMX track/jump creation, clearing and feral animals. Land use changes have resulted in extensive areas of native 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**

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### **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
<i>Litoria booroolongensis</i>	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.
<i>Chalinolobus dwyeri</i>	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 ( <i>Petrochelidon ariel</i> ), 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
<i>Mormopterus norfolkensis</i>	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.
<i>Nyctophilus corbeni</i>	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, bullocke 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.
<i>Pteropus poliocephalus</i>	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.
<i>Saccolaimus flaviventris</i>	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.	
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-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.
<i>Vespadelus troughtoni</i>	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.
<i>Chalinolobus picatus</i>	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
<i>Geophaps scripta scripta</i>	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.
<i>Alectura lathami - E population</i>	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.
<i>Anseranas semipalmata</i>	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
<i>Anthochaera phrygia</i>	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.
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Animal > Birds	E		Predicted		Unlikely. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes ( <i>Typha</i> spp.) and spikerushes ( <i>Eleocharis</i> spp.).	Will not be affected by the Proposal.
<i>Burhinus grallarius</i>	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.
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	Animal > Birds	V		Known		Potential. Casuarina does occur in the Study Area. However this species prefers <i>Allocasuarina diminuta</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.
<i>Certhionyx variegatus</i>	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 ( <i>Eremophila</i> spp.); also from mistletoes and various other shrubs (e.g. <i>Grevillea</i> 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
<i>Chthonicola sagittata</i>	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.
<i>Circus assimilis</i>	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.
<i>Climacteris picumnus victoriae</i>	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 ( <i>Eucalyptus camaldulensis</i> ) 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.	
<i>Daphoenositta chrysoptera</i>	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.
<i>Ephippiorhynchus asiaticus</i>	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.	
<i>Epthianura albifrons</i>	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
<i>Falco hypoleucos</i>	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.
<i>Glossopsitta pusilla</i>	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.
<i>Grantiella picta</i>	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
<i>Grus rubicunda</i>	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.
<i>Hamirostra melanosternon</i>	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.
<i>Hieraaetus morphnoides</i>	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.
<i>Lathamus discolor</i>	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.
<i>Leipoa ocellata</i>	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.
<i>Limosa limosa</i>	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.
<i>Lophoictinia isura</i>	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 (DSEWPoC Search)	Likelihood.	Impact
<i>Melanodryas cucullata cucullata</i>	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.
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	Animal > Birds	V		Known		Unlikely. Associated woodlands dominated by box and ironbark eucalypts, especially <i>E. sideroxylon</i> , <i>E. albens</i> , <i>E. microcarpa</i> , and <i>E. melliodora</i> 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.
<i>Neophema pulchella</i>	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
<i>Ninox connivens</i>	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.
<i>Ninox strenua</i>	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.
<i>Oxyura australis</i>	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.
<i>Pachycephala olivacea</i>	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.
<i>Petroica boodang</i>	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
<i>Petroica phoenicea</i>	Flame Robin	Animal > Birds	V		Predicted		Unlikely. Requires shrubby vegetation of a large patch size.	Will not be affected by the Proposal.
<i>Polytelis swainsonii</i>	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.
<i>Pomatostomus temporalis temporalis</i>	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.
<i>Stagonopleura guttata</i>	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
<i>Stictonetta naevosa</i>	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.
<i>Tyto longimembris</i>	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.
<i>Tyto novaehollandiae</i>	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
<i>Apus pacificus</i>	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.
<i>Ardea alba</i>	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.
<i>Ardea ibis</i>	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.
<i>Ardeotis australis</i>	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.
<i>Hirundapus caudacutus</i>	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.
<i>Myiagra cyanoleuc</i>	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
<i>Haliaeetus leucogaster</i>	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.
<i>Gallinago hardwickii</i>	Latham's 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.
<i>Merops ornatus</i>	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.
<i>Rostratula benghalensis s. lat</i>	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.
<i>Maccullochella peelii peelii</i>	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.
<i>Bettongia penicillata penicillata</i>	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
<i>Bridled Nailtail Wallaby</i>		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.
<i>Cercartetus nanus</i>	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.
<i>Dasyurus geoffroii</i>	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.
<i>Dasyurus maculatus</i>	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
<i>Eastern Hare-wallaby</i>		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.
<i>Lagorchestes leporides</i>	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.
<i>Macropus dorsalis</i>	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.
<i>Petaurus australis</i>	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.
<i>Petaurus norfolcensis</i>	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
<i>Petrogale penicillata</i>	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.
<i>Phascogale tapoatafa</i>	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.
<i>Phascolarctos cinereus</i>	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.
<i>Sminthopsis macroura</i>	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 ( <i>Themeda australis</i> ).	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.
<i>Aprasia parapulchella</i>	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.
<i>Hoplocephalus bitorquatus</i>	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.
<i>Underwoodisaurus sphyrurus</i>	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
<i>Conilurus albipes</i>	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.
<i>Plains Rat</i>		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.
<i>Pseudomys gouldii</i>	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
<i>Rattus villosissimus</i>	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.
<i>Cadellia pentastylis</i> (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	E	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
<i>Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions</i>		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.
<i>Native Vegetation on Cracking Clay Soils of the Liverpool Plains</i>	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 ( <i>Austrostipa aristiglumis</i> ), Queensland Bluegrass ( <i>Dichanthium sericeum</i> ) and Coolibah Grass ( <i>Panicum queenslandicum</i> ). It also contains scattered and patchy shrubs and trees, including Boree ( <i>Acacia pendula</i> ), Rough-barked Apple ( <i>Angophora floribunda</i> ), Fuzzy Box ( <i>Eucalyptus conica</i> ), Bimble Box ( <i>E. populnea</i> ) and Yellow Box ( <i>E. melliodora</i> ). In wetter locations rushes and sedges are common.	Will not be affected by the Proposal.
<i>Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions</i>		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
<i>White Box Yellow Box Blakely's Red Gum Woodland</i>		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.
<i>Tylophora linearis</i>	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.
<i>Bothriochloa biloba</i>	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.
<i>Digitaria porrecta</i>	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.	
<i>Cyperus conicus</i>	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.
<i>Dichanthium setosum</i>	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 ( <i>Aristida ramosa</i> ), Red-leg Grass ( <i>Bothriochloa macra</i> ), Red Grass ( <i>B. decipiens</i> ), Queensland Bluegrass ( <i>Dichanthium sericeum</i> ) or <i>Austrostipa aristiglumis</i>	Will not be affected by the Proposal.
<i>Digitaria porrecta</i>	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 <i>Eucalyptus albens</i> and <i>Acacia pendula</i> . Common associated grasses and forbs in NSW sites include <i>Austrostipa aristiglumis</i> , <i>Enteropogon acicularis</i> , <i>Cyperus bifax</i> , <i>Hibiscus trionum</i> and <i>Neptunia gracilis</i> .	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
<i>Homopholis belsonii</i>	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.
<i>Lepidium aschersonii</i>	Spiny Peppercress	Plant > Herbs and Forbs	V	V	Known		Found on ridges of gilgai clays dominated by Brigalow ( <i>Acacia harpophylla</i> ), Belah ( <i>Casuarina cristata</i> ), Bulloke ( <i>Allocasuarina luehmannii</i> ) and Grey Box ( <i>Eucalyptus microcarpa</i> ). 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.
<i>Swainsona murrayana</i>	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 <i>Maireana</i> 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.	
<i>Thesium australe</i>	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 ( <i>Themeda australis</i> ). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	Will not be affected by the Proposal.
<i>Prasophyllum sp. Wybong (C.Phelps ORG 5269)</i>	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 Ilford, 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.
<i>Pterostylis cobarensis</i>	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 <i>Callitris</i> shrublands on low stony ridges and slopes in skeletal sandy-loam soils. Associated species include <i>Eucalyptus morrisii</i> , <i>E. viridis</i> , <i>E. intertexta</i> , <i>E. vicina</i> , <i>Callitris glaucophylla</i> , <i>Geijera parviflora</i> , <i>Casuarina cristata</i> , <i>Acacia doratoxylon</i> , <i>Senna</i> spp. and <i>Eremophila</i> 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
<i>Philotheca ericifolia</i>		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.
<i>Pomaderris queenslandica</i>	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.
<i>Cadellia pentastylis</i>	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
							<p>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.</p> <p>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.</p>	

## 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

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<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).



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 trees 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.
- Moderate Habitat Value (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, Grey-crowned 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 an 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**

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™. 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.

**Table 3: Desktop Database Search Results**

Name of database searched	Date of search	Type of search	Comment
DSEWPaC Register of Critical Habitat <a href="http://www.environment.gov.au/cgi-bin/sprat/public/publicregisterofcriticalhabitat.pl">http://www.environment.gov.au/cgi-bin/sprat/public/publicregisterofcriticalhabitat.pl</a>	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; <a href="http://www.environment.gov.au/erin/ert/epbc/index.html">http://www.environment.gov.au/erin/ert/epbc/index.html</a>	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: <a href="http://www.environment.nsw.gov.au/threatenedspecies/">http://www.environment.nsw.gov.au/threatenedspecies/</a>	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.



Department of Primary Industries Noxious Weeds Database <a href="http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed">http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed</a>	24.10.12	Gunnedah LGA	
NSW Legislation website: SEPP 44: Koala Habitat Protection <a href="http://www.legislation.nsw.gov.au/fragview/inforce/epi%2B5%2B1995%2Bcd%2B0%2BN?">http://www.legislation.nsw.gov.au/fragview/inforce/epi%2B5%2B1995%2Bcd%2B0%2BN?</a>	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. <a href="http://www.environment.nsw.gov.au/threatenedspecies/aboutKTPsinNSW.htm">http://www.environment.nsw.gov.au/threatenedspecies/aboutKTPsinNSW.htm</a>	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 <a href="http://www.environment.gov.au/biodiversity/threatened/ktp.html">http://www.environment.gov.au/biodiversity/threatened/ktp.html</a>	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) <a href="http://www.birdlife.org/datazone/site/search">http://www.birdlife.org/datazone/site/search</a>	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 <a href="http://biocache.ala.org.au/explore/your-area#-33.11077814509428 148.41198754282232 12 Amphibians">http://biocache.ala.org.au/explore/your-area#-33.11077814509428 148.41198754282232 12 Amphibians</a>	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.

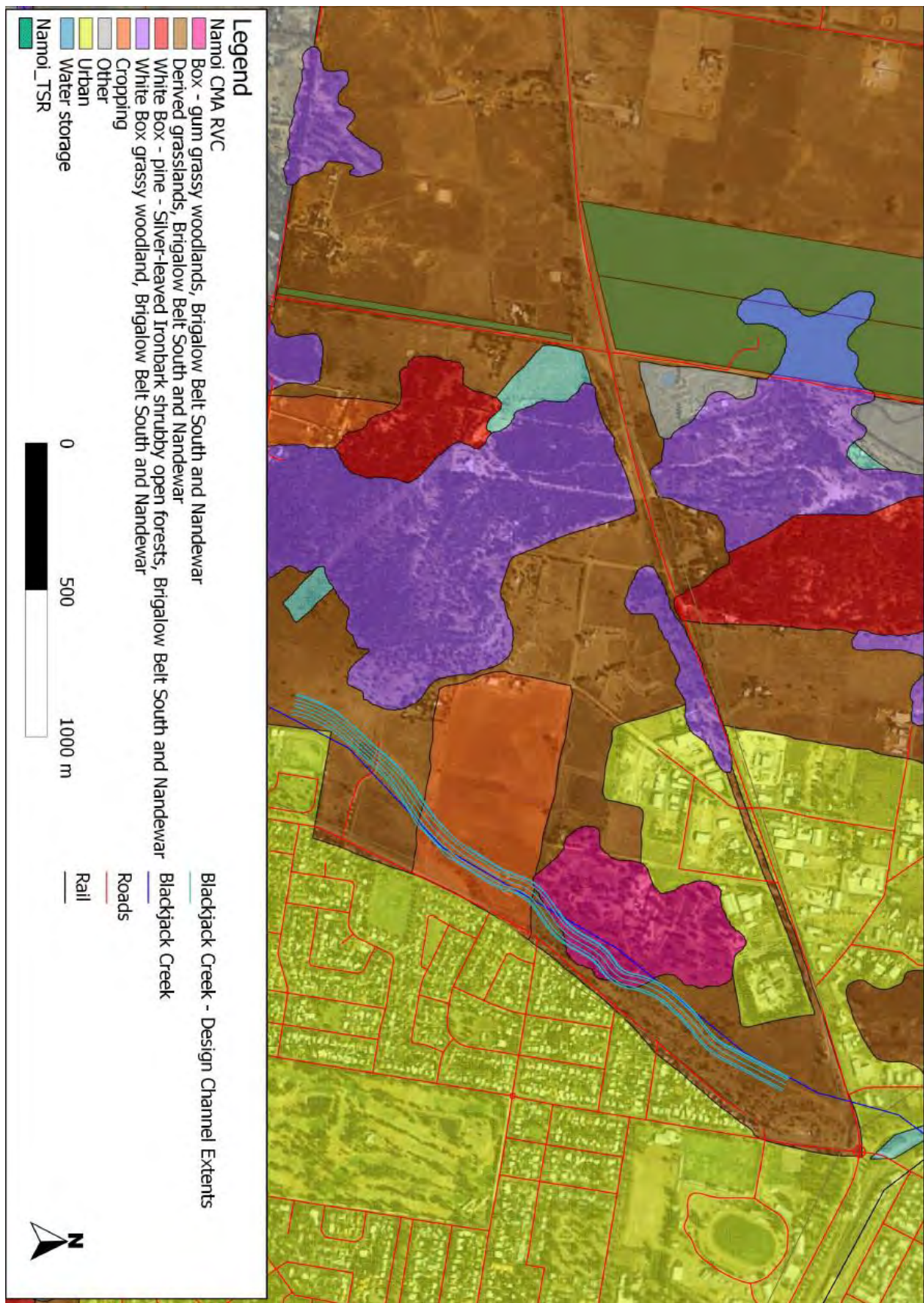
### **6.1.3 Available Vegetation Mapping / Descriptions**

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.

**Table 4: Flora Species Recorded in the Study Area.**

Family	Common Name	Scientific Name	Presence	Status
Aizoaceae	New Zealand Spinach	<i>Tetragonia tetragonioides</i>	X	*
Alliaceae	Fragrant False Garlic	<i>Nothoscordum inodorum</i>	X	*
Anacardiaceae	Pepper Tree	<i>Schinus areira</i>	X	*
Apiaceae	Bishop's Weed	<i>Ammi majus</i>	X	*
Apiaceae	Fennel	<i>Foeniculum vulgare</i>	X	*
Asteraceae	Capeweed	<i>Arctotheca calendula</i>	X	*
Asteraceae	Cobbler's Pegs	<i>Bidens pilosa</i>	X	*
Asteraceae	Yellow Burr-daisy	<i>Calotis lappulacea</i>	X	
Asteraceae	Cough Bush	<i>Cassinia quinquefaria</i>	X	
Asteraceae	Chicory	<i>Cichorium intybus</i>	X	*
Asteraceae	Spear Thistle	<i>Cirsium vulgare</i>	X	*
Asteraceae	Flaxleaf Fleabane	<i>Conyza bonariensis</i>	X	*
Asteraceae	Tall fleabane	<i>Conyza sumatrensis</i>	X	*
Asteraceae	Cretan Weed	<i>Hedypnois rhagadioloides</i>	X	*
Asteraceae	Catsear	<i>Hypochaeris radicata</i>	X	*
Asteraceae	Prickly Lettuce	<i>Lactuca serriola</i>	X	*
Asteraceae	Cotton Fireweed	<i>Senecio quadridentatus</i>	X	
Asteraceae	Prickly Sowthistle	<i>Sonchus asper subsp. asper</i>	X	*
Asteraceae	Common Sowthistle	<i>Sonchus oleraceus</i>	X	*
Asteraceae	Dandelion	<i>Taraxacum officinale</i>	X	*
Asteraceae	Common Sunray	<i>Triptilodiscus pygmaeus</i>	X	
Asteraceae	A Fuzzweed	<i>Vittadinia cervicalis var. cervicalis</i>	X	
Asteraceae	A Fuzzweed	<i>Vittadinia cuneata var. cuneata</i>	X	
Asteraceae	Golden Everlasting	<i>Xerochrysum bracteatum</i>	X	
Boraginaceae	Patterson's Curse	<i>Echium plantagineum</i>	X	‡ *
Boraginaceae	Viper's Bugloss	<i>Echium vulgare</i>	X	‡ *
Boraginaceae	Blue Heliotrope	<i>Heliotropium amplexicaule</i>	X	‡ *
Brassicaceae	Common Peppergrass	<i>Lepidium africanum</i>	X	*
Brassicaceae	Turnip Weed	<i>Rapistrum rugosum</i>	X	*
Brassicaceae	Charlock	<i>Sinapis arvensis</i>	X	*
Brassicaceae	Indian Hedge Mustard	<i>Sisymbrium orientale</i>	X	*
Cactaceae	Common Prickly Pear	<i>Opuntia stricta var. stricta</i>	X	*
Campanulaceae	Tufted Bluebell	<i>Wahlenbergia communis</i>	X	*
Caryophyllaceae	Mouse-ear Chickweed	<i>Cerastium glomeratum</i>	X	*
Caryophyllaceae	Proliferous Pink	<i>Petrorhagia nanteuillii</i>	X	*
Caryophyllaceae	Common Chickweed	<i>Stellaria media</i>	X	*
Casuarinaceae	River Oak	<i>Casuarina cunninghamiana</i>	P/ X	



Family	Common Name	Scientific Name	Presence	Status
		<i>subsp. cunninghamiana</i>		
Chenopodiaceae	Old Man Salt Bush	<i>Atriplex nummularia</i>	X	*
Chenopodiaceae	Climbing Saltbush	<i>Einadia nutans subsp. nutans</i>	X	*
Convolvulaceae	A Bindweed	<i>Convolvulus spp.</i>	X	*
Convolvulaceae	Kidney Weed	<i>Dichondra repens</i>	X	
Cupressaceae	White Cypress Pine	<i>Callitris glaucophylla</i>	X	
Fabaceae (Faboideae)	Emu-foot	<i>Cullen tenax</i>	X	
Fabaceae (Faboideae)	Burr Medic	<i>Medicago polymorpha</i>	X	*
Fabaceae (Faboideae)	Haresfoot Clover	<i>Trifolium arvense</i>	X	*
Fabaceae (Faboideae)	Hop Clover	<i>Trifolium campestre</i>	X	*
Fabaceae (Faboideae)	White Clover	<i>Trifolium repens</i>	X	*
Fabaceae (Faboideae)	Russian vetch	<i>Vicia villosa subs. glaucescens</i>	X	*
Fabaceae (Mimosoideae)	Green Wattle	<i>Acacia deanei</i>	X	
Fabaceae (Mimosoideae)	Cooba	<i>Acacia salicina</i>	P/ X	
Fabaceae (Mimosoideae)	olden Wreath Wattle	<i>Acacia saligna</i>	P/ X	
Fabaceae (Mimosoideae)		<i>Acacia sp.</i>	X	
Fabaceae (Mimosoideae)	River Cooba	<i>Acacia stenophylla</i>	P/ X	
Fumariaceae	Narrow-leaved Fumitory	<i>Fumaria densiflora</i>	X	*
Geraniaceae	Common Crowfoot	<i>Erodium cicutarium</i>	X	*
Geraniaceae	Blue Crowfoot	<i>Erodium crinitum</i>	X	
Goodeniaceae	Scrambles Eggs	<i>Goodenia pinnatifida</i>	X	
Lamiaceae	Dead Nettle	<i>Lamium amplexicaule</i>	X	*
Lamiaceae	White Horehound	<i>Marrubium vulgare</i>	X	*
Lamiaceae	Vervain	<i>Salvia verbenaca</i>	X	*
Loranthaceae	Grey Mistletoe	<i>Amyema quandang var. quandang</i>	X	*
Malvaceae	Small-flowered Mallow	<i>Malva parviflora</i>	X	*
Malvaceae	Pink Pavonia	<i>Pavonia hastata</i>	X	*
Malvaceae	Flannelweed	<i>Abutilon oxycarpum</i>	X	
Meliaceae	White Cedar	<i>Melia azedarach</i>	X	*
Moraceae	Port Jackson Fig	<i>Ficus rubiginosa f. rubiginosa ??</i>	X	
Myrsinaceae	Scarlet Pimpernel	<i>Anagallis arvensis</i>	X	*
Myrtaceae	Crimson Bottlebrush	<i>Callistemon citrinus</i>	P	
Myrtaceae	White Box	<i>Eucalyptus albens</i>	X	
Myrtaceae	Blakely's Red Gum	<i>Eucalyptus blakelyi</i>	P / X	
Myrtaceae	River Red Gum	<i>Eucalyptus camaldulensis</i>	P	
Myrtaceae	Dirty Gum	<i>Eucalyptus chloroclada</i>	P	
Myrtaceae	Yellow Box	<i>Eucalyptus melliodora</i>	P / X	
Myrtaceae	Bimble Box	<i>Eucalyptus populnea subsp. bimbil</i>	X	
Myrtaceae	Coastal Moort	<i>Eucalyptus utilis</i>	P	
Myrtaceae	Mallee Honey-myrtle	<i>Melaleuca 72cuminata subsp. Acuminata</i>	P	
Myrtaceae	Swamp Paperbark	<i>melaleuca ericifolia</i>	P	
Myrtaceae	Prickly-leaved Teatree	<i>Melaleuca styphelioides</i>	P	

Family	Common Name	Scientific Name	Presence	Status
Myoporaceae		<i>Eremophila sp.</i>	X	
Oxalidaceae	Oxalis	<i>Oxalis perennans</i>	X	
Plantaginaceae	Lamb's Tongue	<i>Plantago lanceolata</i>	X	
Poaceae	Purple Wiregrass	<i>Aristida personata</i>	X	
Poaceae	Plains Grass	<i>Austrostipa aristiglumis</i>	X	
Poaceae	Speargrass	<i>Austrostipa scabra</i>	X	
Poaceae	Slender Bamboo Grass	<i>Austrostipa verticillata</i>	X	
Poaceae	Red Grass	<i>Bothriochloa macra</i>	X	
Poaceae	Sand Brome	<i>Bromus arenarius</i>	X	
Poaceae	Prairie Grass	<i>Bromus catharticus</i>	X	*
Poaceae	Soft Brome	<i>Bromus molliformis</i>	X	*
Poaceae	Rhodes Grass	<i>Chloris gayana</i>	X	
Poaceae	Windmill Grass	<i>Chloris truncata</i>	X	
Poaceae	Tall Chloris	<i>Chloris ventricosa</i>	X	
Poaceae	Common Couch	<i>Cynodon dactylon</i>	X	
Poaceae	Queensland Bluegrass	<i>Dichanthium sericeum</i>	X	
Poaceae	Stinkgrass	<i>Eragrostis cilianensis</i>	X	*
Poaceae	African Lovegrass	<i>Eragrostis curvula</i>	X	*
Poaceae		<i>Eragrostis sp.</i>	X	
Poaceae	Wimmera Ryegrass	<i>Lolium rigidum</i>	X	*
Poaceae	Water Couch	<i>Paspalum distichum</i>	X	
Poaceae	Johnson Grass	<i>Sorghum halepense</i>	X	*‡
Poaceae	Rat's Tail Fescue	<i>Vulpia myuros</i>	X	*
Polygonaceae	Curled Dock	<i>Rumex crispus</i>	X	*
Rosaceae ( Amygdaloideae)	English Laurel	<i>Prunus lauroceras</i>	X	*
Rosaceae ( Amygdaloideae)		<i>Prunus sp*</i>	X	*
Rubiaceae	Cleavers	<i>Galium asperine</i>	X	
Rutaceae	Wilga	<i>Geijera parviflora</i>	X	
Sapindaceae	Western Rosewood	<i>Alectryon oleifolius</i>	X	
Solanaceae	Green Cestrum	<i>Cestrum parqui</i>	X	*‡
Solanaceae	African Box thorn		X	*‡
Sterculiaceae	Kurrajong	<i>Brachychiton populneus subsp. Populneus</i>	X	*
Typhaceae	Cumbungi	<i>Typha sp.</i>	X	
Verbenaceae	Purpletop	<i>Verbena bonariensis</i>	X	*

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 high-time weather conditions and malfunction of the echolocation device were not detected.

**Table 5: Terrestrial Fauna Records in the Study Area.**

Family	Common Name	Scientific Name	Status	Number
Acanthizidae	Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>		
Acanthizidae	Striated Thornbill	<i>Acanthiza lineata</i>		
Acanthizidae	Yellow Thornbill	<i>Acanthiza nana</i>		
Acanthizidae	Buff-rumped Thornbill	<i>Acanthiza reguloides</i>		
Acrocephalus	Australian Reed Warbler,	<i>Acrocephalus australis</i>		
Agamidae	Bearded Dragon	<i>Pogona barbata</i>		
Alcedinidae	Laughing Kookaburra	<i>Dacelo novaeguineae</i>		
Alcedinidae	Sacred Kingfisher	<i>Todiramphus sanctus</i>		
Ardeidae	White-necked Heron	<i>Ardea pacifica</i>		
Artamidae	Pied Butcherbird	<i>Cracticus nigrogularis</i>		
Artamidae	Australian Magpie	<i>Cracticus tibicen</i>		
Artamidae	Pied Currawong	<i>Strepera graculina</i>		
Cacatuidae	Sulphur-crested Cockatoo	<i>Cacatua galerita</i>		
Cacatuidae	Little Corella	<i>Cacatua sanguinea</i>		
Cacatuidae	Galah	<i>Eolophus roseicapillus</i>		
Cacatuidae	Cockatiel	<i>Nymphicus hollandicus</i>		
Campephagidae	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>		
Campephagidae	White-winged Triller	<i>Lalage sueurii</i>		
Columbidae	Bar-shouldered Dove	<i>Geopelia humeralis</i>		
Columbidae	Crested Pigeon	<i>Ocyphaps lophotes</i>		
Columbidae	Common Bronzewing	<i>Phaps chalcoptera</i>		
Columbidae	Spotted Dove	<i>Streptopelia chinensis</i>		



Corvidae	Australian Raven	<i>Corvus coronoides</i>		
Elapidae	Eastern Brown Snake	<i>Pseudonaja textilis</i>		
Estrildidae	Double-barred Finch	<i>Taeniopygia bichenovii</i>		
Hirundinidae	Welcome Swallow	<i>Hirundo neoxena</i>		
Leporidae	Brown Hare	<i>Lepus capensis</i> *	Introduced	
Macropodidae	Eastern Grey Kangaroo	<i>Macropus giganteus</i>		
Maluridae	Variegated Fairy-wren	<i>Malurus lamberti</i>		
Meliphagidae	Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>		
Meliphagidae	Blue-faced Honeyeater	<i>Entomyzon cyanotis</i>		
Meliphagidae	Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>		
Meliphagidae	Fuscous Honeyeater	<i>Lichenostomus fuscus</i>		
Meliphagidae	White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>		
Meliphagidae	Noisy Miner	<i>Manorina melanocephala</i>		
Meliphagidae	Little Friarbird	<i>Philemon citreogularis</i>		
Meliphagidae	Noisy Friarbird	<i>Philemon corniculatus</i>		
Molossidae	Mastiff-bat	<i>Mormopterus sp.</i>		
Molossidae	White-striped Freetail-bat	<i>Tadarida australis</i>		
Monarchidae	Magpie-lark	<i>Grallina cyanoleuca</i>		
Muridae	House Mouse	<i>Mus musculus</i>	Introduced	
Pachycephalidae	Grey Shrike-thrush	<i>Colluricincla harmonica</i>		
Pachycephalidae	Rufous Whistler	<i>Pachycephala rufiventris</i>		
Pardalotidae	Striated Pardalote	<i>Pardalotus striatus</i>		
Passeridae	House Sparrow	<i>Passer domesticus</i>	Introduced	
Phalangeridae	Common Brushtail Possum	<i>Trichosurus vulpecula</i>		
Phascolarctidae	Koala	<i>Phascolarctos cinereus</i>	V TSC Act V EPBC Act	1 Male
Psittacidae	Australian King-Parrot	<i>Alisterus scapularis</i>		
Psittacidae	Little Lorikeet	<i>Glossopsitta pusilla</i>	V TSC Act	50+
Psittacidae	Musk Lorikeet	<i>Glossopsitta concinn</i>		
Psittacidae	Eastern Rosella	<i>Platycercus eximius</i>		
Psittacidae	Red-rumped Parrot	<i>Psephotus haematonotus</i>		
Pteropodidae	Grey-headed Flying Fox	<i>Pteropus poliocephalus</i>	V TSC Act V EPBC Act	~ 20
Rhipiduridae	Grey Fantail	<i>Rhipidura albiscapa</i>		
Rhipiduridae	Willie Wagtail	<i>Rhipidura leucophrys</i>		
Scincidae	Robust Ctenotus	<i>Ctenotus robustus</i>		
Scincidae	Dark-flecked Garden Sunskink	<i>Lampropholis delicata</i>		
Sturnidae	Common Myna	<i>Sturnus tristis</i>	Introduced	
Sturnidae	Common Starling	<i>Sturnus vulgaris</i>	Introduced	
Sturnidae	Black Bird	<i>Turdus merula</i>		
Vespertilionidae	Gould's Wattled Bat	<i>Chalinolobus gouldii</i>		

### 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**).

This equates to an area of approximately 6.5 ha of 'Core Koala Habitat' (941 metres by 70 metres) in the reconstruction Site

The entire length of Blackjack Creek in the Reconstruction Site will however be impacted (approximately 13.3 hectares). However the difference of 6.8 hectares (in its current state) is not considered Koala habitat due to current land-use and clearing.

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 Study Area including evidence of Koala activity in the 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
T3	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
T6	E. blakelyi	236333	6569950	LHV	Yes. Scratch, Scat	Advanced regeneration
T7	E. populnea	236292	6569051	MHV, 3M, 3S		Half dead.
T8	E. populnea	236256	6569000	LHV		Advanced regeneration
T9	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	

Tree Number	Species	Easting	Northing	Habitat/ Hollows	Koala Evidence	Habitat notes
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 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
T36	E. populnea	236338	6569124	MHV, 3M		
T37	E. populnea	236345	6569169	MHV,2M,3S	Yes. Scratch, Scats	Possible Aboriginal Scarred Tree



**Table 7: Additional trees / shrubs advanced regrowth in the Impact Footprint.**

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

## 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 dependant 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);
- Anthropogenic Climate Change,

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.

Tree clearing as a result of the Proposal will contribute to anthropogenic Climate Change (albeit slightly). The Carbon sequestration of older larger trees is greater than those to be planted as part of the proposed rehabilitation. The forecasted increase in maximum temperatures and catastrophic weather events as a result of Climate Change would result in more frequent and intense heat waves. This may contribute to animal deaths associated with heat exhaustion and dehydration.

## **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**.



**Table 8: Species Requiring Significance Assessments Under The TSC, FM And EPBC Act**

Common Name	Scientific Name	TSC Act	FM Act	EPBC Act
Little Pied Bat	<i>Chalinolobus picatus</i>	7- Part Test		
Corben's Long-eared Bat	<i>Nyctophilus corbeni</i>	7- Part Test		Assessment of Significance
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	7- Part Test		
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	7- Part Test		
Koala	<i>Phascolarctos cinereus</i>	7- Part Test		Assessment of Significance
Little Lorikeet	<i>Glossopsitta pusilla</i>	7- Part Test		
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	7- Part Test		Assessment of Significance
Barking Owl	<i>Ninox connivens</i>	7- Part Test		
Powerful Owl	<i>Ninox strenua</i>	7- Part Test		

## **8. BIODIVERSITY AND HABITAT OFFSETS**

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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**

Should the proposal go ahead, the following Biodiversity Offsets should be implemented:

1. Habitat values (small, medium and large hollows) of hollow bearing trees are to be replaced at a 1:1 ratio with nest boxes of equivalent size. 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. OEH 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. These nest boxes:
  - a) Are to be maintained until plantings reach a suitable size;

- b) Should be placed in adjacent appropriate habitat as identified in consultation with the National Parks and Wildlife Service;
- 2. 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.
- a) 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 offsetting of subsequent developments in future.
    - g) 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.

1. 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.
  - b) As part of the KPoM a site induction of all personnel should occur, to ensure that koalas are protected within the Reconstruction Site.
4. 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) A suitable qualified person able to identify Koalas will ensure that no Koalas are located in trees to be felled or pruned, or in trees with overlapping crowns. Searches will be conducted prior to every tree removal. Searches will be overseen and checked off by the Project Manager. Where a Koala is present, Koalas will be allowed to move out of trees that are to be cleared or pruned on their own accord, generally over night.
  - e) 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. An increased risk of vehicle collision exists within and directly adjacent to the Reconstruction Site during the construction phase of the Action. A significant increase of vehicular (including plant machinery) movements throughout the Reconstruction Site may occur during this period.
- a) All machinery within the reconstruction Site will be speed limited to a maximum of 20 km/h to reduce the risk of collision with koalas.
  - b) Fencing off the Reconstruction Site may assist in preventing Koala access to the site.
7. 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.
8. 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.
9. Ensure all sprays are waterway friendly as per NSW DPI guidelines.
10. Ongoing weed control should be undertaken in disturbed areas.
11. 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).
12. Progressive rehabilitation of the Study Area would be staged after the completion of each installation stage.

13. Retention of top soil should occur where possible to maintain a viable seed bank and respread after channel construction,
14. Soil should be respread as soon as possible after trenching in order to maximise its fertility, seed viability and microbial activity.
15. 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*.
16. 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.)
17. 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.
18. Rehabilitation of disturbed areas and riparian vegetation will occur along the length of Blackjack Creek in the Reconstruction Site. Trees to be planted as part of the riparian rehabilitation will include River Red Gum (*Eucalyptus cameldulensis*), a preferred Koala feed tree.
19. Implement the proposed biodiversity offset for the Study Area as described in **Section 8.2.**



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## **APPENDIX 1: DATABASE SEARCH RESULTS**

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## OEH Threatened Species Database Results for Namoi (Liverpool Plains Part B) CMA

Scientific name	Common name	Type of species	NSW status	Occurrence
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	Animal > Bats	Vulnerable	Known
<i>Chalinolobus picatus</i>	Little Pied Bat	Animal > Bats	Vulnerable	Known
<i>Nyctophilus corbeni</i>	Corben's Long-eared Bat	Animal > Bats	Vulnerable	Known
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	Animal > Bats	Vulnerable	Known
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	Animal > Bats	Vulnerable	Known
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	Animal > Bats	Vulnerable	Known
<i>Anseranas semipalmata</i>	Magpie Goose	Animal > Birds	Vulnerable	Predicted
<i>Ardeotis australis</i>	Australian Bustard	Animal > Birds	Endangered	Known
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Animal > Birds	Endangered	Predicted
<i>Burhinus grallarius</i>	Bush Stone-curlew	Animal > Birds	Endangered	Known
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	Animal > Birds	Vulnerable	Known
<i>Certhionyx variegatus</i>	Pied Honeyeater	Animal > Birds	Vulnerable	Known
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	Animal > Birds	Vulnerable	Known
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	Animal > Birds	Endangered	Known
<i>Falco hypoleucos</i>	Grey Falcon	Animal > Birds	Endangered	Known
<i>Grus rubicunda</i>	Brolga	Animal > Birds	Vulnerable	Predicted
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard	Animal > Birds	Vulnerable	Known
<i>Limosa limosa</i>	Black-tailed Godwit	Animal > Birds	Vulnerable	Predicted
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	Animal > Birds	Vulnerable	Known
<i>Ninox strenua</i>	Powerful Owl	Animal > Birds	Vulnerable	Predicted
<i>Polytelis swainsonii</i>	Superb Parrot	Animal > Birds	Vulnerable	Known
<i>Pomastostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	Animal > Birds	Vulnerable	Known
<i>Tyto longimembris</i>	Eastern Grass Owl	Animal > Birds	Vulnerable	Known
<i>Grantiella picta</i>	Painted Honeyeater	Animal > Birds	Vulnerable	Known
<i>Lathamus discolor</i>	Swift Parrot	Animal > Birds	Endangered	Known
<i>Leipoa ocellata</i>	Malleefowl	Animal > Birds	Endangered	Known



<i>Lophoictinia isura</i>	Square-tailed Kite	Animal > Birds	Vulnerable	Known
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	Animal > Birds	Vulnerable	Known
<i>Neophema pulchella</i>	Turquoise Parrot	Animal > Birds	Vulnerable	Known
<i>Ninox connivens</i>	Barking Owl	Animal > Birds	Vulnerable	Known
<i>Oxyura australis</i>	Blue-billed Duck	Animal > Birds	Vulnerable	Known
<i>Chthonicola sagittata</i>	Speckled Warbler	Animal > Birds	Vulnerable	Known
<i>Rostratula australis</i>	Australian Painted Snipe	Animal > Birds	Endangered	Known
<i>Stagonopleura guttata</i>	Diamond Firetail	Animal > Birds	Vulnerable	Known
<i>Stictonetta naevosa</i>	Freckled Duck	Animal > Birds	Vulnerable	Known
<i>Tyto novaehollandiae</i>	Masked Owl	Animal > Birds	Vulnerable	Known
<i>Anthochaera phrygia</i>	Regent Honeyeater	Animal > Birds	Critically Endangered	Known
<i>Glossopsitta pusilla</i>	Little Lorikeet	Animal > Birds	Vulnerable	Known
<i>Petroica phoenicea</i>	Flame Robin	Animal > Birds	Vulnerable	Predicted
<i>Petroica boodang</i>	Scarlet Robin	Animal > Birds	Vulnerable	Known
<i>Alectura lathamii</i> - endangered population	Australian Brush-turkey population in the Nandewar and Brigalow Belt South Bioregions	Animal > Birds	Endangered Population	Known
<i>Hieraaetus morphnoides</i>	Little Eagle	Animal > Birds	Vulnerable	Known
<i>Circus assimilis</i>	Spotted Harrier	Animal > Birds	Vulnerable	Known
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Animal > Birds	Vulnerable	Known
<i>Epthianura albifrons</i>	White-fronted Chat	Animal > Birds	Vulnerable	Known
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	Animal > Marsupials	Vulnerable	Known
<i>Macropus dorsalis</i>	Black-striped Wallaby	Animal > Marsupials	Endangered	Known
<i>Petaurus norfolcensis</i>	Squirrel Glider	Animal > Marsupials	Vulnerable	Known
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	Animal > Marsupials	Vulnerable	Known
<i>Phascolarctos cinereus</i>	Koala	Animal > Marsupials	Vulnerable	Known

<i>Sminthopsis macroura</i>	Stripe-faced Dunnart	Animal > Marsupials	Vulnerable	Predicted
<i>Aepyprymnus rufescens</i>	Rufous Bettong	Animal > Marsupials	Vulnerable	Predicted
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	Animal > Marsupials	Vulnerable	Known
<i>Petaurus australis</i>	Yellow-bellied Glider	Animal > Marsupials	Vulnerable	Predicted
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	Animal > Marsupials	Endangered	Known
<i>Perameles bougainville fasciata</i>	Western Barred Bandicoot (mainland)	Animal > Marsupials	Extinct	Known
<i>Lagorchestes leporides</i>	Eastern Hare-wallaby	Animal > Marsupials	Extinct	Known
<i>Onychogalea fraenata</i>	Bridled Nailtail Wallaby	Animal > Marsupials	Extinct	Known
<i>Dasyurus geoffroii</i>	Western Quoll	Animal > Marsupials	Extinct	Known
<i>Bettongia penicillata penicillata</i>	Brush-tailed Bettong (South-East Mainland)	Animal > Marsupials	Extinct	Known
<i>Aprasia parapulchella</i>	Pink-tailed Legless Lizard	Animal > Reptiles	Vulnerable	Known
<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake	Animal > Reptiles	Vulnerable	Known
<i>Underwoodisaurus sphyrurus</i>	Border Thick-tailed Gecko	Animal > Reptiles	Vulnerable	Known
<i>Rattus villosissimus</i>	Long-haired Rat	Animal > Rodents	Vulnerable	Known
<i>Pseudomys pilligaensis</i>	Pilliga Mouse	Animal > Rodents	Vulnerable	Predicted
<i>Pseudomys australis</i>	Plains Rat	Animal > Rodents	Extinct	Known
<i>Conilurus albipes</i>	White-footed Tree-rat	Animal > Rodents	Extinct	Known
<i>Pseudomys gouldii</i>	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 Peppergrass	Plant > Herbs and Forbs	Vulnerable	Known
Thesium australe	Austral Toadflax	Plant > Herbs and Forbs	Vulnerable	Known



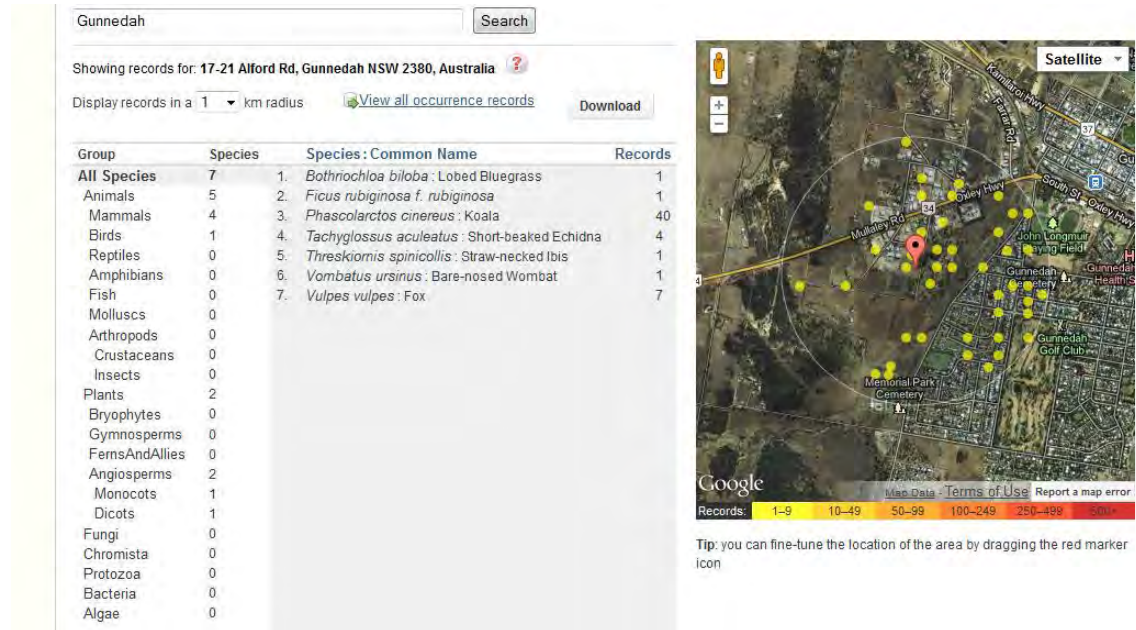
Homopholis belsonii	Belson's Panic	Plant > Herbs and Forbs	Endangered	Known
Cyperus conicus	Cyperus conicus	Plant > Herbs and Forbs	Endangered	Predicted
Digitaria porrecta	Finger Panic Grass	Plant > Herbs and Forbs	Endangered	Known
Swainsona murrayana	Slender Darling Pea	Plant > Herbs and Forbs	Vulnerable	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, <i>Apis mellifera</i> L.	Competition from feral honeybees	Threat > Pest Animal	Key Threatening Process	Predicted
Invasion of the Yellow Crazy Ant, <i>Anoplolepis gracilipes</i> (Fr. Smith) into NSW	Invasion of the yellow crazy ant ( <i>Anoplolepis gracilipes</i> ) into NSW	Threat > Pest Animal	Key Threatening Process	Predicted
Competition and habitat degradation by Feral Goats, <i>Capra hircus</i> Linnaeus 1758	Competition and habitat degradation by Feral Goats, <i>Capra hircus</i> Linnaeus 1758	Threat > Pest Animal	Key Threatening Process	Predicted
Invasion and establishment of the Cane Toad ( <i>Bufo marinus</i> )	Invasion and establishment of the Cane Toad	Threat > Pest Animal	Key Threatening Process	Predicted
Predation and hybridisation by Feral Dogs, <i>Canis lupus familiaris</i>	Predation and hybridisation by Feral Dogs, <i>Canis lupus familiaris</i>	Threat > Pest Animal	Key Threatening Process	Predicted
Introduction of the Large Earth Bumblebee <i>Bombus terrestris</i> (L.)	Introduction of the large earth bumblebee ( <i>Bombus terrestris</i> )	Threat > Pest Animal	Key Threatening Process	Predicted
Predation by the Feral Cat <i>Felis catus</i> (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 <i>Vulpes Vulpes</i> (Linnaeus, 1758)	Predation by the European Red Fox	Threat > Pest Animal	Key Threatening Process	Predicted
Predation by <i>Gambusia holbrooki</i> Girard, 1859 (Plague Minnow or Mosquito Fish)	Predation by the Plague Minnow ( <i>Gambusia holbrooki</i> )	Threat > Pest Animal	Key Threatening Process	Predicted
Predation, habitat degradation, competition and disease transmission by Feral Pigs, <i>Sus scrofa</i> Linnaeus 1758	Predation, habitat degradation, competition and disease transmission by Feral Pigs ( <i>Sus scrofa</i> )	Threat > Pest Animal	Key Threatening Process	Predicted
Importation of Red Imported Fire Ants <i>Solenopsis invicta</i> 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, <i>Oryctolagus cuniculus</i> (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 <i>Chrysanthemoides monilifera</i>	Invasion of native plant communities by bitou bush & boneseed	Threat > Weed	Key Threatening Process	Predicted
Invasion, establishment and spread of Lantana ( <i>Lantana camara</i> L. sens. Lat)	Invasion, establishment and spread of Lantana ( <i>Lantana camara</i> 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 <i>Olea europaea</i> L. subsp. <i>cuspidata</i> (Wall ex G. Don Cirferri)	Invasion of native plant communities by African Olive <i>Olea europaea</i> L. subsp. <i>cuspidata</i> (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 ( <i>Cytisus scoparius</i> )	Invasion and establishment of Scotch Broom ( <i>Cytisus scoparius</i> )	Threat > Weed	Key Threatening Process	Predicted



## Bionet/ Wildlife Atlas Licensed Search Results



## 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 [Environment Assessments](#) 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  
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[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 [Administrative Guidelines on Significance](#).

<a href="#">World Heritage Properties:</a>	None
<a href="#">National Heritage Places:</a>	None
<a href="#">Wetlands of International Importance:</a>	None
<a href="#">Great Barrier Reef Marine Park:</a>	None
<a href="#">Commonwealth Marine Areas:</a>	None
<a href="#">Listed Threatened Ecological Communities:</a>	5
<a href="#">Listed Threatened Species:</a>	20
<a href="#">Listed Migratory Species:</a>	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 [heritage values](#) of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place 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.

<a href="#">Commonwealth Land:</a>	1
<a href="#">Commonwealth Heritage Places:</a>	None
<a href="#">Listed Marine Species:</a>	10
<a href="#">Whales and Other Cetaceans:</a>	None
<a href="#">Critical Habitats:</a>	None
<a href="#">Commonwealth Reserves:</a>	None



## Extra Information

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

<a href="#">Place on the RNE:</a>	2
<a href="#">State and Territory Reserves:</a>	None
<a href="#">Regional Forest Agreements:</a>	None
<a href="#">Invasive Species:</a>	10
<a href="#">Nationally Important Wetlands:</a>	None
<a href="#">Key Ecological Features (Marine)</a>	None

## Details

### Matters of National Environmental Significance

#### Listed Threatened Ecological Communities

#### [ Resource Information ]

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
<a href="#">Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions</a>	Endangered	Community may occur within area
<a href="#">Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia</a>	Endangered	Community may occur within area
<a href="#">Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland</a>	Critically Endangered	Community likely to occur within area
<a href="#">Weeping Myall Woodlands</a>	Endangered	Community may occur within area
<a href="#">White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland</a>	Critically Endangered	Community likely to occur within area

#### Listed Threatened Species

#### [ Resource Information ]

Name	Status	Type of Presence
<b>Birds</b>		
<a href="#">Anthochaera phrygia</a>		
Regent Honeyeater [82338]	Endangered	Species or species habitat may occur within area
<a href="#">Geophaps scripta scripta</a>		
Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat may occur within area
<a href="#">Lathamus discolor</a>		
Swift Parrot [744]	Endangered	Species or species habitat may occur within area
<a href="#">Leipoa ocellata</a>		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
<a href="#">Polytelis swainsonii</a>		
Superb Parrot [738]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
<a href="#">Rostratula australis</a> Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
<b>Fish</b>		
<a href="#">Maccullochella peelii</a> Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
<b>Frogs</b>		
<a href="#">Litoria booroolongensis</a> Booroolong Frog [1844]	Endangered	Species or species habitat may occur within area
<b>Mammals</b>		
<a href="#">Chalinolobus dwyeri</a> Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
<a href="#">Nyctophilus corbeni</a> South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
<a href="#">Petrogale penicillata</a> Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
<a href="#">Phascogale cinereus (combined populations of Qld, NSW and the ACT)</a> Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
<b>Plants</b>		
<a href="#">Digitaria porrecta</a> Finger Panic Grass [12768]	Endangered	Species or species habitat likely to occur within area
<a href="#">Phyllothea ericifolia</a> [64942]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Prasophyllum sp. Wybong (C.Phelps ORG 5269)</a> a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Pterostylis cobarensis</a> Cobar Greenhood Orchid [12993]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Swainsona murrayana</a> Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Thesium australe</a> Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Tylophora linearis</a> [55231]	Endangered	Species or species habitat may occur within area
<b>Reptiles</b>		
<a href="#">Aprasia parapulchella</a> Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat known to occur within area
<b>Listed Migratory Species</b>		<b>[ Resource Information ]</b>
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
<b>Migratory Marine Birds</b>		
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species

Name	Threatened	Type of Presence
<a href="#">Ardea alba</a> Great Egret, White Egret [59541]		habitat likely to occur within area  Species or species habitat may occur within area
<a href="#">Ardea ibis</a> Cattle Egret [59542]		Species or species habitat may occur within area
<b>Migratory Terrestrial Species</b>		
<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
<a href="#">Hirundapus caudacutus</a> White-throated Needletail [682]		Species or species habitat may occur within area
<a href="#">Leipoa ocellata</a> Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]		Species or species habitat may occur within area
<a href="#">Myiagra cyanoleuca</a> Satin Flycatcher [612]		Species or species habitat may occur within area
<a href="#">Xanthomyza phrygia</a> Regent Honeyeater [430]	Endangered*	Species or species habitat may occur within area
<b>Migratory Wetlands Species</b>		
<a href="#">Ardea alba</a> Great Egret, White Egret [59541]		Species or species habitat may occur within area
<a href="#">Ardea ibis</a> Cattle Egret [59542]		Species or species habitat may occur within area
<a href="#">Gallinago hardwickii</a> Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
<a href="#">Rostratula benghalensis (sensu lato)</a> 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 the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Telecommunications Commission

**Listed Marine Species** [\[ Resource Information \]](#)

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

Name	Threatened	Type of Presence
<b>Birds</b>		
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species



Name	Threatened	Type of Presence
<a href="#">Ardea alba</a> Great Egret, White Egret [59541]		habitat likely to occur within area  Species or species habitat may occur within area
<a href="#">Ardea ibis</a> Cattle Egret [59542]		Species or species habitat may occur within area
<a href="#">Gallinago hardwickii</a> Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
<a href="#">Hirundapus caudacutus</a> White-throated Needletail [682]		Species or species habitat may occur within area
<a href="#">Lathamus discolor</a> Swift Parrot [744]	Endangered	Species or species habitat may occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]		Species or species habitat may occur within area
<a href="#">Myiagra cyanoleuca</a> Satin Flycatcher [612]		Species or species habitat may occur within area
<a href="#">Rostratula benghalensis (sensu lato)</a> Painted Snipe [889]	Vulnerable*	Species or species 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		
<a href="#">Gunnedah General Cemetery</a>	NSW	Indicative Place
<a href="#">Gunnedah Railway Station</a>	NSW	Registered
Invasive Species		[ Resource Information ]
Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.		
Name	Status	Type of Presence
Mammals		
<a href="#">Capra hircus</a> Goat [2]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
<a href="#"><u>Felis catus</u></a> Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
<a href="#"><u>Oryctolagus cuniculus</u></a> Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
<a href="#"><u>Sus scrofa</u></a> Pig [6]		Species or species habitat likely to occur within area
<a href="#"><u>Vulpes vulpes</u></a> Red Fox, Fox [18]		Species or species habitat likely to occur within area
<b>Plants</b>		
<a href="#"><u>Lycium ferocissimum</u></a> African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within area
<a href="#"><u>Pinus radiata</u></a> Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
<a href="#"><u>Rubus fruticosus aggregate</u></a> Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
<a href="#"><u>Salix spp. except S.babylonica, S.x calodendron &amp; S.x reichardtii</u></a> Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
<a href="#"><u>Tamarix aphylla</u></a> Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

## 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**

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**7-part tests (TSC Act) for the Koala, Powerful Owl and Barking Owl.**

7-Part Test Criteria	Koala <i>Phascolarctos cinereus</i>	Powerful Owl, Barking Owl
<p>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.</p>	<ul style="list-style-type: none"> <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. The Gunnedah Koala population is both 'regionally significant' (Crowther et al. 2009) and 'nationally significant' (DSEWPac 2010). In 2010 the Koala population in Gunnedah region due to revegetation was inferred to be approximately 3000.</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 (<i>E. albens</i>) is a preferred feed tree in the region, while Blakely's Red Gum (<i>Eucalyptus blakelyi</i>), Tumbledown Red Gum (<i>E. dealbata</i>), White Cypress Pine (<i>Callitris glaucophylla</i>), Bimble Box, and Narrow-leaved Grey Box (<i>E. microcarpa-pilligaensis</i>) 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.</li> <li>A viable local population is considered to occur in the Study Area due to the abundance of evidence (scats and</li> </ul>	<ul style="list-style-type: none"> <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 Test Criteria	Koala <i>Phascolarctos cinereus</i>	Powerful Owl, Barking Owl
	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 associated with 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.	<ul style="list-style-type: none"> <li>• Not relevant</li> </ul>	<ul style="list-style-type: none"> <li>• Not relevant</li> </ul>
3) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: (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 (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,	<ul style="list-style-type: none"> <li>• Not relevant</li> </ul>	<ul style="list-style-type: none"> <li>• Not relevant</li> </ul>
4) in relation to habitat of a threatened species, population or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and (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 (iii) the importance of the habitat to be	<ul style="list-style-type: none"> <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 style="list-style-type: none"> <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 <i>Phascolarctos cinereus</i>	Powerful Owl, Barking Owl
removed, modified, fragmented or isolated to the long-term survival of the 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 style="list-style-type: none"> <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>	<ul style="list-style-type: none"> <li>• Critical habitat for these species has not been declared.</li> </ul>
6) whether the actions proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.	<ul style="list-style-type: none"> <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 style="list-style-type: none"> <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 style="list-style-type: none"> <li>• Schedule 4 of the TSC Act currently lists 36 key threatening processes.</li> <li>• Of these, <i>Anthropogenic Climate Change, Clearing of Native Vegetation, Forest Eucalypt Dieback associated with over-abundant psyllids and bell miners, High Frequency Fire Resulting in the Disruption of Life Cycle Processes in Plants and Animals and Loss of Vegetation Structure and Composition and Predation by the European Red Fox Vulpes vulpes</i> are relevant to the Koala. In addition to these listed key threatening processes, a range of other processes are recognised as threatening the survival of the Koala in NSW.</li> <li>• The removal of trees is likely to increase the koalas vulnerability to foxes during periods of movement along the ground.</li> <li>• Tree clearing as a result of the Proposal will contribute to anthropogenic Climate Change (albeit slightly). The Carbon sequestration of older larger trees is greater than those to be planted as part of the proposed rehabilitation. Climate change will have an unknown affect on the Gunnedah Koala</li> </ul>	<ul style="list-style-type: none"> <li>• As per the left hand column.</li> </ul>

7-Part Test Criteria	Koala <i>Phascolarctos cinereus</i>	Powerful Owl, Barking Owl
	population. The forecasted increase in maximum temperatures and catastrophic weather events as a result of Climate Change would result in more frequent and intense heat waves. This may contribute to Koala deaths associated with heat exhaustion and dehydration.	
Conclusion	<ul style="list-style-type: none"> <li>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.</li> </ul>	<ul style="list-style-type: none"> <li>The proposal will directly remove suitable breeding habitat. However due to the absence of recording these species in the Study Area, disturbance in the Study Are and highly mobile nature of these species, habitat in the Study Area cannot be considered critical to the survival of the species. 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.</li> </ul>



**7-part tests (TSC Act) for Hollow Dependant Microbats and the Little Lorikeet.**

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 style="list-style-type: none"> <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 or result in a decline 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>	<ul style="list-style-type: none"> <li>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.</li> </ul>
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.	<ul style="list-style-type: none"> <li>Not relevant</li> </ul>	<ul style="list-style-type: none"> <li>Not relevant</li> </ul>
3) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: (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 (ii) is likely to substantially and adversely modify the composition of the ecological community such that its	<ul style="list-style-type: none"> <li>Not relevant</li> </ul>	<ul style="list-style-type: none"> <li>Not relevant</li> </ul>

7-Part Test Criteria	Microbats	Little Lorikeet
local occurrence is likely to be placed at risk of extinction,		
4) in relation to habitat of a threatened species, population or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and (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 (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.	<ul style="list-style-type: none"> <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 style="list-style-type: none"> <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).	<ul style="list-style-type: none"> <li>• Critical Habitats do not occur in the locality.</li> </ul>	<ul style="list-style-type: none"> <li>• Critical habitat for this species has not been declared.</li> </ul>
6) whether the actions proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.	<ul style="list-style-type: none"> <li>• 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).</li> </ul>	<ul style="list-style-type: none"> <li>• No recovery plan exists for this 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 style="list-style-type: none"> <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 (<i>Vulpes vulpes</i>) and Predation by the feral cat (<i>Felis catus</i>), have or are currently occurring with Study Area.</li> </ul>	<ul style="list-style-type: none"> <li>• As per left hand column</li> </ul>
Conclusion	<ul style="list-style-type: none"> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>

**DSEWPaC Assessment of significance the Koala and Greater Long-eared Bat**

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it would:	<i>Koala</i>	Greater Long-eared Bat (V) EPBC Act 1999.
<ul style="list-style-type: none"> <li>lead to a long-term decrease in the size of an important population, or</li> </ul>	<ul style="list-style-type: none"> <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. 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 style="list-style-type: none"> <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 style="list-style-type: none"> <li>reduce the area of occupancy of an important population, or</li> </ul>	<ul style="list-style-type: none"> <li>The Proposal will not reduce an area of occupancy.</li> </ul>	<ul style="list-style-type: none"> <li>The potential population of Greater Long-eared Bat in the Study Area is not considered an important population.</li> </ul>
<ul style="list-style-type: none"> <li>fragment an existing important population into two or more populations, or</li> </ul>	<ul style="list-style-type: none"> <li>The proposal will not fragment an existing important population into two or more populations.</li> </ul>	<ul style="list-style-type: none"> <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 style="list-style-type: none"> <li>adversely affect habitat critical<sup>2</sup> to the survival of a species, or</li> </ul>	<ul style="list-style-type: none"> <li>The Proposal is situated within Core Koala Habitat. Core Koala Habitat is considered critical to the survival of the species.</li> </ul>	<ul style="list-style-type: none"> <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>

<sup>2</sup> Habitat critical to the survival of a species refers to:  
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  
ii) areas that are necessary:  
- 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.



An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it would:	<i>Koala</i>	Greater Long-eared Bat (V) EPBC Act 1999.
		<p>Relatively small areas of foraging and roosting cannot be considered critical to the survival of the species in context with the broader landscape.</p> <ul style="list-style-type: none"> <li>It is unlikely that the action will adversely affect habitat critical to the survival of the species.</li> </ul>
<ul style="list-style-type: none"> <li>disrupt the breeding cycle of a population, or</li> </ul>	<ul style="list-style-type: none"> <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 style="list-style-type: none"> <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 style="list-style-type: none"> <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 style="list-style-type: none"> <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 style="list-style-type: none"> <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 style="list-style-type: none"> <li>result in invasive species that are harmful to a vulnerable species becoming established in the species habitat, or</li> </ul>	<ul style="list-style-type: none"> <li>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.</li> </ul>	<ul style="list-style-type: none"> <li>It is unlikely that further invasive species that are harmful to the Greater Long-eared Bat would become established.</li> </ul>
<ul style="list-style-type: none"> <li>interferes substantially with the recovery of the species.</li> </ul>	<ul style="list-style-type: none"> <li>The Proposal has the potential to interfere with the recovery of the species.</li> </ul>	<ul style="list-style-type: none"> <li>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.</li> </ul>
<ul style="list-style-type: none"> <li>Conclusion</li> </ul>	<ul style="list-style-type: none"> <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 style="list-style-type: none"> <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:	<i>Koala</i>	Greater Long-eared Bat (V) EPBC Act 1999.
	<ul style="list-style-type: none"><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**

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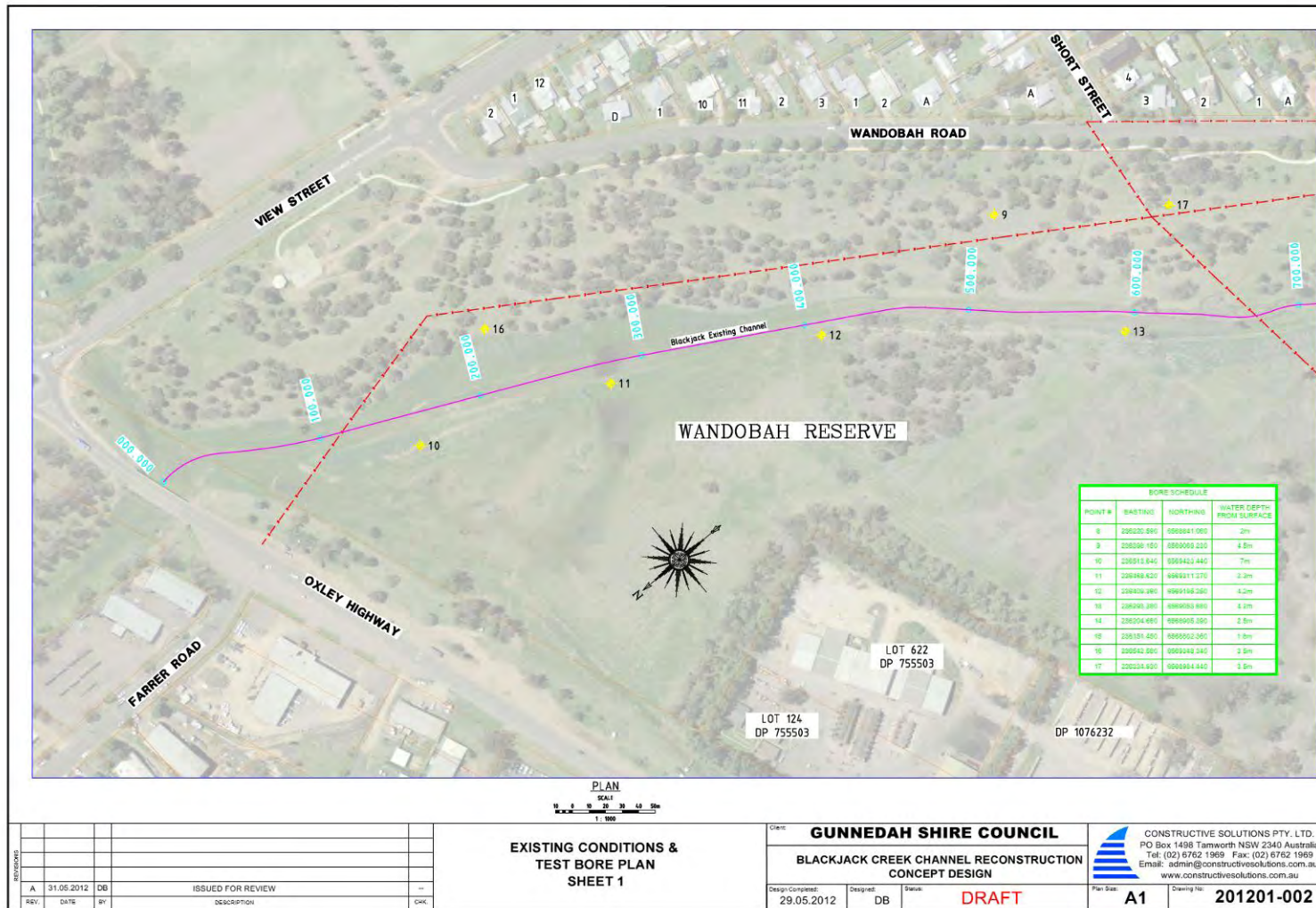




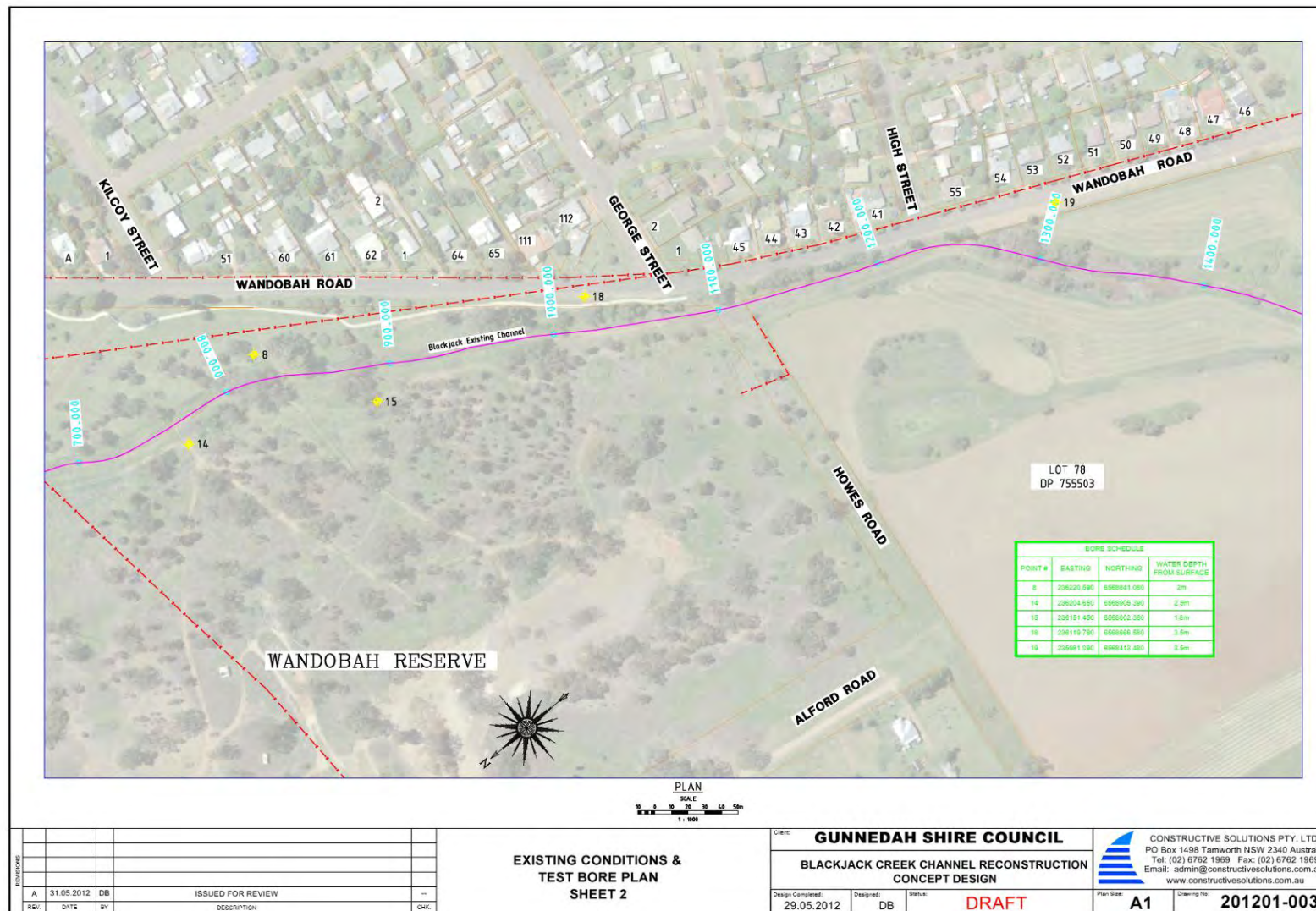
# GUNNEDAH SHIRE COUNCIL CONCEPT DESIGN FOR BLACKJACK CREEK RIPARIAN CORRIDOR / CHANNEL RECONSTRUCTION

SHEET NUMBER	DESCRIPTION
201201-001	COVER SHEET & SHEET INDEX
201201-002	EXISTING CONDITIONS & TEST BORE PLAN SHEET 1
201201-003	EXISTING CONDITIONS & TEST BORE PLAN SHEET 2
201201-004	EXISTING CONDITIONS & TEST BORE PLAN SHEET 3
201201-005	EXISTING CHANNEL LONGITUDINAL SECTION & TYPICAL SECTIONS
201201-006	PLAN & LONGITUDINAL SECTION CH 17.24 - CH 728.77
201201-007	PLAN & LONGITUDINAL SECTION CH 728.77 - CH 1471.81
201201-008	PLAN & LONGITUDINAL SECTION CH 1471.91 - CH 1865.93
201201-009	CROSS SECTIONS CH 17.272 - CH 339.050
201201-010	CROSS SECTIONS CH 438.319 - CH 728.773
201201-011	CROSS SECTIONS CH 859.206 - CH 1152.828
201201-012	CROSS SECTIONS CH 1245.550 - CH 1564.855
201201-013	CROSS SECTIONS CH 1649.961 - CH 1865.928
201201-014	CORE RIPARIAN ZONE - SHEET 1
201201-015	CORE RIPARIAN ZONE - SHEET 2
201201-016	CORE RIPARIAN ZONE - SHEET 3
201201-017	RIPARIAN RESTORATION ZONE DEFINITIONS - SHEET 1
201201-018	RIPARIAN RESTORATION ZONE DEFINITIONS - SHEET 2
201201-019	RIPARIAN RESTORATION ZONE DEFINITIONS - SHEET 3

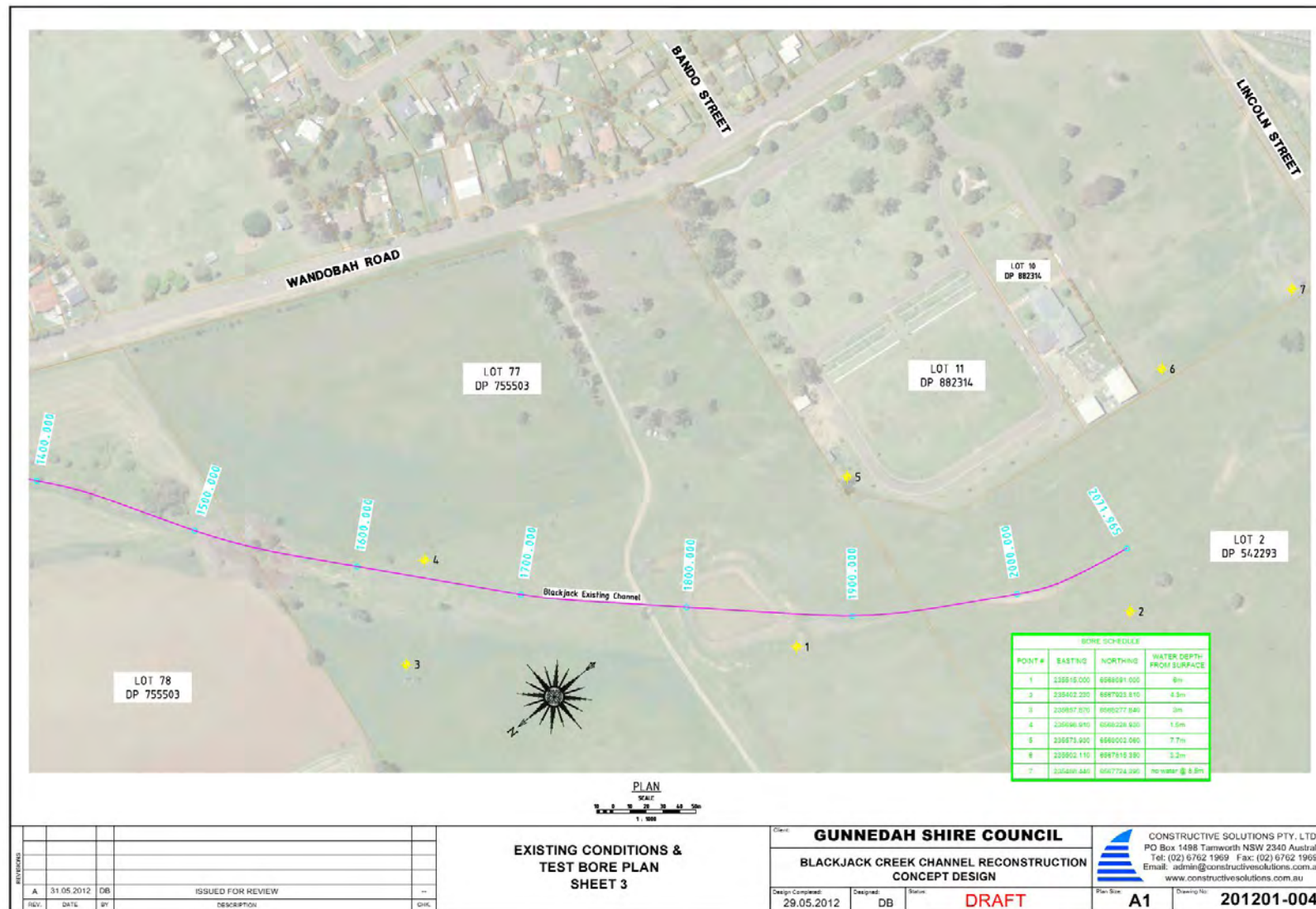
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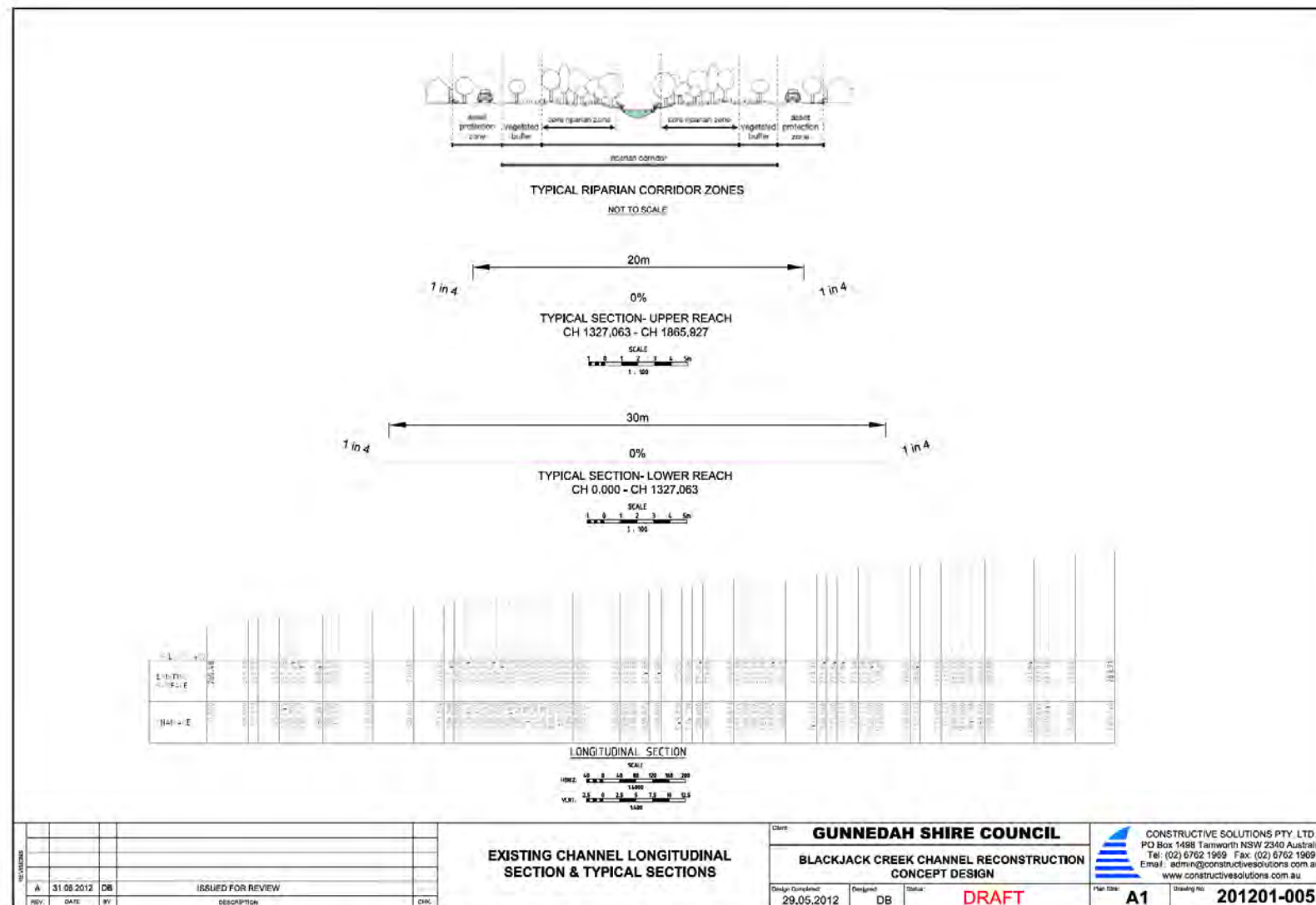




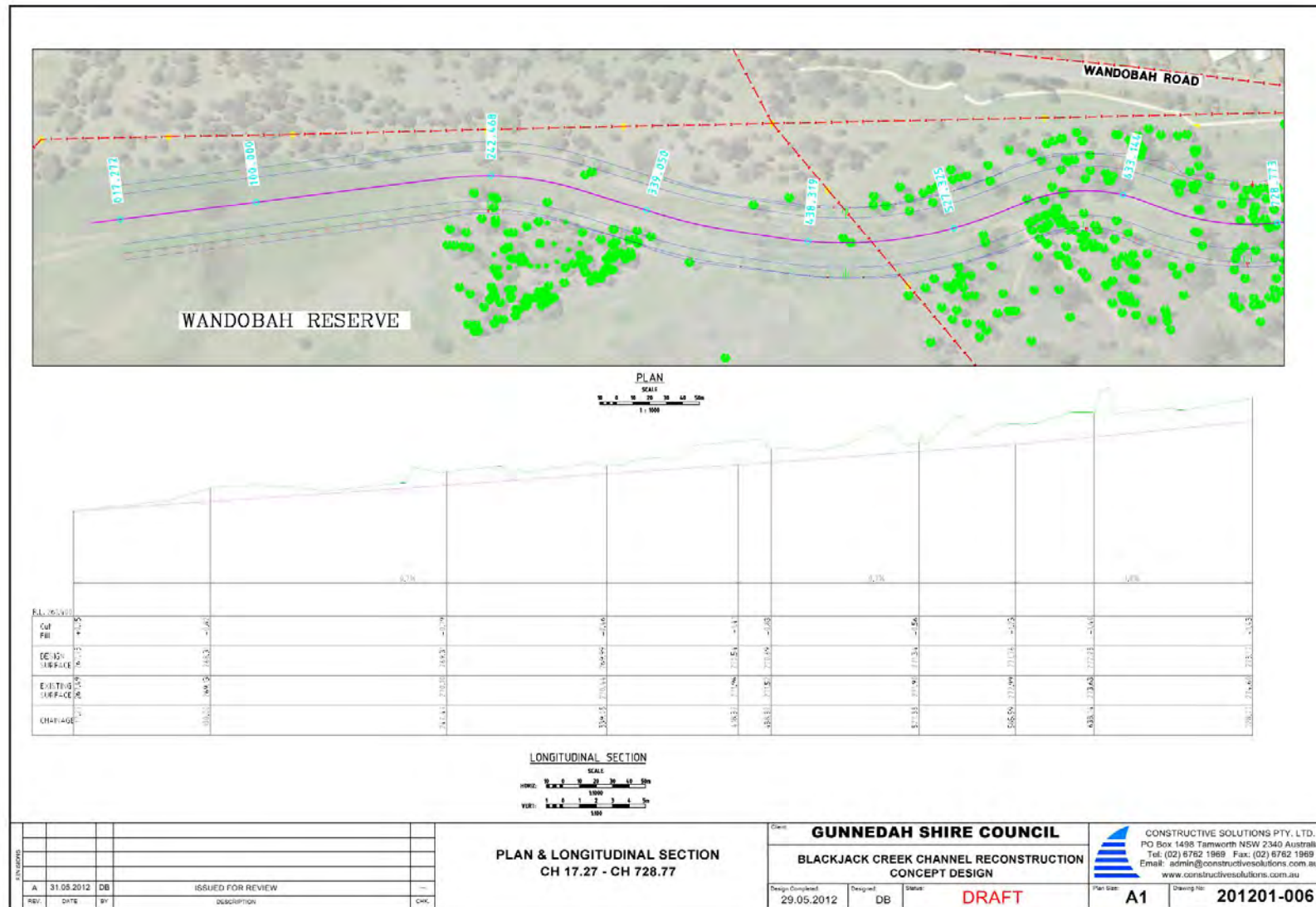




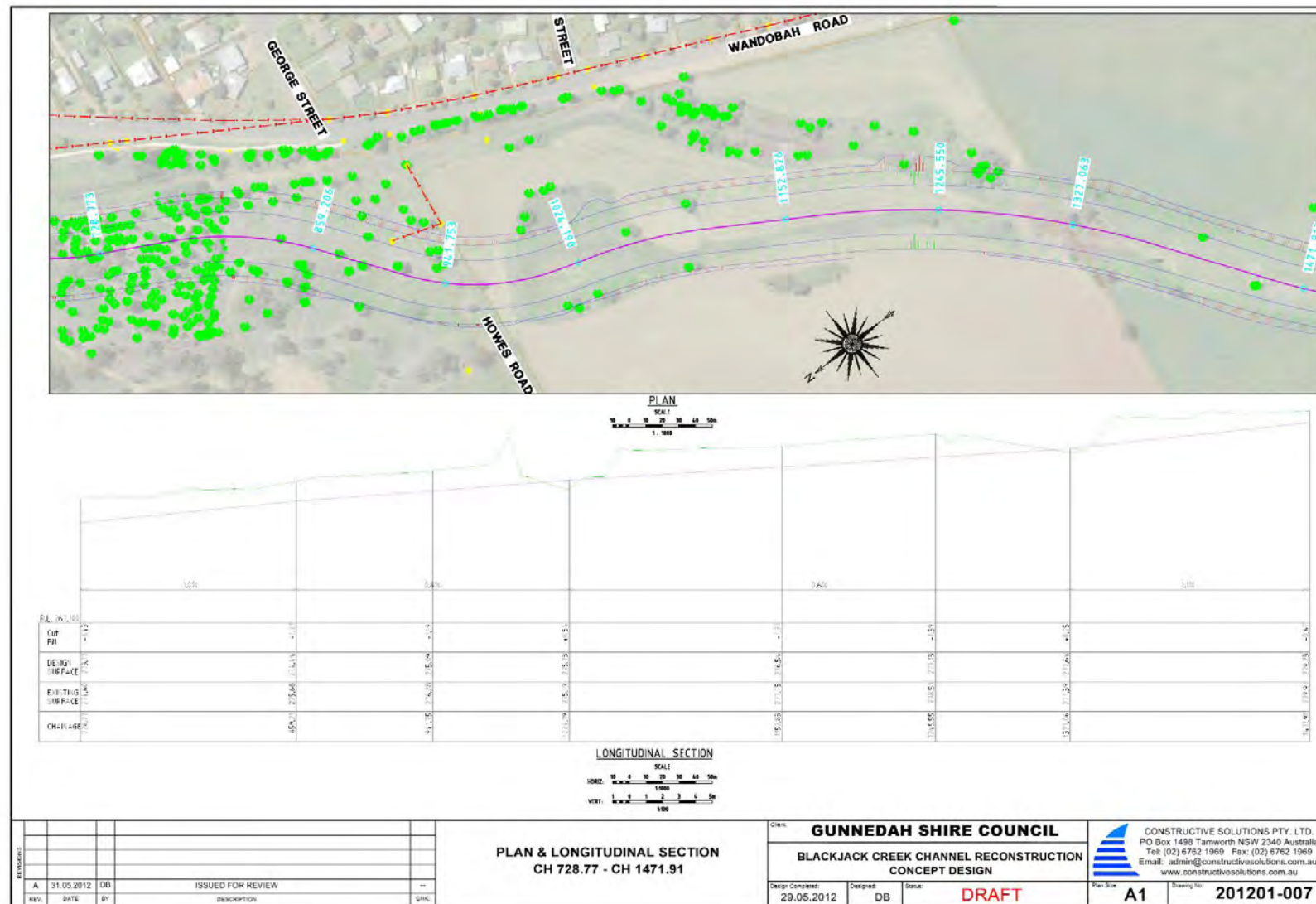


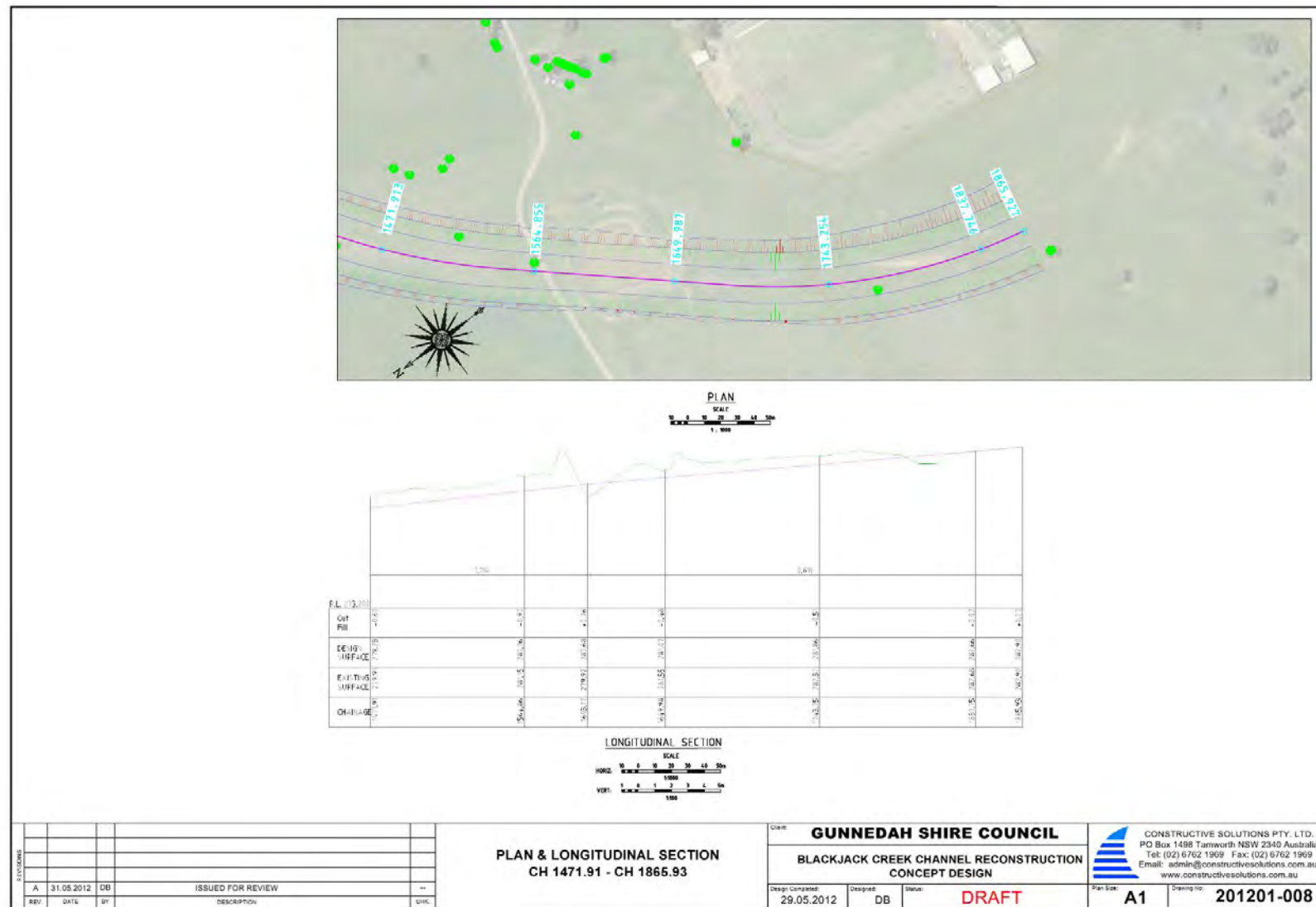


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**APPENDIX I**  
**Vegetation Management**  
**Plan**





# **Blackjack Creek Riparian Corridor/Channel Reconstruction Vegetation Management Plan**

**December 2014**



*Realising potential*

Report prepared by:



Realising potential

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## Acronyms

GSC	Gunnedah Shire Council
NOW	NSW Office of Water
Reconstruction	Blackjack Creek Riparian Corridor/Channel Reconstruction
REF	Review of Environmental Factors
VMP	Vegetation Management Plan
VRZ	Vegetated Riparian Zone

## 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 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 guideline for the preparation of a VMP where a Controlled Activity Approval for disturbance to waterfront land is required. A copy of this guideline is provided as **APPENDIX A**.

The Reconstruction was subject to approval under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999* for impact to the Koala. Approval 2013/6732 was granted on 22 November 2013. Preparation of a VMP for the Reconstruction is also required as Condition 2 of Approval 2013/6732. A copy of the approval notice is provided as **APPENDIX B**.

The requirements of the NOW guideline and Condition 2 of Approval 2013/6732 have been addressed throughout this VMP as detailed in Table 1.

**Table 1 – Conditions addressed in this VMP**

Condition	Requirements	VMP Section
2013/6732 – Condition 2a	Management actions designed to rehabilitate lands disturbed by the action and improve its habitat value to koalas. This must include all lands identified in the map at Schedule 1 of this notice as “Vegetated Riparian Zone”.	Sections 3 and 4
2013/6732 – Condition 2b(i)	Management actions designed to improve koala habitat value, including area and quality, of offset areas identified in the map at Schedule 1 of this notice as “7.29ha unvegetated portion of Wandobah Reserve”. Including: planting of indigenous trees.	Sections 3 and 4
2013/6732 – Condition 2b(ii)	Management actions designed to improve koala habitat value, including area and quality, of offset areas identified in the map at Schedule 1 of this notice as “7.29ha unvegetated portion of Wandobah Reserve”. Including: evidence that the proposed management actions to improve koala habitat are effective at improving koala habitat quality and area.	Sections 3 and 4

2013/6732 – Condition 2b(iii)	Management actions designed to improve koala habitat value, including area and quality, of offset areas identified in the map at Schedule 1 of this notice as “7.29ha unvegetated portion of Wandobah Reserve”. Including: a schedule of koala habitat restoration that compensates for lag time between planting trees and those trees having value as koala habitat.	Sections 3 and 4
2013/6732 – Condition 2c	An ecological monitoring program to monitor the success of management actions in the VMP and define measureable targets and actions, performance indicators, and an adaptive management framework for the duration of the action’s impact on koala habitat.	Section 5
NOW Guideline	Locality details	Section 2
	Riparian corridor width	
	Maps	
	Site photographs	
	Access arrangements	
	Vegetation composition	Section 3
	Planting layout	
	Planting densities	
	Seed sources	
	Rehabilitation methods	Section 4
	Staging and scheduling	
	Maintenance and monitoring provisions, both during and post-construction	Section 5
	Revegetation costs	Section 6



## 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 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.

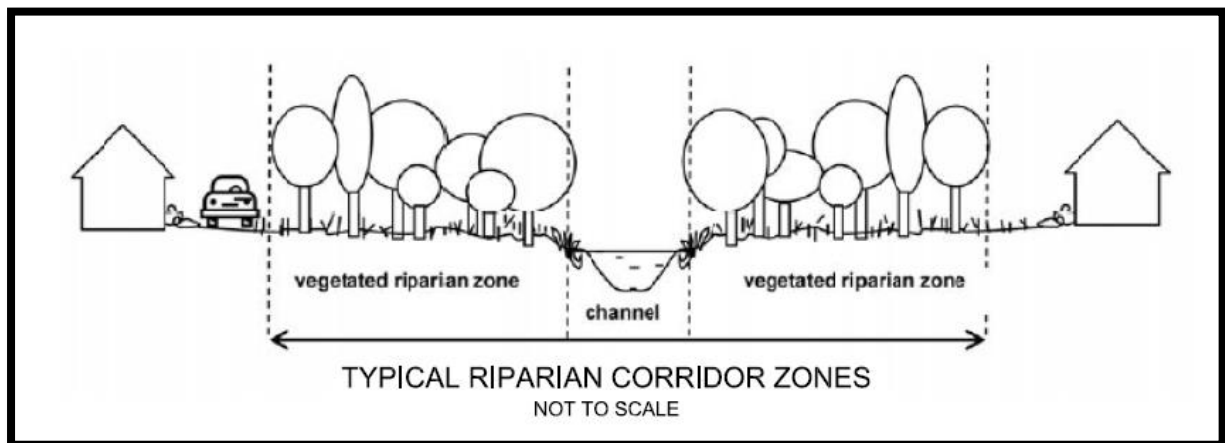


Figure 1 – Typical VRZ (NSW Office of Water 2012)

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 as it is a public recreational reserve, however the Riparian Corridor 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 C**.

### 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 riparian corridor 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.

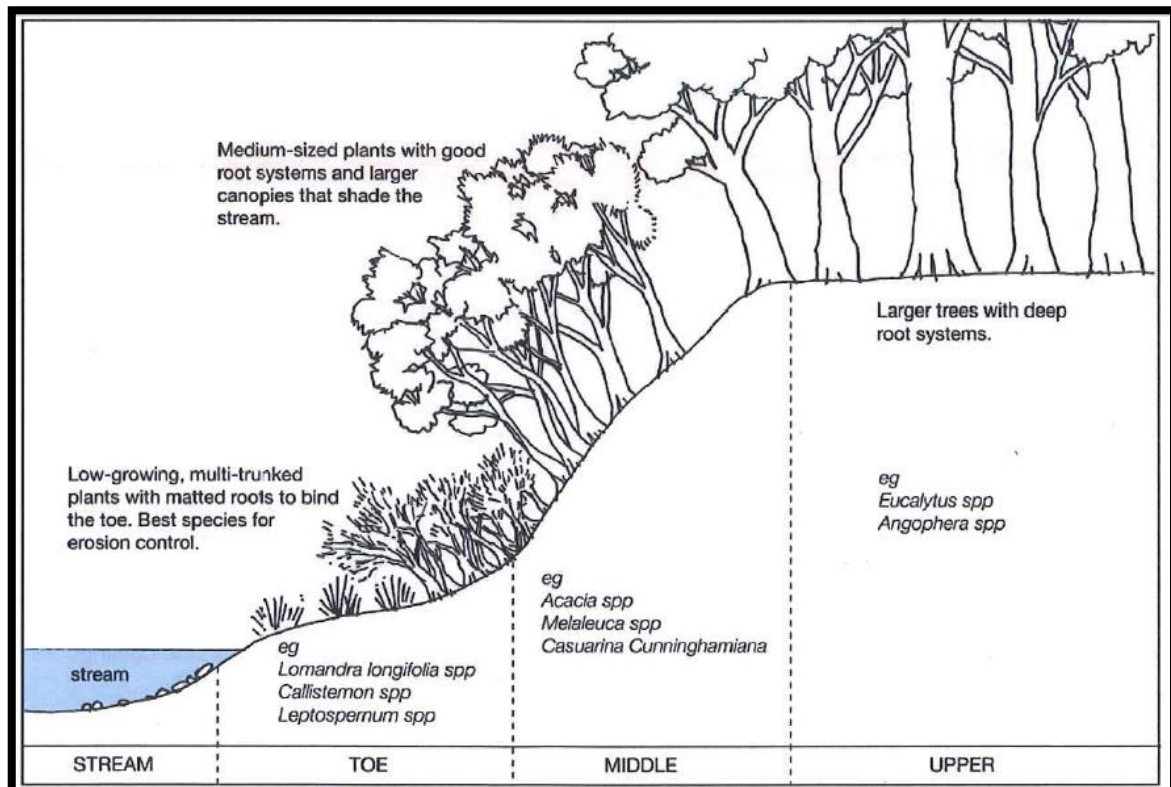


Figure 2 – Typical riparian cross section (NOW 2012)

For the Reconstruction, the widths of the 4 riparian corridor 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 or VRZ – 40m (20m on either side of the stream from the top of the bank).

As the Reconstruction site has been identified as Core Koala Habitat, offsets for area of habitat and number of habitat trees have been determined using the *Environment Protection and Biodiversity Conservation Act 1999* Offsets Assessment Guide. This determined that an effective and appropriate area offset can be achieved through the following:

- Revegetation within the 40m width of VRZ within Wandobah Reserve, as this area is not within the impact area. A 40m width for a length of 941m results in an offset area of 3.764ha;
- Revegetation within the 40m width of VRZ for the remainder of the Reconstruction length. A 40m length for a length of 1021m results in an offset area of 4.084ha; and
- Additional revegetation within the remaining unvegetated portion of Wandobah Reserve. Wandobah Reserve is 33.9ha in size. After subtracting the 9.41ha that comprise of the 5.646ha impact area and the 3.764ha VRZ revegetation area, and the 17.2ha that comprises the remaining vegetated portion, an unvegetated area of 7.29ha remains.

This results in a total offset area of 15.138ha. The offset areas are delineated on the map provided in **APPENDIX D** of this report.

In order to achieve an effective and appropriate offset for the 37 Koala habitat trees which will be removed by the Reconstruction, at least 370 of the 1000 trees planted in the VRZ will be preferred Koala habitat tree species. 200 additional trees will be planted in the 7.29ha unvegetated portion of Wandobah Reserve, with at least 75 of these to be preferred Koala habitat tree species.

In order to emulate local native vegetation communities the Namoi Catchment Management Authority guide *Native Plants for Creek and Rivers in the Namoi* (2012) was used as a guide for species selection. This guide is provided in **APPENDIX E**. Blackjack Creek is located in the Alluvial Plains of Area C in the Namoi Catchment and is classified as a riparian area. The Namoi Catchment Management Authority reviewed the VMP and recommended that, while the above mentioned guide is a useful basis, a reference site will be used in the development of a planting list to provide 'local context'.

During the preparation of the REF a detailed ecological assessment of the Reconstruction site was undertaken. This included assessment of the remnant vegetation within Wandobah Reserve which is outside the footprint of the VRZ and the compilation of a species list. The ecological assessment determined that the remnant vegetation within Wandobah Reserve is consistent with the Biometric vegetation ID NA185 '*Poplar Box grassy woodland on alluvial heavy clay soils in the Brigalow Belt South Bioregion (Benson 101)*' and with the RVC 80 '*Poplar Box grassy woodland on alluvial clay soils, Brigalow Belt South and Nandewar*'.

The remnant vegetation within Wandobah Reserve acts as a local reference site for the development of a planting list. A list of the 44 native species recorded in Wandobah Reserve is provided in **APPENDIX E**. The planting of native remnant species identified in **APPENDIX E** will improve the continuity of vegetation classes throughout Wandobah Reserve and the VRZ. The Namoi Catchment Management Authority guide *Native Plants for Creek and Rivers in the Namoi* (2012) will provide guidance on suitable propagation methods for many of the identified species.

The species listed in **APPENDIX E** will be adhered to as closely as possible, with the potential for some species inclusions and/or exclusions to occur based on seed and/or seedling availability. Anticipated planting densities are provided in Table 2.

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.



**Table 2 – Anticipated planting densities for the Riparian Corridor**

Zone	Area	Vegetation Type	Density	Total to be Planted
Upper/VRZ	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
Toe	20,000m <sup>2</sup>	Sedges and Rushes	5 per 1m <sup>2</sup>	100,000
Entire Riparian Corridor	200,000m <sup>2</sup>	Grasses	15kg per ha	300kg

In order to facilitate the timely establishment of Koala habitat trees in Wandobah Reserve, 200 trees were planted in the 7.29ha unvegetated portion of Wandobah Reserve in September 2013. Allowing time for land acquisition and engagement of a construction contractor, work is not anticipated to commence until early 2016.

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. All seed sources will be notified of the volumes required at least 6 months in advance to ensure stock availability.

## 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 3.

**Table 3 – Revegetation methods**

Vegetation Type	Revegetation Method	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

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 stabilising 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 stabilisation measures proposed in the Reconstruction design, such as reno mattresses and jute mesh, will ensure that the Reconstruction is stabilised 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 post-planting; 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).

## **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 germination. 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 3 – Hydromulch application (Spraygrass 2009)**

A hydromulch mix will be applied to the whole riparian corridor as part of the revegetation of the Reconstruction. In preparation for the hydromulch mix the Riparian Corridor will be ripped, up to 200mm deep, and topsoiled. Where possible, weed growth, large stones and other debris will be removed. The application of the hydromulching native seed will commence immediately after surface preparations have been completed. Table 4 provides the recommended hydromulch mix for the Reconstruction.

**Table 4 – Hydromulching application rates for native grass seed**

Zone	Area	Item	Application Rate	Total to be Applied
Entire riparian corridor	20 ha	Native Seed Mix	15kg per ha	300kg
		Cover Crop Seed (Couch)	35kg per ha	700kg
		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 riparian corridor by means of hydromulching equipment specifically designed for the purpose by operators trained in the use of this equipment.

Watering of the riparian corridor will be carried out in order to keep the wood-fibre moist until satisfactory germination occurs. Post-germination, limited watering will be carried out as necessary to ensure to native grasses reach a stage where they are self-sufficient.

If, during the construction tendering process, it is determined that an alternative method of establishing grasses (e.g. direct seeding) is preferred, this VMP will be updated to reflect the application and monitoring requirements of the alternative method.

#### **4.4 Staging and Scheduling**

The planting of 200 trees in the 7.29ha offset area discussed in Section 3 and delineated in the mapping provided in **APPENDIX D** is to occur in September 2013. Construction is not anticipated to commence until at least 17 months following these plantings, thus allowing time for establishment.

Revegetation of the riparian corridor 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

Table 5 lists the anticipated risks to the revegetation of the Reconstruction site and provides details of the maintenance and monitoring measures which will be utilised by GSC to ensure the establishment and ongoing efficacy of revegetation at the Reconstruction site.

The ongoing management of the Reconstruction will be the responsibility of GSC Parks and Gardens once construction is complete. As such, the Reconstruction will be integrated into the ongoing management of Wandobah Reserve as a whole under GSC's parks and gardens maintenance program. This integration will provide the necessary flexibility for adaptive management as the need arises (e.g. following a flood event or during a drought).

**Table 5 – Risks to revegetation success and monitoring and maintenance measures**

Risk	Maintenance and Monitoring Measures	Timing	Responsibility
Lack of suppliers to meet demand for required plants	<ul style="list-style-type: none"> <li>Gunnedah Forestry Nursery and Fields Native Nursery Uralla to be informed of required plant volumes prior to commencement of Reconstruction to facilitate forward planning.</li> </ul>	Prior to commencement of Reconstruction, with subsequent follow-up as needed during the Reconstruction to ensure ongoing supply.	GSC Project Manager
	<ul style="list-style-type: none"> <li>If preliminary discussions with the above determine a short-fall in plant availability, other local nurseries will be contacted.</li> </ul>	Prior to commencement of Reconstruction, with subsequent follow-up as needed during the Reconstruction to ensure ongoing supply.	GSC Project Manager
Failure of plants to establish	<ul style="list-style-type: none"> <li>Use of long-stem planting technique, as outlined in Section 4.2.</li> </ul>	During planting	GSC Project Manager & Revegetation Contractor
	<ul style="list-style-type: none"> <li>Use of established nurseries to supply plants, ensuring plant quality.</li> </ul>	During planting	GSC Project Manager
	<ul style="list-style-type: none"> <li>Environmental Management Plan and Erosion and Sediment Control Plan for the</li> </ul>	Prior to and during the Reconstruction	GSC Project Manager & Construction Contractor



Risk	Maintenance and Monitoring Measures	Timing	Responsibility
	Reconstruction to include provisions to strip, protect and replace topsoil, and to ensure surface 'roughness' to facilitate plant establishment.		
	<ul style="list-style-type: none"> <li>Regular watering of plants to ensure establishment/germination.</li> </ul>	Weekly during construction	GSC Project Manager & Revegetation Contractor during construction
		Fortnightly for up to 12 months following construction, or until plants are established, whichever is first	GSC Parks and Gardens following construction
	<ul style="list-style-type: none"> <li>Use of infill planting to replace plants which do not successfully establish</li> </ul>	Post-construction as required	Revegetation Contractor as per contract requirements & GSC Parks and Gardens thereafter
	<ul style="list-style-type: none"> <li>Employment/engagement of suitably qualified employees/contractors to undertake the revegetation, particularly with regards to grass establishment.</li> </ul>	Prior to construction	GSC Project Manager
Drought causing plant mortality	<ul style="list-style-type: none"> <li>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.</li> </ul>	Post-construction as required	Revegetation Contractor as per contract requirements & GSC Parks and Gardens thereafter
Flood damage to plants	<ul style="list-style-type: none"> <li>Site inspection following any flood event in Blackjack Creek, with any damaged plants to be monitored and, if mortality occurs, replaced.</li> </ul>	Post-construction as required	Revegetation Contractor as per contract requirements & GSC Parks and Gardens thereafter

Risk	Maintenance and Monitoring Measures	Timing	Responsibility
Severe storm damage to plants	<ul style="list-style-type: none"> <li>Site inspection following any severe storm event in Gunnedah, with any damaged plants to be monitored and, if mortality occurs, replaced.</li> </ul>	Post-construction as required	Revegetation Contractor as per contract requirements & GSC Parks and Gardens thereafter
Bushfire	<ul style="list-style-type: none"> <li>No burning of the Reconstruction will be undertaken by GSC. In the event that a bushfire occurs in the Reconstruction site, it will be dealt with by the Fire Brigade.</li> <li>Site inspections will be undertaken following any bushfire event affecting the Reconstruction, with any damaged plants to be monitored and, if mortality occurs, replaced.</li> </ul>	Post-construction as required, with post-bushfire inspections to occur monthly to ensure regeneration or replacement of affected plants	Revegetation Contractor as per contract requirements & GSC Parks and Gardens thereafter
Vandalism to plants	<ul style="list-style-type: none"> <li>Community members may be encouraged to participate in the revegetation to assist in developing a sense of community ownership, as per the REF.</li> </ul>	During construction	GSC Project Manager and GSC community relations
	<ul style="list-style-type: none"> <li>Site inspection following mowing events in Wandobah Reserve or following a community complaint, with any damaged plants to be monitored and, if mortality occurs, replaced.</li> </ul>	Post-construction as required (with mowing anticipated to occur 6 times per annum)	Revegetation Contractor as per contract requirements & GSC Parks and Gardens thereafter
Damage to revegetation as a result of GSC	<ul style="list-style-type: none"> <li>Mowing only to occur for grasses with heights &gt;10cm and mowing debris will not be allowed to accumulate around shrubs and trees in a manner that they are suffocated.</li> </ul>	Post-construction as required (with mowing anticipated to occur 6 times per annum)	GSC Parks and Gardens

Risk	Maintenance and Monitoring Measures	Timing	Responsibility
maintenance activities	<ul style="list-style-type: none"> <li>Any pruning of vegetation to maintain clearance from infrastructure (e.g. electricity lines) to be undertaken carefully so as not to damage the functionality of the vegetation.</li> </ul>	Post-construction as required, with liaison with necessary stakeholders (e.g. Essential Energy) as required	GSC Parks and Gardens

**APPENDIX F** provides the monitoring and maintenance checklists for the revegetation of the Reconstruction.



## 6. Costs

Table 6 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.

**Table 6 – Anticipated revegetation costs**

Item	Volume	Unit Cost	Total Cost
Tree seedlings (tubestock)	1,200	\$2.50	\$3,000.00
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	4,400	\$1.50	\$6,600.00
Contractor cost to plant tree and shrub seedlings, including placement of plastic sleeves, stakes, and weed matting	4,400	\$5.00	\$22,000.00
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
<b>Total revegetation cost</b>			<b>\$477,600.00</b>

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 7 provides the anticipated maintenance costs for revegetation of the Reconstruction.

**Table 7 – Anticipated annual maintenance costs**

<b>Item</b>	<b>Volume</b>	<b>Unit Cost</b>	<b>Total Cost</b>
Monitoring (2 hours, 12 times per annum)	24hrs	\$60 per hour	\$1,440.00
Refill/infill planting*	n/a	10% of original cost	\$24,760.00
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
<b>Total annual maintenance cost</b>			<b>\$47,320.00</b>

\* 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**

## **NOW VMP Guideline**

## CONTROLLED ACTIVITIES ON WATERFRONT LAND

# Guidelines for vegetation management plans on waterfront land

Controlled activities carried out in, on or under waterfront land are regulated by the *Water Management Act 2000* (WM Act). The NSW Office of Water administers the WM Act 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.

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.

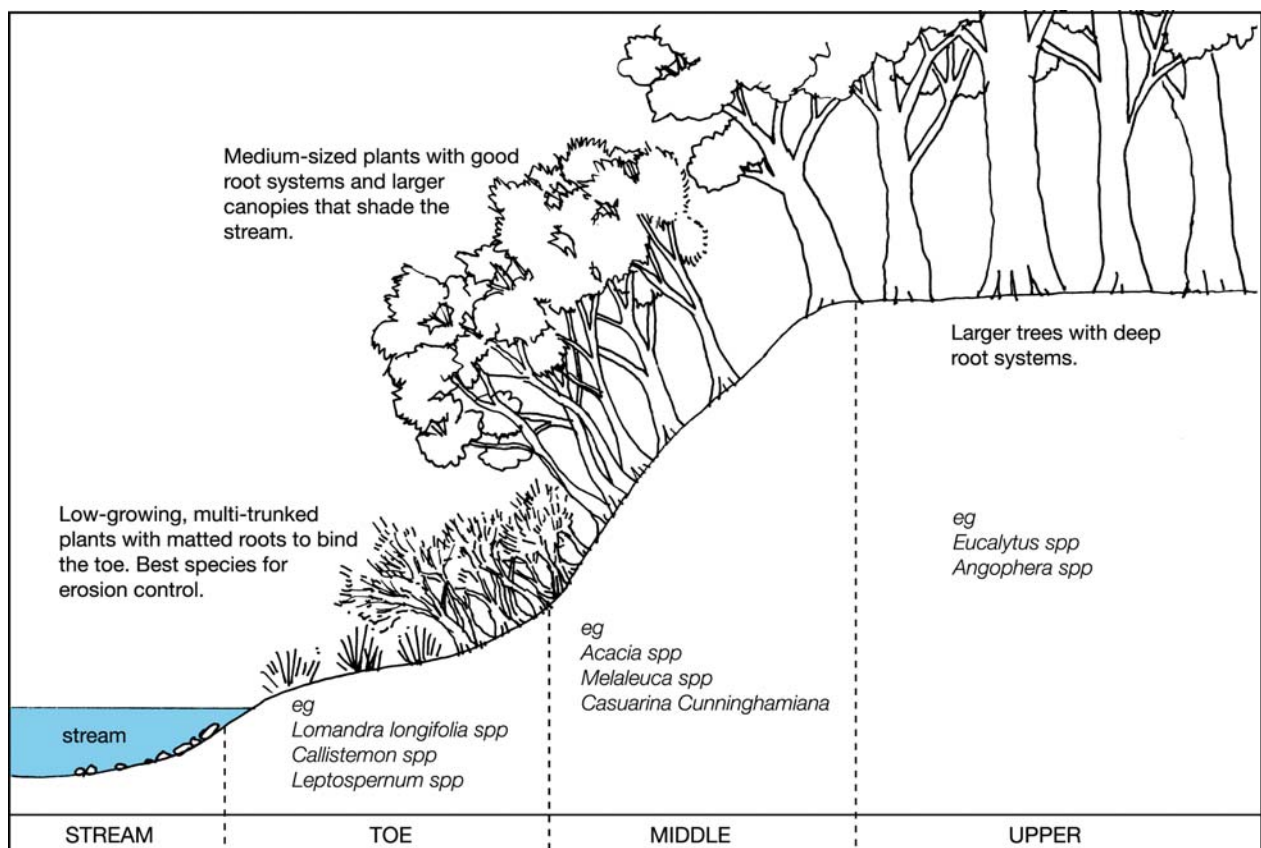
This means that a controlled activity approval must be obtained from the NSW Office of Water before commencing the controlled activity.

## Why is a vegetation plan required?

When a proposed controlled activity disturbs or substantially modifies the riparian corridor, its restoration or rehabilitation will be a requirement of the controlled activity approval. A vegetation management plan (VMP) details how the restoration or rehabilitation will be carried out.

The main objective of a VMP is to provide a stable watercourse and riparian corridor which will emulate local native vegetation communities.

**Figure 1. Typical riparian cross section** - Adapted from Rivercare: Guidelines for Ecological Sustainable Management of Rivers and Riparian Vegetation: Raine, A.W & Gardiner, J.N, (1995), Land and Water Resources Research and Development Corporation, Canberra.



## How should a vegetation management plan be prepared?

A VMP should be prepared by a suitably qualified person and should clearly address the following criteria.

- An appropriate width for the riparian corridor should be identified by consulting either the development consent, the relevant environmental planning instrument or the NSW Office of Water guidelines for riparian corridors. The VMP should consider the full width of the riparian corridor and its functions including accommodating fully structured native vegetation.
- Maps or diagrams which clearly identify the riparian corridor; the existing vegetation; the vegetation to be retained; the vegetation to be cleared; the footprint of construction activities; and areas of proposed revegetation etc. should be prepared.
- The location of the bed and banks or foreshore of waterfront land and the footprint of the riparian corridor should be clearly identified. Vegetated riparian zones must be indicated.
- Photographs of the site should be supplied and photo points should be identified. To assist with future monitoring and reporting requirements, the photo points should be identified by GPS coordinates or by survey. This is particularly important for large scale earthworks or extractive industries.
- Measures for controlling long term access and encroachments (bollards, fences, etc.) into the riparian corridor should be identified.
- Vegetation species composition, planting layout and densities should be identified. The required mix of plant species relates to the actual community to be emulated and the size of the area or areas to be rehabilitated but mature vegetation communities are generally well structured, comprising trees, shrubs and groundcovers species. Planting densities should achieve quick vegetative cover and root mass to maximise bed and bank stability along the subject watercourse.
- Costs associated with high density planting will be recovered through reduced maintenance costs for weeding or replacement planting in the maintenance period specified in the controlled activity approval (CAA).
- Seed or plant sources should be identified. Where possible, native plants and seed sources of local provenance should be used.
- Exotic vegetation should be avoided. The use of exotic species for temporary soil stabilisation is permitted provided they are sterile, non-invasive and easily eradicated when permanent vegetation is established.
- Details of the planting program, rehabilitation methods and staging should be provided. Techniques such as hydro-seeding, direct seeding, brush matting or assisted natural regeneration may be considered.
- Maintenance requirements should extend for a minimum of two years after the completion of works or until such time as a minimum 80 per cent survival rate of each species planted and a maximum 5 per cent weed cover for the treated riparian corridor controlled activity is achieved.
- Project tasks should be defined and described, including a schedule detailing the sequence and duration of works necessary for the implementation of the VMP.
- Costings for the implementation of all components and stages of the work including materials, labour, watering, maintenance which includes plant replacement, monitoring and reporting should be prepared.
- Processes for monitoring and review, including a method of performance evaluation should be identified. This should include replacing plant losses, addressing deficiencies, problems, climatic conditions and successful completion of works.
- Regular reporting on the implementation and status of works covering progress, success or failures and completion should be provided. The number and duration of reporting periods will be identified in the CAA. Works as executed plans and reports detailing how the components of the VMP have been implemented will be required prior to the release of any security held by the NSW Office of Water.
- Security such as bank guarantees may be required before a controlled activity involving the implementation of a VMP is commenced. The amount of security is usually based on the costings provided.



## Where do I go for additional information?

Find out more about controlled activities at the Office of Water website [www.water.nsw.gov.au](http://www.water.nsw.gov.au).

## Contact us

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## **APPENDIX B**

### **Approval Notice**



**Australian Government**  
**Department of the Environment**

**Approval**

**Blackjack Creek, riparian corridor and channel reconstruction, Gunnedah, NSW  
(2013/6732).**

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999*.

**Proposed action**

**person to whom the  
approval is granted**

Gunnedah Council

**proponent's ABN**

ABN 80 183 655 793

**proposed action**

To dredge, widen and realign a 2km section of the Blackjack Creek Gunnedah as described in the referral documentation received by the department for this proposal on 25 January 2013 (EPBC Act referral 2013/6732).

**DECISION to approve:**

**Approval decision**

Controlling Provision	Decision
Listed threatened species and communities (ss 18, 18A)	Approve

**conditions of approval**

This approval is subject to the conditions specified below.

**expiry date of approval**

This approval has effect until 31 December 2023

**Decision-maker**

**name and position**

Mahani Taylor  
Acting Assistant Secretary  
South-Eastern Australia Environment Assessments

**Signature**

**date of decision**

22 November 2013



### Conditions of Approval:

1. The person taking the action must not remove more than 37 koala habitat trees as part of taking this action.
2. To assist in mitigating the impacts of the proposal on the koala and koala habitat, the person taking the action must prepare and submit a Vegetation Management Plan (VMP) for the Minister's written approval prior to commencement of the action. The VMP must include:
  - a. Management actions designed to rehabilitate lands disturbed by the action and improve its habitat value to koalas. This must include all lands identified in the map at Schedule 1 of this notice as "Vegetated Riparian Zone".
  - b. Management actions designed to improve the koala habitat value, including area and quality, of offset areas identified in the map at Schedule 1 of this notice as "7.29ha Offset in Unvegetated portion of Wandobah Reserve". Including:
    - i. Planting of indigenous koala feed trees using locally sourced seed.
    - ii. Evidence that the proposed management actions to improve koala habitat are effective at improving koala habitat quality and area.
    - iii. A schedule of koala habitat restoration that compensates for the lag time between planting of trees and those trees having value as koala habitat.
  - c. An ecological monitoring program to monitor the success of the management actions in the VMP and define measurable targets of management actions, performance indicators, and an adaptive management framework for the duration of the action's impact on koala habitat.

The action must not commence until the VMP is approved by the Minister. The approved VMP must be implemented.

3. To ensure the long term viability of the offset and mitigation measures the person proposing the action must prepare and submit a Management Plan for the whole of Wandobah Reserve for the Minister's written approval prior to commencement of the action. The Wandobah Reserve Management Plan must include:
  - a. Management actions designed to improve the value of the reserve for koala habitat, including:
    - i. Management of unauthorised access to and use of the reserve
    - ii. Management of koala predators that may access the reserve
  - b. An ongoing ecological monitoring program to monitor the success of the management actions in the Wandobah Reserve Management Plan and define measurable targets of management actions, performance indicators, and an adaptive management framework for the duration of the action's impact on koala habitat.

The action must not commence until the Wandobah Reserve Management Plan is approved by the Minister. The approved Wandobah Reserve Management Plan must be implemented, reviewed annually and made available on the website of the person proposing the action for the duration of the impact on koala habitat.

4. Prior to the commencement of the action the person taking the action must provide evidence to the Department of:
  - a. The land tenure of Wandobah Reserve including the legal mechanisms that ensure council are able to manage the site as an offset area for in perpetuity of the proposal on koala habitat.
  - b. Offset attributes, shapefiles and textual descriptions and maps to clearly define the location and boundaries of Wandobah Reserve.
5. Within 30 days after the commencement of the action, the person taking the action must advise the Department in writing of the actual date of commencement.
6. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to these conditions of approval, including measures taken to implement the management plans described in conditions 2 and 3, and make them available upon request to the Department. Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act, or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the Department's website. The results of audits may also be publicised through the general media.
7. Within three months of every 12 month anniversary of the commencement of the action, the person taking the action must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of the management plans described in conditions 2 and 3. Documentary evidence providing proof of the date of publication must be provided to the Department at the same time as the compliance report is published. Non-compliance with any of the conditions of this approval must be reported to the Department within 2 business days of becoming aware of the non-compliance.
8. Upon the direction of the Minister, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to the commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.
9. If the person taking the action wishes to carry out any activity otherwise than in accordance with the management plans described in conditions 2 and 3, the person taking the action must submit to the Department for the Minister's written approval revised versions of those plans. The varied activity shall not commence until the Minister has approved the varied management plans in writing. The Minister will not approve a varied management plan unless the revised plan would result in an equivalent or improved environmental outcome over time. If the Minister approves the revised management plan, that management plan must be implemented in place of the management plan originally approved.
10. If the Minister believes that it is necessary or convenient for the better protection of listed threatened species and ecological communities to do so, the Minister may request that the person taking the action make specified revisions to management plans described in conditions 2 and 3 and submit the revised plans for the Minister's written approval. The person taking the action must comply with any such request. The revised approved plans must be implemented. Unless the Minister has approved the revised plans then the person taking the action must continue to implement the plans originally approved.



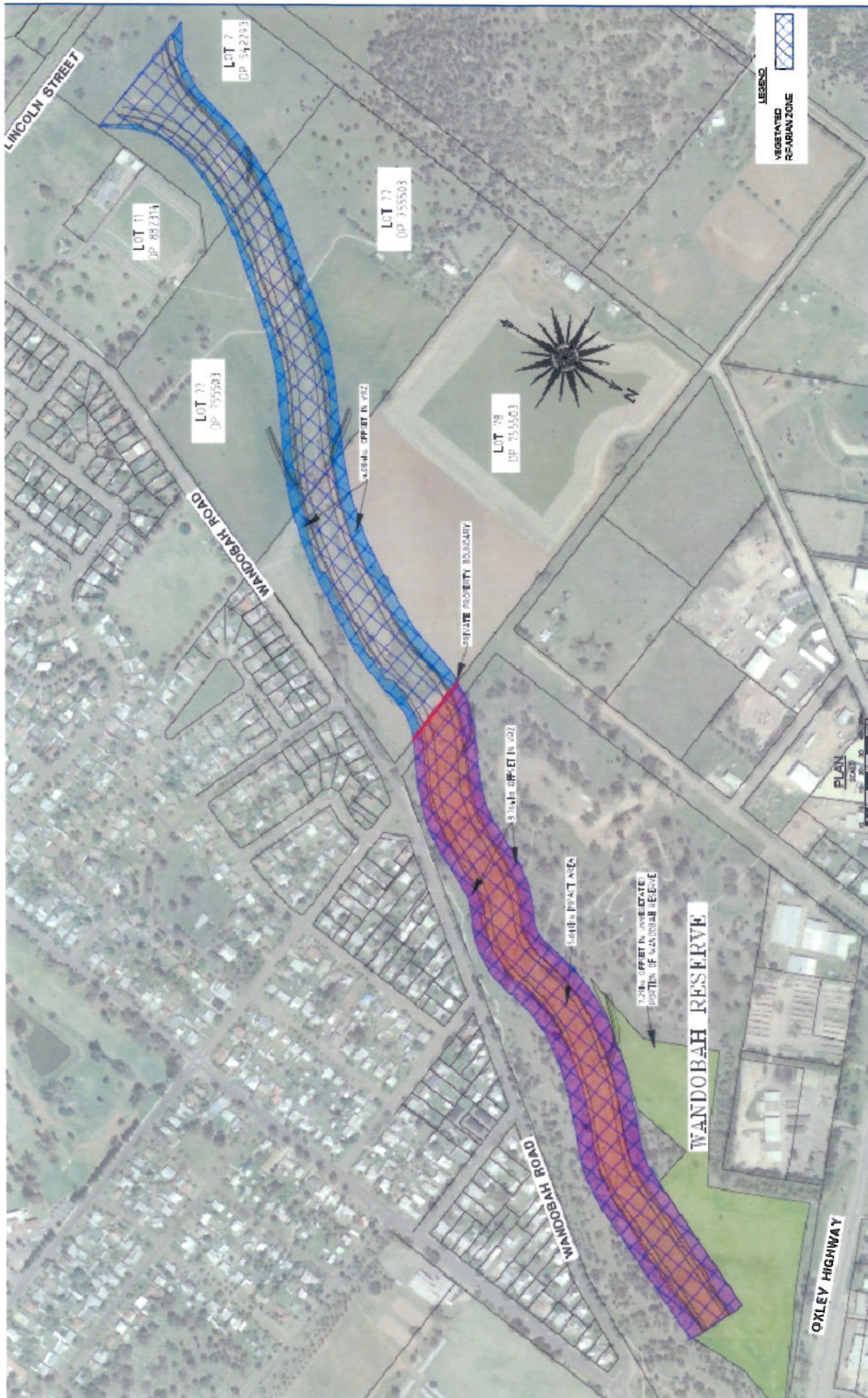
11. If, at any time after 5 years from the date of this approval, the person taking the action has not substantially commenced the action, then the person taking the action must not substantially commence the action without the written agreement of the Minister.
12. Unless otherwise agreed to in writing by the Minister, the person taking the action must publish the management plans described in conditions 2 and 3 on their website. The plans must be published on the website within 1 month of being approved.

### **Definitions**

- a) Department, the Australian Government Department administering the *Environment Protection and Biodiversity Conservation Act 1999*.
- b) Commencement, the earthworks, vegetation removal or construction of any infrastructure, associated with the proposed action.
- c) Koala habitat tree/s, are tree species that are used by koalas for food or shelter. Tree species used by koalas vary spatially and temporally and trees that can be considered koala habitat trees are often highly specific to the local area.
- d) Minister, the Minister administering the *Environment Protection and Biodiversity Conservation Act 1999* and includes a delegate of the Minister.
- e) Offset attributes, mean an '.xls' file capturing relevant attributes of the Offset Area, including the EPBC reference ID number, the physical address of the offset site, coordinates of the boundary points in decimal degrees, the EPBC protected matters that the offset compensates for, any additional EPBC protected matters that are benefiting from the offset, and the size of the offset in hectares.
- f) Shapefiles, means an ESRI Shapefile containing '.shp', '.shx' and '.dbf' files and other files capturing attributes of the Offset Area, including the shape, EPBC reference ID number and EPBC protected matters present at the relevant site. Attributes should also be captured in '.xls' format.



### Schedule 1

[illegible]



## **APPENDIX C**

### **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**



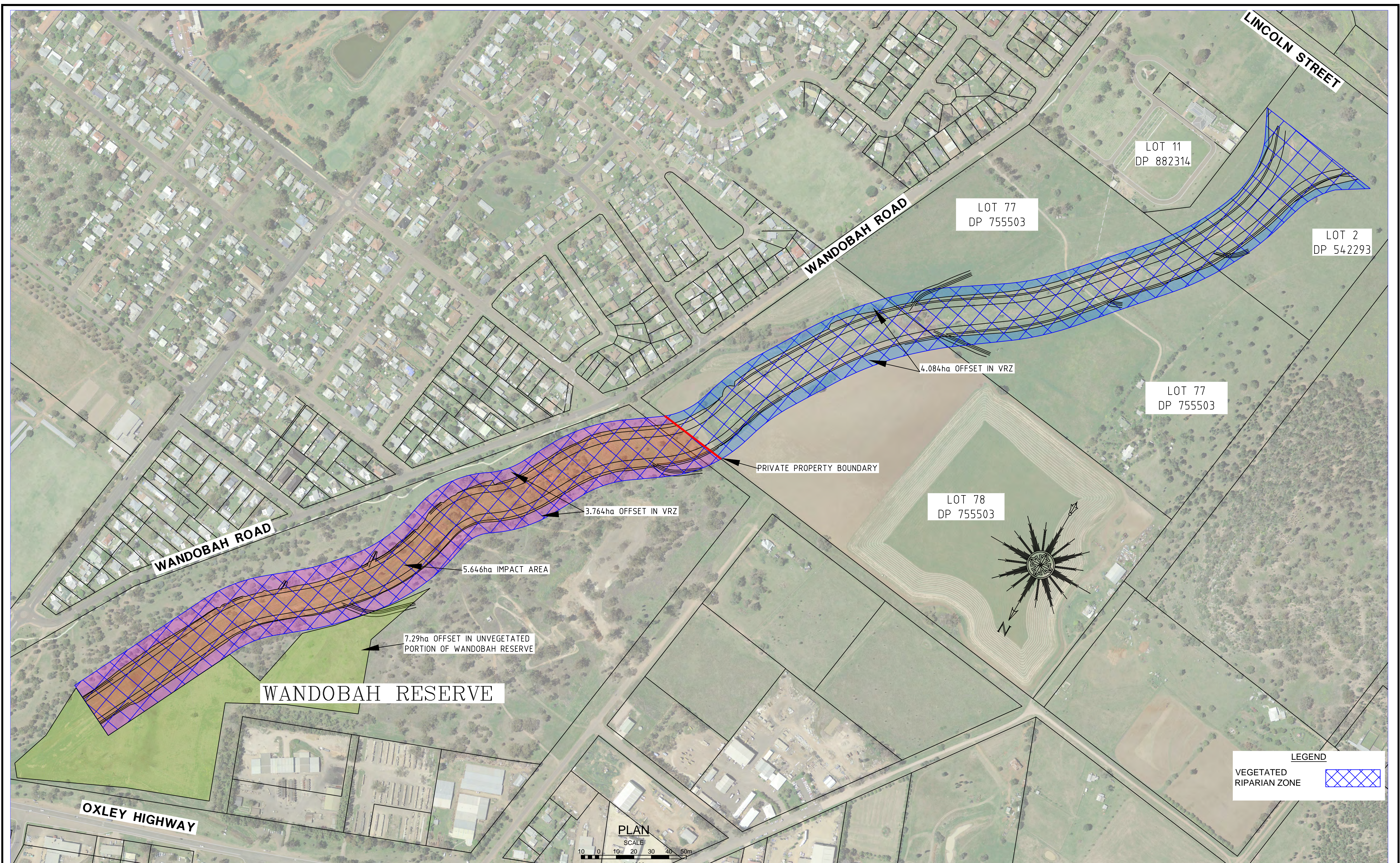
**Figure 5 – Wandobah Reserve looking south. Coordinates -30.983114  
150.238288**



## **APPENDIX D**

### **Offset Areas Map**





REVISIONS					
	A	03.12.2012	DB	ISSUED FOR REVIEW	--
	REV.	DATE	BY	DESCRIPTION	CHK.

1:1000

VEGETATED RIPARIAN ZONE EXTENTS PLAN  
- BLACKJACK CREEK

Client:

GUNNEDAH SHIRE COUNCIL

BLACKJACK CREEK RIPARIAN CORRIDOR &  
CHANNEL RECONSTRUCTION

Design Completed:


03.12.2012

Designed:

DB

Status:

PRELIMINARY



CONSTRUCTIVE SOLUTIONS PTY. LTD.  
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www.constructivesolutions.com.au

Plan Size:

A1

Drawing No:

201201-035



## **APPENDIX E**

### **Planting List**



## Blackjack Creek Riparian Corridor/Channel Reconstruction

### *Native Species Recorded in Wandobah Reserve*

Family	Common Name	Scientific Name
Asteraceae	Yellow Burr-daisy	<i>Calotis lappulacea</i>
Asteraceae	Cough Bush	<i>Cassinia quinquefaria</i>
Asteraceae	Cotton Fireweed	<i>Senecio quadridentatus</i>
Asteraceae	Common Sunray	<i>Triptilodiscus pygmaeus</i>
Asteraceae	Fuzzweed	<i>Vittadinia cervicalaris</i> var. <i>cervicularis</i>
Asteraceae	Fuzzweed	<i>Vittadinia cervicalaris</i> var. <i>cuneata</i>
Asteraceae	Golden Everlasting	<i>Xerochrysum bracteatum</i>
Casuarinaceae	River Oak	<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>
Convolvulaceae	Kidney Weed	<i>Dichondra repens</i>
Cupressaceae	White Cypress Pine	<i>Callitrus glaucophylla</i>
Fabaceae (Faboideae)	Emu-foot	<i>Cullen tenax</i>
Fabaceae (Mimosoideae)	Green Wattle	<i>Acacia deanei</i>
Fabaceae (Mimosoideae)	Cooba	<i>Acacia salicina</i>
Fabaceae (Mimosoideae)	Golden Wreath Wattle	<i>Acacia saligna</i>
Fabaceae (Mimosoideae)		<i>Acacia</i> sp.
Fabaceae (Mimosoideae)	River Cooba	<i>Acacia stenophylla</i>
Geraniaceae	Blue Crowfoot	<i>Erodium crinitum</i>
Goodeniaceae	Scrambled Eggs	<i>Goodenia pinnatifida</i>
Malvaceae	Flannelweed	<i>Abutilon oxycarpum</i>
Moraceae	Port Jackson Fig	<i>Ficus rubiginosa</i>
Myrtaceae	White Box	<i>Eucalyptus albens</i>
Myrtaceae	Blakely's Red Gum	<i>Eucalyptus blakelyi</i>
Myrtaceae	Yellow Box	<i>Eucalyptus melliodora</i>
Myrtaceae	Bimble Box	<i>Eucalyptus populnea</i> subsp. <i>bimbil</i>
Myoporaceae		<i>Eromophila</i> sp.
Oxalidaceae	Oxalis	<i>Oxalis perennans</i>
Plantaginaceae	Lamb's Tongue	<i>Plantago lanceolata</i>
Poaceae	Purple Wiregrass	<i>Aristida personata</i>
Poaceae	Plains Grass	<i>Austrostipa aristiglumis</i>
Poaceae	Speargrass	<i>Austrostipa scabra</i>
Poaceae	Slender Bamboo Grass	<i>Austrostipa verticillata</i>
Poaceae	Red Grass	<i>Bothriochloa macra</i>
Poaceae	Sand Brome	<i>Bromus arenarius</i>

Poaceae	Rhodes Grass	<i>Chloris gayana</i>
Poaceae	Windmill Grass	<i>Chloris truncata</i>
Poaceae	Tall Chloris	<i>Chloris ventricosa</i>
Poaceae	Common Couch	<i>Cynodon dactylon</i>
Poaceae	Queensland Bluegrass	<i>Dichanthium sericeum</i>
Poaceae		<i>Eragrostis sp.</i>
Poaceae	Water Couch	<i>Paspalum distichum</i>
Rubiaceae	Cleavers	<i>Galium asperine</i>
Rutaceae	Wilga	<i>Geijera parviflora</i>
Sapindaceae	Western Rosewood	<i>Alectryon oleifolius</i>
Typhaceae	Cumbungi	<i>Typha sp.</i>

.....

**APPENDIX F**  
**Monitoring and**  
**Maintenance Checklists**



## Blackjack Creek Riparian Corridor/Channel Reconstruction

### *Post-Construction Revegetation Monitoring and Maintenance Checklist*

Issue	Yes	No	Notes/Remedial Action
<b>Soil moisture</b>			
Has watering occurred fortnightly for up to 12 months, or until plants are established?  If not, detail why (e.g. heavy rainfall).			
Has regular monitoring of climatic conditions occurred, with watering of revegetation as necessary (e.g. during drought)?  Details of watering events (date and volume) must be provided.			
<b>Plants</b>			
Has plant damage occurred as a result of drought, bushfire, severe storm flood, or vandalism?  If so, have plants been monitored monthly to ensure recovery or has replacement planting occurred?  Details of monthly monitoring (e.g. plant locations and notes on health) and replacement planting must be provided.			
<b>Mowing and Pruning</b>			
Has all mowing been undertaken only for grasses above 10cm and mowing debris prevented from suffocating emerging/establishing plants?  If not, detail why (e.g. variable terrain resulting in variable mow heights).			
Has any pruning of vegetation to maintain clearance from infrastructure (e.g. electricity lines)			

<p>been undertaken carefully so as not to damage the functionality of the vegetation?</p> <p>If not, detail why (e.g. Essential Energy undertook pruning without notifying GSC).</p>			
<p>Have all large branches resulting from pruning and any rubbish encountered during mowing been prevented from entering the waterway where possible?</p>			

Name.....

Position.....

Signed.....

Date.....

# Blackjack Creek Riparian Corridor/Channel Reconstruction

## *Construction Revegetation Monitoring and Maintenance Checklist*

Issue	Yes	No	Notes/Remedial Action
Is the supply of plants for revegetation secured? If not, have additional sources been identified?			
Are all staff and contractors adequately qualified? Copies of staff and contractor qualifications must be held on record at the GSC offices.			
Has the site been prepared for revegetation in accordance with the provisions of the EMP and ESCP (e.g. surface roughness to facilitate vegetation establishment)? If not, detail how remedial actions will be undertaken to ensure compliance with the EMP and ESCP.			
Has revegetation occurred in accordance with the VMP? If not, detail remedial actions will be undertaken to ensure compliance with the VMP (e.g. planting of additional trees of a particular species to replace unavailable species).			
Has watering been undertaken weekly? If not, detail why (e.g. heavy rainfall).			
Have remedial actions from previous inspection been undertaken?			

Name.....

Position.....

Signed.....

Date.....



**APPENDIX J**  
**Species Impact Statement**  
**– Koala**



Koala in the Cemetery adjacent to the Study Area.

## **KOALA SPECIES IMPACT STATEMENT: BLACKJACK CREEK RESTORATION IN GUNNEDAH, NSW.**

---

**Gunnedah Local Government Area**

**January 2013**

Report Prepared by  
OzArk Environmental & Heritage Management Pty Ltd  
For Constructive Solutions



**Environmental and  
Heritage Management P/L**

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Draft V3.0 edits OzArk to client			
FINAL Approved			
<b>Prepared For</b>	<b>Prepared By</b>		
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## **1 INTRODUCTION**

---

### **1.1 INTRODUCTION**

In accordance with the requirements of the Director General of the Office of Environment & Heritage (OEH), a Species Impact Statement (SIS) has been prepared by OzArk Environmental & Heritage Management (OzArk) to address the anticipated impacts to the Koala associated with the reconstruction and realignment of Blackjack Creek in the town of Gunnedah, NSW.

### **1.2 FORM OF THE SIS**

This Species Impact Statement has been structured to meet all the matters specified in Sections 109 and 110 of the *Threatened Species Conservation Act 1995* (TSC Act) in **Appendix 1**.

### **1.3 PURPOSE**

The purpose of an SIS is to:

- Allow the applicant or proponent to identify threatened species issues and provide appropriate amelioration for adverse impacts resulting from the Proposal;
- Assist consent and determining authorities in the assessment of a development application for Part 5 approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act);
- Assist the Director-General in deciding whether or not concurrence should be granted for the purposes of Parts 5 of the EP&A Act;
- Assist the Director-General or the Minister for the Environment when consulted for the purposes of Part 5 of the EP&A Act; and
- Assist the Director-General in the assessment of Section 91 Licence applications lodged under the TSC Act.

## 1.4 DEFINITIONS AND ABBREVIATIONS

The following table lists definitions and abbreviations found in this report.

**Table 1: Definitions and abbreviations used in this report**

Terminology	Abbreviation	Description
Activity		Has the same meaning as in the EP&A Act. The nature of the proposed activity is described in Section 2.1. Activity and Proposal are synonymous in this report
Average Recurrence Interval	ARI	
Endangered Ecological Community	EEC	
Environment Protection and Biodiversity Conservation Act 1999	EPBC Act	
Department of Sustainability, Environment, Water, Population and Communities	DSEWPoC	
Impact Footprint		Extent of all works for the proposed activity. The Impact Footprint is within the Study Area and includes an area that will be mechanically destroyed or altered to construct infrastructure associated with the activity. The impact footprint is within the Reconstruction Site.
Office of Environment and Heritage	OEH	
Proposal		Proposed activity that will be undertaken within the reconstruction Site. Namely the reconstruction and realignment of Blackjack Creek including riparian rehabilitation and biodiversity offsetting.
Reconstruction Site.		The location where the Proposal will be undertaken. Detailed in Figures 1 and 2.
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).
Threatened Species Conservation Act 1995	TSC Act	

## **2 GENERAL INFORMATION**

---

### **2.1 TITLE OF THE PROPOSAL**

Blackjack Creek Riparian Corridor/Channel Reconstruction

### **2.2 NAME AND POSTAL ADDRESS OF PROPONENT**

Gunnedah Shire Council

Street Address: 63 Elgin Street Gunnedah NSW 2380

Postal Address:

Phone: (02) 67402100

Fax: (02) 67402119

Website: <http://www.gunnedah.nsw.gov.au/>

### **2.3 LAND TENURE INFORMATION**

The Proposal will occur on portions of Lot 7053 DP 1116141 (Wandobah Reserve), Lot 78 DP 755503 ('Fermanagh'), Lot 77 DP 755503 ('Balmoral') and Lot 2 DP 542293 ('Balmoral'). 'Balmoral' and 'Fermanagh' are freehold properties which are not currently owned by Gunnedah Shire Council. As part of the Action, Gunnedah Shire Council will undertake the necessary acquisition process for the sections of these properties that form part of the Reconstruction Site. Informal discussions with the landholders have commenced.

Wandobah Reserve is Crown Land, with Gunnedah Shire Council being the trustee.

### **2.4 OBJECTIVE OF THE ACTIVITY / PROPOSAL**

The Activity is proposed as a result of the Blackjack Floodplain Risk Management Study and Plan (Lyal and Associates 2010), which recommended that channel realignment / reconstruction, with the aim of mitigating the impacts of flooding to local residents, be investigated.

### **2.5 PROPOSAL**

#### **2.5.1 Background to Proposal**

Blackjack Creek is an ephemeral creek with a relatively small catchment flowing through private property and Wandobah Reserve adjacent to a residential area in Gunnedah, New South Wales. Blackjack Creek currently cannot contain flood events greater than the 5 year Average Recurrence Interval (ARI), resulting in a long history of flooding of



the residential properties adjacent to it. As such Gunnedah Shire Council has undertaken investigations into flood mitigation measures in accordance with NSW government Flood Policy.

In accordance with the recommendations of the Blackjack Creek Floodplain Risk Management Study and Plan (Lyll and Associates 2010), Gunnedah Shire Council is proposing to reconstruct the Blackjack Creek riparian corridor/channel for a length of approximately 2km, stretching from 200m downstream of Lincoln Street to 200m upstream of the Oxley Highway Bridge, encompassing Wandobah Reserve and private property. Further detail can be found in the Review of Environmental Factors (REF) provided in **Appendix 3**.

### **2.5.2 Feasible Alternatives**

Several feasible alternatives to the Action have been detailed in the REF. The Blackjack Creek Floodplain Risk Management Study and Plan (Lyll 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 land use. 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 Gunnedah Shire Council 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 Gunnedah Shire Council and the State Emergency Service was recommended.
- The do-nothing approach would not change the current flooding regime. 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.

Full details of each measure, including economic analysis, can be found in the *Blackjack Creek Floodplain Risk Management Study and Plan* (Lyall and Associates 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.

The Blackjack Creek Riparian Corridor/Channel Reconstruction - Channel Options Study and Blackjack Creek Riparian Corridor/Channel Reconstruction - Concept Design Report were 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 along the current alignment 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 *Blackjack Creek Riparian Corridor/Channel Reconstruction - Detailed Design* (Constructive Solutions 2012) provides the most favourable outcome with regards to balancing flood mitigation requirements with environmental considerations such as groundwater, salinity and vegetation.

### **2.5.3 Proposal**

The Proposal will realign/reconstruct Blackjack Creek for approximately 1.9 kilometres stretching from approximately 200 metres south of the Oxley Highway Bridge in Wandobah Reserve to approximately 200 metres north of Lincoln Street. The described activities associated with the Proposal will result in the removal of 30-37 large hollow bearing habitat trees within 'Core Koala Habitat'. Other shrubs and trees planted by LandCare within the Reconstruction Site will also be removed. These shrubs may also be utilised as alternate Koala fodder or for shelter.

### **3 ENVIRONMENTAL SETTING**

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#### **3.1 VEGETATION IN THE RECONSTRUCTION SITE**

The Reconstruction Site 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' (OzArk Environmental & Heritage Management 2012).

Isolated large hollow bearing trees are common. 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. 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 southern portion of the Study Area consisted of wheat paddocks with the odd Pepper Tree and White Cypress Pine.

#### **3.2 CURRENT DISTURBANCE AND LAND USE**

The majority of the Reconstruction Site 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 years 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.

### **3.3 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 possibly 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.

### **3.4 WILDLIFE CORRIDORS AND 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 are 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 ECOLOGICAL ASSESSMENT SURVEY

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A specialist ecological assessment of the site was undertaken by OzArk Environment and Heritage Management Pty Ltd in 2012 in accordance with OEH's Environmental Impact Assessment requirements. The specialist ecological assessment is attached as **Appendix 2**.

Key findings of the ecological assessment include:

- 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;
- 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) – **Figure 5**. A map of all threatened Flora and Fauna records for the Study Area is shown in **Figure 5**;
  - The Koala is the subject of this SIS. 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 per cent as per the Spot Assessment Technique, with one mature male Koala recorded in the Cemetery adjacent to the Study Area. Threats to the Koala were characterised through a 7-Part Test of Significance (TSC Act);
  - 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. 7-Part Tests of Significance (TSC Act) revealed that due to the mobile nature of this species, habitat in the Study Area cannot be considered as critical to its survival and the Proposal will not result in a significant impact to a local population of this species;

- 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. A 7-Part Test of Significance (TSC Act) showed that the Proposal, will not significantly impact a local population of the Grey-headed Flying fox (*Pteropus poliocephalus*). Although a small group was noted in the Reconstruction Site drinking from pooled water in Blackjack Creek, other water sources are located in proximity (i.e. the Namoi River). Due to the mobile nature of this species the Proposal will not result in a significant impact to a local population of this species;
- Threatened Owls (Masked Owl and Barking Owl) are assumed to have suitable habitat in the Study Area based on the variety and number of suitable hollows present and proximity to the Namoi River<sup>1</sup>. 7-Part Tests of Significance (TSC Act) showed that the Proposal, will not significantly impact a local population of these species. Due to the mobile nature of both species, habitat disturbance and the proximity of more suitable habitat (i.e. the Namoi River), it was concluded that the Proposal will not result in a significant impact to a local population of these species.

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<sup>1</sup> Due to extreme winds during the nocturnal assessment call-playback and spotlighting were unsuccessful. Thus the 'precautionary principle' was applied .



## **5 KOALA: THREATENED SPECIES ASSESSMENT**

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### **5.1 DISCUSSION OF CONSERVATION STATUS**

The Koala is listed as 'Vulnerable' under both NSW (TSC Act) and National legislation (EPBC Act), listed as 'Least Concern' under the International Union for Conservation of Nature (IUCN) Red List 2010 and listed as Threatened under the Endangered Species Act 1973 (United States of America).

### **5.2 LOCAL REGIONAL ABUNDANCE**

The town of Gunnedah is known to support a key population of Koalas. *The National Koala Conservation and Management Strategy 2009-2014* identifies the Gunnedah Koala population as a 'significant population'.

As detailed in the *EPBC Act Species Profile and Threats Database for the Koala Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)* (DSEWPac 2012), there are no quantitative estimates of Koala population size for Gunnedah (Curran 1997; Smith 1992). The Gunnedah Koala population was believed to sit at around 3000 animals in 2010. State-wide surveys have indicated that the Gunnedah Koala population is regionally significant (Crowther et al. 2009) and increasing (Smith 1992; Lunney 2009) against the state trend. A recent study confirmed a significant increase in the Gunnedah Koala population in 2006, compared with Koala populations in 1986 (Lunney 2009). Further research has attributed the known unquantified increase in Koala populations in the Gunnedah region to revegetation aimed at addressing soil salinity problems (Lunney et al. 2009). However since this time diminishing availability of habitat, increased vehicle strikes and a heatwave in 2009 led to high Koala mortality (Crowther et al. 2010).

Additional key points outlined in the Smith 1992 relevant to the regional Gunnedah population of Koalas include:

- 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.

### 5.2.1 Conservation in reserves

In NSW Koalas are concentrated on fertile, flat land much of which is outside the reserve system and found on private land (DSEWPac 2010). As identified in the National Koala Conservation and Management Strategy 2009-2014 (DSEWPac 2010) habitat protection on public land is complete in an effort to conserve the Gunnedah koala population.

## 5.3 HABITAT USE

### 5.3.1 Koala Habitat use in the Reconstruction Site

There are several methods of determining the importance of Koala habitat, summarised in **Table 2**. These methods are derived from Phillips (2000b), Callaghan (unpublished) and the *State Environmental Planning Policy No. 44 Koala Habitat Protection* (SEPP 44); as noted in the *Approved Recovery Plan: Recovery Plan for the Koala* (DECC 2009). These methods are not the only available options and they may not be appropriate in all circumstances.

The *Approved Draft Recovery Plan* for the Koala (DECC 2008) provides lists of Koala food trees categorised as primary, secondary and supplementary within Koala Management Areas (KMAs). Primary food trees exhibit a level of use that is significantly higher than that of other Eucalyptus species and is independent of tree density. The Gunnedah LGA is within KMA 6: Western Slopes and Plains. Bimble Box *E. populnea*, Yellow Box (*E. melliodora*), White Box (*E. albens*), Blakely's red gum (*E. blakelyi*) are all found in the Reconstruction Site and adjacent areas. are listed as a secondary food source in this area. Categorising Koala habitat as per Phillips (2000b) the Reconstruction Site is classed as Secondary habitat (class A):

*Primary food tree species present, usually (but not always) growing in association with one or \ more secondary food tree species. Capable of supporting medium density Koala populations ( $\geq 0.10$  Koala/ha but  $< 0.75$  Koala/ha).*

Categorising Koala habitat as per Callaghan (unpublished) the Reconstruction Site is also classed as Secondary habitat (class A):

*Areas of forest or woodland where secondary food tree species alone comprise at least 50% of the overstorey trees (primary Koala food tree species absent). Capable of supporting high to medium-density Koala populations.*

The *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 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.*

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 is well known to support a population of Koalas being the self-proclaimed ‘Koala Capital of the World.’ Furthermore, Poplar Box (*Eucalyptus populnea*) and White Box (*Eucalyptus albens*) recorded in the Reconstruction Site are listed ‘feed tree’ species identified in Schedule 2 of SEPP 44. One Koala was observed in the Cemetery immediately adjacent to the Study Area during the field survey 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.

Thus, the Reconstruction Site has been assessed as being ‘Core Koala habitat’ and identified as an important wildlife corridor (not only for the Koala) facilitating movement within / between urban areas, remnant bushland and the Namoi River (OzArk 2012). The Study Area is considered to be a ‘High Use Activity’ area for with evidence of Koala use at 22 of the 37 Koala habitat trees within Wandobah Reserve in the Study Area. This is a density of 59 per cent as per the SAT technique (Phillips & Callaghan, 1995). One mature male Koala was recorded within the Cemetery, immediately adjacent to the Study Area. 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. Recent collar radio-tracking of Koalas undertaken by Crowther did not result in the tracking of any Koalas in the Reconstruction Site although some were tracked moving into town from the Gunnedah Resource Centre (Crowther pers. comm. 2013). Ongoing research by Crowther indicates that Koalas have occurred in the Reconstruction Site in the past (Crowther pers. comm. 2013 – see **Figure 3**). This is confirmed by the Office of Water and Heritage (OEH) Bionet records in the Reconstruction Site (see **Figure 4**) and by evidence on trees (scats and scratches) in addition to the positive identification of a male Koala. This information confirms that habitat in the Reconstruction Site is used by the local Koala population.

Interactions with the wider Gunnedah population are considered likely due to the interconnecting vegetation that could form movement corridors as discussed previously in Section 3.4.

**Table 2: Classification of the Reconstruction Site using various scientific and legislative methods.**

Method	Area Classification
Phillips (2000b)	Secondary habitat (class A)
Callaghan (unpublished)	Secondary habitat (class A)
SEPP44	Core Koala Habitat
SAT technique (Phillips & Callaghan, 1995).	High Use Activity

### 5.3.2 Koala movements within the Gunnedah Locality

A Study on Koala movements in the Gunnedah locality was published by the Environmental Trust (Restoration) August 2011. Key findings extracted from this study include:

- The GPS tracking data show that koalas are not walking randomly across the landscape, but along the edges of paddocks, roadsides, railway tracks and Travelling Stock Routes (TSRs)
- Koalas are frequently walking across open paddocks to access isolated paddock trees. The level of use of roadside reserves and railway track corridors by koalas highlighted by this study is a major concern as road and rail related injury is one of the highest causes of koala death or entry into care.
- Tracked koalas moved frequently between these plantings, through paddocks to isolated trees and to remnant woodland stands.
- The results of the study show that koalas are moving considerable distances across the landscape, with movement of three to four kilometres over several weeks being a common occurrence. This includes movements to and from

landholder-initiated tree plantings, between plantings, and between old paddock trees and trees along fence lines and remnant tree patches.

- Koalas therefore capitalised on the success of the plantings by using the full diversity of habitat resources available.

## 5.4 ASSESSMENT OF LIKELY IMPACT ON THE KOALA

### 5.4.1 7- Part test and Assessment of Significance

A revised 7-Part Test of Significance for the Koala has been provided as **Table 3**. The test only considers the impact of the Proposal excluding proposed offsets, amelioration or mitigation. Other threatened species considered likely to occur or to have habitat in the Reconstruction Site also had a 7-Part Test of Significance completed to properly characterise the threat to them (**Appendix 2**). It was concluded that no significant impact to a local population of these species would occur as a result of the Proposal.

**Table 3: Revised 7-part test for the Koala**

7-Part Test Criteria	Koala <i>Phascolarctos cinereus</i>
Definition of a Local Population	<ul style="list-style-type: none"> <li>• Local Population: The Gunnedah Koala population was believed to sit at around 3000 animals in 2010. Further information on the local regional abundance of Koalas can be found in Section 5.2 of this SIS.</li> </ul>
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 style="list-style-type: none"> <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. Removing habitat including 'feed trees' and shelter along an identified movement corridor within Core Koala Habitat is considered likely to disrupt the life cycle of the species. In concert with known and predicted threats (See Section 5.5) acting on the Gunnedah Koala population the Proposal may is likely to contribute to the risk of extinction of the local population.</li> </ul>
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.	<ul style="list-style-type: none"> <li>• Not relevant</li> </ul>
3) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: (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 (ii) is likely to substantially and adversely modify the composition of	<ul style="list-style-type: none"> <li>• Not relevant</li> </ul>

7-Part Test Criteria	Koala <i>Phascolarctos cinereus</i>
the ecological community such that its local occurrence is likely to be placed at risk of extinction,	
<p>4) in relation to habitat of a threatened species, population or ecological community:</p> <p>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>(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</p> <p>(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.</p>	<ul style="list-style-type: none"> <li>Core Koala Habitat would be impacted. Impacts are detailed in Section 5.7 of this SIS</li> <li>Habitat is already extremely fragmented and would become further fragmented or isolated. Biodiversity offsets and rehabilitation of the Reconstruction Site would however mitigate against habitat fragmentation. The distance between suitable feed trees and large old trees will however become more fragmented as a result of the Proposal.</li> <li>Koalas will have more appropriate habitat outside of the Study Area that will remain untouched by the Proposal.</li> <li>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.</li> </ul>
5) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).	<ul style="list-style-type: none"> <li>Critical habitat for this species has not been declared. However due to its speciality feeding requirements, any feed trees in Core Koala Habitat are likely to be considered as critical habitat to the species survival.</li> </ul>
6) whether the actions proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.	<ul style="list-style-type: none"> <li>A Koala Recovery Plan (DECC 2008) and National Koala Conservation and Management Strategy 2009–2014 (DEWHA 2009) 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>
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 style="list-style-type: none"> <li>Key threatening processes are addresses in section 5.5 of this SIS. The Proposal does contribute to several key threatening processes</li> </ul>
Conclusion	<ul style="list-style-type: none"> <li>The Proposal is considered likely to cause an impact to a locally occurring population of this species such that it is placed at an increased risk of local extinction. A SIS has been prepared to further characterise the impact to this species.</li> </ul>

## 5.5 CURRENT IMPACTS AND KEY THREATENING PROCESSES

As at January 2013, 36 key threatening processes are listed under the TSC Act. Of these, *Anthropogenic Climate Change*, *Clearing of Native Vegetation*, *Forest Eucalypt Dieback associated with over-abundant psyllids and bell miners*, *High Frequency Fire Resulting in the Disruption of Life Cycle Processes in Plants and Animals* and *Loss of Vegetation Structure and Composition and Predation by the European Red Fox *Vulpes vulpes** are relevant to the Koala. In addition to these listed key threatening processes, a range of other processes are recognised as threatening the survival of the Koala in NSW (see Section 9 below).



Following amendments to Section 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and Section 94 of the TSC Act, which came into effect on 1 November 2005, any actions which lead to the operation or intensification of impacts of a listed key threatening process now require explicit consideration, in terms of whether they are likely to have a significant impact on Koala populations. As such the following KTPs are considered to apply to the Proposal:

- *Anthropogenic Climate Change*

Tree clearing as a result of the Proposal will contribute to anthropogenic Climate Change (albeit slightly). The Carbon sequestration of older larger trees is greater than those to be planted as part of the proposed rehabilitation. Climate change will have an unknown affect on the Gunnedah Koala population. The forecasted increase in maximum temperatures and catastrophic weather events as a result of Climate Change would result in more frequent and intense heat waves. This may contribute to Koala deaths associated with heat exhaustion and dehydration.

- *Clearing of Native Vegetation*

The clearing of native vegetation 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 as a threatening process. Koalas prefer larger old-growth trees for feed trees and shelter and as such, the clearing of native vegetation as a result of the Proposal is likely to contribute to habitat removal and population stress contributing to the Koalas decline.

- *Predation by the European Red Fox *Vulpes vulpes*;*

The removal of trees is likely to increase the Koalas vulnerability to foxes during periods of movement along the ground.

As at January 2012, 19 key threatening processes are listed under the EPBC Act. Of these, Predation by *European red fox*, *Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases* and *Land clearance* are relevant to the Koala. In addition to these listed key threatening processes, a range of other processes are recognised as threatening the survival of the Koala in NSW. Current threats to the Gunnedah Koala population include:

Current threats to the Gunnedah Koala population include:

- Pressure on available habitat;

- Vehicle strike;
- Bushfire.
- Chlamydia. The NSW Office of Environment and Heritage Koala Page note that local extinctions are possible where there is loss of fertility due to Chlamydia.
- Physical Isolation;
- Genetic Isolation;
- Predation;

Future threats to the Gunnedah Koala population have been discussed previously and include:

- Habitat clearing;
- Habitat fragmentation. The NSW Office of Environment and Heritage Koala Page note that local extinctions are possible where there is loss of fertility due to Habitat fragmentation.
- Unknown effect of Climate Change on the Gunnedah Koala population;

The introduction of Chlamydia to the Gunnedah Koala population in 2008 is likely to affect future fecundity and population viability. Finally the impact of forecasted climate change to the local population remains unknown (Lunney and Hutchings 2012; Crowther et al. 2010).

Thus, in an absence of reliable population datasets or population modelling based on current and future threats, all areas of 'Core Koala Habitat' could be considered critical to the species survival. Removal of feed trees including large trees that are preferred by the Koala is considered likely to disrupt the known *important population* of the species contributing to its decline and thus risk of extinction. Riparian vegetation along Blackjack Creek within the Reconstruction Site is also considered to form part of a Koala movement corridor connecting with habitat along the Namoi River and vegetated hills and ridgelines south of Gunnedah. Revegetation will attempt to replace Koala habitat (albeit not immediately) as Koalas are not restricted to using old-growth eucalypts and will frequently use 10 to 20 year-old tree plantings (Crowther and Lunney 2006).

## **5.6 RELEVANT PLANS, POLICES AND DOCUMENTS**

Several plans and documents exist that relate to the Koala as identified on the EPBC website 'Species Profile for the Koala', include:

- Recovery plan for the Koala (*Phascolarctos cinereus*) (New South Wales Department of Environment and Climate Change (NSW DECC), 2008) [State Species Management Plan].

- Update on information relating to status of the Koala since listing advice provided to Minister on 30 September 2010 and incorporating outcomes of the Senate inquiry (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2011ad) [Information Sheet].
- Koala distribution map - colour (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2012c) [Information Sheet].
- Koala distribution map - b/w (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2012d) [Information Sheet].
- National Koala Conservation and Management Strategy 2009-2014 (Natural Resource Management Ministerial Council (NRMMC), 2009) [Information Sheet].
- Threatened Species Scientific Committee letter to the Minister that accompanied the 2010 Listing Advice (Threatened Species Scientific Committee (TSSC), 2010bd) [Information Sheet].
- Assessment of the sensitivity of estimates of the trend in the national Koala population to uncertainty in estimates of the populations at state level (Threatened Species Scientific Committee (TSSC), 2011bi) [Information Sheet].
- Threatened Species Scientific Committee letter to the Minister that accompanied the 2011 Listing Advice (Threatened Species Scientific Committee (TSSC), 2011bk) [Information Sheet].
- Response to the Minister's request for further advice on Koala population boundaries (Threatened Species Scientific Committee (TSSC), 2012q) [Information Sheet].
- Rationale for recommendation by the TSSC to determine that the combined Koala population in Queensland, NSW and the ACT be considered a species for the purposes of the Environment Protection and Biodiversity Conservation Act 1999 (Threatened Species Scientific Committee (TSSC), 2012r) [Information Sheet].
- Threatened Species Scientific Committee letter to the Minister that accompanied the 2012 Listing Advice (Threatened Species Scientific Committee (TSSC), 2012s) [Information Sheet].



- Survey Guidelines for Australia's Threatened Mammals. EPBC Act survey guidelines (Department of the Environment, Water, Heritage and the Arts (DEWHA<sup>2</sup>), 2010l) (Admin Guideline).
- NON-CURRENT Commonwealth Listing Advice on *Phascolarctos cinereus* (Koala) (Threatened Species Scientific Committee (TSSC), 2006jh) [Listing Advice].
- NON-CURRENT Commonwealth Listing Advice on *Phascolarctos cinereus* (Koala) (Threatened Species Scientific Committee (TSSC), 2010bc) [Listing Advice].
- Commonwealth Conservation Advice on *Phascolarctos cinereus* (combined population in Queensland, New South Wales and the Australian Capital Territory) (Threatened Species Scientific Committee (TSSC), 2012o) [Conservation Advice].
- Listing advice for *Phascolarctos cinereus* (Koala) (Threatened Species Scientific Committee (TSSC), 2012p) [Listing Advice].

#### 5.6.1 Consistency with the Approved Recovery Plan: Recovery Plan for the Koala (DECC 2009)

The consistency of the Proposal with the recovery objectives within the *Approved Recovery Plan: Recovery Plan for the Koala* (DECC 2009) are listed in **Table 4**.

**Table 4: Recovery objectives within the Approved Recovery Plan: Recovery Plan for the Koala (DECC 2009)**

National Koala Recovery Strategy – Recovery Actions Objectives	Consistency with Plan	Comments
• <b>Objective 1: Conserve Koalas in their existing habitat</b>	Not consistent	The Reconstruction Site has been deemed 'Core Koala Habitat'. Potential project alternatives that conserve habitat important for Koala conservation have not been selected as the preferred option.
➤ Specific objective 1a: Identify and conserve habitat important for Koala conservation	Not consistent	The Reconstruction Site has been deemed 'Core Koala Habitat'. Potential project alternatives that conserve habitat important for Koala conservation have not been selected as the preferred option.
➤ Specific objective 1b: Assess the impact of habitat loss and fragmentation on Koala populations	N/A	The works could potentially contribute to current research being undertaken.
➤ Specific objective 1c: Integrate Koala habitat conservation into local and state government planning processes	Not consistent	The potential conservation of Koala habitat in the Reconstruction Site has not been integrated into local and state government planning processes. The proposed rehabilitation of the site will however take into account:

<sup>2</sup> Also now SEWPaC

National Koala Recovery Strategy – Recovery Actions Objectives	Consistency with Plan	Comments
		<ul style="list-style-type: none"> <li>The Comprehensive Koala Plan of Management currently being developed by Gunnedah Shire Council in accordance with State Environmental Planning Policy No. 44 Koala Habitat Protection (SEPP 44).</li> <li>The Approved Recovery Plan: Recovery Plan for the Koala (DECC 2009) ; and</li> <li>Crowther et al 2010 advice on the successful revegetation for the Koala in the Gunnedah area.</li> </ul>
➤ Specific objective 1d: Develop appropriate road risk management in Koala habitat	Consistent	Vehicle and heavy machinery collisions will be reduced via mitigation measures during the construction phase of the Proposal.
➤ Specific objective 1f: Develop and implement strategies to reduce the impact of fires on Koala populations	N/A	Bushfire Risk will be reduced via mitigation measures during the construction phase of the Proposal.
• <b>Objective 2: Rehabilitate and restore Koala habitat and populations</b>	Impartial	Rehabilitation and offsetting impacts of Koala habitat would occur. There would however be a 10-20 year time lag until the habitat could be considered likely to be utilised by the Koala population.
➤ Specific objective 2a: Revegetate and rehabilitate selected sites	Consistent	Rehabilitation and offsetting impacts of Koala habitat would occur. There would however be a 10-20 year time lag until the habitat could be considered likely to be utilised by the Koala population.
➤ Specific objective 2b: Make appropriate use of translocation	Consistent	A translocation proposal consistent with the NPWS Policy for the Translocation of Threatened Fauna in NSW (NPWS 2001b) will be prepared for any proposed movement of Koalas. It is unlikely that Koala translocation to elsewhere within the Gunnedah Koala population would be required.
• <b>Objective 3: Develop a better understanding of the conservation biology of Koalas</b>	N/A	
• <b>Objective 4: Ensure that the community has access to factual information about the distribution, conservation and management of Koalas at a national, state and local level</b>	Impartial	Consultation regarding the Proposal will be ongoing. The economic and non-biological value of the Koala in the community requires further consideration. I.e. does the community outweigh flood security in preference to retaining large hollow bearing trees within Core Koala Habitat. Consultation will contribute to the Community Survey being undertaken as part of the Comprehensive Koala Plan of Management to be prepared by Gunnedah Shire Council in accordance with State Environmental Planning Policy No. 44 Koala Habitat Protection (SEPP 44).
➤ Specific objective 4a: Prepare and distribute educational material and involve the community in Koala conservation	Impartial	Consultation regarding the Action will be ongoing. Consultation will contribute to the Community Survey being undertaken as part of the Comprehensive Koala Plan of Management to be prepared by Gunnedah Shire Council in accordance with State Environmental Planning Policy No. 44 Koala Habitat Protection (SEPP 44).
➤ Specific objective 4b: Understand the cultural	Impartial	Consultation regarding the Proposal will be ongoing.

National Koala Recovery Strategy – Recovery Actions Objectives	Consistency with Plan	Comments
significance of Koalas		
<ul style="list-style-type: none"> <li><b>Objective 5: Manage captive, sick or injured Koalas and orphaned wild Koalas to ensure consistent and high standards of care</b></li> </ul>	Consistent	Accredited and licensed wildlife rehabilitation groups will continue to rescue and rehabilitate injured, orphaned and/or diseased Koalas according to the NPWS policy Koala Care in NSW: Guidelines and Conditions (Lunney and Matthews 1997), including an upgraded recording system.
<ul style="list-style-type: none"> <li><b>Objective 6: Manage over-browsing to prevent both Koala starvation and ecosystem damage in discrete patches of habitat</b></li> </ul>	N/A	
<ul style="list-style-type: none"> <li><b>Objective 7: Coordinate, promote the implementation, and monitor the effectiveness of the NSW Koala Recovery Plan across New South Wales</b></li> </ul>	N/A	

## 5.7 DIRECT IMPACTS AS A RESULT OF THE PROPOSAL

### 5.7.1 Habitat Removal

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 5**). This equates to an area of approximately 6.5 ha of ‘Core Koala Habitat’ (941 metres by 70 metres) in the reconstruction Site

The entire length of Blackjack Creek in the Reconstruction Site will however be impacted (approximately 13.3 hectares). However the difference of 6.8 hectares (in its current state) is not considered Koala habitat due to current land-use and clearing.

In addition to those habitat trees identified in **Table 5** additional non-hollow bearing trees / shrubs within the Impact Footprint are listed in **Table 6**. Despite the fact that most of the species listed in **Table 6** are planted, they still provide valuable habitat and flowering resources for threatened species and combat dryland salinity in the Study Area.

**Table 5: Habitat values in the Study Area including evidence of Koala activity in the 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
T3	E. populnea	236391	6569157	HHV, 1 M-L, 1S		
T4	E. populnea	236376	6569144	MHV, 3M, 2S		



Tree Number	Species	Easting	Northing	Habitat/ Hollows	Koala Evidence	Habitat notes
T5	E. blakelyi	236333	6569100	LHV	Yes. Scratch, Scat	Advanced regeneration
T6	E. blakelyi	236333	6569950	LHV	Yes. Scratch, Scat	Advanced regeneration
T7	E. populnea	236292	6569051	MHV, 3M, 3S		Half dead.
T8	E. populnea	236256	6569000	LHV		Advanced regeneration
T9	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 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

Tree Number	Species	Easting	Northing	Habitat/ Hollows	Koala Evidence	Habitat notes
T36	E. populnea	236338	6569124	MHV, 3M		
T37	E. populnea	236345	6569169	MHV,2M,3S	Yes. Scratch, Scats	Possible Aboriginal Scarred Tree

**Table 6: Additional trees / shrubs advanced regrowth in the Impact Footprint.**

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

### 5.7.2 Impact to Wildlife Corridors and Connectivity

Connectivity associated with Blackjack Creek in the Study Area is already restricted by land clearing and houses along Wandobah Road.

In the context of Koala habitat connectivity, Wandobah Reserve is considered to have interconnecting habitat with other 'Core Koala Habitat' within the locality. Removing feed trees along 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 dependant 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.

## 5.8 INDIRECT IMPACTS AS A RESULT OF THE PROPOSAL

Other possible impacts to the Koala include:

- Increased human disturbance to areas of native vegetation;



- Increased risk of vehicular strike during the construction phase of the Proposal.
- Increased risk to ground predators as a result of large tree removal.
- Weed-invasion, rubbish dumping or accidental damage during construction, and associated edge effects;
- Loss of any retained vegetation as a result of changed environmental conditions, particularly through weed invasion or altered hydrology;
- Altered fire or other disturbance regimes associated with increased human activity;
- Degradation of habitat values in the local area due to incremental loss of remnant vegetation.
- Reduction in viability of retained habitat.
- Reduced viability of some fauna species on the site in the longer term due to reductions in population size and reduced habitat area.
- Improvement in size of Koala habitat and 'feed trees' through riparian rehabilitation and biodiversity offsets.

## **6 OFFSETS**

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### **6.1 PROPOSED BIODIVERSITY OFFSETS**

- 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 offsetting of subsequent developments in future.

The following Biodiversity Offsets should be implemented:

- Primary feed trees for Koalas 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 Gunnedah revegetation programs;
  - The Biodiversity Offset Area would be selected in consultation with Gunnedah Shire Council, Landcare and other interest groups in light of information provided within the Koala Recovery Plan and secured in perpetuity.
- 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.
- Habitat values (small, medium and large hollows) of hollow bearing trees are to be replaced at a 1:1 ratio with nest boxes of equivalent size. 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;

- Rehabilitation of disturbed areas and riparian vegetation will occur along the length of Blackjack Creek in the Reconstruction Site. Trees to be planted as part of the riparian rehabilitation will include River Red Gum (*Eucalyptus cameldulensis*), a preferred Koala feed tree. Thus Koala habitat offsets will also occur the whole length of creek in the Reconstruction Site 1900 m x 70 m = 13.3 ha

## 6.2 RELEVANT POLICY

There are the policies that need consideration with respect to offsets:

1. OEH<sup>3</sup> *Principles for the use of biodiversity offsets in NSW* ('OEH Offset Principles').
2. *Biodiversity Offset Policy' for the Namoi Catchment'* (Namoi CMA 2011)
3. EPBC *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* October 2012

EPBC offsets are considered in the Referral to the DSEWPaC Minister. It should be noted that under the EPBC Act Environmental Offsets Policy (DSEWPaC October 2012) the minimum (90%) direct offset requirement have been met for the Protected Matter Attributes *Area of Habitat* and *Koala Feed Trees*.

### 6.2.1 Namoi CMA Biodiversity Offsets Policy 2011

Namoi CMA has recently ratified a '*Biodiversity Offset Policy' for the Namoi Catchment'* (Namoi CMA 2011). 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,
  - g) 30% (in cleared sub-catchments) woody native vegetation extent threshold
  - h) 70% (in intact sub-catchments) woody native vegetation extent threshold
  - i) 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.

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<sup>3</sup> Formerly DECCW.



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.

### 6.2.2 OEH Offset Principles

The consistency of the Proposal with the *Principles for the use of biodiversity offsets in NSW* ('OEH Offset Principles') are indicated in **Table 7**.

**Table 7: OEH Offset Principles**

Principle	Consideration	Consistency
1 Impacts must be avoided first by using prevention and mitigation measures.	Offsets are then used to address remaining impacts. This may include modifying the proposal to avoid an area of biodiversity value or putting in place measures to prevent offsite impacts.	<b>Inconsistent.</b> The Reconstruction Site has been deemed 'Core Koala Habitat'. Potential project alternatives that conserve habitat important for Koala conservation have not been selected as the preferred option.
2 All regulatory requirements must be met.	Offsets cannot be used to satisfy approvals or assessments under other legislation, e.g. assessment requirements for Aboriginal heritage sites, pollution or other environmental impacts (unless specifically provided for by legislation or additional approvals).	Consistent. Assessment of the Proposal under Part 5 of the EP&A Act would ensure all regulatory requirements are met.
3 Offsets must never reward ongoing poor performance.	Offset schemes should not encourage landholders to deliberately degrade or mismanage offset areas in order to increase the value from the offset.	Consistent.
4 Offsets will complement other government programs.	A range of tools is required to achieve the NSW Governments conservation objectives, including the establishment and management of new national parks, nature reserves, state conservation areas and regional parks and incentives for private landholders.	Consistent The proposed offset areas on private land is will be afforded long term protection though acquisition by Gunnedah Shire Council. By offsetting, habitat values (hollows), Core Koala Habitat and area of habitat and addressing KTPs, the offset package is consistent with NSW government programmes.
5 Offsets must be underpinned by sound ecological principles.	They must: <ul style="list-style-type: none"> <li>include the consideration of structure, function and compositional elements of biodiversity, including threatened species</li> <li>enhance biodiversity at a range of scales</li> <li>consider the conservation status of ecological communities</li> <li>ensure the long-term viability and functionality of biodiversity.</li> </ul> Biodiversity management actions, such as enhancement of existing habitat and securing and managing land of conservation value for biodiversity, can be suitable offsets. Reconstruction of ecological communities involves high risks and uncertainties for biodiversity outcomes and is generally less preferable than other management strategies, such as enhancing existing habitat.	Consistent The volume of requisite offsets has not been identified by using the BioBanking Assessment Methodology. It should be noted that under the EPBC Act Environmental Offsets Policy (DSEWPaC October 2012) the minimum (90%) direct offset requirement have been met for the Protected Matter Attributes Area of Habitat and Koala Feed Trees. Offsets aim to rehabilitate and revegetate the riparian environment in addition to offsetting habitat attributes such as hollows and Core Koala

Principle	Consideration	Consistency
		Habitat. The offsets would be managed through a Land Management Plan thus ensuring long term viability of the proposal. Based on known studies undertaken in the Gunnedah locality on the success of koala feed tree plantings, it is likely that the offset strategy will be successful.
6 Offsets should aim to result in a net improvement in biodiversity over time.	Enhancement of biodiversity in offset areas should be equal to or greater than the loss in biodiversity from the impact site. Setting aside areas for biodiversity conservation without additional management or increased security is generally not sufficient to offset against the loss of biodiversity. Factors to consider include protection of existing biodiversity (removal of threats), time-lag effects, and the uncertainties and risks associated with actions such as revegetation. Offsets may include enhancing habitat, reconstructing habitat in strategic areas to link areas of conservation value, or increasing buffer zones around areas of conservation value and removal of threats by conservation agreements or reservation.	Consistent. All comments in the row above are relevant for this principle.
7 Offsets must be enduring - they must offset the impact of the development for the period that the impact occurs.	As impacts on biodiversity are likely to be permanent, the offset should also be permanent and secured by a conservation agreement or reservation and management for biodiversity. Where land is donated to a public authority or a private conservation organisation and managed as a biodiversity offset, it should be accompanied by resources for its management. Offsetting should only proceed if an appropriate legal mechanism or instrument is used to secure the required actions.	Consistent Proposed offsets are not afforded long term protection though land tenure. Commitments have been made to secure the offset in perpetuity; this would maintain the offset once the quarry is decommissioned.  Consistent (Land Management Plan). Proposed offsets are afforded long term protection though the Land Management Plan. Commitment to maintain the offsets once the Proposal is complete requires documentation.
8 Offsets should be agreed prior to the impact occurring.	Offsets should minimise ecological risks from time-lags. The feasibility and in-principle agreements to the necessary offset actions should be demonstrated prior to the approval of the impact. Legal commitments to the offset actions should be entered into prior to the commencement of works under approval.	Consistent. The Proponent has agreed to the offsets stated in the Review of Environmental factors and specialist ecological report
9 Offsets must be quantifiable - the impacts and benefits must be reliably estimated.	Offsets should be based on quantitative assessment of the loss in biodiversity from the clearing or other development and the gain in biodiversity from the offset. The methodology must be based on the best available science, be reliable and used for calculating both the loss from the development and the gain from the offset. The methodology should include:	Consistent. The details of the offsets have been reliably estimated through GIS software and site visit.

Principle	Consideration	Consistency
	<ul style="list-style-type: none"> <li>the area of impact</li> <li>the types of ecological communities and habitat/species affected</li> <li>connectivity with other areas of habitat/corridors</li> <li>the condition of habitat</li> <li>the conservation status and/or scarcity/rarity of ecological communities</li> <li>management actions</li> <li>level of security afforded to the offset site.</li> </ul> <p>The best available information/data should be used when assessing impacts of biodiversity loss and gains from offsets. Offsets will be of greater value where:</p> <ul style="list-style-type: none"> <li>they protect land with high conservation significance</li> <li>management actions have greater benefits for biodiversity</li> <li>the offset areas are not isolated or fragmented</li> <li>the management for biodiversity is in perpetuity (e.g. secured through a conservation agreement).</li> </ul> <p>Management actions must be deliverable and enforceable.</p>	
10 Offsets must be targeted.	They must offset impacts on the basis of like-for-like or better conservation outcome. Offsets should be targeted according to biodiversity priorities in the area, based on the conservation status of the ecological community, the presence of threatened species or their habitat, connectivity and the potential to enhance condition by management actions and the removal of threats. Only ecological communities that are equal or greater in conservation status to the type of ecological community lost can be used for offsets. One type of environmental benefit cannot be traded for another: for example, biodiversity offsets may also result in improvements in water quality or salinity but these benefits do not reduce the biodiversity offset requirements.	Consistent. Offsets are like for like and would achieve a positive income for the Koala and other threatened species that utilise similar habitat. The type and location of offsets proposed is based on current scientific studies undertaken on Koalas in the Gunnedah locality and aims to integrate into existing Koala management plans. Salinity issues will be addressed along Blackjack creek via creek rehabilitation with salt tolerant species that may also provide forage or shelter to the Koala.
11 Offsets must be located appropriately.	Wherever possible, offsets should be located in areas that have the same or similar ecological characteristics as the area affected by the development.	Consistent. Impacts would be offset in the immediate area on the same property. In addition to this, offsets would be aimed at linking remnant habitat with created habitat in the Reconstruction site in an effort to improve connectivity.
12 Offsets must be supplementary.	They must be beyond existing requirements and not already funded under another scheme. Areas that have received incentive funds cannot be used for offsets. Existing protected areas on private land cannot be used for offsets unless additional security or management actions are implemented. Areas already managed by the government, such as national parks, flora reserves and public open	Consistent. Proposed and existing offsets are surplus to impacts and are not already funded or have been funded or considered previously for funding.



Principle	Consideration	Consistency
	space cannot be used as offsets.	
13 Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.	Offsets must be audited to ensure that the actions have been carried out, and monitored to determine that the actions are leading to positive biodiversity outcomes.	Consistent. Assessment of this project under Part 5 of the EP&A Act and the OEH Offset Principles ensures all conditions of consent requirements are met.

### **6.3 EFFECTIVENESS OF OFFSETS**

As detailed in Section 5.3.2, studies undertaken on environmental plantings in the Gunnedah locality (Environmental Trust 2011) support the likelihood that rehabilitation, revegetation and biodiversity offsetting in the Reconstruction Area and beyond will be successful.

Thus, in light of these findings, it is highly likely that Koalas will capitalise on the success of plantings by using the full diversity of habitat resources available.

Offsets for Koala habitat have been targeted to improve habitat extent, connectivity, and supplement primary food trees. Land in which the Biodiversity Offsets will be implemented are partly administered by the Gunnedah Shire Council with the remainder to be acquired. Thus, covenants or zoning conditions can and will be placed on the land to secure it in perpetuity.

## 7 MITIGATION MEASURES

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The ecological assessment conducted by OzArk (OzArk 2012) recommended that Gunnedah Shire Council do not impact large hollow bearing trees in the Reconstruction Site and consider redesigning the Proposal to avoid hollow bearing trees and minimise the amount and type of clearing to reduce the impact to 'Core Koala Habitat'. Maintaining the existing alignment of Blackjack Creek appears the most ecologically sensible.

In light of the development seeking approval, mitigation measures relevant to the Koala include:

- A Koala Plan of Management (KPoM) 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;
  - As part of the KPoM a site induction of all personnel should occur, to ensure that koalas are protected within the Reconstruction Site.
- Thorough inspection of all trees to be trimmed or removed for the presence of Koalas or other fauna immediately prior to clearance;
  - A suitable qualified person able to identify Koalas will ensure that no Koalas are located in trees to be felled or pruned, or in trees with overlapping crowns. Searches will be conducted prior to every tree removal. Searches will be overseen and checked off by the Project Manager. Where a Koala is present, Koalas will be allowed to move out of trees that are to be cleared or pruned on their own accord, generally over night.
- An increased risk of vehicle collision exists within and directly adjacent to the Reconstruction Site during the construction phase of the Action. A significant increase of vehicular (including plant machinery) movements throughout the Reconstruction Site may occur during this period.
  - All machinery within the reconstruction Site will be speed limited to a maximum of 20 km/h to reduce the risk of collision with koalas.
  - Fencing off the Reconstruction Site may assist in preventing Koala access to the site.
- All food scraps and rubbish are to be appropriately disposed of in sealed receptacles to prevent the provision of forage habitat for foxes and dogs and thus reduce the risk of predation to the Koala.



Further mitigation measures specific to the ecology of the site can be found in the Ecological assessment (**Appendix 2**). Mitigation measures to be implemented as part of the Proposal can be found in the REF (**Appendix 3**).

## **8 ADDITIONAL INFORMATION**

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### **8.1 QUALIFICATIONS AND EXPERIENCE OF OZARK STAFF**

The 2012 ecological field assessment and SIS report preparation was undertaken by Heidi Kolkert (ecologist) of OzArk. Qualifications: Bachelor of Arts, Bachelor of Science (Honours). Heidi Kolkert has worked as a specialist ecological consultant for OzArk for approximately five years.

See attached resume **Appendix 4**

### **8.2 LICENSING MATTERS**

OzArk staff hold current NSW Department of Primary Industries (NSW I & I) Ethics Approval No 07/1601, NSW Scientific Research Licence 11194, OEH Data Licence No CON99042 and an Animal Research Approval. Heidi is a Practising Member of NSW Ecological Consulting Society.

### **8.3 SECTION 110 (5) REPORTS**

Section 110(5) of the TSC Act states that

*"The requirements of subsections (2) and (3) in relation to information concerning the State-wide conservation status of any species or population, or any ecological community, are taken to be satisfied by the information in that regard supplied to the principal author of the species impact statement by the National Parks and Wildlife Service, which information that Service is by this subsection authorised and required to provide".*

The information provided by the OEH in fulfilment of this requirement is available at <http://www.environment.nsw.gov.au/threatenedspecies/>. This website provides profiles for threatened species, populations and ecological communities, and links to more detailed information.

Information provided by the OEH has been utilised in the preparation of this report and is cited where appropriate.

### **8.4 ADDITIONAL APPROVALS**

The Proposal has been referred to the Commonwealth of Australia as a controlled action in respect to Sections 18 and 18A listed threatened species and ecological communities) of the EPBC Act (Commonwealth of Australia 2001).

There are no other approvals relating to terrestrial flora and fauna required for the Proposal.

It is recommended that the following form Conditions of Consent (CoC) for development Approval:

- Mitigation measures, and biodiversity offsets as per this SIS and ecological report (OzArk 2012) are implements
- A Koala Plan of Management is implemented prior to project commencement.
- Biodiversity offset areas are be secured in perpetuity prior to project commencement



## 9 PROVISION OF RELEVANT PLANS AND MAPS

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**Figure 1** identifies the location of the Reconstruction Site whilst **Figure 2** is an aerial overview of the Impact Footprint within the Reconstruction Site. **Figure 3** shows Koala distribution in the Gunnedah locality, **Figure 4** Bionet / Wildlife Atlas Recorded Flora & Fauna in proximity to the Reconstruction Site and **Figure 5** shows the location of threatened Fauna and Koala habitat trees within the Reconstruction Site.

Figure 1: Location of the Reconstruction Site.

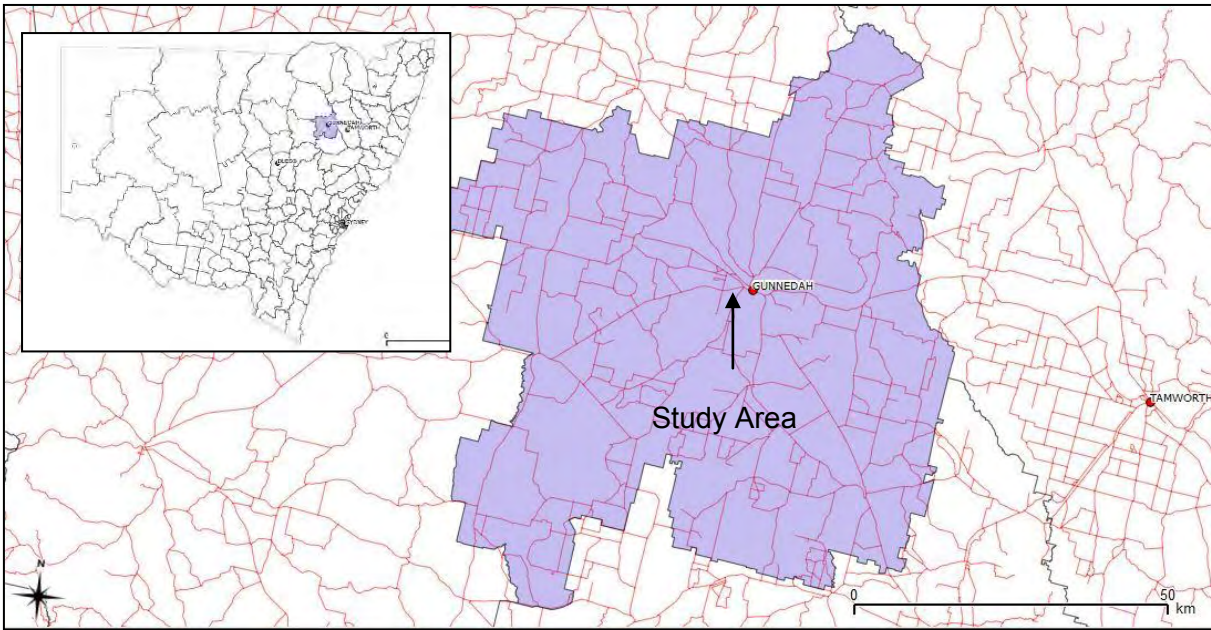
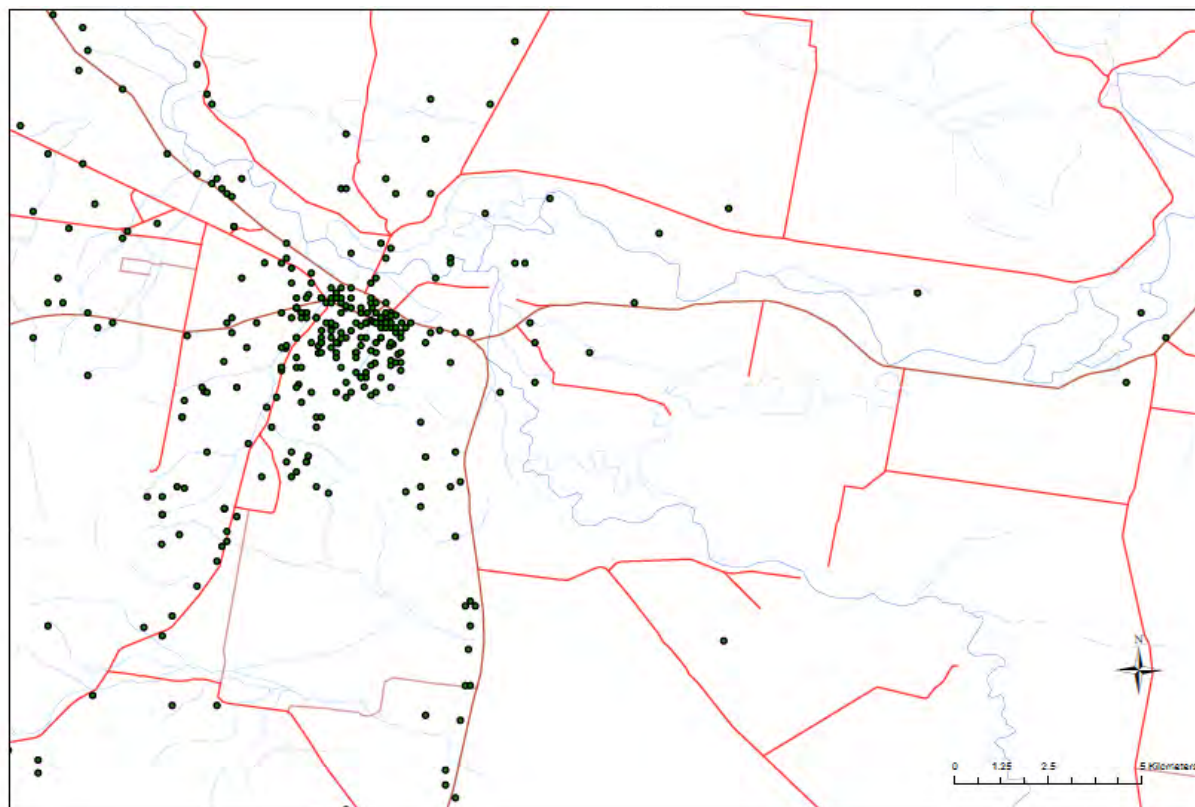


Figure 2: Arial view of the Reconstruction Site showing realignment.



**Figure 3: Koala distribution in the Gunnedah locality (Crowther pers. comm. 2013).**





**Figure 4: Bionet/Wildlife Atlas Recorded Flora & Fauna, Namoi CMA Liverpool Plains (Part B) subregion (Base map source: © Google Earth).**





Figure 5: Location of threatened flora and fauna recorded during the assessment.



## 10 CONCLUSION

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The Gunnedah Koala population is both regionally significant (Crowther et al. 2009) and nationally significant (DSEWPaC 2010). The Reconstruction Site has been classified as 'Core Koala Habitat' under the SEPP 44 – koala habitat guidelines in addition to being identified as an area of 'High Use Activity' through field survey. In an absence of reliable population datasets or population modelling based on current and future threats, all areas of 'Core Koala Habitat' could be considered critical to the species survival. Removal of feed trees including large trees that are preferred by the koala is considered likely to disrupt the known *local population* of the species, contributing to its decline and thus risk of extinction.

Consideration also needs to be given to connectivity. Riparian vegetation along Blackjack Creek within the Reconstruction Site is also considered to form part of a koala movement corridor connecting with habitat along the Namoi River and vegetated hills and ridgelines south of Gunnedah. It is highly likely that the habitat within the Reconstruction Site facilitates Koala movement within the landscape. Revegetation will attempt to replace koala habitat (albeit not immediately) as koalas are not restricted to using old-growth eucalypts and will frequently use 10 to 20 year-old tree plantings (Crowther and Lunney 2006). Although biodiversity offsets compensate for the impact to Koala habitat, Koala 'feed trees' and in the long-term may potentially improve connectivity, the time lag between planting and use may be too great when considering the vulnerability of this species to decline. Finally, the large hollow bearing trees important for many threatened fauna species not just the Koala are considered to have high ecological values and have not been avoided in the design stage of the Proposal.



## 11 REFERENCES

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- Crowther, M.S., D. Lunney, J. Lemon, R. Wheeler & G. Madani (2010). Restoration of koala habitat in Gunnedah II: movement of koalas across a patchy rural landscape. In: Australian Mammal Society 56th Meeting. Canberra, ACT.
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Threatened Species Scientific Committee (TSSC), (2012). Listing advice for *Phascolarctos cinereus* (Koala) (Threatened Species Scientific Committee (TSSC), 2012p) [Listing Advice].

## **APPENDIX 1: CONTENT OF SPECIES IMPACT STATEMENT**

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Items	Section of SIS
1. A species impact statement must include a full description of the action proposed, including its nature, extent, location, timing and layout and, to the fullest extent reasonably practicable, the information referred to in this section.	Section 2
2. A species impact statement must include the following information as to threatened species and populations:	N/A
a) a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action,	Section 5.2
b) an assessment of which threatened species or populations known or likely to be present in the area are likely to be affected by the action,	Section 4
c) for each species or population likely to be affected, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it,	Section 5
d) an estimate of the local and regional abundance of those species or populations,	Section 5.2
e) an assessment of whether those species or populations are adequately represented in conservation reserves (or other similar protected areas) in the region,	Section 5.2.1
(e1) an assessment of whether any of those species or populations is at the limit of its known distribution,	Section 5.3.2
f) a full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region,	Section 5.3
g) a full assessment of the likely effect of the action on those species and populations, including, if possible, the quantitative effect of local populations in the cumulative effect in the region,	Section 5.5 and 5.7.

h)	a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development,	Section 2.5.2
i)	a full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations, including a compilation (in a single section of the statement) of those measures,	Section 7
j)	a list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species or population.	Section 9
3.	<p>A species impact statement must include the following information as to ecological communities:</p> <ul style="list-style-type: none"> <li>a) a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action,</li> <li>b) for each ecological community present, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or any threat abatement plan applying to it,</li> <li>(b1) an assessment of whether those ecological communities are adequately represented in conservation reserves (or other similar protected areas) in the region,</li> <li>(b2) an assessment of whether any of those ecological communities is at the limit of its known distribution,</li> <li>c) a full description of the type, location, size and condition of the habitat of the ecological community and details of the distribution and condition of similar habitats in the region,</li> <li>d) a full assessment of the likely effect of the action on the ecological community, including, if possible, the quantitative effect of local populations in the cumulative effect in the region,</li> <li>e) a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development,</li> <li>f) a full description and justification of the measures proposed to mitigate any adverse effect of the action on the ecological community, including a compilation (in a single section of the</li> </ul>	This section is not applicable.

<p>statement) of those measures,</p> <p>g) a list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the ecological community.</p>	
<p>4. A species impact statement must include details of the qualifications and experience in threatened species conservation of the person preparing the statement and of any other person who has conducted research or investigations relied on in preparing the statement.</p>	<p>Section 7.2 and Appendix 4</p>
<p>5. The requirements of subsections (2) and (3) in relation to information concerning the State-wide conservation status of any species or population, or any ecological community, are taken to be satisfied by the information in that regard supplied to the principal author of the species impact statement by the National Parks and Wildlife Service, which information that Service is by this subsection authorised and required to provide.</p>	<p>Section 4 and Appendix 2.</p>



## **APPENDIX 2: ECOLOGICAL REPORT (OzARK 2012)**

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Attached as a separate document

### **APPENDIX 3: REVIEW OF ENVIRONMENTAL FACTORS (CONSTRUCTIVE SOLUTIONS 2012)**

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Attached as a separate document

## **APPENDIX 4: RESUME OF HEIDI KOLKERT**

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## **APPENDIX K**

### **AHIMS Search**

Constructive Solutions  
Po Box 1498  
Tamworth New South Wales 2340

Date: 23 April 2012

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:

<b>0</b>	<b>Aboriginal sites are recorded in or near the above location.</b>
<b>0</b>	<b>Aboriginal places have been declared in or near the above location. *</b>

**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) (<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 to 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.