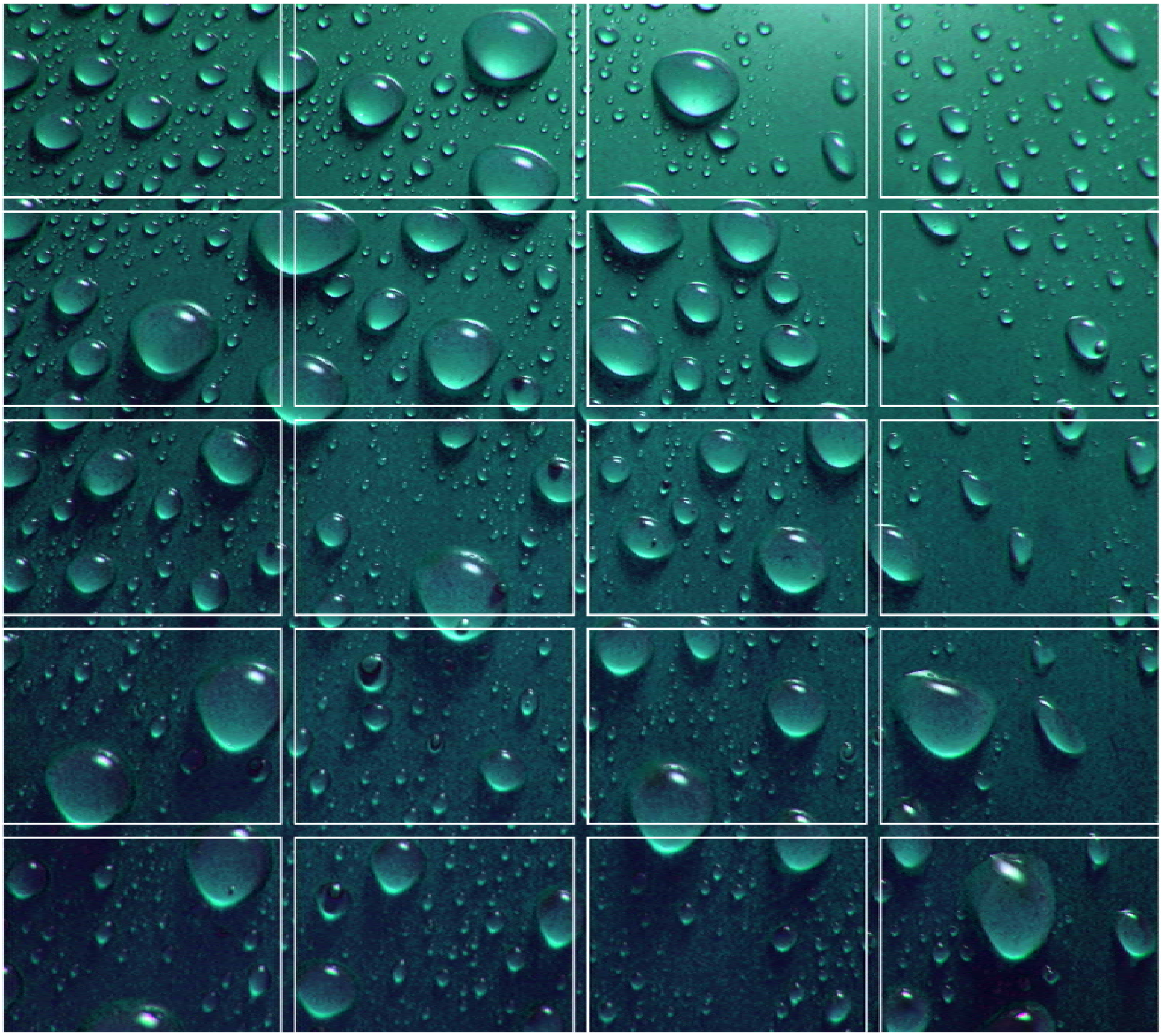

Paling Yards Wind Farm

Hydrological Assessment

For Union Fenosa Wind Australia Pty Ltd

March 2013

0131035_Hydrology_R01

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ERM

Paling Yards Wind Farm

Hydrological Assessment

Union Fenosa Wind Australia Pty Ltd

March 2013

0131035_Hydrology_R01

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Prepared by:	*Adam Coburn*
Position:	*Project Manager*
Signed:	
Date:	*26 March, 2013*
Approved by:	*Murray Curtis*
Position:	*Partner*
Signed:	
Date:	*26 March, 2013*

Environmental Resources Management Australia Pty Ltd Quality System

FINAL REPORT

Union Fenosa Wind Australia Pty Ltd

Paling Yards Wind Farm

Hydrological Assessment

26 March 2013

Reference: 0131035_hydrology_R01

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EXECUTIVE SUMMARY

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Union Fenosa Wind Australia Pty Ltd (UFWA) to undertake a hydrological assessment for the proposed Paling Yards Wind Farm (The Project). The Project comprises up to 59 wind turbine generators (WTGs) located on two properties and the construction of a transmission line along one of four route options.

This hydrological assessment identifies potential water-related risks and appropriate management and mitigation measures to ensure that construction and operation of the proposed wind farm would not result in an unacceptable level of environmental impact.

SITE DESCRIPTION

Landform/Topography

The wind farm site ranges in elevation between 900m and 1065m above sea level and forms part of a prominent elevated plateaux landscape dissected by deep valleys. The geology is characterised by tertiary lava flows forming erosion-resistant basalt caps overlying much older Ordovician and Silurian metasediments.

Transmission line route options 1, 2 and 3 traverse a range of landforms including vegetated, rugged mountainous terrain in the north, near Abercrombie River. Further south the terrain becomes gently undulating with the transmission line options tending to follow ridgelines and existing roads, generally through cleared farming land. A number of broad open valleys and watercourses are traversed. Transmission line route option 4 traverses plateau and ridge lines to the northeast of the wind farm site.

Watercourses

More than 50 ephemeral first order watercourses occur within the proposed Paling Yards Wind Farm site, including the Abercrombie River. These ephemeral first order watercourses exist within open depressions mostly without incised channels or defined bed or banks; they are for the most part stable and well vegetated with pasture grasses. There are very few instances of active erosion along watercourses.

A small number of second and third order watercourses occur within the wind farm site. These occur within defined drainage gullies and larger valleys. The higher order watercourses also tend to be stable and well vegetated, with only minor areas of active erosion.

On the wind farm site the proposed turbines and access tracks are situated in elevated locations such as plateaux areas and along ridge lines and crests. There are no instances where proposed access tracks are required to cross significant watercourses that would require construction of bridges or culverts. There are no crossings of third order or higher watercourses.

Transmission line route options 1, 2 and 3 cross a number of watercourses. Approximately 17 locations where the transmission line crosses third order or higher watercourses are identified across the three options. Option 4 does not cross any third order or higher watercourses.

In consideration of the assessed potential impacts, and concerns raised through the stakeholder consultation process regarding the potential impacts of the proposed extensive transmission line infrastructure leading south towards the Crookwell 2 wind farm substation, UFWA is proposing the Northern Transmission Line Route, (Option 4) due to its shorter length and reduced potential impacts.

WATER REQUIREMENTS

The main water requirements during construction are expected to be for the following activities:

- *concrete production;*
- *construction of roads and hardstands; and*
- *dust suppression.*

The total water demand over the 12 month construction period is estimated at 30 ML. Water use during operation of a wind farm is negligible.

WATER SUPPLY OPTIONS

A number of water supply options have been canvassed, the key options being:

- *surface water collection from existing (or new) dams;*
- *groundwater pumping from existing (or new) bores;*
- *water abstraction from a nearby permanent water source (i.e. Abercrombie River); and*
- *tankering water to site.*

The existing dams at Paling Yards and Mingary Park would be expected to have capacity to provide a good proportion of the project needs in a good rainfall year, though availability may be restricted in a dry year. Construction of a new dam, particularly in a spring fed location, would greatly improve security of surface water supply and would meet the project needs under most rainfall scenarios.

Groundwater supply from a new bore would be capable of supplying a large proportion of the project needs, and this could be considered in combination with use of surface water from existing dams. Surface water could be used when supply is abundant and be supplemented with groundwater when surface storage decreases.

It is unlikely that existing surface water resources or groundwater resources alone could service the project needs; however, options are available to improve surface water collection or pump additional groundwater that would be expected to meet project needs. Further investigation is required to determine the preferred option.

The option of obtaining a water access licence for water abstraction from the Abercrombie River, while feasible, has logistical issues that require further investigation. This would need to assess whether water could be feasibly tankered up the steep road between the river and the site, or whether it could be economically pumped over the distances and elevations required. However, it would seem that the Abercrombie River offers a highly secure source of water for road construction and dust suppression, and that project needs would not be expected to diminish flows to the extent that environmental values or existing water users are adversely affected.

POTENTIAL IMPACTS TO SOIL AND WATER

Potential soil and water impacts were identified and relate mainly to construction activities such as road and turbine construction, trenching for service installation, production and delivery of concrete (and managing concrete wastes) and storage and handling of fuels, oils and other hazardous substances.

A qualitative risk assessment suggests that overall potential risks to water and soils are relatively minor. This is on the basis that:

- *for the most part, works occur on relatively low gradient lands high up in the respective drainage catchments;*
- *there is generally a very low risk of run-on or runoff of concentrated stormwater flows;*
- *construction sites at Paling Yards generally present a low erosion hazard considering factors such as climate, soils and landform;*
- *the landscape of the wind farm is relatively stable with no appreciable erosion;*
- *vegetated buffers over low gradient lands lie between work areas and watercourses;*
- *there is no need to construct vehicle watercourse crossings for any part of the project; and*
- *sustainable water supply options will be pursued through consultation with landowners and relevant Government agencies. Licenses would be obtained as required.*

The identified risks can be managed through implementation of appropriate preventative and management measures. These would be outlined in a construction environmental management plan (CEMP) and soil and water management plan prepared post consent. A conceptual soil and water management plan (SWMP) is provided in this report outlining a range of management practices that would contribute to sound management of the site's soil and water resources.

*SYDNEY CATCHMENT AREA AND **REP1***

Approximately 9 km of the southernmost section of the transmission line route comprising the common part of Options 1, 2 and 3, occurs within the hydrological catchment for Sydney's drinking water supply, as defined in the Drinking Water Catchments Regional Environmental Plan No 1 (REP1).

The proposed transmission line would be constructed across cleared grazing lands and close to existing roadways. Access to individual power poles would be obtained from existing tracks and roads where possible, and otherwise by travelling overland by the most direct or least impact route. Tracks generally would not be formalised unless required over boggy ground. A permanent track would not be constructed along the length of the transmission line. No vehicle watercourse crossings would be constructed and in general there would be no need for works to occur within 20 m of any watercourses, thus affording good buffers between construction activities and sensitive receptors.

Through appropriate management of construction activities including erosion and sediment control, hazardous materials storage and handling, and spill emergency response and clean-up procedures, potential water-related impacts would be contained on-site and prevented from reaching watercourses. These measures will be outlined in a detailed Soil and Water Management Plan to be prepared post consent and before commencement of construction.

It is therefore concluded that the project complies with paragraph (b) of Clause 28(3) of the REP and would maintain a neutral or beneficial effect on water quality.

MITIGATION MEASURES

A summary of recommended management and mitigation measures to address potential soil and water impacts is as follows:

- *prepare a detailed Soil and Water Management Plan (SWMP) prior to construction commencing. The SWMP should be prepared by a suitably qualified person, such as a soil conservationist;*
- *prepare Progressive Erosion and Sediment Control Plans as the project progresses to address management requirements at individual work sites;*
- *design and construct the wind farm and transmission line to minimise land disturbance and therefore reduce the erosion hazard;*
- *stage construction activities to minimise the duration and extent of land disturbance;*
- *manage topsoil resources to minimise the risk of erosion and sedimentation, and maximize reuse of topsoil during rehabilitation;*
- *divert upslope (clean) stormwater around the disturbed site capture sediment-laden runoff from within the disturbed site for diversion to sediment control devices;*

- *rehabilitate the site promptly and progressively as works progress;*
- *inspect and maintain erosion and sediment control devices for the duration of the project;*
- *avoid construction of new vehicle watercourse crossings;*
- *avoid land disturbance within 20 m of minor streams (first and second order watercourses) and 40 m of third order or higher watercourses;*
- *ensure appropriate procedures are in place for the transport, storage and handling of fuels, oils and other hazardous substances, including availability of spill clean-up kits;*
- *minimise disturbance during transmission line construction by using existing access tracks and roads, and avoiding construction of a permanent access track along the transmission line easement;*
- *avoid over-extraction of surface water or groundwater to prevent adverse impacts on environmental flows and water availability for existing licensed users;*
- *obtain any necessary water access licenses; and*
- *ensure appropriate stormwater, collection, treatment and recycling at the concrete batch plant, in accordance with relevant best practice guidelines and any requirements of the NSW Office of Environment and Heritage.*

With the mitigation measures outlined in this report, and given the site characteristics, the overall impact on water resources is expected to be negligible.

1 INTRODUCTION

1.1 BACKGROUND

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Union Fenosa Wind Australia Pty Ltd (UFWA) to undertake a hydrological assessment for the proposed Paling Yards Wind Farm (The Project). The Project comprises up to 59 wind turbine generators (WTGs) located on two properties and the construction of a transmission line along one of four route options. The proposed Paling Yards Wind Farm site is located on the western extent of the Great Dividing Range in NSW, 60km South of Oberon, 60km north of Goulburn and approximately 140 km west of Sydney.

Construction of the proposed Paling Yards Wind Farm has the potential to impact on water resources in several key ways including:

- increasing demand for environmental water during construction;
- sediment pollution of waterways caused by land disturbance and accelerated erosion during construction;
- water pollution caused by improper storage or handling, or incidental spills, of fuels/oils, concrete wastes and other hazardous substances; and
- damage to riparian environments caused by construction activities within and/or near waterways.
- water pollution caused by inadequate management of the site compound facilities waste water and sewage runoff

It is noted that the potential water-related impacts are primarily associated with the construction stage of the project. Once operational, the project will have minimal water usage requirements and limited potential water-related impacts.

This assessment identifies potential water-related risks and appropriate management and mitigation measures to ensure that construction and operation of the proposed wind farm would not result in an unacceptable level of environmental impact. This report will be submitted to the Department of Planning and Infrastructure to support an application for approval of the Project pursuant to Part 3A of the Environmental Planning and Assessment Act 1979 (EPA Act).

1.2 *OBJECTIVES OF THIS ASSESSMENT*

This Hydrology report was prepared with a number of objectives, which are to:

- address the Director-General's Requirements (DGRs) issued by the NSW Department of Planning, in particular those under the heading "Water Supply and Waterways".
- describe the existing soil and water conditions across the Project area;
- identify the key potential soil and water impacts and assess associated risks;
- identify likely impacts to the waterway crossings and measures to minimise impacts;
- provide details of waterway crossings particularly where such crossings are to be located in third order or higher streams;
- identify appropriate management and mitigation measures to ensure that construction and operation of the proposed wind farm would result in an acceptable level of environmental impact, pursuant to the NSW Environment Planning and Assessment Act 1979 and other relevant legislation. A Conceptual Soil and Water Management Plan is provided;
- analyse water demands and supply options to determine whether an adequate and secure water supply is available for the life of the project;
- identify the statutory (licensing) context of the water supply sources and assess potential environmental impacts associated with the identified sources, including impacts on groundwater;
- determine the balance of water supply based on expected construction and operation water requirements; and
- where the project lies within the Sydney drinking water catchment area, assess potential impacts for water pollution consistent with the heads of consideration provided in *Drinking Water Catchments Regional Environmental Plan No.1*, including determining if the project will have a neutral or beneficial effect on water quality.

1.3 *DIRECTOR GENERAL'S REQUIREMENTS*

The Project was determined to be a Major Project to which Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) applies. Director General's Requirements (DGRs) were issued on 6 May 2010. Supplementary Director General's Requirements (SDGRs) containing additional consultation requirements for the assessment were issued on 16 August 2011. The DGRs relevant to hydrology are presented in *Table 1.1.*

Table 1.1 DGRs and SDRGS

Issue	Requirement	Reference
DGRs		
Water Supply and Waterways	The EA must determine whether an adequate and secure water supply is available for the life of the project including the statutory (licensing) context of the water supply sources, and	Refer Chapter 3, Chapter 4.
	assess potential environmental impacts associated with the identified sources, including impacts on groundwater.	Refer Chapter 2, Chapter 5. Refer Section 2.5 and Section 3.3.1
	Where the project would cross significant waterways, the EA must identify likely impacts to the waterways and measures to minimise impacts. Details of the design of waterway crossings where such crossings are to be located in third order or higher streams are to be provided. Particular consideration should be given to the Abercrombie River.	Refer Section 2.3.
	The EA must also assess the potential for water pollution impacts, including the risks to the environment and human health, consistent with the heads of consideration provided in *Drinking Water Catchments Regional Environmental Plan No. 1*, including determining whether the project has a neutral or beneficial effect on water quality.	Refer Chapter 7
Consultation Requirements	The proponent must undertake a consultation program as part of the environmental assessment process, including consultation with, but not necessarily limited to, the following parties: NSW Office of Water Sydney Catchment Authority Lachlan Catchment Management Authority	Refer Table 1.2, Chapter 7

Table 1.2 outlines the consultation undertaken with relevant government departments and agencies throughout the hydrological assessment process.

Table 1.2 ***Agency Consultation***

Agency	Date	Consultation Undertaken	Issues Raised \
NSW Office of Water	5/8/2011	• Phone call and email	• provided advice as to the requirements for water licensing; refer Section 3.3 and Annex A.
Sydney Catchment Authority (SCA)	12/9/2011	• Phone call with SCA Senior Environmental Officer	• outline of Project and discussion of SCA's expectations for the assessment. Refer Section 7.2.
Lachlan Catchment Management Authority (LCMA)	27/2/2012	• Phone call and email	• outline of Project and discussion of LCMA's expectations for the assessment.

1.4 *REGIONAL AND LOCAL CONTEXT*

The site is located on the western extent of the Great Dividing Range, 60km south of Oberon, 60km north of Goulburn in NSW and approximately 140km west of Sydney (refer *Figure 1.1*).

The surrounding area consists predominantly of large rural properties and National Park with the eastern edge of the site being in proximity to the Kanangra Boyd National Park and Abercrombie National Park to the west and south of the site. The site is situated in the Oberon Local Government Area (LGA).

The area is heavily undulating with some steep slopes. The site is bisected by Abercrombie Road which links the towns of Oberon and Goulburn. The closest towns are Porters Retreat and Curraweela which have township populations of approximately 180 and 320 respectively.

Several water courses traverse the area including the Abercrombie River which flows into the Lachlan River. The Abercrombie River forms the southern boundary of the site.

The site is approximately 40km to the northeast of the existing Crookwell 1 wind farm and the approved Crookwell 2 Wind Farm.

1.5 *PROPERTY DETAILS*

The Paling Yards Wind Farm site includes two separate land holdings over approximately 3,900 Hectares, comprising the "Paling Yards" property in the southwest and the "Mingary Park" property in the northeast. Paling Yards comprises approximately 2200 hectares of land while Mingary Park comprises approximately 1400 hectares. In this report the two properties are collectively referred to as the "wind farm site".

The majority of the wind farm site has been cleared of native vegetation and comprises grazing land for sheep and cattle. The site is surrounded by steep terrain and extensive tracts of remnant native vegetation, including National Parks (refer *Figure 1.2*).

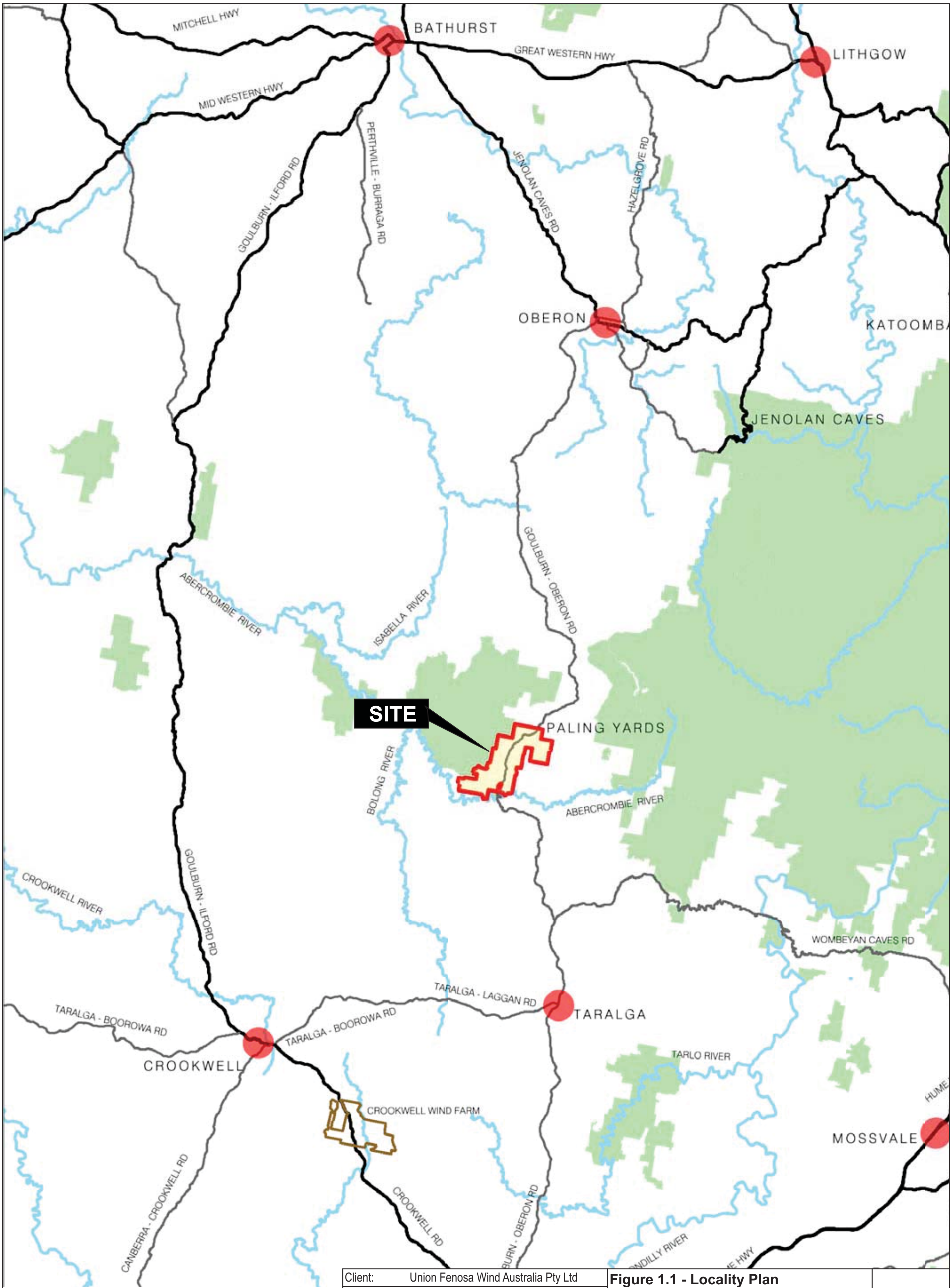

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Figure 1.1 - Locality Plan

Paling Yards
Hydrological Assessment

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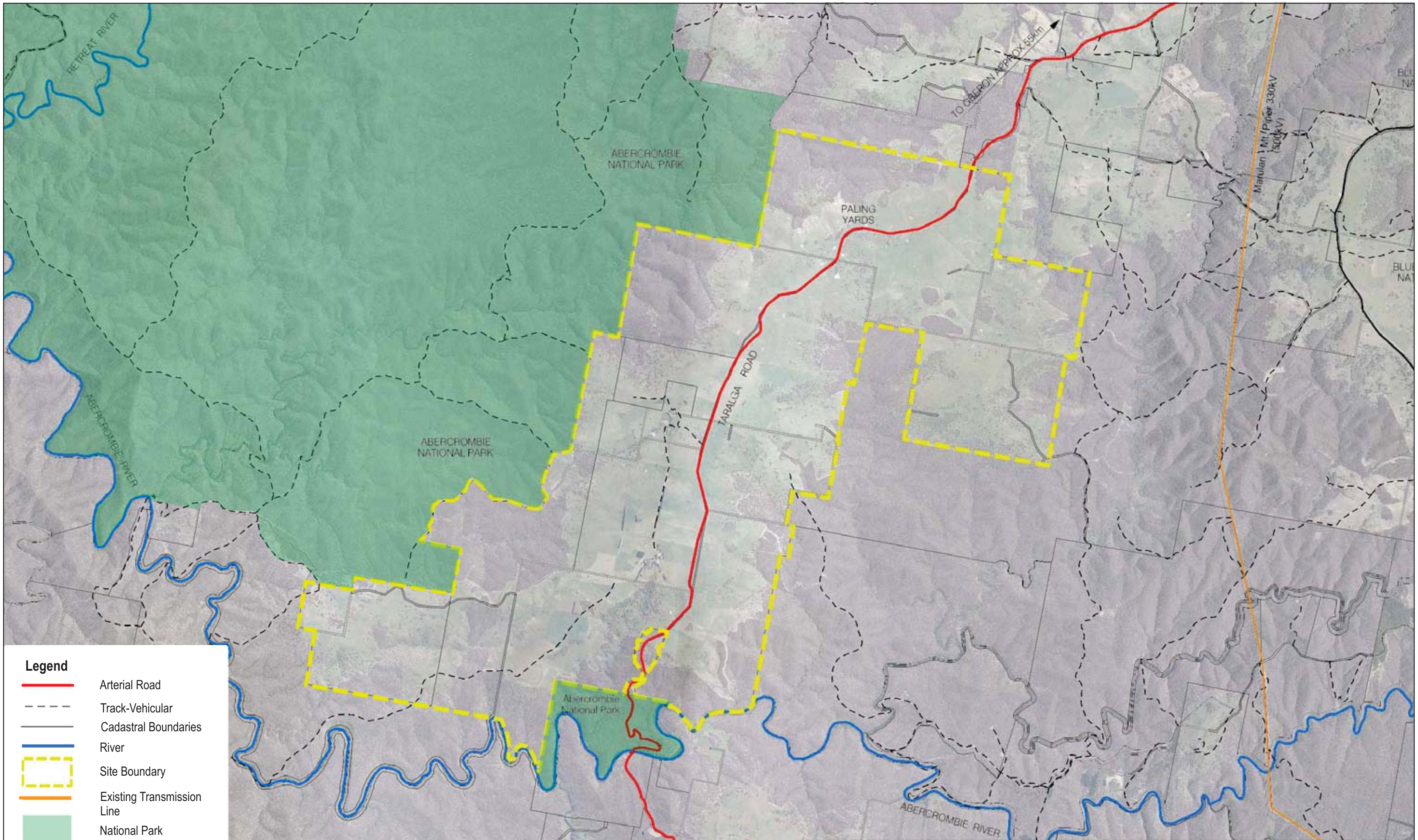

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Figure 1.2 - Site Analysis

Paling Yards
Hydrological Assessment

Environmental Resources Management ANP Pty Ltd

Adelaide, Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

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1.6 PROJECT DESCRIPTION

1.6.1 Wind Farm

The project comprises a number of elements, including:

- up to 59 individual WTGs standing up to 175m at top of blade tip with a capacity of up to 4.5MW each;
- up to 59 individual kiosks for the housing of 33kV Transformers and 33kV Switchgears and associated control systems to be located in the vicinity of the wind turbine towers (in some turbine models the equipment is integrated within the tower or nacelle);
- upgrades to local road infrastructure including up to six access points from Abercrombie Road;
- internal unsealed tracks for vehicle access to turbines and infrastructure;
- an underground electrical and communication cable network linking turbines to each other and the proposed substation;
- up to three wind monitoring masts fitted with various instruments such as anemometers, wind vanes, temperature gauges and potentially other electrical equipment;
- a temporary batching plant to supply concrete for the foundations of the turbines and other associated structures;
- obstacle lighting to selected turbines (if deemed necessary);
- removal of native vegetation within the site and en route to the substation (if required);
- vegetation planting to provide screening;
- wind farm and substation control room and facilities buildings;
- approximately 9 km of overhead transmission line leading north from the proposed wind farm site to the Mt Piper to Bannaby 500kV transmission line located to the east of the site;
- an electrical substation and overland connection to transmission lines; and
- all ancillary and incidental uses and activities.

Figure 1.3 (a-e) provides plans of the proposed turbine layout, also showing the proposed and existing access tracks, topographic details and hydrological context.

Access to the wind farm site would be achieved via Abercrombie Road with Port Kembla the preferred port for delivery of wind farm components.

1.6.2 *Grid Connection / Transmission Lines*

Four options were assessed for the connection to the electricity grid (refer *Figure 1.4*). *Table 1.3* describes the assessed options.

Table 1.3 *Transmission Line Route Options*

<table>
<tr><th colspan="4">Transmission Line Route Options</th></tr>
<tr><th>Assessed Option 1</th><th>Assessed Option 2</th><th>Assessed Option 3</th><th>Assessed and Proposed Option 4</th></tr>
<tr><td>Western most option, runs south along Leighwood Road to the intersection with Golspie Road, and then to the intersection with Tyrl Tyrl Road;</td><td>Middle option, runs approximately 14km directly south not following a defined road, meets the intersection of Golspie and Tyrl Tyrl Road. Most isolated option.</td><td>Eastern-most option, runs south along Taralga Road, and intersects with Tyrl Tyrl Road. Runs close to a number of identified dwellings along Taralga Road.</td><td rowspan="2">Northern option, runs in a northeast direction to connect to the Mt Piper to Bannaby 500kV transmission line approximately 6 km northeast of the proposed wind farm site. The route follows the alignment of Taralga Road on the southern side. Approximately 3 km northeast of the site Option 4 forks into two alternative routes. Both Option 4 alternatives would involve the construction of approximately 9 km of overhead transmission line.</td></tr>
<tr><td colspan="3">Options 1,2 and 3 share a common alignment south from the intersection of Golspie and Tyrl Tyrl Road; following the route of Carrabungla Road, and Woodhouselee Road to connect to the approved Crookwell 2 substation. Options 1, 2 and 3 would all involve the construction of approximately 55km of overhead transmission line.</td></tr>
</table>

The route is currently under investigation to provide more certainty for its exact easement.

The proponent is committed to constructing the transmission line in a way that minimises impact to land and waters over which it traverses. ERM's understanding of how this will be achieved is as follows:

- transmission line power poles will be approximately 200 – 250m apart;
- existing access tracks and roads will be used where ever possible to gain close access to pole locations during construction;
- there will be no permanent access track constructed along the length of the transmission lines. Access will be gained by informally driving over grassed paddocks using the closest route of least impact from existing tracks/roads. Access routes will avoid driving through watercourses. If new tracks are formed through paddocks by vehicle traffic during the course of construction, these will be actively or naturally regenerated (i.e. to grassland) following construction (if required);

- power poles would be located no closer than 20m to any watercourse, including first order or second order 'minor streams' as defined by the Water Management Act 2000. A minimum buffer of at least 40m would be maintained between any construction area and any third order or higher watercourse, defined as "rivers" under the Water Management Act 2000;

- there should be no need to construct watercourse crossings for the purpose of vehicle access, whether permanent or temporary, during transmission line construction. Where transmission lines cross a creek, cables can be pulled (or fired) from one side of a creek to the other without needing to drive across the creek. This will prevent disturbance of the banks of any creek and the riparian zone, and minimise the need for rehabilitation post construction; and

- in situations where construction occurs in wet, boggy, low lying ground, there may be a need to form a temporary access road, though this is expected to be on rare occasions only. In such circumstances, a suitable option would be to lay geotextile then graded aggregate to provide suitable all weather access. This can be removed on completion or retained if agreed with the landowner.

UFWA has decided that the preferred option is the northern Transmission Line route, (Option 4). This decision has been made due to its shorter length, and as a result of concerns raised through the stakeholder consultation process regarding the potential impacts of extensive transmission line infrastructure leading south towards the Crookwell 2 wind farm substation.

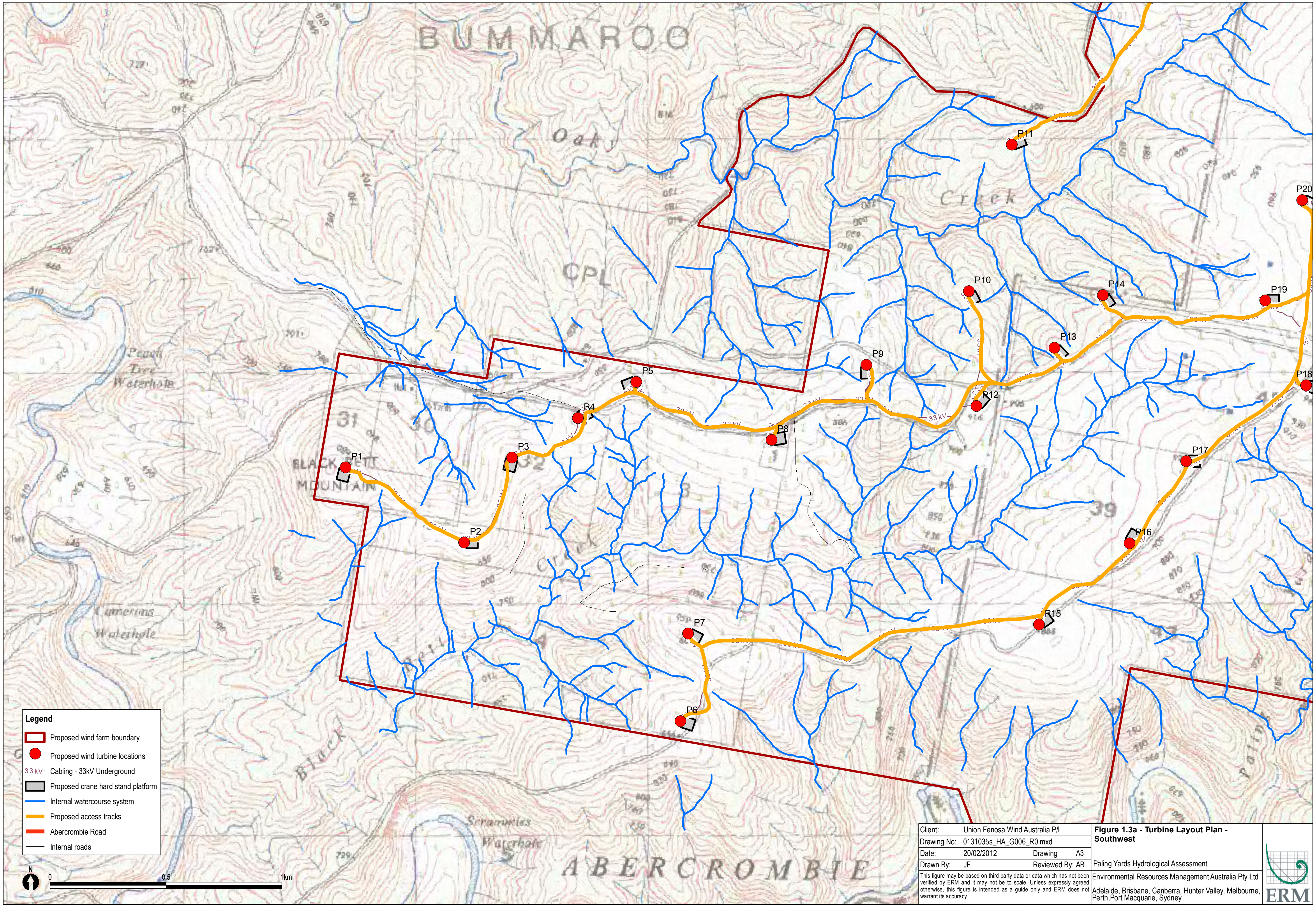

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Figure 1.3a - Turbine Layout Plan - Southwest

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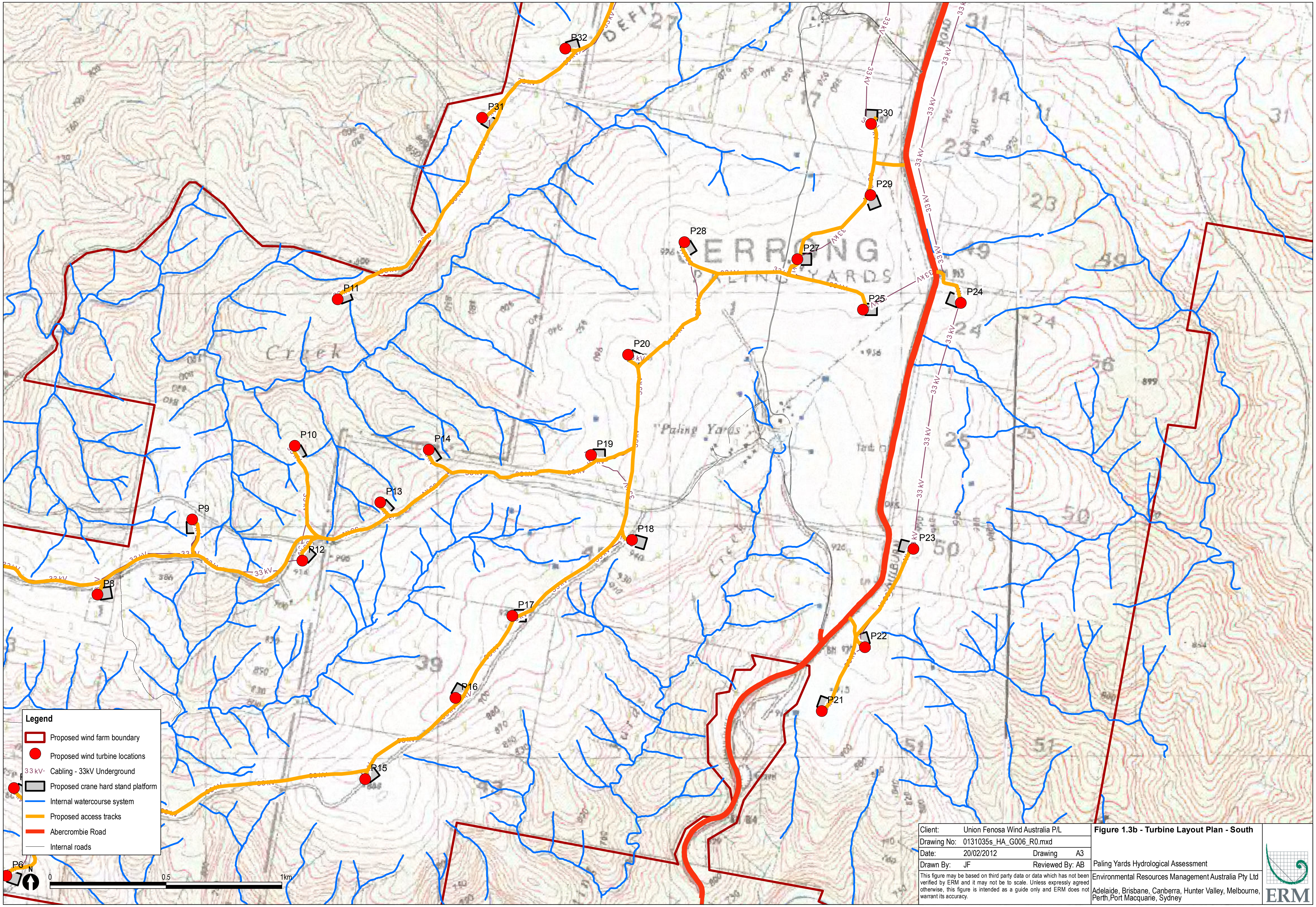

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Figure 1.3b - Turbine Layout Plan - South

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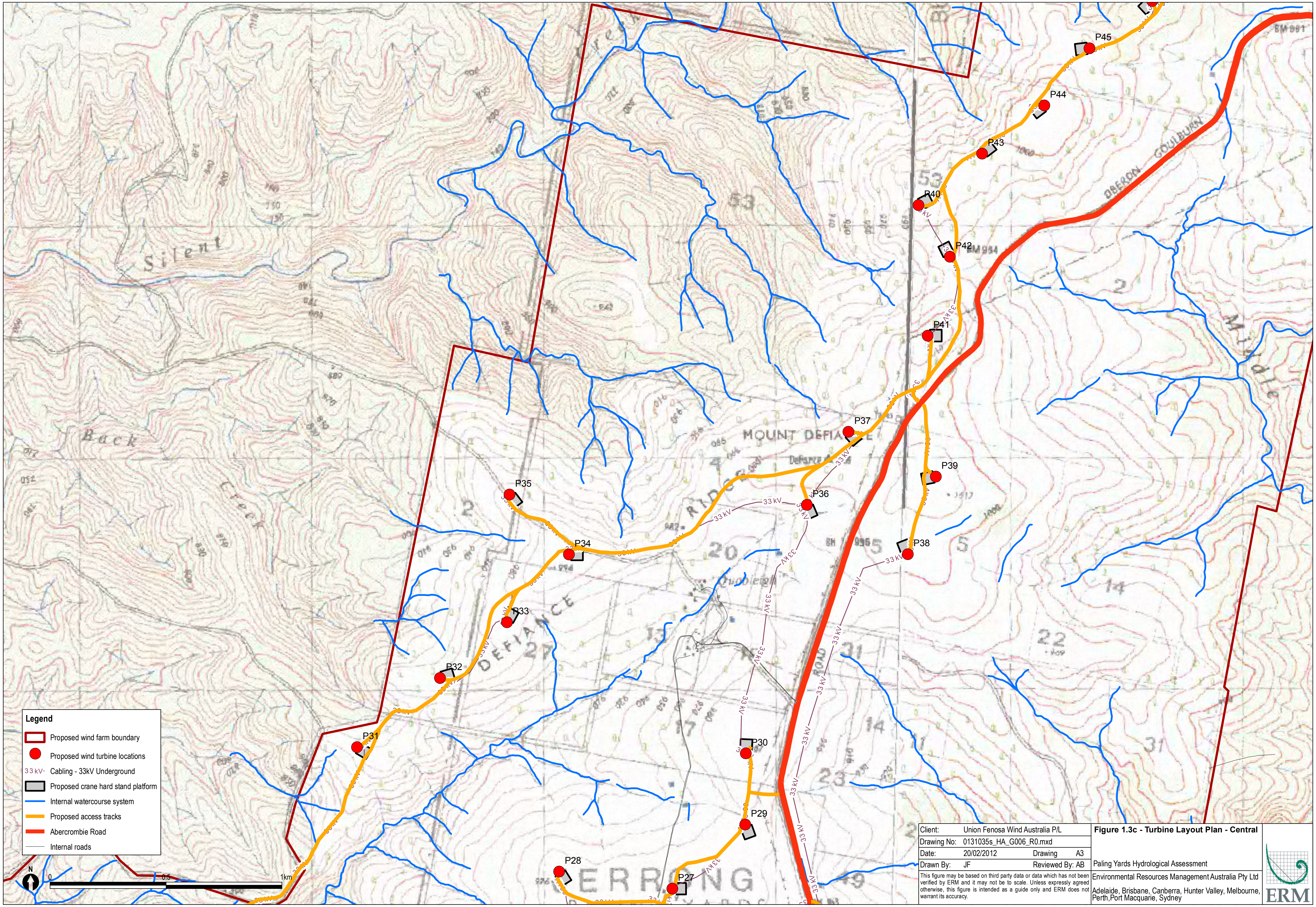
Legend
Proposed wind farm boundary
Proposed wind turbine locations
33kV Cabling - 33kV Underground
Proposed crane hard stand platform
Internal watercourse system
Proposed access tracks
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MOUNT DEFIANCE
DEFIANCE
RIDGE
Silent
Back
Creek
OBERON GOULBURN
ROAD
Middle
ERRONG
Client: Union Fenosa Wind Australia P/L
Drawing No: 0131035s_HA_G006_R0.mxd
Date: 20/02/2012
Drawing A3
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Figure 1.3c - Turbine Layout Plan - Central
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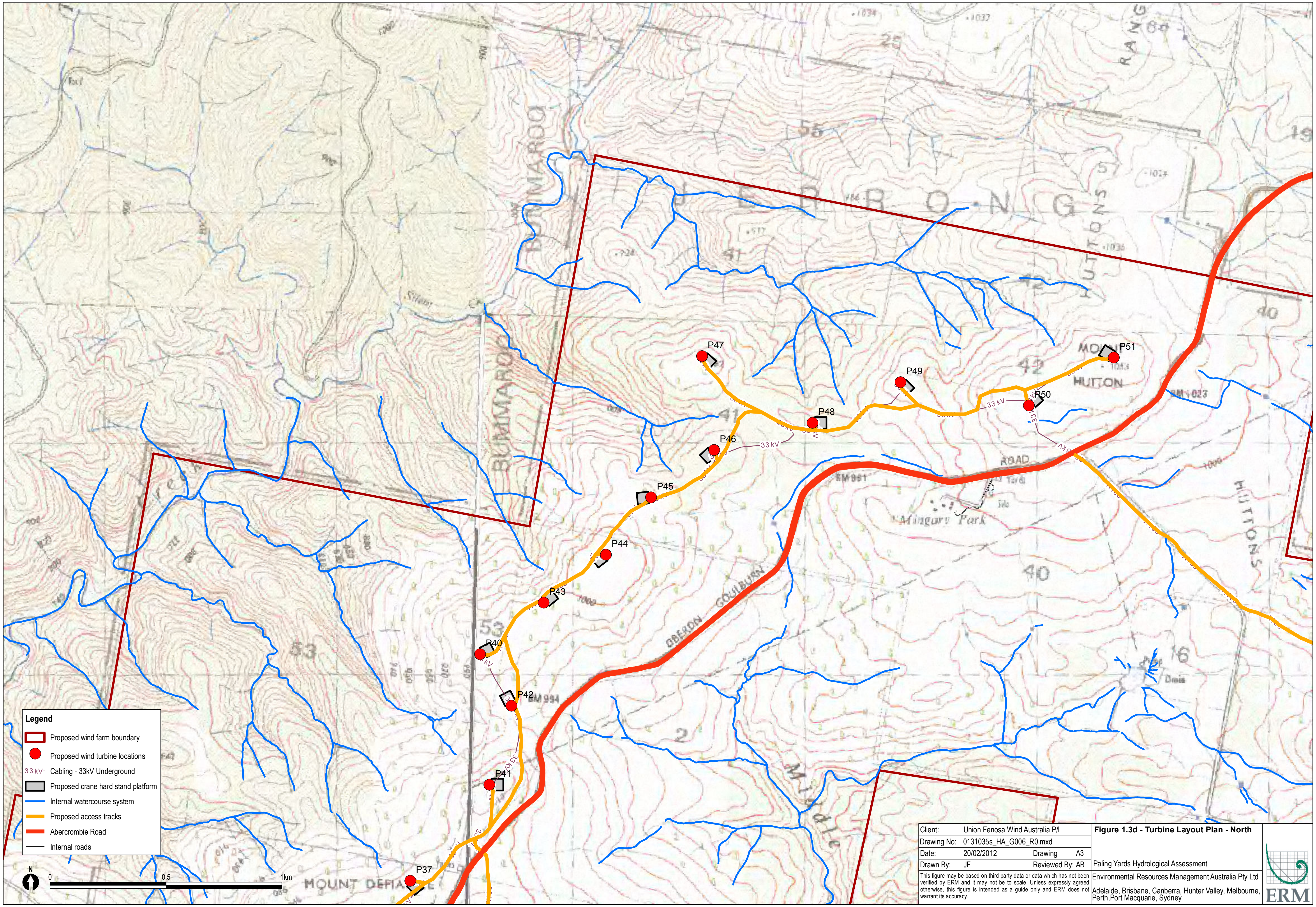
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Abercrombie Road
Internal roads
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Client: Union Fenosa Wind Australia P/L
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Figure 1.3d - Turbine Layout Plan - North
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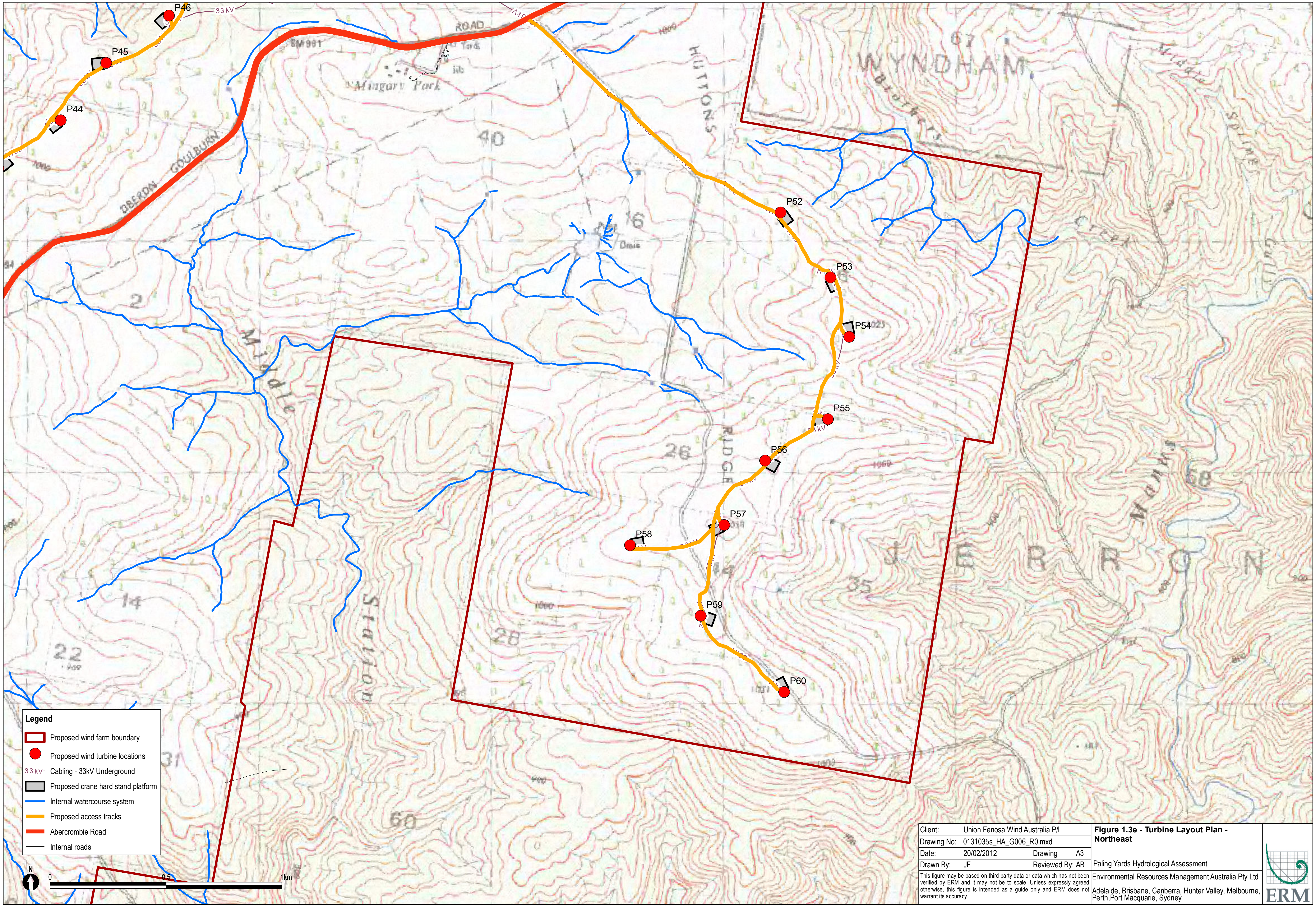

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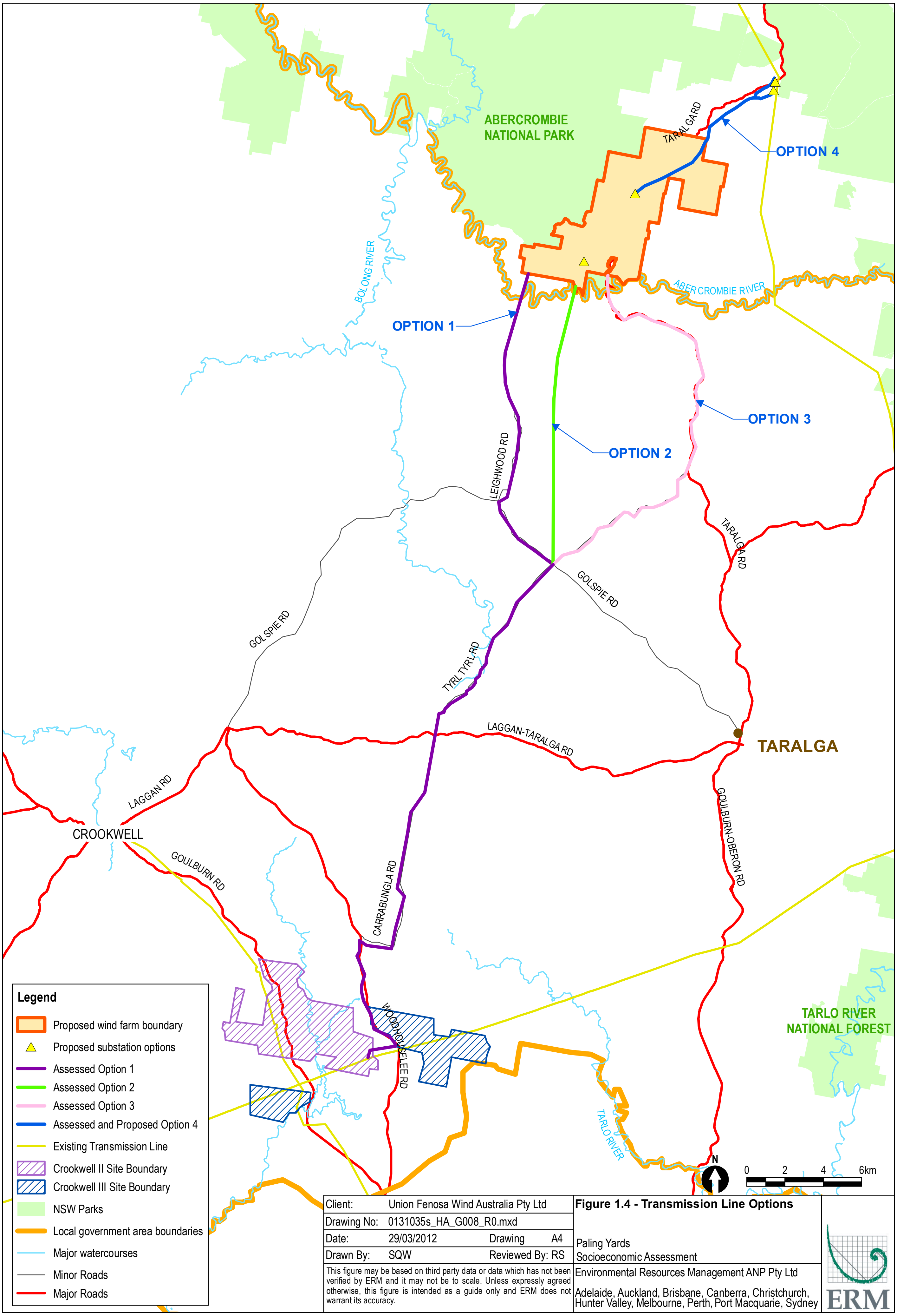
Figure 1.3e - Turbine Layout Plan - Northeast

Paling Yards Hydrological Assessment

Environmental Resources Management Australia Pty Ltd

Adelaide, Brisbane, Canberra, Hunter Valley, Melbourne, Perth,Port Macquarie, Sydney



Client:	Union Fenosa Wind Australia Pty Ltd
Drawing No:	0131035s_HA_G008_R0.mxd
Date:	29/03/2012 Drawing A4
Drawn By:	SQW Reviewed By: RS

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Figure 1.4 - Transmission Line Options

Paling Yards
Socioeconomic Assessment

Environmental Resources Management ANP Pty Ltd
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1.7 *CONSTRUCTION PROGRAM*

The construction program is not finalised. The approximate timeframe for the civil construction work, during which the key soil and water impacts have the potential to occur, would be during the first 9-12 months of construction. The proponent has provided the following as an indicative sequence of works:

- site establishment - Clearing of work areas, levelling and compaction, installation of portable buildings and installation / connection of utility services and site survey;
- internal roadworks - Removal of topsoil, levelling, sub-base compaction, gravel and drainage;
- external roadworks - Upgrade existing roads where required. Provide new access roads to the site as required;
- foundations - Removal of topsoil, excavation, screed concrete, reinforcement steel bottom, installation of foundation ring, reinforcement steel top, concreting, concrete ring and conduits, and backfilling;
- crane pad establishment - Removal of topsoil, base compaction and rock / gravel compaction;
- trenches and cable laying, Overhead Powerline - Excavation, sand infill, cable laying with protective covering, backfilling and compacting, installation of cable route markers and installation of overhead powerline for transferring electricity from the site collector substation to the grid connection point;
- electrical works - Control building switchboards, communications, and Supervisory Control and Data Acquisition (SCADA) systems. Installation of cabling, switchgear and turbine control panels;
- turbine supply - Transport of towers, nacelles, hubs and blades to site;
- turbine erection - Erection of towers, nacelle, blades and installation of cabling;
- substation electrical works - Connection of Wind Farm feeder cables to the substation MV switch room;
- wind farm commissioning - Pre-commissioning of turbines, SCADA, cables testing and optical fibre. Testing and commissioning of turbines, switchgear and SCADA;
- electricity grid connection commissioning - Final commissioning by the transmission network service provider prior to connecting the generated electricity on the national electricity grid; and
- construction closure - Site clean-up, revegetation, landscaping.

2 SITE DESCRIPTION

2.1 LANDFORM/TOPOGRAPHY

2.1.1 *Wind Farm Site*

The wind farm site ranges in elevation between 900m and 1065m above sea level with significant slopes in many areas. It forms part of a prominent elevated plateaux landscape dissected by deep valleys. The geology is characterised by tertiary lava flows forming erosion-resistant basalt caps overlying much older Ordovician and Silurian metasediments.

A number of ephemeral watercourses cross the site which flow generally towards the south and west, to the Abercrombie River. These mostly have the form of open depressions without incised channels or defined bed or banks. There are no permanent watercourses on the wind farm site.

Photograph 2.1 to *Photograph 2.5* provide views of a selection of the landform types found across the wind farm site.

2.1.2 *Transmission Line*

Transmission line route options 1, 2 and 3 traverse a range of landforms including vegetated, rugged mountainous terrain in the north, near Abercrombie River. Further south the terrain becomes gently undulating with the transmission line options tending to follow ridgelines and existing roads, generally through cleared farming land. A number of broad open valleys and watercourses are traversed. Transmission line route option 4 traverses plateaux and ridge lines to the northeast of the site.

UFWA has decided that the preferred option is the northern Transmission line route, (Option 4). This decision has been made due to its shorter length, and as a result of concerns raised through the stakeholder consultation process regarding the potential impacts of extensive transmission line infrastructure leading south towards the Crookwell 2 wind farm substation.

Photograph 2.1 ***View to the northeast from near proposed turbine P13 along one of the prominent ridges in the southwest of "Paling Yards" property. The view shows the hilly landscape typical of the Midgee Soil Landscape***

Photograph 2.2 ***View to the west from near proposed turbine P5 towards Black Bett Mountain in the far west of "Paling Yards" property. Proposed turbine P1 is on top of Black Bett Mountain in the top left of view***

Photograph 2.3 ***View to the northeast from Black Bett Mountain showing "Paling Yards", with undulating hills in the foreground and plateaux in the distance***

Photograph 2.4 ***View to the north from near proposed turbine P27 on "Paling Yards" property. The view shows the plateaux landscape typical of the Taralga Soil Landscape***

Photograph 2.5 *View to the southeast from near proposed turbine P50 on Mount Hutton, on "Mingary Park" property. Proposed turbines P52 to P59 are located on the plateaux in the distance*

2.2 SOILS

2.2.1 *Wind Farm Site*

Soils information was obtained from the Goulburn 1:250 000 Soil Landscapes sheet report prepared by the Soil Conservation Service of NSW (Hird, 1991). The wind farm site contains two soil landscapes – the Taralga Soil Landscape and Midgee Soil Landscape. Key features of these landscapes are described in *Table 2.1*.

The Taralga Soil Landscape is formed on tertiary volcanics and occupies the more elevated plateaux areas. The Midgee Soil Landscape is formed on Ordovician and Silurian sediments and occurs at lower elevations, often on sideslopes and in valleys.

Table 2.1 Key Characteristics of Soil Landscapes over the proposed Paling Yards Wind Farm

Soil Type	Taralga (ta)	Midgee (mi)
Landform Patterns	Plateaux or valleys of gently undulating to undulating rises	Rolling low hills and hills
Geology	Remnant tertiary lava flows – olivine basalt and dolerite	Undifferentiated Ordovician and Silurian sediments including sandstone, siltstone, greywacke, phyllite, shale, slate and quartzite. Heavily folded and with varying degrees of deformation and metamorphism
Common Soil Types	Krasnozems and Xanthozems on crests; Chocolate soils on sideslopes; Prairie soils on footslopes	Yellow earths and Yellow Podzolic soils most common; some Red Podzolic Soils; Lithosols, Soloths and red Earths
Elevations	> 800m	600 - 900m
Slope Gradient	Typically 2-15%	Typically 10 - 30%
Local Relief	between 5 and 40m	Between 30 and 100m
Drainage	Drainage plains rather than incised stream channels	Fixed, shallow erosion stream channels, closely to very widely spaced, form a non-directional of convergent integrated tributary network. Following good rains springs are a feature of sideslopes
Native vegetation	Brown barrel-ribbon gum community - with well-developed but discontinues substratum of small trees and shrubs. Above 900m snow gum communities may be found	Dry Sclerophyll - forest of red Stringybark and scribbly gum
Existing Land use	Grazing, fodder crops, rapeseed cultivation, orchards and vegetable growing may also occur	Light grazing of sheep and cattle
Soil Erosion	Sheet erosion occurs where soils are cleared for cultivation; also on steep gradients where there is soil creep and occasionally slumping	Widespread minor to moderate sheet erosion. Gullying of drainage lines also occurs
Erodibility (Topsoil)	Low to Moderate	High
Erodibility (Subsoil)	Low	Moderate to High

Source: Hird, 1991

2.2.2 *Transmission Line*

Transmission line route option 4 traverses the Taralga and Midgee Soil Landscapes as described in *Table 2.1*.

The transmission line route options 1, 2 and 3 traverse a number of additional soil landscapes. A brief description of these is provided in *Table 2.2*.

Table 2.2 Brief Description of Soil Landscapes over the Transmission Line Route Options 1, 2 and 3

Soil Landscape	Description
Lickinghole (li)	Steep to very steep hills on Ordovician metasediments; Relief 100-250m; Slopes 30->50%; Shallow, mostly stony, fine sandy to loamy lithosols and red and yellow earths; Minor to moderate existing sheet erosion, soil creep and gullying; High soil erodibility and high erosion hazard
Macalister (mc)	Remnant basalt plateaux and exposed underlying metasediments and granites, and minor areas of laterite; Relief 10-70m; Slopes 5-15%; Complex soil distribution: chocolate soils, krasnozems, red and yellow podzolic soils, red and yellow earths, lateritic red earths/podzolic soils; Little existing erosion on fertile soils; Low to high soil erodibility and low to moderate erosion hazard
Oberon	Uplands on metasediments and volcanics; Relief <10m; Slopes 1-10%; Red earths, red podzolic soils, yellow earths, yellow podzolic soils; Minor existing sheet erosion and some gullying of drainage lines; Moderate to high soil erodibility and moderate erosion hazard
Garland (ga)	Undulating rises and valleys between rolling low hills formed on granite; Relief 10-50m; Slopes <15%; Yellow mottled duplex soils, light red podzolic soils, sandy red/yellow earths and siliceous sands; Gullying of unstable drainage lines, minor sheet erosion; Low to high soil erodibility and low to high erosion hazard; Occasional salting in low lying areas
Blakney Creek (bc)	Footslopes and valley floors of metasediments; Relief 20-50m; Slopes <10%; Yellow duplex soils similar to Soloths, some yellow earths, red podzolic soils; active gullying and some saline areas; Moderate to severe existing sheet and gully erosion, saline areas in many valley flats; Moderate to high soil erodibility and moderate to high erosion hazard

Source: Hird, 1991

2.3 SURFACE WATERS AND WATERCOURSE CROSSINGS

In this section and elsewhere throughout this report, a reference to stream order relates to the Strahler system of stream ordering. This is explained as follows:

- starting at the top of a catchment, any watercourse that has no other watercourses flowing into it is classed as a first-order watercourse;
- where two first-order watercourses join, the watercourse becomes a second-order watercourse;
- if a second-order watercourse is joined by a first-order watercourse - it remains a second-order watercourse;
- when two or more second-order watercourses join they form a third-order watercourse; and
- a third-order watercourse does not become a fourth-order watercourse until it is joined by another third-order watercourse, and so on.

2.3.1 *Wind Farm Site*

More than 50 ephemeral first order watercourses occur within the wind farm site. These ephemeral first order watercourses exist within open depressions mostly without incised channels or defined bed or banks; they are for the most part stable and well vegetated with pasture grasses. There are very few instances of active erosion along watercourses.

Far fewer second and third order watercourses occur within the wind farm site. These occur within defined drainage gullies and larger valleys. The higher order watercourses also tend to be stable and well vegetated, with only minor areas of active erosion.

All watercourses on the site are ephemeral. Overall site drainage is generally towards the south and west, to the Abercrombie River. *Figures 1.3 (a to e)* indicate the drainage patterns on the wind farm site.

On the wind farm site the proposed turbines, access tracks, cabling and other associated infrastructure are situated in elevated locations such as plateaux areas and along ridge lines and crests. There are no instances where proposed access tracks or cabling are required to cross significant watercourses that would require construction of bridges or culverts. There are no crossings of third order or higher watercourses.

There are a small number of locations (likely less than 5) where new access tracks and cabling may cross ephemeral first order watercourses. These are typically located very high within the respective catchments. All disturbance areas associated with turbine construction would be located greater than 20 m from all watercourses and significantly further away from third order and higher order watercourses.

If needed, watercourse crossings (including major drainage lines) will be designed appropriately and in consultation with a qualified engineer and in accordance with the NSW Office of Water Guidelines for Controlled Activities (2012) to minimise impacts on the existing banks, water flow, animal passage and on the movement of flows and ensure that they do not impact on water quality.

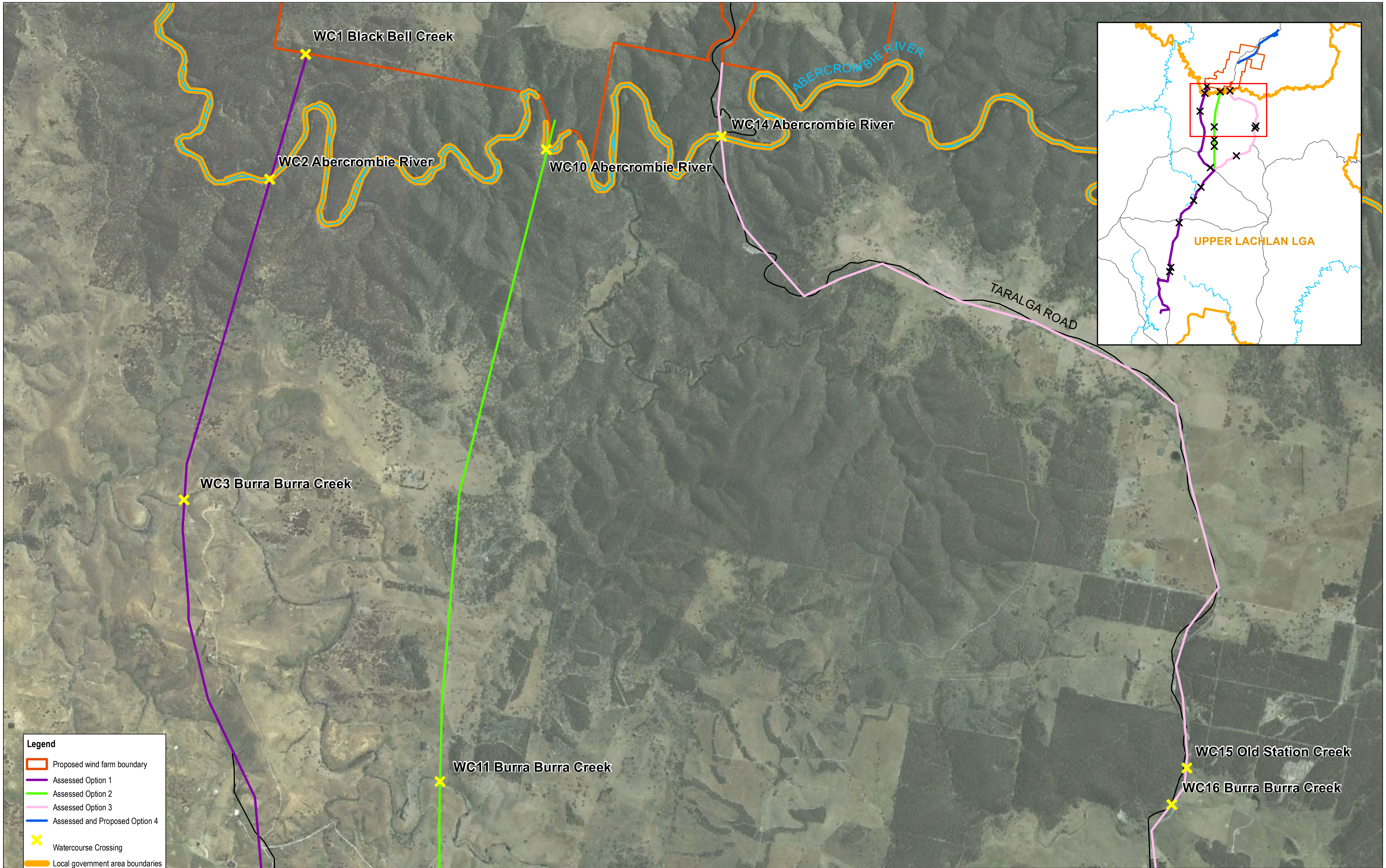
2.3.2 *Transmission Line*

Transmission line route options 1, 2 and 3 cross a number of watercourses. Approximately 17 locations where the transmission line crosses third order or higher watercourses have been identified across the three options and are shown in *Figure 2.1 (a to e)*. Option 4 does not cross any third order or higher watercourses.

Table 2.3 summarises these crossings with details of watercourse name (taken from the relevant 1:25,000 topographic map), stream order, the major river catchment to which it belongs, a description of the general landform in the vicinity of the crossing, and an assessment of whether the crossing is near to existing roads and formed crossings.

The proponent is committed to constructing the transmission line in a way that minimises impact to land and waters over which it traverses.

UFWA has decided that the preferred option is the northern Transmission Line route, (Option 4). This decision has been made due to its shorter length, and as a result of concerns raised through the stakeholder consultation process regarding the potential impacts of extensive transmission line infrastructure leading south towards the Crookwell 2 wind farm substation.



Notes:
Crossings of major watercourses only are shown, these being third-order or higher watercourses under the Strahler system.

Image: Google Earth Pro 2011

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Drawing No:	0131035s_HA_G001_R2.mxd
Date:	21/02/2012 — Drawing A3
Drawn By:	SQW — Reviewed By: AB

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Figure 2.1a - Transmission Line Watercourse Crossings

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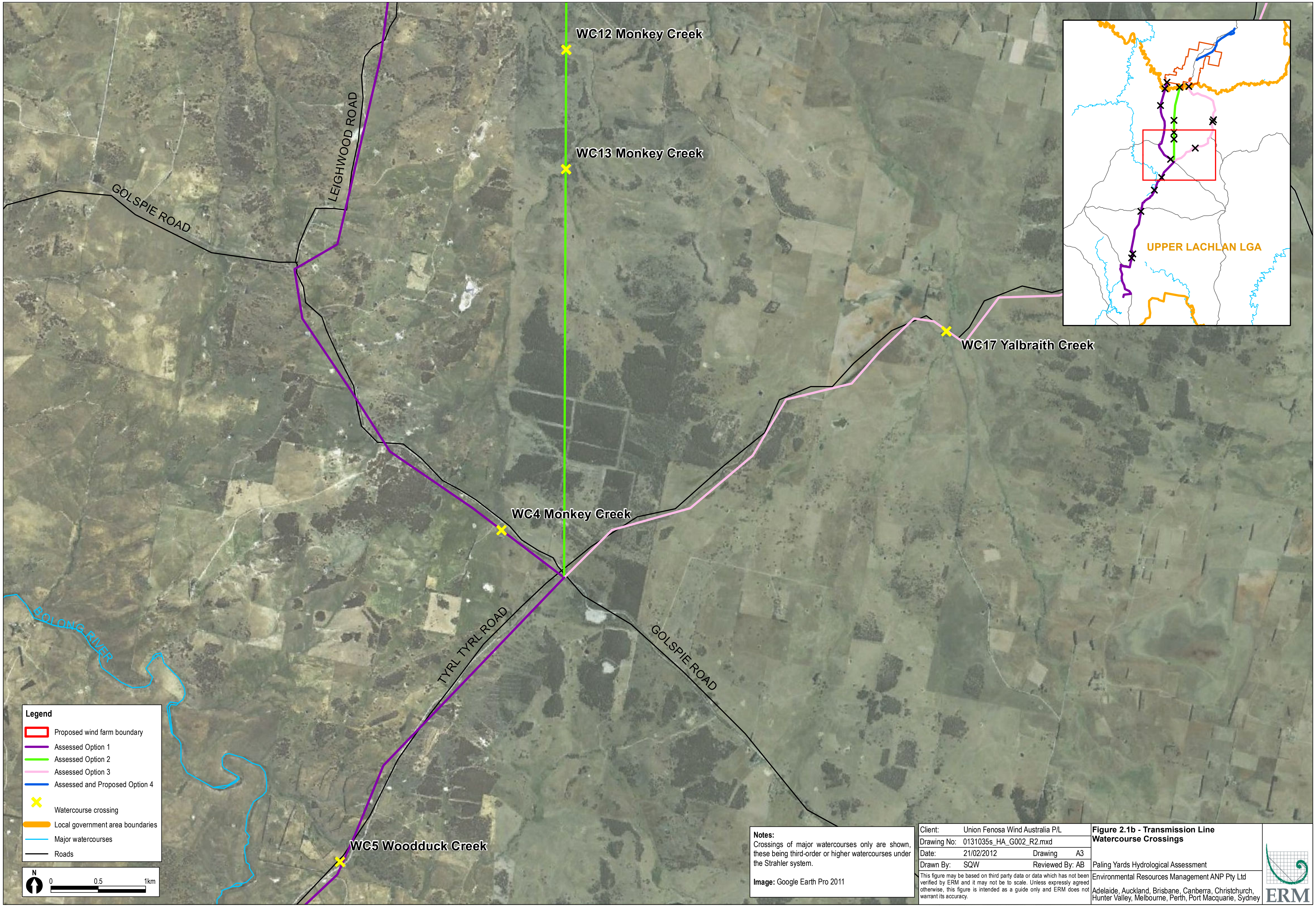

Notes:
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Image: Google Earth Pro 2011

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Figure 2.1b - Transmission Line Watercourse Crossings

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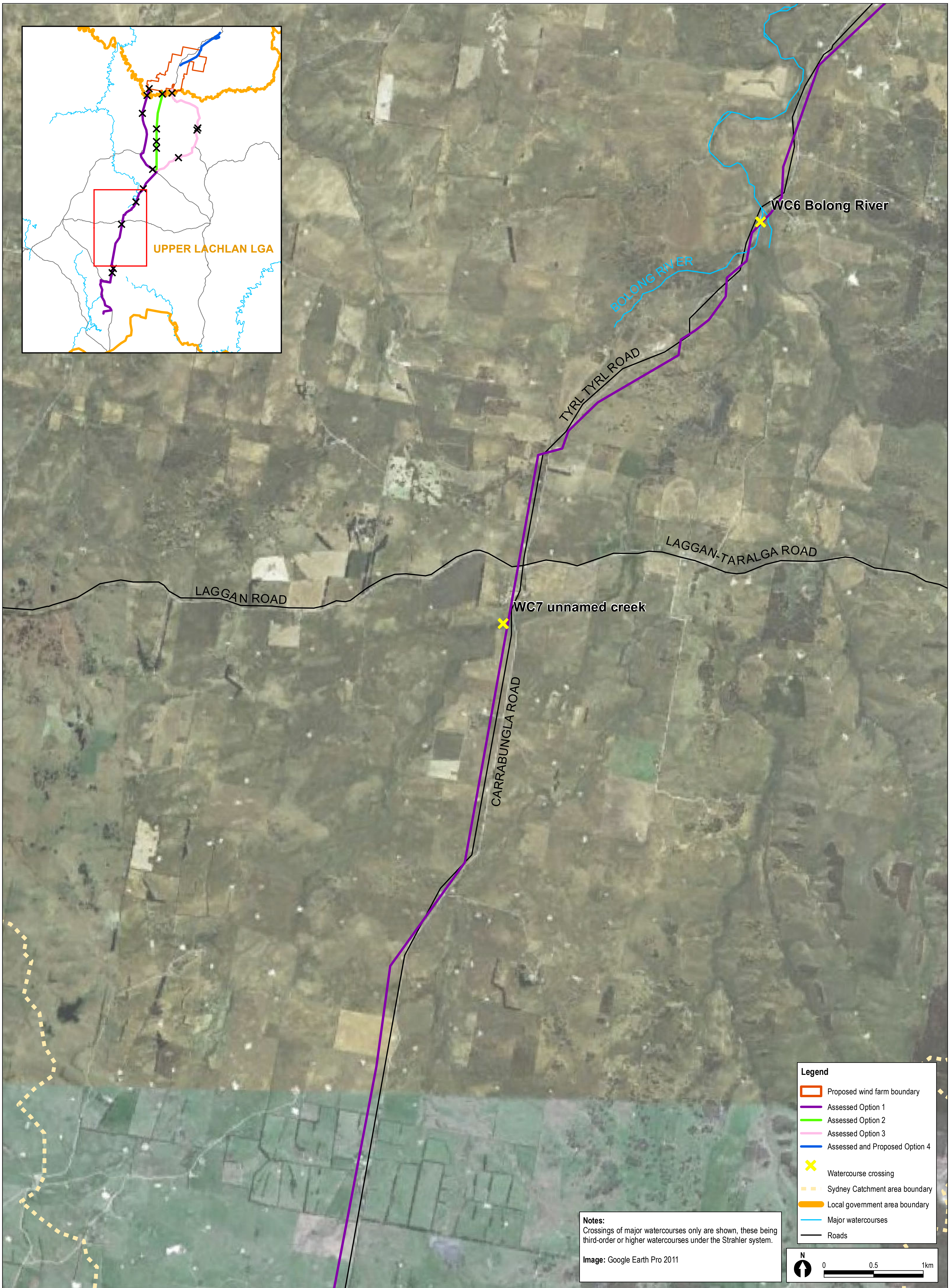

Notes:
Crossings of major watercourses only are shown, these being third-order or higher watercourses under the Strahler system.

Image: Google Earth Pro 2011

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Figure 2.1c - Transmission Line Watercourse Crossings

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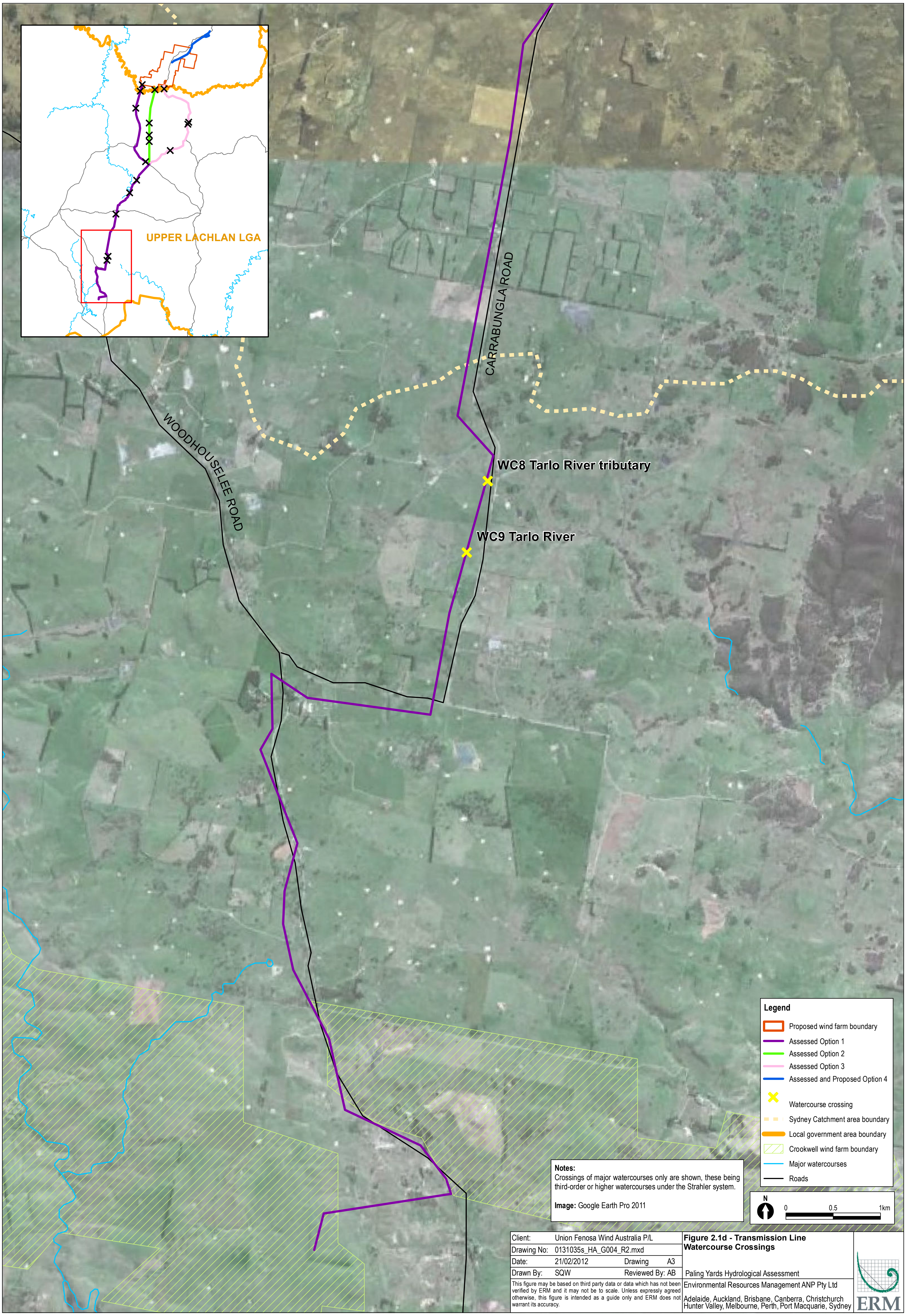

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Figure 2.1d - Transmission Line Watercourse Crossings

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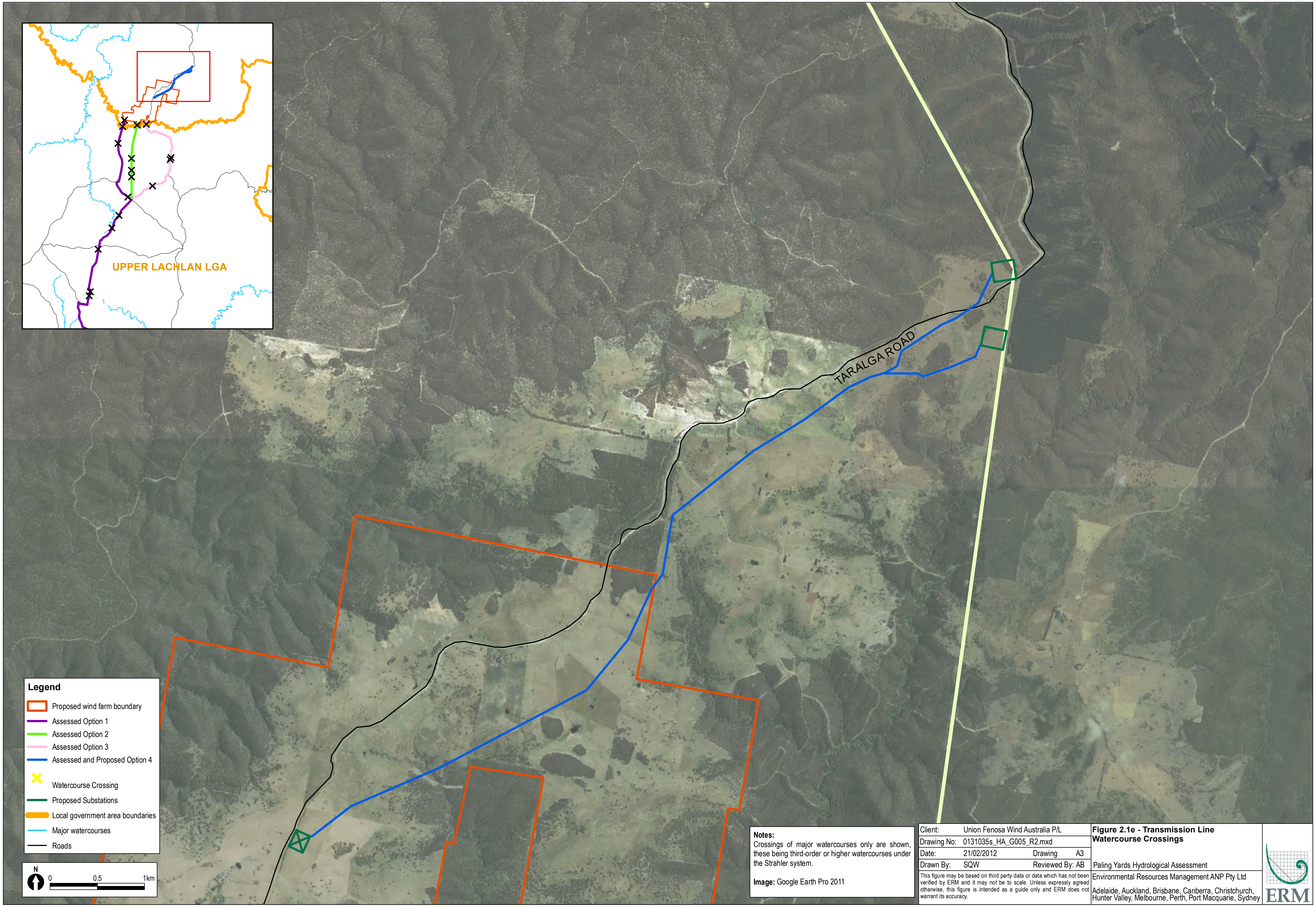
ERM



Notes:
Crossings of major watercourses only are shown, these being third-order or higher watercourses under the Strahler system.

Image: Google Earth Pro 2011

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Figure 2.1e - Transmission Line Watercourse Crossings

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Table 2.3 Watercourse Crossings for Transmission Line Route Options 1, 2 and 3

Crossing ID	Watercourse name	River catchment	Description	Nearby road/ crossing	Stream order
Option 1					
WC1	Black Bell Creek	Abercrombie (Lachlan)	deep valley, creek draining through "Paling Yards" farm, cleared land	No	3rd
WC2	Abercrombie River	Abercrombie (Lachlan)	deep valley, naturally vegetated mountain stream	No	4th or higher
WC3	Burra Burra Creek	Abercrombie (Lachlan)	moderately deep valley, mostly cleared farmland	No	4th or higher
WC4	Monkey Creek	Abercrombie (Lachlan)	broad open depression, cleared farmland	Yes	3rd
WC5	Woodduck Creek	Bolong (Abercrombie)	moderately deep valley, mostly cleared farmland	Yes	4th
WC6	Bolong River	Bolong (Abercrombie)	moderately deep valley, mostly cleared farmland	Yes	4th or higher
WC7	unnamed creek	Bolong (Abercrombie)	broad open valley with gentle slopes and stable low gradient watercourse, cleared farmland	Yes	4th
WC8	Tarlo River tributary	Tarlo (Wollondilly)	broad open valley with gentle slopes and stable low gradient watercourse, cleared farmland	Yes	3rd
WC9	Tarlo River	Tarlo (Wollondilly)	broad open valley with gentle slopes and stable low gradient watercourse, cleared farmland	Yes	3rd
Option 2					
WC10	Abercrombie River	Abercrombie (Lachlan)	deep valley, naturally vegetated mountain stream	No	4th or higher
WC11	Burra Burra Creek	Abercrombie (Lachlan)	moderately deep valley, mostly cleared farmland	No	4th or higher
WC12	Monkey Creek	Abercrombie (Lachlan)	moderately deep valley, mostly cleared farmland	No	3rd
WC13	Monkey Creek	Abercrombie (Lachlan)	moderately deep valley, mostly cleared farmland	No	3rd
WC5	Woodduck Creek	Bolong (Abercrombie)	moderately deep valley, mostly cleared farmland	Yes	4th
WC6	Bolong River	Bolong (Abercrombie)	moderately deep valley, mostly cleared farmland	Yes	4th or higher
WC7	unnamed creek	Bolong (Abercrombie)	broad open valley with gentle slopes and stable low gradient watercourse, cleared farmland	Yes	4th
WC8	Tarlo River tributary	Tarlo (Wollondilly)	broad open valley with gentle slopes and stable low gradient watercourse, cleared farmland	Yes	3rd
WC9	Tarlo River	Tarlo (Wollondilly)	broad open valley with gentle slopes and stable low gradient watercourse, cleared farmland	Yes	3rd
Option 3					
WC14	Abercrombie River	Abercrombie (Lachlan)	deep valley, naturally vegetated mountain stream	Yes	4th or higher
WC15	Old Station Creek	Abercrombie (Lachlan)	moderately deep valley, mostly cleared farmland	Yes	3rd
WC16	Burra Burra Creek	Abercrombie (Lachlan)	moderately deep valley, mostly cleared farmland	Yes	4th or higher
WC17	Yalbraith Creek	Abercrombie (Lachlan)	broad open valley with gentle slopes and stable low gradient watercourse, cleared farmland	Yes	4th

Crossing ID	Watercourse name	River catchment	Description	Nearby road/ crossing	Stream order
WC5	Woodduck Creek	Bolong (Abercrombie)	moderately deep valley, mostly cleared farmland	Y	4th
WC6	Bolong River	Bolong (Abercrombie)	moderately deep valley, mostly cleared farmland	Y	4th or higher
WC7	unnamed creek	Bolong (Abercrombie)	broad open valley with gentle slopes and stable low gradient watercourse, cleared farmland	Y	4th
WC8	Tarlo River tributary	Tarlo (Wollondilly)	broad open valley with gentle slopes and stable low gradient watercourse, cleared farmland	Y	3rd
WC9	Tarlo River	Tarlo (Wollondilly)	broad open valley with gentle slopes and stable low gradient watercourse, cleared farmland	Y	3rd

1. The watercourse crossings listed are only for 3rd order or higher watercourses. They are ordered north to south for each option
2. River catchments display the initial receiving river and then (in brackets) subsequent receiving river

2.4 DAMS

Numerous dams for stock and domestic water supply are located across the wind farm site. A summary of these dams is provided in *Table 2.4*.

These details are considered when assessing the properties' maximum harvestable rights dam capacities (refer *Section 3.1.5*) and potential for using existing or new dams to supply construction water to the project (refer *Section 4.2*).

Table 2.4 Summary of Dams and Approximate Volumes

Name (nominal)	Qty	Location	Width	Length	Surface Area	Depth	Vol	Vol
					m^2	m	m^3	ML
Paling Yards								
P1	1	near homestead, top	60	35	2100	6.0	5040	5.0
P2	1	near homestead, mid	35	40	700	4.0	1120	1.1
P3	1	near homestead, bottom	55	70	2700	4.0	4320	4.3
P4	1	near woolshed	60	30	1400	3.0	1680	1.7
P5	5	several other small dams, roughly circular, nominal 15m diameter	15	15	200	2.0	800	0.8
							Total	13.0
Mingary Park								
M1	1	main large dam in gully	50	100	5000	8.0	12000	12.0
M2	1	upstream (NE) of M1	30	60	1500	6.0	3600	3.6
M3	1	west of M1	50	50	1500	4.0	2400	2.4
M4	1	800m NE of M1	40	55	1500	4.0	2400	2.4
M5	1	800m W of M3	55	70	1900	4.0	3040	3.0
M6	1	250m NW of M5	70	20	1000	3.0	1200	1.2
M7	1	350m N of M5	65	30	1300	3.0	1560	1.6
M8	1	800m NE of M5	50	25	1300	3.0	1560	1.6
M9	1	house paddock	40	25	1000	3.0	1200	1.2

Name (nominal)	Qty	Location	Width	Length	Surface Area	Depth	Vol	Vol
M10	10	numerous other small dams, roughly circular, nominal 20m diameter	20	20	300	2.5	3000	3.0
							Total	32.0

1. All dimensions are approximate only and have not been surveyed.
2. Volumes were estimated by multiplying depth by surface area, and applying a conversion factor ranging between 0.4 and 0.8 to account for dam shape and batters

2.5 GROUNDWATER

2.5.1 *Registered Bores*

A search of the NSW Government's NRAtlas website (http://www.nratlas.nsw.gov.au/) reveals seven registered bores within 5km of the wind farm site. These bores are shown in *Figure 2.2*. A summary of bore details is provided in *Table 2.5*.

Bore GW701355 is located on the Paling Yards property and landowner Mr Bell advised that although it has a pumping capacity of around 3,000 gallons per hour (approximately 13,500 L/hr), he typically only pumps it at 400 gallons/hour (1800L/hr) to avoid depletion of the aquifer. Bore GW032488 is the main supply bore at Mingary Park. Mr Johnston, landowner of Mingary Park confirmed that this also has a pumping capacity of around 3,000 gallons per hour (13,500 L/hr) but this rate is often not achieved.

Based on the bore data, water bearing zones occur at depths significantly greater than would be intercepted by any earthworks associated with wind farm construction.

Figure 2.2 Registered Bores

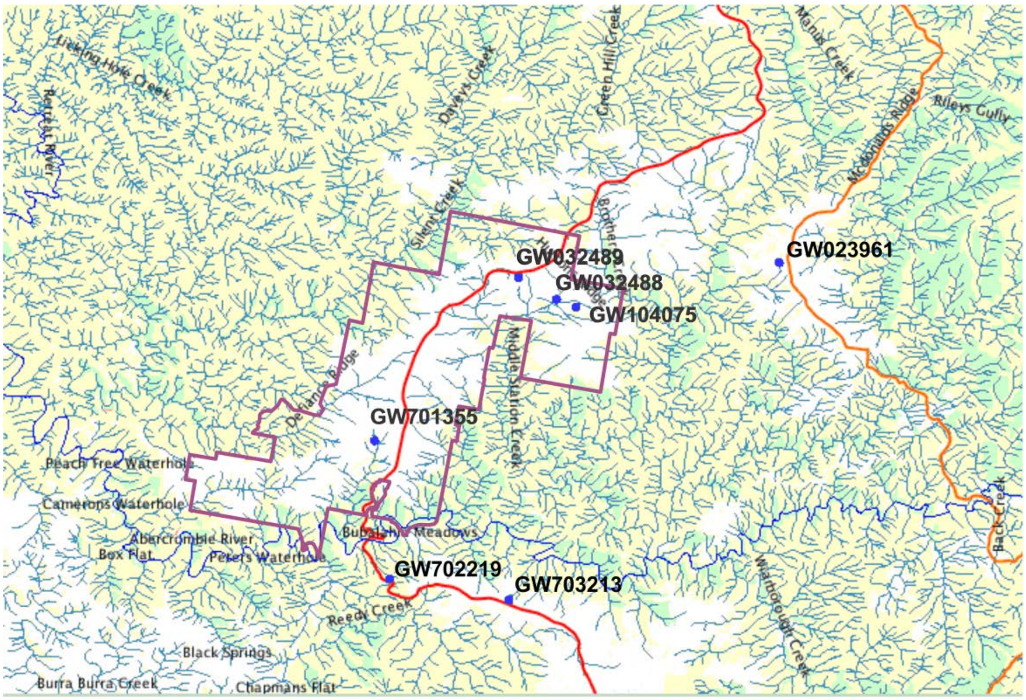


Table 2.5 Details of Registered Bores within 5km of the Paling Yards Wind Farm

Bore No.	Purpose	Total depth	Water bearing zone/s	Type	Standing Water level (m)	Yield (L/s)
GW023961	Domestic	52.70m	43.30m; 52.70m	Claystone	n/a	0.04; 0.09
GW032488	Domestic /Stock	29.30m	7.90 m	Clay white	18.30 m	0.51
GW032489	Domestic /Stock	64.20m	no details (reconditioned bore)	n/a	n/a	n/a
GW701355	Domestic /Stock	70.00m	20.0-21.0m; 37.0-38.0m; 65.0-66.0m	Basalt	3.0 m	4.44
GW104075	Domestic /Stock	48.00m	29.0-30.0m	Broken blue shale	12.0m	4.1
GW703213	Domestic /Stock	64.0m	45.0-48.0m	Basalt	35.0m	0.44
GW702219	Domestic /Stock	100.00m	no details (abandoned bore)	n/a	n/a	n/a

2.5.2 *Geotechnical Testing*

URS (2011) provided the results of recent geotechnical testing. Information was sourced from Test Pit testing conducted in the vicinity of each proposed turbine as well as two cored boreholes. The results of the geotechnical survey indicate groundwater was observed in some of the test pits or boreholes, and that actual groundwater levels may fluctuate significantly in response to seasonal effects, regional rainfall, and other factors that are not related to this investigation.

Based on past experience URS (2011) anticipates that the fractured basalt and the underlying Tertiary sediments are typically water bearing and can form perched water tables on weathered Ordovician basement. The regional water table in fractured Ordovician bedrock is anticipated to be a considerable depth.

2.6 *CLIMATE*

2.6.1 *Rainfall*

An understanding of rainfall magnitude and variability will contribute to the water balance assessment, in predicting availability of surface water runoff for collection through the year.

There are two Bureau of Meteorology (BOM) weather stations located close to Paling Yards, both of these have long rainfall records covering greater than 100 years (*Table 2.6*)

Table 2.6 Climate Summary Data

	Oberon (063063)	**Taralga (070080)**
Record	1888- Present	1882 - Present
Station elevation (m AHD)	1053	845
Median Annual Rainfall	824.1	786
Mean Annual Rainfall (mm)	842.2	803.4
10th %ile	538.1	569.6
90th %ile	1117.5	1108.2
Total for 2010	1208	966.5

1. Data obtained from Bureau of Meteorology's climate data online facility, accessed 1/09/2011

Data from the Taralga weather station was used in further assessments, this being the closest station to Paling Yards.

2.6.2 *Evaporation*

Neither of the abovementioned weather stations measure daily pan evaporation. The nearest weather station that records pan evaporation is at Goulburn TAFE (Station No. 070263). Mean annual pan evaporation at Goulburn is 1277.5 mm. Mean monthly pan evaporation ranges through the year, from a maximum of 195 mm in January to a low of 33 mm in June.

2.6.3 *Moisture Balance*

Moisture balance is defined simply as the difference between evaporation and rainfall. It is useful to understand the site moisture balance and how this varies through the year. Times of highest moisture deficit (ie when evaporation exceeds rainfall) are likely to require greater water inputs for dust suppression along unsealed roads and for general road and hardstand construction.

Annually, average pan evaporation significantly exceeds average rainfall leading to an overall moisture deficit. A comparison of monthly average rainfall and evaporation is provided in *Table 2.7*. It can be seen that the moisture balance varies through the year, from a maximum deficit of approximately 122 mm in December and January, to a surplus of 41.7 mm in June.

Table 2.7 Moisture Balance

	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Evaporation (Goulburn)	195.3	148.4	127.1	78	49.6	33	37.2	58.9	84	120.9	147	189.1	1277.5
Rainfall (Taralga)	72.7	68.1	65.4	58.9	59.8	74.7	67.3	66.9	61.9	70.9	68	66.5	803.4
Moisture Balance	122.6	80.3	61.7	19.1	-10.2	-41.7	-30.1	-8	22.1	50	79	122.6	474.1

1. All values are based on long term averages, in mm

3 WATER LICENSING AND STATUTORY MATTERS

3.1 WATER MANAGEMENT ACT 2000

The objectives of the *Water Management Act 2000* (WM Act) are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations. The provisions of the WM Act are being progressively implemented in NSW, repealing various other pieces of legislation in the process.

Since 1 July 2004 the new licensing and approvals system under the WM Act has been in effect in those areas of NSW covered by operational water sharing plans – these areas cover most of the State's major regulated river systems. For areas outside the limits of water sharing plans, licensing provisions of the *Water Act 1912* are still in force. The Project site is located within the jurisdiction of two water sharing plans:

- *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012*; and
- *Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011*.

The provisions of these two water sharing plans apply where water supply for the Project is to be accessed via surface water and/or groundwater. Further discussion of these plans and how they relate to the Project is provided in the following sections.

3.1.1 Water Sharing Plans

Introduction

Water sharing plans are one of the final components of the NSW Government's comprehensive overhaul of the water management strategies in the state. Water sharing plans are developed under the WM Act, which requires the plans to:

- share water between all water users and the environment;
- improve the health of our rivers;
- provide security of access for water users;
- meet the social and economic needs of regional communities; and
- facilitate water trading.

Once a water sharing plan commences, the licensing provisions of the WM Act come into effect in the plan area. This means that existing *Water Act 1912* licences will be converted to WM Act water access licences, and water supply works and use approvals. The water access licences are therefore separated from land and as a result trading is enhanced.

Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012

The Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources commenced on 14 September 2012. Under this plan, annual access to water for an individual licence holder is governed by their entitlement and climatic availability. However, the combined licence holders' annual access to water is managed through long-term average annual extraction limits (LTAAELs). The LTAAEL applies differently for unregulated surface water and alluvial groundwater sources. For unregulated surface water the LTAAEL applies across a number of water sources grouped together, either across the entire catchment, or part of the catchment (e.g. all water sources above a regulated dam). This group of water sources is referred to in the plan as the extraction management unit (EMU). For alluvial groundwater sources the LTAAEL is typically set for each water source (NSW Office of Water, 2012).

Unregulated water sources are also managed on a day-to-day basis in the plan through the definition of daily access rules that govern when licence holders are permitted to extract water. Generally, as a minimum, licence holders pumping from an unregulated water source cannot pump when there is no visible flow at their pump site or below the full capacity of a natural pool.

In addition to the annual limits, access rules, commonly known as the cease to pump (CtP) rules, provide protection for fish and other aquatic species during dry times. The CtP applies to the majority of unregulated river access licences, such as those used for irrigation, farming, industrial and recreational uses. Aquifer access licences that extract groundwater that is highly connected to the unregulated surface water may also have a CtP rule applied (NSW Office of Water, 2012).

Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011

The Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources commenced on 16 January 2012.

This plan relates to a specific aquifer type, e.g. fractured rock or porous rock, which is separate to plans covering alluvial aquifers, as these have been prepared in conjunction with associated surface water sharing plans (such is the case with *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012).*

Under this plan an individual licence holder's annual access to water is governed by their entitlement and climatic availability. However the combined licence holders' annual access to water is managed in the draft plan through long-term average annual extraction limits (LTAAELs). Firstly, the long-term average storage component of each groundwater source is reserved as planned environmental water. Secondly, a portion of the long-term average annual recharge of each groundwater source is reserved as planned environmental water, with the remainder potentially available for extraction. The portion of the long-term average annual recharge reserved as planned environmental water is determined based on a risk assessment that weighs up the environmental values of each groundwater source against socio-economic dependence (NSW Office of Water, 2012).

3.1.2 Basic Landholder Rights

Under the WM Act, extraction of water for basic landholder rights (BLR) does not require a licence, although in the case of accessing groundwater under BLR the bore must still be approved by the NSW Office of Water. Part 1 of the WM Act outlines basic landholder rights which include domestic and stock rights (Section 52 of the Act), harvestable rights (Section 53 of the Act) and native title rights (Section 55 of the Act).

In relation to harvestable rights, Section 53 of the WM Act states:

'(1) An owner or occupier of a landholding within a harvestable rights area is entitled, without the need for any access licence, water supply work approval or water use approval:

(a) to construct and use a dam for the purpose of capturing and storing rainwater run-off, and

(b) to use water that has been captured and stored by a dam so constructed,

in accordance with the harvestable rights order by which the area is constituted.'

The site is within a harvestable rights area and the harvestable rights have been calculated (refer *Section 3.1.5)*.

3.1.3 Approvals Generally

The WM Act describes, under Sections 89, 90 and 91, a range of approvals including water use approvals, water management work approvals and activity approvals. However, due to the project application being a transitional project under Part 3A, the provisions of Section 75U of the *Environmental Planning and Assessment Act 1979 (EP&A Act)* apply, which states:

'(1) The following authorisations are not required for an approved project (and accordingly the provisions of any Act that prohibit an activity without such an authority do not apply):

(h) a water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the *Water Management Act 2000*.

The requirement for these approvals under section 91 of the WM Act is therefore excluded. The requirement to hold a water access licence for the required take of water, however, is not excluded and is discussed further in Sections ***Error! Reference source not found.*** and *0.0.0* of this report.

3.1.4 Activity Approvals

Section 91 of the WM Act states the following in relation to activity approvals:

(1) There are two kinds of activity approvals, namely, controlled activity approvals and aquifer interference approvals.

(2) A controlled activity approval confers a right on its holder to carry out a specified controlled activity at a specified location in, on or under waterfront land.

(3) An aquifer interference approval confers a right on its holder to carry out one or more specified aquifer interference activities at a specified location, or in a specified area, in the course of carrying out specified activities.

Subsections (1) and (2) of the above are excluded due to the transitional provisions of Part 3A, (under Section 75U of the EP&A Act), as discussed in *Section 3.1.3* of this report.

The aquifer interference provisions of subsection (3) are currently in force within water sharing areas involving groundwater use. The Project site falls within the bounds of two water sharing plans relating to groundwater use and as such the provisions of subsection 90(3) of the WM Act apply.

3.1.5 Harvestable Rights

The WM Act establishes basic rights for access to water by rural landowners and outlines several categories of farm dams that do not require a license. The harvestable rights provisions enable landholders to construct dams, in certain positions (e.g. on hillsides and minor watercourses), that capture up to 10% of the average regional rainfall runoff for their property without requiring a licence. This is known as the maximum harvestable rights dam capacity (MHRDC).

The Farm Dams Policy in NSW provides a process for calculating MHRDC. Under this policy the rural harvestable right for this area is 0.08 ML/hectare, i.e. for every hectare of land up to 0.08 ML of storage may be provided in dams without the need for dams to be licensed. For dams exceeding the MHRDC right a license must be obtained.

The harvestable rights allowances for Paling Yards and Mingary Park properties are contained in *Table 3.1*.

Table 3.1 Maximum Harvestable Rights Dam Capacities

Property	Size (ha)	HR multiplier (ML/ha)	HR Dam allowance (ML)	Existing dam capacity (ML)	Available harvestable rights capacity (ML)
Paling Yards	2200	0.08	176	13	163
Mingary Park	1400	0.08	112	36	76

1. HR – Harvestable Rights

Both properties have substantial available harvestable rights capacity, allowing additional non-licenced, harvestable rights dams to be constructed. This is a potential water supply option for the project, however, it should be noted that water extracted from harvestable rights dams must be used on the property that the dam is located on and hence this should be considered when confirming any use of existing or new harvestable rights dams for the Project at construction stage.

Harvestable rights dams may only be constructed on hillsides and on minor watercourses. Minor watercourses are defined by the Strahler stream ordering method, as first-order or second-order watercourses that do not permanently flow.

3.1.6 Water Access Licences

Except for basic landholder rights (discussed in *Section 3.1.2* of this report), all other water extraction either requires an authorisation under a water access licence (WAL) or some form of exemption. The WM Act establishes categories and sub-categories of access licences. Examples include:

- local water utility – a category of access licence for town water purposes;
- domestic and stock – a category access licence for landholders who cannot access water under basic landholder rights (i.e. their property does not directly front a river, lake or estuary, or have an underlying aquifer);
- unregulated river – a category of access licence that covers purposes such as irrigation, industry, mining, recreation and general farming;
- unregulated river special additional (high flow) – a category of access licence with high flow access conditions, originally attached to an unregulated river access licence;
- aquifer – a category of access licence that covers purposes such as irrigation, industry, mining, recreation and general farming for water extracted from a groundwater source;
- supplementary water – a category of access licence that may be issued during the life of a plan for certain alluvial groundwater sources;

- Aboriginal cultural – a specific sub-category of access licence that allows water to be taken by Aboriginal persons or communities for personal, domestic and communal purposes (generally up to 10 megalitres per year per licence); and
- Aboriginal community development – a specific sub-category of access licence that allows water up to specified limits to be taken by Aboriginal persons or communities for commercial purposes.

The most relevant WAL categories for this Project are the 'unregulated river' (for surface water extraction) and aquifer (for groundwater extraction) categories. The total entitlement or share component for each category of access licence that applies at the start of the plan is estimated and is included in the relevant plan.

For the purposes of the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2011,* the following share components apply:

'24 Share components of unregulated river access licences

It is estimated that at the time of commencement of this Plan the share components of unregulated river access licences authorised to take water from these water sources total 38,617 unit shares, distributed as follows:

(a) 773 unit shares in the Abercrombie River above Wyangala Water Source'; and

25 Share components of aquifer access licences

It is estimated that at the time of commencement of this Plan the share components of aquifer access licences authorised to take water from the Upper Lachlan Alluvial Groundwater Source total 169,203 unit shares.

For the purposes of the *Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011,* the following share components apply:

22 Share components of aquifer access licences

It is estimated that the share components of aquifer access licences authorised to take water from these groundwater sources total 98,775 unit shares, distributed as follows:

(d) 69,248 unit shares in the Lachlan Fold Belt MDB Groundwater Source.'

The following sections provide a discussion of the relevant licences required for surface water and groundwater extraction outside of basic landholder rights for the Project.

Surface Water Extraction

Extraction from a surface water supply outside the harvestable rights capacity, or from an unregulated water source (i.e. the Abercrombie River) will require a WAL (unregulated river category) under section 56 of the WM Act in accordance with the annual extraction limits and access rules of the relevant water sharing plans.

Groundwater Extraction

It is not expected that wind farm construction activities would intercept groundwater. Any excavations would be relatively shallow, the deepest being up to about 3 m for turbine footing construction.

There is the potential for one or more new groundwater production bores to be installed to supply water for construction (discussed further in *Section 4.2.2* of this report). If this option is pursued then an application for a WAL (aquifer category) under section 56 of the WA Act will be required, in accordance with annual extraction limits and access rules of the relevant water sharing plans. If groundwater is to be sourced from alluvial groundwater sources then the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012* applies. If groundwater is to be sourced from fractured rock, then the *Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011.*

Copies of the Rule Summary Sheets produced by the NSW Office of Water for the relevant water sharing plans are provided in *Annex E.*

3.2 WATER ACT 1912

In those water sources (rivers, lakes and groundwater aquifers) in NSW where water sharing plans have not been gazetted and commenced, the *Water Act 1912* (the "Water Act") still regulates new water licences and the trade of water licences and allocations. Given that the Project is located on land which is now subject to two water sharing plans, as described in *Section 3.1* of this report, the provisions of the Water Act no longer apply to this Project.

4 WATER BALANCE

4.1 CONSTRUCTION WATER DEMANDS

The main water requirements during construction are expected to be for the following activities:

- concrete production;
- construction of roads and hardstands; and
- dust suppression.

Discussions were held with the proponent to understand the construction program and to help estimate the likely quantities of water required at different stages of the project and in total over the life of construction.

Water demand estimates are based on the following information:

- total length of internal unsealed road network (may be either upgraded existing tracks, or new tracks) is approximately 30 km;
- it is assumed that tracks will be constructed up to 6-10 m wide and with 0.3-0.4 m depth of imported road base/aggregate that would need to be laid and compacted;
- during track construction water would be added to aid compaction of road base at a rate of approximately 4% by weight. It is noted that this is an average, with lesser quantities likely to be required during wet/cool conditions, and greater quantities during hot/dry conditions. The total water requirement for road construction is approximately 5.7 ML. Allowing a 50% contingency factor results in a total water demand of 8.5 ML;
- road construction is likely to occur for about the first six to eight months of the project and spread relatively uniformly over this time;
- an additional allowance of 50kL/day is provided for road maintenance, dust suppression and wash down, for the 12 month construction period (assume 6 days per week);
- construction of crane hardstands at each turbine location will involve a similar process to track construction with similar water requirements for compaction. Assuming there are 59 pads with footprints 40m x 50m x 0.4m deep, the total water requirement is approximately 3.8 ML. Pad construction would occur mainly between months two and nine of the project, and spread relatively evenly during this time; and

- water is required for concrete production for turbine footings. The final footing design is not available. However, an estimate is made based on there being 59 footings in total, hexagonal in shape, approximately 17m in diameter and with an average thickness of 2.5 m. This equates to a concrete volume of approximately 560 m^3 per foundation and a total concrete volume of approximately 33,600 m^3. Water input estimate is based on a typical cement:sand:aggregate ratio of 1:2:3 and a water:cement ratio of 0.4. The total water estimate to produce 33,600 m^3 of concrete is approximately 2400 m^3 (or 2.4 ML). Concrete production is expected to occur mainly between months three and eleven, and spread relatively evenly during this time.

The total water demand over the 12 month construction period is approximately 30 ML. A breakdown of the pattern of use is summarised in *Table 4.1*.

Table 4.1 Water Demand

	Water demand by activity (kL/month)				
Month	**roads**	**hardstands**	**concrete**	**misc. (dust suppression, maintenance)**	**Total per month**
1	1060			1250	2060
2	1060	475		1250	2535
3	1060	475	270	1250	2805
4	1060	475	270	1250	2805
5	1060	475	270	1250	2805
6	1060	475	270	1250	2805
7	1060	475	270	1250	2805
8	1060	475	270	1250	2805
9		475	270	1250	1745
10			270	1250	1270
11			270	1250	1270
12				1250	1000
Totals	8500	3800	2400	15000	29700 (annual)

4.2 WATER SUPPLY OPTIONS

A number of water supply options have been canvassed, the key options being:

- surface water collection from existing (or new) dams;
- groundwater pumping from existing (or new) bores;
- water abstraction from a nearby permanent water source (ie Abercrombie River); and
- tankering water to site.

All options have advantages and disadvantages as well as different licensing and approvals requirements. An overview of the options is provided in the following sections. Licensing and statutory matters have been addressed in *Chapter 3*. Preliminary discussions regarding water licensing have been held with Jeanette Nestor, licensing officer with the NSW Office of Water. A copy of correspondence received from the NSW office of Water is provided in *Annex A*.

The options presented below demonstrate that water can be feasibly supplied to the project; however, the method to be adopted has not yet been decided. This decision would be made following further discussion with relevant landholders as well as an assessment of economic and other factors associated with each option.

4.2.1 Surface Water Collection

The wind farm site has many dams that supply water for stock and domestic purposes (refer *Section 2.3*). These dams could be used to supply water for wind farm construction purposes subject to agreement with the relevant landowners. Preliminary discussions took place with both Mr Richard Bell (of Paling Yards) and Mr Hugh Johnston (Mingary Park) regarding this option.

There is approximately 45ML of existing storage capacity in dams. This is approximately double the estimated total water needs of the project. It would be anticipated that during a good rainfall year, runoff yields into dams would be sufficient to fill the dams several times over. This would be confirmed in a detailed water balance investigation, as part of the Water Management Plan, prior to the construction phase. If this were the case, water could be taken from existing dams at rates that would be unlikely to compromise the ability to supply the existing stock and domestic needs provided this was carefully managed. Conversely, in a dry year the existing surface water storages would likely have limited capacity to supply additional users and landholders would be keen to preserve available water for existing agricultural operations.

A summary of the discussions with relevant landholders and a review of available options follows.

Paling Yards

Mr Bell indicated that stock and domestic water on the property is currently supplied mainly from the site’s two bores. He indicated that if conditions were favourable (i.e. good rainfall) he may be willing to offer access to dam waters; however, in a drought however he would be unlikely to offer such access.

Mr Bell offered the option of constructing a new dam or dams on his property to supply construction water. An ideal location proffered by Mr Bell occurs on Paling Yards approximately 1.2 km east-southeast of the Paling Yards homestead, on the eastern side of the Goulburn-Oberon Road. The site occurs at the junction of two first order drainage lines, one of these being spring-fed. A new dam at this location could be built without the need for a license provided it meets the requirements under the NSW Government's Farm Dams Policy and is within the harvestable rights allowance of the property. The Paling Yards property has approximately 163ML of unutilised harvestable rights dam allowance (refer *Section 3.1.5*), more than enough to install a new dam or dams to meet the project needs.

A new dam in the location described above would have an estimated catchment area of 30 hectares. A multiplier of 0.08 is used in this area by the Office of Water to calculate harvestable rights. This multiplier is based on dams having a capacity equivalent to 10% of the average annual runoff from the property. It is estimated that average annual runoff is approximately 0.8 ML per hectare; therefore, a dam with a catchment area of 30 hectares would have a potential yield of approximately 24 ML. It is noted that the suggested location is spring fed and likely to have significantly greater yields. Although heavily reliant on rainfall patterns, this water supply option would have the potential to supply all the project's total water needs. Sizing of the dam would need to be based on a more detailed assessment of average rainfall patterns and catchment yields, as well as economic considerations. A dam of approximately 10 ML would be useful for initial consideration.

Mingary Park

Mr Johnston advised that he would most likely have spare surface water to provide to the project. The largest dam has a capacity of approximately 12 ML and has been used before by the Council for road construction/maintenance purposes.

Mr Johnston also nominated a number of locations where new dams could be considered, including spring-fed locations that would offer good security of supply.

4.2.2 *Groundwater pumping*

The existing bores at both Paling Yards and Mingary Park are licensed for stock and domestic use and are not licensed to supply the construction project. A new bore, or bores, could be sunk and licensed for industrial purposes. The Office of Water confirmed in its correspondence (refer *Annex A*), that it would consider approving construction of a new bore for an industrial purpose, but with a zero share entitlement. A water entitlement would then need to be purchased on the open market.

Based on the existing bore data it is reasonable to assume that a new bore could be installed that would have a secure yield of about 1 L/s, possibly better depending on the aquifer. This amounts to a potential long term pumping rate of approximately 100 kL/day, or 3 ML/month. Assuming such yields were achieved, this would be capable of supplying the construction water needs of the project. Consideration would need to be given to water storage and this could be in a new or existing dam. All work would be subject to agreement with the landholders. It would be possible to on-sell any water entitlement over the new bore to the landholder at the completion of construction. Alternately, the landholder could apply for a new stock and domestic license over the bore.

4.2.3 *Surface Water Abstraction (Abercrombie River)*

As outlined in *Section 3.1.6*, a WAL may be applied to source water from an unregulated water source. A potential water source is the Abercrombie River. Review of online river flow data (available at http://waterinfo.nsw.gov.au) suggests the Abercrombie River at Hadley (Station 412066) which is near the site, has daily flows that regularly exceed 200 ML/day. This suggests that there would be justification in permitting water abstraction for the project without impacting environmental flows or the rights of existing licensed users.

Water would need to be tankered or pumped from the Abercrombie River to the site, and this would involve significant logistical issues. Any pump/pipeline configuration would likely need to deliver water through a vertical lift of between 200 m and 300 m, and over distances greater than a kilometre from the source.

A small water tanker could draw water from near the Abercrombie River bridge, but further investigation is required as to whether it would be capable of carting water up the steep and winding section of road between the bridge and the wind farm site.

4.2.4 *Commercial Water tanker*

A fallback water supply option is employing a commercial water tanker to bring water to the site. This option has not been investigated in detail as it is unlikely to be economically feasible or necessary for the project.

4.2.5 *Summary*

There are feasible options for supplying water to the construction project. These include the use of local surface water and groundwater supplies. The existing dams at Paling Yards and Mingary Park would be expected to have capacity to provide a good proportion of the project needs in a good rainfall year, though availability may be restricted in a dry year. Construction of a new dam, particularly in a spring fed location, would greatly improve security of surface water supply and would meet the project needs under most rainfall scenarios.

Groundwater supply from a new bore would be capable of supplying a large proportion of the project needs, and this could be considered in combination with use of surface water from existing dams. Surface water could be used when supply is abundant and be supplemented with groundwater when storage decreases.

It is unlikely that existing surface water resources or groundwater resources alone could service the project needs; however, options are available to improve surface water collection or pump additional groundwater that would be expected to meet project needs. Further investigation is required to determine the preferred option.

The option of obtaining a WAL from the Abercrombie River, while feasible, has logistical issues that require further investigation. This would need to assess whether water could be feasibly tankered up the steep road between the river and the site, or whether it could be economically pumped over the distances and elevations required. However, it would seem that the Abercrombie River offers a highly secure source of water for road construction and dust suppression, and that project needs would not be expected to diminish flows to the extent that environmental values or existing water users are adversely affected.

5 POTENTIAL IMPACTS TO SOIL AND WATER

The following table provides a brief description of the potential impacts to soil and water on and adjacent to the site resulting from the construction activities.

Table 5.1 Potential Soil and Water Impacts

Construction Activities	Potential Impacts to Soil and Water
Unsealed Road Network	Creation of fugitive dust due to vehicle movements; Erosion of unsealed roadways and resultant sedimentation of runoff from road surfaces; Erosion of roads and roadside drainage; Mud tracking at confluence of internal access tracks with public road network; and Six access points with Abercrombie Road have potential mud tracking implications from unsealed internal access roads.
Watercourse Crossings	Erosion of drainage lines and subsequent sedimentation; and Removal of vegetation and subsequent increased erosion potential.
Establishment of Pad Sites (e.g. substation site, tower foundation sites)	Erosion of relatively large disturbed areas during establishment and subsequent sedimentation of runoff.
Trenching	Erosion of trench sites; Erosion from trench spoil stockpiles and subsequent sedimentation should it reach a waterway; Water collected in the trench following rainfall events may have high sediment content and if not managed appropriately, dewatering could contaminate surface waters.
Dewatering of Site	Introduction of contaminated water to natural surface waters, including release of water with high suspended solids.
Stockpile management	Erosion of stockpiles and loss of soil resource; and Introduction of contaminated water to natural surface waters;
Concrete Batching Plant	Contamination of waterways from concrete associated water; and Release of water to soil and/or water bodies with increased pH, TSS and potentially other contaminants;
General Construction Activities	Hydrocarbon spills from machinery (burst hoses, mechanical failures, leaking machinery, etc); Contamination of waterways from hazardous substances due to incorrect storage (including drums and containers and spent oil filters etc.); Increased refuse in streams due to littering; Contamination of soils and waterways from poor refuelling practices; and Discovery of previously contaminated sites.
Water Supply	Over-extraction of surface water or groundwater resulting in reduced environmental flows, reduced water availability for existing licensed users and impacts on water–dependent ecosystems

A qualitative risk assessment suggests that overall potential risks to water and soils are relatively minor. This is on the basis that:

- for the most part, works occur on relatively low gradient lands high up in the respective drainage catchments;
- there is generally a very low risk of run-on or runoff of concentrated stormwater flows;
- construction sites at Paling Yards generally present a low erosion hazard considering factors such as climate, soils and landform. Note that an erosion hazard assessment is provided in *Annex B*.
- the landscape of the wind farm is relatively stable with no appreciable erosion;
- vegetated buffers over low gradient lands lie between work areas and watercourses;
- there is no need to construct vehicle watercourse crossings for any part of the project; and
- sustainable water supply options will be pursued through consultation with landowners and relevant Government agencies. Licenses would be obtained as required.

The identified risks can be managed through implementation of appropriate preventative and management measures. These would be outlined in a construction environmental management plan (CEMP) and soil and water management plan prepared post consent. *Chapter 6* provides outlines a range of management practices that would contribute to sound management of the site's soil and water resources.

6 CONCEPTUAL SOIL AND WATER MANAGEMENT PLAN

6.1 INTRODUCTION

In NSW, best practice guidance on soil and water management at construction sites is provided in the document *Managing Urban Stormwater: Soils and Construction, Volume 1, 4th edition* (Landcom, 2004; also known as the "Blue Book"). The Blue Book provides an overarching guideline, though is particularly targeted to urban development. A number of more targeted supporting guidelines are published under Volume 2 of the Managing Urban Stormwater series, including the following that are particularly relevant to construction of the proposed wind farm and transmission lines:

- *Managing Urban Stormwater: Soils and Construction, Volume 2A, Installation of Services* (NSW Department of Environment and Climate Change, 2008a) (hereafter referred to as "Volume 2A"); and

- *Managing Urban Stormwater: Soils and Construction, Volume 2C, Unsealed Roads* (NSW Department of Environment and Climate Change, 2008b) (hereafter referred to as "Volume 2C").

The Blue Book specifies that an Erosion and Sediment Control Plan (ESCP) is required for small urban development projects where an area of 250–2500 m^2 will be disturbed, and a more detailed and broadly focused soil and water management plan is required (SWMP) where more than 2500 m^2 will be disturbed.

Volume 2A recognises that this two-tiered approach is not particularly suitable for erosion and sediment control planning for non-urban developments or activities, such as installing services or constructing roads. It recommends that an ESCP should be prepared for *all* service installation projects where more than 250 m^2 will be disturbed, with the content and level of detail in the ESCP determined by the nature of the project, the site and the surrounding environment.

ERM has prepared this Conceptual SWMP to outline the fundamental principles to be followed in the planning and implementation of erosion and sediment control measures for the project. This Conceptual SWMP provides guidance on the suite of best management practices that may be relevant to control soil and water impacts during construction, and outlines how a combination of controls may be used during particular activities.

It is not feasible to prepare a detailed SWMP at this stage that addresses all work sites, as works will be dispersed over large distances, will occur in stages, and in many cases have not yet been subject to detailed design.

This Conceptual SWMP does not include detailed engineering design of structures, nor does it provide plans showing the layout of all erosion controls across the site. It is recommended that Progressive ESCPs should be prepared for this purpose once detailed design plans are available, particularly the detailed road and drainage designs. In many cases these progressive ESCPs will be relatively simple documents, such as a sketch plan showing the layout of controls with attached commentary, prepared on topographic or drainage plans.

The head construction contractor will prepare their own Construction Environmental Management Plan (CEMP) including a Detailed Soil and Water Management Plan that will include elements of this Conceptual SWMP and any additional measures required to manage the erosion, sedimentation and water quality risks of the project. The SWMP will outline the requirements for preparation of Progressive ESCPs for each area of works, and with a particular focus on high risk locations such as on steep lands and in the vicinity of watercourses. It is recommended that the SWMP be prepared in accordance with the Managing Urban Stormwater guidelines, particularly Volumes 2A and 2C.

6.2 *EROSION HAZARD ASSESSMENT*

Erosion hazard was estimated using the Revised Universal Soil Loss Equation (RUSLE) and details are provided in *Annex B*. The RUSLE provides a quantitative estimation of erosion hazard based on five factors: rainfall erosivity; soil erodibility; slope length and gradient; soil cover and management practices. A detailed description of the RUSLE equation and its contributing factors is provided in Landcom (2004).

The overall erosion hazard has been assessed as low. This is a consequence of favourable climatic conditions (low rainfall erosivity) and the low slope gradient where disturbance will occur, which limit the generation of high velocity, erosive runoff. Localised areas of greater erosion hazard will exist, for example where steeper slopes occur (e.g. road batters) and in areas of concentrated water flow, such as along watercourses and table drains. Particular attention to erosion control should be applied in these areas.

6.3 *DESIGN ARIS AND CALCULATION OF PEAK FLOWS FOR CONTROL DEVICES*

Certain erosion and sediment devices, particularly those associated with the conveyance of concentrated water flows, should be designed by suitably qualified persons to ensure that they are sized and suitably stabilised to safely convey the predicted stormwater flows they will carry.

Landcom NSW (2004) (the "Blue Book") recommends average recurrence intervals (ARIs) for design of erosion and sediment controls as shown in *Table 6.1*. All earthworks, including waterways/drains/spillways and their outlets, will be constructed to be stable in at least the 10-year ARI, time of concentration (tc) storm event.

Table 6.1 ***Design ARIs in Years for Erosion and Sediment Controls***

Control Measure Life	0-12 months	12-28 months
Diversion bank	1-10	10-20
Level Spreader	1-10	10-50
Waterway	1-10	10-50
Sediment trap	1-5	5-20
Outlet Protection	1-20	20-100
Grade Stabilisation	1-20	1-100

1. Landcom (2004)

Calculation of design flows requires knowledge of catchment areas as well as historical hydrological data on rainfall intensity, frequency and duration (IFD). An IFD table was developed for the site using the process outlined in Australian Rainfall and Runoff (Pilgrim, 1987) and a copy is provided in *Annex C*.

Data from the IFD table may be used to calculate peak flows and design control measures for individual catchments, during preparation of Progressive ESCPs. Designs should be undertaken by suitably experienced personnel.

6.4 *GENERAL MANAGEMENT PRACTICES*

The Blue Book outlines a range of management principles that underpin good soil and water management at construction sites. These may be paraphrased as follows:

- investigate site features and assess constraints;
- develop and implement plans for the management of soil and water;
- minimise disturbance;
- strip and stockpile topsoil for use in subsequent rehabilitation;
- divert upslope (clean) stormwater around the disturbed site
- reduce erosion;

- capture sediment-laden runoff from within the disturbed site for diversion to sediment control devices;
- rehabilitate the site promptly and progressively as works progress; and
- inspect and maintain erosion and sediment control devices for the duration of the project.

The following sections outline a range of general erosion and sediment control practices that will be relevant to the construction project. These sections do not provide detailed specifications but rather, describe a general approach that would be appropriate. Reference is made to a number of Standard Drawings (SD) (e.g. SD4-1) published in the Blue Book. These Standard Drawings have been reproduced at *Annex D*.

6.4.1 *Staging of Work*

Implementation of erosion and sediment controls prior to site disturbance is critical. Staging of works following the implementation of these controls demonstrates a proactive approach to soil and water management, and can be highly effective in minimising soil and water risks and management demands at any given time. The following factors should be considered:

- plan construction activities such that the area of disturbance at any one time is restricted to the minimum practicable;
- have a single stabilised site access point defined by barrier or sediment fencing, to prevent unnecessary disturbance at access locations;
- install sediment fence downslope and boundary fencing around perimeter of site to define the work areas and minimise disturbance outside construction boundaries (to be regularly maintained);
- install upstream stormwater diversion drains and stabilise their outlets (where required);
- install sediment traps with stabilised outlets as shown in Progressive ESCPs;
- direct runoff from disturbed areas to sediment traps during construction, using earth banks or drains;
- remove vegetation and store in appropriate locations (eg away from watercourses and riparian lands) and respread cut vegetation where appropriate during rehabilitation;
- commence earthworks, stripping topsoil and subsoil independently and storing these separately. Topsoil should be preserved for use later in rehabilitation;

- install erosion and sediment controls as required during progression of construction works and maintain existing controls;
- rehabilitate site as soon as practicable after completion of construction; and
- decommission/remove controls when site is successfully stabilised and vegetation established.

6.4.2 *Erosion Control*

Erosion control should be prioritised in all aspects of the work – this being the most effective way to minimise site degradation and reduce potential impacts on land and water resources. Effective erosion control reduces the loss of sediment and improves the effectiveness and reliability of downstream sediment and pollution controls.

In addition to the erosion control measures outlined in the staging section above, the following are a series of general erosion control measures that apply to the day-to-day construction activities:

- stabilise the access point by sealing with concrete, asphalt or loose rock fill (refer SD6-14);
- limit unnecessary vehicle movements across the site to those only required for construction activities and ensure movements are contained to the predefined construction access ways;
- limit stripping of topsoil to within 2 weeks of commencing construction activities to minimise the time and area that soil is exposed to erosive forces;
- where more than one contractor is on-site at any one time, co-ordinate works so that sites do not remain disturbed for longer than is necessary;
- stockpiles should be located greater than 40m from natural waterways (refer SD 4-1);
- stockpiles are to have a buffer of at least 5m from areas likely to receive concentrated water flows, including earth banks and roads;
- unsealed access roads are to be kept moist by water carts during windy conditions and times of heavy traffic, to prevent dust generation; and
- all areas of concentrated flow (diversion banks and waterways), will be designed by a suitably qualified person to convey and remain stable during the design storm event. Stabilisation with 350 gram per square metre (gsm) jute matting or equivalent may be required (refer SD 5-7).

6.4.3 *Stormwater Management*

The following stormwater management controls apply to all construction activities and will be utilised during site development:

- where required, divert clean stormwater away from areas to be disturbed by construction activities using earth banks or catch drains. Note that in some cases low-impact diversions can be created using sandbags or similar. Earth banks may also be used and construction requirements are shown in:
  - SD 5-5 for temporary earth banks (low flow); and
  - SD 5-6 for permanent earth banks (high flow).
- permanent diversion banks will be sized by a suitably qualified person, using hydrological data and design standards as recommended in the Blue Book. Note that the need for upslope diversion may be removed where construction sites have minimal upslope catchment or the risk of stormwater run-on is low. This is likely to be the case for the vast majority of turbine sites;
- collect dirty water in earth banks or catch drains for diversion to sediment control structures as determined in the Progressive ESCP Drawings.
- install temporary earth diversion banks (refer SD 5-5) at the direction of the site manager to mitigate against unforseen erosion hazards, particularly when rain is forecast. These shall be used to shorten slope lengths, or to divert localised run-on away from high hazard areas (such as unstable batters);
- check dams (SD 5-4) using rock aggregate, sandbags or geotextile "sausages" may be installed within drains and diversion channels to help reduce erosion, especially on steep sections. Care will be taken to ensure there is adequate provision for a spillway that allows flows to be retained within the diversion channel and not escape thereby potentially causing scouring and/or flooding of adjacent lands; and
- maintain slope lengths no greater than 80 metres in disturbed areas and preferably <50 metres on exposed road surfaces. To reduce slope lengths in construction areas install temporary earth diversion banks following SD 5-5. On roads consider the use of cross banks and mitre drains to shed water from the surface.

6.4.4 *Sediment Control*

Sediment traps will be used to treat sediment laden runoff that is generated from disturbed areas and maintain the sediment as close as possible to its source.

Sediment traps work by trapping water and allowing the coarser fragment of the sediment to settle out under gravity. Sediment traps are most effective for sheet flows of runoff rather than concentrated flow. Use of sediment traps in areas of concentrated flow such as drains are often ineffective, with the result often being scouring and further erosion.

The most easily recognisable and common form of sediment trap is sediment fencing, but sediment traps may also include earth bunds, geotextiles, rock or a combination of these (such as a rock-sock which involves wrapping rock in geotextile). Installation and sizing of these traps should be such that water does not find an alternative flow path underneath or around the trap. Anchoring of the traps should be sufficient to provide for strength and reliability of the trap. Traps should be designed with consideration to larger storm events, and incorporate spillways and bypasses to prevent scouring and erosion of adjacent areas.

Sediment fencing will be a primary sediment control method used throughout the construction stage of the project. The following principles apply to the use of sediment fencing:

- sediment fence (refer SD 6-8) should be placed downslope of disturbed areas to help retain the coarser sediment fraction;

- sediment fences will have a return of 1 metre upslope at intervals of approximately 20 metres. Returns are installed to subdivide the catchment area of the sediment fence, to improve its effectiveness and help prevent structural damage during peak flows. The catchment area of each section of fence should be small enough to limit flow if concentrated at one point to less than 50 L/s in the 10-year ARI storm event;

- place sediment fence as close as possible to along the contour, to provide a maximum surface area to the passage of stormwater;

- sediment fences require regular maintenance, with captured sediment to be removed prior to it reaching a third of the height of the sediment fence. Place sediment extracted from maintenance in a suitable location so as to prevent further sedimentation; and

- sediment basins are a specific type of sediment trap comprising large earth dams designed to capture dirty water runoff, and are the most effective of all sediment trapping devices. They may only be required at the larger construction sites such as the concrete batching plant and substation. Otherwise most of the work areas are relatively small and dispersed, and sediment control can be achieved using conventional sediment traps, without the use of sediment basins. Detailed design and sizing of sediment basins, where required, will be included in the Progressive ESCPs.

6.4.5 *Pollution Control and Waste Management Measures*

All fuels, oils and hazardous substances used on site will be stored in appropriately bunded locations to prevent release to the environment. Bulk storage areas for fuels, oils and chemicals used during construction will be contained within an impervious bund to retain any spills of more than 110% of the volume of the largest container in the bunded area. Any spillage will be immediately contained and absorbed with a suitable absorbent material. Storage will comply with *AS 1940- 1993 The Storage and Handling of Flammable and Combustible Liquids*.

Spill clean-up kits will be located in numerous, well known locations throughout the site. Use of items within the spill kit will be demonstrated to all construction personnel. Spill kits should include floating booms in locations close to waterways (where relevant). Spill kits require regular maintenance to ensure that sufficient material is available in the event of a spill.

Material Safety Data Sheets (MSDS) will be available for all chemicals used on the site. All site personnel should be aware of the location of the MSDS.

Refuelling of equipment on-site or any other activity which could result in a spillage of a chemical, fuel or lubricant will be undertaken away from watercourses and stormwater drainage lines. In the event water is polluted by chemicals and/or fire fighting materials (e.g. foams) the water will be collected, and disposed at an approved Liquid Waste Treatment Facility. A designated refuelling area should be established with drip trays installed and spill kits on stand-by. Should refuelling in the field be required, absorptive mats and drip trays are to be used in the refuelling process.

Bins will be available for the deposit of waste materials. Where possible, bins for recycling will be made available to facilitate separation and appropriate reuse or disposal of recyclable materials.

6.4.6 *Site Rehabilitation*

Rehabilitation of distributed soil is to take place progressively on the site as different aspects of the project are completed. As some individual construction areas are completed, rehabilitation should accordingly be undertaken to stabilise and effectively finalise areas from an erosion and sediment perspective. Site stabilisation can be achieved by several measures including the following:

- vegetative cover;
- mulch;
- rock armouring;

- paving;
- concrete;
- geofabrics; and
- synthetic soil binders.

It is essential that all disturbed lands be stabilised to mitigate ongoing erosion problems and prevent sediment pollution of downstream lands and waterways. The preferred site stabilisation method will be identified on a site by site basis and included within the Progressive ESCPs. In most areas it is likely that revegetation to pasture grasses would be the preferred approach.

When selecting stabilisation methods a key factor that will be considered is the form of water runoff over the stabilised area. Areas subject to concentrated flow (i.e. watercourses and drains) will require different stabilisation techniques to those subject to sheet flow.

In areas of sheet flow vegetation will generally be acceptable and the revegetation goal over much of the site will be to re-establish pasture grasses, to achieve a similar condition and pasture species composition to present so that the lands may continue to be used for grazing purposes.

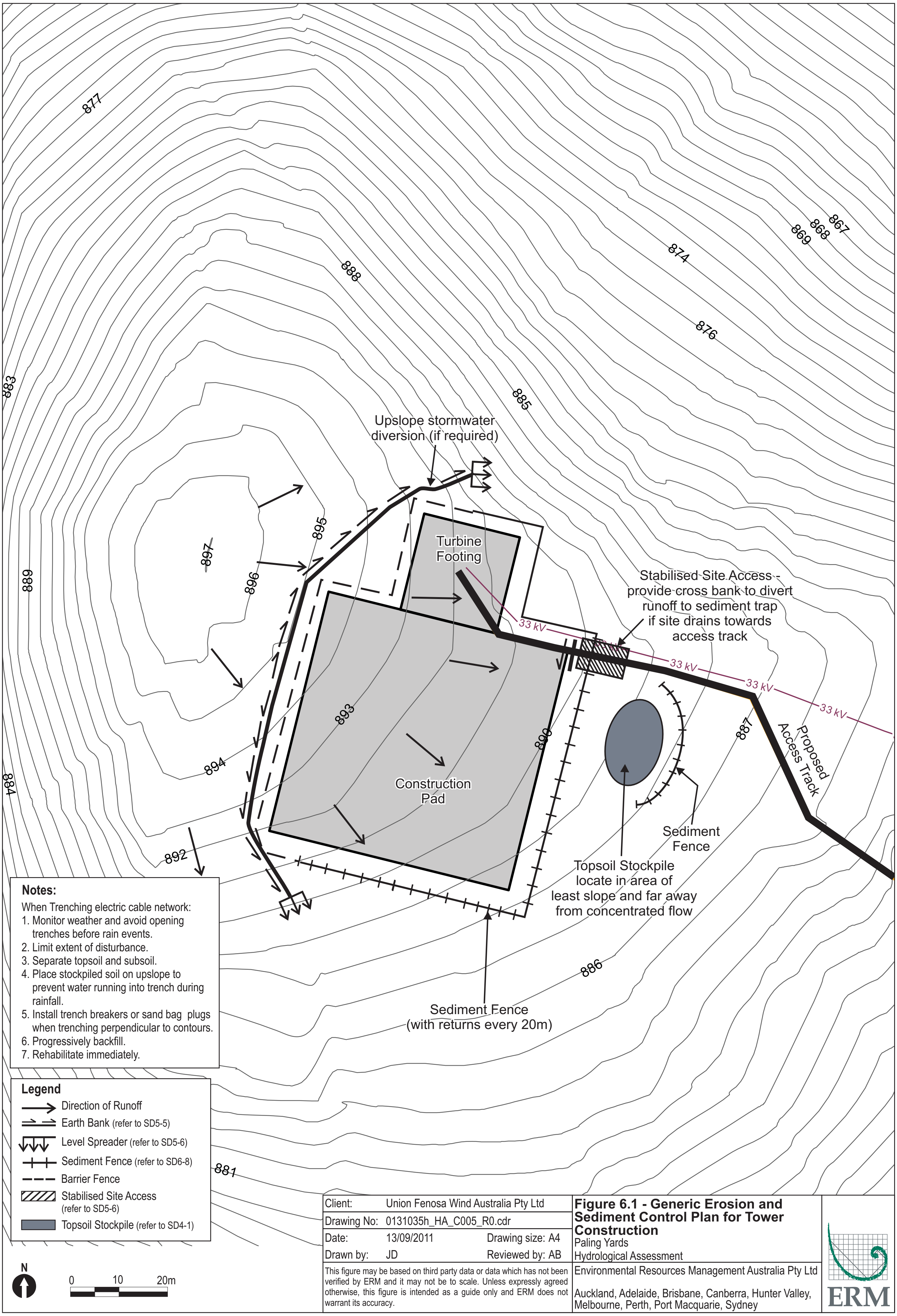
Areas of concentrated flow can be subject to scouring velocities and periodic inundation that render vegetation establishment difficult or impossible. Therefore, measures like hard armouring, and use of geofabrics to assist vegetation establishment is often required. To determine appropriate stabilisation techniques in areas of concentrated flow peak flows will be calculated and stabilisation designed accordingly, by reference to guidelines such as Landcom (2004) that provide advice for acceptable velocities within vegetated channels. Particularly steep slopes may require protection in the form of hard armouring if it is considered unlikely that vegetation will become established or will become stressed and jeopardise the stability of the slope. This detail will be outlined in the Progressive ESCPs.

6.5 MITIGATION MEASURES TO ADDRESS SPECIFIC CONSTRUCTION ACTIVITIES

6.5.1 Pad Sites

The term 'pad sites' is used to describe areas that may be cleared, levelled and then stabilised with road base and aggregate, for example crane hardstand areas, the substation site, and the concrete batching plant. Pad sites should be established in accordance with the *Section 6.4 Staging of Works*.

A Generic Erosion Sediment Control Plan (ESCP) has been developed for the layout of a pad site. In this case the ESCP is for a tower foundation and crane hardstand area, but the general principles and layout are universal to all pad sites. An outline of the erosion and sediment control measures to be undertaken during trenching activities is also provided on the Generic ESCP. The ESCP is provided in *Figure 6.1*.



Client:	Union Fenosa Wind Australia Pty Ltd
Drawing No:	0131035h_HA_C005_R0.cdr
Date:	13/09/2011 — Drawing size: A4
Drawn by:	JD — Reviewed by: AB

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 6.1 - Generic Erosion and Sediment Control Plan for Tower Construction

Paling Yards

Hydrological Assessment

Environmental Resources Management Australia Pty Ltd

Auckland, Adelaide, Brisbane, Canberra, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

6.5.2 *Trenching*

The turbines and substation will be linked across the site through a network of underground electricity cables that predominately follow the site access road network. The following management measures are relevant to trenching activities:

- minimise the land area to be disturbed;
- avoid trenching in locations of concentrated water flow;
- where possible utilise directional drilling techniques in areas of concentrated water flow;
- monitor weather and avoid opening trenches prior to forecast rainfall;
- fill trenches as soon as possible after opening – aim for three days from opening to closing trench;
- separate topsoil and subsoil during excavation and replace in order;
- when trenching parallel to site contours (across grade), soil from the excavation should be placed and compacted on the uphill side of the trench to form an earth bank. This is to prevent clean stormwater entering the trench (where after it must be managed as "dirty" water) by directing stormwater around and away from the open trench. This measure may be avoided where trenches are expected to be open for less than 24 hours and where the likelihood of rain is low;
- when trenching perpendicular to contours use sandbag plugs or bulkheads to shorten the length of stormwater flow and consequent erosion in the trench; and
- progressively backfill trenches and rehabilitate as soon as possible. Leave backfilled trenches with a slightly elevate profile to allow for settlement, and to prevent the trenches from becoming a depression that can concentrate stormwater.

6.5.3 *Dewatering*

Water has the potential to collect in trenches, sediment traps and low lying depressions across the project site following rainfall events. This water is likely to become contaminated with suspended sediment and will require management to ensure that downstream waterways are not polluted.

Dewatering can be undertaken such that water collected is reused on the site within water carts, for dust suppression on unsealed access tracks and watering of rehabilitated areas. Discharging runoff to a natural waterway is generally not supported. However, this may be undertaken if the water is first treated to ensure acceptable quality for discharge is achieved. As a general rule, discharge waters should have a TSS < 50 mg/L. Where possible, discharge water should be directed to vegetated areas to encourage infiltration. Vegetated areas act as a filter, assisting in the removal of sediment from the discharged water. Dewatering bags may also be used.

6.5.4 Unsealed Internal Tracks

A network of unsealed tracks will be developed throughout the site to allow access to the turbines, substation and batching plant. The network of access tracks will remain unsealed throughout both the construction and operation phases of the project. It is recommended that this be factored into the design of the roadways and road widths be altered upon completion of the construction phase. During the construction phase the internal road network will need to be wide enough to cater for the larger vehicles delivering the turbine equipment. However, following the completion of the construction process the road is likely to be used only by light utility vehicles, thus allowing the track width to be reduced. The decrease in road widths following the construction period will require ripping of the redundant edges of the road surface and the spreading of soil and mulch mixed with native grass seeds over the redundant area.

The focus of erosion and sediment control for unsealed roads will be on maintaining good stormwater drainage. The primary aim is to ensure that stormwater is readily shed from the road surface and, most importantly, is not allowed to track longitudinally along the road for any great distance.

Six access points with Abercrombie Road are proposed for the internal road network. Mud tracking will be a significant risk in these locations and as such stabilised entry points will be required. This may involve the sealing of the internal track with bitumen for 50m into the site at confluence points with Abercrombie Road along with the use of cattle grids and wheel washes, or a layer of crushed rock.

The following mitigation measures should also be considered during the planning and implementation phases of the track construction:

- as far as possible, locate tracks along ridgelines and in areas without large upslope catchments to minimise the erosion hazard and drainage requirements;
- limit the clearing width to the minimum that is practicable;
- retain any cleared vegetation (i.e. trees and shrubs) for use later in rehabilitation;

- strip and stockpile topsoil separately for use in rehabilitation;
- minimise cut and fill by constructing the road at-grade where ever possible;
- ensure the road surface has a cross-sectional grade to allow free surface drainage and avoid excessive ponding and concentration of flow in wheel ruts;
- employ outfall drainage where practicable to shed water over the downslope batter of the road, especially where the road alignment is generally parallel to the contours;
- where the road is positioned along a crest or ridge use a crowned road surface that sheds water to both sides;
- when grading roads, avoid the formation of windrows along the shoulders. These retain water on the road surface and increase erosion;
- where table drains are used, ensure these are properly stabilised and install regularly spaced mitre drains to discharge water from drains, releasing this in well vegetated, stable areas;
- mitre drains shall be installed regularly to convey runoff from the road shoulders and any table drains to disposal areas away from the road alignment. As a general rule the maximum spacing between mitre drains should be 50m, however this may be reduced in high erosion hazard areas (e.g. on steep slopes). Mitre drains should have a grade of no more than 5%. They should discharge to areas that are well stabilised and free of obstructions (e.g. large rocks, tree trunks);
- cross-banks (or rollover banks) or cross-drains should be considered in suitable locations to shed water from the road surface, discharging water in well vegetated, stable areas. Cross-banks are earth banks that extend across the road roughly perpendicular to the road alignment. They contain a bank and upstream channel to direct runoff across the road surface, to prevent the concentration of runoff along the road surface and reduce runoff velocities, thereby reducing erosion. These measures are highly useful where roads are aligned acutely to or perpendicular to the contours over long distances; and
- stabilise road batters using a suitable combination of rolled erosion control products (RECPs) such as jute matting, mulching, spray-on stabilisation measures (e.g. hydromulching or bitumen emulsion) revegetation and hard armouring where required (e.g. within flow lines).

Although crossing of waterways is not planned a recommended waterway crossing Standard Diagram is included (SD 5-1).

6.5.5 Concrete Batching Plant

Establishment of the concrete batching plant will be similar to the establishment of all the pad sites and as such erosion and sediment controls are somewhat universal. However new water management issues are created during the operation of the plant. The following mitigation measures are proposed during the operation of the concrete batching plant:

- separate stormwater collection and drainage systems will be provided to allow for discharge of clean stormwater (through a system designed to minimise local erosion) and collection and reuse of contaminated stormwater (through a first flush collection pit);

- a stormwater recycling system will be provided with capacity sufficient to store contaminated runoff generated by 20 mm rain within 24 hours, with operating management system to use collected wastewater as soon as possible (to maintain containment capacity);

- suitable compounds will be provided for the placement of waste concrete and mortar slurries (either at the concrete batching plant or at individual works compounds, or both). These may comprise shallow excavations that are suitably bunded to prevent stormwater ingress. Dried concrete will be disposed by an approved means;

- a wash bay for concrete trucks will be provided. Water discharged from the wash bay will be encouraged to evaporate and/or infiltrate the soils, and any surplus flows will be directed to sediment traps;

- wet weather stormwater discharges will be monitored for pH and suspended solids;

- any excess contaminated waste water will be disposed of off-site by a licensed waste contractor; and

- the area of the batching plant will be fully rehabilitated after the construction phase is completed.

6.5.6 Site Monitoring and Maintenance

Essential to an effective system of sediment control devices, is an adequate inspection, maintenance and cleaning program. Inspections, particularly during storms, will show whether devices are operating effectively. Where a device proves inadequate, it should be quickly redesigned to make it effective.

Recommended Inspection Schedules will be developed in the Detailed Soil and Water Management Plan.

7 SYDNEY CATCHMENT AREA AND REP1

7.1 INTRODUCTION

Approximately 9 km of the southernmost section of the transmission line route comprising the common part of Options 1, 2 and 3, occurs within the hydrological catchment for Sydney's drinking water supply, as defined in the *Drinking Water Catchments Regional Environmental Plan No 1* (REP1). This constitutes the Wollondilly River catchment. The approximate catchment boundary is shown in *Figure 2.1d*.

The Sydney Catchment Authority (SCA) has provided input to the project DGRs and considers that water quality issues for that part of the project within the drinking water catchment should be consistent with the REP. In particular the SCA considers that the environmental assessment should include an assessment as to whether the project will have a neutral or beneficial effect on water quality. It has been recommended that this assessment:

- consider REP1 and have regard to the aims and water quality objectives detailed in the plan; and
- contain relevant studies such as a Water Cycle Management Study.

7.2 CONSULTATION WITH SCA

ERM's Adam Bishop (hydrologist) had a phone conversation with the SCA's Neil Abraham (Senior Environmental Officer) on 12 September 2011. The nature of the project was discussed along with SCA's expectations for the assessment.

ERM explained the proposed construction methodology, particularly the measures that would assist in limiting potential impacts to soil and water resources.

SCA confirmed that a qualitative approach to the assessment of neutral or beneficial effect was generally acceptable for smaller scale works. It was agreed that this approach would be reasonable for the proposed transmission line route option.

SCA confirmed that a conceptual soil and water management plan should be included in the assessment. This should demonstrate conceptually the range of measures that would be used to limit soil and water impacts, making reference where relevant to the SCA-endorsed Current Recommended Practices (CRPs).

7.3 CONCEPTUAL SOIL AND WATER MANAGEMENT PLAN

Chapter 6 provides a conceptual SWMP that together with information contained elsewhere in this hydrological assessment are designed to meet the SCA's requirements for a watercycle management study. This information is prepared with reference to the Blue Book and associated Volume 2 documents that outline best practice soil and water management for installation of services and construction of unsealed roads. These documents are endorsed as Current Recommended Practices by the SCA.

7.4 NEUTRAL OR BENEFICIAL EFFECT

As specified in Clause 28(3) of the REP, a **"neutral or beneficial effect on water quality"** means development that:

*(a) has **no** identifiable potential impact on water quality, or*

*(b) will **contain** any such impact on the site of the development and prevent it from reaching any watercourse, waterbody or drainage depression on the site, or*

*(c) will **transfer** any such impact outside the site by treatment in a facility and disposal approved by the consent authority (but only if the consent authority is satisfied that water quality after treatment will be of the required standard).*

7.4.1 Factors Relevant to the Assessment

Coming from the north, proposed transmission line route options 1, 2 and 3 would follow Carrabungla Road and enter the drinking catchment approximately 3.3 km north of Middle Arm Road. It would then turn and follow Middle Arm Road in a westerly direction approximately 1.7 km to meet Woodhouselee Rd. It would then turn south following Woodhouselee Road a distance of approximately 3.7 km to reach the Crookwell 2 wind farm.

In the region of Carrabungla Road the transmission line crosses a small number of minor streams (first and second order watercourses) as well as two third order watercourses within the Tarlo River valley, in the very upper catchment of the Tarlo River. These crossings are referred to as WC8 Tarlo River Tributary and WC9 Tarlo River (refer *Figure 2.1d*).

In the region of Woodhouselee Road the transmission line may cross one or two first order watercourses, but this would depend on the final design location.

The landscape in this region comprises plateau and gently undulating hills with broad open valleys. Watercourses are stable and well vegetated with little evidence of erosion or incision.

The proposed transmission line would be constructed across cleared grazing lands and close to existing roadways. *Section 1.6.2* summarises the construction methodology and describes how the proposed transmission line would be constructed to minimize environmental impacts. Key to this is the avoidance of constructing a permanent track along the length of the easement. Access to individual power poles would be obtained from existing tracks and roads where possible, and otherwise by travelling overland by the most direct or least impact route. Tracks generally would not be formalised unless required over boggy ground. No vehicle watercourse crossings would be constructed and in general there would be no need for works to occur within 20 m of any watercourses, thus affording good buffers between construction activities and sensitive receptors. Concrete batching would not be undertaken within the drinking catchment area and any concrete required for transmission line installation would be brought to site. No onsite sewage management systems are proposed to be installed within the drinking catchment under this project.

Construction activities within the drinking catchment are expected to comprise small, dispersed areas of disturbance focused around installation of power poles. Suitable erosion controls in these areas would include diversion of upslope stormwater (if required), placement of sediment fence downslope, and installation of barrier fence to define the work area and limit disturbance. Selection of access routes will also be important. These should avoid watercourses and riparian areas with a general aim of providing a minimum 40m buffer between construction activities and watercourses. No vehicle watercourse crossings would be constructed.

Through appropriate management of construction activities including erosion and sediment control, hazardous materials storage and handling, and spill emergency response and clean-up procedures, potential water-related impacts would be contained on-site and prevented from reaching watercourses. These measures will be outlined in a detailed Soil and Water Management Plan to be prepared post consent and before commencement of construction.

It is therefore concluded that the project complies with paragraph (b) of Clause 28(3) of the REP and would maintain a neutral or beneficial effect on water quality.

In maintaining a neutral effect on water quality in this area, the project is also consistent with the aims and water quality objectives of REP1.

8 MITIGATION MEASURES

A summary of recommended management and mitigation measures to address potential soil and water impacts is as follows:

- prepare a detailed Soil and Water Management Plan (SWMP) prior to construction commencing. The SWMP should be prepared by a suitably qualified person, such as a soil conservationist;
- prepare Progressive Erosion and Sediment Control Plans as the project progresses to address management requirements at individual work sites;
- design and construct the wind farm and transmission line to minimise land disturbance and therefore reduce the erosion hazard;
- stage construction activities to minimise the duration and extent of land disturbance;
- manage topsoil resources to minimise the risk of erosion and sedimentation, and maximize reuse of topsoil during rehabilitation;
- divert upslope (clean) stormwater around the disturbed site capture sediment-laden runoff from within the disturbed site for diversion to sediment control devices;
- rehabilitate the site promptly and progressively as works progress;
- inspect and maintain erosion and sediment control devices for the duration of the project;
- avoid construction of new vehicle watercourse crossings;
- avoid land disturbance within 20 m of minor streams (first and second order watercourses) and 40 m of third order or higher watercourses;
- ensure appropriate procedures are in place for the transport, storage and handling of fuels, oils and other hazardous substances, including availability of spill clean-up kits;
- minimise disturbance during transmission line construction by using existing access tracks and roads, and avoiding construction of a permanent access track along the transmission line easement;
- avoid over-extraction of surface water or groundwater to prevent adverse impacts on environmental flows and water availability for existing licensed users;
- obtain any necessary water access licenses; and
- ensure appropriate stormwater, collection, treatment and recycling at the concrete batch plant, in accordance with relevant best practice guidelines and any requirements of the NSW Office of Environment and Heritage.

9 *CONCLUSION*

This hydrological assessment identifies soil and water constraints related to the proposed Paling Yards wind farm and connection to the grid. Overall constraints are relatively minor with the erosion hazard rated as low over the majority of the site. A standard suite of erosion and sediment controls may be adopted in most areas.

Water supply options are available to meet the needs of the construction project and include use of surface water from existing dams, or new dams, or via water abstraction from a permanent source such as the Abercrombie River. Groundwater pumping via a new bore would also be a viable option. Further assessment of water supply options is required to identify the most feasible and economic option. Water access licensing would need to be addressed depending on the preferred option, and should be discussed with licensing officers at the NSW Office of Water.

A detailed Soil and Water Management Plan should be prepared for the project prior to construction commencing.

UFWA has decided to propose the northern Transmission line route, (Option 4). This decision has been made due to its shorter length, and as a result of concerns raised through the stakeholder consultation process regarding the potential impacts of extensive transmission line infrastructure leading south towards the Crookwell 2 wind farm substation. With the mitigation measures outlined in this report, and given the site characteristics, the overall impact on the water resources is expected to be negligible.

REFERENCES

Hird (1991) **Soil Landscapes of the Goulburn 1:250 000 Sheet.** Soil Conservation Service of NSW, Sydney

Landcom (2004) **Managing Urban Stormwater Soils and Construction** (Volume 1, 4th edition). Landcom, Sydney.

NSW Department of Environment and Climate Change (2008a) **Managing Urban Stormwater Soils and Construction: Volume 2A, Installation of Services**

NSW Department of Environment and Climate Change (2008b) **Managing Urban Stormwater Soils and Construction: Volume 2C, Unsealed Roads**

Pilgrim, D.H. (ed) (1987) **Australian Rainfall and Runoff: A Guide to Flood Estimation**. Institute of Engineers

Sydney Catchment Authority (2006) **Neutral or Beneficial Effect on Water Quality Assessment Guidelines**

URS (2011) **Paling Yards Wind Farm Geotechnical Exploration, Review and Advice.** Unpublished report to Union Fenosa Wind Australia

NSW Office of Water (August 2010) **Controlled activities: Guidelines for Watercourse Crossings.**

Annex A

NSW Office of Water Correspondence

Adam Bishop

From: Jeanette Nestor [Jeanette.Nestor@water.nsw.gov.au]
Sent: Friday, 5 August 2011 4:03 PM
To: Adam Bishop
Subject: Re: Wind Farm environmental assessment, water supply/licensing options
Attachments: 20 May 2005.pdf

Hi Adam

I apologies for the delay. Some options for you to consider as follows:

- As discussed the proposed Wind Farm is to be located in the Lachalan Fold Belt Groundwater Management Area. The Office of Water is unable to accept a new licence for a new entitlement for Industrial/Commercial purposes due to the current embargo in place. You are however able to apply under Part 5 of the *Water Act 1912,* for a new licence with a zero share entitlement for the purpose of purchasing an existing entitlement and trading it onto the zero share licence. To find an active entitlement it is suggested that you contact a water trader.

- You may have the ability to construct and use water from farm dams under the Farm Dams Policy. A self assessment would be required to determine the Maximum Harvestable Rights for the property prior to the construction of any additional dams. For information regarding the Farm Dams Policy see the following weblink http://www.water.nsw.gov.au/Water-licensing/Basic-water-rights/Harvesting-runoff/default.aspx

- Should you wish to access water from a nearby watercourse and transport that water by tanker to the site. There is an exemption (copy attached) in which you may apply for a Permit under Part 2 of the *Water Act 1912 ,* for industrial road construction and dust suppression. For an application form please follow the weblink http://www.water.nsw.gov.au/Water-licensing/Applications/default.aspx.

If you have any questions please don't hesitate to call.

Jeanette

Jeanette Nestor
Licensing Officer - Licensing
NSW Office of Water
Ph: 02 6841 7447
Fax: 02 6884 0096

WATER ACT 1912

Section 22BA – Amendment of Order

Murray-Darling Basin

THE Water Administration Ministerial Corporation, being satisfied the water sources in the shaded area in Schedule A are unlikely to have more water available than is sufficient to meet the requirements of those already entitled by law to take water from the water sources (and such other requirements for water from the sources as have been determined by the Ministerial Corporation), hereby amends the Order made under section 22BA on 10 May 2000 and published in the *Government Gazette* on 12 May 2000 and now declares that on and from the date of publication of this amending order in the *Government Gazette* no application for an entitlement for a work to which Part 2 of the Water Act 1912, extends may be made except as specified below until this order is revoked and subsequent Notice published in the *Government Gazette*.

This order relates to all applications for entitlements other than applications for entitlements for:

1. Water supply (including supply for irrigation) for experimental, research or teaching purposes;
2. Water supply for stock purposes:

   For the purpose of this Clause 'stock' means stock of a number not exceeding the number pastured ordinarily on the land having regard to seasonal fluctuations in the carrying capacity of the land and not held in close concentration for a purpose other than grazing. This excludes feedlots and piggeries, in particular.
3. Water supply for private domestic purposes;
4. Water supply for town or village water supply purposes;
5. Permits for extraction of water for industrial (road construction/dust suppression) purposes, bank revegetation or environmental enhancement purposes;
6. Permits for extraction of water by water carters provided any water abstracted shall be used for drought relief purposes;
7. Permits to extract water for hydrostatic testing of gas pipelines;
8. Snow making hydro-power generation or other commercial undertakings provided any water abstracted is returned to the water source undiminished in quantity;
9. Works in the Western Division of the State of New South Wales (as referred to in section 4 of the Crown Lands Act 1989) which are located on terminal lakes or pans which are not part of or connected to a river system;
10. Works referred to in any Order made under section 5 (5) of the Water Act 1912.

Additional Invalidation

The Water Administration Ministerial Corporation declares that no application under Part 2 of the Act for a licence within the Yass River catchment, as shown in the shaded area in Schedule B may be made except for a dam for the conservation of water for stock and/or domestic purposes where the maximum amount of water conserved will not exceed the Maximum Harvestable Right entitlement for the property on which it is located.

Signed for the Water Administration Ministerial Corporation.

Dated: 16 May 2005

DIRECTOR GENERAL,
Department Infrastructure, Planning and Natural Resources

Annex B

Erosion Hazard Assessment

B.1 *REVISED UNIVERSAL SOIL LOSS EQUATION*

Managing Urban Stormwater: Soils and Construction, Volume 1 (Landcom, 2004) describes a method for assessing erosion hazard using the revised universal soil loss equation (RUSLE). The RUSLE is designed to predict the long term, average, annual soil loss from sheet and rill erosion at nominated sites under specified management conditions. It is used to assess erosion hazard at construction sites and estimate sediment flux to sediment traps.

The RUSLE equation is represented by:

A = R K LS P C

where,

A = computed soil loss (tonnes/ha/yr)

R = rainfall erosivity factor

K =soil erodibility factor

LS = slope length/gradient factor

P = erosion control practice factor

C = ground cover and management factor.

R-Factor

The rainfall erosivity factor, *R*, is a measure of the ability of rainfall to cause erosion. It is the product of two components: total energy (E) and maximum 30 minute intensity for each storm (I_{30}). Rosewell and Turner (1992) identified a strong correlation between the R-factor and the 2-year ARI, 6-hour storm event (denoted S) and proposed the following equation:

$R = 164.74 (1.1177)^{S} S^{0.6444}$

Where S = 7.17 mm/h (at Hawkesdale, from IFD chart)

Using the above, at Paling Yards R = 1302.

K-Factor

The soil erodibility factor, K, is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff. Texture is the principle component affecting K, but structure, organic matter and permeability also contribute. In the RUSLE, it is a quantitative value that is normally experimentally determined.

Soil K-factor data was estimated with reference to the soil descriptions provided in Hird (1991). On the Taralga Soil Landscape both topsoils and subsoils have low erodibility. A maximum K-factor of 0.02 would be appropriate for these soils. Topsoils and subsoils of the Midgee Soil Landscape have moderate to high erodibility and K-factors of 0.04 would be a reasonable estimate on these soils. It is noted however that the majority of disturbance would occur on the Taralga Soil Landscape. A conservative K-factor of 0.04 is adopted.

LS-Factor

The slope length-gradient factor, LS, describes the combined effect of slope length and slope gradient on soil loss. It is the ratio of soil loss per unit area at any particular site to the corresponding loss from a specific experimental plot of known length and gradient. The LS factor can be read from Table Al in the Blue Book). It should be noted that an increase in slope gradient has a proportionately greater effect on LS, compared with an increase in slope length.

The site has variable gradients including some areas with slopes up to about 15 % (and in some areas higher), but in the turbine locations is commonly only gently sloping with gradients less than 5 %. Slope lengths in disturbed areas would be typically less than 80 m. Under the combination of 80 m slope length and 5 % gradient the LS Factor is 1.19. On steeper slopes it is assumed that slope lengths would be kept shorter through the use of appropriate stormwater controls. Under the combination of 40 m slope length and 15 % gradient the LS Factor is 3.00.

P-Factor

The erosion control practice factor, P, is the ratio of soil loss with a nominated surface condition ploughed up and down the slope. It is reduced by practices that reduce both the velocity of runoff and the tendency of runoff to flow directly downhill. At construction and mining sites, it reflects the roughening or smoothing of the soil surface by machinery. The P-factor used here is 1.3 that is normally assigned to compacted construction sites.

C-Factor

The cover factor, C, is the ratio of soil loss from land under specified crop or mulch conditions to the corresponding loss from continuously tilled, bare soil. The most effective method of reducing the C-factor is maintenance, or formation of a good ground cover. The best practices are those that reduce both the amount of soil exposed to raindrop impact and the erosive effects of runoff.

The C-factor assigned here during mining operations is 1.0, typical of that for bare, compacted soil. Table A3 in the Blue Book (Edition 4) provides estimated C-factors for various cover types. It is worth noting that the C-factor is the factor that can be most readily manipulated to affect a change in erosion hazard. For example, changing the soil surface from a condition of bare, compacted earth (C = 1.0) to one with 70% cover of grasses (C = 0.05) leads to a proportionate reduction in soil loss, i.e. 20 times lower erosion hazard.

B.2 PREDICTED SOIL LOSS

Using the RUSLE, the predicted annual soil loss is 81 tonnes/hectare/year under the combination of 80 m slope length and 5 % gradient. This is Soil Loss Class 1 (< 150 tonnes/ha/yr) which is rated Very Low (refer Table 4.2 in the Blue Book). Under the combination of 40 m slope length and 15 % gradient predicted annual soil loss is 203 tonnes/hectare/year which is Soil Loss Class 2 (151 to 225 tonnes/ha/yr) which is rated Low.

Based on this assessment it is concluded that the overall site erosion hazard is low and consequently, a standard suite of erosion and sediment controls may be widely employed. Specialised techniques may be required in high hazard areas, such as steep slopes and areas of concentrated flow.

Annex C

IFD Table

Paling Yards NSW

Location: 34.16 S 149.75 E

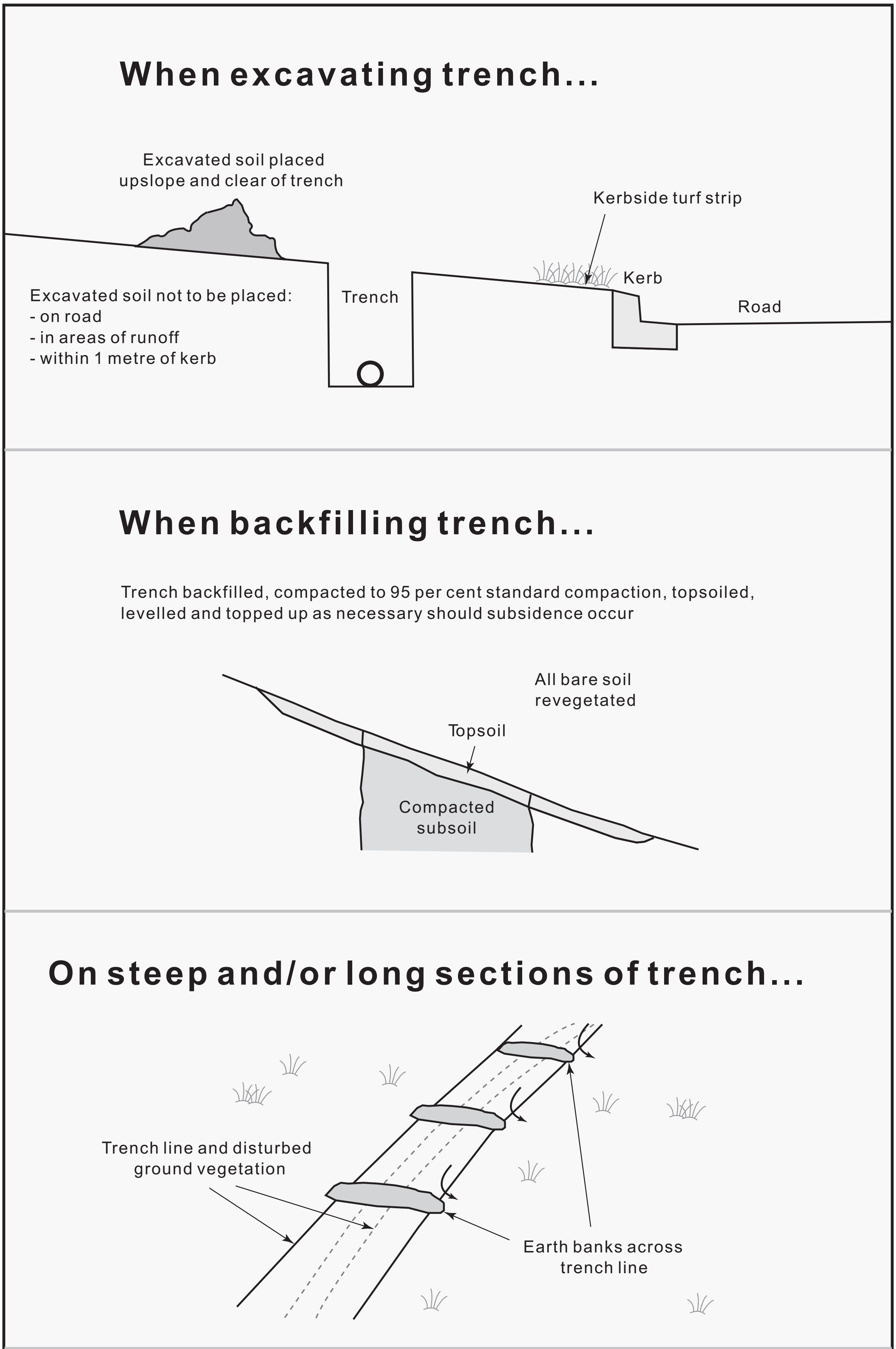
RUSLE *R-factor* = 1302

Simple	**I (mm/hr) for ARI (yrs)**						
Time	1 Year	2 years	5 years	10 years	20 years	50 years	100 years
5 mins	58.7	76.7	102	117	138	166	188
6 mins	54.8	71.5	94.7	109	128	154	174
10 mins	44.7	58.2	76.4	87.6	103	123	139
20 mins	32.6	42.2	54.5	62.1	72.2	85.8	96.4
30 mins	26.4	34	43.7	49.5	57.4	67.9	76.1
1 hr	17.7	22.7	28.9	32.5	37.5	44	49.2
2 hrs	11.5	14.7	18.5	20.7	23.8	27.8	31
3 hrs	8.83	11.3	14.1	15.8	18.1	21.1	23.5
6 hrs	5.62	7.17	8.91	9.94	11.3	13.2	14.6
12 hrs	3.57	4.54	5.62	6.25	7.12	8.27	9.15
24 hrs	2.24	2.85	3.52	3.91	4.46	5.17	5.72
48 hrs	1.36	1.73	2.15	2.38	2.72	3.15	3.49
72 hrs	0.99	1.26	1.56	1.73	1.97	2.29	2.53

Extended	**I (mm/hr) for ARI (yrs)**						
Time (mins)	1	2	5	10	20	50	100
5	58.7	76.7	101.6	117.2	137.7	165.6	187.7
6	54.8	71.5	94.7	109.1	128.2	154.0	174.5
7	51.6	67.3	89.0	102.4	120.3	144.3	163.4
8	48.9	63.8	84.2	96.8	113.5	136.1	154.0
9	46.7	60.8	80.1	91.9	107.7	129.0	145.9
10	44.7	58.2	76.4	87.6	102.6	122.8	138.7
11	42.9	55.8	73.2	83.9	98.1	117.3	132.4
12	41.3	53.7	70.3	80.5	94.0	112.4	126.8
13	39.9	51.8	67.7	77.4	90.4	107.9	121.7
14	38.6	50.1	65.3	74.7	87.1	103.9	117.1
15	37.4	48.5	63.2	72.1	84.1	100.2	112.9
16	36.3	47.0	61.2	69.8	81.3	96.9	109.0
17	35.2	45.7	59.3	67.7	78.8	93.8	105.5
18	34.3	44.4	57.6	65.7	76.4	90.9	102.2
19	33.4	43.2	56.0	63.8	74.2	88.3	99.2
20	32.6	42.2	54.5	62.1	72.2	85.8	96.4
21	31.8	41.1	53.2	60.5	70.3	83.5	93.8
22	31.0	40.2	51.8	59.0	68.5	81.3	91.3
23	30.3	39.2	50.6	57.6	66.8	79.3	89.0
24	29.7	38.4	49.5	56.2	65.2	77.4	86.8
25	29.1	37.6	48.4	55.0	63.7	75.6	84.8
26	28.5	36.8	47.3	53.8	62.3	73.9	82.9
27	27.9	36.0	46.4	52.6	61.0	72.2	81.0
28	27.4	35.3	45.4	51.5	59.7	70.7	79.3
29	26.9	34.7	44.5	50.5	58.5	69.3	77.6
30	26.4	34.0	43.7	49.5	57.4	67.9	76.1
31	25.9	33.4	42.9	48.6	56.3	66.6	74.6
32	25.5	32.8	42.1	47.7	55.2	65.3	73.2
33	25.0	32.3	41.4	46.9	54.2	64.1	71.8
34	24.6	31.8	40.7	46.0	53.3	63.0	70.5
35	24.2	31.2	40.0	45.3	52.3	61.9	69.3
36	23.8	30.7	39.3	44.5	51.5	60.8	68.1
37	23.5	30.3	38.7	43.8	50.6	59.8	66.9
38	23.1	29.8	38.1	43.1	49.8	58.8	65.8
39	22.8	29.4	37.5	42.4	49.0	57.9	64.8
40	22.5	28.9	37.0	41.8	48.3	57.0	63.7
41	22.1	28.5	36.4	41.2	47.6	56.1	62.8
42	21.8	28.1	35.9	40.6	46.9	55.3	61.8
43	21.5	27.8	35.4	40.0	46.2	54.5	60.9
44	21.3	27.4	34.9	39.4	45.5	53.7	60.0
45	21.0	27.0	34.4	38.9	44.9	52.9	59.2
46	20.7	26.7	34.0	38.4	44.3	52.2	58.4
47	20.5	26.3	33.5	37.9	43.7	51.5	57.6
48	20.2	26.0	33.1	37.4	43.1	50.8	56.8
49	20.0	25.7	32.7	36.9	42.6	50.2	56.1
50	19.7	25.4	32.3	36.4	42.1	49.5	55.3
51	19.5	25.1	31.9	36.0	41.5	48.9	54.6
52	19.3	24.8	31.5	35.6	41.0	48.3	54.0
53	19.1	24.5	31.2	35.2	40.5	47.7	53.3
54	18.8	24.2	30.8	34.7	40.1	47.1	52.7
55	18.6	24.0	30.5	34.3	39.6	46.6	52.1
56	18.4	23.7	30.1	34.0	39.1	46.1	51.4
57	18.2	23.5	29.8	33.6	38.7	45.5	50.9
58	18.1	23.2	29.5	33.2	38.3	45.0	50.3
59	17.9	23.0	29.2	32.9	37.9	44.5	49.7
60	17.7	22.7	28.9	32.5	37.5	44.0	49.2

Annex D

Standard Drawings for Erosion and Sediment Control



Construction notes for figure 6.1

1. Do not open any trench unless it is likely to be closed in three days
2. Place excavated material up-slope of the trench
3. Stockpile topsoil separately from subsoil
4. Divert runoff from the line of the cut with diversions as directed by SD 5-2
5. Rehabilitate in accordance with specification

Figure 6.1 Erosion and sediment control during trenching activities

Source: Managing Urban Stormwater: Soils and Construction - Volume 2A Installation of Services

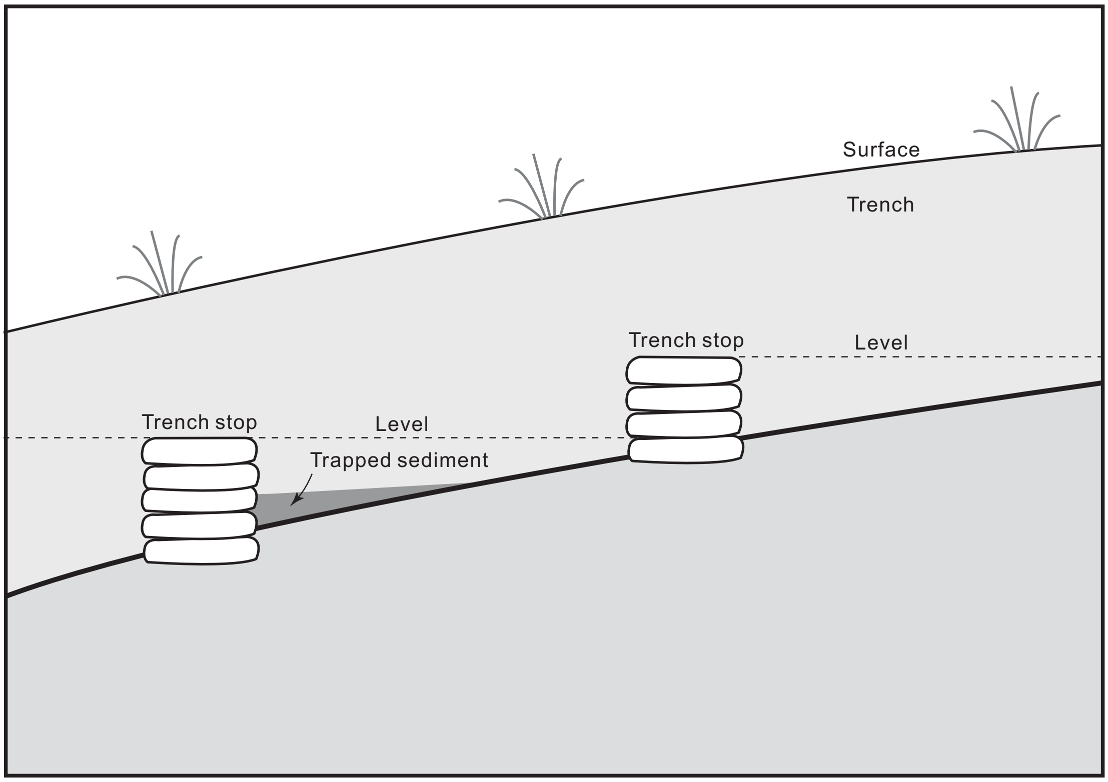


Figure 6.2 Typical trench stop detail

Source: Managing Urban Stormwater: Soils and Construction - Volume 2A Installation of Services

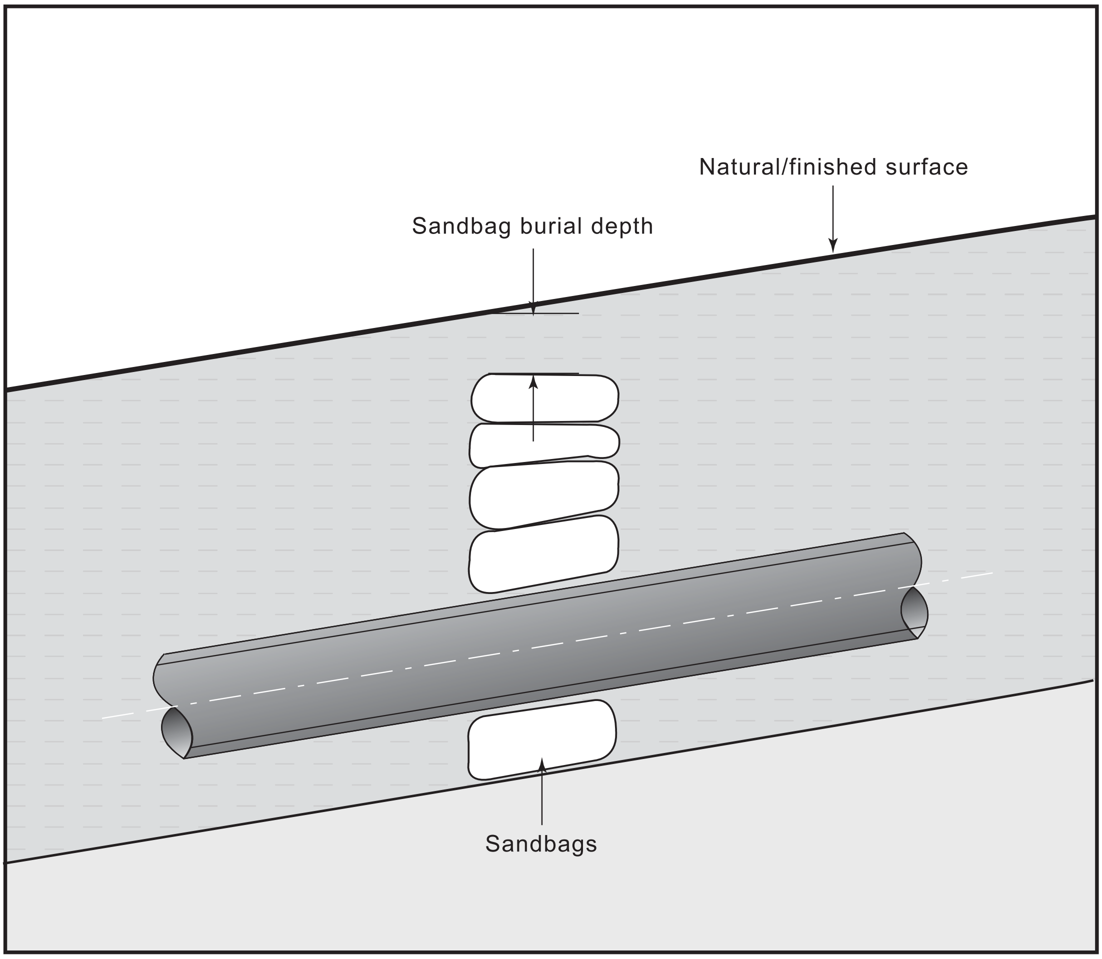
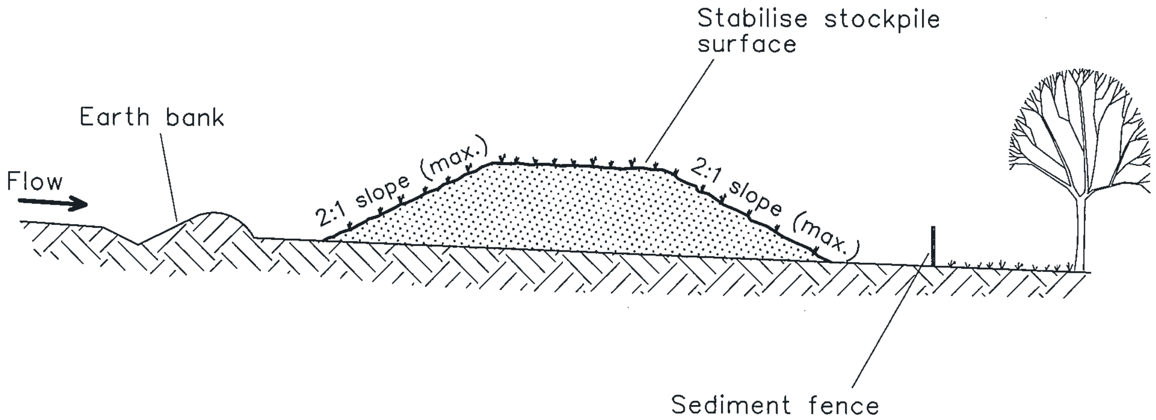


Figure 6.3 Detail of typical seepage collar or bulkhead

Source: Managing Urban Stormwater: Soils and Construction - Volume 2A Installation of Services



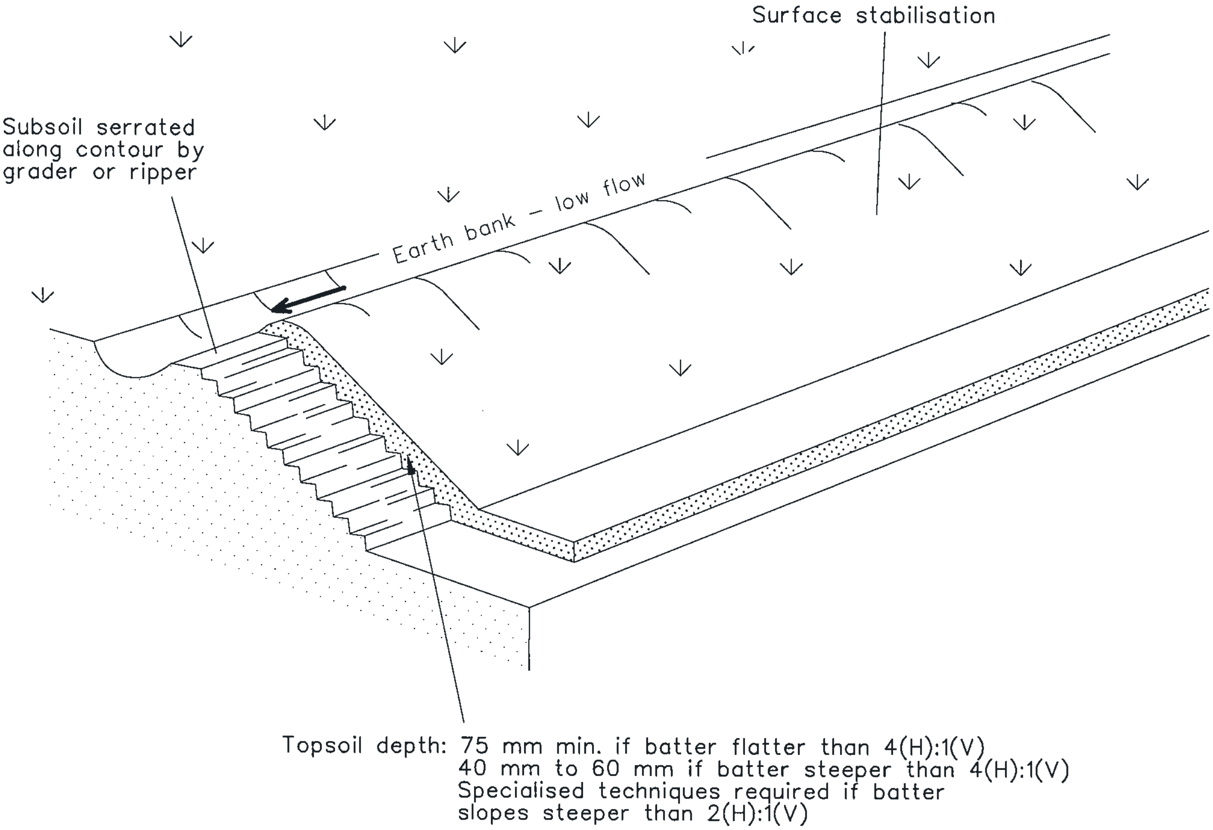
Construction Notes

1. Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
2. Construct on the contour as low, flat, elongated mounds.
3. Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
4. Where they are to be in place for more than 10 days, stabilise following the approved ESCP or SWMP to reduce the C-factor to less than 0.10.
5. Construct earth banks (Standard Drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-8) 1 to 2 metres downslope.

STOCKPILES

SD 4-1

SOURCE: Managing Urban Stormwater, Soils and Construction (Vol 1, 4th ed.)



Construction Notes

1. Scarify the ground surface along the line of the contour to a depth of 50 mm to 100 mm to break up any hardsetting surfaces and to provide a good bond between the respread material and subsoil.

2. Add soil ameliorants as required by the ESCP or SWMP.

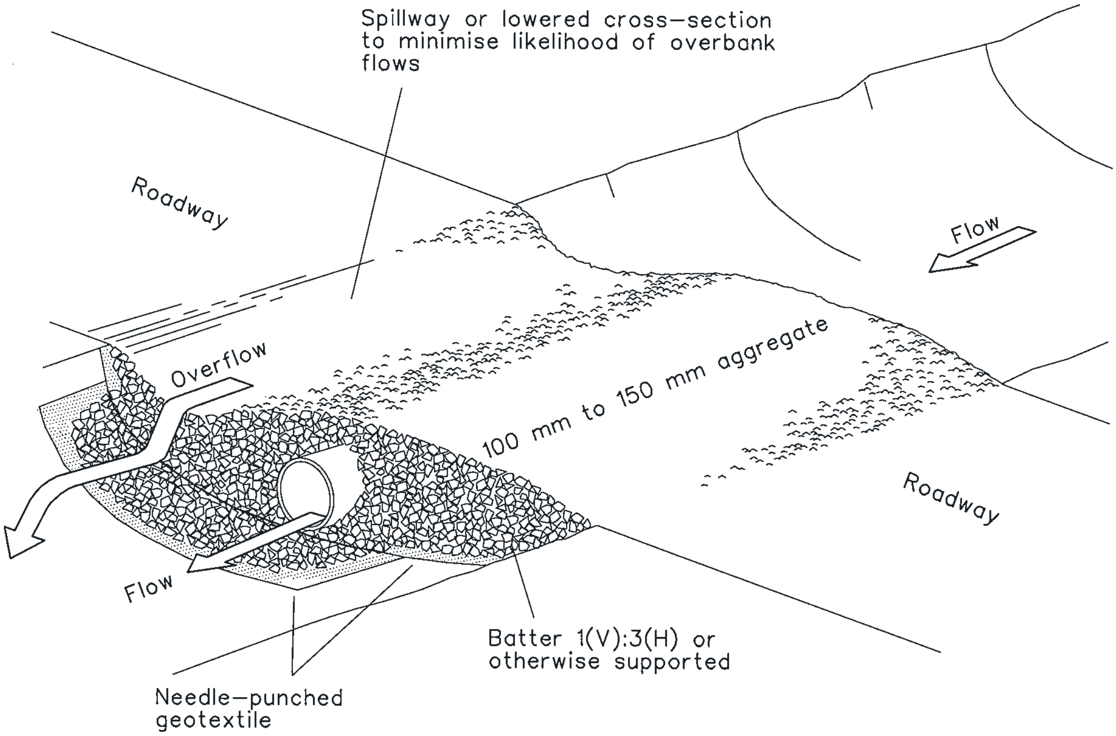
3. Rip to a depth of 300 mm if compacted layers occur.

4. Where possible, replace topsoil to a depth of 40 to 60 mm on lands where the slope exceeds 4(H):1(V) and to at least 75 mm on lower gradients.

REPLACING TOPSOIL

SD 4-2

SOURCE: Managing Urban Stormwater, Soils and Construction (Vol 1, 4th ed.)



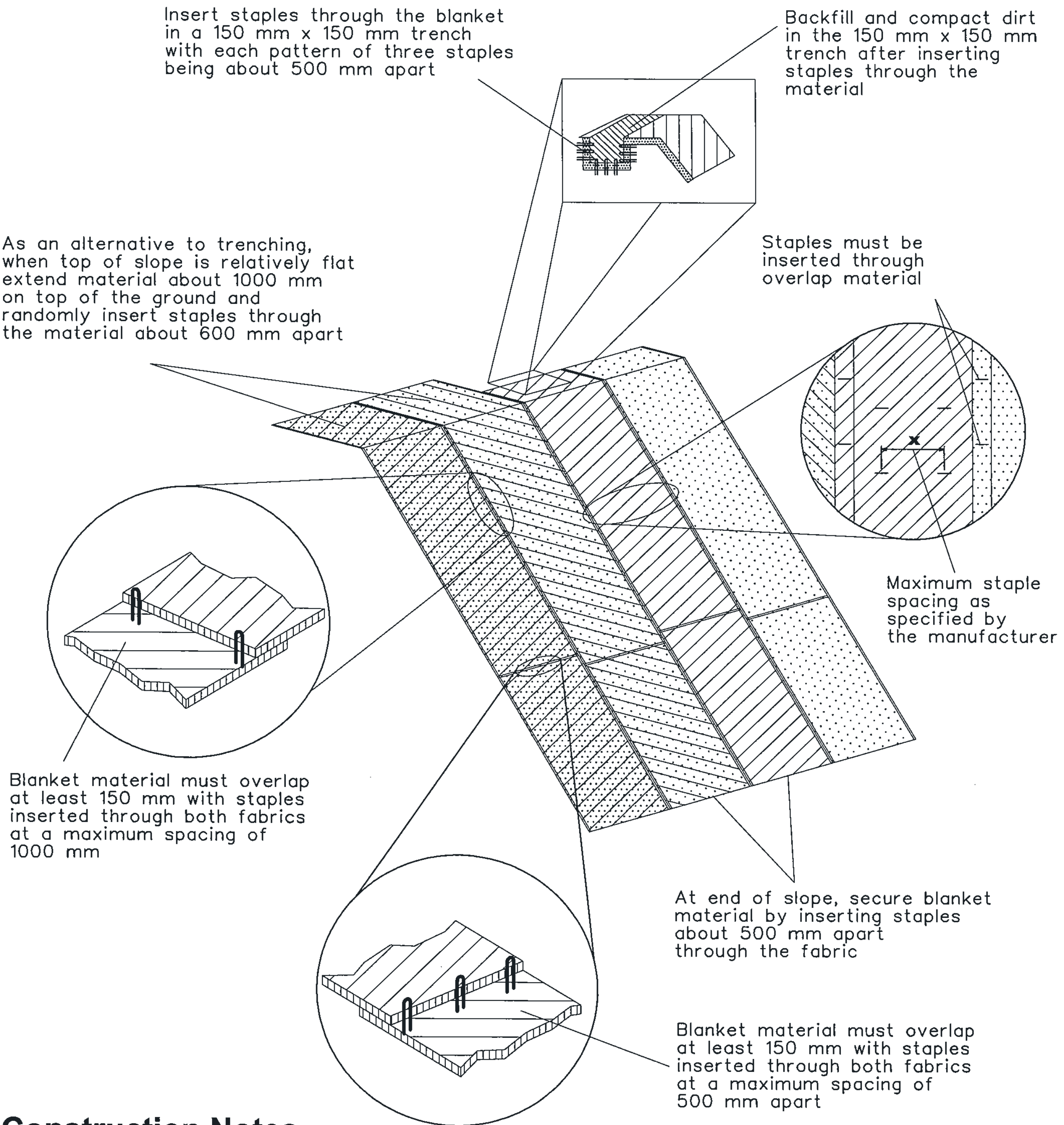
Construction Notes

1. Prohibit all traffic until the access way is constructed.
2. Strip any topsoil and place a needle-punched textile over the base of the crossing.
3. Place clean, rigid, non polluting aggregate or gravel in the 100 mm to 150 mm size class over the fabric to a minimum depth of 200 mm.
4. Provide a 3-metre wide carriageway with sufficient length of culvert pipe to allow less than a 3(H): 1 (V) slope on side batters.
5. Install a lower section to act as an emergency spillway in greater than design storm events.
6. Ensure that culvert outlets extend beyond the toe of fill embankments.

TEMPORARY WATERWAY CROSSING

SD 5-1

SOURCE: Managing Urban Stormwater, Soils and Construction (Vol 1, 4th ed.)

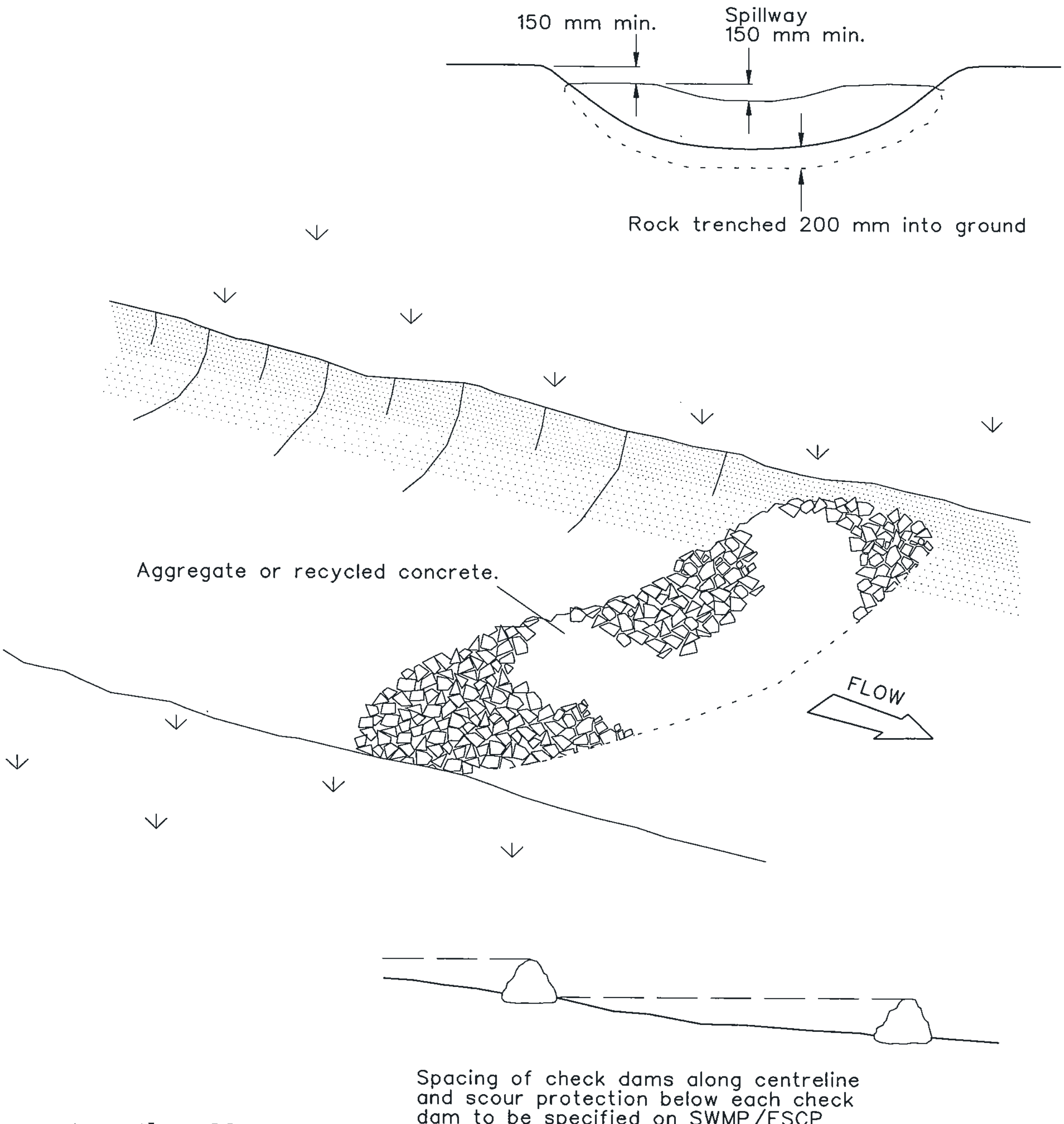


Construction Notes

1. Remove any rocks, clods, sticks or grass from the ground surface before laying the matting.
2. Spread topsoil to at least 75 mm depth.
3. Where appropriate, complete fertilising and seeding on a properly prepared seedbed (Standard Drawing 7-1) before laying the matting.
4. Ensure the fabric can be continuously in contact with the soil by grading the surface carefully first.
5. Lay the matting in "shingle-fashion" with the ends of each upstream roll overlapping the next roll downslope.
6. Ensure sufficient staples are used to maintain a good contact between the soil and the matting.

RECP : SHEET FLOW **SD 5-2**

SOURCE: Managing Urban Stormwater, Soils and Construction (Vol 1, 4th ed.)



Construction Notes

1. Check dams can be built with various materials, including rocks, logs, sandbags and straw bales. The maintenance program should ensure their integrity is retained, especially where constructed with straw bales. In the case of bales, this might require their replacement each two to four months.

2. Trench the check dam 200 mm into the ground across its whole width. Where rock is used, fill the trenches to at least 100 mm above the ground surface to reduce the risk of undercutting.

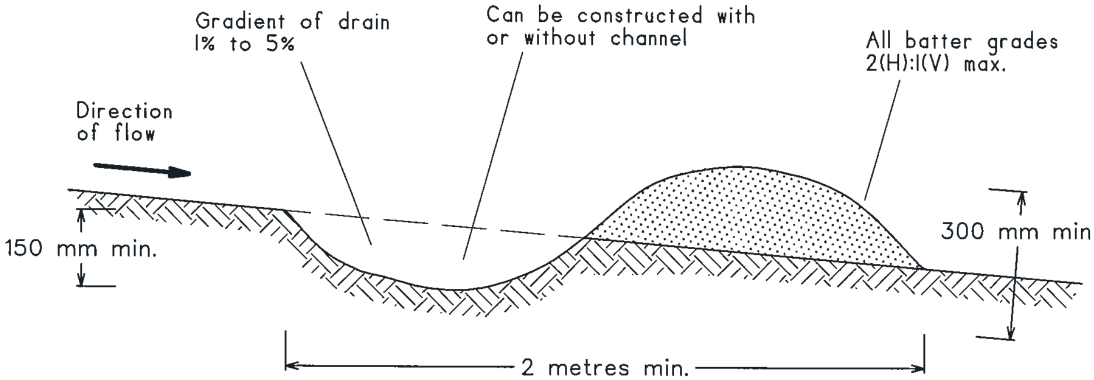
3. Normally, their maximum height should not exceed 600 mm above the gully floor. The centre should act as a spillway, being at least 150 mm lower than the outer edges.

4. Space the dams so the toe of the upstream dam is level with the spillway of the next downstream dam.

ROCK CHECK DAM

SD 5-4

SOURCE: Managing Urban Stormwater, Soils and Construction (Vol 1, 4th ed.)



NOTE: Only to be used as temporary bank where maximum upslope length is 80 metres.

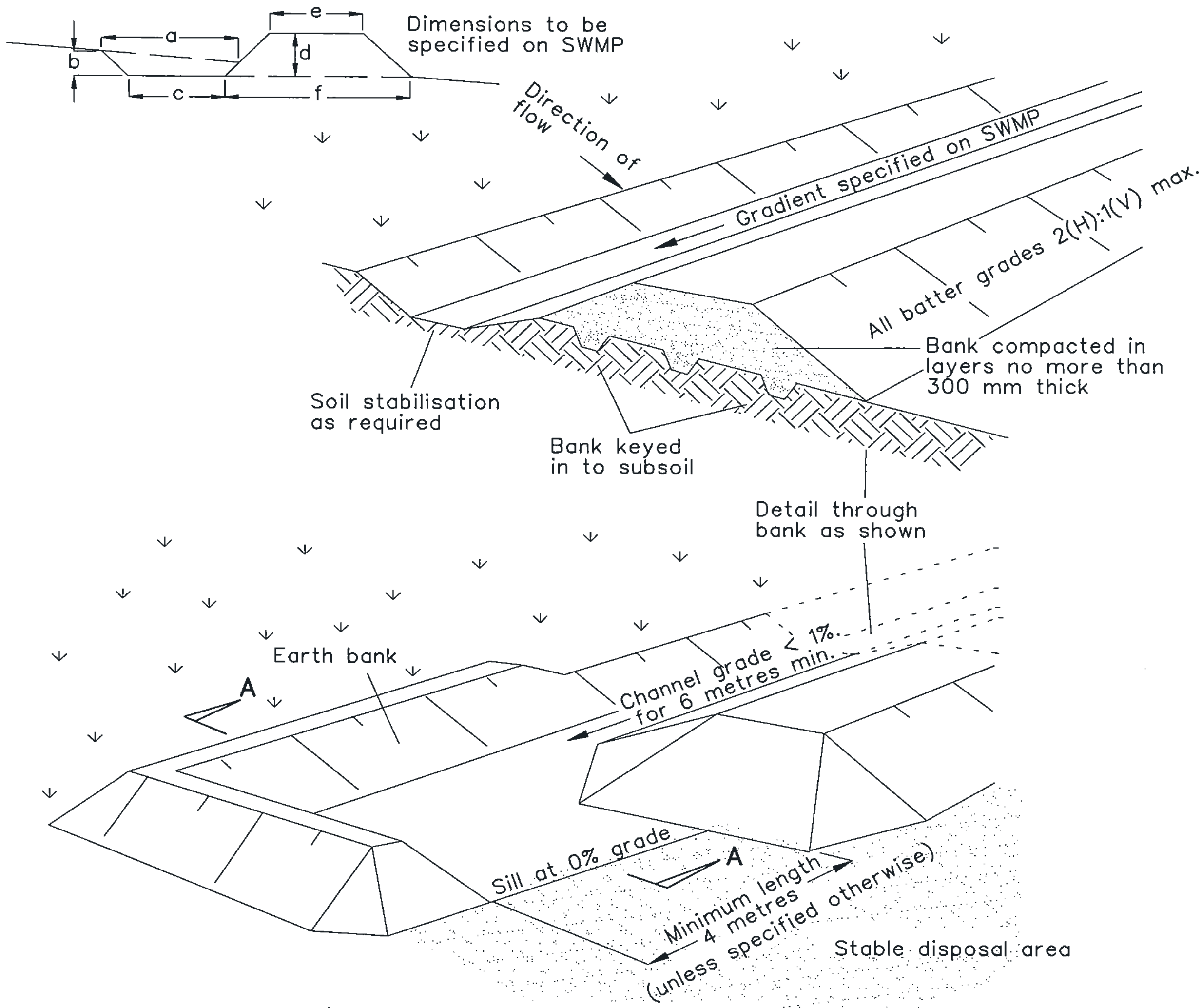
Construction Notes

1. Build with gradients between 1 percent and 5 percent.
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V shaped.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction.

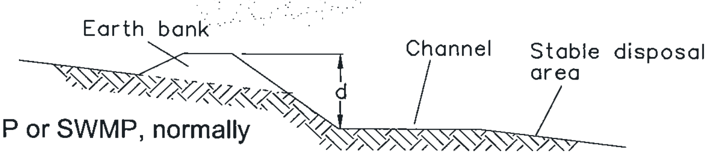
EARTH BANK (LOW FLOW)

SD 5-5

SOURCE: Managing Urban Stormwater, Soils and Construction (Vol 1, 4th ed.)



Level Spreader (or Sill)



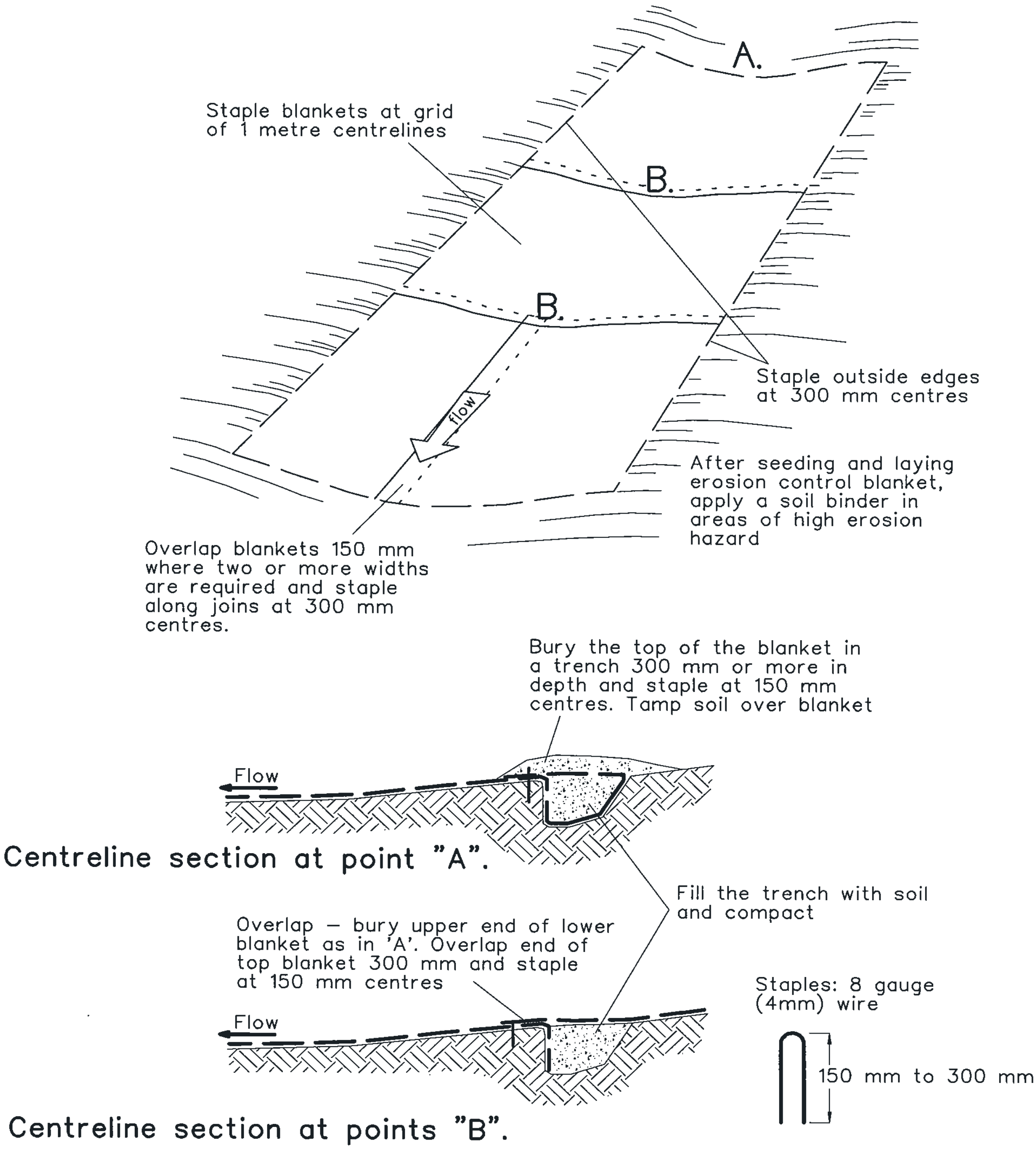
Section AA

Construction Notes

1. Construct at the gradient specified on the ESCP or SWMP, normally between 1 and 5 percent
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V-shaped, at the dimensions shown on the SWMP.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction following Table 5.2 in Landcom (2004).
7. Where discharging to erodible lands, ensure they outlet through a properly constructed level spreader.
8. Construct the level spreader at the gradient specified on the ESCP or SWMP, normally less than 1 percent or level.
9. Where possible, ensure they discharge waters onto either stabilised or undisturbed disposal sites within the same subcatchment area from which the water originated. Approval might be required to discharge into other subcatchments.

EARTH BANK (HIGH FLOWS) — SD 5-6

SOURCE: Managing Urban Stormwater, Soils and Construction (Vol 1, 4th ed.)

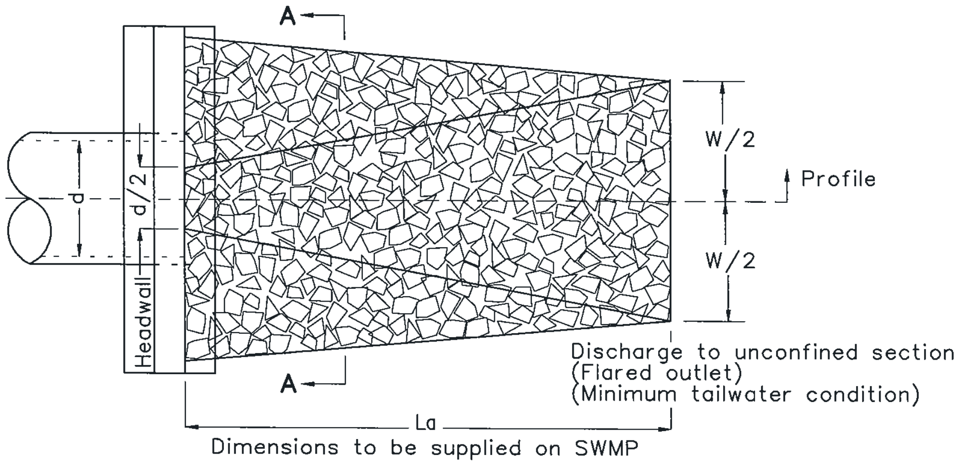


Construction Notes

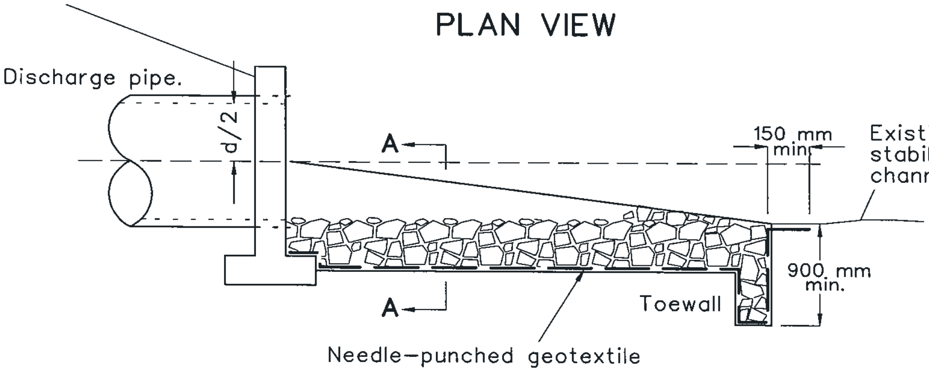
1. Remove any rocks, clods, sticks or grass from the surface before laying matting
2. Ensure that topsoil is at least 75 mm deep.
3. Complete fertilising and seeding before laying the matting.
4. Ensure fabric will be continuously in contact with the soil by grading the surface carefully first.
5. Lay the fabric in "shingle-fashion", with the end of each upstream roll overlapping those downstream. Ensure each roll is anchored properly at its upslope end (Standard Drawing 5-7b).
6. Ensure that the full width of flow in the channel is covered by the matting up to the design storm event, usually in the 10-year ARI time of concentration storm event.
7. Divert water from the structure until vegetation is stabilised properly.

RECP : CONCENTRATED FLOW　　SD 5-7

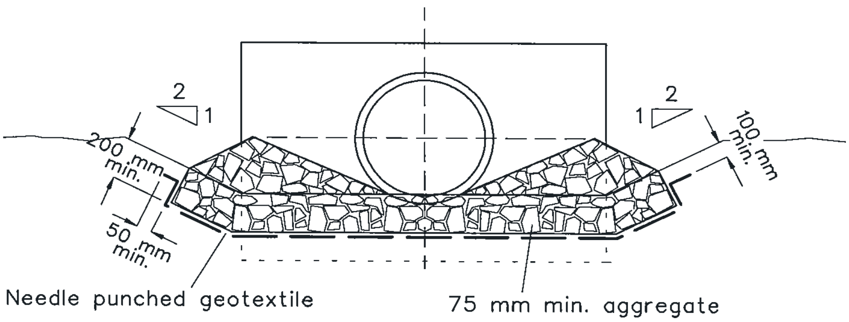
SOURCE: Managing Urban Stormwater, Soils and Construction (Vol 1, 4th ed.)



PLAN VIEW



PLAN VIEW

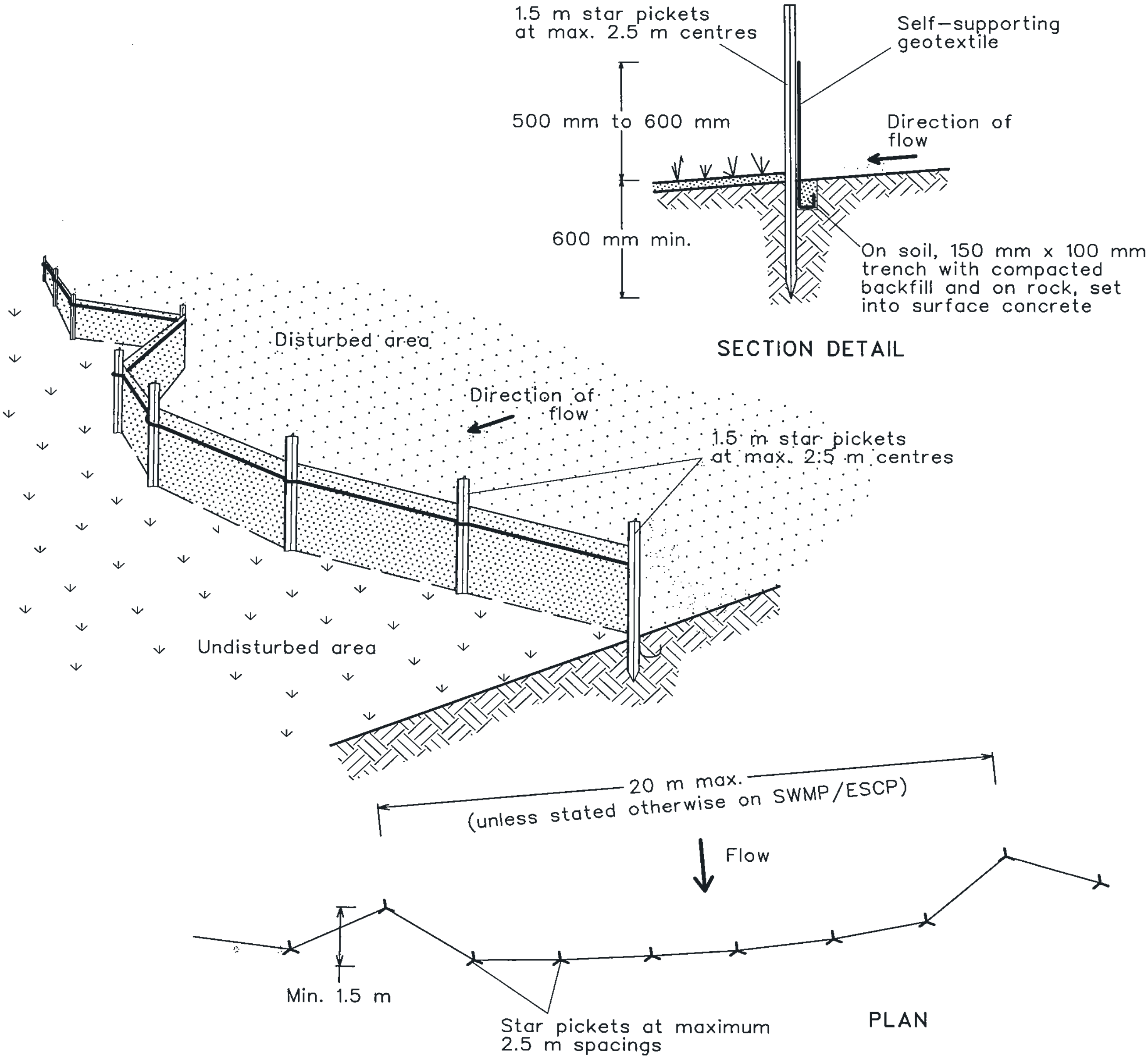


CROSS SECTION AA

Construction Notes

1. Compact the subgrade fill to the density of the surrounding undisturbed material.
2. Prepare a smooth, even foundation for the structure that will ensure that the needle-punched geotextile does not sustain serious damage when covered with rock.
3. Should any minor damage to the geotextile occur, repair it before spreading any aggregate. For repairs, patch one piece of fabric over the damage, making sure that all joints and patches overlap more than 300 mm.
4. Lay rock following the drawing, according to Table 5.2 of Landcom (2004) and with a minimum diameter of 75 mm.
5. Ensure that any concrete or riprap used for the energy dissipater or the outlet protection conforms to the grading limits specified on the SWMP.

ENERGY DISSIPATER **SD 5-8**



Construction Notes

1. Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.

2. Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.

3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.

4. Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.

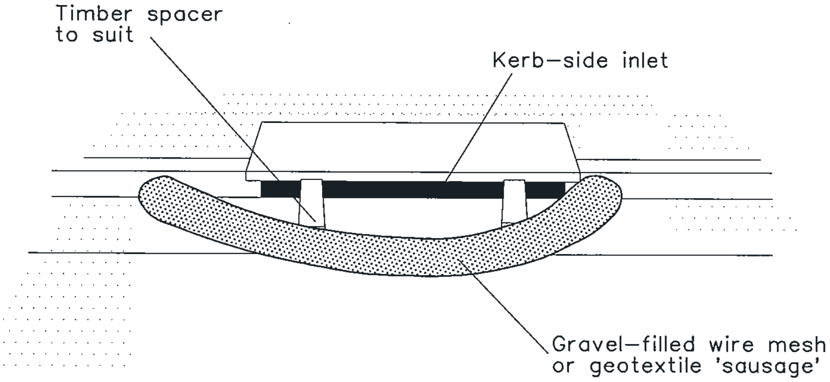
5. Join sections of fabric at a support post with a 150-mm overlap.

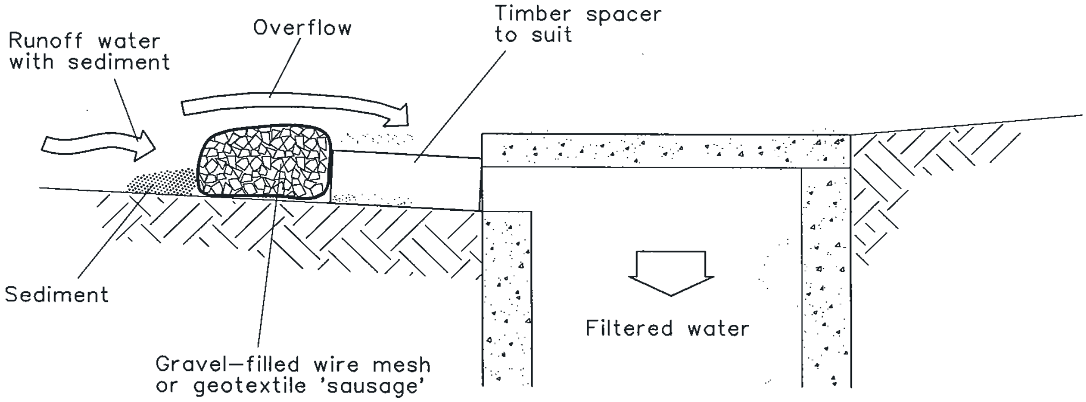
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

SEDIMENT FENCE

SD 6-8

SOURCE: Managing Urban Stormwater, Soils and Construction (Vol 1, 4th ed.)





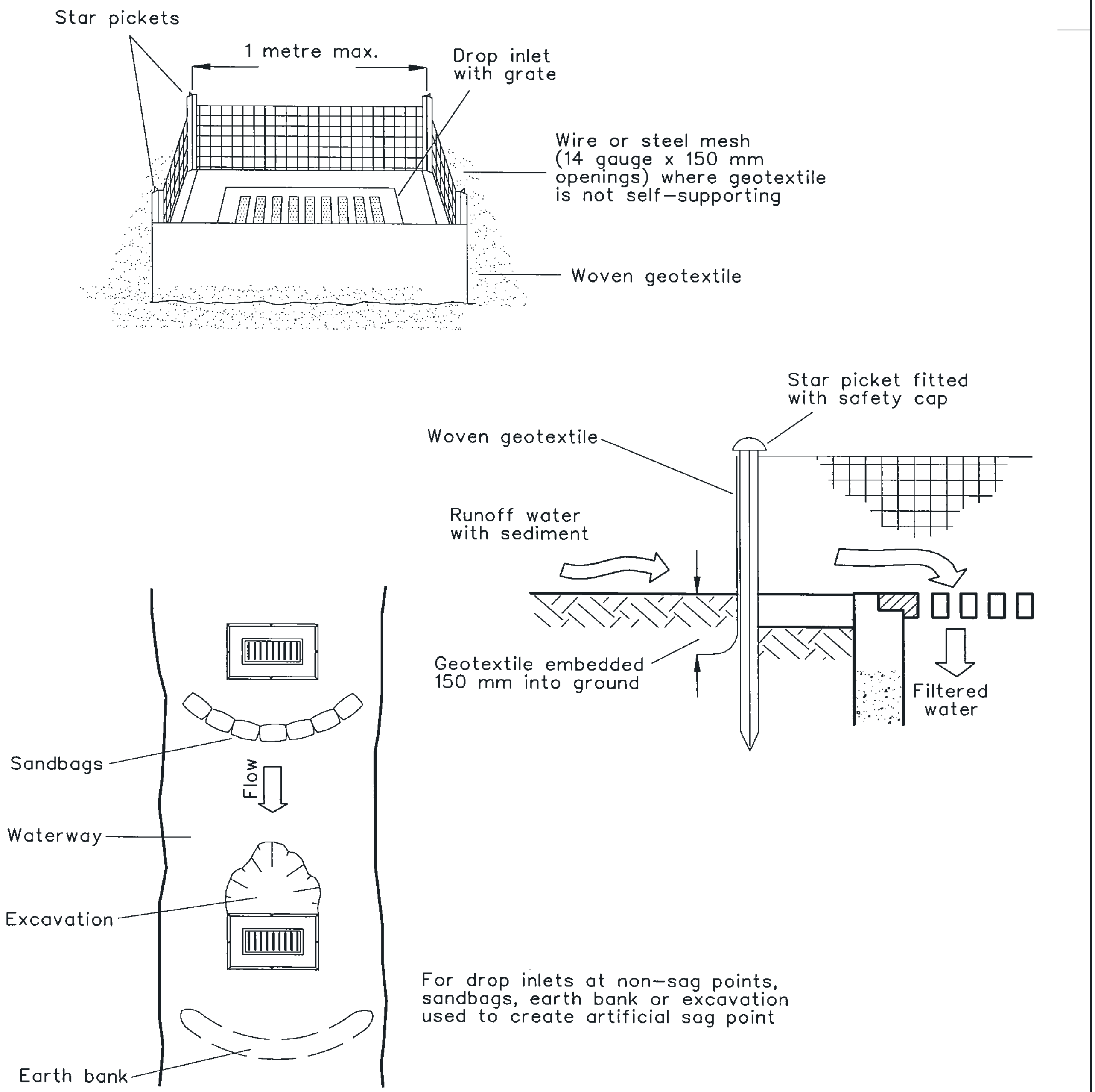
NOTE: This practice only to be used where specified in an approved SWMP/ESCP.

Construction Notes

1. Install filters to kerb inlets only at sag points.
2. Fabricate a sleeve made from geotextile or wire mesh longer than the length of the inlet pit and fill it with 25 mm to 50 mm gravel.
3. Form an elliptical cross-section about 150 mm high x 400 mm wide.
4. Place the filter at the opening leaving at least a 100-mm space between it and the kerb inlet. Maintain the opening with spacer blocks.
5. Form a seal with the kerb to prevent sediment bypassing the filter.
6. Sandbags filled with gravel can substitute for the mesh or geotextile providing they are placed so that they firmly abut each other and sediment-laden waters cannot pass between.

MESH AND GRAVEL INLET FILTER — SD 6-11

SOURCE: Managing Urban Stormwater, Soils and Construction (Vol 1, 4th ed.)



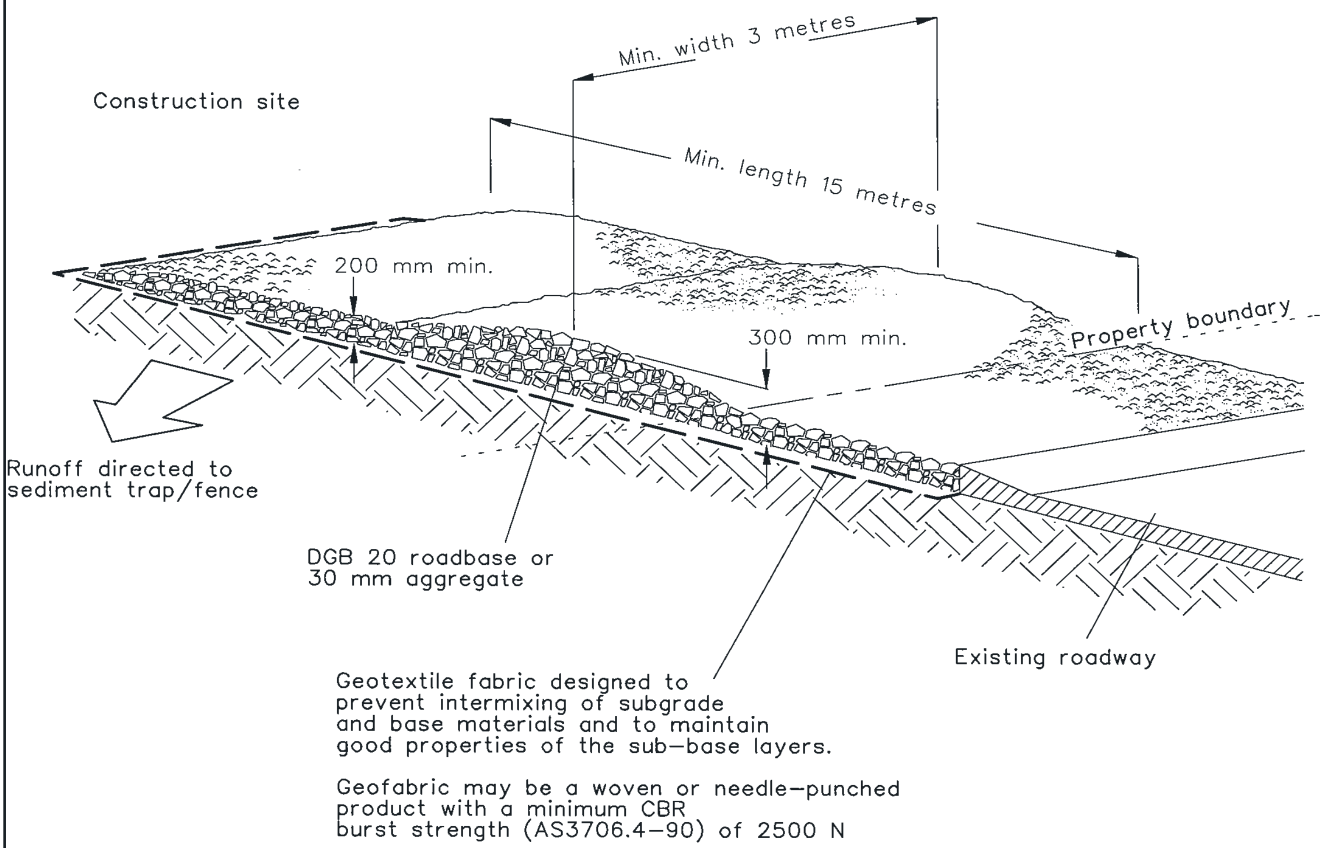
Construction Notes

1. Fabricate a sediment barrier made from geotextile or straw bales.
2. Follow Standard Drawing 6-7 and Standard Drawing 6-8 for installation procedures for the straw bales or geofabric. Reduce the picket spacing to 1 metre centres.
3. In waterways, artificial sag points can be created with sandbags or earth banks as shown in the drawing.
4. Do not cover the inlet with geotextile unless the design is adequate to allow for all waters to bypass it.

GEOTEXTILE INLET FILTER

SD 6-12

SOURCE: Managing Urban Stormwater, Soils and Construction (Vol 1, 4th ed.)

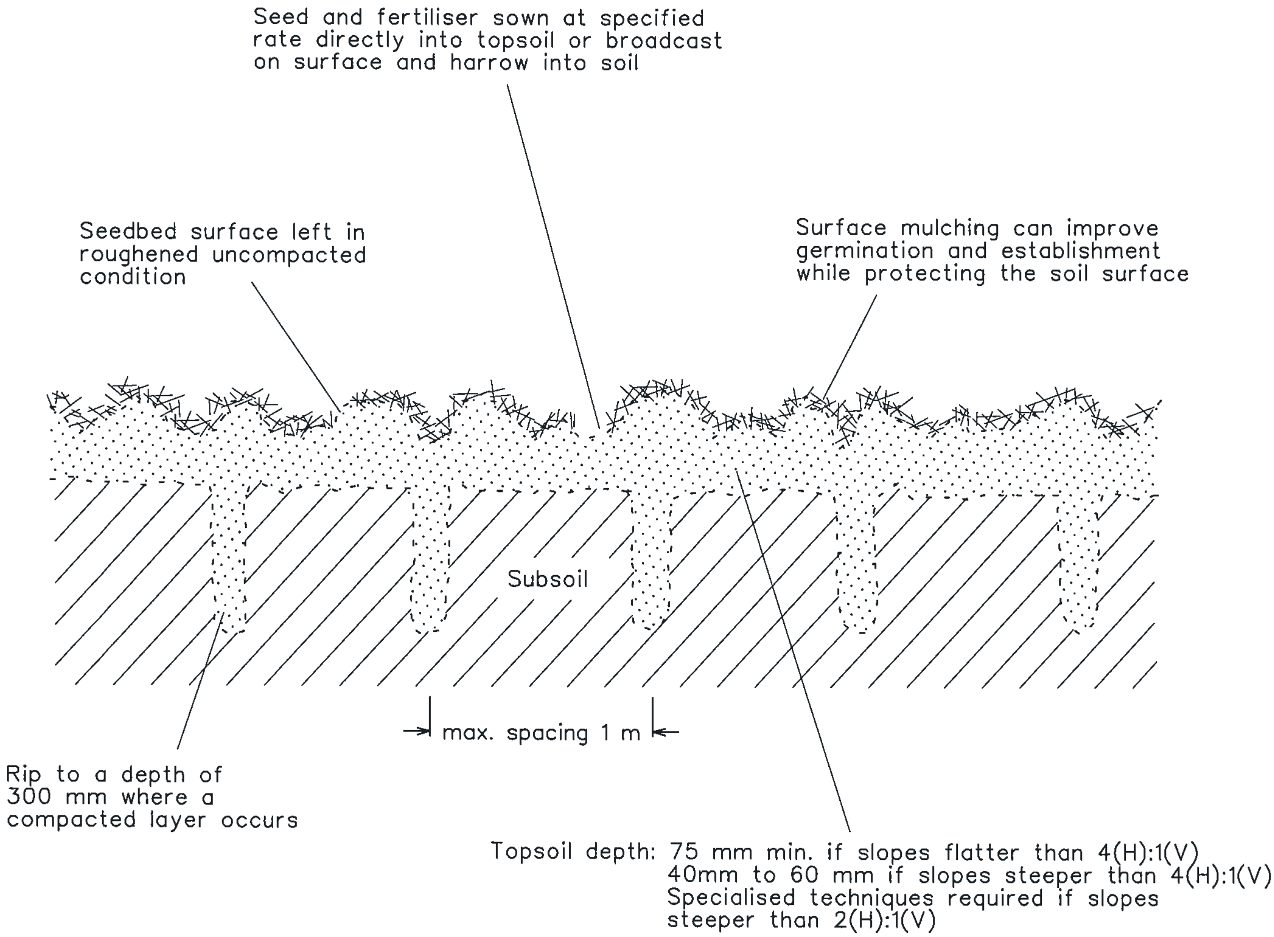


Construction Notes

1. Strip the topsoil, level the site and compact the subgrade.
2. Cover the area with needle-punched geotextile.
3. Construct a 200-mm thick pad over the geotextile using road base or 30-mm aggregate.
4. Ensure the structure is at least 15 metres long or to building alignment and at least 3 metres wide.
5. Where a sediment fence joins onto the stabilised access, construct a hump in the stabilised access to divert water to the sediment fence

STABILISED SITE ACCESS SD 6-14

SOURCE: Managing Urban Stormwater, Soils and Construction (Vol 1, 4th ed.)



Construction Notes

1. Loosen compacted soil before sowing any seed. If necessary, rip the soil to a depth of 300 mm. Avoid rotary hoe cultivation.
2. Work the ground only as much as necessary to achieve the desired tilth and prepare a good seedbed.
3. Avoid cultivation in very wet or very dry conditions.
4. Cultivate on or close to the contour where possible, not up and down the slope.

SEEDBED PREPARATION — SD 7-1

SOURCE: Managing Urban Stormwater, Soils and Construction (Vol 1, 4th ed.)

Annex E

Rule Summary Sheets For Relevant Water Sharing Plans

NSW Government — Department of Primary Industries — Office of Water

Rules summary sheet

Abercrombie River above Wyangala water source

Water sharing plan	Lachlan Unregulated and Alluvial Water Sources
Plan commencement	14 September 2012
Term of the plan	10 years
Rules summary **The following rules are a guide only. For more information about your actual licence conditions please call the NSW Office of Water, Forbes on (02) 6850 2800.**	
Access rules for rivers and creeks	
Cease to pump	For years one to five, users must cease to pump when the flow at the reference point is 0 ML/day. For years six to ten, users must cease to pump when the flow at the reference point is equal or less than 7 ML/day. **Note:** This rule applies to all extraction from rivers and creeks including natural in-river pools within the channels of rivers and creeks.
Reference point	Abercrombie River at Abercrombie gauge (412028)
Access rules for natural off-river pools	
Cease to pump	Pumping is not permitted when the water level in that natural off-river pool is lower than its full capacity **Note:** 'Full capacity' can be approximated by the pool water level at the point where there is no visible flow into and out of that pool. **Note:** Natural off-river pools include those pools which are located on flood runners, floodplains and effluents e.g. lakes, lagoons and billabongs.
Reference point	Individual natural off-river pool
Notes on access rules	
These access rules do not apply: 1. If the existing *Water Act 1912* entitlement had more stringent access licence conditions. These existing conditions will be carried forward under the plan and are included in appendix 3. 2. To major water utility, local water utility or unregulated river (town water supply) access licences. 3. To water taken for domestic consumption by stock and domestic access licences. 4. For the first 5 years of the plan to water taken for stock watering by stock and domestic access licences. 5. To water taken from existing dams. Any existing licence conditions associated with a dam will be carried forward under the plan.	
Trading rules	
INTO water source	Not permitted.
WITHIN water source	Permitted, subject to assessment except into the area upstream of the junction of the Abercrombie River and Bolong River, from the catchment area downstream.

More information about the planning process for the Lachlan Unregulated and Alluvial Water Sources is available at the NSW Office of Water website: www.water.nsw.gov.au

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Rules summary sheet
Lachlan Fold Belt MDB Groundwater Source

Water sharing plan	NSW Murray-Darling Basin Fractured Rock Groundwater Sources
Plan commencement	16 January 2012
Term of the plan	10 years
Water source	The waters in this groundwater source include all groundwater contained in: a) all rocks within the outcropped and buried areas b) all alluvial sediments within the outcropped areas within the boundary of the Lachlan Fold Belt MDB Groundwater Source as shown on the registered map. This does not include water: a) contained in the water sources as defined in another water sharing plan b) contained in any alluvial sediments below the surface of the ground within the excluded alluvial areas as shown on the registered map c) contained in all geological formations to a depth of 60 metres below the surface of the ground within the excluded GAB shallow areas as shown on the registered map. d) contained in the Liverpool Ranges Basalt MDB, Orange Basalt, Warrumbungle Basalt, Yass Catchment and Young Granite Groundwater Sources.

Rules summary

The following rules are a guide only. For more information about your actual licence conditions, please contact NSW Office of Water on 1800 353 104.

Limits to the availability of water	
Assessment of average annual extraction against the long-term average annual extraction limit	Growth in extractions will be assessed against the long-term average annual extraction limit over a three year period with a five per cent tolerance. Assessments will commence in the fourth year of the plan.
Available water determinations	Available water determinations will be made at the commencement of each water year for: • stock and domestic, local and major water utilities and specific purpose access licences – 100 per cent of share component • aquifer access licences – one megalitre per unit share or lower amount as a result of a growth in extraction response.

Access rules	
Granting access licences	Granting new water access licences may be considered for the following categories: • local water utility, major water utility, domestic and stock and town water supply, and salinity and water table management *These are specific purpose access licences in clause 19 of the Water Management (General) Regulation 2011.* • aquifer (Aboriginal cultural), up to 10 megalitres per year Granting of water access licences may also be considered as part of a controlled allocation order made in relation to any unassigned water in this water source. **Note:** Prior to any controlled allocation being made there must be consideration of maximum volumes representing the total share components of access licences in the water source, future priority requirements, including basic landholder rights and specific purpose access licences, and exemptions that do not require an access licence.
Carryover	• Up to 10 per cent of entitlement can be carried over. *No carryover is allowed for domestic and stock, local water utility, salinity and water table management or special purpose access licences.*
Take limit	The maximum amount of water permitted to be taken in any one water year is the water allocation accrued in the water access account for that water year including carryover from the previous year, adjusted for allocation assignments out of or into individual accounts.

Rules for granting and amending water supply works approvals	
Minimising interference between neighbouring water supply works	Water supply works (bores) are not to be granted or amended within the following distances of existing bores: • 400 metres from an aquifer access licence bore on another landholding • 200 metres from a basic landholder rights bore on another landholding • 500 metres from a local or major water utility access licence bore • 400 metres from an Office of Water monitoring bore • 200 metres from a property boundary. *The plan lists circumstances in which these distance conditions may be varied.*
Protecting bores located near contamination	Water supply works (bores) are not to be granted or amended within: • 250 metres of contamination identified within the plan • between 250 metres and 500 metres of contamination as identified within the plan unless no drawdown of water will occur within 250 metres of the contamination • a distance greater than 500 metres of contamination as identified within the plan if necessary to protect the water source, the environment or public health or safety. *The plan lists circumstances in which these distance conditions may be varied and exemptions from these rules.*
Protecting bores located near sensitive environmental areas	Water supply works (bores) used solely for extracting basic landholder rights are not to be granted or amended within: • 100 metres of high priority groundwater dependent ecosystems (GDE) listed in the plan • 40 metres of the top of the high bank of a river or stream. Bores not used solely for extracting basic landholder rights are not to be granted or amended within: • 200 metres of a high priority GDE listed in the plan • greater than 200 metres of a high priority groundwater dependent ecosystem listed in the plan if the bore is likely to cause drawdown at the perimeter of any high priority GDE listed in the plan • 500 metres from a high priority karst or escarpment • 40 metres of the top of the high bank of a river or stream. *The plan lists circumstances in which these distance conditions may be varied and exemptions to these rules*.
Protecting groundwater dependent culturally significant sites	Water supply works (bores) are not to be granted or amended within the following distances of groundwater dependent cultural significant sites: • 100 metres for basic landholder rights bores • 200 metres for bores not used solely for extracting basic landholder rights. *The plan lists circumstances in which these distance conditions may be varied and exemptions from these rules*

Rules for granting and amending water supply works approvals	
Managing the use of existing bores within restricted distances	Existing water supply works (bore) can continue extraction of groundwater with the maximum annual amount extracted equivalent to the shares nominated at the commencement of the plan within • 500 metres of contamination listed in the plan • any of the distance restrictions listed above.
Managing local impacts	The Minister may prohibit or restrict the taking of water from a water source in order to manage local impacts in groundwater sources, where required to: • maintain or protect water levels in an aquifer • maintain, protect or improve the quality of water in an aquifer • prevent land subsidence or compaction in an aquifer • protect groundwater-dependent ecosystems • maintain pressure, or to ensure pressure recovery, in an aquifer.

Trading rules	
INTO groundwater source	Not permitted.
WITHIN groundwater source	Permitted: • subject to any applicable local impact management restrictions • unless the dealing would result in the total extraction authorised under access licences from the Lachlan Fold Belt MDB (Mudgee) Management Zone exceeding the limit authorised at the commencement of the plan.
Conversion to another category of access licence	Not permitted: • except those allowed under the Minister's Access Licence Dealing Principles.
Between states	Permitted: • where there is an interstate agreement for such dealings • such arrangements are specified in the Minister's Access Licence Dealing Principles.

More information about the macro planning process for the NSW Murray-Darling Basin Fractured Rock Groundwater Sources is available on the NSW Office of Water website **www.water.nsw.gov.au**.

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