This is a sub-plan to be used in conjunction with the Environmental Management Plan

ElectraNet Project EnergyConnect SA to NSW Interconnector 330kV and 275kV Transmission Lines

Customer: ElectraNet

Contract Number: EC 14171

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1 PURPOSE

The purpose of this sub-plan is to describe how potential impacts of construction and maintenance works within or adjacent to waterways will be managed during the project. All works with the potential to impact on waterways will be implemented in accordance with the management measures and strategies contained in this sub-plan.

2 DOCUMENT SCOPE

The scope of this plan applies to all Downer workers for ElectraNet's Project EnergyConnect (SA PEC). This plan incorporates the requirements in ElectraNet's project relevant documents including Scope for Environmental Management Plan EC.14171 – Project EnergyConnect Major Works Contract – Design and Construct; Safety and Sustainability Standards; and Engineering Contract Specifications.

This sub-plan has been developed to cover the permit application requirements for a Water Affecting Activity in respect of a watercourse, lake or bank of a lake in accordance with Section 104 of the *Landscape South Australia Act 2019* (SA).

Where additional management requirements are identified outside the scope of the Environmental Management Plan (EMP) and this sub-plan specific environmental controls will be identified, and documentation/procedures updated.

3 ENVIRONMENTAL MANAGEMENT PLAN STRUCTURE

A series of environmental sub-plans, as referenced in the project's Environmental Management Plan, aim to identify environmental risks and opportunities, and provide mitigation controls to manage those risks with an emphasis on the critical risks and controls.

As with the Environmental Management Plan, sub-plans reference any IMS documents (including but not limited to, procedures, work instructions, and forms), customer specific requirements, and project specific documents required to execute the project.

Updates to sub-plans are subject to the document review and approval process detailed in the project's Document Control Plan.

4 REFERENCED & ASSOCIATED DOCUMENTS

4.1 Legislation

The *Landscape South Australia Act 2019* (SA) administrated by the Department of Environment and Water (DEW) replaced the *Natural Resources Management Act 2004* on July 1, 2020. Under this new legislation, natural resource management regions have been replaced by landscape regions. The western 20km of the project is under the Northern and Yorke Management region and the remainder of the project is under the Murraylands and Riverland Management Region.

Water Affecting Activities (WAA) are activities and works that can impact on the health and condition of water resources, water dependant ecosystems and other water users. Under the *Landscape South Australia Act 2019*, an approved permit is required to undertake a water affecting activity. A WAA permit is required to be obtained from the regional landscape board in accordance with their Regional Landscape Board Plan*.

*Murraylands and Riverland regional are finalising their regional landscape plan which is due to be delivered in 2021. Until this is implemented the South Australian Murray-Darling Basin Natural Resources Management Plan applies.

In accordance with the Act, activities and works that require a WAA permit include:

- Building structures, obstructing or depositing solid materials in a watercourse (e.g. constructing creek crossings, erosion control)
- Excavating material from a watercourse (e.g. removing sand or soil, cleaning out drainage channels)
- Destroying vegetation in a watercourse (e.g. removal of reeds)
- Draining or discharging water or wastewater into a watercourse or lake (e.g. desalination waste, stormwater discharge, drainage and salinity control)
- Drilling, deepening and back filling wells, bores and ground water access trenches.

This sub-plan has been developed as part of the permit application for a WAA in respect of a watercourse, lake or bank of a lake in accordance with Section 104 of the *Landscape South Australia Act 2019*. This sub-plan details the following:

- Works to be undertaken
- Removal or vegetation
- Excavation of rock, sand or soil
- Environmental risks and controls

The Water Quality Policy is subordinate legislation to the South Australian Environment Protection Act 1993. The policy supports the general environmental duty requirement that all reasonable and practicable measures must be taken to prevent or minimise environmental harm. In doing so, persons who pollute or might pollute waters must avoid exceeding (to an extent that is reasonably practicable) the Water Quality Guidelines (if relevant waters are declared to have those environmental/community values).

The Environmental Protection Act 1993 and the Environmental Protection (Water Quality) Policy 2015 include licensing requirements for dewatering under the Act. Water will not be discharged directly or indirectly to marine waters or inland waters at a volume of more than 100 kl containing suspended solids in concentration exceeding 25mg/l. Turbidity and pH will be tested prior to water discharge regardless of volume. If water quality exceeds these objectives, water will be treated and retested prior to dewatering. It is not anticipated that any Environmental Licences or Prescribed Activities under the EPA or Water Quality Policy will be triggered with the scope of works.

All dewatering will be conducted in accordance with the *Water Quality Guideline: Environmental management of dewatering during construction activities* (SA EPA, 2018). This document guides proponents on their obligations under the Environment Protection Act 1993 (EP Act) and the Environment Protection (Water Quality) Policy 2015 (Water Quality Policy), with respect to environmental management of dewatering during construction activities.

Environmental Hold Point

Prior to the commencement of ground disturbance works on waterway crossings, a WAA permit will be submitted and approved by Murraylands and Riverland Landscape Board or Northern and Yorke Landscape Board. All works within or adjacent to waterways will be undertaken in accordance with the WAA permit.

4.2 Standards and Guidelines

The standards and guidelines applicable to waterway crossing management are listed in the following table.

Australian Standards and Guidance Material
Best Practice Erosion & Sediment Control for building and construction sites (International Erosion Control Association, 2008)
Environment Protection (Water Quality) Policy 2015
Erosion & Sediment Control Field Guide for Road Construction (Witheridge, 2017)
South Australian Murray-Darling Basin Natural Resources Management Plan*
Northern and Yorke's Landscape Plan 2021/2026

Water Quality Guideline: Environmental management of dewatering during construction activities (SA EPA, 2018)

4.3 Downer Documents

DOWNER DOCUMENTS	
POLICIES	
DG-ZHAN-PO200	Environmental Sustainability Policy
PRINCIPLES	
DG-ZH-PN002	10 Environmental Principles
PROCEDURES	
DG-DM-PR003	Operational Change Management Procedure
DG-QA-PR003	Internal Audits Procedure
DG-RM-PR003	Project Risk and Opportunity Management
DG-ZH-PR006	Incident Management Procedure
DG-ZH-PR007	Zero Harm Performance Monitoring and Reporting Procedure
DG-ZH-PR015	Emergency Management Procedure
DG-ZH-PR116.1	Inspections Procedure
STANDARDS	
DG-HR-ST013	Training & Competency Management Standard
DG-ZH-ST002	Legislative and Other Requirements Standard
DG-ZH-ST013	Zero Harm Worker Consultation Standard
DA-ZH-ST064	Soil and Water Management Standard

PROJECT SPECIFIC DOCUMENTS	
PLANS	
14171-DOW-PRM-PLN-0362	Quality Management Plan
14171-DOW-PRM-PLN-0388	Emergency Preparedness Management Plan
14171-DOW-PRM-PLN-0379	Environmental Management Plan
14171-DOW-PRM-PLN-0380	Waste Management Plan Sub-plan
14171-DOW-PRM-PLN-0381	Weed, Pest and Disease Management Sub-plan
14171-DOW-PRM-PLN-0552	Biodiversity and Rehabilitation Management Sub-plan
14171-DOW-PRM-PLN-0383	Landholder Liaison Sub-plan
14171-DOW-PRM-PLN-xxxx	Sedimentation, Erosion and Drainage Management Sub-plan
14171-DOW-PRM-PLN-0526	Cultural Heritage Management Sub-plan
14171-DOW-PRM-PLN-0387	Bush Fire Management Plan
14171-DOW-PRM-PLN-0361	Safety Management Plan

4.4 Approvals and Client Documents

PROJECT APPROVALS AND CLIENT DOCUMENTS	
DA	TBC
ECS	ElectraNet Section 3 - Engineering Contract Specification (November 2020) Section 3.2a: Transmission Lines - Detailed Design

	Section 3.2b: Transmission Lines - Construction
SEMP	ElectraNet Scope of Environmental Management Plan
S&S	ElectraNet Safety and Sustainability Standards

5 DEFINITIONS

The following terms are used in this document.

CAZ Plans	Construction Activity Zones (CAZ) include all ground disturbing activities, access routes and work areas associated with the project including: • New tracks, pads and facilities • Maintenance of existing access tracks including grading, widening or stabilisation • Areas of disturbance associated with demolition works. These designated CAZ will be available as spatial data and/or PDF maps for all workers.
Downer Worker	All individuals working for Downer as: employees, contingent labour hire, contractors, subcontractors, apprentices, trainees, and work experience students.
EMP	Environmental Management Plan for the Project
INX	The Zero Harm database used to record, investigate and follow-up events, including audits, hazards, incidents, inspections, meetings, observations, risk assessments, reviews, and suggestions.
WAA permit	For all activities that can have an adverse impact on the health or condition of water resources, a Water Affecting Activity (WAA) permit is required.

6 SURFACE AND GROUNDWATER

The project is located within the Lower Murray Valley catchment of the Murray-Darling Basin, which makes up 9 % of the total areas (1.1million km2) of the Murray Darling Basin (MDBA 2020).

The transmission line corridor is not located in any surface water or water resource management prescribed water areas under the Landscape South Australia Act 2019 and does not cross any prescribed water courses. The proposed alignment traverses outside the eastern edge of the River Murray Prescribed Water Course areas (the boundary is Old Wentworth Roads / Renmark Wentworth Road).

The western end of the transmission line corridor traverses a few small ephemeral creeks which arise in the slopes of the Mount Lofty Ranges. These creeks usually flow out of the ranges only in very wet years and discharge to the plans of the east for short distances before dissipating by evaporation or infiltration into permeable sediments (Barnett 2015).

6.1 River Murray

The River Murray is the dominant surface water feature in the region. It flows in a generally west direction from the South Australia-NSW border to Morgan, where it turns southwards. The River Murray is located south of the transmission line corridor. Between Morgan and Renmark, the distance to the main channel varies from 5km (near Morgan, Cadell and Overland Corner) to 10-15km in other areas. North of Renmark, the transmission line corridor follows the edge of the floodplain, at distances of approximately 6-9km from the main river channel. The eastern end of the transmission line corridor intersects the River Murray Floodplain Area defined under the River Murray Act. This floodplain area is also listed under the Ramsar convention as the Riverland site of international importance.

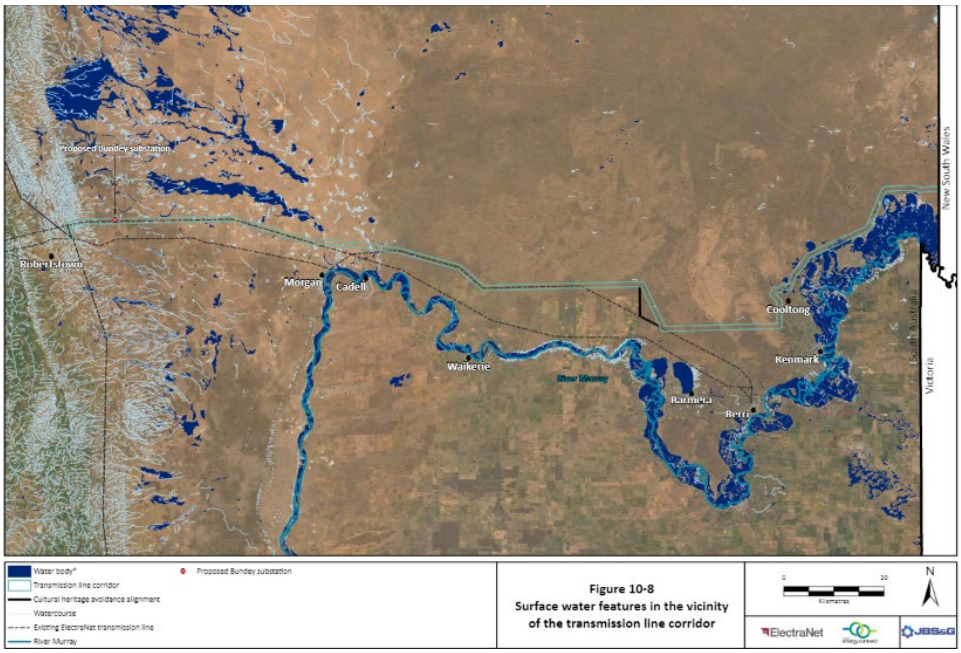


Figure 1 – Floodplain Area

6.2 Other Watercourses

Surface water features in the region other than the River Murray are limited, due principally to the semi-arid climate, relatively flat topography and generally sandy soils. The western end of the transmission corridor traverses a few small ephemeral creeks which arise in the slopes of the Mount Lofty Ranges.

Only the larger of these watercourses reach the River Murray in exceptionally wet years (if at all). The transmission line crosses two of the larger water courses: Burra Creek and Emu Gully

6.2.1 Burra Creek

Burra Creek is located approximately 7km north of Morgan, it has an incised channel in the vicinity of the transmission line corridor. The Burra Creek catchment is the only defined catchment boundary in the region. Its headwaters commence just north of Mount Bryan (approx. 95km north-west of Morgan) and flow in a southerly direction towards Worlds End (approx. 60km west of Morgan), before changing in direction to the east and flowing towards its discharge point in the River Murray. Flow from Burra Creek to the River Murray is rare, as the lower reaches are essentially flood-out plains and lack defined drainage. The last time this occurred is estimated to be around 1941.

6.2.2 Emu Gully

Emu Gully is located approximately 3km north-east of Cadell, it is very broad and shallow in profile with no incised channel. The catchment of Emu Gully extends approximately 80km to the north-west and is characterised by discontinuous drainage lines with often broad and poorly defined channels, numerous depressions and swamps and an extensive network of farm dams along the major flow paths.

6.3 Groundwater

Most of the transmission corridor is situated with in the Murray Basin, a low -lying sedimentary basin, containing a multi-layered regional groundwater system. The groundwater in the region typically flows into the Murray Basin to the River Murray which acts as a drain for all aquifer systems in the Murray Basin and is the focus for Groundwater discharge (Barnett 2015).

Depth to shallow groundwater along the transmission corridor is mapped at greater than 20m for the western two thirds of the corridor (DEW 2016a). It is mapped at shallower depths (5-10m) in several areas near the eastern end of the transmission line (north of Barmera and adjacent to the Riverland Ramsar site). Salinity is mapped at between 14,000 and 35,0000 mg/L for most of the transmission corridor (DEW 2016b). Salinity is

lower west of Morgan (in the range of 1500mg/L – 70000mg/L) and higher in several areas near the eastern end of the transmission line (north of Barmera, north of Renmark and near the state border) where it is greater than 35000mg/L.

Groundwater abstraction if required will be assessed and managed so that it does not result in drawdown of aquafers and reduction of groundwater availability for flora, fauna and groundwater users. It is not expected that the project will have a significant if any impact on groundwater levels.

If groundwater is used (i.e. for dust suppression), the volumes used will be quite low and extraction will be short term. If existing groundwater wells are used for water supply, the use of the wells and volume extracted will be via agreement with the landowner.

6.3.1 Groundwater Wells

There are 59 wells recorded in WaterConnect within the transmission line corridor and 1049 within 5km of the proposed alignment. Groundwater is used for watering stock in areas where the salinity is suitable. Most reported salinities for wells within 5km of the proposed alignment are unsuitable for stock watering (of the 402 bores where salinity is reported, 106 have salinities less than 13000mg/L and only 11 have salinities less than 1200mg/L). The use of saline water for dust suppression is expected to have negligible impact.

Water to be sourced for the project is to be through the township potable water, and the need for installation of groundwater wells is not expected to be required for the project.

7 CONSTRUCTION IMPACTS

Vehicle, machinery and equipment access is required to each structure along the transmission line during construction. To allow safe access, maintenance or upgrades of waterway crossings may be required.

In addition, the location of the new structures and any supporting temporary infrastructure, such as stringing corridors and pads, has the potential to impact on waterways.

The potential impacts during construction on waterways include:

- Alteration of the waterway bed and banks including change in flow velocity
- Increased potential for erosion and sedimentation
- Impacts on aquatic or riparian flora and fauna
- Effects of compaction on sub-surface flow
- Effects on downstream users

The other potential impact on waterways during construction is contamination from hydrocarbons, chemicals or waste. Details on management measures for hydrocarbon and chemical contamination are provided in the Sedimentation, Erosion and Drainage Sub-plan. Details on management measures for waste are provided in the Waste Management Sub-plan.

8 MITIGATION AND CONTROL

The following management measures and mitigation strategies will be undertaken to mitigate the potential impacts on waterways during construction.

8.1 Planning

As part of planning for the construction activities, scouting of the access and transmission line structures has been undertaken by Downer. This scouting included ground-truthing the location of waterways, condition of existing waterway crossings, and determining works for safe access. In addition, any environmental sensitivities and controls were noted during the onsite inspection. Information gathered from this scouting has informed the development of the mitigation and control measures in this sub-plan.

8.1.1 Transmission Line Design

During design of the transmission line route and structure locations, the location of environmentally sensitive areas was considered. This included the location of waterways and riparian vegetation.

Where practicable, structures have been located at least 50m from waterways. Access to the structures has been considered to minimise impact such as using existing waterway crossings, where practicable. Temporary supporting infrastructure, such as stringing pads, have also been located at least 50m from waterways where practicable. These measures have been implemented to mitigate the disturbance of waterways and riparian vegetation.

For disturbance of waterways and riparian vegetation during construction that cannot be avoided then mitigation and control measures will be implemented as per the following Sections. Waterway crossing design, construction and rehabilitation requirements are detailed in the Section below.

9 WATERWAY CROSSINGS

This Section details the general design, construction and rehabilitation requirements for waterway crossings.

9.1 Design Considerations

Existing waterway crossings along access tracks may have steep banks and unstable material in the bed which can prevent vehicle, machinery and equipment access. Similarly, for locations of new waterway crossings, the steepness of the banks and material in the bed may prevent access. The following has been considered during design of waterway crossings to allow for safe access.

9.1.1 Alignment

Preference will be given to aligning approach tracks perpendicular to the waterway. Also, where practicable, the crossing will be located on straight sections of the waterway and where banks are low and stable.

9.1.2 Waterway Flow

When designing and constructing the waterway crossing, flow within the waterway must be maintained with no permanent obstructions caused by the crossing. This includes:

- Designed and constructed to minimise interference with natural channel form and capacity
- Constructed in a way that does not block, damage or interfere with water flow
- No windrows of soil or debris left on the lower side of the track or across drainage lines
- Constructed to minimise disturbance on the banks except in the location of the crossing
- Constructed to divert stormwater to undisturbed vegetation to prevent erosion

During construction, works will be scheduled for periods when ephemeral streams are either:

- Dry - preferred condition
- Wet but not flowing - dewatering may be required
- Low flow - dewatering required

If there is significant or permanent flow within a waterway then an alternative access route may be determined rather than constructing a waterway crossing for the works.

9.1.3 Waterway Bed Material

Design of the waterway crossing will be influenced by the type of bed material within the watercourse. A summary of considerations of the waterway design for different types of bed material are provided in the Table below.

Table 1: Waterway crossing design considerations for bed material (Adapted from Witheridge, 2017)

Bed Material	Crossing Design Considerations
Clay	▪ Clay-based waterways are almost impossible to cross at bed level if the bed is damp because the bed will quickly turn to mud. ▪ Temporary vehicle crossings of clay-based waterways normally require a culvert, or possibly a rock-lined ford if the bed is dry.
Sand	▪ Sand-based waterways can experience significant sediment (sand) flows during both minor and major floods. ▪ These waterways can often be crossed by vehicles at bed level (ford crossing) with minimal sediment release or damage to the waterway, even if the bed is wet.
Gravel	▪ Gravel-based waterways usually contain a series of pools and riffles along the channel bed.

	▪ The channel bed is typically flat, and bed- level crossings (fords) are normally located at riffles where flows are shallow. ▪ It is important to avoid sand and fine sediments entering the riffle, so drainage and sediment controls are usually required on the approach roads.
Rock	▪ The waterway bed is normally very stable on rock-based waterways, and few restrictions apply to the location of vehicle crossings other than to avoid disturbance to important riparian vegetation. ▪ In between the individual rock outcrops, these waterways may contain sections of clay, sand or gravel-based channels, in which case the above rules apply as appropriate for the type of substrate.

9.1.4 Soil Properties

The design of the waterway crossing will be influenced by the properties of the soil. The soil types that require considered for waterway crossings are detailed in the Table below.

Table 2: Soil properties design considerations

Soil Type	Waterway Crossing Design Considerations

Acid sulphate soils	▪ These soils can already be acidic or have the potential to become acidic if disturbed.
	▪ Prior to the disturbance of soils below an elevation of 5 m AHD, the acid sulphate potential should be determined.
	  ▪ From CSIRO mapping, the transmission line has a low to extremely low probability of potential acid sulphate soils occurring.
	  ▪ Onsite signs of acid sulphate soils: black boggy soil, slimy red ooze; reddish-yellow iron rich deposits; hard impermeable iron-rich crusts; shiny oil-like surface layers; scalded and infertile patches of earth.
	▪ Specific management measures for actual and potential acid sulphate soils to be implemented during construction as required.

Dispersive soils	▪ These soils are highly prone to erosion often leading to tunnel and gully erosion.
	▪ Dispersive soils are typically located in the subsoil layer while the topsoil is usually non-dispersive.
	▪ Seasonal waterlogging can be an issue due to poorly structured subsoil.
	▪ Locations with the potential for dispersive soils include:
	  ▪ F2, G3 and M4 subsoil categories have been identified as having the potential to be dispersive (Hall et al, 2009).
	  ▪ Onsite signs of dispersive soils: distinctive erosion patterns including fluting and tunnels.
	▪ Specific management measures for dispersive soils to be implemented during construction as required.

Saline soils	▪ Saline soils can impact on water quality within the waterway and introduce complex revegetation issues.
	▪ Waterlogging and flooding can be an issue for saline soils.
	▪ Locations with the potential for high to extremely saline soils include:
	  ▪ Low lying areas with poor to very poor drainage and where saline groundwater is within approximately 1 m of land surface.
	  ▪ Soil classification N2 are saline soils (Hall et al, 2009).
	  ▪ Onsite signs of saline soils: springs and saline baseflow; areas of poor crop emergence; seasonally or permanently wet areas; salt efflorescence in summer; indicator plant species (e.g. sea barley grass, samphire).

	▪ Specific management measures for saline soils to be implemented during construction as required.

9.1.5 Vegetation and Bed Rock Disturbance

Preference will be given to positioning the waterway crossing to avoid disturbance of riparian vegetation and bed rock. Where practicable, the waterway crossing will be designed to utilise riparian vegetation, bed rock and other existing structures (i.e. large rocks, logs) within the erosion control design of the crossing.

It should be noted that other environmental factors, such as protected vegetation, and cultural heritage sensitivities that may be associated with waterways will also be considered during planning and construction.

Clearing of vegetation is to generally be carried out by hand felling on the beds or banks of watercourses. Waterbodies are to be kept clear of felled trees, and the integrity of the bed or banks are to be maintained to mitigate potential erosion.

9.2 Crossing Types

Creek crossings typically require levelling of the banks on the approaches into the crossing and stabilisation of the creek bed to allow vehicle access. The types of waterway crossings to be constructed are summarised below.

9.2.1 Ford Crossings

Fords are waterway crossings that are constructed almost at bed level. The low flow passes over the structure rather than through a culvert below. Fords are ‘wet’ crossings so they should be used only when flows are anticipated to be low or non-existent during the construction period.

Fords are suitable for ephemeral waterways with little or no defined drainage channel, no lasting pools, and little or no vegetation. If it is anticipated that the waterway will have permanent or frequent flow during construction, a culvert may be needed to prevent disturbance to the channel.

9.2.2 Culvert Crossings

Culverts are arched, boxed or piped conduits that allow water to pass under the track. They are usually made of concrete or galvanised corrugated steel pipe. The location and size of the culvert will be determined by the flow capability requirements of the waterway. Culvert crossings are typically used on wide or deep waterway crossings or waterways with permanent or regular flow.

9.3 Construction Requirements

The general construction requirements for waterway crossings are detailed in the following Sections.

9.3.1 Dry Ford Crossing

For construction of a dry ford crossing, the approaches into the crossing are typically levelled or recessed into the bank. Approximately 300-450 mm or two rock layers below the existing bed level will be excavated for the placement of rock to stabilise the crossing. The excavated bed level and approaches will be lined with geofabric and stabilised with at least two layers of suitably sized rock. All rock used in waterway crossings must be suitably sized to withstand the velocity of water flow without washing downstream.

A downstream cut-off trench may be installed to prevent scouring on the downstream side of the crossing. Cut-off trenches are generally required for creek crossings subject to higher flow velocities. The trench will be installed at the most downstream point of the crossing, approximately 300-600 mm or four rock layers deep, and filled with suitably sized rock to the bed level.

The final level of the ford crossing should be no be greater than 150 mm from the existing bed level on the downstream side of the crossing.

Prior to the commencement of works, the disturbance area and any No-Go areas will be identified and delineated onsite with flagging and signage as required.

Vegetation and topsoil must be stripped first from disturbance areas and stockpiled separately. Any excess soil excavated from the crossing will also be stockpiled separately. All stockpiles will be located above the waterway flow level and away from drainage lines into the waterway.

Drainage control on the approach tracks must be installed to prevent stormwater running down the track, unfiltered, into the waterway. Typically, a cross drain (whoa-boy) will be installed to divert stormwater off the track and into adjacent grass or rocks to filter sediments from the runoff.

The exposed banks formed by recessing the approach tracks will be stabilised by spreading topsoil and adding stockpiled vegetation, seed, straw or mulch as soon as practicable following completion of the crossing.

9.3.2 Wet Ford Crossing

Waterways that have some ponding or intermitted flow, although not permanently flowing, will typically have a ford crossing installed. Wet ford crossings generally follow the same crossing construction methods as dry ford crossings with the additional requirement being dewatering of any ponded water if required. For management of dewatering see Section 9.3.4.

Plant should operate from outside of any water to prevent spills into the waterway. Additional erosion and sediment controls may be required such as downstream cut-off trenches or rock armouring to stabilise the bed and banks.

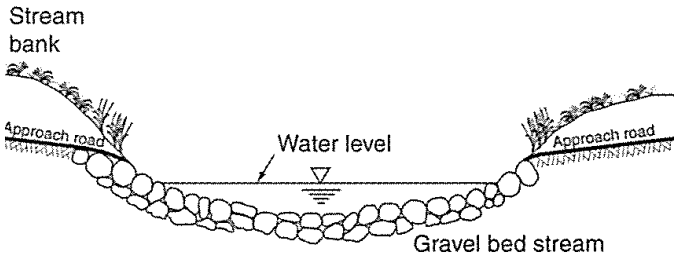


Figure 2: Wet ford crossing (Sourced from: IECA, 2008)

9.3.3 Culvert Crossing

For waterways with ponded water in the disturbance area, prior to commencing the works the water will need to be pumped out. For management of dewatering see Section 9.3.4. For waterways with low flow, the water may be bypassed around the construction area through the installation of a bypass pump or cofferdam/s and bypass pump as shown in the Figure below.

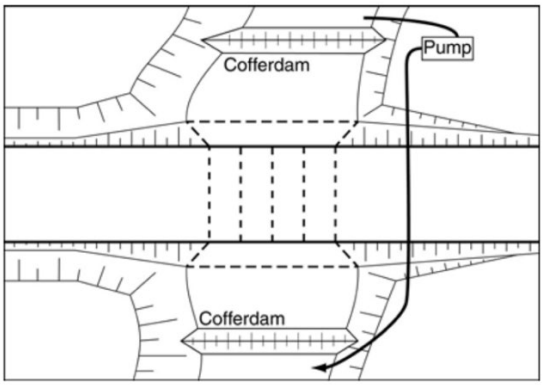


Figure 3: Cofferdam with bypass flow (Sourced from: Witheridge, 2017)

For construction of a culvert crossing, the approaches into the crossing are typically levelled or recessed into the bank. Material, silt, clay and sand, in the crossing may be removed to provide a stable base for installation of the culvert.

The culvert must be sized to have a capacity to accommodate peak flow volumes. Other requirements for construction of the culvert crossing include:

- Culvert to be positioned within the lowest point of the waterway. Where practical, align the culvert with the downstream channel to minimise bank erosion.
- Culvert to be located at bed level and gradient similar to the waterway, which should be gently sloping.
- Water velocities in the culvert should be similar to those within the waterway before the culvert was constructed. There should be no differences in the flow rates upstream, in and downstream of the culvert.

An apron from the culvert discharge point and track approaches will be lined with geofabric and stabilised with at least two layers of suitably sized rock. All rock and fill placed below the high-water mark must be free of fines, contaminants and other waste materials. All rock used in waterway crossings must be suitably sized to withstand the velocity of water flow without washing downstream.

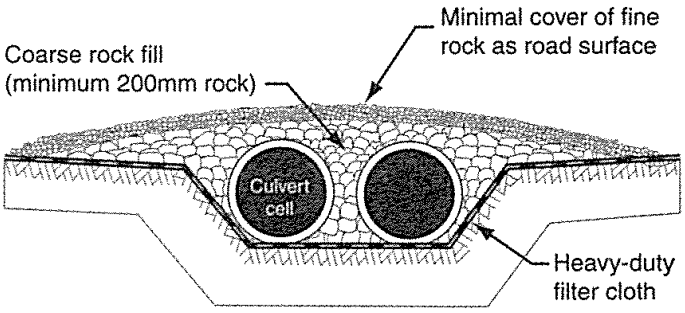
Prior to the commencement of works, the disturbance area and any No-Go areas will be identified and delineated onsite with flagging and signage as required.

Vegetation and topsoil must be stripped first from disturbance areas and stockpiled separately. Any excess soil excavated from the crossing will also be stockpiled separately. All stockpiles will be located above the waterway flow level and away from drainage lines into the waterway.

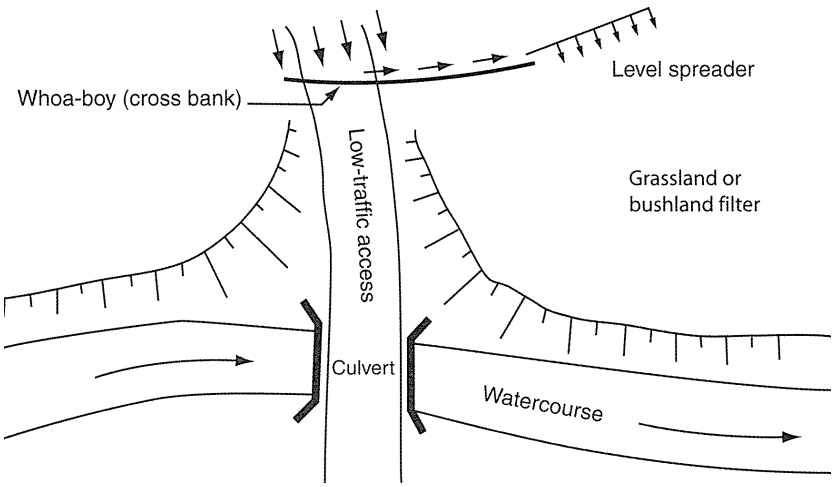
Drainage control on the approach tracks must be installed to prevent stormwater running down the track, unfiltered, into the waterway. Typically, a cross drain (whoa-boy) will be installed to divert stormwater off the track and into adjacent grass or rocks to filter sediments from the runoff.

The exposed banks formed by recessing the approach tracks will be stabilised by spreading topsoil and adding stockpiled vegetation, seed, straw or mulch as soon as practicable following completion of the crossing.

Clean, uncontaminated rock can be placed within ponded water, if required. The rock should be of a suitable size to withstand the velocity of water flow without washing downstream. Plant should operate from outside of any water to prevent spills into the waterway. Additional erosion and sediment controls may also be required such as downstream cut-off trenches or rock armouring to stabilise the bed and banks.



General design requirements for culverts



Use of whoa-boy to protect cross bank of waterway

Figure 4: Culvert pipe design requirements (Sourced from: IECA, 2008)

9.3.4 Dewatering

Prior to dewatering ponded areas or ephemeral creeks, the water will be tested for pH and turbidity. The pH and turbidity levels will determine if the water is suitable for pumping onto vegetated areas and if further controls for sediment are required during dewatering.

Dewatering will be undertaken in accordance with the ***DA-ZH-ST064 Soil and Water Management Standard***. The discharge limits for south central Australia is 6.5-9.0 pH units and 50 NTU for turbidity.

A ***DA-ZH-FM064.1 Water Release Permit*** will be developed and authorised by the Environmental Advisor and Supervisor prior to commencing dewatering. Depending on the suitability of the water, it will be discharged onto vegetated areas to allow for natural filtration or passed through a filtration system such as a filter sock.

Water will not be discharged directly or indirectly to marine waters or inland waters at a volume of more than 100 kl containing suspended solids in concentration exceeding 25mg/l. Turbidity and pH will be tested prior to water discharge regardless of volume. If water quality exceeds the objectives, water will be treated and retested prior to dewatering. It is not anticipated that any Environmental Licences under the EPA will be triggered with the scope of works.

Prior to dewatering, the water will be tested and assessed to determine if the following water quality objectives are achieved.

Water Quality	Methodology	Objective
Turbidity	Turbidity Tube	<50NTU
pH	pH testing Strips	6.5 – 8.5

9.3.5 Management of Specific Soil Types

The general management requirements for the different soil types to minimise secondary impacts, such as production of acidic soils, and prevent erosion and sedimentation are detailed in the Table below.

Table 3: Management of specific soils (Adapted from Witheridge, 2017)

Soil Type	Control Measures
Acid sulphate soils	▪ Minimise soil disturbance. Where disturbance is necessary, minimise the duration of exposure, especially for sandy soils. ▪ Treat exposed soils as required. ▪ Backfill open excavations within 24 hours.
Dispersive soils	▪ Avoid ‘cutting’ drainage channels into dispersive soils. Divert and channel water using flow diversion banks or topsoil windrows. ▪ Avoid the use of check dams in drains containing exposed dispersive soils. ▪ Key to managing dispersive soils is to over-excavate all surfaces by at least 500 mm and then to cap the exposed dispersive soil with non-dispersive soil. Exposed dispersive soils typically only need to be capped with a 200 to 300 mm layer of non-dispersive soil. However, when working in a waterway crossing, an allowance must be made for additional soil disturbance by animals and natural stream erosion.
Saline soils	▪ Minimise soil disturbance. Where disturbance is necessary, prevent mixing of saline and non-saline soils. ▪ Prevent changes to stream flows and water ponding. ▪ Cover saline soils with non-saline soils before protecting the soil and reducing evaporation with mulch, cleared vegetation, reseeding etc.

9.3.6 Vegetation Removal

All disturbance of riparian vegetation will be avoided, wherever possible. In addition, all bed rock and other existing structures (i.e. large rocks, logs) in waterways will be avoided, wherever practicable.

If it is necessary to remove riparian vegetation, then wherever practical this vegetation will be cut at ground level with the roots left in the ground to aid soil stabilisation.

Disturbance and any No-Go areas will be identified and delineated onsite with flagging and signage as required prior to the commencement of works.

9.4 Rehabilitation

Soil stabilisation and rehabilitation of disturbed areas will be implemented as part of the construction of the waterway crossings. Rock will be used to stabilise disturbed areas that are prone to erosion. Coir logs may be incorporated into the toe to protect newly stabilised banks from minor flows as an alternative to rock stabilisation. Topsoil will be spread over disturbed areas and stockpiled vegetation, seed, straw or mulch added as soon as practicable following completion of the crossing.

Throughout the duration of the Project, the waterway crossings will be inspected, and further maintenance and rehabilitation works implemented as required.

10 MANAGEMENT MEASURES

The following table outlines the management measures that will be implemented throughout the project to prevent potential impacts on waterways.

Ref	Mitigation Strategy	Location / Activity	Downer Procedure	Responsibility	Management Measure & Monitoring of Controls
Pre-execution Phase					
SEMP	Ensure a WAA permit is obtained prior to commencing works on waterways.	Planning Phase	WAA permit	Environmental Advisor	A WAA permit will be obtained from Landscape Board prior to commencing any water affecting activity in a waterway (if required). This may include construction of access tracks through ephemeral creek beds, removal of trees and vegetation in or near watercourses or discharge of surface or underground water into a watercourse.
S&S	Develop, implement, monitor and review a documented process or management plan that controls all aspects of the management of soil in accordance with applicable legislation and good practice.	Prior to commencing onsite	This sub-plan	Environmental Advisor	This sub-plan has been developed to include: • a risk assessment process • provisions for soil erosion and sediment control • identification of affected soil volumes, detailing soil reuse and stockpile management
S&S	All personnel must be fully informed of their specific environmental obligations and are suitably trained and competent to undertake works in accordance with ElectraNet and Downer requirements.	Prior to commencing works onsite	Project Induction	Construction Manager Environmental Advisor	Personnel undertaking the works will be competent for their role and tasks. All personnel are required to undertake the Project Induction which includes soil and water management, prior to commencement onsite.
Execution Phase					
SEMP	Ensure works are undertaken in a manner compliant with applicable WAA permit.	Ongoing throughout works	DA-ZH-ST064 Soil and Water Management	Environmental Advisor	A WAA will be submitted and approved prior to commencing works on waterway crossings. All construction works will be undertaken in accordance with the WAA permit and this sub-plan.

11 MONITORING & REPORTING

In addition to the requirements outlined in the Environmental Management Plan, the following table outlines the monitoring and reporting to be undertaken during the pre-execution, execution, and post-execution phases of the project relating to waterways management.

The table below will be updated with any monitoring requirements associated with Licences that may be obtained throughout the duration of the project.

Monitoring & Reporting Requirements	Responsibility	Reference
Pre-execution Phase		
Undertake pre-construction survey to identify sediment and erosion control requirements.	Environmental Advisor	ECS
Execution Phase		
Monthly formal environmental inspections through Environmental Inspection Checklist	Environmental Advisor	S&S
Post-execution Phase		
Post-construction inspections will be undertaken within four weeks of construction completion	Construction Manager	ECS

12 REFERENCES

Hall, Maschmedt and Billing, 2009, The Soils of Southern South Australia. The South Australian Land and Soil Book Series, Volume 1: Geological Survey of South Australia. Department of Water, Land and Biodiversity Conservation, Government of South Australia.

International Erosion Control Association (IECA), 2008, Best Practice Erosion & Sediment Control - for building and construction sites, Australasian Chapter.

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Witheridge, 2017, Erosion & Sediment Control Field Guide for Road Construction. Catchments and Creeks Pty Ltd., Brisbane, Queensland