Appendix N Erosion and Sediment Control Plan

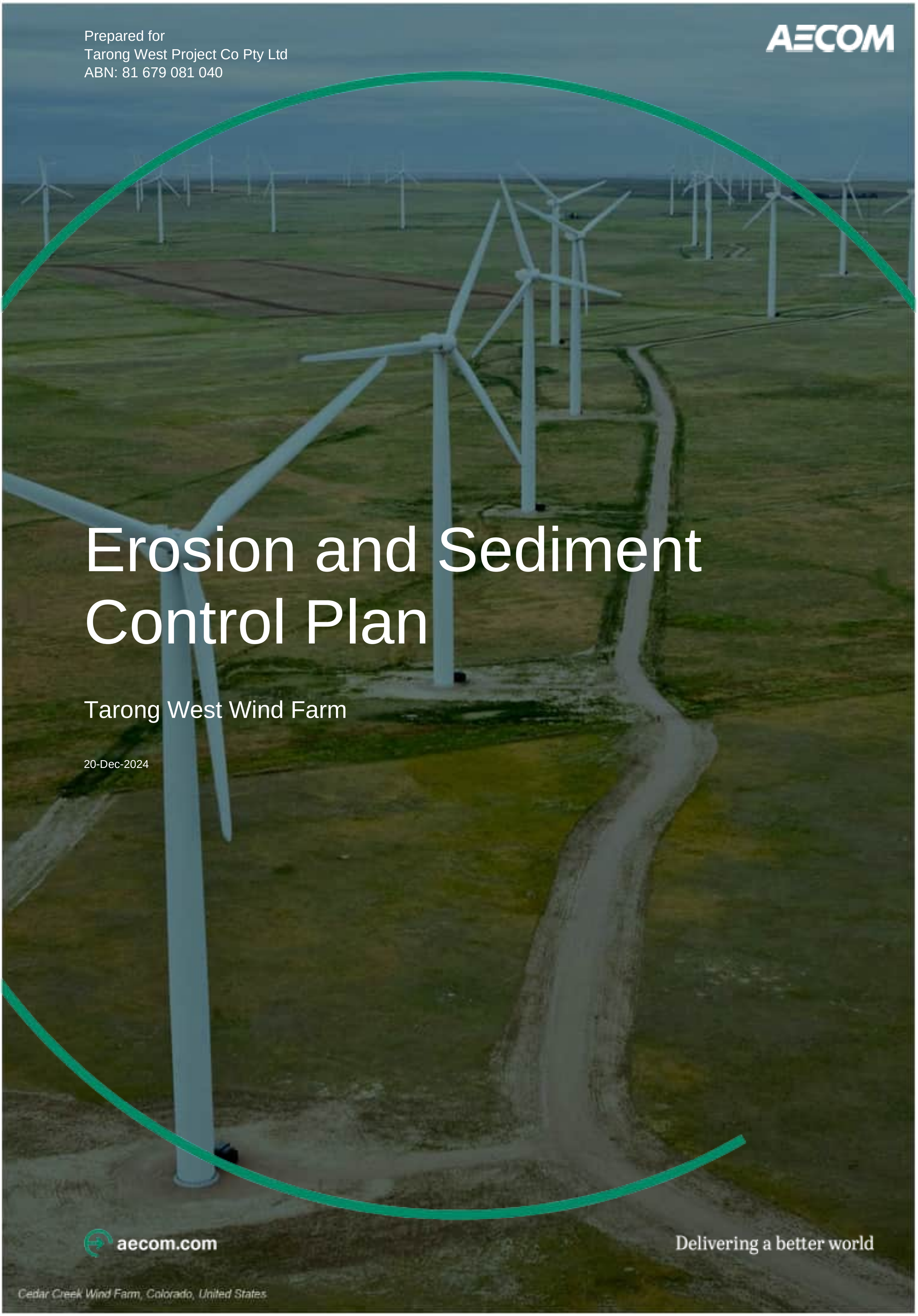
Prepared for
Tarong West Project Co Pty Ltd
ABN: 81 679 081 040

AECOM

Erosion and Sediment Control Plan

Tarong West Wind Farm

20-Dec-2024



Cedar Creek Wind Farm, Colorado, United States

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Erosion and Sediment Control Plan

Tarong West Wind Farm

Client: Tarong West Project Co Pty Ltd

ABN: 81 679 081 040

Prepared by

AECOM Australia Pty Ltd

20-Dec-2024

Job No.: 60704414

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 and ISO45001.

Quality Information

Document Erosion and Sediment Control Plan

Ref 60704414

Date 20-Dec-2024

Originator [redacted]

Checker/s

Verifier/s [redacted]

Revision History

Rev	Revision Date	Details	Approved	
			Name/Position	Signature
A	20-Dec-2024	Final	[redacted]	

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1.0 Introduction

1.1 Overview

This Erosion and Sediment Control Plan (ESCP) has been prepared by AECOM Australia Pty Ltd (AECOM) on behalf of Tarong West Project Co Pty Ltd (the Proponent) for the Tarong West Wind Farm (the Project). The ESCP identifies key risks, environmental sensitivities and controls that should be considered as the Project moves through its design and construction phases.

The Project requires approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the assessment approach requires a Public Environment Report (PER) (EPBC 2023/09643) to be prepared. This ESCP responds to section 7.2.2 of the PER guidelines, which stipulates the requirements for an ESCP outlining avoidance, mitigation and monitoring of sediment loads.

The Project proposes the development of up to 97 wind turbines and associated infrastructure to be developed west of Kingaroy, Queensland, within the South Burnett Regional Council Local Government Area. The Project will be established over freehold rural properties, State land and reserves, totalling approximately 17,500 ha (Project Site), with a planning corridor footprint of up to 1,953 ha and a maximum clearing and construction footprint of 872 ha within the corridor.

The Project infrastructure is comprised of linear, non-linear and temporary infrastructure. The overall footprint of the infrastructure will be determined by the final wind farm design including the design of access tracks, underground cabling and overhead lines. Vegetation clearing, excavation and working within proximity to watercourses will be required to establish the project.

The EPBC Act protects a multitude of species and threatened ecological communities (i.e. protected matters). Inadequate erosion and sediment control can lead to irreversible harm on these protected matters. Hence the Proponent must meet its requirements under relevant legislation and planning guidelines by demonstrating that it is feasible and practicable to manage potential sediment, and erosion impacts during all site activities.

This ESCP is provided to demonstrate the Proponent’s commitment to managing erosion and sediment risks at the Project Site and addressing all regulatory and planning requirements.

1.2 Scope

The Best Practice Erosion and Sediment Control (BPESC) (AustIECA, 2008) outlines the planning process for Erosion and Sediment Control Planning. The overall planning process is shown in Figure 1.

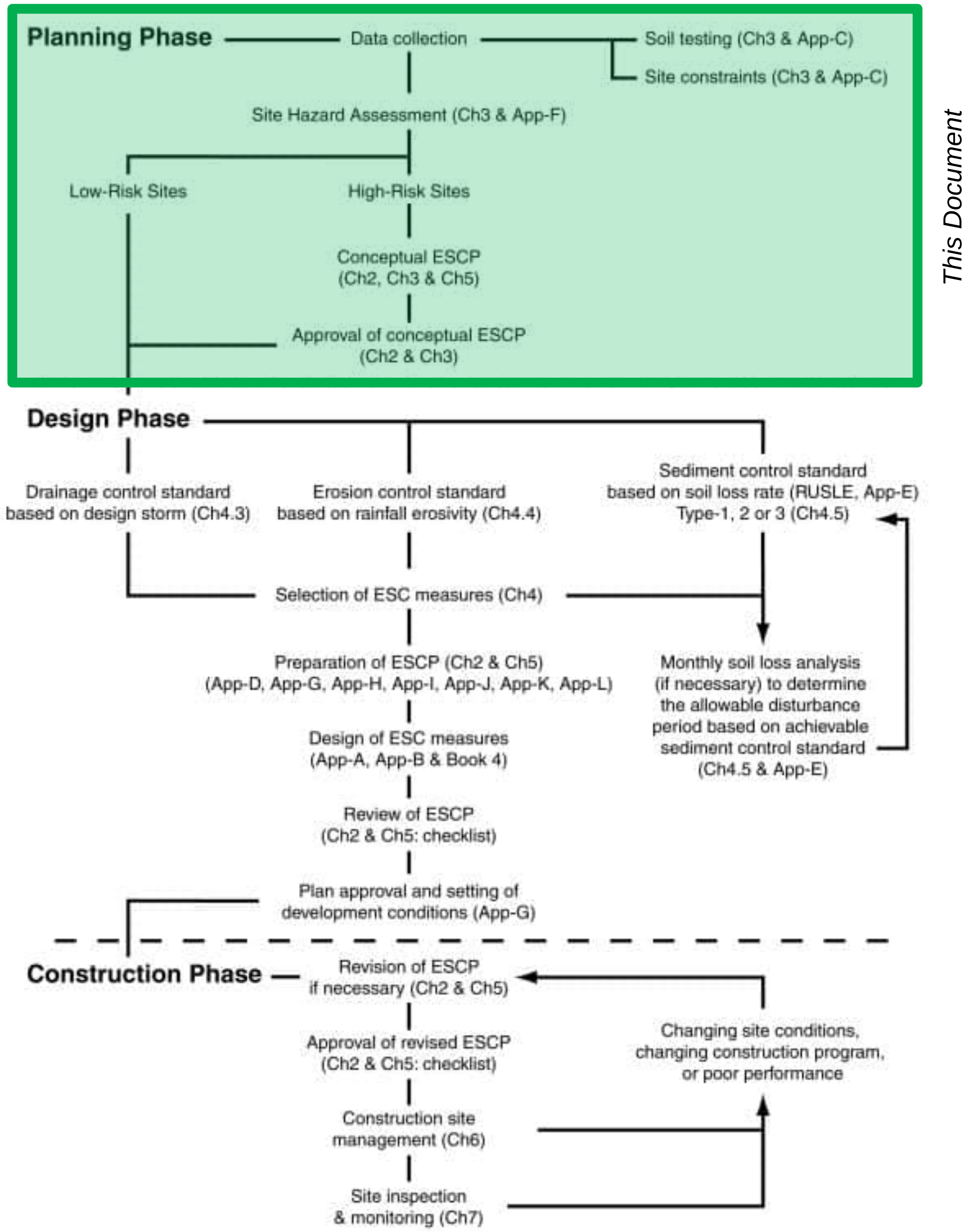


Figure 1 IECA Planning Process

The scope of this document is the ESCP shown in the Planning Phase portion of the diagram.

A ESCP is generally not as detailed as a final ESCP as they are typically prepared before key site layout, design and construction methodology information is finalised. It does not include detailed engineering design of controls and structures, and it does not provide plans showing the layout of all erosion controls across the Project Site. As noted, in Section 1.1, these will be developed during detailed design by the Proponent and their selected EPC contractor.

1.3 Erosion and Sediment Control Framework

1.3.1 Regulatory Framework and Relevant Guidelines

The following regulatory framework and relevant guidelines are applicable to erosion and sediment control for the Project:

- International Erosion Control Association (IECA) Best Practice Erosion and Sediment Control Books 1 – 8 (2008).
- Section 7.2.2 Management plans – information required of the Guidelines for Public Environment Report (PER) (DCCEEW, 2023)
- Section 7.1.7 Avoidance, mitigation and management – information required of the Guidelines for Public Environment Report (PER) (DCCEEW, 2023) (refer Table 1)

Table 1 Section 7.1.7 - Avoidance, mitigation, and management of the PER Guidelines

Request	Information Required
Provide discussion on the measures employed to avoid, minimise, and mitigate impacts to MNES from short- and long-term erosion and sedimentation, including but not limited to:	• identification of potentially affected wetlands, waterways, tributaries and drainage lines • scheduling of activities (e.g., avoiding construction during wet periods) • implementation of best-practice erosion and sediment control measures, including the details of the type and location of erosion and sediment control devices to be installed, based on the anticipated soil, weather and construction conditions. • minimising the extent and duration of soil disturbance • prompt stabilisation of disturbed areas • controlling water movement through the proposed action area, including the diversion of clean flows around disturbed areas • the development of performance criteria • regular monitoring during construction, operation and decommissioning to ensure performance criteria are being maintained, including a full inspection of erosion and sediment controls following a heavy rainfall event (>25 mm in 24 hours) to identify and undertake any necessary rectification works.

1.4 Report Structure

The structure and content of this ESCP is designed to satisfy the requirements of the IECA Best Practice Erosion and Sediment Control content within the Tarong West Wind Farm (EPBC2023/09643) PER Guidelines (DCCEEW, 2023).

Table 2 Report Structure

Section	Description
Section 1 – Introduction	Introduces the scope and purpose of the plan.
Section 2 – Erosion and Sediment Control Principles	Outlines general principles of erosion and sediment control.
Section 3 – Existing Environment	Describes the natural setting of the project
Section 4 – Project Activities	Describes the proposed activities, relevant to erosion and sediment control planning
Section 5 – Identified Risks and Controls	Identifies key risks and controls for future erosion and sediment control planning.

Section	Description
Section 6 – Inspections and Monitoring	Conceptual development of inspection and monitoring requirements.
Section 7 – Conclusions and Recommendations	Closes the plan.

2.0 Erosion and Sediment Control Principles

2.1 Overview

Preventing unacceptable levels of sediments and contaminants from leaving the Project Site and entering the receiving waters is one of the most important functions of sediment and erosion control. As per IECA (2008), the two primary control methods of sediment and erosion control are as follows:

- Erosion control – prevention or minimisation of soil erosion (from dispersive, non-dispersive or competent material) caused by rain drop impact, or water flow.
- Sediment control – trapping or retention of sediment either moving along the land surface, contained within runoff (i.e. from up-slope erosion) or from windborne particles.

Erosion control and sediment control are two very different activities. Erosion control measures concentrate on preventing or minimising soil erosion. Sediment control measures are purposed to mitigate erosion and sediment mobilisation.

2.2 Erosion

Soil erosion is the process through which the effects of wind, water or physical action displace soil particles, causing them to be transported.

The most common forms of water erosion are as follows:

- splash erosion is the spattering of soil particles cause by the impact of raindrops on soil
- sheet erosion is the uniform removal of soil in thin layers from sloping land
- rill erosion is the removal of soil by water concentrated in small but well-defined channels
- gully erosion produces channels deeper and larger than rills, generally greater than 300 mm deep.

Another form of erosion is dusting, whereby soil particles are mobilised by wind action and/or vehicles. Dusting can be exacerbated by conditions such as:

- vegetation removal (clearing)
- topsoil and/or subsoil stripping
- dry and hot climatic conditions
- vehicle movements.

2.3 Sediment Control

The primary function of sediment control measures is to trap the coarser sediment fraction. Sediment basins and some filtration systems used during dewatering operations are possibly the only sediment control techniques that have any significant ability to trap finer sediment particles such as silts or clays. Due to the difficulty of trapping these finer sediments, priority should be given to the use of effective erosion control measures wherever practical.

3.0 Existing Environment

3.1 Climatic Conditions

Based on the Köppen Classification system, the climate for the Project Site is located within the subtropical zone (moderately dry winter).

The rainfall is seasonally distributed with a distinct wet season typically present from November through April and a drier season extending from May through October. The median rainfall received during the summer wet season is approximately 400 mm; however, the wet season rainfall is subject to a high degree of variability. Rainfall data is available from the Bureau of Meteorology (BoM) weather station at Warragai rainfall station (040246), located approximately 1.5 km west of the north-western boundary of the Project Area and at an elevation of 444 m AHD.

The closest open temperature recording station for the locality is located approximately 35 km east at Kingaroy Airport Station (Bureau of Meteorology [BoM] station 040922). The mean daily maximum summer temperatures are approximately 30°C and approximately 20°C during winter.

3.2 Hydrology and Drainage

The Project Site incorporates six main catchments which include the Boyne River and its main tributaries which include Mannuem Creek, Middle Creek, Jumma Creek, Boughyard Creek and Ironpot Creek (refer Figure 2). The runoff distribution for the catchments is complicated due to the number of contributing catchments, consequently all rainfall within the Project Site will enter the Boyne River system.

The Middle Creek catchment is contained within the Project Site to near entirety and therefore all run-off within this catchment is generated within Project Area before entering the Boyne River further downstream. Boughyard Creek, Jumma Creek and Ironpot Creek all have a number of contributing tributaries and hence have larger catchments. As a result, portions of these catchments lie within the Project Site before entering the Boyne River system.

The Boyne River system is a major tributary of the Burnett basin which has an approximate area of 2,496 km^2 (DES, 2013, formally DEHP) and makes up approximately 8 % of the 32,220 km^2 Burnett Basin.

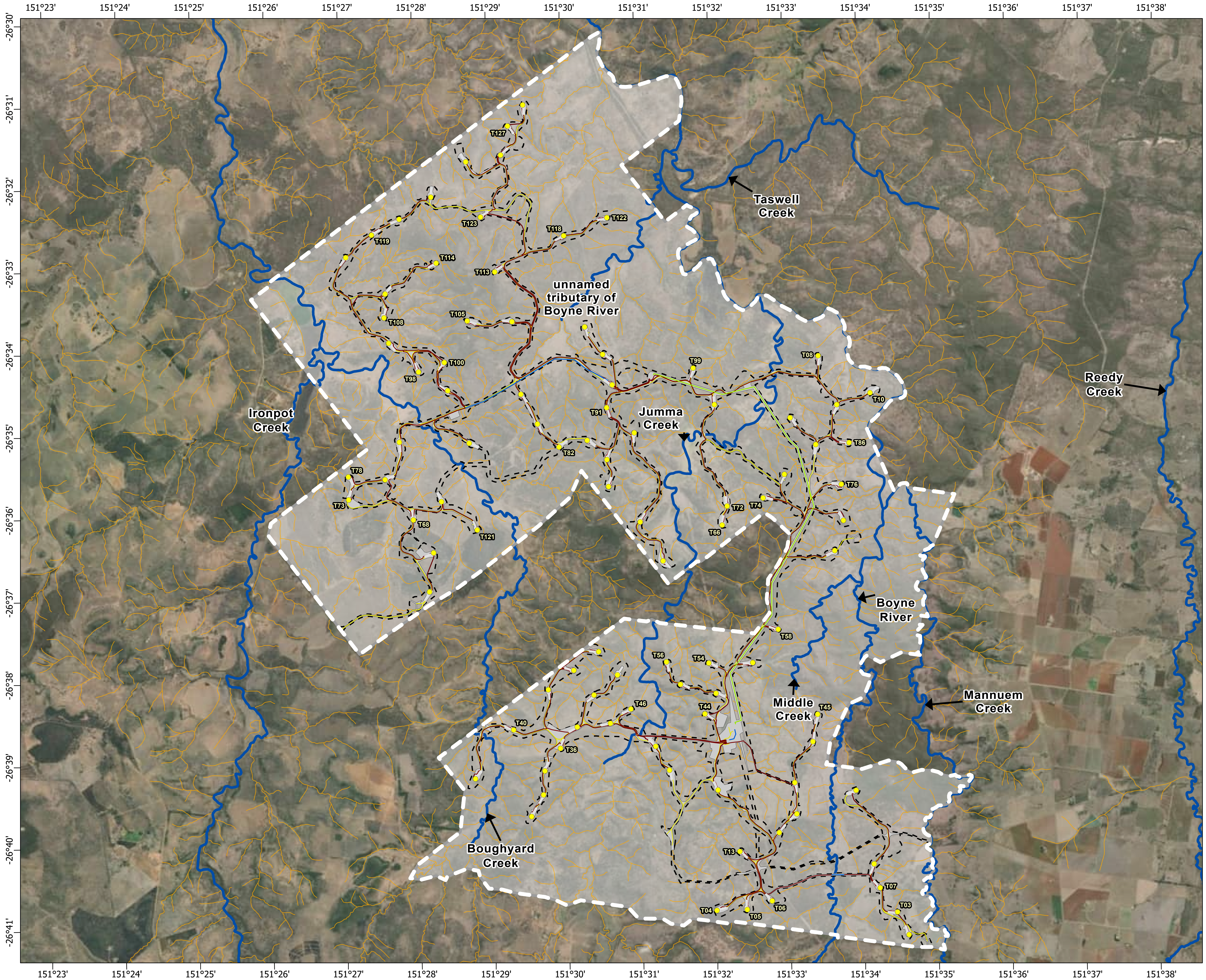
As the Project Site contains the Boyne River watercourse and is contributed to by its upstream tributaries it is considered that drainage within the footprint is moderate in terms of width. Channels are well-defined with low to moderate gradients ranging from 0.2 to 1.3 % grade. The drainage features are considered moderate across the planning corridor with approximately 50% of the streams within the total catchment having a stream order of 1 with the remaining waterlines having a stream order of 2 or 3 (based upon the Horton Stream Order approach).

Geotechnical investigations have been undertaken across the Project area and throughout these investigations number of creek banks were observed to have been eroded by existing water flow. Emerson class testing indicates that the site soils are not dispersive. Risk is to be controlled through appropriate design and construction through an approved erosion and sediment control plan (ESCP) to reduce the flow velocity of surface water.

A review of publicly available information on the Queensland Globe database shows fifteen (15) registered water bores located within the project footprint. Groundwater levels of between 5 to 10m below ground level were commonly encountered. Further long-term monitoring of water levels is recommended to, effectively, eliminate the risk that drainage measures are required to reduce the potential for uplift hydrostatic forces on wind turbine foundations.

Turbine foundations are preferentially positioned in areas of elevation such as ridgelines which results in a reduced risk of floating foundations and dewatering. It is noted that there are currently groundwater monitors located in bores across the whole Project extent and the groundwater monitoring is in progress.

Access tracks across the project are typically placed on ridgelines, which will reduce possible risk of erosion.



km
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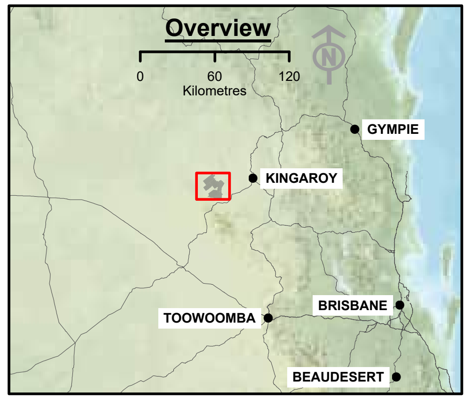
Legend

- WTG
- Watercourse Identification Map Watercourses
- Watercourse Identification Map Drainage Features
- Turbine hardstand
- Cables - overhead 33kV
- Cables - overhead 275kV
- Cables - underground
- Access track
- Site Boundary
- Clearing footprint
- Planning corridor



Spatial Reference: GDA 1994 MGA Zone 56
Datum: GDA 1994
Units: Metre

TARONG WEST WIND FARM
PUBLIC ENVIRONMENT REPORT (2024)

Hydrology and Drainage

Figure 2

It should be expected that groundwater levels will vary seasonally, following periods of heavy rainfall and influenced by overland flow paths.

3.3 Soils

The soils spatial data available from the Queensland Government (Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development) is mapped on Figure 3. The southern and western sections of the site are mapped as vertosols, with ferrosols mapped in the central-eastern portion, changing to sodosols for the northern-most section.

- Vertosols: a grey, shrink-swell, cracking clay soil with a self-mulching surface and a gypsic horizon in the subsoil. Vertosols have moderate to low permeability, depending on surface condition and water content. Erosion hazard is moderate on disturbed slopes. The soil type is usually extremely saline below 0.5 m and strongly acid at depth.
- Ferrosols: well-drained soils with red or yellow-brown colour with clay-loam to clay textures associated with areas of former volcanic activity. Ferrosol topsoils typically contain 35-50% clay, with kaolinite the dominant clay mineral, and high iron content. They have a relatively stable structure and used for intensive crop production in the Kingaroy region.
- Sodosols: a texture-contrast soil that is strongly sodic and not strongly acid in the upper 0.2 m of the red clayey B horizon, the lower part of which is calcareous. Sodosols have low to very low permeability in the sodic B horizon. Erosion hazard is high, due to a highly dispersive layer below 0.15m. The soil type has high to very high salinity below 0.30 m.

Based on the results of the Proponent's geotechnical works undertaken to date, materials classified as Topsoil were typically described as clayey sand, clay or sandy clay and were generally encountered up to 0.2-0.3m depth below the existing surface level.

The regional mapping of soils suggest that a variety of soil conditions could be encountered across the distributed project development which is also consistent with the results of the geotechnical works.. TWWF site ground conditions are highly variable due to not only variations in the regional geology but significant variations in the degree of weathering. Whilst some outcropping was observed in places, the test pitting and drilling works generally encountered soil strength or extremely weathered rock materials in the upper few metres of the subsurface profile.

The primary soils risks associated with the project are expected to be:

- Dispersive soils (Sodosols) may require specific erosion and sediment control measures to be instated, and specific construction or handing methods may need to be used to manage potential impacts. However, based on the Geotechnical Report, the Emerson class testing indicates that the dominant site soils are not dispersive.
- Acidic soil and saline soils (such as the Vertosols) may need to be treated with soil ameliorants if they are disturbed. However, based on the Geotechnical Report there are no acid sulfate soils (ASS) mapped in the study area, as per the Guidelines for the Use of Acid Sulfate Soil Risk Maps (DLWC 1998).

Additional site-specific findings have been included in the Geotechnical Report and are listed below:

- Predominantly soil cover was observed at the surface, with some outcropping present at topographical high spots with scattered rock fragments encountered throughout. An excavation to the west of the proposed Powerlink substation exposed extremely weathered granitic soils.
- Based on the guidance of the AS2870-2011 and the reactivity of the soils encountered during the geotechnical investigation, the site is classified as 'M' being moderately reactive, which may experience moderate ground movements from moisture change.

More details on soil risks and controls are described in Section 5.0

km
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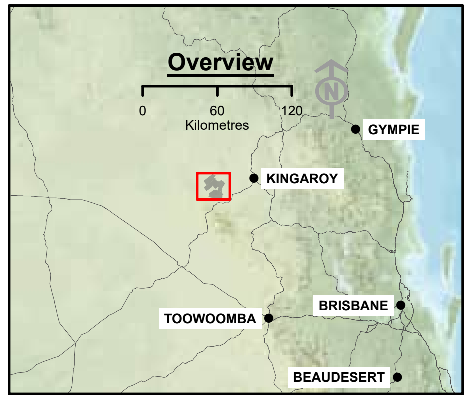
2
3

Legend

- WTG
- Mast (temporary)
- Mast (permanent)
- Cables - overhead 33kV
- Cables - overhead 275kV
- Cables - underground
- Existing Powerlink 275kV Overhead Line
- Turbine hardstand
- Access track
- Contours (25m interval)
- Site Boundary
- Planning corridor
- Clearing footprint
- Batch Plant
- Borrow pit
- Laydown
- Operations and maintenance building
- Site compound
- Substation
- Switching station
- Helipad

Soil Classification Orders (indicative)

- Ferrosols
- Sodosols
- Vertosols



Spatial Reference: GDA 1994 MGA Zone 56
Datum: GDA 1994
Units: Metre

TARONG WEST WIND FARM
PUBLIC ENVIRONMENT REPORT

EROSION AND SEDIMENT CONTROL PLAN

Soils and Terrain

Figure 3

3.4 Surface Water Quality

No direct water quality measurements or qualitative water quality information is available for any watercourses that reside within the Project Site. The nearest publicly available water quality data is from the Boyne River DNRME stream gauge at Carters (GS 136315A). Although this gauge is located approximately 35 km downstream of the Project boundary there is likely to be some similarities for the upstream water quality. A summary of the water quality characteristics at Boyne River at Carters (GS 136315A) is presented in Table 3.

Table 3 Water Quality Data for DNRME Stream Gauge Boyne River at Carters (136315A)

Water Quality Data	Units	Maximum Result	Median Result	Minimum Result
Nitrate as NO_3	mg/L	12	1	0
Total Nitrogen	mg/L	1.8	0.585	0.4
Total Phosphorus	mg/L	0.4928	0.0825	0.049
Dissolved Oxygen	mg/L	9.8	6.5	5.4
Turbidity	NTU	338	14	1
Suspended Solids	mg/L	2500	20	2
pH		8.5	7.8	6.99
Salinity	µS/cm	1670	1050	150
Sulphate	mg/L	23	7	1.4

3.5 Land Use and Infrastructure

Cleared land within the Project Site is predominantly used for grazing. Built infrastructure is generally limited to those associated with the host-landowners' agricultural properties, including homesteads and sheds.

The Project Site is traversed in the north by state-controlled Kingaroy-Burrandowan Road, and dissected by several local roads, including Ironpot Road, Jumma Road, Boyne River Road and Greystonlea-Jumma Road.

There is an existing transmission line easement that traverse the Project Site from north to south.

4.0 Project Activities

This section provides an overview of project lifecycle activities with potential to generate impacts to soil and water quality.

4.1 Project Elements

The Project will involve the construction and operation of a wind farm consisting of up to 97 wind turbines with an overall rated capacity of up to 436.5 megawatts (MW) of clean and renewable electricity to supply to the National Electricity Market (NEM). The Project will be established over freehold rural properties, State land and reserves, totalling approximately 17,500 ha (Project Site), with a planning corridor of approximately 1,953 ha and a maximum clearing and construction footprint of 872 ha within the corridor. The planning corridor includes the proposed wind turbines, access tracks, underground cables, overhead lines and other associated infrastructure. Except for where there are turbine towers and associated infrastructure, the existing land will continue to be used for rural purposes including grazing livestock and cropping.

Further specific design of project infrastructure, access tracks and watercourse crossing infrastructure will be undertaken by the Proponent and their construction contractor within detailed design. This will be carried out with consideration to the information outlined in sections 1.3 and 2.0.

Erosion and sediment control features have been described in Section 5.2 of this report.

4.2 Construction

Construction activities that could influence levels of erosion and sediment loss include:

- access track formation, traffic use and maintenance (e.g. compaction and dust generation).
- hardstand pavement construction of crane pads, blade laydown areas and boom pads.
- watercourse crossing structures, e.g. bridges, culverts and level bed crossings.
- vegetation clearing and grubbing.
- earthworks including bulk movements, grading and levelling.
- establishment and management of stockpiles of uncompacted soils and vegetation.
- establishment of construction sites (substation, laydown areas, tower foundations).
- trenching, including excavation, filling, and/or directional drilling.
- site stabilisation and rehabilitation.

4.3 Operation and Maintenance

Operation and maintenance activities that could influence levels of erosion and sediment loss include:

- road traffic use and road maintenance (e.g. compaction and dust generation).
- stormwater flows from hardstand and disturbed areas.

5.0 Identified Risks and Controls

An assessment of the potential for erosion hazards associated with the proposed development has been undertaken. This has considered:

1. The general spatial and temporal assessment of the erosion hazards associated with the proposed development.
2. The potential risks associated with the hazards.
3. The likely control measures and design criteria that are to be applied to mitigate the identified risks.

A summary of the assessment is provided in Section 5.1.6, including the likely controls, which will be amended or confirmed in the detailed ESCP.

To support a planned approach to erosion and sediment control, proposed project activities have been categorised:

- Access Tracks:
  - Network of access tracks to facilitate construction and ongoing operation and maintenance of the turbines.
- Turbine Hardstand Areas:
  - Footing and hardstand area associated with each turbine.
- Infrastructure Areas:
  - Substations, temporary laydown areas, construction compound, operation and maintenance facilities
- Trenching and Overhead Power Lines:
  - Associated with cabling and transmission works.

It is noted that the area of disturbance for the Project activities is generally small and distributed, except for infrastructure areas.

5.1 Site Hazard Assessment

5.1.1 Soil Loss Estimation

As part of the erosion and sediment control planning process, preliminary calculations have been developed to estimate the potential rate of soil loss over site infrastructure areas. The calculations are preliminary due to detailed design of turbine hardstand and infrastructure areas being ongoing. Based on the geotechnical investigations undertaken to date, TWWF site ground conditions are highly variable due to variations in the regional geology and significant variations in the degree of weathering. Therefore, all soil types: Vertosols, Ferrosols and Sodosols have been assessed in the below calculations.

The calculations were developed utilising the RUSLE (Revised Universal Soil Loss Equation) equation, as described in AustIECA (2008). The RUSLE equation is:

$$A = R \times K \times LS \times C \times P$$

Where
A = Annual soil loss due to erosion (t/ha/yr)
R = rainfall erosivity factor
K = Soil erodibility factor
LS = topographic factor derived from slope length and slope gradient
C = cover and management factor
P = erosion control practice factor

R Factor parameters were adopted from AustIECA (2008) as listed for the location of Toowoomba, and are listed in Table 4.

Table 4 Adopted R-Factor

Month	R-Factor
Jan	504
Feb	414
Mar	285
Apr	161
May	127
Jun	100
Jul	89.7
Aug	58.1
Sep	79.2
Oct	166
Nov	248
Dec	409
Annual	2642

Based on the geotechnical works undertaken to date, materials classified as Topsoil were typically described as clayey sand, clay or sandy clay and were generally encountered up to 0.2-0.3m depth below the existing surface level, therefore the potentially present surface soil types of Vertosols, Ferrosols and Sodosols (refer Section 3.2) were utilised. Based on the soil texture class K Factor values were adopted (refer Table 5).

Table 5 Preliminary K Factors

Soil Type	Soil Texture Class	K Factor
Vertosols	Medium Clay	0.015
Ferrosols	Sandy Clay	0.018
Sodosols	Light Clay Loam	0.025

LS Factors describe the length and gradient of disturbed areas. Based on the available layout of turbine hardstand and infrastructure areas, included in the Appendix A (Crane Pad plans), the hardstand pads gradients are 1%. LS factors were adopted as listed in Table 6.

Access tracks or roads and the associated longitudinal drainage were not considered for this site hazard assessment as they present a very low erosion risk due to the absence of any upstream catchment, the very short flow lengths, the engineered stabilised surface and the frequency of drainage controls. These controls are discussed in more detail in Section 5.2.3.1.

Table 6 Preliminary LS Factors

Type	Assumed Flow Length	Gradient	LS Factor
Turbine	60 m	1%	0.18
Infrastructure Area	200 m	1%	0.24

C Factors describe the extent of cover (such as canopies) which reduce the impact erosivity of rainfall. C Factors were adopted as 1, representing no significant cover (refer Table 7).

Table 7 Preliminary C Factors

Type	C Factor
Turbine Hardstands	1
Infrastructure Areas	1

P Factors describe the surface conditions expected within disturbance areas. The default construction site condition was adopted as listed in Table 8.

Table 8 Preliminary P Factors

Surface Condition	P-Factor
Compacted and smooth (default construction phase condition)	1.3

The outcomes of the RUSLE equation development, for the potentially present soils and infrastructure types are listed in Table 9.

Table 9 RUSLE Estimates

Soil Type	Infrastructure Type	Annual Soil Loss Estimate (tonnes/ha/yr)
Vertosols	Turbine Hardstand Area	9.27
Ferrosols		11.13
Sodosols		15.46
Vertosols	Infrastructure Area	12.36
Ferrosols		14.84
Sodosols		20.61

Overall, the annual soil loss estimates (t/ha/yr) are minor, principally influenced by:

- low adopted gradients and flow distances in the Project design (LS Factors)
- moderate rainfall intensity at the site location

AustIECA (2008) provides an erosion hazard assessment table (Soil Loss Class), to inform the magnitude of erosion hazard which is reproduced in Table 10.

Table 10 Soil Loss Class

Erosion Hazard	Soil loss (tonnes/ha/year)	Soil Loss Class
Very Low	0 - 150	1
Low	151 - 225	2
Low to Moderate	226 - 350	3
Moderate	351 - 500	4
High	501 - 750	5
Very High	751 - 1500	6

Erosion Hazard	Soil loss (tonnes/ha/year)	Soil Loss Class
Extremely High	>1501	7

The preliminary loss estimates suggest the erosion hazard for the Turbine and Infrastructure areas is generally Very Low (Soil Loss Class 1).

These estimates, whilst conceptually derived, suggest that erosion risks are of a minor scale, requiring common-sense application of ESC control measures. In general, a requirement for instatement of sediment basins and pond systems is not currently expected.

Notwithstanding, the erosion hazard of the site infrastructure should be revisited when the following information is available:

- detailed design of infrastructure areas

A key element of risk to be considered is the extent to which Sodosol soil types, or other dispersive soil types, are expected to be disturbed, as the erosion hazard of these soils can be significant. Dispersive soils can require specific erosion and sediment control planning.

However as stated in the Geotechnical Report, the Emerson class testing indicated that the dominant site soils are not dispersive.

5.1.2 Access Tracks

Access tracks have the potential to cause erosion and sediment issues during both the construction and operation phase.

The proposed access tracks traverse minor gullies, as well as more significant drainage paths. The tracks also traverse watercourses. However, these are outside the scope of this erosion and sediment control plan as site-specific detailed design information is required.

Typical details for the access tracks are attached in Appendix A.

Currently, a layout of the proposed access tracks has been developed, however a detailed design has not been completed. Accordingly, the precise elevations of the access track crest, and locations of cut or fill excavation are not yet known.

Where the access tracks are elevated compared to the existing ground level, upstream flow paths are likely to be interrupted by the access track. Conversely, any locations of access track formed in excavation are likely to prevent flows from conveying further downstream.

The key activities associated with the proposed access tracks are as follows:

- vegetation removal (clearing)
- topsoil stripping and sub-excavation
- earthworks (track construction)
- vehicles (construction plant and operational use)

The key risks associated with the activities required for access track construction are as follows:

Table 11 Access Tracks - Key ESC Risks

Risk	Description	Applicability	
		Construction	Operational
Mobilisation of soil	Mobilisation of soil from cleared and/or sub-excavated footprint of access tracks. Mobilisation of soil may occur in dry (dusting) or wet conditions (erosion).	Yes	No

Risk	Description	Applicability	
		Construction	Operational
Disruption of drainage paths	The construction of access tracks has the potential to alter the existing drainage path structures, resulting in changed hydraulic conditions during runoff events. Where a drainage path is obstructed, reduced runoff may result in loss of vegetation and subsequent erosion or gullying. Where a drainage path receives additional catchment areas, increased runoff may result in hydraulic scour.	Yes	Yes
Hydraulic scour	Where drainage features are instated (such as culvert crossings or sag points), hydraulic scour may occur.	Yes	Yes
Dusting of access track materials	Wind induced mobilisation of access track materials	Yes	Yes

The primary ESC risks are posed during the construction phase, during clearing and earthworks. After construction, a residual risk relates to the ongoing maintenance and management of the road and associated stormwater drainage system.

It is noted that overall, the density of disturbance posed by the proposed access track system is low, however the ESC risk is distributed over a wide area.

5.1.3 Turbine Hardstand Areas

The key activities associated with the proposed Turbine Hardstand Areas are as follows:

- vegetation removal (clearing)
- topsoil stripping and sub-excavation
- earthworks (hardstand)
- construction (turbine)
- vehicles (construction plant)

The key risks associated with the activities required for Turbine Hardstand areas are listed in Table 12:

Table 12 Turbine Hardstand Areas - Key ESC Risks

Risk	Description	Applicability	
		Construction	Operational
Mobilisation of soil	Mobilisation of soil from cleared and/or sub-excavated footprint of access tracks. Mobilisation of soil may occur in dry (dusting) or wet conditions (erosion).	Yes	No
Hydraulic scour	Concentrated flow may result in hydraulic scour of soil and other materials where: • Upstream flows are diverted around hardstand areas (as local drains) • Runoff generated over hardstand areas are discharged downstream	Yes	Yes
Dusting of hardstand materials	Wind induced mobilisation of hardstand materials	Yes	Yes

Care must be taken during excavation for the required hardstand footing to avoid loosening or disturbing the founding materials. Over excavation or disturbance of the base by disturbing blocks of rock in the excavation base should be avoided and an excavation methodology developed to avoid disturbance of the base. Disturbed material below the base of the excavation will likely require removal and the excavation base reinstated. Treatment for disturbed material will be included in foundation design. Typical treatment includes dental concrete for rock based foundations and mechanical compaction for soil based foundations. Compaction or a blinding layer of concrete, depending on foundation type, should be placed over the prepared foundation as soon as practicable to reduce the potential for loosening of the surface.

The primary ESC risks are posed during the construction phase, during clearing and earthworks. After construction, a residual risk relates to the ongoing maintenance and management of the hardstand turbine areas.

Overall, the area of each turbine hardstand (approximately 3200m^2 based on the preliminary Crane Pad layout in Appendix A) is relatively small to the whole project area but distributed. Additionally, the location of hardstand areas is typically at elevation, proximate to topographic rises (ridgelines), which reduces the erosion risk posed by runoff events due to lack of large concentrated flowpaths.

5.1.4 Infrastructure Areas

The infrastructure areas will contain temporary and long-term infrastructure associated with the project, such as construction lay-down areas, substations and operation and maintenance areas.

The key activities associated with the proposed infrastructure areas are as follows:

- vegetation removal (clearing)
- topsoil stripping and sub-excavation
- earthworks (hardstand) including areas of cut and fill
- construction (offices, substations, battery energy storage system, etc)
- vehicles (construction plant).

The key risks associated with the activities required for Turbine Hardstand areas listed in Table 13:

Table 13 Infrastructure Areas - Key ESC Risks

Risk	Description	Applicability	
		Construction	Operational
Mobilisation of soil	Mobilisation of soil from cleared and/or sub-excavated footprint of access tracks. Mobilisation of soil may occur in dry (dusting) or wet conditions (erosion).	Yes	No
Hydraulic scour	Concentrated flow may result in hydraulic scour of soil and other materials where: • Upstream flows are diverted around infrastructure areas such as trenching and overhead power lines (as local drains) • Runoff generated over hardstand areas are discharged downstream	Yes	Yes
Dusting of hardstand materials	Wind induced mobilisation of infrastructure materials	Yes	Yes

5.1.5 Trenching and Overhead Power Lines

Trenching involves the excavation of alignments for the purpose of installation of services, followed by fill works to re-establish natural ground levels. Construction of overhead power lines may include clearing of footings, pad construction and tower construction and installation.

The key activities associated with the proposed trenching are as follows:

- vegetation removal (clearing)
- topsoil stripping
- excavation, trenching and installation of services
- earthworks (fill)

The key risks associated with the activities required for trenching areas are listed in Table 14:

Table 14 Trenching and overhead powerline areas - Key ESC Risks

Risk	Description	Applicability	
		Construction	Operational
Mobilisation of soil	Mobilisation of soil from cleared and/or sub-excavated footprint of trenching alignments. Mobilisation of soil may occur in dry (dusting) or wet conditions (erosion).	Yes	No
Hydraulic scour	Concentrated flow may result in hydraulic scour of soil and other materials where: • Upstream flows are diverted around infrastructure areas such as trenching and overhead power lines (as local drainage) • Runoff generated over infrastructure areas are discharged downstream	Yes	Yes

5.1.6 Summary

The proposed project activities have been assessed using RUSLE calculations, with key activities and ESC risks associated with the project infrastructure assessed.

Overall, the anticipated erosion and sediment risks associated with the project are considered very low to low, in association with the generally small footprint areas of disturbance. The most significant risks are associated with the proposed access tracks, which have the potential to impact existing drainage paths and waterways. The Project is undertaking all necessary approval application processes to ensure all waterway crossings are compliant with relevant guidelines and legislation. The design protection against erosion and overtopping is to be included in the detailed design of each crossing for which approvals are required.

5.2 Control Measures

5.2.1 Sequencing/scheduling

A key mitigation method for erosion and sediment risks is the proper sequencing of ESC during the planning, design and construction phases. Correct sequencing of ESC activities ensures that appropriate mitigations are in place prior to activities occurring that pose erosion and sediment risks to the downstream receiving environment. The sequence of activities will most likely comprise:

- Prior to Design Phase:

  Site soil sampling and testing has been conducted in the geotechnical works undertaken to date.

- Design Phase:

  - Progression of the detailed design to refine and finalise the layout of proposed infrastructure and temporary construction works, and further site soils investigations, hydraulic sizing and design of the stormwater drainage system will be completed.
  - ESC considerations may be integrated into the drainage design, which may be reflected in the ESCP. The design may consider:
    - temporary control measures (to mitigate erosion during the construction phase)
    - permanent control measures (to mitigate erosion throughout operation of the completed project).
  - The ESCP may be revised to comprise Contractor's ESCP specific to the design and analysed soil conditions.
  - Key construction personnel will be trained in the application and execution of the 'for construction' ESCP.
- Construction Phase:
  - Prior to significant construction works:
    - temporary or permanent diversion drains may be installed to prevent runoff from upstream catchments eroding the exposed soils
    - sediment control features may be installed at locations downgradient of earthworks
  - During construction:
    - preserve existing vegetation at planned disturbance areas for as long as possible
    - routine monitoring and inspection of construction areas and downstream receiving drainage paths and waterways will be undertaken
    - depending on weather, dust suppression activities may be undertaken
    - regular clean out and maintenance of ESC features may occur, including removal of sediment from sediment control features.
    - It is likely that regular maintenance and repairs will be required along the unsealed access roads during the project construction phase when heavy construction traffic is expected to degrade the pavement surface.
    - Batter slopes to be 1V:3H when in Fill, 1V:2H when in Cut and max 1V:4H in trafficable areas. Limited to cut and fills with a total height of around 3m based on the Geotechnical Report's recommendations. For cuts/fills greater than 3m in height, it is recommended that location specific advice is sought during detailed design to ensure the advice remains appropriate.
    - Batter slopes or benching will be required during excavation of footings and trenches generally for safety reasons. Permanent batter slopes may be required elsewhere on site for access track construction, hardstand or substation platforms. Recommended batter slopes in rock strength materials will be dependent on the nature and orientation of defects with batters laid back 2V:1H likely to be suitable in most cases. The proximity of stockpiles, cranes and delivery vehicles to the footing excavation would also need to be considered in the design of batter slopes.
    - Scheduling of construction activities and works are dependent on the weather conditions. In the event of heavy rainfall, construction scheduling is to be adjusted due to the safety risk and to avoid the risk of sediment and erosion within the site.

The ESC measures would be proposed to remain in place during the construction phase, until a stable, non-eroding landform had been constructed, whereupon they would be removed, or repurposed as designated outflows for runoff from internal areas for the operational phase.

Additionally, construction works may be sequenced to limit the extent of works that are in a cleared and/or stripped phase, to limit the footprint of works that has not been constructed to a stable non eroding landform at any given time.

- Operational Phase:
  - Ongoing inspection and maintenance of the stormwater drainage system will occur.
  - Maintenance works on access tracks and hardstands such as grading and rolling.
- Decommissioning Phase.

5.2.2 Review of Controls

A review of potential control methods, for consideration in future ESCP activities was completed.

Erosion control techniques suitable for project disturbance areas are listed in Table 15.

Table 15 Erosion Control Techniques – Surface(s)

Technique	Typical Use
Gravelling	• Protection of non-vegetated soils from raindrop impact erosion. • Stabilisation of site office area, car parks and access tracks or roads.
Revegetation	• Temporary and permanent stabilisation of soil. • Stabilisation of long-term stockpiles of uncompacted soils
Rock Mulching	• Stabilisation of long term, non-vegetated banks and minor drainage channels.
Compaction	• Compaction of hardstand areas utilising construction plant (such as rollers) to produce a stable non-eroding surface.
Dust Suppression	• Treating areas such as road surfaces and bare soils to minimize windborne erosion.

Supplementary sediment controls are used in areas where the sediment producing catchment is small or the potential for producing sediment laden runoff is low. A list of appropriate supplementary sediment control techniques is given in Table 16.

Table 16 Supplementary Sediment Control Techniques (IECA 2008)

Technique	Typical Use
Check Dam / Sediment Trap	• Supplementary sediment trap in minor concentrated flow areas. • Trapping sediments in table drains and minor drainage lines. • Check dams may be constructed of rock, sand bags or compost filled socks.
Buffer Zones / Grass Filter Strips	• Mostly suited to sandy soils • Can provide some degree of turbidity control while the buffer zone remains unsaturated.
Sediment Fence	• Supplementary device for sheet flow from minor catchment areas. • Suitable for all soil types. • Require maintenance after every runoff event.

Should the risk of erosion increase following soil sampling, primary sediment control techniques may be required and are listed in Table 17.

Table 17 Primary Sediment Control Techniques (IECA 2008)

Technique	Typical Use
Rock Filter Dam	• Locations where there is sufficient room to construct a relatively large rock embankment. • The incorporation of a filer cloth is the preferred construction technique if the removal of fine-grained sediment is critical (high maintenance).

Technique	Typical Use
Sediment Basin (Type C)	• Best suited to coarse grained soils. • Use when working areas containing coarse grained good settling soils.
Sediment Basin (Type F and D)	• Best suited to fine grained or dispersive soils. • Use for trapping coarse and fine sediments. • Assists with turbidity control.

5.2.2.1 Minimum Controls

To mitigate the identified risks, minimum ESC controls for the development are recommended to comprise the elements listed in Table 18. A list of other general ESC considerations for the types of project activities proposed is outlined in Table 19.

Table 18 Minimum ESC Controls

Aspect	Control(s)
Erosion Control – Upstream of construction areas	Design and instatement of the stormwater drainage system, including: • Longitudinal drainage (Access Tracks) • Transverse drainage - Culvert and/or pipes (Access Tracks) • Temporary Diversion (Trenching) • Permanent Diversion (Infrastructure Areas, Turbine Hardstand Areas)
Dusting from construction areas	• Dust suppression
Erosion Control - construction areas	• Planning to minimise the total disturbed footprint at any given time
Erosion at outlets of construction areas	Instatement of: • Rock splash-pad • Sediment Fencing (or similar) • Sediment Traps at concentrated flow locations
Erosion within the table drains	Rock lining at table drains For > 10% drain grade - Full Rock Lined Drain recommended For 7%-10% drain grade - Rock Checks at 5m Spacing For 5%-7% drain grade - Rock Checks at 10m Spacing For 2%-5% drain grade - Rock Checks at 20m Spacing Additional scour protection may be required in areas of unstable subgrade on site.

Table 19 Identified risks and controls

Phase / Activity	Risk of impacts to/from	Typical controls
Design	Generally: • Soil • Creeks • Vegetation	• The need for sediment trap or basin during the construction phase will be confirmed by a revision of the soil loss estimation calculation (RUSLE). • An at-site soils risk assessment will be undertaken for access track, turbine and trenching areas. The general ESC measures may assume coarse sediment control is required. Further measures for silt and dispersive measures may be instated, if the soils are identified. • Any further detailed design should take into consideration the requirements from this ESCP. • Detailed design should consider the content of the Flood Assessment (AECOM, 2023a) and preliminary Stormwater Management Plan (AECOM, 2023b) prepared on the preliminary design, and undertake additional modelling if required as design and site investigations progress.
Construction planning and site preparation	Generally: • Soil • Creeks • Vegetation	• Prepare a CEMP that includes the staging of clearing and earthworks. • Develop a fully detailed ESCP prepared by a suitable qualified person on the final project design. • In accordance with the detailed ESCP, install ESC controls. • Ensure that erosion and sediment controls are regularly maintained, and new controls installed as required, as works proceed. • Only remove temporary erosion and sediment controls after their associated landforms are complete and permanent controls are fully established.
Clearing, grubbing	• Accelerated soil erosion • Gully erosion • Rill erosion • Sheet erosion • Wind erosion / dusting	• Land clearing areas to be surveyed and clearly defined prior to clearing commencing. • Land clearing will not occur unless preceded by the installation of appropriate drainage and sediment control measures. The exception would be any land clearing necessary to allow installation of these control measures. • Land clearing to be staged to minimise the extent and duration of soil disturbance. • The time between clearing and grubbing will be minimised. • Cleared vegetation should be mulched for use on the site or as an erosion control aid where practicable and where biosecurity measures allow.
Earthworks	• Accelerated soil erosion • Mass movement • Soil structure	• Plan construction works to limit the amount of disturbed area at any one time. • Divert clean stormwater from upslope of disturbed areas using earth banks or catch drains, with energy dissipaters or level spreaders at their outlets as appropriate, to discharge stormwater in safe areas, avoiding erosion and flooding hazards. This requirement may be removed in situations where there is minimal risk of run-on (for example on crests). • Enact dust suppression measures for major disturbance areas. • Final site landscaping and revegetation will be undertaken as soon as practicable.
Stockpiles of uncompacted soils	• Accelerated soil erosion • Wind erosion	• Topsoil is stripped and stockpiled immediately before bulk earthworks occur. • Ensure stockpiles are located away from areas subjected to overland flow. • Topsoil stockpiles are covered or stabilised (e.g., hydro-mulched) to minimise loss through wind and water erosion.
Site stabilisation and revegetation	• Accelerated soil erosion • Mass movement • Gully erosion • Rill erosion • Sheet erosion • Stream bank erosion • Wind erosion • Scalding	• Site stabilisation may be achieved using vegetation, rock armouring, paving, concrete, geotextiles or any other cover that protects the ground surface against erosion. • The preferred site stabilisation method(s) will be identified on a site by site basis and included within the detailed ESCP. • 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 most areas, revegetation will be the preferred method of stabilisation. • Use pasture grasses so that the lands may continue to be used for grazing purposes. Landowners are to be consulted and provide agreement on rehabilitation seed mixes to be used prior to construction works commencing (or as agreed between the developer and the landholder) to achieve a similar condition and pasture species composition to present conditions. • Annual cover crops may be used to provide temporary cover and under sown with the desired mix of perennial species (or as agreed between the developer and the landholder). • Revegetation details and proposed vegetation monitoring plan to be provided in the detailed ESCP and CEMP/Vegetation Management Plan.

5.2.3 Drainage System

5.2.3.1 Permanent Drainage

Permanent drainage refers to diversion channels that will remain during the operational period of the project, such as:

- diversion drains for turbine hardstand and infrastructure areas
- longitudinal drains associated with proposed access tracks
- transverse culverts and pipes associated with proposed access tracks.

Any permanent diversion should be designed such that it appears and functions as a natural feature in the landscape largely indistinguishable from the natural watercourses in the area. A natural channel or flow path has features that develop through geomorphologic processes, such as channel and floodplain capacity, meanders, riffles and vegetation, to provide an environment where these conditions can continue to develop at a rate consistent with its environment. This is referred to as dynamic equilibrium. Similar features should be designed into the diversion channel in order to obtain a similar dynamic equilibrium.

Where the diversion is replacing an existing channel such as a gully, the existing gully should be used as a 'template' to design the diversion. That is, the diversion design should mimic the channel shape, floodplain capacity, bed slope etc. of the natural channel it replaces, where possible. Where the diversion collects an increased catchment of overland flow as it traverses downstream, a nearby natural channel that has a similar catchment area could be used as a template.

For all permanent diversions, vegetation should be used as the primary method of stabilising channel banks, terraces and floodplain drainage paths.

The following general principles should be followed in the design of drainage controls for unsealed roads, where necessary:

- Where upstream catchments flow towards the access road, stormwater runoff will be collected on the high side of the road and conveyed via roadside table drains prior to discharge via culverts or spillways placed at catchment low points.
- Scour protection can be implemented to reduce the impact of the concentrated stormwater flows from the culverts. Potential forms of scour protection include rock protection and drainage level spreaders.
- Stormwater runoff from unsealed roads should be allowed to shed at regular intervals. The runoff should be discharged into a sediment trap or released as sheet flow via a level spreader into adjacent vegetation to limit erosion and disturbance of near surface soils.
- Where stormwater runoff from unsealed roads collects within longitudinal table drains adjacent to the roadway, this water should ideally be discharged from the table drain at regular intervals.
- Where table drains are steep and water cannot shed, such as through a cutting or into a river channel, the alternate controls should be considered.
- When access is required across a slope, the road should be sited as close as possible to the contour of the land. This allows upslope water runoff to pass evenly across the track, thus avoiding concentrated flow.
- When an access road diagonally traverses a slope, the road will likely collect and concentrate upslope stormwater runoff. The collected runoff will need to shed at regular intervals using a level spreader or drainage channels.
- Wherever practical, longitudinal drainage such as table drains should form wide U-shaped drains to minimise potential invert erosion. Deep V-shaped drains should be avoided where roads are constructed on steep slopes along a cutting. 1V:2H batter slope to be adopted typically across the site and max 1V:4H to be adopted in trafficable areas. Table Drain Size to be confirmed during detailed design phase.

5.2.3.2 Temporary Drainage Controls

In accordance with IECA (2008), drainage channels, whether permanent or temporary, should be designed and constructed at a gradient that limits the maximum flow velocity to a value not exceeding the maximum allowable flow velocity for the given surface material.

Excessive flow velocities can cause channel erosion, usually along the invert of the drain, which can then lead to bank slumping and widening of the channel.

The flow velocity can be reduced by either:

- reducing the depth of flow (increasing the width of the channel)
- reducing the bed slope
- reducing the peak discharge (reducing catchment area)
- increasing channel roughness.

If the channel width, depth or gradient cannot be altered, then there are two options for controlling erosion as follows:

- reduce the flow velocity through the placement of rock check dams
- increase the effective scour resistance in the channel through the placement of an effective channel liner such as rock or an appropriate liner.

6.0 Inspections and Monitoring

An adequate inspection and maintenance program is essential to an effective system of drainage, erosion and sediment control devices.

Minimum monthly inspections of ESC measures are required during construction phase.

Frequency of the inspection during operations phase will be determined by the Proponent in conjunction with the Contractor.

Throughout construction, operation and decommissioning a full inspection of erosion and sediment controls will be undertaken following a heavy rainfall event (>25mm in 24 hours) to identify and undertake any necessary rectification work.

The development of performance criteria will occur under the Contractor's ESCP concurrent with detailed design of the measures to be implemented. However, the performance criteria must have regard to the Queensland Acid Sulfate Soils Technical Manual (Dear, et al., 2024) and BPESC (AustIECA, 2008).

6.1 Construction phase

The ESC risks during the construction phase will be documented and managed under the Contractor's ESCP. The plan will consider subsequent data available as the project progresses to detailed design.

The plan is expected to detail:

- planned ESC measures for infrastructure areas
- at site processes for identifying erodible and/or dispersive soils.

Frequency of inspection of ESC measures, such as:

- at the commencement of the wet season period (1 November) (e.g., at stockpiles of uncompacted soil or vegetation, trenches)
- proceeding significant rainfall events (e.g., creek crossings, sediment basin inlets and outlets).

ESC works to be executed under the Construction ESCP include:

- ensuring pre-clearing works, are instated
- maintaining erosion and sediment control measures
- inspecting adjacent drainage paths and waterways for any developing erosion issues
- ensuring ESC measures are in place until a stable non-eroding landform has been achieved, as detailed in the ESCP
- removal of temporary ESC measures.

The EPC contractor is expected to document their incident reporting procedures including:

- the chain of responsibility
- procedures for recording instances of ESC issues and corrective actions
- monthly reporting procedures (if required)
- internal recording and filing procedures.

6.2 Operations phase

Once the construction period has ended, an Operations ESCP is to be developed and executed by the site operator based on as-built conditions. The plan is expected to document the ongoing erosion and sediment control management, including:

- Management of the permanent stormwater network, including ongoing inspection, monitoring, cleaning and, if necessary, remediation. The stormwater network is expected to comprise:
  - Longitudinal and transverse drainage of the proposed access tracks
  - Local drains for infrastructure areas
- Management of road pavement surfaces, hardstand areas and batter slopes.
- Monitoring of drainage paths in proximity to site infrastructure, and remedial works, if required.

6.3 Decommissioning

Decommissioning of the site will operate according to an ESCP specific to the decommissioning and rehabilitation program or as required by regulatory authorities at the time. The execution of the ESCP will depend upon the parties involved in the decommissioning program.

7.0 Conclusions and Recommendations

This ESCP is provided to demonstrate Tarong West Wind Farm's commitment to managing drainage, erosion and sediment risks at the Project Site and addressing applicable regulatory and planning requirements.

In preparing this document, the IECA entitled Best Practice Sediment and Erosion Control Guidelines (2008), SDAP Guidance Material – State Code 16: Native vegetation clearing and State Code 23: Wind Farm development have been considered.

Further recommendations for sediment and erosion control relevant to this project include:

- Prepare a detailed construction ESCP that is in accordance with the IECA Best Practice Erosion and Sediment Control Guidelines prior to any disturbing works. The detailed ESCP may contain (but is not limited to):
  - site specific targets for soil and water quality management
  - erosion assessment using the Revised Universal Soil Loss Equation (RUSLE) (if required)
  - pro forma checklists and forms for inspections, monitoring and reporting
  - any conditions stipulated by regulatory authorities based on this preliminary ESCP or the preliminary stormwater management plan (AECOM, 2022b)
  - signature of a suitably qualified and experienced professional.
- As the construction phase completes, develop an operations ESCP, scoped to cover the ongoing management and maintenance of the site.

8.0 References & Supporting Documents

AustIECA (2008), Best Practice in Erosion and Sediment Control, Australasia Division of International Erosion Control Association, November 2008.

AECOM (2023a). Tarong West Wind Farm – Flood Assessment, AECOM Australia Pty Ltd, 2023, Brisbane

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ANZECC/ARMCANZ (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, 2018, Canberra.

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Environmental Protection Act 1994 (EP Act), Queensland Government, current as 9 December 2019.

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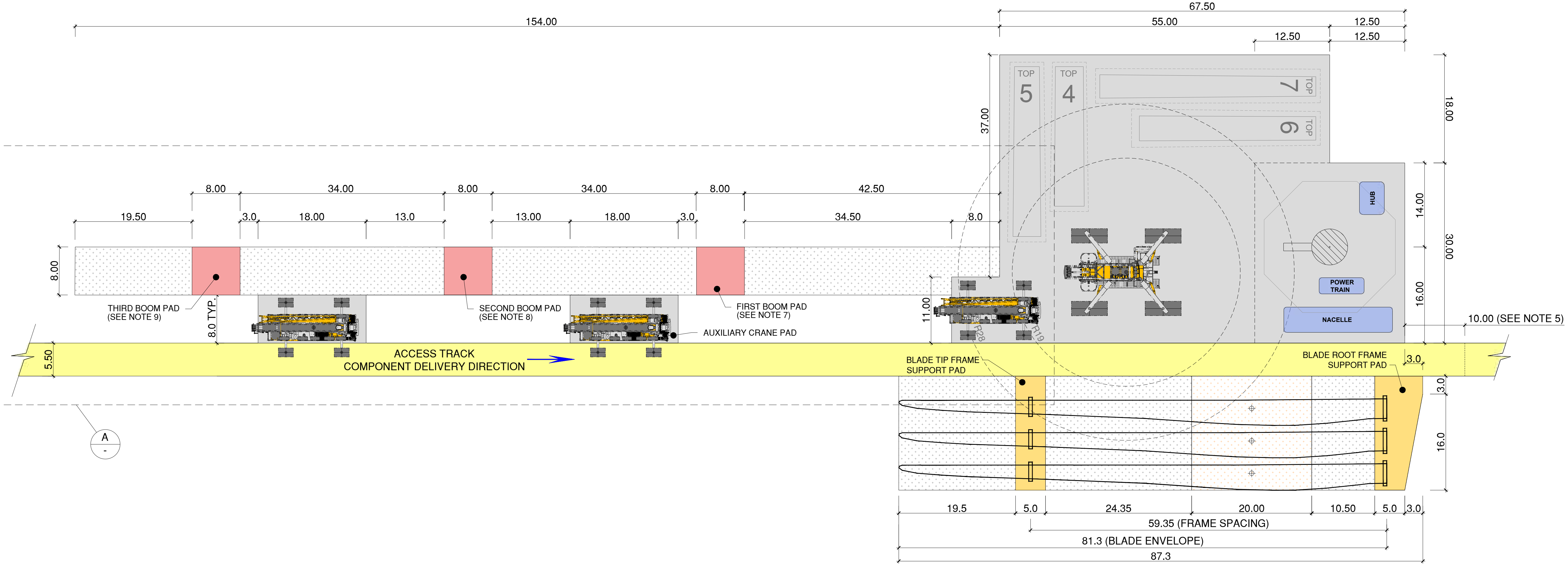
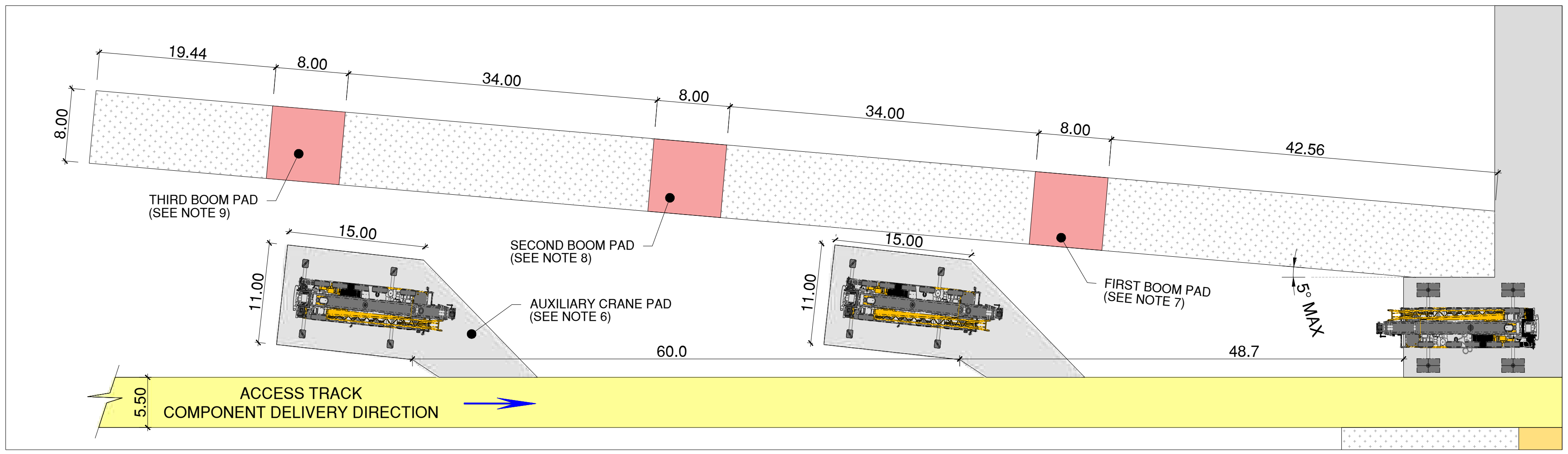
International Erosion Control Association (IECA), 2008, Best Practice Erosion and Sediment Control – For Construction and Building Sites, Published 2008)

Department of Environment and Science (DES) (2022) Erosion and sediment control (ESC) on construction sites | Environment | Department of Environment and Science, Queensland (des.qld.gov.au)

Appendix A

Typical Access Track Details





A
-
OPTIONAL ARRANGEMENT
BOOM ASSIST CRANE PADS

NOTES:

1. THESE DETAILS ARE TO BE REVIEWED AND MAY BE AMENDED BY THE CONTRACTOR DURING THE EXECUTION OF THE WORKS.
2. PAD GRADIENTS:
   - 2.1. 1.0% FOR THE MAIN CRANE, TOWER LAYDOWN, FOUNDATION AREA, AND BOOM PADS
   - 2.2. 2.0% MAX FOR THE AUXILIARY CRANE PADS
3. SAFETY CLEARANCE (NO GO ZONE) MAY BE REQUIRED BEYOND THESE DIMENSIONS FOR HARDSTAND THAT ARE IN SIGNIFICANT FILL.
4. ALL UNITS ARE IN METERS.
5. A MINIMUM TRACK EXTENSION OF 10m IS TO BE CONSTRUCTED FOR HARDSTANDS AT THE END OF A STRING. ADDITIONAL EXTENSION MAY BE REQUIRED FOR PULL TRUCKS.
6. OPTIONAL ARRANGEMENT FOR BOOM ASSIST CRANE PADS THAT CAN BE USED WHERE THE ACCESS TRACK GRADIENT HINDERS THE CRANE PAD GRADIENT SPECIFIED IN NOTE 2.
7. FIRST BOOM PAD: MAXIMUM 2.3m IN ELEVATION BELOW THE NEAREST EDGE OF MAIN HARDSTAND.
8. SECOND BOOM PAD: MAXIMUM 4.5m IN ELEVATION BELOW THE NEAREST EDGE OF MAIN HARDSTAND.
9. THIRD BOOM PAD: MAXIMUM 5.5m IN ELEVATION BELOW THE NEAREST EDGE OF MAIN HARDSTAND.
10. BOOM PAD ELEVATION CAN BE INDEPENDENT OF THE ACCESS TRACK AND AUXILIARY CRANE PAD.
11. BLADE FINGERS:
    - 11.1. MUST MATCH INTO THE ACCESS TRACK.
    - 11.2. MAX 1.0% GRADIENT IN ALL DIRECTIONS FOR THE INDIVIDUAL FINGER.
    - 11.3. MAX 1.0% GRADIENT DIFFERENCE BETWEEN THE TWO BLADE FINGERS.
12. INCLINE BOOM CORRIDOR
    - 12.1 IN LOCATIONS ALONG THE BOOM CORRIDOR WHERE THE EXISTING TERRAIN IS SUCH THAT THE BOOM IS LAID AT A POSITIVE ANGLE, THE BOOM MAY BE ASSEMBLED ON ANGLE UP TO +13%. (IDEALIST GRADIENT).
    - 12.2 THE AUXILIARY CRANE PADS MUST BE WITHIN 10m ELEVATION OF THE IDEALISTIC GRADIENT.
13. 5 DEG HORIZONTAL ROTATION OF THE CRANE BOOM MAY BE EXCEEDED AT A SITE-SPECIFIC LOCATIONS BASED ON TERRAIN, ELEVATION, ASSIST CRANE LIMITATION (E.G. REACH RADIUS) SUBJECT TO CONFIRMATION FROM VESTAS.

HARDSTAND BEARING CAPACITY: 250 kPa

ACCESS TRACK BEARING CAPACITY: 250 kPa / AXLE LOAD (SEE NOTE 11)

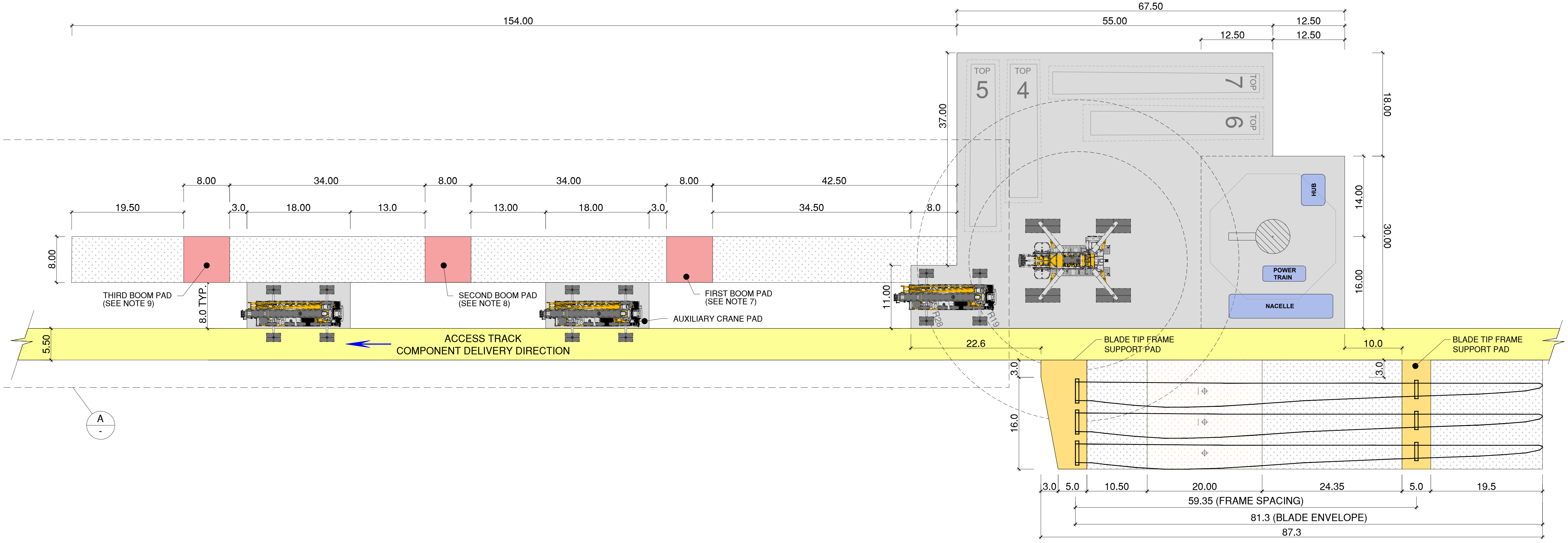
BLADE LAYDOWN BEARING CAPACITY: 200 kPa

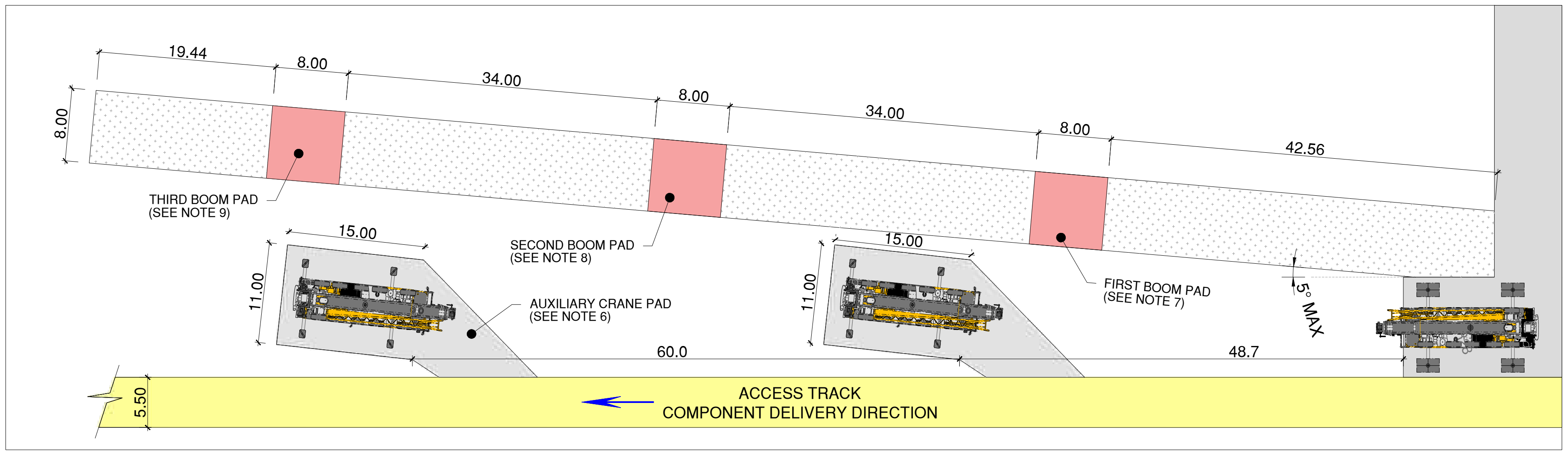
BOOM PADS BEARING CAPACITY: 150 kPa

AREA FREE OF OBSTACLES.

BLADE GRIPPER AREA TO BE 0.5m LOWER THAN THE BLADE FINGER FINISHED SURFACE

NOTE: PRELIMINARY DRAWING SUBJECT TO APPROVAL OF THE CLIENT	PROJECT: TARONG WEST 97xV163 4.5MW HH166m	AUTHOR: Vestas	SCALE: 1:700 (0m 5 10 15 20 25m)	DATE: 15 - April - 2024	DRAWING: CRANE PAD RES TYPE 1	DRAW UP: DCAVI DATE: CHECK BY: BOYDA DATE: APPROVAL: JODWY DATE:	REVISION Rev1 / DRAWING Nº: 2.3.1 FORMAT A3 / PAGE 1 OF 1





A - OPTIONAL ARRANGEMENT
BOOM ASSIST CRANE PADS

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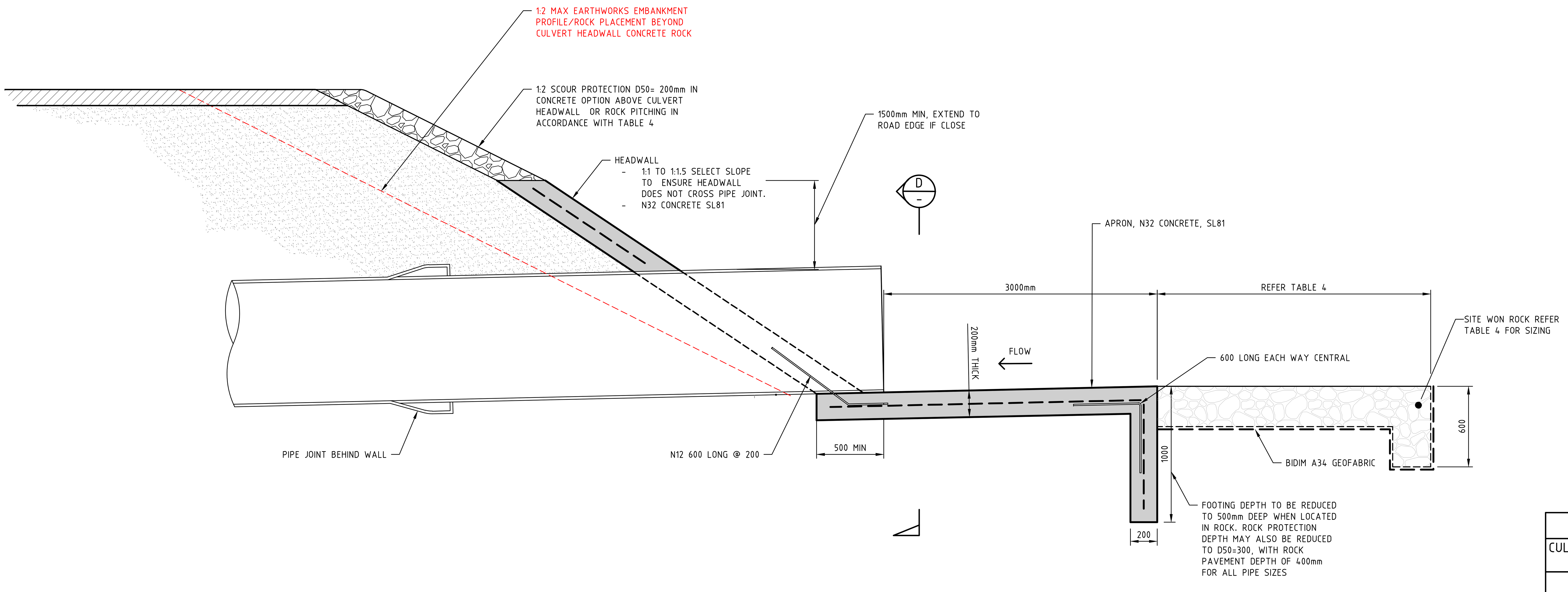
   - 11.2. MAX 1.0% GRADIENT IN ALL DIRECTIONS FOR THE INDIVIDUAL FINGER.
   - 11.3. MAX 1.0% GRADIENT DIFFERENCE BETWEEN THE TWO BLADE FINGERS.
12. INCLINE BOOM CORRIDOR
   - 12.1 IN LOCATIONS ALONG THE BOOM CORRIDOR WHERE THE EXISTING TERRAIN IS SUCH THAT THE BOOM IS LAID AT A POSITIVE ANGLE, THE BOOM MAY BE ASSEMBLED ON ANGLE UP TO +13%. (IDEALIST GRADIENT).
   - 12.2 THE AUXILIARY CRANE PADS MUST BE WITHIN 10m ELEVATION OF THE IDEALISTIC GRADIENT.
13. 5 DEG HORIZONTAL ROTATION OF THE CRANE BOOM MAY BE EXCEEDED AT A SITE-SPECIFIC LOCATIONS BASED ON TERRAIN, ELEVATION, ASSIST CRANE LIMITATION (E.G. REACH RADIUS) SUBJECT TO CONFIRMATION FROM VESTAS.

- HARDSTAND BEARING CAPACITY: 250 kPa
- ACCESS TRACK BEARING CAPACITY: 250 kPa / AXLE LOAD (SEE NOTE 11)
- BLADE LAYDOWN BEARING CAPACITY: 200 kPa
- BOOM PADS BEARING CAPACITY: 150 kPa
- AREA FREE OF OBSTACLES.
- BLADE GRIPPER AREA TO BE 0.5m LOWER THAN THE BLADE FINGER FINISHED SURFACE

NOTE: PRELIMINARY DRAWING SUBJECT TO APPROVAL OF THE CLIENT	PROJECT: TARONG WEST 97xV163 4.5MW HH166m	AUTHOR: Vestas	SCALE: 1:700 (0m 5 10 15 20 25m)	DATE: 15 - April - 2024	DRAWING: CRANE PAD RES TYPE 2	DRAW UP: DCAVI DATE: / CHECK BY: BOYDA DATE: / APPROVAL: JODWY DATE:	REVISION Rev1 / FORMAT A3	DRAWING Nº: 2.3 / PAGE 1 OF 1



CULVERT HEADWALL TYPE 2

NOT TO SCALE

WATERWAY BARRIER CONSTRUCTION NOTES

IN ACCORDANCE WITH THE DEPARTMENT OF AGRICULTURE AND FISHERIES (DAF) 'ACCEPTED DEVELOPMENT REQUIREMENTS FOR OPERATIONAL WORK THAT IS CONSTRUCTING OR RAISING WATERWAY BARRIER WORKS'. THE FOLLOWING APPLIES FOR CULVERT APRONS STREAM BED SCOUR PROTECTION AND ROUGHENING ELEMENTS:

CULVERT APRONS ON HIGH IMPACT (RED) MODERATE IMPACT (AMBER), AND LOW IMPACT (GREEN) WATERWAYS MUST:
- NOT TO BE STEEPER THAN WATERWAY BED GRADIENT
- ABUT CULVERT INVERT AT THE SAME LEVEL, ENSURING NO DROP ELEVATION AT THE JOIN
- WHERE APRON ARE AT BED LEVEL ARE TO BE ROUGHENED TO SIMULATE NATURAL BED CONDITIONS

STREAM BED SCOUP PROTECTION ON HIGH IMPACT (RED), MODERATE IMPACT (AMBER) AND LOW IMPACT (GREEN) WATERWAYS MUST:
- NOT TO BE STEEPER THAN A 1 IN 20 GRADIENT OR THE NATURAL CHANNEL GRADIENT, WHICHEVER IS STEEPER
- INCORPORATE LOW FLOW CHANNEL
- HAVE CLEAN ROCKS (MINIMAL FINE MATERIAL), AT LEAST 100mm DIAMETER
- ROCK ARMOURING NOT TO BE OVER COMPACTED BUT LEFT PROUD AND UNEVEN
- ABUT CULVER APRON AT SAME LEVEL, ENSURING NOT DROP IN ELEVATION AT THE JOIN

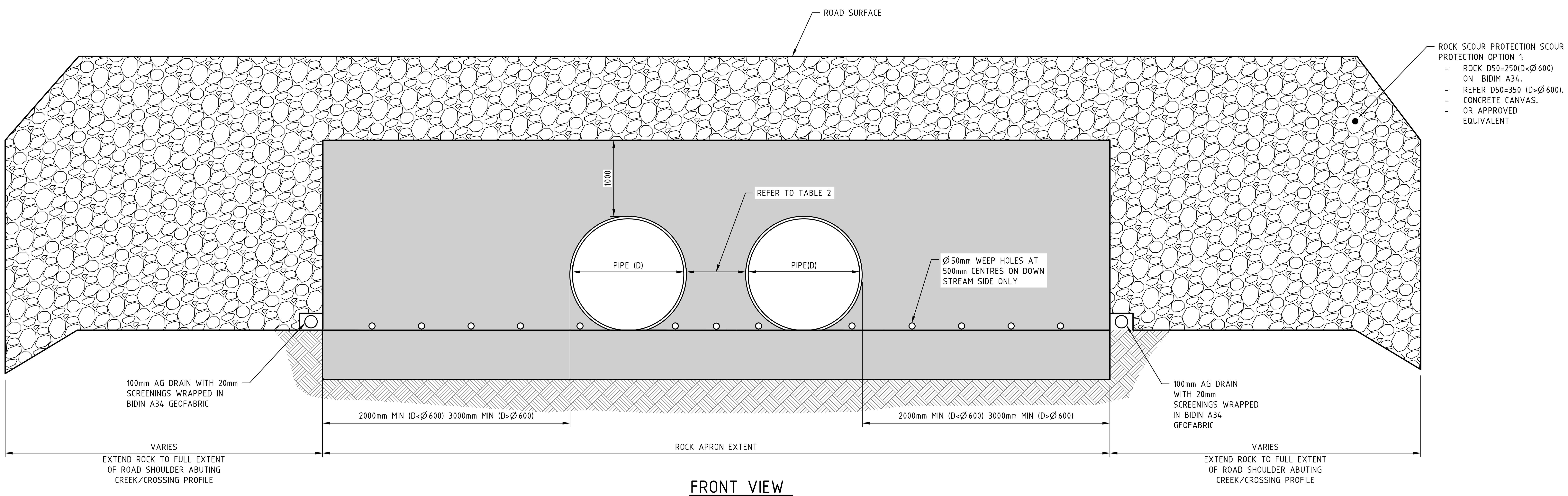
ROUGHENING ELEMENTS ON HIGH IMPACT (RED) WATERWAYS MUST COMPLY WITH THE FOLLOWING:
- THE OUTERMOST CELLS MUST INCORPORATE ROUGHENING ELEMENTS ON THEIR BANKSIDE WALLS OR ON BOTH SIDEWALLS FOR A SINGLE CELL CULVERT. THESE MUST BE INSTALLED TO A MINIMUM OF 95% OF THE FULL HEIGHT OF THE VERTICAL EXTENT OF THE CULVERT SIDEWALLS WITH A GAP OF NO GREATER THAN 30mm AT THE BOTTOM.
- BE INSTALLED ON UPSTREAM WINGWALLS ON BOTH BANKS TO THE HEIGHT OF THE UPSTREAM OBVERT OR THE FULL HEIGHT OF THE WINGWALLS

WHERE ROUGHENING ELEMENTS ARE BAFFLES, MUST BE:
- MAXIMUM 150mm PROTRUSION WIDTH INTO THE FLOW
- MAXIMUM 10mm THICK
- WITHIN 1.2m UPSTREAM AND DOWNSTREAM OF THE UPSTREAM CULVERT INLET, BAFFLES - MUST BE SPACED AT TWICE THE HORIZONTAL PROTRUSION (WIDTH) OF THE BAFFLE IE MAX 300mm CENTRES
- THROUGHOUT THE REST OF THE STRUCTURE, BUFFLES MUST BE SPACED AT 4 x HORIZONTAL
- PROTRUSION WIDTH OF THE BUFFLE (IE. MAX 600mm CENTRES)

REFER TO THE DOCUMENT ' ACCEPTED DEVELOPMENT REQUIREMENTS FOR OPERATIONAL WORK THAT IS CONSTRUCTING OR RAISING WATERWAY BARRIER WORK' FOR FURTHER GUIDANCE ON MINIMISING CONSTRUCTION IMPACT.
FURTHERMORE, ANY INSTREAM TEMPORARY WATERWAY BARRIER (WHICH MAY INCLUDE SEDIMENT CONTROL MEASURE) MUST MEET SECTION 7 OF THE ACCEPTED DEVELOPMENT REQUIREMENTS.
SPECIFIC DESIGN REQUIREMENTS FOR EACH CROSSING ARE NOTED ON THE LAYOUT PLANS.

TABLE 4 - ROCK SIZING

CULVERT OUTLET/INLET PIPE SIZE	BED GRADE	ROCK SIZE	ROCK PLACEMENT DEPTH	ROCK APRON LENGTH
≤ ø600	<5%	D_{50}=300	1.5 x D_{50}	4D or 3000mm, WHICHEVER IS GREATER
>Ø 600 TO ≤ ø1200	<5%	D_{50}=400	1.5 x D_{50}	4D or 3000mm, WHICHEVER IS GREATER
> ø1200	<5%	D_{50}=450	1.5 x D_{50}	4D or 3000mm, WHICHEVER IS GREATER
	>5%	CONSULT DESIGN ENGINEER ON CASE BY CASE BASIS	1.5 x D_{50}	4D or 3000mm, WHICHEVER IS GREATER



FRONT VIEW

SECTION D

SCALE NTS

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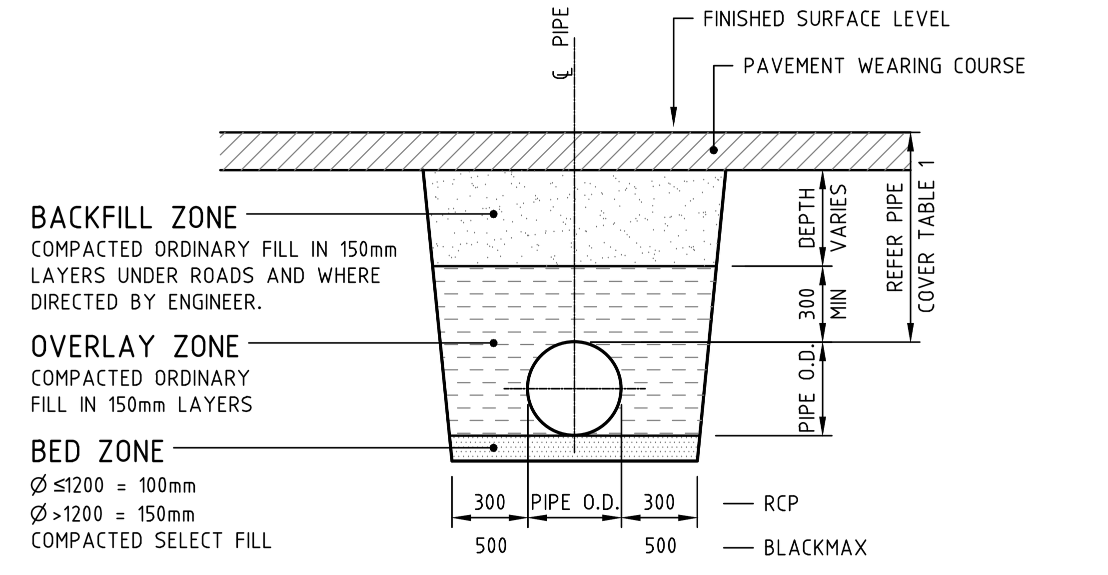
A	01.11.2024	ISSUED FOR INFORMATION	KK	EN	EN

TARONG WIND FARM
CIVIL WORKS
DRAINAGE DETAILS
CULVERT CONCRETE HEADWALL

A1
DOCUMENT NUMBER
Project Number / Sheet No. / Rev.
Design / Drawn
WGA221123-DR-CV-0018 A



RCP PIPE TRENCH INSTALLATION - SINGLE PIPE

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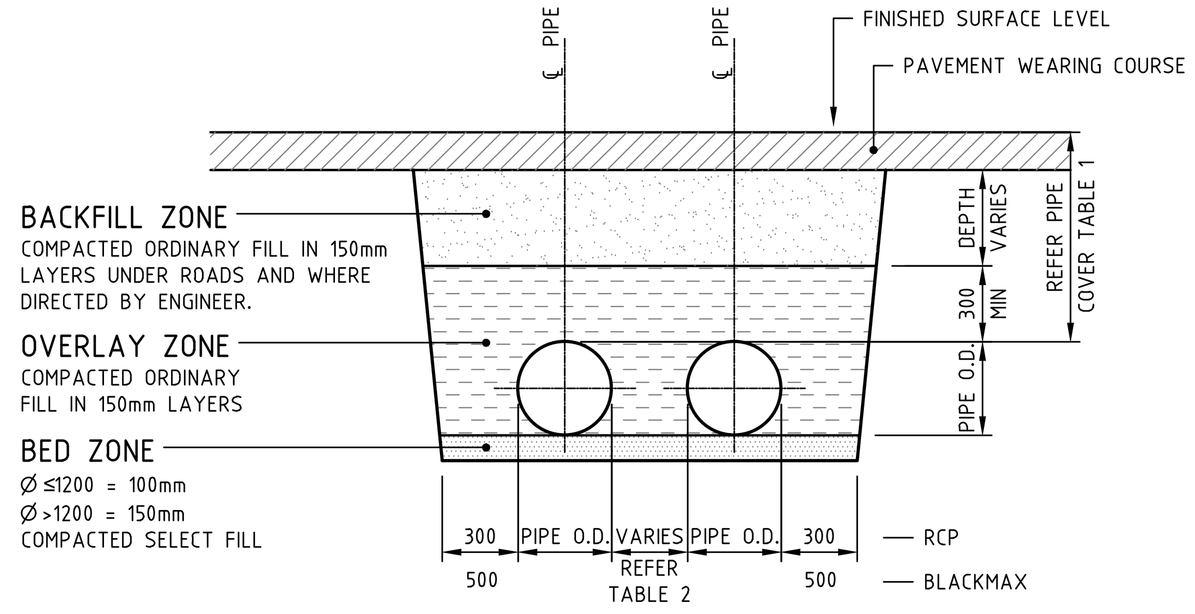

RCP PIPE TRENCH INSTALLATION - MULTI BARRELS

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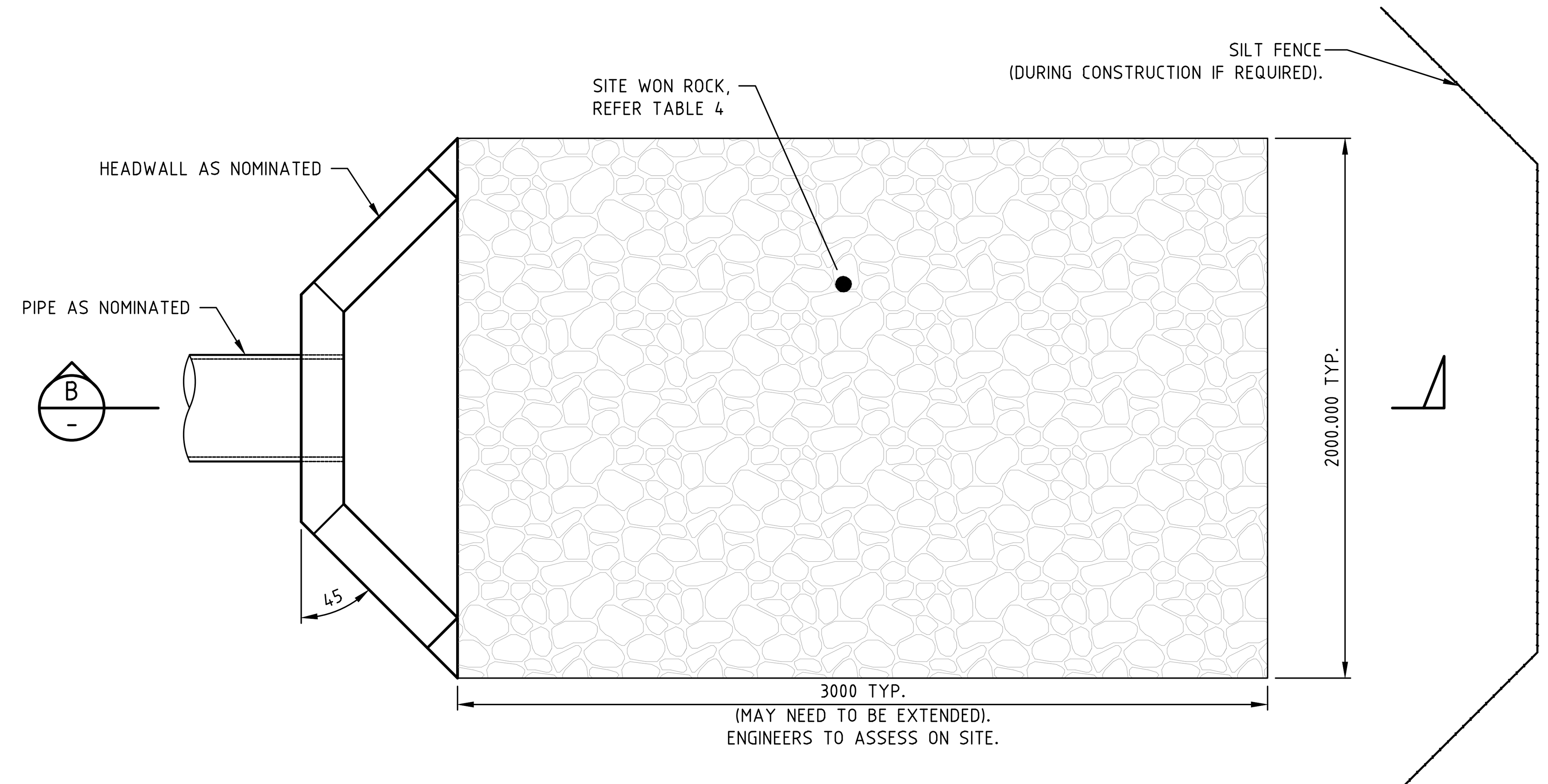
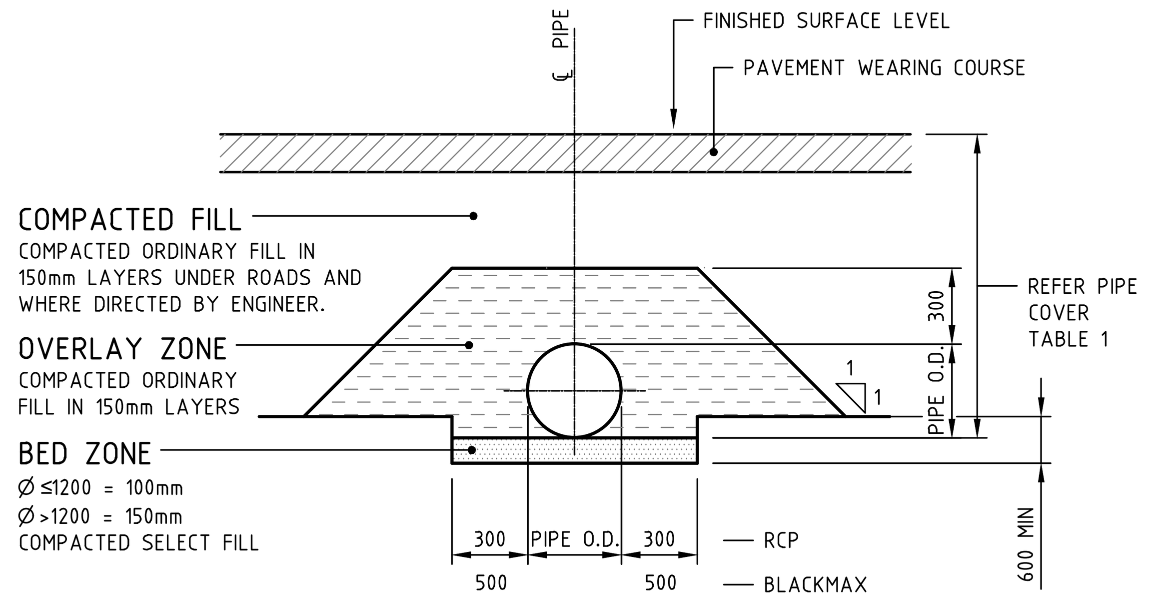


CULVERT HEADWALL - TYPE 1 (<Ø1200 PIPE/DUAL BARREL)

1:20

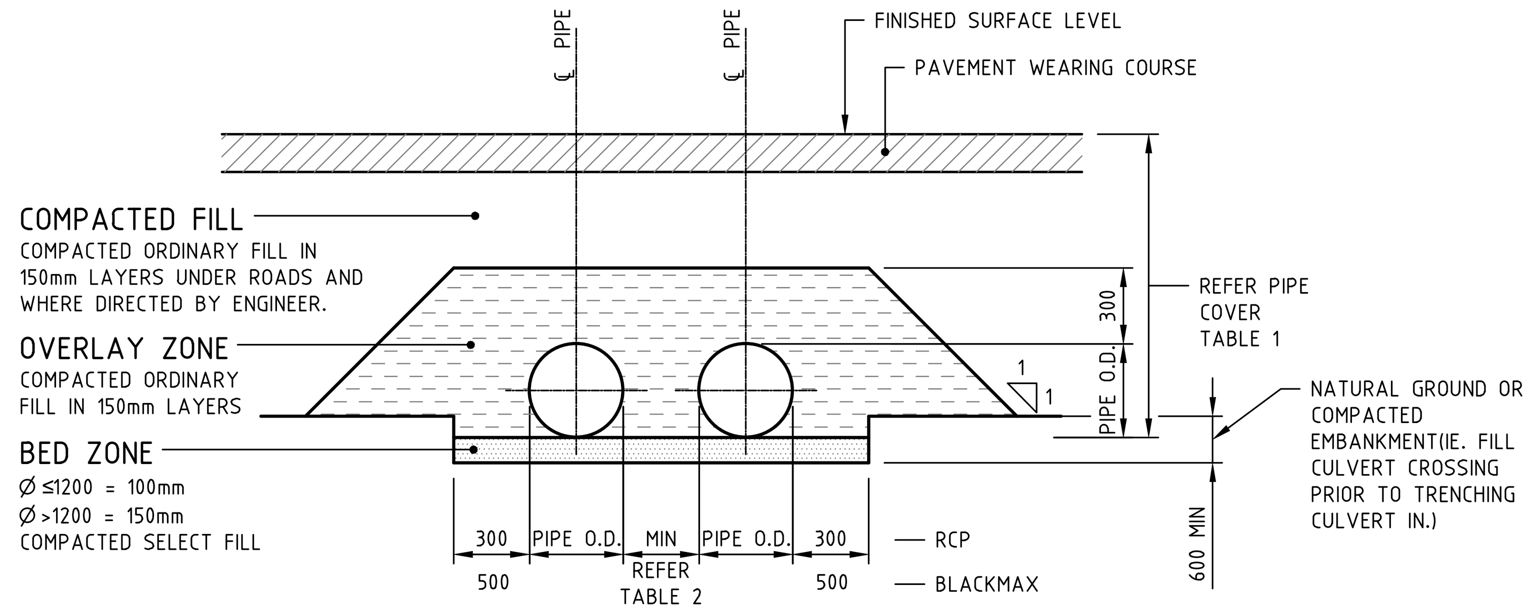
NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. CULVERT LOCATION AND INVERT LEVELS TO BE TO BE CONFIRMED ON SITE BY CONTRACTOR AND VERIFIED BY DESIGN ENGINEER PRIOR TO CONSTRUCTION.
3. BEDDING MATERIAL, FOUNDATION COMPACTION AND BACKFILL COMPACTION TO BE AS PER THE SPECIFICATION.
4. MINIMUM PIPE SPACING HAVE BEEN NOTED AS PER AS5372 ENVIRO PIPE SPECIFICATION, HOWEVER NOTING CONSIDERATION TO SITE MATERIALS AND CONSTRUCTION METHODS IN SELECTING THE APPROPRIATE SPACING.



RCP PIPE ENBANKMENT INSTALLATION - SINGLE PIPE

1:25



RCP PIPE ENBANKMENT INSTALLATION - MULTI BARRELS

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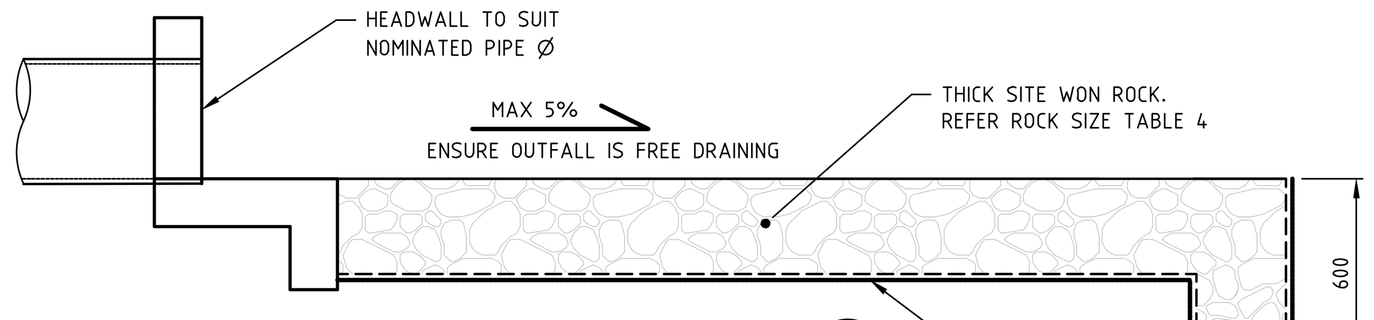
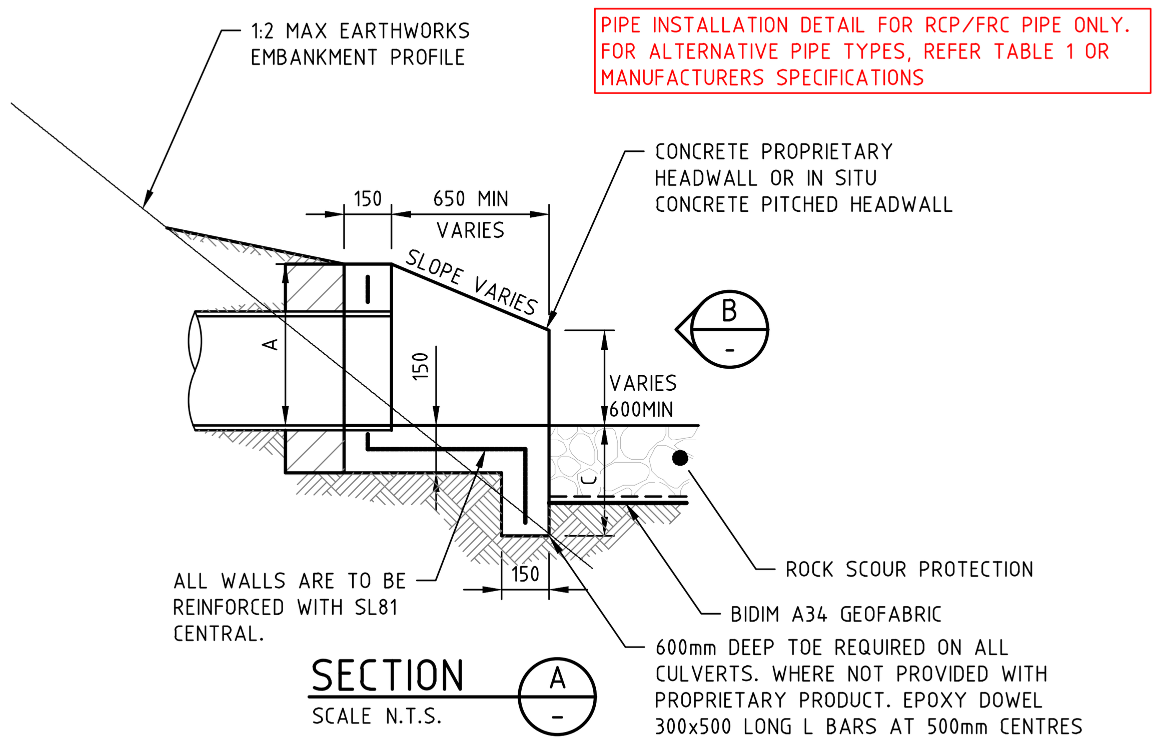


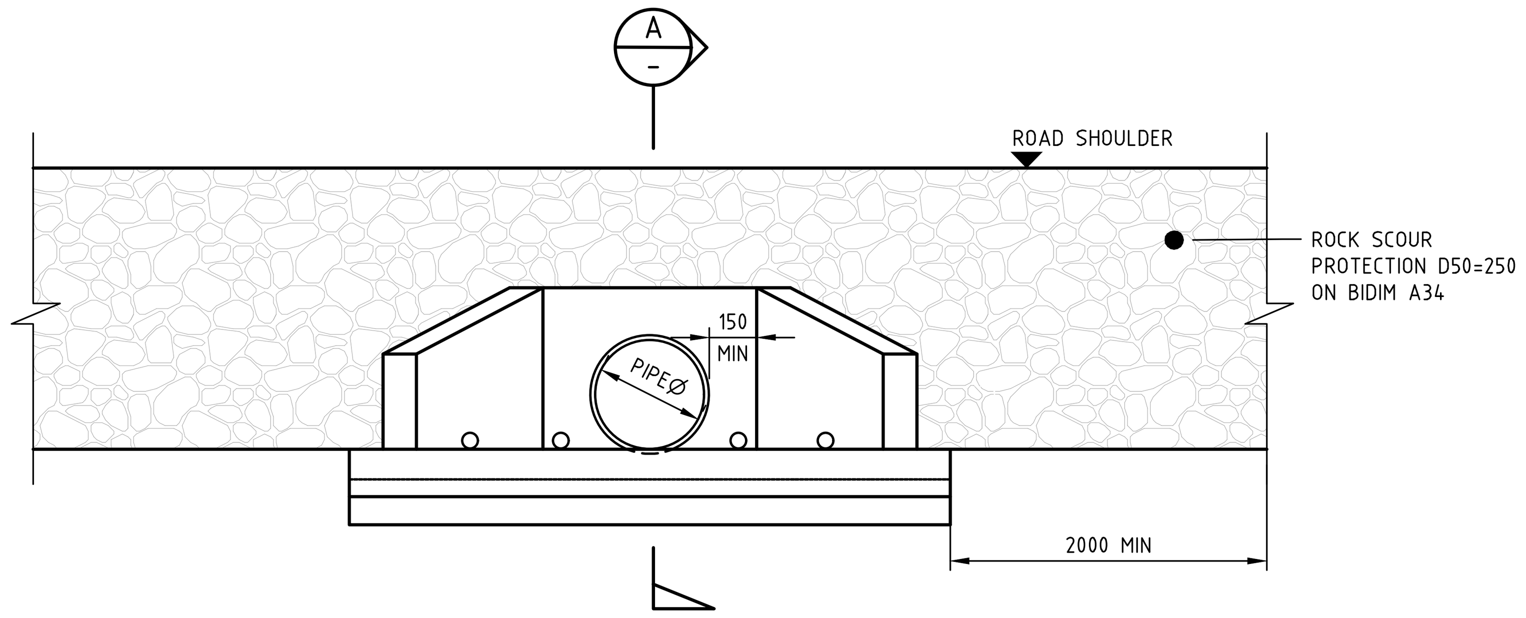
SECTION B
SCALE 1:20

PIPE INSTALLATION DETAIL FOR RCP/FRC PIPE ONLY. FOR ALTERNATIVE PIPE TYPES, REFER TABLE 1 OR MANUFACTURERS SPECIFICATIONS



SECTION A
SCALE N.T.S.

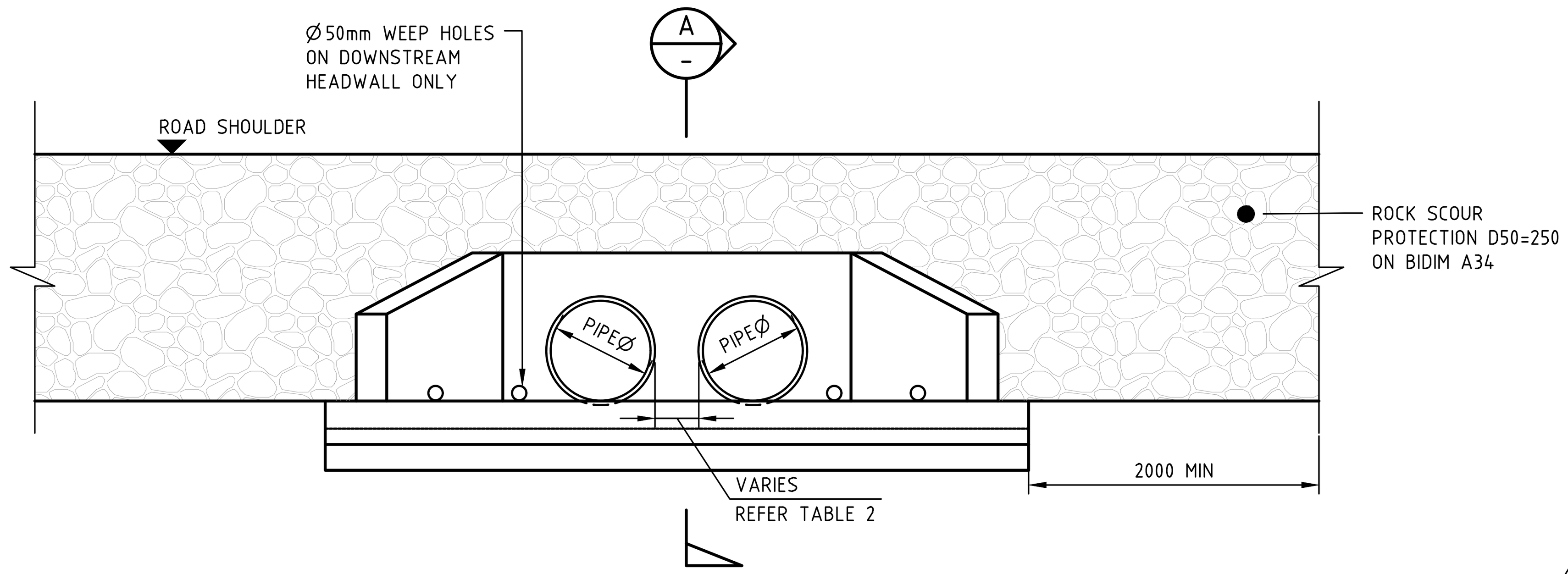
HEADWALL WITH APRON TOE



HEADWALL - SINGLE PIPE

ELEVATION B
SCALE N.T.S.

NOTE: ALL WALL HEIGHTS, THICKNESSES, APRON & REINFORCEMENTS ARE MIN. REQUIREMENTS & WILL VARY ACCORDING TO SITE CONDITIONS.



HEADWALL - MULTI BARRELS

ELEVATION B
SCALE N.T.S.

NOTE: ALL WALL HEIGHTS, THICKNESSES, APRON & REINFORCEMENTS ARE MIN. REQUIREMENTS & WILL VARY ACCORDING TO SITE CONDITIONS.

TABLE 1 - ULTIMATE PIPE COVERS				
PIPE TYPE	ACCEPTABLE NOMINAL SIZES	MINIMUM COVER REQUIREMENTS	MAX FILL DEPTH ABOVE THE PIPE	PIPE SUPPORT TYPE
RCP (recommended)	All	400min(500 DESIRABLE) (WHERE LOWER COVERS ARE REQUIRED CONSULT DESIGN ENGINEER)	≤5m CL4 ≤8m CL8 ≥8m REFER DESIGN ENGINEER	H2 min
FRC	DN 375 - 900	>500mm (WHERE LOWER COVERS ARE REQUIRED CONSULT DESIGN ENGINEER)	≤5m CL4 ≤8m CL8 ≥8m REFER DESIGN ENGINEER	H2 min
BLACK MAX/ENVIRO PIPE (OR APPROVED EQUIVALENT)	DN450-750 (LARGER PIPES ON A CASE BY CASE BASIS)	DN450-650mm DN525-700mm DN600-700mm DN750-750mm 750mm DESIRABLE REFER MANUFACTURERS SPECIFICATIONS	≤ 8m SN8 REFER MANUFACTURERS SPECIFICATIONS	AS2566.2 BURIED FLEXIBLE PIPES: PART 2: INSTALLATION OR MANUFACTURERS INSTRUCTIONS

TABLE 3 - TABLE DRAIN SCOUR PROTECTION TREATMENT	
DRAIN GRADE %	TREATMENT
>8%	FULLY ROCK LINED OR CONCRETE CANVAS OR APPROVED EQUIVALENT WHERE NOTED
6% - 8%	GRASS LINED AND ROCK CHECKS AT 5m SPACING
4% - 6%	GRASSED LINED AND ROCK CHECKS AT 10m SPACING
2% - 4%	GRASS LINED AND ROCK CHECKS AT 20m SPACING
<2%	GRASS LINED

NOTE:
WHERE SECTIONS OF DRAIN ARE LOCATED IN SOILS WITH DISPERSIVE PROPERTIES, CONSIDERATION IS TO BE GIVEN TO TREATMENT OPTIONS SUCH AS CHEMICAL AMELIORATION, CAPPING OR REPLACING WITH MIN. 100mm OF NON DISPERSIVE MATERIALS AND/OR FULLY ROCK LINED AS IDENTIFIED AND DETERMINED BY THE DESIGN ENGINEER

TABLE 2 - SPACING BETWEEN PIPES		
PIPE DIAMETER Ø, D	COMPACTED FILL (DESIRABLE/MIN)	CLSM (DESIRABLE/MIN)
RCP ≤600	300/150	200/100
RCP >600, ≤1200	600/200	200/100
RCP >1200	900/ D/6	200/100
ENVIRO PIPE (REFER MANUFACTURER SPECIFICATION)	600 / DN≤450 - 200 DN>450 TO DN≤900 - 300	DN≤450-150 DN>450-200

1000 500 0 1000 2000
SCALE BAR (mm) 1:50

500 250 0 500 1000
SCALE BAR (mm) 1:25

400 200 0 400 800
SCALE BAR (mm) 1:20

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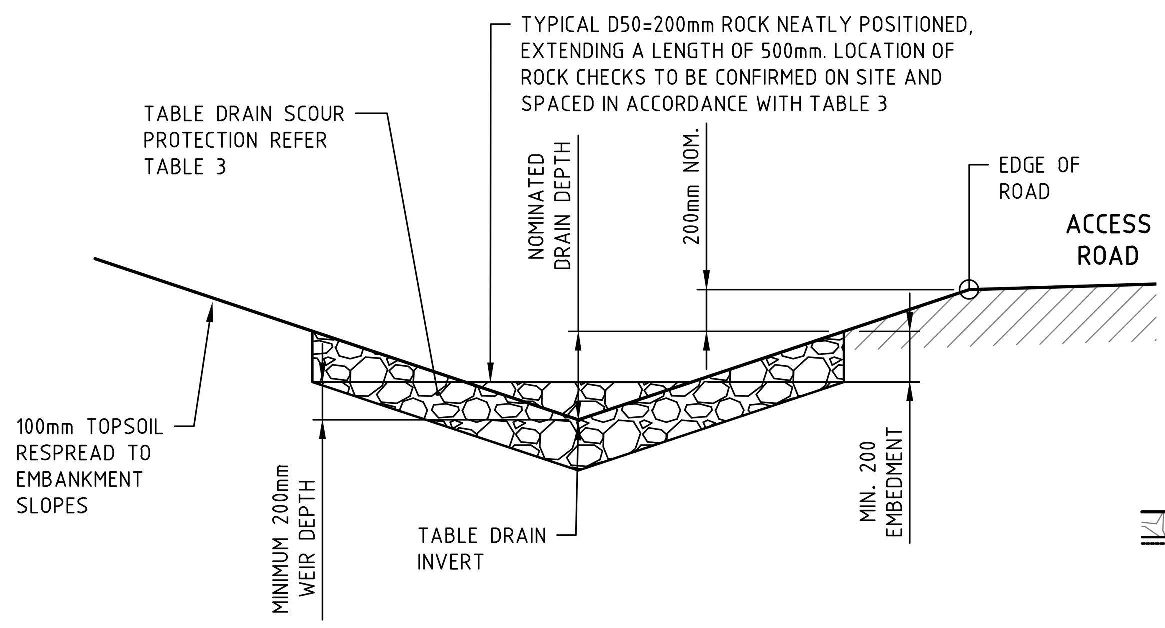
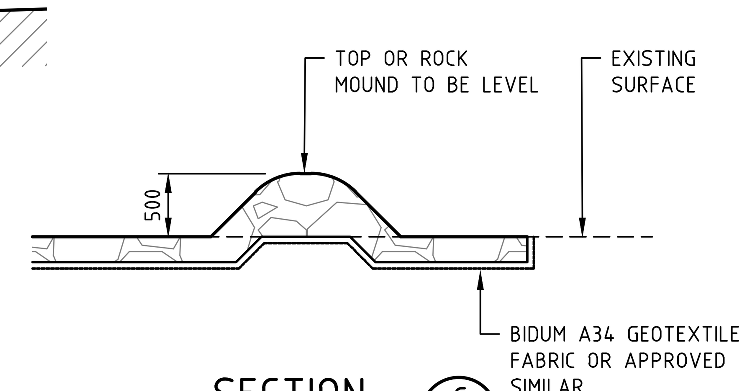
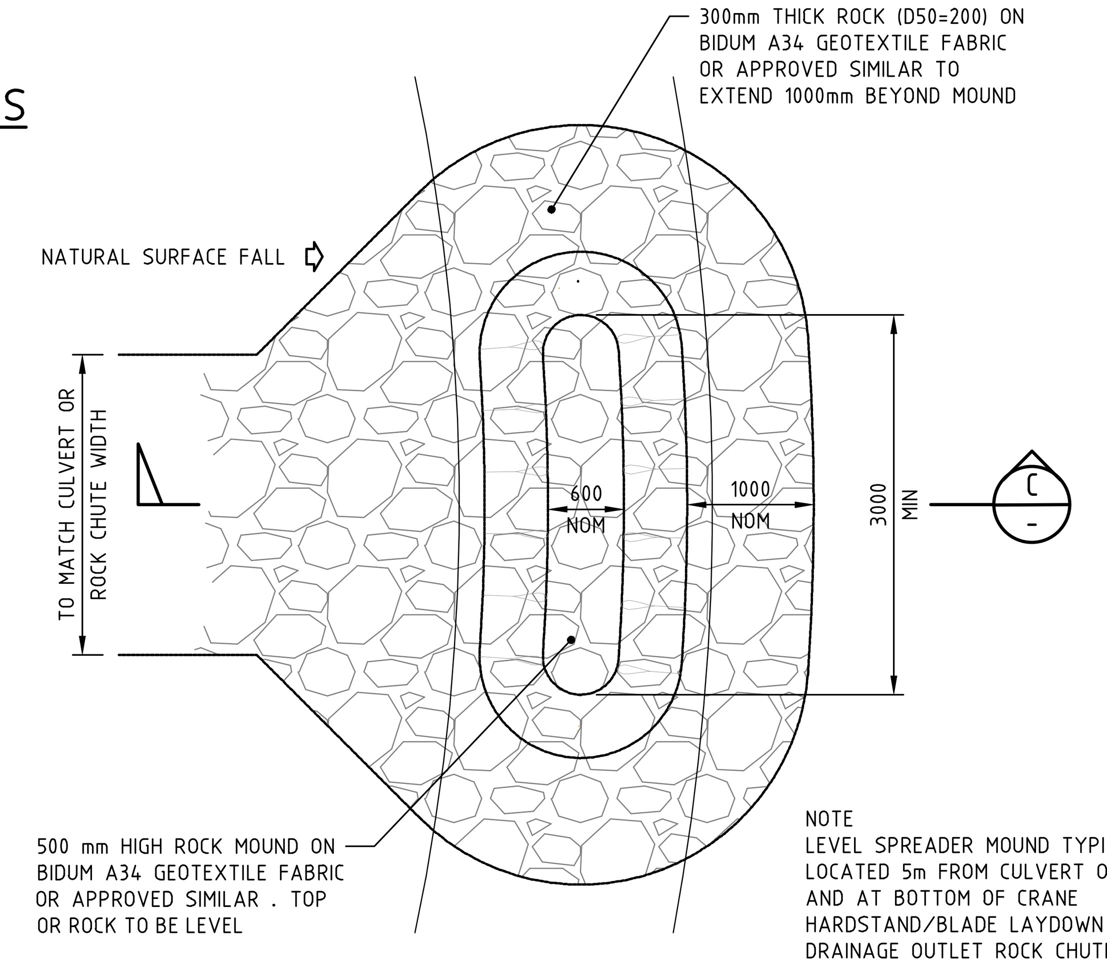


TYPICAL ROCK CHECK INSTALLATION DETAIL

SCALE 1:25



SECTION C
SCALE 1:50



PLAN - TYPICAL DRAINAGE LEVEL SPREADER

(FOR USE AS REQUIRED ON SITE)

SCALE 1:50

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C	01.11.2024	REISSUED FOR INFORMATION	KK	EN	EN

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TARONG WIND FARM
CIVIL WORKS
DRAINAGE DETAILS
PIPE ENBANKMENT

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Project Number Sheet No. Rev.
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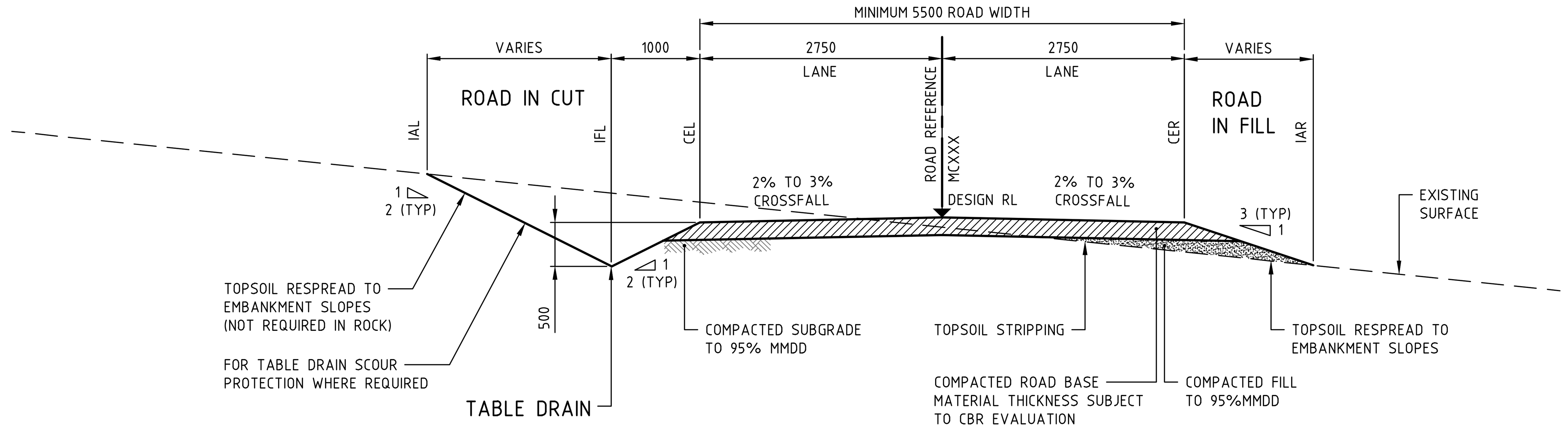
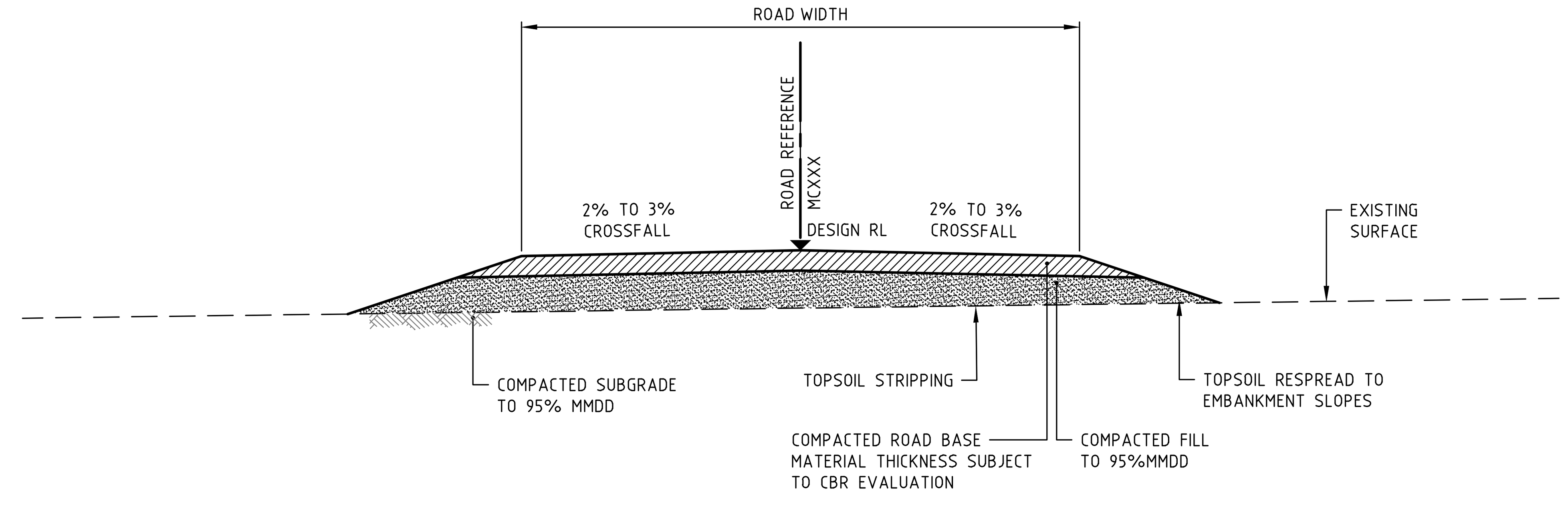
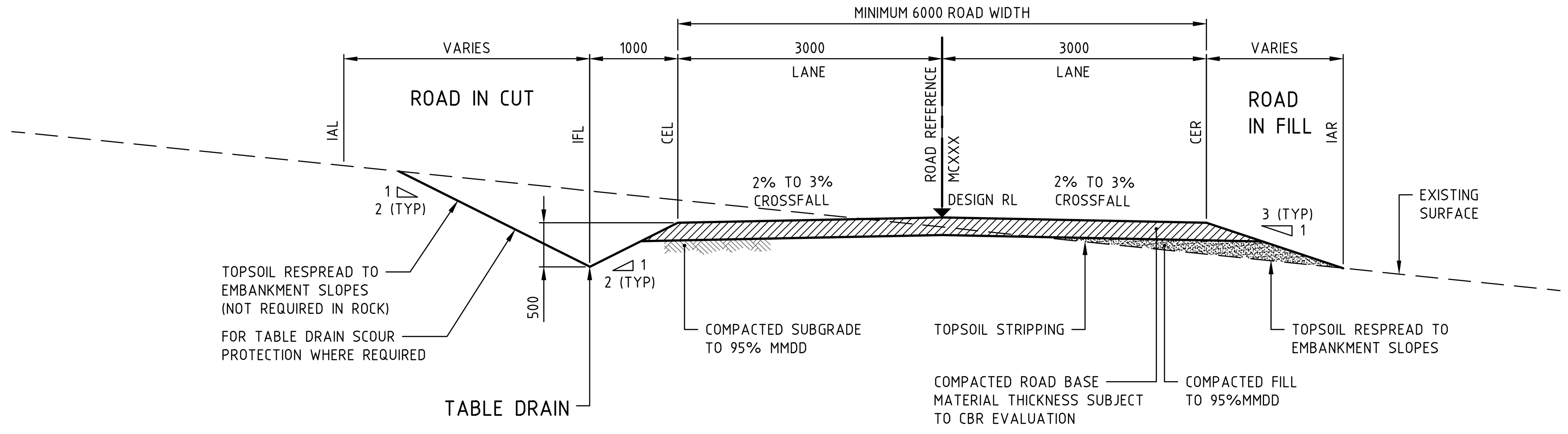


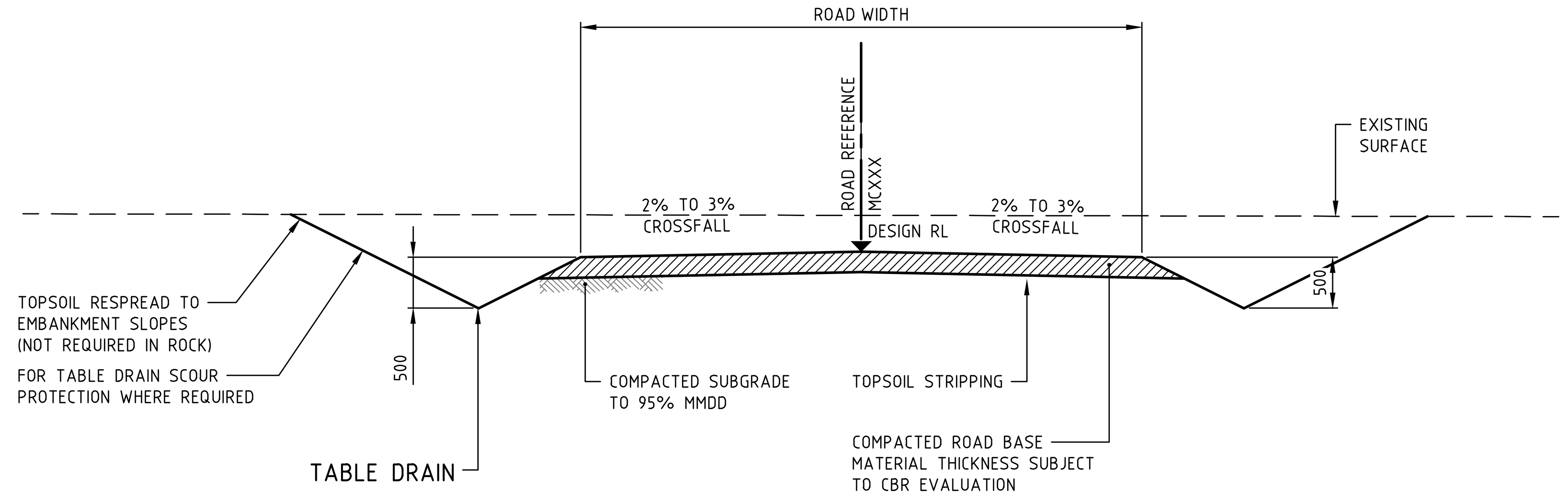
TYPICAL ACCESS ROAD - 5.5m CROWNED
SCALE 1:50



TYPICAL ACCESS ROAD - 100% FILL
SCALE 1:50



TYPICAL ACCESS ROAD - 6.0m CROWNED
SCALE 1:50



TYPICAL ACCESS ROAD - 100% CUT
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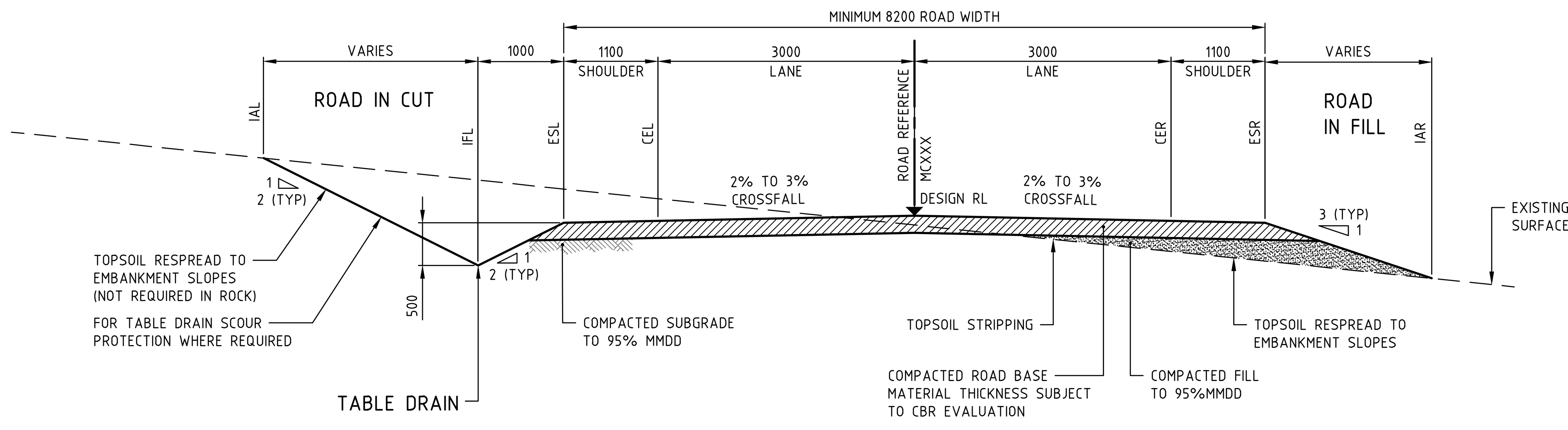

TYPICAL ACCESS ROAD - 8.2m CROWNED
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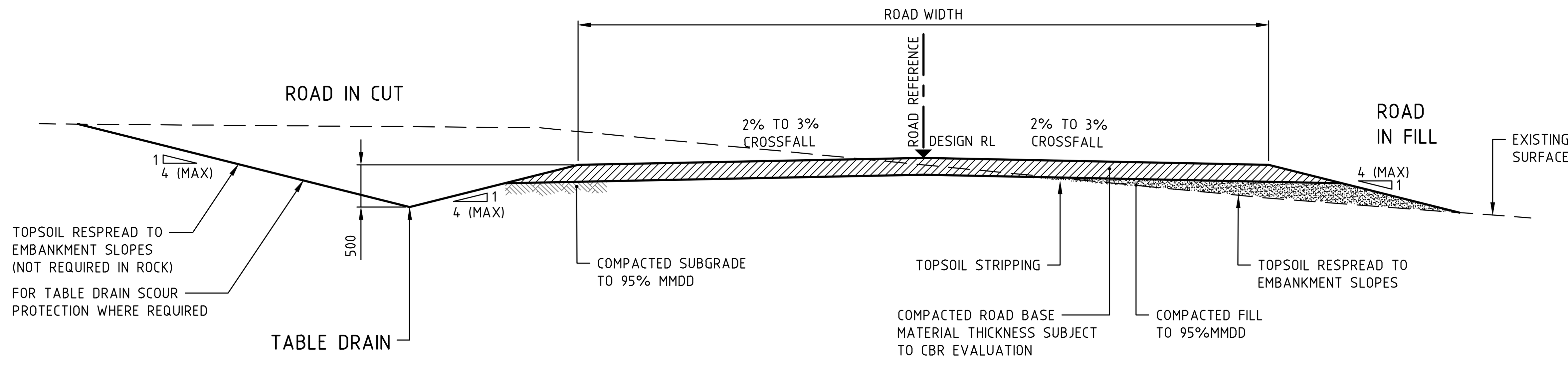

TYPICAL ACCESS ROAD - TRAFFICABLE
SCALE 1:50

PRELIMINARY PAVEMENT THICKNESS

PAVEMENT TYPE	CBR (%)	ROAD BASE MATERIAL MIN THICKNESS (mm)	DESIGN BEARING PRESSURE (KPa)
HARDSTAND	>20	200	250
	8	300	
	5	400	
	4	550	
	3	950	
AUXILIARY CRANE PAD	>20	200	250
	8	300	
	5	400	
	4	550	
	3	950	
ACCESS TRACK	>20	150	250
	8	170	
	5	230	
	4	260	
	3	300	
BLADE LAYDOWN AREAS	10	150	200
	5	200	
BOOM PADS	10	150	150
	5	200	

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D	24.11.2023	REISSUED FOR INFORMATION	PM	EN	MH
E	22.07.2024	REISSUED FOR INFORMATION	KK	EN	EN
F	01.11.2024	REISSUED FOR INFORMATION	KK	EN	EN

Vestas WGA

TARONG WIND FARM
CIVIL WORKS
TYPICAL DETAILS
ACCESS ROAD DETAILS

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