COFFS HARBOUR BYPASS

Construction Soil and Water Management Plan

CHBPW-FGJV-NWW-WA-PLN-000001-Revision J - Coffs Harbour Bypass

FERROVIAL GAMUDA JOINT VENTURE

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DOCUMENT DETAILS

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DOCUMENT AUTHORISATION

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J	17/04/2023	Update following DPE Water Comment, minor update to Appendix C (ER endorsed)	

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ABBREVIATIONS

Abbreviation	Expanded Text
ANZG	Australia and New Zealand Guidelines for Fresh and Marine Water Quality
ASS	Acid Sulfate Soil
ASSMP	Acid Sulfate Soil Management Plan
BOM	Bureau of Meteorology
CBMP	Construction Biodiversity Management Plan
CEMP	Construction Environmental Management Plan
CHB	Coffs Harbour Bypass
CLMP	Contaminated Land Management Plan
CSSI	Critical State Significant Infrastructure
CSWMP	Construction Soil and Water Management Plan
DAWE	Commonwealth Department of Agriculture, Water and Environment
DPE	NSW Department of Planning and Environment
DPE, EESG	NSW Department of Planning and Environment – Environment, Energy and Science Group
DPI	NSW Department of Primary Industries
EIS	Environmental Impact Statement
ESCP	Erosion and Sediment Control Plan
EEC	Endangered Ecological Community
EMM	Environmental Management Measures
EPA	NSW Environment Protection Authority
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
EPL	Environmental Protection Licence
EWMS	Environmental Work Method Statements
FGJV	Ferrovial Gamuda Joint Venture
MCoA	Ministers Conditions of Approval
OEH	Office of Environment and Heritage
PDCMP	Panama Disease Control Management Plan
PESCP	Progressive Erosion and Sediment Control Plan
PIRMP	Pollution Incident Response Management Plan
PDLP	Place Design Landscape Plan
POEO Act	Protection of the Environment Operations Act 1997
R1	Panama disease - Tropical Race 1
RAP	Remediation Action Plan
REMM	Revised Environmental Management Measure
RUSLE	Revised Universal Soil Loss Equation
SEPP	NSW State Environmental Planning Policy

STR4	Panama disease – Subtropical Race 4
SWMP	Soil and Water Management Plan
TSC Act	Threatened Species Conservation Act 1995
WQO	Water Quality Objectives
WRMP	Waste and Resources Management Plan

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1 INTRODUCTION

1.1 CONTEXT

This Construction Soil and Water Management Sub Plan (CSWMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for the Coffs Harbour Bypass (the Project).

This CSWMP has been prepared to address the requirements of the Minister's Conditions of Approval (MCoA), the environmental management measures listed in the Coffs Harbour Bypass Environmental Impact Statement (EIS), Submissions and Amendment Report and all applicable legislation.

1.2 BACKGROUND

Chapters 17, 18, 19 and 20 of the Coffs Harbour Bypass EIS assessed the Project's likely potential flooding, hydrology, soil, sediment, and water quality impacts. As part of the EIS development, a detailed flooding and water quality assessment was prepared to address the Secretary's Environmental Assessment Requirements issued by the Department of Planning and Environment (DPE).

The EIS identified the potential for direct and indirect impacts on soil and water quality but concluded that provided the proposed mitigation and management measures are implemented, no significant long-term impacts would be expected.

1.3 ENVIRONMENTAL MANAGEMENT SYSTEMS OVERVIEW

The environmental management system overview is described in Section 4.1 of the CEMP.

The CEMP describes the overall system for environmental management. That system forms part of the environmental management framework of the Coffs Harbour Bypass project.

The CSWMP has been developed as part of the CEMP in consultation with:

- NSW Department of Primary Industries (Fisheries Branch) (DPI (Fisheries));
- NSW Department of Primary Industries (Water) (DPI (Water));
- NSW Department of Primary Industries (Agriculture) (DPI Agriculture); and
- City of Coffs Harbour.

The relevant CSWMP environmental control measures will be incorporated in detailed location or activity-specific Environmental Work Method Statements (EWMS) prepared and implemented for all high risk activities and all works undertaken within or adjacent to waterways, or immediately adjacent to drainage lines. The EWMS will detail measures to avoid or minimise risks from erosion and sedimentation to water quality and biodiversity. EWMSs will be developed in accordance with Section 4.1.5 of the CEMP.

In addition, Erosion and Sediment Control Plans (ESCPs) will be developed in consultation with an appointed project soil conservationist. The Primary ESCP (Appendix A of this CSWMP) includes an overarching erosion risk and hazard assessment; and identifies management strategies and controls to be implemented to effectively manage erosion and sedimentation during construction, including construction sediment basin requirements. The Primary ESCP will be complemented by Progressive ESCPs which provide site-specific details on location, timing and installation of erosion and sediment control measures. Progressive ESCPs will be regularly prepared and updated throughout construction in order to effectively capture changes in conditions, including:

- Construction activity or work location changes;
- Site condition changes;
- Flow path changes; and
- Other management plan changes that could impact on soil and water quality conservation.

This CSWMP will be reviewed as part of the CEMP (refer to Section 9 and Section 10 of the CEMP).

2 PURPOSE AND OBJECTIVES

2.1 PURPOSE

The purpose of this CSWMP is to describe how construction impacts on soil and water will be minimised and managed, during all phases of planning, construction and rehabilitation.

2.2 OBJECTIVES

The key objectives of the CSWMP are to ensure all MCoA, environmental management measures and licence requirements relevant to soil and water including water quality are described, scheduled and assigned responsibility as outlined in:

- The Environmental Impact Statement;
- Submissions and Amendment Reports prepared for the CHB project;
- MCoA;
- Transport for NSW (TfNSW) Specifications G36, G38 and G40; and
- NSW EPA issued Environment Protection Licence [to be obtained].

To achieve compliance with the conditions and objectives of the project requirement documents above, the Ferrovial Gamuda Joint Venture (FGJV) will undertake the following:

- Ensure appropriate measures are implemented to address the relevant MCoA outlined in Table 4 Ministers Conditions of Approval Relevant To The CSWMP and the safeguards detailed in the Submissions Report Revised Environmental Management Measures (REMMs) in Table 5 Relevant Revised Environmental Management Measures;
- Ensure best management practice controls and procedures are implemented during construction activities to avoid or minimise erosion/sedimentation impacts and potential impacts to water quality in rivers, creeks and groundwater along the Project corridor;
- Document the procedures and plans to manage construction work activities to avoid or minimise their soil, water and groundwater impacts; and
- Ensure that work activities are managed so as not to cause a flood risk.

2.3 TARGETS

- The implementation of this Plan will be directed to the purpose of achieving the following targets which have been established for the management of soil and water quality impacts that may occur as the result of construction of the Project: Ensure full compliance with the relevant legislative requirements and Commonwealth and State MCoA;
- Meet Environmental Protection Licence water quality discharge parameters for all sediment basin discharges;
- Manage downstream water quality impacts attributable to the project (i.e., maintain waterway health by avoiding the introduction of nutrients, sediment and chemicals outside of that permitted by the environmental protection licence and/or ANZG guidelines);
- Implement enhanced erosion control measures and best management practice mitigation measures in catchments linked to the Solitary Islands Marine Park to minimise the potential for water quality impacts during all phases of construction and rehabilitation;
- Ensure training on best practice soil and water management is provided to all construction personnel through site inductions. More detailed training of staff directly involved with installation and maintenance of erosion and sediment controls is to be delivered, covering project specific approval requirements, Environmental Protection Licence (EPL) compliance and the erosion and sediment control principles detailed within “Managing Urban Stormwater: Soils and Construction, Volumes 1 and 2”;

- Ensure groundwater monitoring and protection measures are implemented to ensure that potential impacts to potable water supplies, groundwater dependent ecosystems, licenced abstractions or overlying soils are managed effectively;
- Manage potential or actual acid sulfate soils to prevent oxidation and any subsequent engineering, landscape, agricultural, ecological, aquacultural, ecotoxicological or human health impacts; and
- Manage potential or actual impacts associated with soils and vegetation affected by Panama disease and provide control measures, monitoring and reporting requirements to manage the risk of spread of Panama disease (Tropical Race 1 (R1) and Subtropical Race 4 (STR4)) associated with the Coffs Harbour Bypass Project.

The potential for a corrective action or other consequence as a result of any failing to achieve one of the above targets will be specific to the target which has not been met and will be determined by the compliance processes described in the CEMP.

2.4 ENVIRONMENTAL PERFORMANCE OUTCOMES

The EIS outlined a set of performance outcomes in Section 29-4. The performance outcomes related to soil and water are outlined within Table 1.

TABLE 1 SOIL AND WATER PERFORMANCE OUTCOMES

Desired performance outcome	Project outcome
Soils **The environmental values of land, including soils, subsoils and landforms, are protected. Risks arising from the disturbance and excavation of land and disposal of soil are minimised, including disturbance to acid sulfate soils and site contamination.**	• An erosion and sediment control plan is prepared and implemented prior to construction commencing and updated regularly during the construction period to suit specific site characteristics. • Construction is undertaken in accordance with the Soil and Water Management Plan and Contaminated Land Management Plan and as result any contaminated sites and contamination is managed in accordance with EPA requirements.
Water Quality **The project is designed, constructed and operated to protect the NSW Water Quality Objectives where they are currently being achieved, and contribute towards achievement of the Water Quality Objectives over time where they are currently not being achieved, including downstream of the project to the extent of the project impact including estuarine and marine waters (if applicable).**	• Operational water quality treatment measures are incorporated into the design to minimise impacts on sensitive receiving environments. • All temporary and permanent soil, erosion and water quality safeguards are inspected and maintained during construction to ensure effective implementation. Inspections assess success of the controls, actions required to ensure on-going effective operation, and compliance with any statutory approvals.
Water – Hydrology **Long term impacts on surface water and groundwater hydrology (including drawdown, flow rates and volumes) are minimised. The environmental values of nearby, connected and affected water sources, groundwater and dependent ecological systems including estuarine and marine water (if applicable) are maintained (where values are achieved) or improved and maintained (where values are not achieved). Sustainable use of water resources.**	• During construction, treated water is reused as construction water or dust suppression; • Changes to environmental water availability and flows are minimised, and impacts on natural hydrological attributes, including creeks, waterways and groundwater sources are minimised; and • Waterway realignments are designed to maintain a similar hydrologic and geomorphic manner as the existing conditions, and the design addresses the requirements of DPIE.
Flooding **The project minimises adverse impacts on existing flooding characteristics. Construction and operation of the project avoids or minimises the risk of, and adverse**	• Flooding associated impacts during construction are minimised and/or managed through the implementation of the Construction Flood Management Plan; and

impacts from, infrastructure flooding, flooding hazards or dam failure.	• The project reduces flood extents and peak water levels downstream of the project in accordance with the floodplain management objectives.

3 ENVIRONMENTAL REQUIREMENTS

Soil and water management protection is governed and provisioned by associated legislation, regulation and guidelines as well as the committed mitigation measures and relevant MCoA.

3.1 RELEVANT LEGISLATION AND GUIDELINES

3.1.1 LEGISLATION

Table 2 lists the principal legislation and regulation that applies to soil and water management. A full list of legislation required is detailed in Appendix A of the CEMP.

TABLE 2 PRINCIPAL LEGISLATION AND REGULATION RELEVANT TO SOIL AND WATER MANAGEMENT

Legislation and regulation	Relevance
Protection of the Environment Operations Act 1997 (POEO Act)	Details requirements surrounding water pollution control, plant maintenance and operation, materials management requirements, land pollution and reporting contamination.
Protection of the Environment (General) Regulation 2009 (as amended)	Supports the operation of the POEO Act at least cost to the community and assists the NSW Environment Protection Authority to achieve the objectives of the POEO Act and other legislation that it administers.
***Environmental Planning and Assessment Act 1979* (EP&A Act).**	Describes the processes for consenting development in NSW, managing land use and implementing environmental planning instruments. Describes certain permitting and licencing streaming and exclusion provisions that will apply to the work.
Water Management Act 2000	Describes the requirements surrounding water access and use, water management works and waterfront land.
National Environment Protection (Assessment of Site Contamination) Measure 1999	Provides national objectives with general guidelines for the assessment of site contamination
Contaminated Land Management Act 1997 (CLM Act)	Provides requirements for reporting contamination and notification to the EPA.
Soil Conservation Act 1938	Provides for the conservation of soil resources and farm water resources and for the mitigation of erosion
Fisheries Management Act 1994	Provides for conservation of key fish habitats, threatened species, populations and ecological communities of fish and marine vegetation
Marine Estate Management Act 2014	Provides for the management of the marine estate (coastline, estuaries, and marine waters of NSW), marine parks and aquatic reserves
Marine Estate Management Regulation 2017	Regulation supporting the Marine Estate Management Act 2014
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	Provides a framework for protection of the Australian environment, including its biodiversity and its natural and culturally significant places

3.1.2 GUIDELINES AND STANDARDS

The main guidelines, specifications and policy documents relevant to this plan are detailed in Table 3.

TABLE 3 GUIDELINES AND STANDARDS RELEVANT TO SOIL AND WATER MANAGEMENT

Guidelines and standards	
Quality Assurance	• Quality Assurance Specification G36: Environmental Protection (TfNSW); • Quality Assurance Specification G38: Soil & Water Management (TfNSW); and • Quality Assurance Specification G40: Clearing and Grubbing (TfNSW).
Dewatering	• Technical Guideline: Environmental Management of Construction Site Dewatering (EMS-TG-011) (Roads and Maritime, 2011); and • Pacific Highway Practice Note for Dewatering (Roads and Maritime, 2014).
Acid sulphate soil management	• Guidelines for the Management of Acid Sulfate Materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulphidic Black Ooze (Roads and Maritime, 2005); • Acid Sulfate Soils Assessment Guidelines (Acid Sulfate Soil Management Advisory Committee, 1998); • Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998); • Acid Sulfate Soil and Rock Publication 655.1 (Environment Protection Authority Victoria (EPA Victoria), July 2009); • Waste Classification Guidelines Part 4: Acid Sulfate Soils (EPA. 2014); • Sulfate Specification for Structural Backfills (Reid, J M, Czerewko, M A & Cripps, J C, 2001); • National Acid Sulfate Soils Guidance - National Acid Sulfate Soils Sampling and Identification Methods Manual (Department of Agriculture Water and the Environment 2022); *and* • National Acid Sulfate Soils Guidance - National Acid Sulfate Soils Identification and Laboratory Methods Manual (Department of Agriculture Water and the Environment 2022).
Biodiversity	• Biodiversity Guidelines – Protecting and managing biodiversity on RTA projects (2011).
Saline soil management	• Roads and Salinity (Department of Infrastructure, Planning and Natural Resources, 2003); • Introduction to Urban Salinity (Department of Natural Resources (DNR), 2006); • Building in a Saline Environment (DNR, 2006); and • Salinity Management Guidelines (Blacktown City Council and Landcom, 2008).
Water quality management	• Australian and New Zealand Guidelines for Fresh and Marine Water Quality. (ANZG 2018); • Water sensitive urban design guideline (Roads and Maritime 2017d); • Policy and Guidelines for Fish Habitat Conservation and Management (DPI 2013); • Controlled Activities for Works on Waterfront Land – Instream Works (DPI 2012c); • NSW Water Quality Objectives Objectives (WQO) and indicators defined in the Ecohealth Project; • Australian Drinking Water Guidelines (Natural Resource Management Ministerial Council (NRMMC), 2011); • Guidelines for Controlled Activities for Works on Waterfront Land – Outlet Structures (DPI 2012b); and • Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (NSW Environment Protection Authority, 2004).
Floodplain management	• Floodplain Risk Management Guideline: Practical Consideration of Climate Change (Department of Environment and Climate Change (DECC), 2007).
Contaminated land, biosecurity and groundwater management	• Guideline for the Management of Contaminated Land (Roads and Maritime, 2013); • Guidelines for Assessment and Management of Contaminated Groundwater (Department of Environment and Conservation (DEC), 2007);

	• Queensland's Department of Agriculture and Fisheries guidelines including Panama disease tropical race 4: Biosecurity standards and guidelines (2015) and Panama disease tropical race 4: Decontamination guide (2016); • National Environment Protection (Assessment of Site Contamination) Measure April 2011 Schedule B1 Guideline on Investigation Levels for Soil and Groundwater; • Environment Protection Authority: Sampling design part 1 - application, Contaminated Land Guidelines 2022; and • Environment Protection Authority: Sampling design part 2 - interpretation, Contaminated Land Guidelines 2022.
Watercourse crossings	• Department of Primary Industries Guidelines for Controlled Activities (2012); • Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings. NSW Fisheries, Cronulla, 16 pp (Fairfull, S. and Witheridge, G. (2003)); and • Technical Briefing Note: Temporary Waterway Crossings Minimum Standards (Pacific Complete 2017).
Erosion and sediment control (including stormwater, stockpile and spill management)	• Code of Practice for Water Management: Roads and Development Management (Roads and Maritime, 1999); • Environmental Direction: Management of Tannins from Vegetation Mulch (Roads and Maritime, 2012); • Technical Guideline: Temporary Stormwater Drainage for Road Construction (Roads and Maritime, 2011); • Guidelines for Construction Water Quality Monitoring (Roads and Maritime, 2003); • Stockpile Site Management Guidelines (Roads and Maritime, 2008); • Managing Urban Stormwater: Soils and Construction, Volume 1 and Volume 2 (Landcom, 2004) (also referred to as the 'Blue Book'); • Bunding and Spill Management: Insert to the Environmental Protection Manual for Authorised Officers (Technical Section) (NSW Department of Environment and Conservation (DEC), 1997); • Guidelines for Treatment of Stormwater Runoff from the Road Infrastructure (AP-R232) (AusRoads, 2003); • Guideline for Batter Stabilisation Using Vegetation (Roads and Maritime Services (2015); • Australian Standard: AS1940 – 2004, The Storage and Handling of Flammable and Combustible Liquids (Standards Australia, 2004); • Environmental Best Management Practice Guideline for Concreting Contractors (DEC, 2004); • IECA (2008) Best Practice Erosion and Sediment Control; and • IECA Best Practice Erosion and Sediment Control Appendix A 2018 revision.
Waste Classification Guidelines	• Waste Classification Guidelines Part 1: Classifying waste (NSW EPA, 2014); • Waste classification guidelines Part 2: Immobilisation of waste (NSW EPA, 2014); and • Waste classification guidelines Part 4: Acid sulfate soils (NSW EPA, 2014).

3.2 MINISTER'S CONDITIONS OF APPROVAL

The MCoA relevant to this Plan are listed in Table 4 below. A cross reference is also included to indicate where the condition is addressed in this Plan or other Project management documents.

TABLE 4 MINISTERS CONDITIONS OF APPROVAL RELEVANT TO THE CSWMP

<table>
<tr><th>CoA No.</th><th>Condition Requirements</th><th>Document Reference</th></tr>
<tr><td>C4</td><td>The CEMP Sub-plans in Table 3 must be prepared in consultation with the government agencies identified for each CEMP Sub-plan. The outcomes of consultation with government agencies in accordance with Condition A5 must be provided with the relevant CEMP Sub-Plan.
<table>
<tr><th></th><th>Required CEMP Sub-plan</th><th>Relevant government agencies to be consulted for each CEMP Sub-plan</th></tr>
<tr><td>(f)</td><td>Soil and water</td><td>DPI Fisheries, DPIE Water Group, DPI Agriculture, Council</td></tr>
</table></td><td>Evidence of consultation process to be provided with finalised document in submission to DPE.</td></tr>
<tr><td>C5</td><td>The CEMP Sub-plans must state how:
(a) the environmental performance outcomes identified in the documents listed in Condition A1 will be achieved;
(b) the mitigation measures identified in the documents listed in Condition A1 will be implemented;
(c) the relevant terms of this approval will be complied with; and
(d) issues requiring management during construction, as identified through ongoing environmental risk analysis, will be managed.</td><td>CSWMP Sections 3, 4, 5, 6, 7, 8 and Appendices</td></tr>
<tr><td>C6</td><td>Any of the CEMP Sub-plans may be submitted along with, or subsequent to, the submission of the CEMP but in any event, no later than one (1) month before construction.</td><td>Noted</td></tr>
<tr><td rowspan="4">C11</td><td>The Soil and Water Management Sub-plan must include:</td><td></td></tr>
<tr><td>a) details of enhanced erosion sediment controls in catchments that flow directly to the Solitary Islands Marine Park;</td><td>Primary Erosion and Sediment Control Plan</td></tr>
<tr><td>b) a construction water reuse strategy; and</td><td>Construction Water Reuse Strategy</td></tr>
<tr><td>c) a groundwater management plan.</td><td>Construction Surface and Ground Water Quality Monitoring Programs (TfNSW)</td></tr>
<tr><td>C12</td><td>Construction must not commence until the CEMP and all CEMP Sub-plans have been approved by the Planning Secretary. The CEMP and CEMP Sub-plans, as approved by the Planning Secretary, including any minor amendments approved by the ER must be implemented for the duration of construction. Where construction of the Critical State Significant Infrastructure (CSSI) is staged, construction of a stage must not commence until the CEMP and sub-plans for that stage have been approved by the Planning Secretary.</td><td>Document control and approvals detailed in CSWMP version control table</td></tr>
<tr><td>C13</td><td>The Construction Monitoring Programs in Table 4 must be prepared in consultation with the relevant government agencies identified for each to compare actual performance of construction of the CSSI against the performance predicted in documents listed in Condition A1 or in the CEMP.
<table>
<tr><th></th><th>Required Construction Monitoring Programs</th><th>Relevant government agencies to be consulted for each Construction Monitoring Program</th></tr>
<tr><td>(a)</td><td>Air quality</td><td>EPA, DPI Agriculture, Council</td></tr>
<tr><td>(b)</td><td>Noise and vibration</td><td>EPA, Council.</td></tr>
<tr><td>(c)</td><td>Surface & Ground Water Quality</td><td>EPA, DPI Agriculture, DPI Fisheries, DPIE Water Group, Council</td></tr>
</table></td><td>Construction Surface and Ground Water Quality Monitoring Programs (TfNSW)</td></tr>
</table>

CoA No.	Condition Requirements	Document Reference
C14	Each Construction Monitoring Program must provide: (a) details of baseline data available; (b) details of baseline data to be obtained and when; (c) details of all monitoring of the project to be undertaken; (d) the parameters of the project to be monitored; (e) the frequency of monitoring to be undertaken; (f) the location of monitoring; (g) the reporting of monitoring results; (h) procedures to identify and implement additional mitigation measures where results of monitoring are unsatisfactory; and (i) any consultation to be undertaken in relation to the monitoring programs.	Construction Surface and Ground Water Quality Monitoring Programs (TfNSW)
C15	The Construction Monitoring Programs must be developed in consultation with relevant government agencies as identified in Condition C13 of this approval and must include information requested by an agency to be included in a Construction Monitoring Programs during such consultation. Details of all information requested by an agency including copies of all correspondence from those agencies, must be provided with the relevant Construction Monitoring Program.	Consultation records with relevant agencies provided to DPE with CSWMP submission
C16	The Construction Monitoring Programs must be endorsed by the ER and then submitted to the Planning Secretary for approval at least one month before the commencement of construction.	Consultation records with ER and written endorsement provided to DPE with CSWMP submission
C17	Construction must not commence until the Planning Secretary has approved all of the required Construction Monitoring Programs, and all relevant baseline data for the specific construction activity has been collected.	Construction Surface and Ground Water Quality Monitoring Programs (TfNSW)
C18	The Construction Monitoring Programs, as approved by the Planning Secretary including any minor amendments approved by the ER must be implemented for the duration of construction and for any longer period set out in the monitoring program or specified by the Planning Secretary, whichever is the greater.	Construction Surface and Ground Water Quality Monitoring Programs (TfNSW)
C19	The results of the Construction Monitoring Programs must be submitted to the Planning Secretary, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program. Note: Where a relevant CEMP Sub-plan exists, the relevant Construction Monitoring Program may be incorporated into that CEMP Sub-plan.	Construction Surface and Ground Water Quality Monitoring Programs (TfNSW)
E77	All reasonably practicable erosion and sediment controls must be installed and appropriately maintained to minimise water pollution. When implementing such controls, any relevant guidance in the Managing Urban Stormwater series must be considered.	CSWMP Primary Erosion and Sediment Control Plan
E78	Prior to the commencement of construction that would result in the disturbance of potential or contaminated land and/or soil, a **Site Contamination Report** must be prepared and submitted to the Planning Secretary for Information. The report must be consistent with *Contaminated Land Management Act 1997* (NSW) and prepared by a suitably qualified and experienced person. Nothing in this condition prevents the Proponent from preparing individual Site Contamination Reports for separate sites. Under this condition Panama disease is not considered to be a contaminant.	Contaminated Land Management Plan
E79	The Site Contamination Report must provide details on: (a) the outcomes of Stage 1 and Stage 2 contamination assessments; (b) nature and extent of any existing remediation (such as impervious surface cappings);	Contaminated Land Management Plan

CoA No.	Condition Requirements	Document Reference
	(c) measures to identify handle and manage potential contaminated soils, materials and groundwater; (d) whether the land is suitable (for the intended final land use) or can be made suitable through remediation; and/or (e) potential contamination risks from the CSSI to human health and receiving waterways.	
E80	Should remediation be required to make land suitable for the final intended land use, a **Remediation Action Plan** (RAP) must be prepared and implemented and submitted to the Planning Secretary for information prior to undertaking remediation. The plan must detail how the environmental and human health risks will be managed during the disturbance, remediation and/or removal of contaminated soil or groundwater.	Contaminated Land Management Plan
E81	If remediation is required, a **Section A Site Audit Statement** and **Site Audit Report**, must be prepared by a Site Auditor accredited by the EPA under the *Contaminated Land Management Act 1997* (NSW). Nothing in this condition prevents the Proponent from engaging the Site Auditor to prepare Site Audit Statements for individual work sites.	Contaminated Land Management Plan
E82	A **Section A Site Audit Statement** and its accompanying **Section A Site Audit Report**, which state that the contaminated land disturbed by the work has been made suitable for the intended land use, must be submitted to the Planning Secretary and Council after remediation and no later than prior to the commencement of operation of the CSSI. Contaminated land must not be used for the purpose approved under the terms of this approval until a Section A Site Audit Statement is obtained which states that the land is suitable for that purpose and any conditions on the Section A Site Audit Statement have been complied with.	Contaminated Land Management Plan
E83	An **Unexpected Contaminated Land and Asbestos Finds Procedure** must be prepared and submitted to the Planning Secretary before the commencement of work and must be followed should unexpected, contaminated land or asbestos (or suspected contaminated land or asbestos) be excavated or otherwise discovered. The requirements of **Conditions E79** to **E82** must be incorporated into this Procedure.	Contaminated Land Management Plan
E84	The **Unexpected Contaminated Land and Asbestos Finds Procedure** must be implemented throughout work.	Contaminated Land Management Plan
E103	The CSSI must be designed, constructed and operated so as to maintain the NSW *Water Quality Objectives* where they are being achieved as at the date of this approval, and contribute towards achievement of the NSW *Water Quality Objectives* over time where they are not being achieved as at the date of this approval, unless an EPL in force in respect of the CSSI contains different requirements in relation to the NSW *Water Quality Objectives*, in which case those requirements must be complied with.	Compliance process in CSWM Construction Water Quality Impact Review
E104	A **Construction Water Quality Impact Review**, consistent with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018), must be prepared prior to commencement of construction. The water quality impact review must address the matters in **Appendix B**. The **Construction Water Quality Impact Review** must be submitted to the EPA and Planning Secretary for information one month before the commencement of construction.	Construction Water Quality Impact Review

CoA No.	Condition Requirements	Document Reference
E105	Drainage feature crossings (permanent and temporary watercourse crossings and stream diversions) and drainage swales and depressions must be carried out in accordance with relevant guidelines and designed by a suitably qualified and experienced person.	CSWMP Primary Erosion and Sediment Control Plan Detailed design
E106	The Proponent must consider the Guidelines for controlled activities on waterfront land riparian corridors (Department of Industry 2018) when carrying out work within 40 metres of a watercourse, including its bed.	CSWMP Primary Erosion and Sediment Control Plan, EWMS Detailed design
E107	Where water abstraction from a waterway is proposed, a qualified aquatic ecologist must be engaged to assess if it is suitable for water abstraction and when pumping must cease.	CSWMP Construction Water Reuse Strategy, EWMS CBMP
E108	Any pumps sumps used in natural waterways must be screened with mesh no greater than 5mm in size.	EWMS, Construction Water Reuse Strategy CBMP
E110	Operational groundwater inflows into each tunnel must be no greater than one litre per second across any given kilometre (1L/s/km). Compliance with this condition cannot be determined by averaging groundwater inflows across the length of the tunnel(s).	Design Report
E111	The Proponent must identify and commit to the implementation of 'make good' provisions for groundwater users in the event of a material decline in water supply levels, quality and quantity from existing registered bores associated with groundwater changes from either construction and/or ongoing operational dewatering caused by the CSSI.	CSWMP Section 7 – Compliance Management Design Reports

3.3 ENVIRONMENTAL MANAGEMENT MEASURES

Relevant REMMs from the EIS Submissions and Amendment Reports are listed in Table 5 below. This includes reference to required outcomes, the timing of when the commitment applies, relevant documents or sections of the environmental assessment influencing the outcome and implementation.

TABLE 5 RELEVANT REVISED ENVIRONMENTAL MANAGEMENT MEASURES

Ref#	Commitment	CSWMP Reference
UD02	Temporary and permanent drainage infrastructure will be designed to incorporate water sensitive urban design principles where possible in accordance with the Water Sensitive Urban Design Guideline (Roads and Maritime 2017d). This could include replacing concrete lined longitudinal catch drains with vegetated swales and the operational water quality control measures.	Detailed design
SC01	Phase 2 contamination investigations will be undertaken in areas of potential contamination identified during the preliminary site investigation (RCA 2016). The investigation will be carried out in accordance with the Guideline for the Management of Contamination (Roads and Maritime Services 2013d). This will include soil sampling from targeted areas including: • Banana plantations within proposed cuttings (analysed for arsenic, lead and organochlorin pesticides including DDT, Aldrin and Dieldrin);	CSWMP Site Contamination report CBMP Appendix H – Panama Disease Control Management Plan (PDCMP)

Ref#	Commitment	CSWMP Reference
	• Incremental soil sampling along construction footprint at existing Pacific Highway where there is a history of truck accidents to assess potential lead and hydrocarbon contamination; • Targeted soil sampling at locations with dumped materials, fill materials and other agricultural uses; and • Areas of PASS within construction footprint to determine oxidised pH level.	
SC02	A Contaminated Land Management Plan will be prepared and implemented as part of the CEMP for any areas of existing contaminated land or to address land contamination likely to be caused by the activity. The plan will be prepared in accordance with relevant requirements of the Guideline for the Management of Contamination (Roads and Maritime Services 2013d). As a minimum the plan will address the following matters: • Control measures to divert surface runoff away from the contaminated land; • Capture and manage of any surface runoff contaminated by exposure to the contaminated land; • Further investigations required to determine the extent, concentration, and type of contamination, as identified in the Phase 2 contamination investigations; • Manage the remediation and subsequent validation any certification land, including any certification required; • Measures to ensure the safety of site personnel and local communities during construction; and • Procedures to identify and manage any unexpected contamination finds during construction.	CSWMP Contaminated Land Management Plan
SC03	If site contamination investigations indicate that construction works will impact contaminant that are present on site in concentrations above the intended land use criteria, then a Remedial Action Plan will be developed, and remediation works carried out in consultation with the EPA and in accordance with the Guideline for the Management of Contamination (Roads and Maritime Services 2013d).	CSWMP Contaminated Land Management Plan
SC04	A Soil and Water Management Plan will be prepared in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom 2004) and Appendix B, updated erosion and sediment management report of the Submissions Report and implemented as part of the CEMP. The plan will identify all reasonably foreseeable risks relating to soil erosion and water pollution associated with carrying out the activity and describe how these risks will be managed and minimised during construction. The plan will include arrangements for managing pollution risks associated with spillage or contamination on the site and adjoining areas.	CSWMP and appendices
SC05	A primary Erosion and Sediment Control Plan will be prepared and implemented as part of the Soil and Water Management Plan. The plan will identify detailed measures and controls to be applied to minimise erosion and sediment control risks including: • Runoff, diversion, and drainage points; • Sediment basins and sumps; • Scour protection; • Stabilising disturbed areas as soon as possible, check dams, fencing and swales; and • The need for site-specific plans to address staged implementation arrangements. The plan will also include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	CSWMP Primary Erosion and Sediment Control Plan
SC06	A suitably qualified and experienced soil conservationist will be engaged during construction of the project to advise and review the implementation and management of erosion and sediment controls.	Site ESCP's and Inspection Reports

Ref#	Commitment	CSWMP Reference
SC07	Batters will be designed and constructed to minimise risk or exposure, instability and erosion, and to support long term, ongoing best practice management, in accordance with the Guideline for Batter Stabilisation Using Vegetation (Roads and Maritime Services 2015f). In considering the application of best practice management, the combination of mulch and topsoil, in establishing vegetation on batters will also be investigated.	Detailed design
SC08	A site-specific emergency spill response procedure will be developed as part of the Soil and Water Management Plan and include spill management measures in accordance with the Roads and Maritime Code of Practice for Water Management and relevant EPA guidelines. The procedure will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities.	CSWMP Incident Response Protocol
SC09	An Acid Sulfate Soils Management Plan will be prepared and implemented as part of the Soil and Water Management Plan. The plan will be prepared in accordance with the Guidelines for the Management of Acid Sulfate Materials (RTA 2005).	CSWMP Acid Sulfate Soils Management Plan
WM06	Where reasonable and feasible, water captured within the construction footprint will be prioritised for reuse as construction water or dust suppression.	CSWMP Construction Water Reuse Strategy, EWMS
SW01	A Water Quality Monitoring Program will be prepared and implemented prior to and during construction and operation to identify whether the project is resulting in adverse impacts on water quality and assess compliance with statutory requirements and project targets. Monitoring will continue for a period of three years following construction, or before if it can be proved that no impact has occurred. The monitoring program will be prepared in accordance with the Guideline for Construction Water Quality Monitoring (RTA n.d.) and details provided in Chapter 19, Surface water quality of the EIS. The monitoring program will include requirements for: • Identification of monitoring locations which are representative of the potential impacts; • Collection of baseline information prior to construction; • Consideration of the identified sensitive environments; • Water quality objectives to assess potential impacts against; • Contingency and ameliorative measures in the event that adverse impacts are experienced; and • Reporting of the monitoring results.	CSWMP – Construction Surface and Groundwater Quality Monitoring Programs (TfNSW).
SW02	Dewatering of existing storages (e.g. dams) will occur overland in vegetated areas or will be used for dust suppression activities and not discharged directly into waterways to minimise release of high levels of nutrients and or contaminants directly into the waterways.	EWMS
SW03	Any dewatering activities will be undertaken in accordance with the Technical Guideline: Environmental Management of Construction Site Dewatering (RTA 2011b), in a manner that prevents pollution of waters.	EWMS
SW04	A detailed Environmental Work Method Statement will be prepared and implemented for all works undertaken within or immediately adjacent to waterways. The Environmental Work Method Statement will detail measures to avoid or minimise risks from erosion and sedimentation to water quality and biodiversity. It will be prepared in accordance with relevant guidelines including, but not limited to consideration of: • Biodiversity Guidelines – Protecting and managing biodiversity on RTA projects; • Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings; and • Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom 2004).	EWMS

Ref#	Commitment	CSWMP Reference
SW05	Mulch stockpiles and the potential generation of tannin leachates will be managed through the implementation of a Management of Tannins from Vegetation Mulch Procedure. The procedure will be prepared in accordance with the Environmental Direction for the Management of Tannins from Vegetation Mulch (Roads and Maritime Services 2012). The procedure will include but not be limited to: • Planning and staging vegetation processing activities; • Management of temporary mulch stockpiles (less than one week); • Stockpile location and management to minimise the production and release of tannins including use of impermeable bunds and sumps to capture tannin leachate; • Monitoring the stockpiles for the production of tannin leachate including post-rainfall inspection requirements; and • Response(s) to tannin leachate production.	CSWMP- Management Of Tannins From Vegetation Mulch, EWMS
SW06	An inspection and monitoring program as part of the Soil and Water Management Plan will be implemented during construction to ensure effective implementation of all temporary and permanent soil, erosion, and water pollution safeguards. The timing and frequency of inspections will be set out in the Soil and Water Management Plan. The inspections will assess implementation and success of the controls, actions required to ensure ongoing effective operation, and compliance with any statutory approvals. A register of inspections will be established.	CSWMP Section 7.3
SW07	Stormwater and road runoff will be directed towards operational water quality treatment structures that will assist in the removal of pollutants from discharge water to protect ecosystem and human health.	Detailed design
SW08	The type and design of the specific stormwater treatment measures will continue to be refined as part of the detailed design process with the aim of achieving the NSW Water Quality Objectives where reasonable and feasible. This will include review of the proposed stormwater treatment train and consideration of best management practice guidelines including the Water sensitive urban design guideline (Roads and Maritime Services 2017d).	Detailed design
GW01	Stockpiles containing PASS or ASS treatment areas will be lined and bunded in accordance with the Guidelines for the Management of Acid Sulfate Materials (RTA 2005) to prevent leachate contaminating groundwater.	Acid Sulfate Soils Management Plan
GW02	Additional groundwater monitoring standpipes will be included for Type A cuts for alluvial aquifers along the project and in the areas around the major embankments to supplement existing data.	Groundwater Monitoring program (TfNSW) Groundwater Management Plan
GW03	Captured groundwater from tunnelling will be treated using temporary water treatment plants and transferred to storage dams for reuse during construction as a source of non-potable water.	Groundwater Monitoring Program (TfNSW) Groundwater Management Plan
GW04	Unless used as a source of non-potable water for the project, groundwater captured by cuttings and tunnels will be returned into the aquifer down gradient and within the same catchment from where it was intercepted where reasonable and feasible.	Construction Water Reuse Strategy Groundwater Management Plan
GW05	Engineering measures for long-term management of groundwater inflow to cuttings and tunnels will be designed and constructed to ensure groundwater is recharged downgradient of the cutting or tunnel from where it is captured and within the same catchment where reasonable and feasible. This will be facilitated by, but not limited to, absorption trenches, infiltration galleries/pits, sediment basins, and grassed swales.	Finalised drainage design drawings Groundwater Management Plan
GW06	Where groundwater recharge downgradient of the cutting or tunnel is not reasonable and feasible, measures will be designed and implemented that transfer seepage water downstream via water quality basins before being discharged into a downstream drainage channel or creek, within the same catchment.	Finalised drainage design drawings Groundwater Management Plan

Ref#	Commitment	CSWMP Reference
GW07	Additional geotechnical and hydrological investigations and modelling will be carried out for the Gatelys Road tunnel during detailed design to improve predictions of likely groundwater inflows, inform construction methodologies and develop engineering measures to reduce groundwater ingress where inflow rates are still anticipated to exceed 1L/s per kilometre. Investigations and modelling will be undertaken in consultation with Water Group, DPIE.	Detailed Design Report Groundwater Management Plan
GW08	Monitoring of groundwater levels and quality will be included in the Water Quality Monitoring Program detailed in Chapter 19, Surface water quality SW01.	Groundwater Monitoring program (TfNSW) Groundwater Management Plan
GW09	Monitoring of seepage into cuttings will be carried out and evaluated against the predictions of the numerical modelling undertaken during detailed design.	Groundwater Monitoring Program (TfNSW) Groundwater Management Plan
GW10	Major embankments will be designed to enable distributed flow of surface water to prevent ponding.	Finalised design drawings
GW11	Additional ground truthing and site inspections will be undertaken for potentially impacted groundwater bores/supply wells (including supply well GW068986), springs, Jordans Creek (near Cut 20), and agricultural dams within and immediately surrounding the zone of drawdown. The purpose of the ground truthing and site inspections is to confirm predicted impacts and develop make good provisions where required in consultation with affected property owners.	Groundwater Monitoring Program (TfNSW) Groundwater Management Plan
GW12	Sites used for stockpiles, washdown areas, refuelling and chemical storage will be located away from areas of shallow groundwater or appropriately lined and bunded to protect groundwater.	Construction Ancillary Facilities Management Plan Erosion and Sediment Control Plan
AG02	Impacted irrigation water sources and/or infrastructure will be restored, replaced, relocated, or compensated for in consultation with affected property owners.	Finalised design drawings, Property Adjustment Plans
FF28	Coffer dams will be used during work undertaken within or immediately adjacent to waterways where reasonable and feasible to prevent or minimise increased turbidity. In the event that coffer dams are not reasonable and feasible, silt curtains would be used.	Detailed design, Erosion and Sediment Control Plans, EWMS
HZ04	All fuels, chemicals and other hazardous materials will be stored in a roofed, fire-protected and impervious bunded area at least 50 m from waterways, drainage lines, basins, flood-affected areas or slopes above 10%. Bunding design will comply with relevant Australian Standards and should generally be in accordance with guidelines provided in the EPA Authorised Officers Manual. Appropriate on-site signage will be provided to identify the materials stored.	Construction Ancillary Sites Establishment Management Plan, EWMS
HZ05	Appropriate spill containment equipment will be provided on-site and located at strategic, accessible locations.	Pollution Incident Response Management Plan, EWMS
FH05	During the initial establishment and operation period of realigned or adjusted waterways, regular inspections will be carried out to ensure effective design of the realignment. An inspection program will be documented in the Soil and Water Management Plan. The inspections will assess implementation and success of the controls and identify any maintenance actions required.	Inspection Records Table 14
FH06	Scour protection for bridges and culverts will be designed in accordance with Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge 2003) and Guidelines for Controlled Activities for Works on Waterfront Land – Outlet Structures (DPI 2012b).	Detailed Design Table 14

CoAs and REMMs relevant to the impact of construction on flooding are addressed in the Flood Management Plan prepared under CoA C4(c).

CoAs and REMMs relevant to the management of impact on aquatic or terrestrial flora and fauna, including biosecurity, are addressed in the Construction Biodiversity Management Plan (CBMP) prepared under CoA C4(b).

3.4 PERMITS AND LICENSES

An Environment Protection License (EPL) will apply to the Project. Management of soil and water pollution will be undertaken in accordance with the EPL, including the prevention of pollution through erosion and sedimentation controls, and the discharge of water offsite.

In accordance with legislative requirements, a Pollution Incident Response Management Plan (PIRMP) will be required for the licensed activity. The PIRMP will be prepared as a standalone document and will align with the Incident Response Protocol as provided in Appendix E.

An EPL will be obtained for relevant scheduled activities associated with the scope of work for the project. The EPL will prescribe water quality parameters to be measured and associated discharge criteria. They will also likely detail the monitoring and analytical requirements by reference to authority publications (e.g., Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (NSW Environment Protection Authority, 2004)). Any other relevant licenses or permits will be obtained in the lead up to and during construction as required.

4 EXISTING ENVIRONMENT

The following sections summarise what is known about factors influencing soils and water within and adjacent to the Project corridor. The key reference documents are the Project EIS Chapters 18, 19 and 20 and the CHB Submissions and Amendment Reports.

Site topography is highly variable and complex. In the southern third of the project, slopes are mostly very gentle (less than 5%) and include some low-lying, flood-prone lands. In the central and northern thirds of the proposal slopes are steeper, typically around 10 to 30% but with some small areas of very steep (around 65%) terrain.

4.1 SOILS

Soil landscapes intersected by the project are described within the document Soil Landscapes of the Coffs Harbour 1:100,000 Sheet Report (Milford 1999). Table 6 provides a summary of soil landscapes, including potential constraints that influence erosion and sediment control during construction. A map of soil landscape units is shown in Figure 1.

Table 6 provides a summary of various soil landscape unit parameters (where these are described by Milford 1999).

TABLE 6 SOIL LANDSCAPE DESCRIPTIONS

Landscape name	Landscape type	Landscape description	Depth	Drainage	Soil description	Acidity, salinity/sodicity	Erodibility/ Hazards
Coffs Creek	Alluvial	Level to gently undulating floodplains	Deep	Moderate to poorly drained	Alluvial, yellow and red podzolic soils, yellow earths, Gleyed podzolic soils	Strong to very strong acidity	Foundation hazard, seasonal water logging, permanents high water tables, localised flood hazards
Ulong	Erosional	Undulating to rolling low hills on Late Carboniferous metasediments	Moderately deep to deep	Well drained	Red and brown earths, low wet bearing strength	Strongly to very strongly acidic soils	Localised water erosion hazard, steep slopes and high run-on
Newport Creek	Swamp	Low, level to gently undulating coastal back barrier floodplains on Pleistocene estuarine sediments	Deep	Poorly drained	Yellow podzolic soils and humic gleys. High topsoils organic matter and low fertility. Low to very low wet bearing strength	Strongly to very strongly acidic, strongly sodic, strongly saline soils	Localised water erosion hazard, Flood hazard, seasonal water logging, foundation hazard
Moonee	Transferral	Undulating rises, footslopes and drainage plains next to steep low hills on Carboniferous metasediments	Moderately deep to deep	Poorly drained	Humic gleys	Strongly to very strongly acidic soil, high subsoil sodicity	High subsoil erodability, water erosion hazard, permanent high-water tables
Megan	Erosional	Rolling hills to hills on Late Carboniferous Metasediments	Moderately deep to deep	Well drained	Structured red earths and brown earths	Strongly acidic	High erodability, high water erosion hazard, foundation hazard

Suicide	Colluvial	Steep hills and dissected valleys on Late Carboniferous metasediments	Moderately deep to deep	Well drained	Stony structured, yellow earths on crests and upper slopes	Strongly acidic, strong subsoil acidity	High water erosion hazard, foundation hazard, localised rockfall hazard

TABLE 7 SOIL LANDSCAPE PARAMETERS

Landscape Name	Proportion of Project (%)	K-factor	Unified Soil Classification System (USCS)	Dispersion (%)	Dispersion	Cation Exchange Capacity (CEC)	pH
Coffs Creek	20	0.017 – 0.04	-	-	-	-	-
Ulong	15	0.017 – 0.04	CL	< 10	slight	Very Low - Medium	4.8 – 5.4
Newports Creek	< 1	0.086	-	-	-	Very Low	4.4
Moonee	2	0.023 - 0.079	ML	5 - 30	negligible to high	Very Low	4.3 – 5.3
Megan	55	0.026 -0.04	-	-	-	-	-
Suicide	8	0.024 – 0.037	CL, ML	11 - 21	slight to high	Low	4.8 – 6.7

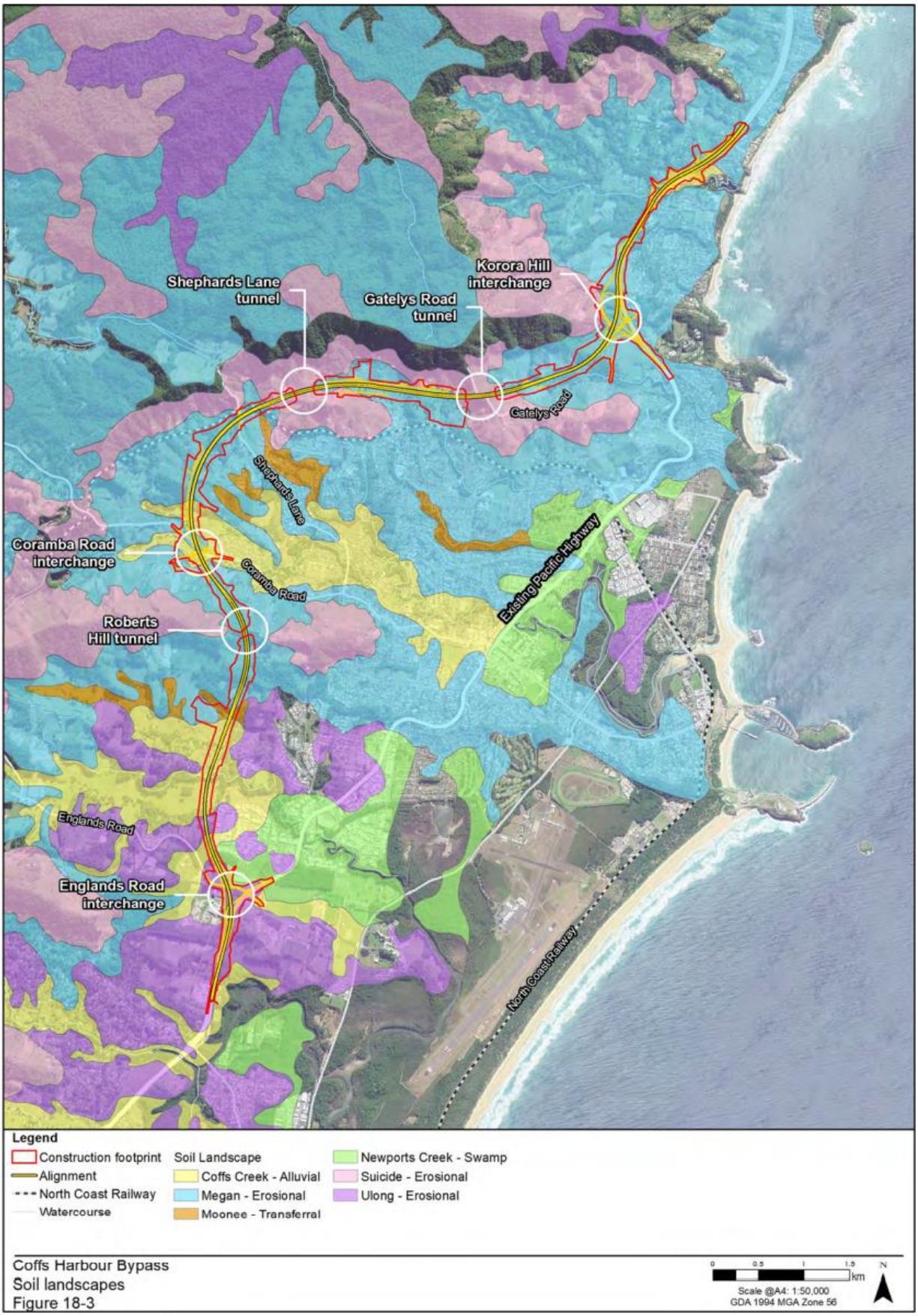

FIGURE 1 MAPPED SOIL LANDSCAPED OF THE SUBJECT AREA

4.2 SURFACE WATER

The Project crosses six waterways across the Korora Basin, Coffs Creek, and Boambee Creek sub-catchments. Further details of the characteristics, environmental sensitivities and known water quality of each defined sub-catchment are provided in the following section.

4.2.1 BELLINGER RIVER AND COFFS HARBOUR CATCHMENT

The project is located within the Bellinger River and Coffs Harbour catchments which extend from the Newry State Forest in the south up to Lake Arragan in the north and out to the Dorrigo Plateau in the west. The Bellinger River and Coffs Harbour catchments cover over 1000 square kilometres and include a range of smaller coastal creek sub-catchments bordered by the Great Dividing Range. The section of the Bellinger River and Coffs Harbour catchments where the Project is located is quite narrow with the head waters occurring within the surrounding escarpment of the Great Dividing Range before flowing through the sub-catchment and water sharing areas of the Korora Basin (Pine Brush creek and Jordans Creek), Coffs Creek (Treefern Creek and Coffs Creek) and Boambee Creek (Figure 2).

FIGURE 2 PROJECT AREA CATCHMENTS AND SUB-CATCHMENTS

4.2.2 MAJOR WATERWAYS

The Project traverses six major waterways, with multiple tributaries which generally flow in an easterly direction from the foothills of the Great Dividing Range and discharge in the ocean. The lower reaches of the sub-catchments are subject to tidal effects and estuarine processes and are extensively connected to groundwater in the alluvial areas near the coast. The six major waterways are shown in Figure 2 with a brief description of the waterways and project components provided in Table 8.There are also a number of small unnamed creeks and ICOLLS downstream of the Project area, particularly north of Jordans Creek.

TABLE 8 SUMMARY DESCRIPTION OF MAJOR WATERWAYS

Waterway	Description	Project components
Pine Brush Creek	Pine Brush Creek is a fourth order stream with headwaters in the steep, northern end of the Coffs escarpment. Where it crosses the construction footprint, Pine Brush Creek is in a reasonable condition with good ecological value, aquatic habitat and a generally intact riparian corridor. The estuarine and tidal reaches (including intermittently) of Pine Brush Creek are part of Solitary Islands Marine Park habitat protection zone.	The existing Pacific Highway crosses Pine Brush Creek on a multi-span bridge. The Project includes the construction of two new multi-span bridges across Pine Brush Creek, with the retention of the existing bridge. The Project requires work within the Pine Brush Creek and realignment of the channel is required upstream of the new bridge. Realignment of a smaller tributary of Pine Brush Creek, upstream of the highway is also required.
Jordans Creek	Jordans Creek is a third order stream, with headwaters in the lower escarpment slopes. The majority of the upper catchment of this creek has been modified for agriculture, with native vegetation reduced in the riparian zone. The estuarine and tidal reaches (including intermittently) of Pine Brush Creek are part of Solitary Islands Marine Park habitat protection zone.	The Project passes through a reach of Jordans Creek that has reasonable riparian vegetation cover and aquatic habitat. The Project requires realignment of the headwaters of this waterway and use of culverts to cross Jordans Creek and a number of its tributaries.
Treefern Creek	Treefern Creek is a third order stream. The upper catchment of this waterway has largely been cleared for agriculture, including the construction of a farm dam. The lower reaches of Treefern Creek pass through urban areas of Coffs Harbour, eventually flowing into the tidal reaches of Coffs Creek. The estuarine and tidal reaches (including intermittently) of Pine Brush Creek are part of Solitary Islands Marine Park habitat protection zone.	The Project traverses the headwaters of Treefern Creek, at the base of the escarpment. The design require the realignment of the headwaters of Treefern Creek and culvert crossings over the new channels.
Coffs Creek	The main channel of Coffs Creek is a fourth order stream where it crosses the project near Coramba Road. There are also a number of lower order reaches in the upper catchment that are within the construction footprint. The upper catchment of this waterway has been cleared, with limited aquatic value and riparian vegetation. The estuarine and tidal reaches (including intermittently) of Pine Brush Creek are part of Solitary Islands Marine Park habitat protection zone.	The main channel of Coffs Creek will be traversed by bridges associated with the main carriageway and Coramba Road interchange. The Bennetts Road detention basin will be modified for flood mitigation purposes and there are also a number of lower order streams of this waterway in the upper catchment that will be diverted through culverts.
Newports Creek	Newports Creek and its tributaries drain the North Boambee Valley. Its upper catchment is in the well vegetated escarpment. The floodplain catchment has been cleared, with some narrow strips of riparian vegetation retained.	The Project crosses six tributaries of Newports Creek, including the main channel. The main channel and larger tributaries will be crossed by bridges, with waterway realignments potentially required. Smaller tributaries will be crossed by culverts.

Boambee Creek	Boambee Creek begins in the upper escarpment and traverses through rural residential areas west of the existing highway. The main channel of Boambee Creek crosses the existing Pacific Highway to the south of the Project.	The Project does not include any components within or immediately adjacent to Boambee Creek. At its closest point, the waterway is located about 250 m from the construction footprint.

4.2.3 SENSITIVE RECEIVING ENVIRONMENT

A sensitive receiving environment is defined as one that has a high conservation or community value or supports ecosystems or water for human use and is particularly sensitive to pollution and/or degradation of water quality. The following sections describe sensitive receiving environments relevant to the project.

4.2.3.1 SOLITARY ISLANDS MARINE PARK

The tidal reaches of Pine Brush Creek, Jordans Creek, Treefern Creek and Coffs Creek are habitat protection zone within the Solitary Islands Marine Park. Habitat protection zone is subject to special legislative objects and protection under the *Marine Estate Management Act 2014* and regulations. The NSW Marine Park boundary extends along Pine Brush Creek to Opal Boulevard and then to James Small Drive, with the construction footprint occurring adjacent to the NSW Solitary Islands Marine Park boundary.

The Solitary Islands Marine Park is the oldest marine park in NSW. The marine park extends about 100km north from Coffs Harbour to the Sandon River and covers a total area of 72,000 hectares. It includes the reaches of all estuaries to their tidal limits and up to mean high water mark. The Commonwealth Solitary Islands Marine Park is directly adjacent to the seaward boundary of the NSW Solitary Islands Marine Park and covers an additional 152 square kilometres. This section of the Commonwealth Marine Park is considered a matter of national environmental significance (MNES) under the EPBC Act.

This significance is reflected in the project approval requirements that enhanced erosion and sediment controls be implemented in all catchments flowing to the Solitary islands Marine Park (MCoA E11), additional to industry best practice site erosion controls complying with “Managing Urban Stormwater: Soils and Construction, Volumes 1 and 2” . Sediment basins within the catchment are to be designed and installed to accommodate a 90$_{th}$ percentile rain event, based on soil loss calculations using the Revised Universal Soil Loss Equation (RUSLE). Where the Project Soil Conservationist confirms that site constraints such steep terrain restrict the construction of 90$_{th}$ percentile sediment basins, proposed alternative best practice controls are to be detailed in an Erosion and Sediment Control Plan to the satisfaction of TfNSW.

4.2.3.2 WETLANDS

The Project is located within catchments of three Coastal Management SEPP wetlands - Boambee wetlands, Coffs Creek wetlands and Pine Brush Creek wetlands.

There is a small section of the mapped Boambee wetlands within 100 metres of the southern end of the Project area (Figure 3 Solitary Islands Marine Park and NSW Coastal Management SEPP Wetland). However, no project works will occur within the wetland, or the 50 metres wetland buffer.

Coffs Creek wetlands are located over five kilometres downstream from the construction footprint along Coffs Creek, and about 3.7 kilometres downstream from the construction footprint along Treefern Creek. Coffs Creek wetlands consist of small sections of tidal wetlands and are within and adjacent to sections of the Solitary Islands Marine Park.

The wetlands associated with Pine Brush Creek are mapped about 800 metres downstream from the construction footprint and are also within the Solitary Islands Marine Park.

4.2.3.3 THREATENED FRESHWATER FISH HABITAT

Southern purple spotted gudgeon (*Mogurnda adspersa*) is listed in NSW as an endangered species. Potential habitat includes the main channel of the upper Coffs Creek and upper Newports Creek (DPI 2009). However, no southern purple spotted gudgeon were identified within the aquatic habitat surveys (see EIS Chapter 10, Biodiversity) and habitat for this species is considered to be limited within the wider EIS study area.

During the desktop and field ecological surveys carried out for the Project, no other threatened freshwater fish species were considered likely to occur or identified within the construction footprint. Habitat suitability and field surveys suggest that the construction footprint provides negligible habitat for threatened fish species (as described within EIS).

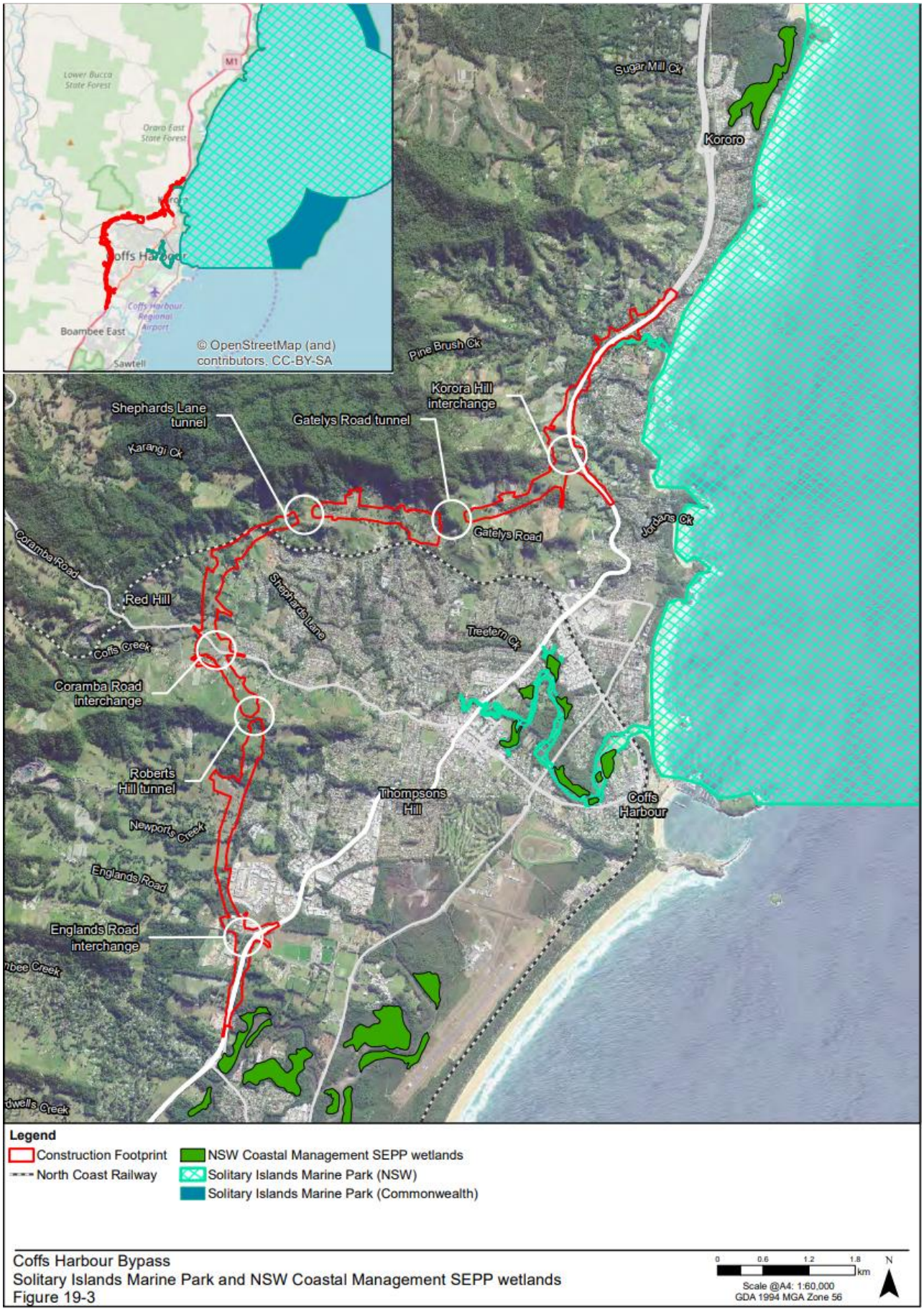

FIGURE 3 SOLITARY ISLANDS MARINE PARK AND NSW COASTAL MANAGEMENT SEPP WETLAND

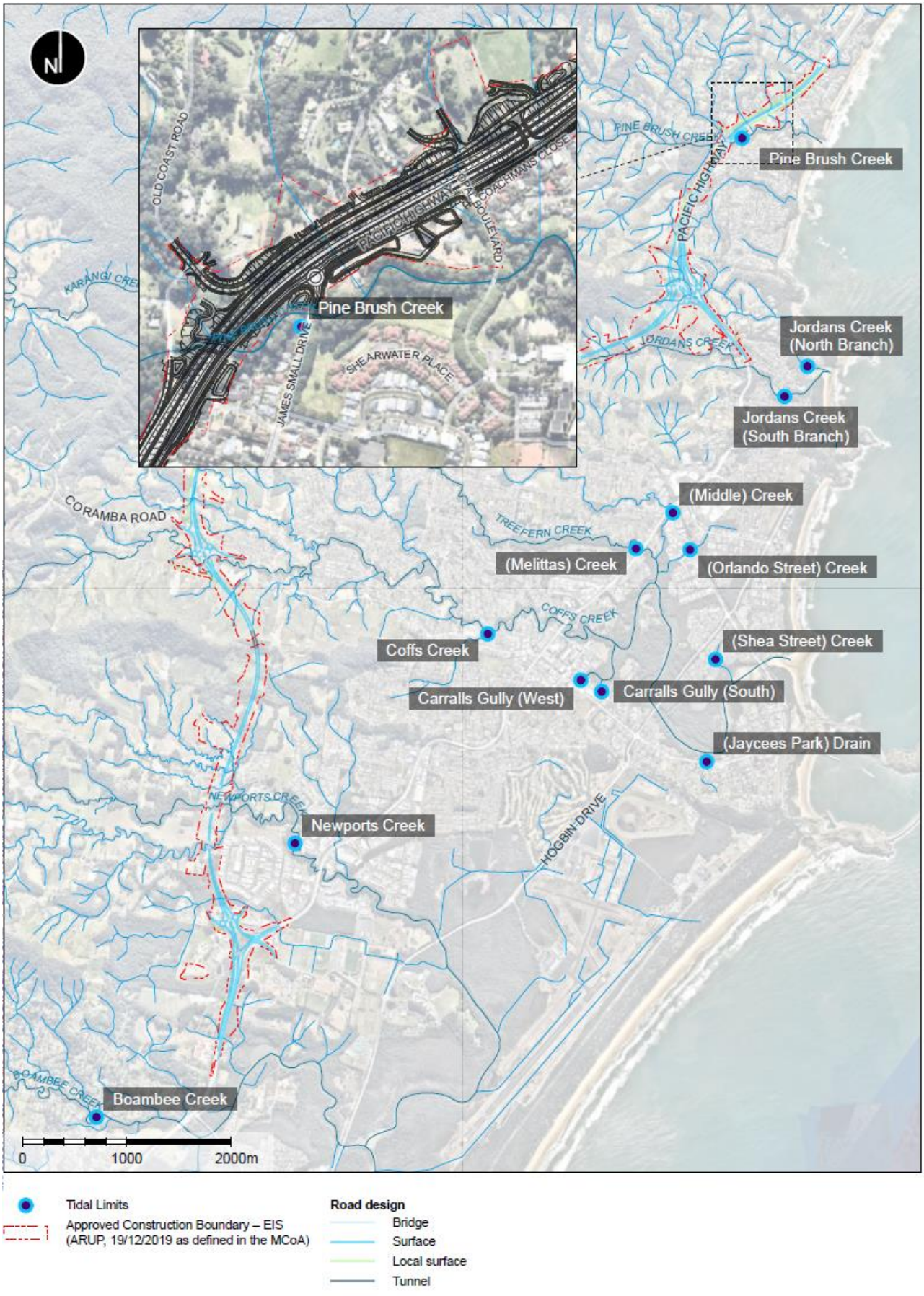

FIGURE 4 MAP OF PROJECT FOOTPRINT AND TIDAL EXTENT OF CREEKS

4.2.4 SURFACE WATER QUALITY

4.2.4.1 WATER QUALITY ASSESSMENTS

An assessment conducted by Coffs Harbour City Council (CHCC) and Department of Planning and Environment – Environment, Energy and Science Group (DPE, EESG) investigated river and estuarine conditions within the Coffs Creek and Boambee Creek catchment areas between 2014 and 2016. This assessment determined that water quality in the Coffs Creek catchment was a grade D+ (poor), meaning that very few of the NSW Water Quality Objectives (WQO) and indicators defined in the Ecohealth Project were met. The Boambee Creek sub-catchment was slightly better, being given a grade of C (fair), meaning only some of the NSW WQOs were met.

The Coffs Creek Coastal Zone Management Plan (CHCC 2012) identified a number of major issues related to water quality which could affect the water quality in the catchment including:

- Poor water quality resulting from runoff in developed and agricultural areas;
- Riverbank erosion and sedimentation and its effects on habitat and water quality;
- Management of the estuary entrance and water depth;
- Decline in riverbank and aquatic vegetation and habitat;
- Climate change, flooding and sea level rise;
- Fishing and the impact on fish stocks;
- Increasing demands for improved recreational use and public access; and
- Pressures from urban expansion on natural and cultural values.

Water quality in the area is affected by urbanisation with significant land use changes expected to continue within the catchment with residential, rural, and industrial development.

While it is likely that watercourses within the Project area would be classified as highly disturbed systems (being urban streams receiving road and stormwater runoff), ANZG 2018 recommend that the guideline trigger values for slightly to moderately disturbed systems should also apply to highly disturbed ecosystems wherever possible.

4.2.4.2 CONSTRUCTION WATER QUALITY IMPACT REVIEW

A Construction Water Quality Impact Review (CWQIR), consistent with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018), will be prepared prior to commencement of construction. The CWQIR will address the following:

- Describe the existing surface water quality for any waterway likely to be affected by the construction activities;
- State the ambient WQOs and environmental values for the receiving waters relevant to the Project;
- State the indicators and associated guideline values or criteria for the identified environmental values. This information will be sourced from the ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality;
- Identify and estimate the quality and quantity of all pollutants that may be introduced into the water cycle by source and discharge point and describe the nature and degree of impact that any discharge(s) may have on the receiving environment;
- Demonstrate that all practical measures to avoid or minimise water pollution and protect human health and the environment from harm will be implemented;
- Identify sensitive receiving environments (including the Solitary Islands Marine Park) and develop a strategy to avoid or minimise impacts to these environments;
- Assess the significance of any identified impacts including consideration of the relevant ambient water quality outcomes. Demonstrate how the proposal will be designed and operated to:
    - protect the NSW WQOs for receiving waters where they are currently being achieved; and
- Contribute towards achievement of the NSW WQOs over time where they are not currently being achieved; and
- Include details of a construction stage surface water quality monitoring program.

4.2.4.3 RESULTS OF AMBIENT WATER QUALITY SAMPLING

Water quality monitoring - EIS preparation

Water quality results from the field surveys completed in 2018 during preparation of the EIS are provided in Table 8, with a more detailed summary of sampled key sampled parameters provided in Table 9. Sampling locations are shown in Figure 5. Water quality results were compared to the relevant Bellinger River and Coffs Harbour WQOs (waterways affected by urban development and uncontrolled streams) for aquatic ecosystems. Where sampled water quality parameters are outside the range prescribed in the NSW WQOs, cells are shaded red.

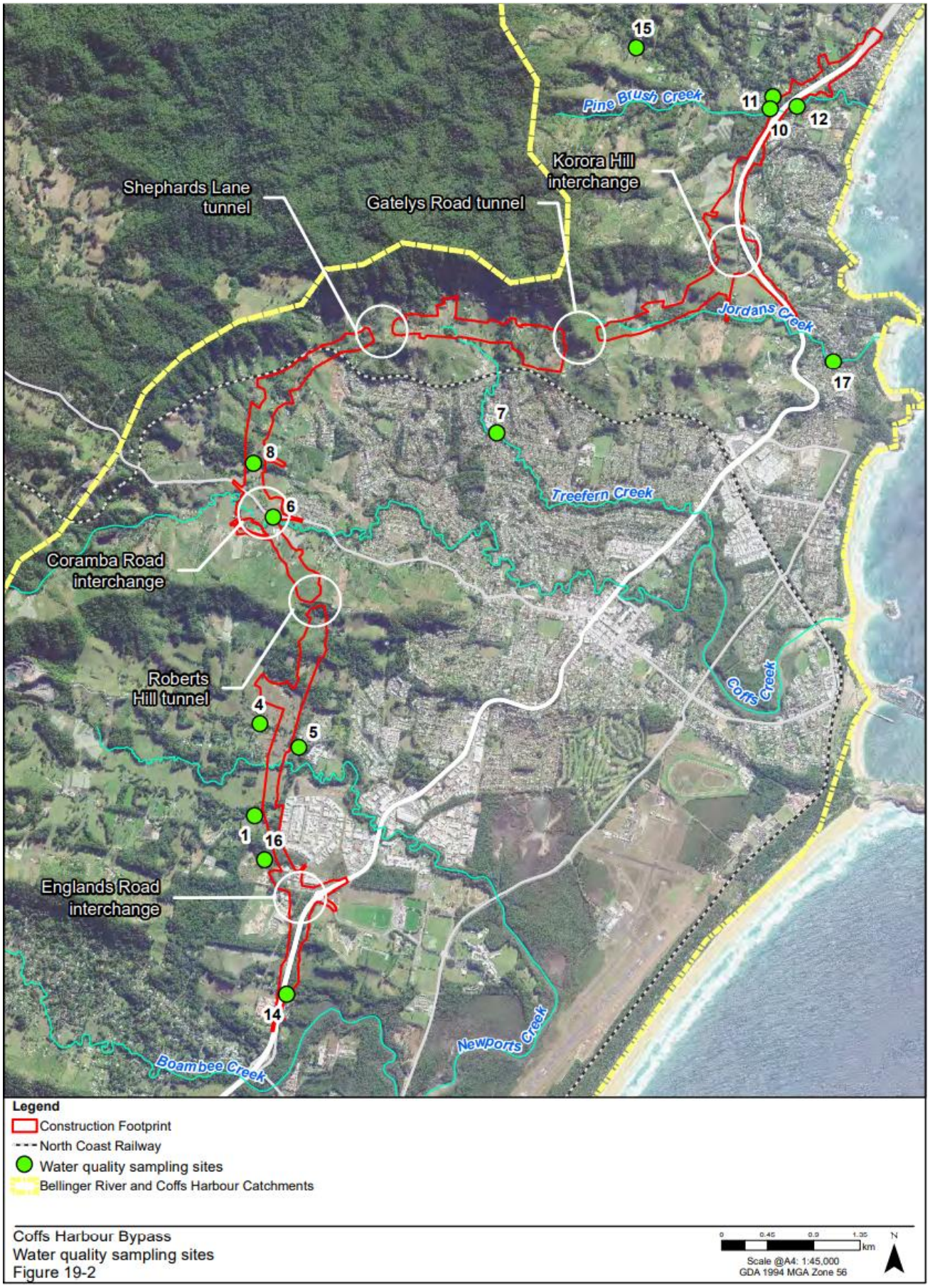

FIGURE 5 WATER QUALITY SAMPLING SITES

TABLE 9 EXISTING WATER QUALITY CONDITIONS

Waterway	Samples collected	Description of key water quality parameters
Pine Brush Creek	Samples collected at Sites 10, 11 and 12 adjacent to existing Pacific Highway	• Water clarity good, with all samples well below the NSW WQO for turbidity; • Sites 10 and 12 recorded nitrogen concentrations above the NSW WQOs; and • Water clear, with low turbidity and no visible films or debris.
Jordans Creek	Samples collected at Site 17 located downstream from the project	• Water clarity good, with samples well below the NSW WQO for turbidity • Nitrogen concentration above the NSW WQO
Treefern Creek	Samples collected at Site 7 located downstream from the project	• Water clarity good, with samples well below the NSW WQO for turbidity and no visible films • Exotic vegetation cover dominant in riparian zone • Dissolved oxygen percentage saturation measured slightly below the NSW WQO • Elevated nitrogen concentration measured at four times higher than the NSW WQO • Substantially elevated phosphorous concentrations measured at 35 times higher than the NSW WQOs
Coffs Creek	Samples collected at Sites 6 and 8 within the project	• Water clarity good, with one sample below the NSW WQO for turbidity and the other within the range. • Exotic vegetation cover dominant, with some visible turbidity • Dissolved oxygen percentage saturation measured below the NSW WQO at both sites Nitrogen concentration above NSW WQO at both sites
Newports Creek	Samples collected at Sites 1, 4, 5 and 16	• Extremely low dissolved oxygen concentration at Site 16 • Site 16 also high concentrations of nitrogen and phosphorous above the NSW WQOs • Site 1 also had concentrations of nitrogen above the NSW WQOs • Native vegetation cover in riparian zone and no visible films or debris
Boambee Creek	Samples collected at Site14 within the project	• Water clarity good, with samples below the NSW WQO for turbidity • No visible oils, films or floating debris • Extremely low dissolved oxygen percentage saturation • Concentrations of nitrogen and phosphorous above the NSW WQOs • Site 14 also has elevated levels of zinc present in both dissolved and total metals

Detailed results from all sites sampled are shown below in Table 10, results can be summarised as follows:

- All sites sampled were within the normal range of the relevant WQOs for pH and electrical conductivity. Most sites were below the normal range for turbidity and dissolved oxygen.
- The majority of the sites sampled experienced dissolved oxygen levels below the relevant WQOs. Low dissolved oxygen is often a by-product of higher concentrations of nutrients, such as nitrogen and phosphorus.
- Total nitrogen (inclusive of ammonia, nitrates and nitrites) exceeded relevant WQOs for most sites. This was anticipated given the current and historic land usage in the catchment.
- Three sites substantially exceeded relevant WQO for total phosphorus. These three sites also had generally higher concentrations of most metals and other analytes. These sites included one as part

of the lower Boambee Creek catchment, and the other was downstream of the Coffs Coast Resource Recovery Park (Site 14).

- Concentrations of most metals were below the relevant trigger levels for all sites except for zinc (dissolved) at one site, which slightly exceeded the default guideline value (ANZG 2018).All other metals, and total petroleum hydrocarbons were either below available guidelines values and/or below the laboratory limit of reporting (LOR).
- There were some fluctuations between the wet season and dry season with the dry season often having higher concentrations of the various parameters measured. This reflects the seasonal influence on the quality of the water in the region.

TABLE 10 WATER QUALITY SAMPLING RESULTS FOR KEY CHEMICAL PARAMETERS

Parameter	Unit	NSW WQO	1 Newports Creek	4 Newports Creek	5 Newports Creek	6 Coffs Creek	7 Treefern Creek	8 Coffs Creek	10 Pine Brush	11 Pine Brush	12 Pine Brush	14 Boambee Creek	15 Pine Brush	16 Newports Creek	17 Jordans Creek
pH	pH Unit	6.5-8.5	7.47	7.06	6.83	6.92	7.14	6.76	6.96	6.89	7.11	7.14	7.05	7.16	7.12
Electrical Conductivity	µS/cm	125-2200	146.63	134.17	132.83	206.00	176.17	138.00	218.00	209.83	218.00	265.83	173.83	772.33	192.00
Turbidity	NTU	6 to 50	2.01	2.53	6.87	5.40	0.72	18.13	0.77	0.64	0.67	5.13	2.05	10.77	0.80
Dissolved Oxygen	% sat	85-110	66.45	33.95	33.40	69.80	82.80	55.70	84.75	92.60	85.15	19.10	77.25	9.95	80.40
Total Nitrogen	mg/L	<0.35	0.212	0.195	0.206	0.933	2.0	0.725	0.508	0.331	0.463	1.195	0.341	4.133	0.640
Total Phosphorus	mg/L	<0.025	0.009	0.0083	0.0078	0.0068	0.878	0.0074	0.0063	0.005	0.005	0.071	0.008	0.130	0.008
Calcium (Dissolved)	µg/L	-	3.25	2.44	2.08	8.21	3.05	3.25	2.75	2.40	2.81	17.50	2.49	44.07	4.90
Hardness	mg/L	90	23.50	21.00	16.00	43.13	16.39	24.00	18.00	19.13	21.50	68.50	21.00	155.00	29.50
Zinc (total)	µg/L	8	3.96	2.21	1.94	5.33	6.93	2.23	2.05	2.25	2.28	48.05	2.48	53.12	2.50

Note: Red cells indicate average values outside of the NSW WQOs

Water quality monitoring - Pre-construction phase

Pre-construction phase surface water quality monitoring for the Project was undertaken over a 12-month period from December 2019 to November 2020. The purpose of this monitoring was to establish baseline surface water quality data for the Project, support assessment of potential impacts, and refine mitigation measures to be implemented during construction and operation phases.

The monitoring included a range of parameters including physio-chemical properties, hydrocarbons, nutrients and heavy metals.

Results from pre-construction water quality monitoring are available within the document “Pre-Construction Surface Water Monitoring Report. Coffs Harbour Bypass: December 2019 to November 2020” (TfNSW 2021).

4.3 GROUNDWATER

Groundwater characteristics, potential impacts and mitigation measures are described within the Groundwater Management Plan (Appendix F).

4.4 RAINFALL

Bureau of Meteorology (BoM) rainfall statistics for Coffs Harbour are contained in Table 11. Note that BoM station 059040 closed in 2015 but has over 70 years of data available. The current BoM station (059151) has insufficient data for the generation of long-term averages.

Local knowledge suggests that rainfall on the immediate hinterland ranges around Coffs Harbour urban area can be higher than on the coastal fringe, although rainfall data is not available for a location on the ranges in the immediate vicinity of the proposal. As such, data for BoM station 059040 are reported here, but the risk of higher rainfall is taken into account in assessing the relative risk of erosion for the Project. It is not unusual for the Coffs Harbour Airport BoM station (59151) to experience a few events each year in which over 100 mm for a 24 hour period is recorded during the higher rainfall months of December to March.

TABLE 11 MONTHLY RAINFALL FOR COFFS HARBOUR (BOM 059040)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm)	187.5	224.8	234.6	178.4	160.8	120.8	72.5	79.5	59.9	96.3	114.7	144.9	1699
Mean no of days with rain >1mm	9.4	9.7	10.8	8.5	7.7	6.3	4.5	4.5	4.5	6.7	8.2	8.4	89.2

The Bureau of Meteorology reports the 2-year, 6-hour rainfall event as 16.6 mm/hr for the hinterland area that the proposal traverses. This translates to a Revised Universal Soil Loss Equation (RUSLE) R-Factor of 6390 which is very high. The risk of high rainfall is considered to be a significant constraint for construction-phase erosion and sediment control on this proposal.

4.5 HISTORIC FLOODING

The Coffs Harbour area has experienced numerous flood events, the most significant recent events were experienced in 1996 and 2009, resulting in widespread impacts and the area being declared a natural disaster zone. Following these events, several detention basins have been constructed in the Coffs Harbour LGA to mitigate the risk to the community in extreme flood events. These detentions basins include:

- The basin near Goodenough Terrace in the upper tributaries of Coffs Creek;
- The basin next to Isles Drive in North Boambee Valley (Webb, Mckeown & Associates Pty Ltd. 2007); and
- Several small basins located in the upper regions of the Coffs Harbour LGA. These are assumed to be at full capacity already as a conservative measure and only for agricultural use.

Additionally, four detention basins were designed as part of the CHCC Flood Mitigation Programme (CHCC 2018a) to provide flood protection for a 1 per cent AEP event. These basins were designed to alleviate the downstream flooding in the Coffs Creek catchment. The four basins are shown in Figure 6and comprise:

- Bakers Road detention basin at William Sharpe Drive, West Coffs Harbour;
- Bennetts Road detention basin;
- Spagnolos Road detention basin; and
- Shephards Lane detention basin.

The four detention bases were constructed and are fully operational. The project would affect the Bennetts Road and Spagnolos Road detention basins at the Coramba Road interchange as shown in Figure 6. The Shephards Lane detention basin is potentially affected by the bridge over the North Coast Railway (BR12) and the Bakers Lane detention basin is downstream of the project.

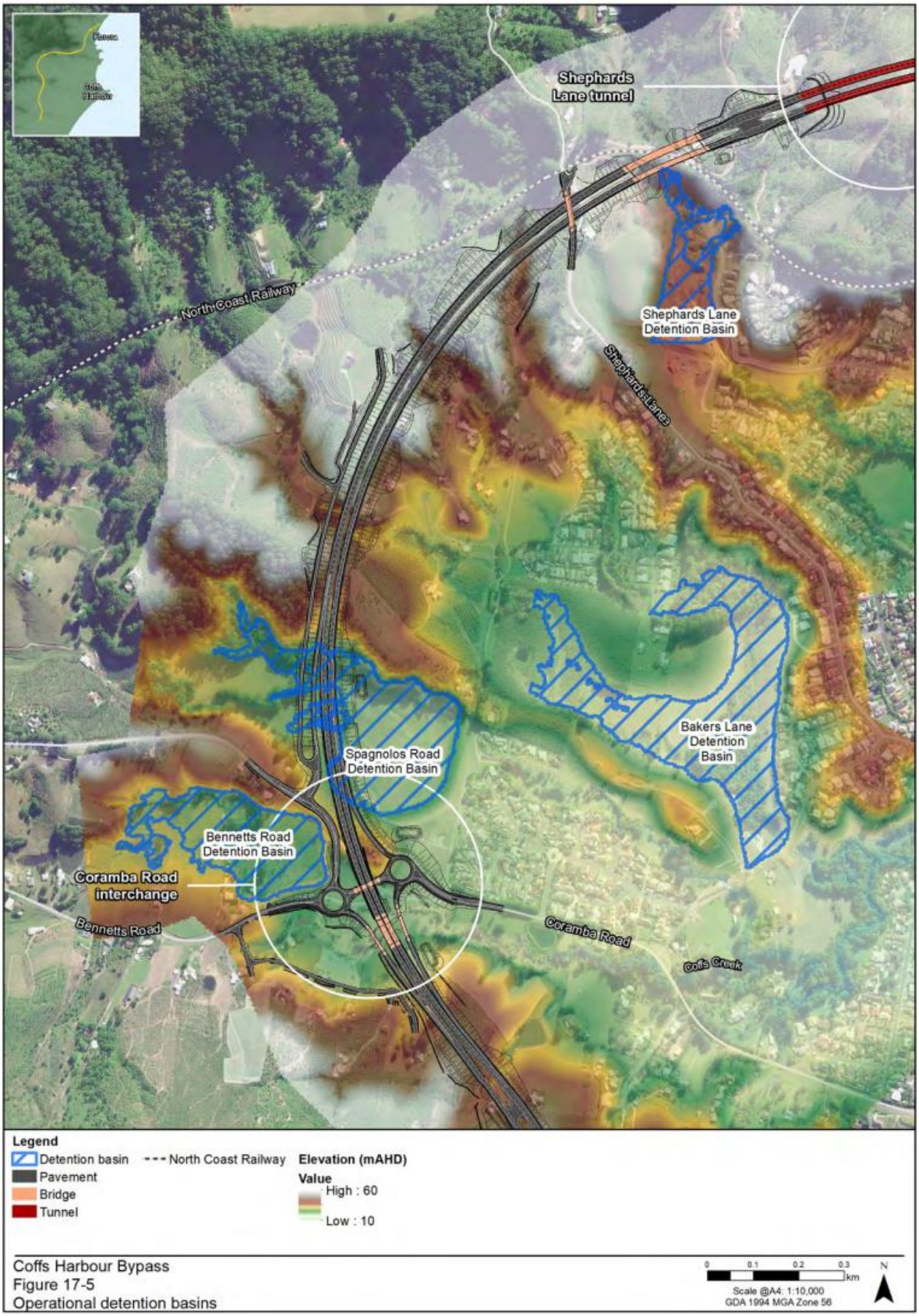

FIGURE 6 FLOOD MITIGATION DETENTION BASINS

4.5.1 WATERWAYS AND CATCHMENTS INTERACTING WITH THE PROJECT

The EIS describes how the project would interact with the following catchments:

- North Boambee Valley
- Coffs Creek
- Northern creeks.

Each catchment consists of unique topography with several sub-catchments, major waterways and tributaries.

4.5.1.1 NORTH BOAMBEE VALLEY

The Boambee Creek and Newports Creek catchment covers an area of about 50 square kilometres and drains directly to the Pacific Ocean, there are several small, unnamed tributaries draining into Newports Creek and Boambee Creek. The upper catchment area is primarily steep and densely vegetated, draining from west to east. The middle and lower reaches are characterised by a large floodplain and become more urbanised towards the coastline.

Boambee Creek and Newports Creek are crossed by several transport corridors, including the Pacific Highway and Hogbin Drive. The Boambee Newports Floodplain Risk Management Study (GHD 2016) reported that the Pacific Highway would be overtopped in the 1 per cent AEP event at several locations including at Newports Creek near Cunninghams Store, the Coffs Harbour Health Campus and at Cook Drive. Hogbin Drive was reported to be overtopped at Coffs Harbour Airport, Southern Cross University, John Paul College, Boambee Creek, and south of Hi-tech Estate. North Boambee Road (opposite Mansbridge Drive) was also reported to be overtopped in the 18 per cent AEP event.

4.5.1.2 COFFS CREEK

The Coffs Creek catchment area, shown in Figure 6 is about 25 square kilometres and consists of a flat coastal floodplain in the east rising to a steep escarpment on the west. This terrain is conducive to extreme weather events. Elevations range from 10 metres AHD to over 490 metres AHD within a few kilometres. A majority of the urbanised area is located in the low-lying coastal region of the catchment, while the upper catchment consists primarily of agricultural land and densely vegetated areas.

The Coffs Creek catchment drains through three main creek lines including Coffs Creek and two northern tributaries; Treefern Creek and an unnamed creek which flows parallel to Bray Street. Below the Pacific Highway, Coffs Creek is an estuary which is a key recreational and environmental resource. All tidal reaches of Coffs Creek are habitat protection zone within the Solitary Islands Marine Park. West of the existing Pacific Highway the creek then splits into two smaller tributaries and then into a series of minor watercourses that divide the adjacent hillsides.

4.5.1.3 NORTHERN CREEKS

Topography in the northern creeks catchment consists of steep upper ridges covered by dense bushland with tributaries draining into low-lying terrain on the western side of the existing Pacific Highway. Kororo Basin, Jordans Creek, Pine Brush Creek and an unnamed waterway at Sapphire Beach (informally referred to as ‘Nautilus Creek’) are the main waterways within the northern creeks catchment and define the four small sub-catchments.

These sub-catchments and their approximate total area are shown in Table 12. All four sub-catchments flow from the steep ridges on the west through the upper tributaries in an easterly direction towards the coastline. Land use within the northern creeks catchment area consists of undisturbed forest, grazing, horticulture and urban. The urban area is primarily in the lower regions of the catchment and consists of residential houses, apartments, a conference centre and golf course, and beach front resorts.

TABLE 12 NORTHERN CREEKS SUB-CATCHMENTS

Sub-catchment	Total area (km^2)
Jordans Creek	2.7
Kororo Basin	1.4
Pine Brush	8.4
Sapphire Beach	0.5

Jordans Creek sub-catchment drains from a small unnamed tributary under the existing Pacific Highway and through a small creek alongside beachfront villas which is susceptible to frequent flooding.

Pine Brush Creek sub-catchment is drained through several upper tributaries that flow into one larger section of Pine Brush creek under the existing Pacific Highway and into the ocean.

Rainfall within the Kororo Basin is governed by steep small upper tributaries that drain into the waterways which surround sections of the Pacific Bay Resort and golf course.

All tidal (including intermittent) reaches of the northern creeks are habitat protection zone within the Solitary Islands Marine Park, with the construction footprint located adjacent to the Solitary Islands Marine Park boundary (Pine Brush Creek).

4.5.2 FLOOD MANAGEMENT DURING CONSTRUCTION

A Construction Flood Management Plan has been prepared to address the following aspects and impacts:

- The impacts on hydrology and flooding during the construction phase;
- Control measures and procedures for construction activities to avoid, minimise or manage potential adverse impacts to construction works in the event of a flood within or adjacent to the project;
- Management responses for ancillary sites;
- Flood monitoring to forecast large rainfall and flood events and notification measures;
- Emergency response and evacuation procedures in the event of a flood during the construction phase;
- Control measures and procedures for construction activities to avoid, minimise or manage potential adverse impacts to construction works in the event of a flood within or adjacent to the project;
- Suitable evacuation routes and procedures for evacuation of site personnel;
- A register of all materials stored in work areas prone to flooding;
- Control measures for stockpiling within the floodplain to minimise loss of material in flood events;
- Protocols for equipment and materials that can be removed from the subject area during a flood event where reasonable and feasible;
- Consultation and coordination with local residents, CHCC and other relevant stakeholders; and
- Induction of all construction site staff and visitors to ensure awareness and the emergency response procedures.

5 ENVIRONMENTAL ASPECTS AND IMPACTS

This section describes the construction activities that will require management to minimise any potential soil and water impacts.

5.1 CONSTRUCTION ACTIVITIES

The potential for impacts on soil and water will depend on a number of factors. Primarily, impacts will be dependent on the nature, extent and magnitude of construction activities and their interaction with the natural environment. Table 1Table 13 summarises the associated soil and water impacts that may result from construction activities.

TABLE 13 KEY ASPECTS AND POTENTIAL ACTION/IMPACT

Environmental issue	Construction activity	Potential Action/Impact
Hydrology and flood risk		
Catchment values	• Temporary waterway crossings • In-stream work platforms • Culvert and drainage work • Bridge construction	• Compromised catchment values (including loss of environmental values and resources that contribute to the integration of values) • Catchment water quality degradation or pollution • Catchment supply change/loss (as a result of blocking supply waterways) • Impact to fish passage
Flood risk	• Temporary waterway crossings • Culvert and drainage work • Bridge construction • Paving (increase of the impermeable area)	• Increased flood risk and influx • Work footprint inundation (including worker risk and increased chemical spill risk) • Site compound inundation (including worker exposure risk and increased chemical spill risk) • Waterlogging (including worker risk and increased chemical spill risk)
Soils, sediments and water quality		
Topography (slope stability)	• Earthworks (including borrow site work) • Soft soil work • Drilling and piling	• Loss of slope stability (leading to erosion and sedimentation)
Geology (permeability and leaching)	• Earthworks (including borrow site work) • Soft soil work • Drilling and piling	• Altered permeability (leading to groundwater movement and contaminant migration) • Increased risk for leaching and contaminant migration (caused by contaminant release or disturbance of existing contaminants).
Soil landscape (erosion and sedimentation)	• Vegetation clearance, including aquatic and riparian vegetation • Mulching • Topsoil stripping • Earthworks (including borrow site work) • Soil movement and transfer • Embankment construction • Culvert and drainage work • In-stream work platforms • Bridge construction • Stockpiling	• Soil erosion • Nutrient mobilisation and release (leading to water quality degradation or pollution) • Dust propagation (refer to the Construction Air Quality Management Plan) Contamination (release of contaminants or encountering contaminants leading to soil quality degradation or contamination) • Waterlogging (leading to worker exposure risk and increased chemical spill risk)

	• Drilling and piling	
Acid sulfate soils (acid generation)	• Topsoil stripping • Culvert and drainage work • Dewatering and clearing • Earthworks (including borrow site work) • Stockpiling • Drilling and piling	• Potential and actual acid sulfate soil disturbance (sulphuric acid generation leading to heavy metal leaching both of which have terrestrial and aquatic ecological impacts including fish disease, kills, loss of food resource, reduced fish migration and recruitment potential, disturbance to water plant communities and secondary effects on water quality; and potential human health risks) • Agricultural impacts and land quality degradation • Ecological impacts • Surface water quality degradation and pollution • Groundwater quality degradation and pollution • Soil structure degradation and loss (including infrastructure instability) • Loss of infrastructure integrity (i.e. corrosion)
Encountering contamination / pollution	• Topsoil stripping • Excavation • Demolition • Road cutting work • Earthworks (including borrow site work) • Stockpiling • Drilling and piling	• Contaminant mobilisation leading to soil degradation or contamination • Spread of Panama disease from affected banana plantation areas • Contaminant mobilisation leading to water quality degradation or pollution • Contaminant mobilisation leading to aquatic and terrestrial ecology degradation • Contaminant mobilisation leading to human health impacts including worker exposure.
Causing contamination / pollution	• Topsoil stripping • Earthworks (including borrow site work) • Stockpiling (leaching and tannins) • Chemical and fuel storage, handling, use and disposal • Ancillary facility operations • Concrete batching • Noxious weed and pathogen management • Drilling and piling	• Contaminant release leading to soil degradation or contamination • Spread of Panama disease from affected banana plantation areas • Water quality degradation or pollution • Aquatic and terrestrial ecology degradation, including fish kills • Human health impacts (including worker exposure)
Receiving waters and sensitive environments	• Temporary waterway crossings • Culvert and drainage work • In-stream work platforms • Bridge construction • Topsoil stripping • Earthworks (including borrow site work) • Stockpiling • Chemical and fuel storage, handling, use and disposal • Ancillary facility operations • Concrete batching • Noxious weed and pathogen management • Drilling and piling	• Dust settlement (smothering) • Sedimentation and siltation (loss of ecological function) (via soil erosion, runoff and dust propagation) • Wetland degradation (as a result of sediment, contaminant and/or pollutant release and migration) • Fish habitat degradation/loss (as a result of sediment, contaminant and/or pollutant release and migration), particularly seagrass • Spread of Panama disease from the Coffs Harbour Bypass Project footprint • Work in riparian zone
Surface water quality	• Temporary waterway crossings • Culvert (diversions) and drainage work	• Siltation (leading to loss of ecological function) (via soil exposure, erosion, runoff, dust propagation and vegetation removal)

	• In-stream work platforms • Bridge construction • Bank work • Vegetation removal (riparian vegetation) • Chemical and fuel storage, handling, use and disposal • Earthworks • Stockpiling\ Materials transport • Topsoil stripping • Ancillary facility operations (chemical storage, earthworks, construction material processing, concrete batching, vehicle wash down, vehicle refuelling and high frequency vehicle movements) • Noxious weed and pathogen management • Drilling and piling	• Nutrient, metal, organic material and pollutant loading (leading to loss of aquatic values and ecological function) • Water quality degradation (as a result of sediment, contaminant, tannin or pollutant release and migration) (with reduced tolerance due to existing poor water quality) • Aquatic ecology degradation (as a result of sediment, contaminant and/or pollutant release and migration) • Recreational, cultural and economic use degradation (e.g. loss of swimming or tourism due to water quality impacts) • Work in riparian zone
Groundwater (water table)	• Water use and extraction • Earthworks (including borrow site work) • Dewatering • Earthworks (construction of cuttings) • Drilling and piling	• Loss of groundwater supply • Change in flow dynamics and characteristics (including changes below ground and at the surface) • Secondary impacts on vegetation and ecosystem health (due to loss of supply) • Groundwater quality degradation or pollution • Rapid pollution dispersion and migration (with secondary impacts)
Groundwater (use)	• Chemical and fuel storage, handling, use and disposal • Ancillary facility operations • Water use and extraction • Concrete batching • Noxious weed and pathogen management • Dewatering • Earthworks (construction of cuttings) • Drilling and piling	• Loss of supply (due to groundwater quality degradation, pollution, siltation, flow changes and/or water table depression)
Groundwater (dependent ecosystems)	• Chemical and fuel storage, handling, use and disposal • Ancillary facility operations (chemical storage, earthworks, construction material processing, concrete batching, vehicle wash down, vehicle refuelling and high frequency vehicle movements) • Water use and extraction • Noxious weed and pathogen management • Dewatering • Earthworks (construction of cuttings) • Drilling and piling	• Ecological degradation, loss of habitat and ecosystem health impacts (due to flow changes, water table depression, and/or groundwater pollution).

Some impacts on soil and water attributable to the Project are anticipated. Relevant aspects and the potential for related impacts have been considered in a risk assessment at Appendix A2 and Section 3.4 of the CEMP. The unmitigated risk associated with the above impacts are rated by considering the combined likelihood for the impacts to occur and the magnitude of the impact should it occur. Appendix A2 also assesses the residual risk accounting for the committed mitigation measures that will be

implemented as described in the MCoA and EIS Submissions Report REMMs summarised below in Chapter 6.

6 ENVIRONMENTAL CONTROL MEASURES

Specific measures and requirements to meet the objectives of this SWMP and to address impacts on soil and water are outlined in Table 14.

TABLE 14 SOIL AND WATER MANAGEMENT AND MITIGATION MEASURES

ID	Measure/Requirement	When to implement	Responsibility	Reference
Erosion, drainage and sediment control				
CSWMP 01	A Project Soil Conservationist (with experience in environmentally sensitive design) will be engaged during detailed design and construction to develop an erosion and sedimentation management report to inform the soil and water management plan and will be regularly consulted throughout construction to provide advice on erosion and sediment control design, installation and maintenance.	Pre-construction / Construction	Environment Manager	TfNSW QA G36 TfNSW QA G36 REMM (SC06).
CSWMP 02	Progressive ESCPs to be prepared prior to commencing each stage or parcel of work and will be updated following any construction activity or work location changes, site condition changes, flow path changes or other relevant management plan changes. Progressive ESCPs will detail controls required to avoid erosion and sedimentation of the site, surrounding areas, watercourses, drainage systems, water bodies and wetlands.	Pre-construction / Construction	Environment Manager Foreman/Site Supervisor	TfNSW QA G38
CSWMP 03	Erosion and sediment control measures will be implemented and maintained at all work sites in accordance with the principles and requirements in Managing Urban Stormwater – Soils and Construction, Volume 1 (Landcom 2004) and Volume 2D (DECC 2008).	Construction	Environment Manager Foreman/Site Supervisor	TfNSW QA G38
CSWMP 04	Active work areas will be stabilised at the end of each day's work and/or just prior to inclement weather to reduce erodibility. Slope breaks will be installed to reduce slope length.	Construction	Environment Manager Foreman/Site Supervisor	TfNSW QA G38 Managing Urban Stormwater: Soils and Construction. Vol 1 (Landcom 2004) and Vol 2D (DECC 2008).
CSWMP 05	Hardstand material, rumble grids or similar will be provided at exit points from construction areas onto public roads to minimise the tracking of soil and particulates onto public roads. The design of these controls must facilitate the requirements of the Panama Disease Control Management Plan.	Pre-construction / Construction	Environment Manager Foreman/Site Supervisor Project Engineer	TfNSW QA G38 Managing Urban Stormwater: Soils and Construction. Vol 1 (Landcom 2004) and Vol 2D (DECC 2008).

ID	Measure/Requirement	When to implement	Responsibility	Reference
CSWMP 06	Vehicle movements from site will be minimised during wet weather if the tracking of mud may become an issue	Pre-construction / Construction	All project personnel	Good practice Managing Urban Stormwater: Soils and Construction. Vol 1 (Landcom 2004) and Vol 2D (DECC 2008).
CSWMP 07	Batters will be designed and constructed to minimise risk or exposure, instability and erosion, and to support long term, ongoing best practice management, in accordance with the Guideline for Batter Stabilisation Using Vegetation (Roads and Maritime Services 2015). Batters will be constructed to assist the retention of topsoil on batter slopes in accordance with Managing Urban Stormwater – Soils and Construction, Volume 1 (Landcom 2004) and Volume 2D (DECC 2008).	Pre-construction / Construction	Design Manager Environment Manager Project Engineer Soil Conservationist	REMM (SC07) Guideline for Batter Stabilisation Using Vegetation (Roads and Maritime Services 2015f)
CSWMP 08	ESCPs will detail how upstream water will be managed and diverted around or through disturbed areas so it is not polluted by the construction activities. Clean water diversion works will be implemented in accordance with RMS Pacific Highway Practice Note “Temporary Clean Water Diversion (May 2012)” prior to removal of topsoil or filling operations.	Pre-construction / Construction	Design Manager Environment Manager Project Engineer Soil Conservationist	TfNSW QA G38
CSWMP 09	Catch drains, contour and diversion drains across exposed areas will be installed immediately following clearing, and re-established and maintained during topsoil removal and earthwork operations. Drains will be appropriately stabilised with scour protection provided at outlets in accordance with Managing Urban Stormwater – Soils and Construction, Volume 1 (Landcom 2004) and Volume 2D (DECC 2008).	Construction	Environment Manager Foreman/Site Supervisor Project Engineer	TfNSW QA G38
CSWMP 10	Wastewater or “dirty” water generated during the construction process will be collected, treated and disposed of by appropriate means, including the installation of sediment barriers downslope of all disturbed areas. In areas where it is not possible to direct dirty water to sediment basins, other sediment controls will be implemented in accordance with Managing Urban Stormwater – Soils and Construction, Volume 1 (Landcom 2004) and Volume 2D (NSW DECC 2008).	Construction	Environment Manager Foreman/Site Supervisor Project Engineer	TfNSW QA G38 Managing Urban Stormwater: Soils and Construction. Vol 1 (Landcom 2004) and Vol 2D (DECC 2008).
CSWMP 11	Clean and dirty water runoff will be adequately separated to avoid mixing where possible through the use of diversions, clean water drains, and the early installation of permanent drainage infrastructure	Construction	Environment Manager Foreman/Site Supervisor Project Engineer	TfNSW QA G38

ID	Measure/Requirement	When to implement	Responsibility	Reference
CSWMP 12	Temporary and permanent drainage infrastructure will be designed to incorporate water sensitive urban design principles where possible in accordance with the Water sensitive urban design guideline (Roads and Maritime 2017d). This could include replacing concrete lined longitudinal catch drains with vegetated swales and the operational water quality control measures.	Pre-construction	Design Manager Project Engineer Environment Manager Soil Conservationist	REMM (UD02) Water Sensitive Urban Design Guideline (Roads and Maritime 2017d)
CSWMP 13	Sediment basins must be designed and constructed in accordance with Managing Urban Stormwater – Soils and Construction, Volume 1 (Landcom 2004) and Volume 2D (NSW DECC 2008); and Best Practice Erosion and Sediment Control Appendix B (IECA 2018)	Pre-construction / Construction	Design Manager Environment Manager Soil Conservationist Foreman/Site Supervisor	TfNSW QA G38
CSWMP 14	Sediment basins must be cleaned out whenever the accumulated sediment exceeds 60% of the sediment storage zone. Accumulated sediment from sediment basins and traps must be removed in such a manner as not to damage the structures and disposed of, or reused, in accordance with Waste and Resources Management Plan (WRMP).	Construction	Environment Manager Foreman/Site Supervisor	TfNSW QA G38
CSWMP 15	Provide and maintain suitable access to sediment basins and sediment traps to allow inspection, maintenance, monitoring and cleaning out in all weather conditions.	Construction	Environment Manager Foreman/Site Supervisor Project Engineer	TfNSW QA G38
CSWMP 16	Remove all temporary construction sediment retention basins and sediment traps before completion, making all areas good, but not before all upstream areas have been vegetated or otherwise stabilised in accordance with Managing Urban Stormwater – Soils and Construction, Volume 1 (Landcom 2004) and Volume 2D (NSW DECC 2008).	Construction	Environment Manager Foreman/Site Supervisor Project Engineer	TfNSW QA G38
CSWMP 17	Wherever possible, all required sediment basins and associated drainage will be installed and commissioned prior to the commencement of clearing and grubbing works in that catchment that could cause sediment to leave site. (Except where clearing is required for basin installation and site access, material storage and safety requirements to facilitate sediment basin construction).	Pre-construction / Construction	Environment Manager Project Engineer Soil Conservationist Foreman/Site Supervisor	TfNSW QA G38
Acid sulfate soils – Refer to Acid Sulfate Soils Management Plan (Appendix B)				
Stockpile management				

ID	Measure/Requirement	When to implement	Responsibility	Reference
CSWMP 18	Stockpiles will be managed in accordance with TfNSW Technical Guideline EMS-TG-010: Stockpile Site Management and the Landcom (2004) guidelines and the Stockpile Management Protocol (Appendix G). Stockpiles will comply with the following: • Locate stockpiles outside of the tree protection zone of trees or native vegetation identified for retention and in areas of low ecological or heritage conservation value; • Locate stockpiles as far as possible from residential dwellings and other noise sensitive areas and at least 5 m from likely areas of concentrated water flows and at least 10 m from waterways that are classified as Class 1 and Class 2 from the DPI Fisheries guideline "Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings"; • Keep stockpile heights to no greater than 2 m and slopes to no steeper than 2:1; • Cover, or otherwise protect from erosion, stockpiles that will be in place for more than 20 days as well as any stockpiles that are susceptible to wind or water erosion, within 10 days of forming each stockpile; • Keep topsoil that is not contaminated by noxious weeds in stockpiles for later spreading on fill batters and other areas. Other material may also be stockpiled but kept separated from the topsoil stockpiles; • Implement measures to prevent the growth of weeds in topsoil stockpiles; • Materials must be stockpiled only in stockpile sites in accordance with the approved CEMP, with appropriate erosion and sediment controls; • Maintain a register of stockpiles in accordance with the requirements of the CEMP; and • All stockpiles located within the project EPL premise boundary	Pre-construction / Construction	Environment Manager Project Engineer Soil Conservationist Foreman/Site Supervisor	TfNSW QA G38 "Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings".
Tannin management				

ID	Measure/Requirement	When to implement	Responsibility	Reference
CSWMP 19	Mulch stockpiles and the potential generation of tannin leachates will be managed through the implementation of a Management of Tannins from Vegetation Mulch Procedure. The procedure will be prepared in accordance with the Environmental Direction for the Management of Tannins from Vegetation Mulch (Roads and Maritime Services 2012). The procedure will include but not be limited to: • Planning and staging vegetation processing activities; • Management of temporary mulch stockpiles (less than one week); • Stockpile location and management to minimise the production and release of tannins including use of impermeable bunds and sumps to capture tannin leachate; • Monitoring the stockpiles for the production of tannin leachate including post-rainfall inspection requirements; and • Response(s) to tannin leachate production.	Pre-construction / Construction	Environment Manager Project Engineer Foreman/Site Supervisor	Environmental Direction for the Management of Tannins from Vegetation Mulch (Roads and Maritime Services 2012) REMM (SW05)
Dewatering				
CSWMP 20	Dewatering will be undertaken and managed in accordance with the Pacific Highway Projects Dewatering Guidelines. A specific EWMS for dewatering will be prepared which will outline the dewatering methodology, testing requirements, supervision requirements, staff responsibilities and training, and approvals required before any de-watering activity begins. The personnel responsible for approval and/or carrying out dewatering activities must be adequately trained and inducted on the EWMS.	Pre-construction / Construction	Environment Manager Project Engineer Foreman/Site Supervisor	TfNSW G38
CSWMP 21	Dewatering activities will be undertaken in a manner that complies with the conditions of the Environment Protection Licence and does not cause erosion and/or pollute the environment.	Construction	Environment Manager Foreman/Site Supervisor	TfNSW G38
CSWMP 22	Where flocculants and coagulants are proposed for use to settle suspended sediments, the appropriate application rate, as well as method of applying the gypsum will be determined and noted within the ESCP.	Pre-construction / Construction	Environment Manager Soil Conservationist	TfNSW G38
CSWMP 23	Where a flocculant or coagulant other than gypsum is proposed to treat site water, it must be demonstrated that the proposed flocculant or coagulant is suitable for use (application to be submitted as per TfNSW template “Alternative flocculants and coagulants – template to propose use”)	Pre-construction / Construction	Environment Manager Soil Conservationist	TfNSW G38

ID	Measure/Requirement	When to implement	Responsibility	Reference
CSWMP 24	Apply the flocculant or coagulant (whether gypsum or another approved material) to settle suspended sediments within 24 hours of the conclusion of each rain event causing runoff.	Construction	Environment Manager Foreman/Site Supervisor	TfNSW G38
CSWMP 25	Prior to the commencement of dewatering, the entire system will be inspected, including intakes and outlets, pumping and discharge locations. Wherever possible, dewatering activities will be supervised directly. Where not directly supervised, a risk assessment must be carried out and mitigation measures implemented to eliminate the risks of pollution and to prevent the occurrence of the following: • intake suction placed within the deposited sediments resulting in discharge of sediment laden waters • erosion at discharge locations and downstream areas • inadvertent or intentional controlled discharge of untreated waters • impacts to receiving environments (i.e Threatened Species).	Construction	Environment Manager Foreman/Site Supervisor	TfNSW G38
CSWMP 26	The following records will be kept in relation to dewatering: • dewatering procedure • date and time for each discharge at each location • water quality test results for each discharge • personnel approving the dewatering activities • evidence of discharge monitoring, or risk assessment and mitigation measures used to eliminate the risks of pollution or erosion • any other EPA licence requirements where issued.	Construction	Environmental Site Representative	TfNSW G38
Work in and adjacent to waterways				
CSWMP 27	A detailed Environmental Work Method Statement will be prepared and implemented for all works undertaken within or adjacent to waterways, or immediately adjacent to drainage lines. The Environmental Work Method Statement will detail measures to avoid or minimise risks from erosion and sedimentation to water quality and biodiversity. It will be prepared in accordance with relevant guidelines including, but not limited to consideration of: • Biodiversity Guidelines – Protecting and managing biodiversity on RTA projects • Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings	Pre-construction / Construction	Environment Manager Project Engineer	Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings REMM (SW04)

ID	Measure/Requirement	When to implement	Responsibility	Reference
	• Managing Urban Stormwater: Soils and Construction Vol 1 (Landcom 2004) and Vol 2D (DECC 2008) EWMS for works that are within the sub-catchments that drain into the Solitary Islands Marine Park will be prepared in consultation with DPI Fisheries.			
CSWMP 28	Works will be programmed to minimise the extent and duration of disturbance to vegetation. This will include leaving clearing and initial earthworks in intermittent and permanent watercourses until subsequent works are about to commence. Works in permanent and intermittent watercourses are to be undertaken during low flows and when upcoming weather forecast (as per BoM website for the Mid North Coast district forecast region) indicates suitable conditions for the nature and scale of activity.	Pre-construction / Construction	Project Engineer Foreman/Site Supervisor Environment Manager	TfNSW G38 TfNSW G40
CSWMP **29**	Creek realignments and/or adjustments will be designed to behave in a similar hydrologic and geomorphic manner as existing conditions and will consider the requirements of the Policy and Guidelines for Fish Habitat Conservation and Management (DPI 2013). Revegetation and adequate scour protection will be provided so there are no hydraulic impacts on bed and bank stability, erosion, sedimentation or riparian vegetation in accordance with the Controlled Activities for Works on Waterfront Land – In-stream Works (DPI 2012c). Works that involve the realignment of waterways that may affect the Solitary Islands Marine Park, including Pine brush Creek will be designed in consultation with DPI Fisheries.	Pre-construction / Construction	Project Engineer Foreman/Site Supervisor Environment Manager	REMM (FH04)
CSWMP 3**0**	Where water abstraction from a waterway is proposed, a qualified aquatic ecologist will be engaged to assess if the waterway is suitable for abstraction; and when pumping must cease.	Pre-construction / Construction	Environment Manager Project Engineer	MCoA E107
CSWMP 3**1**	Any pumps sumps used in natural waterways must be screened with mesh no greater than 5mm in size.	Pre-construction / Construction	Environment Manager Project Engineer	MCoA E108
CSWMP 32	Scour protection for bridges and culverts will be designed in accordance with Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge 2003) and Guidelines for Controlled Activities for Works on Waterfront Land – Outlet Structures (DPI 2012b).	Detailed Design	Environment Manager	REMM FH06
Contamination				
CSWMP 33	Phase 2 contamination investigations will be undertaken in areas of potential contamination identified during the preliminary site investigation (RCA 2016). The investigation will be carried out in accordance with the Guideline for the	Pre-construction	Project Manager Environment Manager	REMM (SC01)

ID	Measure/Requirement	When to implement	Responsibility	Reference
	Management of Contamination (Roads and Maritime Services 2013d). This will include soil sampling from targeted areas including: • Banana plantations within proposed cuttings (analysed for arsenic, lead and organochlorin pesticides including DDT, Aldrin and Dieldrin) • Incremental soil sampling along construction footprint at existing Pacific Highway where there is a history of truck accidents to assess potential lead and hydrocarbon contamination • Targeted soil sampling at locations with dumped materials, fill materials and other agricultural uses • Areas of PASS within construction footprint to determine oxidised pH level.			Guideline for the Management of Contamination (Roads and Maritime Services 2013d)
CSWMP 34	If site contamination investigations indicate that construction works will impact contaminants that are present on site in concentrations above the intended land use criteria, then a Remedial Action Plan will be developed, and remediation works carried out in consultation with the EPA and in accordance with the Guideline for the Management of Contamination (Roads and Maritime Services 2013d).	Pre-construction / Construction	Environment Manager Project Engineer Foreman/Site Supervisor	REMM (SC03) Guideline for the Management of Contamination (Roads and Maritime Services 2013d)
Groundwater – refer to Groundwater Management Plan (Appendix F)				
Operational stormwater				
CSWMP 35	Stormwater and road runoff will be directed towards operational water quality treatment structures that will assist in the removal of pollutants from discharge water to protect ecosystem and human health.	Pre-construction / Construction	Design Manager	REMM (SW07) Water Sensitive Urban Design Guideline (Roads and Maritime 2017d)
CSWMP 36	The type and design of the specific stormwater treatment measures will continue to be refined as part of the detailed design process with the aim of achieving the NSW Water Quality Objectives where reasonable and feasible. This will include review of the proposed stormwater treatment train and consideration of best management practice guidelines including the Water sensitive urban design guideline (Roads and Maritime Services 2017d).	Pre-construction / Construction	Design Manager	REMM (SW08) Water Sensitive Urban Design Guideline (Roads and Maritime 2017d)
Revegetation				
CSWMP 37	Rehabilitation and revegetation of the construction footprint will occur with local indigenous plant species progressively during construction. Revegetation of the site is to be staged as work proceeds, incorporating progressive topsoiling and vegetation establishment as specified within TfNSW QA R178	Construction	Environment Manager Project Engineer	REMM (AH08) TfNSW QA R178
Refuelling, washdown and chemical storage				

ID	Measure/Requirement	When to implement	Responsibility	Reference
CSWMP 38	A schedule of all hazardous materials (as defined by the Waste Minimisation and Management Act 1995 and Regulations 1996) in use on the construction site will be maintained.	Pre-construction / Construction	Environment Manager Safety Manager	TfNSW QA G36
CSWMP 39	Fuels, chemicals and other hazardous materials must be stored in suitably located, roofed, fire-protected and bunded areas with an impermeable floor to minimise the impact of any spillage or contamination on the Site and adjoining areas. The bunded area must be able to contain 120% of the volume of the largest single stored volume within the bund.	Construction	Environment Manager Safety Manager Project Engineer Foreman/Site Supervisor	TfNSW QA G36 REMM (HZ04)
CSWMP 40	All fuels, chemicals, and liquids must be stored on slopes less than 1:10 and at least 50 m away from aquatic habitat and flood prone areas.	Construction	Environment Manager Safety Manager Project Engineer Foreman/Site Supervisor	TfNSW QA G36
CSWMP 41	Sites used for refuelling and chemical storage will be located away from areas of shallow groundwater or appropriately lined and bunded to protect groundwater.	Pre-construction / Construction	Environment Manager Project Engineer Foreman/Site Supervisor	REMM (GW12)
CSWMP 42	To minimise the possibility of pollution to site, EMWS(s) will be prepared for the following activities: • refuelling or maintenance and cleaning of plant and equipment including concrete agitators, bitumen spray bars and asphalt pavers; • on-site batching of concrete and asphalt; • mixing of bitumen with cutting oil and additives; • application of liquid membranes, including paint and thermoplastic, resin, emulsion, precoat agent and curing compound; • bulk fuel or chemical deliveries; • removal and disposal of excess chemicals and water used for washing down of equipment; • pumping out of oil and grease collection pits; • decanting operations such as for fuel, chemicals and bitumen • installation of controls for the capture and filtering of all chemicals that may runoff in storm events (e.g. wax and hydrocarbon curing compounds, bitumen tack coat and saw cutting material)	Pre-construction / Construction	Environment Manager Project Engineer	TfNSW QA G36
Spill prevention and response				

ID	Measure/Requirement	When to implement	Responsibility	Reference
CSWMP 43	• A site-specific emergency spill response procedure has been developed (Appendix E) and will be implemented in accordance with the Roads and Maritime Code of Practice for Water Management and relevant EPA guidelines. The procedure will be implemented throughout Project construction as required.	Pre-construction	Environment Manager Safety Manager	TfNSW QA G36 REMM (SC08)
CSWMP 44	Spill kits will be located to allow for timely response to uncontained spills. Adequate quantities of suitable material to counteract spillage will be readily available. Site inductions will include a briefing on the use of spill kits.	Construction	Environment Manager Safety Manager Project Engineer Foreman/Site Supervisor	TfNSW QA G36 REMM (HZ05)
Monitoring of performance				
CSWMP 45	Monitor onsite weather conditions using onsite installed AWS. Daily records of rainfall at the site (in millimetres), are to be measured at the same time each day.	Construction	Environment Manager Project Engineer	TfNSW QA G38
CSWMP 46	Monitor upcoming weather conditions daily using the BoM website and / or on-site AWS. Prepare the site for potential rain events when there is more than a 50% chance of > 10 mm of rainfall (as forecast by BoM website).	Construction	Environment Manager Project Engineer Foreman/Site Supervisor	TfNSW QA G38
CSWMP 47	Post rainfall event monitoring are to be undertaken within 3 hours (during normal work hours and days) or within 24 hours (outside normal work hours and days) of the start of all rainfall events that cause runoff to occur (when rainfall exceeds 10mm in a 24 hour period as a minimum) and during periods of prolonged rainfall.	Construction	Environment Manager	TfNSW QA G38
CSWMP 48	An inspection and maintenance program will be implemented during construction to ensure effective implementation of all temporary and permanent soil, erosion and water pollution safeguards. The inspections will assess implementation and success of the controls, actions required to ensure on-going effective operation, and compliance with any statutory approvals. A register of inspections will be established.	Construction	Environment Manager Project Engineer Foreman/Site Supervisor	SW06 (REMM)
CSWMP 49	During the initial establishment and operation period of realigned or adjusted waterways, regular inspections will be carried out to ensure effective design of the realignment and identify any maintenance actions required.	Construction	Environment Manager Project Engineer Foreman/Site Supervisor	TfNSW QA G38 FH05 (REMM)
CSWMP 50	Maintain a register of inspection and maintenance of erosion control and sediment capture measures, dates of discharge, water treatment (flocculation) performed, discharge water quality, volumes of sediment removed from each device, method of disposal of the sediment and daily rainfall.	Construction	Environment Manager	TfNSW QA G38
CSWMP 51	Review the effectiveness of the ESCP following each rainfall event exceeding 10mm.	Construction	Environment Manager	TfNSW QA G38

ID	Measure/Requirement	When to implement	Responsibility	Reference
	Revise the CSWMP, ESCP and Stockpile Management Plan when erosion/sedimentation control measures, stabilisation control measures and other soil and water control measures are found to be not fully effective, including review of design parameters.			

6.1 CONSTRUCTION DEWATERING

Dewatering will be undertaken and managed in accordance with the Pacific Highway Projects Dewatering Guidelines. Further, a specific EWMS for dewatering will be prepared and will consider and/or incorporate the following detail:

- Areas of the site that will require dewatering;
- Dewatering methods that will minimise potential environmental impacts;
- Opportunities for reuse;
- Consideration of Panama disease mitigation measures;
- The limitations for any proposed reuse methods;
- Discharge locations and adequate energy dissipation;
- Water quality criteria for discharge and/or reuse;
- Treatment techniques required to meet the water quality criteria; and
- Water sampling and testing requirements.

Dewatering of existing storages (e.g. dams) will occur overland in vegetated areas or will be used for dust suppression activities and not discharged directly into waterways to minimise release of high levels of nutrients and or contaminants directly into the waterways.

A CWQIR, consistent with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018), will be prepared prior to commencement of construction. Construction water quality discharge criteria will be assessed during preparation of the CWQIR, in consultation with NSW EPA, and documented within the Project EPL.

7 COMPLIANCE

7.1 ROLES AND RESPONSIBILITIES

The Project Team's organisational structure and overall roles and responsibilities are outlined in Section 4 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Section 6 of this Plan.

7.2 TRAINING

All employees, contractors and utility staff working on site will undergo site induction training relating to soil and water management issues. The induction training will address elements related to soil and water management, where required, including:

- Existence and requirements of this sub-plan and associated Environmental Work Method Statements;
- Relevant legislation;
- Roles and responsibilities for soil and water management;
- The location of potential or actual acid sulfate soils;
- The location of potential contaminated land;
- The location of all sensitive receiving waters;
- Water quality management and protection measures;
- Water quality, aquatic habitats and the Solitary Islands Marine Park;
- The requirements of the Panama Disease Control Management Plan; and
- Procedure to be implemented in the event of an unexpected discovery of potential contaminated land and asbestos material.

Targeted training in the form of toolbox talks or specific training will also be provided to personnel with a key role in soil and water management. Examples of training topics include:

- Erosion and sediment control plans, implementation, and maintenance;
- Sediment and water quality basin construction. Operation and maintenance;
- Working near or in drainage lines and creeks;
- Emergency response measures in high rainfall events;
- Pollution incident response management planning;
- Lessons learnt from incidents and emergencies;
- Mulch and tannin management;
- Spill response and incident management;
- Stockpile location criteria; and
- Identification of potentially contaminated spoil, and fill material.

Further details regarding staff induction and training are outlined in Section 5 of the CEMP.

7.3 MONITORING AND INSPECTION PROGRAM

Regular monitoring and inspections will be undertaken in the lead up to, during and following construction. Monitoring and inspections form a fundamental aspect of ongoing project risk analysis and will include, but not be limited to:

- Weekly site inspections are to be undertaken in all project areas with the Contractor Environmental Representative and area Supervisor/Foreman in attendance, action lists are to be produced to address any maintenance issues or additional controls required, a register of all actions raised and detailing the close out of actions is to be maintained;
- Pre rainfall and post rainfall inspections are to be undertaken to evaluate the effectiveness of erosion and sediment controls measures. Pre rainfall inspections are to be triggered by a forecast of

50% probability of more than 10 mm. Post rainfall event inspections are to be undertaken within 3 hours (during normal work hours and days) or within 24 hours (outside normal work hours and days) of the start of all rainfall events that cause runoff to occur (when rainfall exceeds 10mm in a 24 hour period as a minimum) and during periods of prolonged rainfall. Action lists are to be produced to address any maintenance requirements or additional controls required;

- During the initial establishment and operation period of realigned or adjusted waterways, regular inspections will be carried out to ensure effective design of the realignment, these inspections are to be undertaken as part of the rainfall and weekly site inspection process as a minimum or in accordance with the frequency stated in the EWMS prepared for the location specific scope of works, aspects of the works to be inspected would typically include a review of the implementation of erosion and sediment control measures in accordance with approved plans and identification of any maintenance requirements, water quality checks and comparisons, evidence of any flora or fauna impacts from the works and the status of revegetation and landscaping;
- Construction sediment basin water quality prior to discharge in accordance with a specific sediment basin management EWMS to be developed prior to sediment basin construction and operation;
- Up and downstream of the project alignment water quality monitoring at nominated locations will be undertaken monthly in accordance with the Surface Water Quality Monitoring Program (TfNSW);
- Groundwater monitoring, both level and quality at nominated locations will be undertaken quarterly in accordance with the Groundwater Monitoring Program (TfNSW); and
- Daily records of rainfall to determine if local rainfall events may trigger a wet weather surface water sampling event as required in the Surface and Ground Water Quality Monitoring Programs.

Monitoring requirements outlined in the Submissions / Amendment Reports are specified in Chapter 6. For details on the type, timing, frequency, methodology, assessment criteria and associated reporting requirements, refer to the Surface and Groundwater Water Quality Monitoring Programs.

Additional requirements and responsibilities in relation to inspections are documented in Section 8.2 of the CEMP.

7.4 WEATHER MONITORING

A network of automatic weather stations has been established by TfNSW along the project alignment. The data collected from the automatic weather stations shall:

- Provide a more detailed early understanding of potential rainfall and other adverse weather impacts;
- Provide the opportunity for proactive and early inspection and maintenance response to erosion and sedimentation and the effects of other adverse climatic conditions before pollution occurs;
- Trigger weather alarms and messages to relevant site personnel to take action where appropriate;
- Assess and validate the performance of installed erosion and sediment control measures against the design performance criteria;
- Provide compliance data for statutory monitoring onsite; and
- Inform trigger levels for post rain inspections.

Each station shall record rainfall, temperature, relative humidity, wind speed, wind direction and bathometric pressure. The rain gauge within each mobile automatic weather station will be of the tipping bucket type. Each station will conform to relevant standards for the location of such devices including compliance with TfNSW Specification R272 and shall be fully protected and secured.

Data from the automatic weather stations will be accessible via short message service (SMS) alarms or queries to a mobile phone and downloadable to a desktop console logger or laptop computer. SMS queries and alarms will be sent to the project team and relevant FGJV representatives. The Environmental Representative will have access to the data at all times. Each station will download data to the internet and allow live views of weather data by authorised users; which will include Environmental Representative.

In accordance with normal standard construction practices, weather forecasts will be used to guide work activities undertaken onsite. Forecasts will be checked at the start of each day and before any new work activity that may be affected by rainfall or adverse weather. Works in permanent and

intermittent watercourses are to be undertaken during low flows and when upcoming weather forecast (as per BoM website for the Mid North Coast district forecast region) indicates suitable conditions for the nature and scale of activity. Where weather forecasts predict conditions that may pose an environmental risk, site environmental controls will be inspected and secured to reduce erosion and sediment control impacts. Contingency planning to prevent spills will also involve monitoring for predicted flood events and the removal from flood prone areas of fuels, chemicals, , contaminated stockpiles, plastics, and debris that may mobilise in marine park catchments.

7.5 AUDITING

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this sub plan, MCoA and other relevant approvals, licenses, and guidelines. Audit requirements are detailed in Section 8 of the CEMP.

7.6 REPORTING

Reporting requirements and responsibilities are documented in Chapter 8 of the CEMP and the Surface Water and Groundwater Monitoring Programs (TfNSW).

8 REVIEW AND IMPROVEMENT

8.1 CONTINUOUS IMPROVEMENT

Continuous improvement of this Plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance;
- Determine the cause or causes of non-conformances and deficiencies;
- Allow for updates to the CEMP, Sub-plans and associated management documents to occur to reflect the outcomes of ongoing risk analysis of construction activities;
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies;
- Verify the effectiveness of the corrective and preventative actions;
- Document any changes in procedures resulting from process improvement; and
- Make comparisons with objectives and targets.

8.2 SWMP UPDATE AND AMENDMENT

The processes described in Section 9 of the CEMP may result in the need to update or revise this Plan. This will occur as needed.

Only the Environment Manager, or delegate, has the authority to change any of the environmental management documentation.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure – refer to Section 10.2 of the CEMP.

APPENDICES

APPENDIX A PRIMARY EROSION AND SEDIMENT CONTROL PLAN

COFFS HARBOUR BYPASS

Primary Erosion and Sediment Control Plan

Revision B - Coffs Harbour Bypass

FERROVIAL GAMUDA JOINT VENTURE

DOCUMENT DETAILS

Document Title	Primary Erosion and Sediment Control Plan
Project Name	Coffs Harbour Bypass
Client	Transport for New South Wales
Application No.	SSI-7666
Principal Contractor	Ferrovial Gamuda Joint Venture

DOCUMENT AUTHORISATION

	Name	Position	Signature	Date
Prepared by	Tim Elder	Environment Lead & CPESC		
Reviewed by	Erran Woodward	FGJV Approvals Lead		
Approved by	Hari Corliss	FGJV Environment & Sustainability Manager		
Approved by	Daniel Perez	FGJV Project Director		
Approved by	Scott Lawrence	TfNSW Representative		
Endorsed by	Duncan Thomas	Environmental Representative		

VERSION CONTROL

Revision	Date	Description	Approval
A	30/9/2022	Draft for TFNSW review	
B	15/11/2022	Draft for ER Review	

DISTRIBUTION OF CONTROLLED COPIES

This ESCP is available to all personnel and sub-contractors via the project document control management system. An electronic copy can be found on the project website.

The document is uncontrolled when printed. One controlled hard copy of the ESCP and supporting documentation will be maintained by the Quality Manager at the project office and on the project website.

Copy No.	Issued to	Version
1		
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GLOSSARY/ABBREVIATIONS

Abbreviation	Expanded Text
ASR	Acid sulfate rock
ASS	Acid sulfate soils
BoM	Bureau of Meteorology
CEMP	Construction Environment Management Plan
CPESC	Certified Professional in Erosion and Sediment Control
CoA	Conditions of Approval
EIS	Environmental Impact Statement
ESC	Erosion and sediment control
ESCP	Erosion and Sediment Control Plan
EWMS	Environmental Work Method Statement
IECA	International Erosion Control Association
NTU	Nephelometric Turbidity Units
PDCMP	Panama Disease Construction Management Plan
RUSLE	Revised Universal Soil Loss Equation
SWMP	Construction Soil and Water Management Sub Plan
TfNSW	Transport for New South Wales
TSS	Total Suspended Solids
USCS	Unified Soil Classification System

CONTENTS

TABLES

1 INTRODUCTION

1.1 CONTEXT

This Primary Erosion and Sediment Control Plan (ESCP) forms part of the Construction Soil and Water Management Sub Plan (SWMP) and Construction Environmental Management Plan (CEMP) for the Coffs Harbour Bypass (the project).

1.2 BACKGROUND

The project includes construction of a 14-kilometre bypass of Coffs Harbour and associated upgrade of the existing Pacific Highway. The project will provide a four-lane divided highway that bypasses Coffs Harbour, passing through the North Boambee Valley, Roberts Hill and then traversing the foothills of the Coffs Harbour basin to the west and north to Korora Hill.

A detailed project description is provided within the Coffs Harbour Bypass Environmental Impact Statement (EIS) (Arup 2019).

1.3 PURPOSE

The purpose of this ESCP is:

- To provide an overarching plan demonstrating general drainage, erosion and sediment control practices for the project
- To minimise actual and potential environmental harm resulting from soil erosion and sediment transport associated with project construction
- To identify how soil erosion and sediment transport will be addressed during construction
- To ensure compliance with relevant project environmental documents, licences, permits, approvals and specifications.

This ESCP will be complimented by ongoing Progressive ESCPs. As staged construction progresses, specific up-to-date details on the location and installation of erosion and sediment control measures will be provided through updated Progressive ESCPs.

1.4 SCOPE

This ESCP incorporates the following key elements:

- Prepared by a Certified Professional in Erosion and Sediment Control (CPESC)
- Provides an overarching erosion risk and hazard assessment
- Identifies management strategies and controls to be implemented to effectively manage erosion, and subsequent sediment mobilisation during the construction stage
- Provides recommendations and designs consistent with applicable legislation, best practice guidelines, project environmental documents, licences, permits, approvals and specifications.

1.5 RELATIONSHIP TO OTHER PROJECT PLANS AND REPORTS

This ESCP has been prepared to support the SWMP and CEMP, and complies with Conditions of Approval (CoA), environmental management measures and licence requirements. This ESCP outlines practices consistent with the EIS, relevant specifications, and best practice guidelines and publications including:

- Managing Urban Stormwater; Soils and Construction Vol. 1, 4th edition. (Landcom 2004). Referred to as the Blue Book
- Managing Urban Stormwater; Soils and Construction Vol. 2D. Main Roads Construction. (DECCW 2008). Referred to as the Blue Book

- Best Practice Erosion and Sediment Control. International Erosion Control Association (IECA) (2008)
- Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull, S. and Witheridge, G. 2003)
- TfNSW Environmental Direction 25: Management of Tannins from Vegetation Mulch
- TfNSW Technical Guideline: Temporary Stormwater Drainage for Road Construction
- TfNSW Technical Guideline EMS-TG-011: Environmental Management of Construction Site Dewatering
- TfNSW Technical Guideline EMS-TG-010: Stockpile Site Management
- TfNSW Specification G38. Soil and Water Management. Version for: Coffs Harbour Bypass. Referred to as G38
- TfNSW Specification G36. Environmental Protection. Version for: Coffs Harbour Bypass. Referred to as G36.
- TfNSW Specification G40. Clearing and Grubbing. Version for: Coffs Harbour Bypass. Referred to as G40.
- TfNSW Specification R44. Earthworks. Referred to as R44.
- TfNSW Specification R178. Vegetation. Version for: Coffs Harbour Bypass. Referred to as R178.

1.6 EROSION AND SEDIMENT CONTROL PRINCIPLES

This ESCP is prepared and certified in accordance with the following principles of effective erosion and sediment control (ESC):

- Assess constraints and opportunities for erosion and sediment control during the planning/design phase
- Plan early for erosion and sediment control
- Minimise the extent and duration of disturbance
- Manage soils, including conserving topsoil for later reuse in rehabilitation
- Control water flow on, through and off the site
- Minimise erosion as much as possible
- Maximise sediment retention onsite
- Rehabilitate disturbed lands progressively, ensuring rehabilitation is effective to reduce the erosion hazard
- Conduct regular inspections of the site to identify potential problems and allow for rectification or repair
- Maintain all erosion and sediment controls, including cleaning out sediment traps, until the upslope catchments are effectively rehabilitated
- Monitor, plan for and respond to rainfall and flooding events.

2 EXISTING ENVIRONMENT

The existing environment and factors influencing soils and water within and adjacent to the project corridor is discussed within Section 4 of the SWMP. Key factors for erosion and sediment control management are discussed below.

2.1 TOPOGRAPHY

Site topography is highly variable and complex. In the southern third of the project, slopes are mostly very gentle (less than 5%) and include some low-lying, flood-prone lands. In the central and northern thirds of the proposal slopes are steeper, typically around 10 to 30% but with some small areas of very steep (around 65%) terrain.

2.2 SOILS

2.2.1 SOIL LANDSCAPES

Soil landscapes intersected by the project are described within the document Soil Landscapes of the Coffs Harbour 1:100,000 Sheet Report (Milford 1999). Table 2-1 provides a summary of soil landscapes including potential constraints that influence erosion and sediment control during construction.

Table 2-2 includes a summary of various soil landscape unit parameters (where these are described by Milford 1999). K-factors are increased by 20% for soil loss calculations where dispersion is high (Moonee and Suicide soil landscape units). Cation exchange capacity is a general indicator of soil storage capacity for available, positively charged plant nutrients such as Calcium, Magnesium and Potassium. Results are low to medium for analysed soil landscape units.

TABLE 2-1: SOIL LANDSCAPE DESCRIPTIONS

Landscape name	Landscape type	Landscape description	Depth	Drainage	Soil description	Acidity, salinity/sodicity	Erodibility/ Hazards
Coffs Creek	Alluvial	Level to gently undulating floodplains	Deep	Moderate to poorly drained	Alluvial, yellow and red podzolic soils, yellow earths, Gleyed podzolic soils	Strong to very strong acidity	Foundation hazard, seasonal water logging, permanents high water tables, localised flood hazards
Ulong	Erosional	Undulating to rolling low hills on Late Carboniferous metasediments	Moderately deep to deep	Well drained	Red and brown earths, low wet bearing strength	Strongly to very strongly acidic soils	Localised water erosion hazard, steep slopes and high run-on
Newports Creek	Swamp	Low, level to gently undulating coastal back barrier floodplains on Pleistocene estuarine sediments	Deep	Poorly drained	Yellow podzolic soils and humic gleys. High topsoils organic matter and low fertility. Low to very low wet	Strongly to very strongly acidic, strongly sodic, strongly saline soils	Localised water erosion hazard, Flood hazard, seasonal water logging, foundation hazard

					bearing strength		
Moonee	Transferral	Undulating rises, footslopes and drainage plains next to steep low hills on Carboniferous metasediments	Moderately deep to deep	Poorly drained	Humic gleys	Strongly to very strongly acidic soil, high subsoil sodicity	High subsoil erodibility, water erosion hazard, permanent high-water tables
Megan	Erosional	Rolling hills to hills on Late Carboniferous Metasediments	Moderately deep to deep	Well drained	Structured red earths and brown earths	Strongly acidic	High erodibility, high water erosion hazard, foundation hazard
Suicide	Colluvial	Steep hills and dissected valleys on Late Carboniferous metasediments	Moderately deep to deep	Well drained	Stony structured, yellow earths on crests and upper slopes	Strongly acidic, strong subsoil acidity	High water erosion hazard, foundation hazard, localised rockfall hazard

TABLE 2-2. SOIL LANDSCAPE PARAMETERS

Landscape Name	Proportion of Project (%)	K-factor	Unified Soil Classification System (USCS)	Dispersion (%)	Dispersion	Cation Exchange Capacity (CEC)	pH
Coffs Creek	20	0.017 – 0.04	-	-	-	-	-
Ulong	15	0.017 – 0.04	CL	< 10	slight	Very Low - Medium	4.8 – 5.4
Newports Creek	< 1	0.086	-	-	-	Very Low	4.4
Moonee	2	0.023 -0.079	ML	5 - 30	negligible to high	Very Low	4.3 – 5.3
Megan	55	0.026 -0.04	-	-	-	-	-
Suicide	8	0.024 – 0.037	CL, ML	11 - 21	slight to high	Low	4.8 – 6.7

2.2.2 ACID SULFATE MATERIAL

Acid sulfate materials, including Acid Sulfate Soils (ASS) and Acid Sulfate Rock (ASR), are discussed in Section 18.2.4 of the EIS.

Areas of PASS were confirmed by laboratory testing within the construction footprint near Englands Road, North Boambee Road and Coramba Road (Arup 2019).

Preliminary TfNSW ASR risk mapping indicates the construction footprint is located in areas of low and medium ASR risk. Following subsequent laboratory testing, the EIS concluded that ASR is unlikely to be a risk to the project (Arup 2019).

Management of ASS and ASR is outlined within the Acid Sulfate Soils Management Plan.

2.3 SURFACE WATER

This Project falls within the Korora Basin, Coffs Creek and Boambee Creek sub-catchments, all located within the Bellinger River and Coffs Harbour catchment.

There are six major waterways within the Project area, with multiple tributaries which generally flow in an easterly direction from the foothills of the Great Dividing Range and discharge in the ocean. These are Pine Brush Creek, Jordans Creek, Treefern Creek, Coffs Creek, Newports Creek and Boambee Creek. The lower reaches of the sub-catchments are subject to tidal effects and estuarine processes and are extensively connected to groundwater in the alluvial areas near the coast.

The Project area also includes a number of small unnamed Intermittently Closed and Open Lakes and Lagoons (ICOLLS), particularly north of Jordans Creek.

2.4 SENSITIVE RECEIVING ENVIRONMENTS

The project includes a number of areas which are defined as sensitive receiving environments. These include:

- Solitary Islands Marine Park (includes all tidal waters of the Jordans, Coffs, and Pine Brush Creek catchments, as well as smaller unnamed ICOLL catchments in the Project area. The NSW Marine Park boundary extends along Pine Brush Creek to Opal Boulevard and then to James Small Drive, with the construction footprint occurring about 150 metres upstream from the NSW Solitary Islands Marine Park boundary).

- Coastal Management SEPP wetlands (Pine Brush Creek wetlands, Coffs Creek wetlands and Boambee wetlands)
- Threatened freshwater fish habitat (potential habitat for Southern purple spotted gudgeon within upper Coffs Creek and upper Newports Creek).

Project approvals require that enhanced erosion and sediment controls be implemented in the sub-catchments flowing to the Solitary Islands Marine Park (CoA), additional to industry best practice site erosion controls complying with the Blue Book. Sediment basins within these sub-catchments are to be designed and installed to accommodate a 90th percentile rain event (for Type D basins). Where site constraints such as steep terrain and available footprint restrict the construction of 90th percentile sediment basins, proposed alternative best practice controls will be provided.

2.5 GROUNDWATER

Groundwater presents in three distinct strata within the project area – shallow surficial deposits, alluvial deposits and fractured bedrock aquifers.

Groundwater levels below ground level vary from less than five metres to about 43 m, with the deepest groundwater generally corresponding to topographically higher areas (ie. around Shephards Hill and Gatelys Road).

Groundwater level monitoring indicates that groundwater is affected by seasonal climatic variations and rainfall events. Between the wetter period from November to April, levels were generally elevated at most of the monitoring locations compared to the period between May and October when they were typically in recession.

Groundwater level variation over the period of monitoring (July 2017 to February 2019) indicated variations in groundwater level of between less than one metre and up to 12 m. Changes in groundwater level indicate that there is variable response in the fractured bedrock aquifer to rainfall

events. Some monitoring locations showed rapid and large changes in water levels following rainfall events whereas other locations showed much less response with greater lag time (Arup 2019).

2.6 RAINFALL

Bureau of Meteorology (BoM) rainfall statistics for Coffs Harbour are presented in Table 2-2.

TABLE 2-3: MONTHLY RAINFALL FOR COFFS HARBOUR (BOM STATION 059040)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm)	187.5	224.8	234.6	178.4	160.8	120.8	72.5	79.5	59.9	96.3	114.7	144.9	1699
Mean no of days with rain >1mm	9.4	9.7	10.8	8.5	7.7	6.3	4.5	4.5	4.5	6.7	8.2	8.4	89.2

The risk of high rainfall depth and high rainfall intensity is considered to be a significant constraint for construction-phase erosion and sediment control.

3 EROSION HAZARD AND RISK

3.1 EROSION HAZARD

Erosion hazard is assessed using the Revised Universal Soil Loss Equation – RUSLE (Landcom 2004). This equation is commonly used to predict the long term, average, annual soil loss from sheet and rill erosion under specified management conditions. Adopted values are based upon a fully cleared site stripped of topsoil, representing the highest risk scenario.

The RUSLE is represented by the equation: A = R * K * LS * P * C, where A refers to the rate of potential soil loss (t/ha/yr). Other parameters are described below.

3.1.1 RAINFALL EROSIVITY (R-FACTOR)

The rainfall erosivity factor (R-factor) is a measure of the ability of rainfall to cause erosion. The Bureau of Meteorology reports the 2-year, 6-hour rainfall event as 16.6mm/hr for the hinterland area that the proposal traverses. This translates to a Revised Universal Soil Loss Equation (RUSLE) R-Factor of 6390.

3.1.2 ERODIBILITY (K-FACTOR)

The K-factor is a numerical representation of the ability of soils to resist the erosive energy of rain (IECA 2008). In the absence of specific laboratory analysis, K-factors are adopted from the document Soil Landscapes of the Coffs Harbour 1:100,000 Sheet Report (Milford 1999). A K-factor of 0.04 has been adopted for the majority of work areas throughout the construction footprint (91%), with 0.044 adopted for Suicide soil landscape unit (8%); and 0.095 adopted for work areas within the Moonee and Newports Creek soil landscape units (3%). K-factors are increased by 20% for known occurrences of dispersive soils.

3.1.3 SLOPE

The LS-factor is a numerical representation of the length-slope combination. Slope grades are highly variable across the project, ranging from flat to very steep. Slope lengths for staged construction will typically be less than 80 m.

3.1.4 COVER AND MANAGEMENT FACTOR (C-FACTOR)

During the construction stage, a fully cleared project site is assumed (i.e. 0 % groundcover representing a C-factor of 1). As construction progresses and soil stabilisation practices are implemented, groundcover will progressively increase, reducing the C-factor and potential soil loss. The presence of rock within cuts will also justify a lower C-factor for these areas.

3.1.5 EROSION CONTROL PRACTICE FACTOR (P-FACTOR)

The P-factor measures the combined effect of all support practices and management variables. It also represents structural methods for controlling erosion (IECA 2008). The nominated P-factor for all areas without permanent stable groundcover is 1.3 (based on the default construction phase condition).

3.2 POTENTIAL SOIL LOSS

Potential soil loss for construction sub-catchments is presented in Appendix A.

3.3 EROSION RISK

Erosion risk ratings based on historical monthly rainfall depth data for Coffs Harbour are provided in Table 3-1.

Erosion risk ratings are moderate from July to October, and high to extreme for other months of the year (IECA 2008).

TABLE 3-1: MONTHLY EROSION RISK RATINGS FOR COFFS HARBOUR (BOM STATION 059040)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean rainfall (mm)	187.5	224.8	234.6	178.4	160.8	120.8	72.5	79.5	59.9	96.3	144.7	144.9
Erosion risk rating	High		Extre-me	High			Moderate				High	

4 DRAINAGE AND EROSION CONTROL

4.1 DRAINAGE CONTROL

Drainage control refers to the management of both 'clean' stormwater runoff around and through the site; and 'dirty' site stormwater runoff to enable treatment of sediment prior to release offsite, as defined below:

Clean water:	Water that either enters site from an external source and has not been further contaminated by sediment within site; or water that has originated from the site and is of such quality that it does not need to be treated in order to achieve the required water quality standard (IECA 2008).
Dirty water:	Site water not defined as clean, thereby requiring treatment with appropriate controls prior to release from site (IECA 2008).

4.2 DRAINAGE CONTROL MEASURES

Drainage control measures (temporary and permanent) enable management of stormwater within work areas, including to:

- divert 'clean' up-slope run-on water either around or through the site at non-scouring velocities
- collect 'dirty' runoff generated within construction areas and the delivery of this water to an appropriate sediment control measure
- minimise the risk of soil erosion caused by site-generated flows within the project, using intermediate flow treatment and release points
- control of the flow velocity, volume and location of water passing through the project at drainage line and waterway crossings.

The drainage control measures to be adopted for the project are outlined within Table 4-2.

Typical design measures are detailed within Appendix D. Progressive ESCPs provide site-specific details.

4.2.1 DRAINAGE CONTROL STANDARDS

Design standards for temporary drainage control measures are consistent with the recommendations for a receiving environment identified as 'sensitive' as defined by the Blue Book. A sensitive receiving environment is one that has a high conservation value or supports human uses of water that are particularly sensitive to degraded water quality.

Temporary drainage controls for sensitive areas are to be designed to convey water at a non-erosive hydraulic capacity as per G38, outlined within Table 4-1.

TABLE 4-1: DESIGN AVERAGE RECURRENCE INTERVALS FOR TEMPORARY CONTROL MEASURES (ADOPTED FROM G38)

Control Measure	Estimated Design Life	
	0 – 12 months	> 12 months
	Design Average Recurrence Interval (ARI) (years)	
Diversion bank	10	20/100*
Level spreader	10	20/100*
Waterway	10	20/100*
Sediment basin:		

Primary outlet **Emergency outlet (overflow)**	5 20	10 100
Sediment trap	5	10
Outlet protection	20	50
Grade stabilising structure	20	50

**Note: 2nd number refers to major flow as defined in Australian Rainfall and Runoff*

TABLE 4-2: DRAINAGE CONTROL MEASURES

Control Measure	Description	Typical application	Materials	Design considerations
Catch drain	An open channel constructed along the high side of a road cutting or embankment, outside the batter, to intercept and redirect surface water.	Clean water diversion	Earth, concrete, rock, jute	Minimum freeboard of 0.15m
Check dams	Semipervious or impervious structures placed within a channel bed or against earth bank	Used to reduce flow velocity and resulting erosion within open channels and along banks	Rock, sandbags, coir logs	Channels < 10 % grade Maximum height 0.5 m
Chute	A grade stabilising structure constructed to convey concentrated flow from one elevation down to another.	Batter runoff; sediment basin spillways; drainage channels.	Geotextile, rock, turf, rock-filled mattresses, concrete	Capacity and materials sized for design storm discharge
Culvert	Pipe or box structure.	Convey water underneath structures and work areas; clean water diversion; crossings;	Concrete, PVC, plastic (e.g. Black maxx)	Minimum 1 in 2-year ARI for temporary crossings
Diversion bank	A bank constructed to provide an open channel without excavation.	Collect sheet runoff (clean or dirty) and divert to stable outlet; divert up-slope runoff around a stockpile or soil disturbance; divert stormwater away from an unstable slope; direct water to the inlet of a chute; act as a form of topsoil stockpile	Earth, sandbags, coir logs, bitumen berm	Not used on slopes > 10% Require stable outlet Minimum 0.15m freeboard Max batters 2(h):1(v)
Diversion drain / open drain	An excavated open channel that leads water away from a given area	Intercept and redirect surface runoff water including catch drains, diversion banks and drains, earth banks, batter drains and inlet and outlet drains.	Earth (lined), geotextile, concrete, rock,	Stable outlet Channel lining (erosion control) Check dams
Earth bank	Temporary open channel constructed at a low gradient across a slope in the form of a ditch with a bank on its lower side	Intercept and divert runoff from the site to nearby stable areas at non-erosive velocities.	Earth	Maximum upslope length < 80 m Max batters 2(h):1(v) Gradients between 1 and 5 % Parabolic or trapezoidal profile

Level spreader (or level sill)	A flat stabilised area at the outlet of an open drain	Spreads the water over a sufficient width (as sheet flow) to reduce the velocity and energy of the water and prevent downstream erosion.	Stable surface (e.g. grass, rock)	Upslope channel grade < 1% Minimum sill length 4 m Discharge to stabilised or undisturbed areas < 10 % grade

4.2.2 MANAGEMENT OF 'CLEAN' AND 'DIRTY' WATER

To minimise the risk of mixing of 'clean' and 'dirty' water, the following approach will be adopted:

- Permanent transverse drainage will be installed during the early stages of construction wherever possible to enable clean water to bypass through the construction area
- Temporary transverse drainage will be installed where site constraints and/or construction program limit the opportunity to install permanent drainage in the first instance
- Drainage measures will typically include concrete (permanent), PVC or plastic (temporary) culverts and protected open lined channels.

Details of site drainage (temporary and permanent) are included in Progressive ESCPs.

4.2.3 DRAINAGE CONTROL ON UNPROTECTED SLOPES

Long unprotected slopes will be subdivided into manageable drainage areas to prevent the development of rill erosion. Earth banks or diversion banks are to be constructed at regular intervals to divert surface runoff to a stable outlet.

Recommended spacing of these structures for unprotected slopes is provided within Table 4-3 (IECA 2018). Bank grade is to not exceed 1% to reduce the potential for erosion within channels.

TABLE 4-3: RECOMMENDED MAXIMUM DRAIN/BANK SPACING ON UNPROTECTED SLOPES (FROM IECA 2008)

Slope gradient	Horizontal spacing
1 %	80 m
2 %	60 m
4 %	40 m
6 %	32 m
10 %	25 m
15 %	19 m
20 %	16 m
25 %	14 m
30 %	12 m
40 %	9 m
50 %	6 m

4.3 EROSION CONTROL

Erosion control is the primary approach to be taken to prevent adverse impacts associated with sedimentation. Construction activities are to be undertaken to reduce the duration of soil exposure to erosion by wind and water, by holding soil in place or shielding it.

4.3.1 EROSION CONTROL MEASURES

Erosion control measures to be adopted include appropriate scheduling of construction activities, structural controls and vegetative measures aimed at maximising groundcover and managing runoff at a non-erosive velocity.

The specific measures implemented will documented in Progressive ESCP(s) and be based on seasonal erosion risk and construction activities.

Proposed controls include:

- staging of the works to reduce overall exposed area as far as practical
- promptly stabilising exposed areas once construction stage has been completed (with an emphasis on permanent works)
- protection of soil surface (temporary and permanent) including placement of hardstand surfaces, use of soil binder, vegetation establishment (including landscaping), and protection with mats & blankets (eg. jute, geotextile)
- ameliorants to stabilise catchment surfaces and reduce erosion (e.g. spreading gypsum across disturbed areas)
- dust suppression by wetting of exposed surfaces, application of soil binder, and/or application of soil cover
- monitoring, planning for and responding to rainfall and flooding events.

Typical design measures are detailed within Appendix D. Progressive ESCPs provide site-specific details.

4.3.2 ENHANCED EROSION CONTROL MEASURES

Enhanced erosion control refers to strategies and measures to protect soil surfaces that are supplementary to those routinely adopted as best practice (as identified within the Blue Book). Enhanced erosion control will be adopted for construction within the following high-risk areas:

- catchments that flow to and include the Solitary Islands Marine Park
- sensitive receivers identified within the Panama Disease Construction Management Plan (PDCMP)
- areas where construction sediment basins are desirable but are unable to be practically constructed (eg. due to topographic constraints, area of protected vegetation etc.).

Enhanced erosion control strategies and measures include standard erosion control practices in addition to implementation of one or more of the following:

- managing clearing activities to ensure high risk areas are maintained with existing cover for as long as possible
- maintenance of wide and dense vegetation buffers
- undertaking soil disturbance activities in high-risk areas within periods of lower erosion risk (July to October) as far as the schedule allows
- undertaking works in permanent and intermittent watercourses during low flows and when upcoming weather forecast (as per BoM website for the Mid North Coast district forecast region) indicates suitable conditions for the nature and scale of activity
- initial disturbance footprint to be kept the minimum necessary to allow installation of sediment control before additional disturbance
- treating disturbed surfaces with ameliorants and binders to reduce potential sheet erosion as required based on risk assessment (eg. application of gypsum, surface mulching, soil binders)
- installing slope breaks at reduced intervals
- protecting surfaces prior to a forecast rainfall event as required based on risk assessment (ie. cover with binders, mats, blankets)
- reduced exposure of erodible surfaces through additional placement of temporary cover as required based on risk assessment

Enhanced erosion control measures will be supplemented with enhanced sediment control measures, including construction of 90th %ile construction sediment basins (and/or HES basins) within Solitary Island Marine Park catchments.

Progressive ESCPs provide site-specific details on high-risk areas and the enhanced erosion (and sediment) control measures to be adopted.

4.3.3 EROSION CONTROL STANDARDS

For a project site with a moderate to extreme hazard rating, IECA (2008) recommends the adoption of the erosion control standards outlined in Table 4-4.

TABLE 4-4: EROSION CONTROL STANDARDS

Risk Rating	Site Clearing and Rehabilitation	Channel Clearing and Stabilisation
Moderate **(Jul – Oct)**	Disturbed soil surfaces stabilised with minimum 70 % cover within 20 days of completion of works within any area of the work site Staged construction and stabilisation of earth batters (steeper than 6H:1V) in maximum 3m vertical increments wherever reasonable and practicable Unfinished earthworks are suitably stabilised if rainfall is reasonably possible, and disturbance is expected to be suspended for a period exceeding 20 days.	Disturbed soil surfaces stabilised with minimum 80 % cover within 10 days of completion of works within any area of the work site Non-completed channel works stabilised if exposed, or expected to be exposed, for a period exceeding 20 days.
High **(Nov – Feb)** **(Apr – Jun)**	Disturbed soil surfaces stabilised with minimum 75 % cover within 10 days of completion of works within any area of the work site Staged construction and stabilisation of earth batters (steeper than 6H:1V) in maximum 3m vertical increments wherever reasonable and practicable Soil stockpiles and unfinished earthworks are suitably stabilised if disturbance is expected to be suspended for a period exceeding 10 days.	Disturbed soil surfaces stabilised with minimum 90 % cover within 5 days of completion of works within any area of the work site Non-completed channel works stabilised if exposed, or expected to be exposed, for a period exceeding 10 days.
Extreme **(Mar)**	Disturbed soil surfaces stabilised with minimum 80 % cover within 5 days of completion of works within any area of the work site Staged construction and stabilisation of earth batters (steeper than 6H:1V) in maximum 2m vertical increments wherever reasonable and practicable Soil stockpiles and unfinished earthworks are suitable stabilised if disturbance is expected to be suspended for a period exceeding 5 days.	Disturbed soil surfaces stabilised with minimum 90 % cover within 5 days of completion of works within any area of the work site Non-completed channel works stabilised if exposed, or expected to be exposed, for a period exceeding 5 days.

4.3.4 SITE STABILISATION

Following the completion of construction activities, long-term protection of the site from erosion will be provided by permanent stabilised surfaces comprising constructed pavements, lined drainage features and landscaping (as per applicable plans).

Revegetation of the site is to be staged as work proceeds, incorporating progressive topsoiling and vegetation establishment as specified within R178.

Erosion and sediment controls are to remain in place until minimum 70 % self-sustaining groundcover (or equivalent) is achieved for general earthworks areas; and minimum 90 % groundcover for drainage channels. Erosion and sediment controls are to be carefully removed following site stabilisation to prevent any plastic and debris pollution to aquatic environments and the Solitary Islands Marine Park.

5 SEDIMENT CONTROL

Sediment control measures will be installed in combination with drainage and erosion control measures to provide effective pollution management. The project will adopt a 'treatment train' approach, where various control measures are utilised in sequence.

Sediment control measures include systems, procedures and materials to filter, trap and/or settle sediment from sediment-laden waters. In addition to adopting measures as per the Blue Book and IECA (2008) standard drawings, variations to these may be implemented where it can be demonstrated that they are equally as effective and meet the intent of best practice guidelines.

Typical design measures are detailed within Appendix D. Progressive ESCPs provide site-specific details on sediment control measures to be implemented.

5.1 SEDIMENT CONTROL STANDARDS AND REQUIREMENTS

The potential soil loss (derived from the RUSLE) is used to inform the standard of sediment control required for each construction sub-catchment, based on a construction period > 12 months (as per G38 and the Blue Book) (Table 5-1 and Appendix A). The sensitivity of the receiving environment and duration of disturbance also informs design criteria for temporary erosion and sediment control measures.

Where potential soil loss from sub-catchments does not trigger a sediment basin (Type 1), alternative sediment traps (Type 2 and Type 3) will be implemented.

As discussed in Section 4.3.2, enhanced erosion controls will also be implemented in areas where construction sediment basins are unable to be practically constructed (e.g. due to topographic constraints, area of protected vegetation etc.), along with alternative Type 2 and Type 3 sediment control measures.

TABLE 5-1: SEDIMENT CONTROL STANDARDS

Standard	Required where	Example	Specs/Function
Type 1	Catchment area > 2,500 m^2 and soil loss > 150 m^3/yr	Construction sediment retention basin (sediment basin)	Rapid settlement of coarse-grained particles (e.g. sand and coarse silt) during all storm events that flow through the basin. Settlement of fine-grained particles that are allowed to pass through the basin under controlled conditions. Basin Types: Type A: Duration of catchment disturbance > 12mths. Sized for storms up to the 1 year ARI 24 hour storm event. Type B: Duration of catchment disturbance < 12mths. Sized for discharge of 0.5 times the peak 1 in1 year ARI critical duration storm. Type D: Sized for storms up to 85th%ile five-day duration event (non-Marine Park); and 90th%ile five-day duration event (Solitary Island Marine Park catchment). Embankment and emergency spillway designed to be structurally sound in 1 in 100-year ARI storm event

Type 2*	Soil loss < 150 m3/yr and: Catchment area > 1000 m2 & soil loss rate > 75 t/ha/yr; or Catchment area > 2,500 m2 & soil loss rate 75–150 t/ha/yr	Sediment weir Rock Filter Dam Filter Bag/Tube Coir logs Excavated sediment trap Mulch berm	Capacity to capture and hold at least 90% of material > 0.14mm. Capacity to capture and hold one month's sediment loss from the catchment Designed to maintain its hydraulic and structural integrity in 1 in 10-year ARI storm event
Type 3*	Soil loss < 150 m3/yr and soil loss rate is < 75 t/ha/yr.	Rock check Rock filter berm Sediment fence	Capacity to capture and hold at least 90% of material > 0.42 mm Sufficient sediment retention capacity to capture and hold one month's sediment loss from the catchment Designed to maintain its hydraulic and structural integrity in 1 in 10-year ARI storm event
Supple-mentary	Form an important component of the erosion and sediment control system when implemented as supplementary measures	Grass filter strips Check dams Kerb inlets Construction exits.	Not considered effective to meet the Type 3 standard in isolation

* Note: Specific control measures listed as Type 2 and Type 3 satisfy the definition of *sediment traps and filters* as described within *G38* (i.e. temporary measures used to trap or filter sediment in runoff from small areas).

5.2 CONSTRUCTION SEDIMENT RETENTION BASINS (SEDIMENT BASINS)

5.2.1 SEDIMENT BASIN TYPE

The type of sediment basins considered for use during construction of the Project include high efficiency sediment (HES) basins (Type A and Type B), and standard batch treatment basins (Type D).

Type A and Type B sediment basins provide a high standard of runoff treatment and operate effectively for practically all site water runoff events. Type B sediment basins are generally larger than Type A and may retain runoff for onsite re-use. Type D sediment basins allow batch treatment of runoff retained up to the design rainfall event. Rainfall events exceeding the Type D design criteria may discharge through the basin, allowing little opportunity for treatment for these events.

Overview of the design and operational features of these different sediment basin types are provided in Table 5-2 (IECA 2008).

TABLE 5-2: OVERVIEW OF DESIGN AND OPERATION OF BASIN TYPES

Basin Type	Features
Type A	All inflows receive treatment Size is governed by both minimum volume and minimum surface area requirements Require a forebay (inlet chamber) separate to the main pond Operation relies on the installation of an automatic chemical dosing system Typically requires flocculants other than gypsum Discharge is via a floating decant system which collects water from the top of the water column during the storm event Typically required to be dewatered prior to a rainfall event that is likely to produce runoff Sized for the 1 year ARI, 24 hour storm event

Type B	All inflows receive treatment Size is primarily governed by minimum required surface area Require a forebay (inlet chamber) separate to the main pond Typically larger in volume and surface area than Type A Operation relies on the installation of an automatic chemical dosing system Typically requires flocculants other than gypsum Ideally dewatered prior to a rainfall event that is likely to produce runoff, although water may be retained for use as construction water during dry conditions Sized for a discharge of 0.5 times the peak 1 in 1 year ARI critical duration storm
Type D	Only retained runoff receives treatment (rainfall that exceeds basin design capacity will not receive treatment) Size is governed by minimum required volume Operation relies on chemical dosing, using either an automatic or manual dosing system Required to be dewatered prior to a rainfall event that is likely to produce runoff Typical flocculant is gypsum (calcium sulfate) Sized for the 90th %ile, 5-day rainfall depth for Solitary Island Marine Park catchment; otherwise the 85th%ile, 5-day rainfall depth.

The type of basin used for each sub-catchment (where basins are required) will be based on:

- sub-catchment topography and available basin footprint impacting on basin geometry
- sub-catchment characteristics (eg. within Panama disease area, soil characteristics)
- environmental sensitivity of basin discharge location (sensitive receivers)
- construction schedule
- requirement to retain runoff for on-site reuse
- effectiveness of specific flocculants to achieve water quality outcomes
- approval of alternative flocculants and coagulants (other than gypsum) by the Principal (refer also to Section 5.2.5).

5.2.2 SEDIMENT BASIN CONSTRUCTION

In accordance with G38 and the Blue Book, construction sediment basins are to be constructed as follows:

- Installed together with associated connecting stormwater drainage (temporary/permanent pipes and/or catch drains) prior to commencement of any construction activities within basin sub-catchments
- Located within project boundary
- Clearing to be to the minimum extent necessary, particularly within threatened or endangered ecological communities
- Install depth meter to clearly show required 5-day design capacity and 60 % sediment storage zone (to identify maintenance trigger)
- Install signage identifying basin number
- Designed to be easily maintainable
- Inlets, outlets and spillways to be constructed using suitable stabilised outlets approved by the project CPESC.
- Where construction sediment retention basins are to be converted to operation water quality basins post construction, the specific construction steps outlined within G38 will apply.

5.2.3 SEDIMENT BASIN DESIGN DETAILS

Design details for all construction sediment basins (both Type A and Type D) are provided within a Construction Sediment Basin Register (example provided in Appendix B – subject to detailed design). This register includes the following information for each basin location:

- Basin ID
- Basin Type
- Basin location
- Catchment area
- Annual soil loss
- Forebay volume (HES basins)
- Sediment storage volume
- Settling zone volume
- Total basin volume
- 60% sediment storage zone depth
- 5-day x%ile depth
- Primary spillway type (pumped or syphon)
- Emergency spillway width
- Emergency spillway depth
- Discharge point
- Flocculant / coagulant details.

The layout of construction sediment basins is shown in Appendix C (indicative layout subject to detailed design). Details are included within Progressive ESCPs.

The final Construction Sediment Basin Register will be maintained on the Project drive as a live document.

5.2.4 SEDIMENT BASIN MANAGEMENT

Construction sediment basins are to be managed in accordance with the following:

- Treatment and discharge of sediment basin to be within a maximum 5-day period (Type D basins) from runoff-producing rainfall (sooner if major rainfall event substantially diminishes residual stormwater capacity, or otherwise to meet EPL requirements)
- Reuse captured stormwater for construction activities whenever possible
- Flocculants/coagulants to be applied to assist settlement of sediment prior to discharge (e.g. gypsum applied within 24 hrs of the conclusion of runoff event)
- Desilted whenever accumulated sediment exceeds 60% of the storage zone (at a minimum)
- Dispose of removed sediment such that it will not be conveyed back into the construction areas, watercourses or off-site
- Provide and maintain suitable access to sediment basins and traps to allow cleaning out in all weather conditions
- Be regularly monitored to ensure structural integrity is maintained, including inlets and outlets.

5.2.5 FLOCCULATION AND COAGULATION

Flocculation of sediment basins is required to assist settlement of fine clays prior to discharge to the receiving environment. The application of a coagulant/flocculant is to occur within 24 hours of the conclusion of each runoff producing rainfall event. Typically, gypsum (calcium sulphate) is used for Type D basins. This requires application across the sediment basin surface (spray or hand cast) at an approximate rate of 32 kg per 100 m3 of water volume.

Where alternative flocculants / coagulants are proposed (e.g. anionic polymers for high efficiency sediment basins), chemical analysis will be undertaken to ensure they are effective and will not result in toxic impacts to the receiving environment. Agreement by the Principal will be required prior to use.

5.2.6 SEDIMENT BASIN DISCHARGE

All construction site dewatering, including sediment basin discharge will be undertaken under a permit system included within a Project EWMS (Environmental Work Method Statement).

Prior to discharging water from basins, water will be tested to ensure it meets the criteria set out within the EPL for nominated discharge points.

Where a statistical correlation can be demonstrated between turbidity (NTU) and Total Suspended Solids (TSS) through the construction phase for discharge water, turbidity measurements may be adopted as a parameter to assess suitability for discharge from sediment basins before laboratory data is available (upon acceptance by Principal).

5.2.7 DECOMISSIONING AND REMOVAL

Temporary sediment basins (and traps) will be decommissioned upon completion of works and stabilisation of upslope catchment surfaces in accordance with the Blue Book. This will require completion of works and stabilisation of more than 90 percent of the contributing catchment, as far as can be practically achieved.

Sediment basins and traps are to be removed (unless converted to operational water quality basins as required by stormwater management design) so as to restore the ground disturbed by the construction of the sediment basins/traps to a similar condition to that previously existing, as per G38. This includes:

- Removal of all redundant mattresses from the inlets and spillway(s) and their subsequent burial into the basin area or their use as scour protection or their removal from site
- Spreading and compaction of the embankment material into the basin area
- Removal of access roads
- Removal and appropriate disposal/reuse of sediment (including potentially contaminated sediment)
- Compacting the disturbed ground to at least the relative density of the material in the adjacent ground
- Ensuring redundant basin area does not hold water once backfilled
- Removal of all plastic and loose debris to prevent any plastic pollution to aquatic environments and the Solitary Islands Marine Park.

The status of sediment basin (and trap) decommissioning will be provided through Progressive ESCPs.

6 MANAGEMENT OF SPECIFIC ACCESS

6.1 SITE ACCESS

Access to construction areas is to meet the following requirements:

- Incorporate specific access and egress control measures detailed within the Panama Disease Control Management Plan
- Minimise access road construction to ensure the least amount of site disturbance
- Main access roads to be protected with a non-erosive surface (e.g. gravel hardstand, sealed)
- Access to incorporate stabilised exit points. These are to be monitored for excessive sediment tracking onto adjacent public roads
- Batters, watercourse crossings and associated access track approaches are to be suitably stabilised from erosion
- Roads to be graded to a crown, or with crossfall drainage
- Runoff from roads to be directed to sediment control measures.

6.2 VEGETATION CLEARING AND GRUBBING

Clearing activities associated with the project are to be undertaken consistent with relevant plans, approvals and the following control measures:

- Vegetation clearing and grubbing to be in accordance with G40
- Staging and programming of work activities is to minimise the duration and extent of exposed soil, including minimising time between clearing, initial earthworks and stabilisation
- Vegetation clearing shall be to the minimum amount necessary to allow access or approved works
- Approved areas for clearing to be clearly identified
- Areas of protected vegetation and significant areas of vegetation are to be retained and must be clearly identified prior to the commencement of clearing activities
- Erosion and sediment controls are to be installed prior to commencement of broadscale clearing activities for all areas
- Previously cleared areas shall be utilised where possible for access, laydown and turn around points
- Disturbance to watercourses and associated riparian zones must be avoided unless essential and limited to the minimum extent practicable. Management of production of tannin leachate from clearing activities (including mulch) is to be in accordance with TfNSW Environmental Direction 25: Management of Tannins from Vegetation Mulch, Appendix I to the SWMP.

6.3 SPOIL AND TOPSOIL

6.3.1 STOCKPILING

Stockpile sites are to be managed so as not to cause environmental harm as a result of sedimentation. Stockpile sites are to be designed, established, operated and decommissioned in accordance with TfNSW Stockpile Site Management Guideline, G36, G38 and R178. Refer to the Stockpile Management Protocol Appendix H to the SWMP.

Stockpiles will be protected from stormwater runoff consistent with the following principles:

- Stockpiles of erodible material will be protected from upslope ‘clean’ stormwater surface flows. This will include the installation of diversion berms / bunds to collect sheet runoff and divert around stockpile locations to stable outlet areas
- ‘Dirty’ stormwater runoff from within stockpile areas will be directed to the appropriate standard of sediment control (as per Blue Book) prior to release to the receiving environment
- Stockpiles will be formed and stabilised according to the following criteria:
- Incorporate specific control measures detailed within the Panama Disease Control Management Plan
- Stockpile heights are to be no greater than 2 m, and slopes to no steeper than 2H:1V.

- Long term (> 20 days) stockpiled material will be protected from erosion with an appropriate protective cover (synthetic or organic)
- Stockpiles susceptible to wind or water erosion will be protected from erosion as per Table 4-4 (within a maximum of 10 days of forming each stockpile), with an appropriate protective cover (synthetic or organic).
- Dust management measures (including for the management of vehicle movements associated with stockpiling activities) will be implemented.

Details of stockpile protection and stabilisation measures will be provided within Progressive ESCPs.

6.3.2 TOPSOIL PRESERVATION

Earthworks are to incorporate the stripping and preservation of topsoil for reuse (wherever practical). The depth of topsoil stripping is dependent upon soil type, however ideally the upper 50 mm of the soil profile is to be retained separately from other material (as it contains most of the biological activity and nutrients required for successful rehabilitation).

Topsoil stockpiles are to be maintained separate from other materials. Topsoil that is not contaminated by noxious weeds is to be kept in stockpiles for later spreading on fill batters and other areas.

Stockpiled topsoil is to be seeded with a sterile cover crop or stabilised with soil binding polymer in accordance with RMS R178, for stabilisation and weed suppression.

6.4 PILING AND PIER CONSTRUCTION

Piling will be required in several locations along the Project, including for bridges, abutments and retaining walls. Works at a number of these locations will require the installation of temporary structures including piling platforms, crane pads and rock working platforms.

Piling activities, including establishment of platforms, laydown areas, and waste management, are to be undertaken in accordance with the following:

- Construction of working platform, access and associated elements is to be within the approved clearing limits and project boundary
- Laydown areas to be protected by non-erosive hardstand surface
- Floating silt curtains are to be installed to contain runoff from working platforms, piers and abutments, to isolate potentially turbid water from clean water. Curtains are to be installed and managed in accordance with the design fact sheet (Catchments and Creeks 2010) available at: https://austieca.com.au/documents/item/340.
- Working platforms are to be constructed from clean (shot) rock. Working platforms are to incorporate a geotextile perimeter curtain extending 1 m above the platform surface (or similarly bunded). Suitable clean rock material (as per crane specifications) is to form the surface of the working platform.
- Temporary drainage crossings incorporating provision for clean water bypass (via culverts) are to be installed in accordance with Section 6.5 below. Temporary crossings are to be designed to convey the 2-year ARI flow event (as a minimum) in a non-erosive manner.
- Bored spoil material is to be fully contained within bunded areas and immediately removed to the designated stockpile. No stockpiling is to occur on working platforms or adjacent floodplain.
- Displaced water and concrete slurry are to be fully contained within bunded sumps/receptacles and immediately removed to the designated area. No storage of concrete slurry or displaced water is to occur on working platforms or adjacent floodplain.
- Abutments are to be stabilised with permanent protection (as per engineering plans) as soon as possible following earthworks.

Erosion and sediment control management of piling activities is detailed within a specific Progressive ESCP.

6.5 TEMPORARY DRAINAGE CROSSINGS

Temporary waterway crossings will be designed, constructed and maintained in accordance with the following requirements:

- Crossings to be designed with consideration for a stable flow path during construction and to maintain integrity of drainage lines
- Location of crossings is to allow a stable bypass to be provided for clean cross drainage during construction.
- Site runoff is to be prevented from directly entering the drainage channel
- Culvert pipes (where used) are to be installed as follows:
  - Culverts are to have sufficient capacity to ensure minimal disturbance to channel flow for the design discharge
  - Culvert cells aligned with the channel
  - Culvert cells to extend well beyond the fill embankment
  - Rock (or geotextile) is to be used to protect fill from being swept into the channel
  - Rip rap is used at crossings and approaches
  - Energy dissipation to be installed on culvert outlets
- Low-flow conditions will be maintained
- No additional flooding impacts are to occur greater than those assessed for the operational phase
- Fish passage will be maintained in accordance with the relevant waterway classification and DPIE guideline Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge 2003)
- Material used in temporary waterway crossings will be selected to minimise risk of fine sediment material entering the waterway
- Include erosion and sediment controls in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom 2004)
- Any material used in the temporary creek crossing will be removed following construction and the site rehabilitated to its existing condition or if not possible, an equivalent stable condition.

The above requirements will be supplemented by learnings from the Woolgoolga to Ballina Pacific Highway upgrade project, specifically the requirements of the Technical Briefing Note: Temporary Waterway Crossings Minimum Standards (Pacific Complete 2017) developed in consultation with EPA and other relevant government agencies.

6.6 CONSTRUCTION SITE DEWATERING

Dewatering of site, including excavations, tunnel construction and sediment control devices, will be undertaken as described within the SWMP, and specifically outlined within a Project EWMS (consistent with the TfNSW Technical Guideline Environmental Management of Construction Site Dewatering, EMS-TG-011).

6.7 ANCILLARY AREAS

Ancillary areas include temporary infrastructure required to support the construction program such as site compounds, temporary work, batching and lay-down areas. The erosion and sediment control principles and strategies discussed within this document will equally apply to all ancillary areas. Details of specific areas are documented within Progressive ESCP's.

Ancillary areas are to be constructed as per relevant engineering plans, incorporating the following:

- Constructed as hardstand surfaces with low erodibility
- Site runoff directed to stormwater networks via drainage and sediment control measures
- Include additional soil cover (e.g. soil binder) and dust suppression as required.

6.8 TUNNEL EXCAVATION

The Project involves excavation of three tunnels through ridges at Roberts Hill, Shepherds Lane and Gatelys Road, totalling around 1000 metres in length. Typical activities include:

- Excavation and installation of temporary and permanent support measures of tunnel portals
- Excavation of tunnels and cross passages using drilling and blasting equipment
- Finishing works and commissioning.

The erosion and sediment control principles and strategies discussed within this document will equally apply to all tunnel excavation activities, including management of spoil material. Details of specific ESC requirements are documented within Progressive ESCP's.

6.9 IDENTIFIED HIGH RISK AREAS

The Erosion and Sediment Management Report prepared by SEEC (2020) identified several high-risk areas / activities requiring special consideration. Where not previously addressed within this document, these areas are incorporated within Table 6-1, along with proposed actions.

Erosion and sediment control management of high-risk areas are detailed within specific Progressive ESCPs.

TABLE 6-1: HIGH RISK AREAS AND RECOMMENDATIONS

Location	Reason for high-risk	Proposed actions
CH12650 to 12950	Highly erodible soils	Exposed soils are to be ameliorated prior to forecast rainfall by dusting them with gypsum at 0.2 kg/m2.
Various locations along whole project	Sediment basin construction - limited space, topographical constraints and/or significant habitat impacting ability to construct basin to required capacity (or geometry).	Alternative sediment controls. Enhanced erosion control (e.g. installation of slope breaks prior to forecast rainfall (>50% chance of more than 10mm)).
Whole project	Permanent transverse drainage located within existing drainage features.	Temporary clean water diversions to be installed and located to bypass permanent drainage locations. Permanent drainage measures to be installed early in the construction schedule wherever possible. Permanent drainage works to be isolated from the clean water network until fully stabilised.
Solitary Islands Marine Park catchments	Sensitive receiving environment	Adoption of High Efficiency Sediment (HES) Basins to provide improved water quality outcomes where risk based assessment identifies HES Basins as the most suitable for the given setting.
CH12800 to 22000	Very high to extreme erosion hazard	Enhanced erosion control (e.g. installation of slope breaks prior to forecast rainfall (>50% chance of more than 10mm)). Progressive batter stabilisation.
Sediment basins within the 5-year ARI flood level	Higher risk of flooding due to basin footprint located within the 1 in 5-year ARI flood level	Armour the outer face of the basin's earth wall for stability and flood protection.

7 COMPLIANCE MANAGEMENT

7.1 ROLES AND RESPONSIBILITIES

The Project Team's organisational structure and overall roles and responsibilities are outlined in Section 3.3 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Section 6 of the SWMP.

7.2 TRAINING

Training requirements for all employees, contractors and utility staff working on site are outlined in Section 7.2 of the SWMP.

7.3 PROGRESSIVE ESCPS

Ongoing ESC requirements will be documented within specific Progressive ESCPs. These ESCPs will be prepared on site drainage drawings to provide up-to-date details on the design, location, timing and installation of ESC measures across the project. This will include the following construction stages/situations:

- Where a new stage of construction works is commenced and/or controls require alteration due to change in work practices (e.g. topsoil strip, bulk earthworks, final stabilisation)
- A specific methodology is adopted
- Activities are undertaken in a specific area for a particular purpose (e.g. stockpiling, site compound, batch plant)
- A change in the design occurs
- The desired outcome (e.g. protection of receiving environments) is not being achieved.

All Progressive ESCP's will be consistent with project environmental documents, licences, permits, approvals and specifications, with specific measures in accordance with this ESCP and the Blue Book.

An up-to-date register of Progressive ESCPs will be maintained on the Project drive as a live document. This register will clearly track staging of construction works and implementation of ESC controls.

7.4 ESC INSTALLATION AND MAINTENANCE

The installation and maintenance of all ESC measures is to be overseen by a suitably qualified person (e.g. CPESC). Installation is to be consistent with ESCPs.

All required temporary erosion and sediment control measures must be fully operational and maintained in proper working order until permanent stabilisation is achieved. This includes:

- Identified soil erosion areas to be resolved as soon as possible, with additional control measures implemented to prevent recurrence
- Settled sediment must be removed as soon as reasonable and practicable from any sediment basin if:
  - It is anticipated that the next storm is likely to cause sediment to settle above 60 % of the sediment basin's sediment storage zone; or
  - The elevation of settled sediment is at or above 60 % of the basin's sediment storage zone.
- All other sediment control devices must be de-silted and made fully operational as soon as reasonable and practicable after runoff-producing rainfall, or if the sediment retention capacity of the device falls below 75% of the design retention capacity (IECA 2008)
- Dispose of removed sediment such that it will not be conveyed back into the construction areas, watercourses or off site.

7.5 MONITORING, INSPECTIONS & REPORTING

Monitoring, inspection and reporting is outlined in Section 7 of the SWMP. Specific monitoring associated with ESC performance is to be undertaken as outlined in the schedule provided within Table 7-1.

TABLE 7-1: ESC MONITORING AND REPORTING SCHEDULE

Inspection/Monitoring	Frequency	Recording/Action
Rainfall	Daily	Record daily site rainfall in millimetres
Contractor's Environmental Inspection	Weekly	Inspection report: Site inspection of ESC performance and maintenance. Includes: Entire site All ESC measures Stormwater entry and exit points Stockpile areas Rectify any non-conformances to erosion and sediment controls immediately.
Wet weather event rainfall inspection	Forecast of 50% probability of rain event of more than 10mm. Within 3 hrs (during normal work hours and days) or within 24 hrs (outside normal hours and days) of the start of all rainfall events that cause runoff to occur (as a minimum following a rain event of 10mm or more within a 24 hr period) and during periods of prolonged rainfall.	Inspection report: Site inspection of ESC performance and maintenance. Keep a register of all inspections performed and of maintenance or repairs carried out. Review the effectiveness of the ESCP following each rainfall event exceeding 10mm. Revise the SWMP, ESCP and Stockpile Management Sub Plan when erosion/sedimentation control measures, stabilisation control measures and other soil and water control measures are found to be not fully effective, including review of design parameters used for Blue Book calculations.
Realigned or adjusted waterways	Regular – as part of weekly and wet weather event inspections as minimum	To ensure effective design of the realignment. Includes: review of the implementation of ESC measures in accordance with approved plans identification of any maintenance requirements water quality checks and comparisons evidence of any flora or fauna impacts from the works status of revegetation and landscaping
Dewatering (including sediment basin discharge)	When required	Maintain register to document the following: Dates of discharge Water treatment (flocculation) performed Discharge water quality Volumes of sediment removed from each device Weather conditions (incl. daily rainfall, mean daily temperature, maximum daily temperature, mean relative humidity percentage and maximum relative humidity percentage Measures taken to avoid discharge (date, time, mode, volume and purpose of water reused)

		Water level at the basin before and after water re-use measures and before discharge Duration and flow rate of discharge Personnel involved in the discharge/dewatering activities Dewatering procedure, including signed Permit to Pump Water quality monitoring results.

7.6 UPDATES AND VARIATIONS

Updates and amendments to the SWMP are outlined within Section 8 of the SWMP.

ESCPs will be regularly revised with updates recorded (typically within Progressive ESCPs) in the following situations:

- The contract program or work methods change
- A new stage of works is commenced
- The work methods and control structures are found to be ineffective or are no longer required
- Controls require alteration due to change in seasonal conditions
- Changes occur in slope gradients and drainage paths
- A change in the design occurs that materially affects the site works
- The desired outcome (e.g. protection of receiving environments) is not being achieved.

The frequency of updates will be based upon currency of the existing implementation schedule, stage of construction, season, and performance of controls already in place.

Each revision of the ESCP will be reviewed by the project Soil Conservationist and recorded within an ESCP register.

8 REFERENCES

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APPENDICES

APPENDIX A1 (INDICATIVE) POTENTIAL SOIL LOSS CALCULATIONS

SOIL LOSS (INDICATIVE) – NON-MARINE PARK CATCHMENTS

PARAMETERS																				
Chainage	9800 – 10300	9700 – 1100	10100 – 10500	10400 – 10500	10300 – 10600		10500 – 10600	10500 – 10900	10700 – 10800	10700 – 10800	10800 – 11100	10800 – 11100	11000 – 11100		11100 – 11500		11100 – 11500		11500 – 11600	11500 – 11600
Location on alignment	R	L	L	L	L		R	R	R	R	R	L	L		L		R		R	L
Site Catchment Areas																				
Undisturbed (ha)	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disturbed (ha)	2.1	0.32	2	0.5	0.6	1.2	0.9	4.9	0.9	1.1	3.2	2.4	0.25	0.5	0.6	1.3	0.3	1.1	0.32	0.15
Total catchment area (ha)	2.30	0.52	2.20	0.50	0.60	1.20	0.90	4.90	1.10	1.10	3.20	2.40	0.25	0.50	0.60	1.30	0.30	1.10	0.32	0.15
Rainfall data																				
Design rainfall depth (days)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Design rainfall depth (percentile)	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Design rainfall depth (mm)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
Intensity: 2-yr, 6-hr storm	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
RUSLE Factors																				
Rainfall erosivity - R (adopted)	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390
Soil erodibility - K	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Slope length - L	40	40	30	40	40	40	40	40	40	40	40	40	15	15	15	30	15	30	40	15
Slope gradient (existing) - S	15	15	15	10	20	10	5	12	3	3	5	8	50	1	50	5	50	5	15	15
Length/gradient (existing) - LS	3.05	3.05	2.47	1.75	4.32	1.75	0.80	2.27	0.47	0.47	0.80	1.31	4.20	0.11	4.20	0.68	4.20	0.68	3.05	1.34
Erosion control practice - P	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover in disturbed catchment - %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ground cover in disturbed catchment - C	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Soil loss																				
Soil Loss (Tonnge Rate) t/ha/yr	1013	1013	819	581	1435	581	266	754	156	156	266	435	1394	37	1394	226	1394	226	1013	444
Soil Loss (Volume Rate) m3/ha/yr	780	780	630	447	1104	447	204	580	120	120	204	335	1072	28	1072	174	1072	174	780	342
Soil Loss Class	6	6	6	5	6	5	3	6	2	2	3	4	6	1	6	2	6	2	6	4
Soil Loss (Volume Total) m3/yr	1637	249	1260	224	1199		184	2843	108	132	654	804	282		869		513		249	51
Sediment Control Type	Type 1	Type 1	Type 1	Type 1	Type 1		Type 1	Type 1	Type 2	Type 2	Type 1	Type 1	Type 1		Type 1		Type 1		Type 1	Type 2

PARAMETERS																		
Chainage	1700 – 1200		1700 – 1200		2000 – 1210		12000 – 12100	12200 – 12400	12200 – 12400	12400 – 12600		12400 – 12600	12400 – 12600	2600 – 1300		2600 – 1330		13300 – 13500	13500 – 13600
Location on alignment	R		L		R		L	R	L	R		L	L	R		L		R	R
Site Catchment Areas																			
Undisturbed (ha)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disturbed (ha)	0.4	1.5	0.4	1.7	0.1	0.45	0.1	0.24	0.24	0.6	0.3	0.2	0.3	0.9	1.6	3.9	6.7	1.6	1.9
Total catchment area (ha)	0.40	1.50	0.40	1.70	0.10	0.45	0.10	0.24	0.24	0.60	0.30	0.20	0.30	0.90	1.60	3.90	6.70	1.60	1.90
Rainfall data																			
Design rainfall depth (days)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Design rainfall depth (percentile)	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Design rainfall depth (mm)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
Intensity: 2-yr, 6-hr storm	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
RUSLE Factors																			
Rainfall erosivity - R (adopted)	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390
Soil erodibility - K	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.067	0.095	0.040	0.040
Slope length - L	10	40	10	40	10	40	15	10	10	20	10	5	10	15	20	40	40	40	40
Slope gradient (existing) - S	50	2	50	1	50	2	50	50	50	50	2	50	2	50	3	18	4	25	28
Length/gradient (existing) - LS	3.33	0.31	3.33	0.16	3.33	0.31	4.20	3.33	3.33	5.89	0.18	1.88	0.18	4.20	0.34	3.82	0.63	5.54	6.23
Erosion control practice - P	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover in disturbed catchment - %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ground cover in disturbed catchment - C	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Soil loss																			
Soil Loss (Tonnge Rate) t/ha/yr	1106	103	1106	53	1106	103	1394	1106	1106	1957	60	625	60	1394	113	2126	497	1841	2070
Soil Loss (Volume Rate) m3/ha/yr	851	79	851	41	851	79	1072	851	851	1505	46	481	46	1072	87	1635	382	1416	1592
Soil Loss Class	6	1	6	1	6	1	6	6	6	7	1	5	1	6	1	7	4	7	7
Soil Loss (Volume Total) m3/yr	459		410		121		107	204	204	903		96	14	1104		8941		2266	3026
Sediment Control Type	Type 1		Type 1		Type 2		Type 2	Type 2	Type 2	Type 1		Type 2	Type 3	Type 1		Type 1		Type 1	Type 1

SOIL LOSS (INDICATIVE) – MARINE PARK CATCHMENTS

PARAMETERS																
Chainage	**13900 – 14100**	**13900 – 14200**	**14200 – 14300**	**14200 – 14500**	**14500 – 14700**	**14700 – 14800**	**14800**	**14700 – 15000**	**14700 – 14800**	**15000 – 15200**	**15000 – 15200**	**15200 – 15400**	**15400 – 15500**	**15500 – 15600**	**15500 – 15800**
Location on alignment	**L**	**R**	**R**	**R**	**R**	**L**	**L**	**R**	**R**	**L**	**R**	**R**	**R**	**L**	**R**
Site Catchment Areas															
Undisturbed (ha)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disturbed (ha)	1.5	5.2	0.4	4.4	1.6	1.3	0.4	3.2	0.7	1.2	1.9	2.4	0.3	0.24	0.6
Total catchment area (ha)	1.50	5.20	0.40	4.40	1.60	1.30	0.40	3.20	0.70	1.20	1.90	2.40	0.30	0.24	0.60
Rainfall data															
Design rainfall depth (days)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Design rainfall depth (percentile)	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
Design rainfall depth (mm)	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9
Intensity: 2-yr, 6-hr storm	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
RUSLE Factors															
Rainfall erosivity - R (adopted)	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390
Soil erodibility - K	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Slope length - L	40	40	40	40	50	15	15	80	15	40	40	40	40	40	40
Slope gradient (existing) - S	18	18	18	8	5	50	10	18	50	5	8	20	15	30	15
Length/gradient (existing) - LS	3.82	3.82	3.82	1.31	0.91	4.20	0.81	6.42	4.20	0.80	1.31	4.32	3.05	6.69	3.05
Erosion control practice - P	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover in disturbed catchment - %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ground cover in disturbed catchment - C	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Soil loss															
Soil Loss (Tonnge Rate) t/ha/yr	1269	1269	1269	435	302	1394	268	2133	1394	266	435	1435	1013	2223	1013
Soil Loss (Volume Rate) m3/ha/yr	976	976	976	335	233	1072	206	1641	1072	204	335	1104	780	1710	780
Soil Loss Class	6	6	6	4	3	6	3	7	6	3	4	6	6	7	6
Soil Loss (Volume Total) m3/yr	1465	5077	391	1473	372	1394	82	5251	751	245	636	2650	234	410	468
Sediment Control Type	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 2	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 2	Type 1

PARAMETERS															
Chainage	**15500 – 15800**	**15800 – 15900**	**15900 – 16100**	**16100 – 16400**	**16300 – 16400**	**16400 – 16600**	**16400 – 16600**	**16700 – 16900**	**16700 – 16900**	**16900 – 17100**	**17600 – 17800**	**17300 – 17800**	**17800 – 18200**	**18100 – 18350**	**18350 – 18450**
Location on alignment	**L**	**R**	**R**	**R**	**R**	**R**	**L**	**L**	**R**	**R**	**R**	**L**	**R**	**R**	**R**
Site Catchment Areas															
Undisturbed (ha)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disturbed (ha)	2.4	2.3	1.2	3.7	1.2	1.9	1.5	1.5	0.3	3.1	1.9	5.3	4.5	1.5	0.8
Total catchment area (ha)	2.40	2.30	1.20	3.70	1.20	1.90	1.50	1.50	0.30	3.10	1.90	5.30	4.50	1.50	0.80
Rainfall data															
Design rainfall depth (days)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Design rainfall depth (percentile)	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
Design rainfall depth (mm)	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9
Intensity: 2-yr, 6-hr storm	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
RUSLE Factors															
Rainfall erosivity - R (adopted)	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390
Soil erodibility - K	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Slope length - L	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
Slope gradient (existing) - S	30	25	40	40	30	30	40	40	50	45	20	20	10	10	20
Length/gradient (existing) - LS	6.69	5.54	8.74	8.74	6.69	6.69	8.74	8.74	10.42	9.58	4.32	4.32	1.75	1.75	4.32
Erosion control practice - P	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover in disturbed catchment - %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ground cover in disturbed catchment - C	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Soil loss															
Soil Loss (Tonnge Rate) t/ha/yr	2223	1841	2904	2904	2223	2223	2904	2904	3462	3183	1435	1435	581	581	1435
Soil Loss (Volume Rate) m3/ha/yr	1710	1416	2234	2234	1710	1710	2234	2234	2663	2449	1104	1104	447	447	1104
Soil Loss Class	7	7	7	7	7	7	7	7	7	7	6	6	5	5	6
Soil Loss (Volume Total) m3/yr	4104	3257	2681	8266	2052	3249	3351	3351	799	7591	2098	5852	2013	671	883
Sediment Control Type	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1

PARAMETERS															
Chainage	18450 - 18600	18600 - 18800	18800 - 18900	19300 - 19600	19700 - 19950	19600 - 19900	19900 - 20100	20100 - 20500	20500 - 20700	20700 - 20900	20700 - 20900	20700 - 20900	20900 - 21200	21000 - 21200	20900 - 21100
Location on alignment	R	R	R	L	L	L	R	R	R	L	L	R	R	R	R
Site Catchment Areas															
Undisturbed (ha)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disturbed (ha)	3.1	3.3	1.5	3.4	0.9	4	1	4.3	4.8	0.77	2.3	2.7	2.5	0.18	1.5
Total catchment area (ha)	3.10	3.30	1.50	3.40	0.90	4.00	1.00	4.30	4.80	0.77	2.30	2.70	2.50	0.18	1.50
Rainfall data															
Design rainfall depth (days)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Design rainfall depth (percentile)	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
Design rainfall depth (mm)	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9
Intensity: 2-yr, 6-hr storm	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
RUSLE Factors															
Rainfall erosivity - R (adopted)	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390
Soil erodibility - K	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Slope length - L	40	40	40	40	15	40	15	40	40	40	40	40	40	40	40
Slope gradient (existing) - S	20	25	32	20	8	10	8	35	22	20	15	12	13	10	13
Length/gradient (existing) - LS	4.32	5.54	7.10	4.32	0.62	1.75	0.62	7.72	4.81	4.32	3.05	2.27	2.53	1.75	2.53
Erosion control practice - P	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover in disturbed catchment - %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ground cover in disturbed catchment - C	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Soil loss															
Soil Loss (Tonnge Rate) t/ha/yr	1435	1841	2359	1435	206	581	206	2564	1598	1435	1013	754	841	581	841
Soil Loss (Volume Rate) m3/ha/yr	1104	1416	1815	1104	158	447	158	1972	1229	1104	780	580	647	447	647
Soil Loss Class	6	7	7	6	2	5	2	7	7	6	6	6	6	5	6
Soil Loss (Volume Total) m3/yr	3423	4673	2722	3754	142	1789	158	8479	5899	850	1793	1567	1617	81	970
Sediment Control Type	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 2	Type 1

PARAMETERS														
Chainage	20700 - 21300	21300 - 21500	21300 - 21700	21500 - 21800	21800 - 22000	21800 - 22000	22000 - 22300	22000 - 22300	22400 - 22600	22400 - 22600	22600 - 23200	23100 - 23300	23300 - 23600	23300 - 23600
Location on alignment	L	L	R	L	R	L	L	R	L	R	R	L	L	R
Site Catchment Areas														
Undisturbed (ha)	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.2	0.0	0.3	2.7	0.8	0.0	0.0
Disturbed (ha)	5.2	1.6	1.4	2.3	1.7	0.9	0.9	0.7	1.3	0.9	6.6	1.1	1.5	0.7
Total catchment area (ha)	5.20	1.60	2.50	2.30	1.70	0.90	0.90	0.90	1.30	1.20	9.30	1.90	1.50	0.70
Rainfall data														
Design rainfall depth (days)	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Design rainfall depth (percentile)	90	90	90	90	90	90	90	90	90	90	90	90	90	90
Design rainfall depth (mm)	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9
Intensity: 2-yr, 6-hr storm	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
RUSLE Factors														
Rainfall erosivity - R (adopted)	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390
Soil erodibility - K	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Slope length - L	40	40	40	40	40	40	40	40	40	40	40	40	40	40
Slope gradient (existing) - S	11	18	25	20	21	3	5	5	5	3	5	2	2	3
Length/gradient (existing) - LS	2.01	3.82	5.54	4.32	4.56	0.47	0.80	0.80	0.80	0.47	0.80	0.31	0.31	0.47
Erosion control practice - P	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover in disturbed catchment - %	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ground cover in disturbed catchment - C	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Soil loss														
Soil Loss (Tonnge Rate) t/ha/yr	668	1269	1841	1435	1517	156	266	266	266	156	266	103	103	156
Soil Loss (Volume Rate) m3/ha/yr	514	976	1416	1104	1167	120	204	204	204	120	204	79	79	120
Soil Loss Class	5	6	7	6	7	2	3	3	3	2	3	1	1	2
Soil Loss (Volume Total) m3/yr	2672	1562	1982	2540	1983	108	184	143	266	108	1350	87	119	84
Sediment Control Type	Type 1	Type 1	Type 1	Type 1	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 2	Type 2

APPENDIX A2 CONSTRUCTION SEDIMENT BASIN REGISTER (INDICATIVE)

CONSTRUCTION SEDIMENT BASIN CAPACITY (INDICATIVE) – NON-MARINE PARK CATCHMENTS

PARAMETERS																				
Control Type	Basin	Basin	Basin	Basin		Basin	Basin	Basin	Basin		Basin		Basin	Basin		Basin		Basin	Basin	
Chainage	9800 - 10300	9700 - 1100	10100 - 10500	10300 - 10600		10500 - 10600	10500 - 10900	10800 - 11100	10800 - 11100	11100 - 11500		11100 - 11500		11500 - 11600	11700 - 12000		11700 - 12000		12600 - 13300	13300 - 13500	13500 - 13600
Basin ID	B9850R	B9900L	B10300L	B10600R		B10650R	B10700R	B11000R	B11000L	B11200L		B11450R		B11600R	B11700R		B11800L		B12600L	B13400R	B13500R
Site Catchment Areas																					
Undisturbed (ha)	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disturbed (ha)	2.1	0.32	2	0.6	1.2	0.9	4.9	3.2	2.4	0.6	1.3	0.3	1.1	0.32	0.4	1.5	0.4	1.7	3.9	6.7	1.6	1.9
Total catchment area (ha)	2.30	0.52	2.20	0.60	1.20	0.90	4.90	3.20	2.40	0.60	1.30	0.30	1.10	0.32	0.40	1.50	0.40	1.70	3.90	6.70	1.60	1.90
Soil loss																					
Soil Loss (Tonnge Rate) t/ha/yr	1013	1013	819	1435	581	266	754	266	435	1394	226	1394	226	1013	1106	103	1106	53	2126	497	1841	2070
Soil Loss (Volume Rate) m3/ha/yr	780	780	630	1104	447	204	580	204	335	1072	174	1072	174	780	851	79	851	41	1635	382	1416	1592
Soil Loss Class	6	6	6	6	5	3	6	3	4	6	2	6	2	6	6	1	6	1	7	4	7	7
Sediment Storage Volume (2mth storage)	**273**	**42**	**210**	**110**	**89**	**31**	**474**	**109**	**134**	**107**	**38**	**54**	**32**	**42**	**57**	**20**	**57**	**12**	**1063**	**427**	**378**	**504**
Soil Loss (Volume Total) m3/yr	1637	249	1260	1199		184	2843	654	804	869		513		249	459		410		8941		2266	3026
Settling Zone																					
Soil Hydrologic Group	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Volumetric runoff coefficient	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
Settling Zone Volume	950	215	908	248	496	372	2023	1321	991	248	537	124	454	132	165	619	165	702	1610	2767	661	785
Sediment Pond Design																					
Sediment Storage Volume	273	42	210	110	89	31	474	109	134	107	38	54	32	42	57	20	57	12	1063	427	378	504
Settling Zone Volume	950	215	908	248	496	372	2023	1321	991	248	537	124	454	132	165	619	165	702	1610	2767	661	785
Total Basin Volume (Type D)	1223	257	1118	358	585	403	2497	1430	1125	355	575	178	486	174	222	639	222	714	2673	3194	1039	1289
Basin volumes (m3)																					
TYPE D (BATCH TREATMENT)	1223	257	1118	942		403	2497	1430	1125	930		664		174	862		936		5867		1039	1289
TYPE A (HES BASIN)	1306	292	1249	1020		508	2790	1819	1363	1077		793		179	1077		1191		6047		906	1077

CONSTRUCTION SEDIMENT BASIN CAPACITY (INDICATIVE) – MARINE PARK CATCHMENTS

PARAMETERS																	
Control Type	Basin	Basin	Basin	Basin	Basin	Basin	Basin	Basin	Basin	Basin	Basin	Basin	Basin	Basin	Basin	Basin	Basin
Chainage	13900 - 14100	13900 - 14200	14200 - 14500	14700 - 14800	14700 - 15000	15000 - 15200	15000 - 15200	15200 - 15400	15400 - 15500	15500 - 15800	15500 - 15800	15800 - 15900	15900 - 16100	16100 - 16400	16400 - 16600	16600 - 16900	16700 - 16900
Basin ID	B14100L	B14200R	B14500R	B14600L	B14800R	B15100L	B15200R	B15300R	B15400R	B15500R	B15650L	B15900R	B16000R	B16100R	B16600R	B16650L	B16750R
Site Catchment Areas																	
Undisturbed (ha)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disturbed (ha)	1.5	5.2	4.4	1.3	3.2	1.2	1.9	2.4	0.3	0.6	2.4	2.3	1.2	3.7	1.9	1.5	0.3
Total catchment area (ha)	1.50	5.20	4.40	1.30	3.20	1.20	1.90	2.40	0.30	0.60	2.40	2.30	1.20	3.70	1.90	1.50	0.30
Soil loss																	
Soil Loss (Tonnge Rate) t/ha/yr	1269	1269	435	1394	2133	266	435	1435	1013	1013	2223	1841	2904	2904	2223	2904	3462
Soil Loss (Volume Rate) m3/ha/yr	976	976	335	1072	1641	204	335	1104	780	780	1710	1416	2234	2234	1710	2234	2663
Soil Loss Class	6	6	4	6	7	3	4	6	6	6	7	7	7	7	7	7	7
Sediment Storage Volume (2mth storage)	**244**	**846**	**246**	**232**	**875**	**41**	**106**	**442**	**39**	**78**	**684**	**543**	**447**	**1378**	**541**	**558**	**133**
Soil Loss (Volume Total) m3/yr	1465	5077	1473	1394	5251	245	636	2650	234	468	4104	3257	2681	8266	3249	3351	799
Settling Zone																	
Soil Hydrologic Group	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Volumetric runoff coefficient	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Settling Zone Volume	888	3077	2604	769	1893	710	1124	1420	178	355	1420	1361	710	2189	1124	888	178
Sediment Pond Design																	
Sediment Storage Volume	244	846	246	232	875	41	106	442	39	78	684	543	447	1378	541	558	133
Settling Zone Volume	888	3077	2604	769	1893	710	1124	1420	178	355	1420	1361	710	2189	1124	888	178
Total Basin Volume (Type D)	1132	3923	2850	1001	2768	751	1230	1862	217	433	2104	1904	1157	3567	1665	1446	311
Basin volumes (m3)																	
TYPE D (BATCH TREATMENT)	1132	3923	2850	1001	2768	751	1230	1862	217	433	2104	1904	1157	3567	1665	1446	311
TYPE A (HES BASIN)	849	2961	2504	736	1849	604	1002	1385	170	343	1385	1327	690	2139	1095	863	170

PARAMETERS															
Control Type	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**
Chainage	**17600 - 17800**	**17300 - 17800**	**17800 - 18200**	**18100 - 18350**	**18350 - 18450**	**18450 - 18600**	**18600 - 18800**	**18800 - 18900**	**19300 - 19600**	**19600 - 19900**	**20100 - 20500**	**20500 - 20700**	**20700 - 20900**	**20700 - 20900**	**20800 - 20900**
Basin ID	**B17700R**	**B17800L**	**B18200R**	**B18250R**	**B18350R**	**B18550R**	**B18650R**	**B18800R**	**B19R00L**	**B19900L**	**B20300R**	**B20700R**	**B20750L**	**B20800R**	**B20820R**
Site Catchment Areas															
Undisturbed (ha)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disturbed (ha)	1.9	5.3	4.5	1.5	0.8	3.1	3.3	1.5	3.4	4	4.3	4.8	0.77	2.3	1.5
Total catchment area (ha)	1.90	5.30	4.50	1.50	0.80	3.10	3.30	1.50	3.40	4.00	4.30	4.80	0.77	2.30	1.50
Soil loss															
Soil Loss (Tonnge Rate) t/ha/yr	1435	1435	581	581	1435	1435	1841	2359	1435	581	2564	1598	1435	1013	841
Soil Loss (Volume Rate) m3/ha/yr	1104	1104	447	447	1104	1104	1416	1815	1104	447	1972	1229	1104	780	647
Soil Loss Class	6	6	5	5	6	6	7	7	6	5	7	7	6	6	6
Sediment Storage Volume (2mth storage)	**350**	**975**	**335**	**112**	**147**	**570**	**779**	**454**	**626**	**298**	**1413**	**983**	**142**	**299**	**162**
Soil Loss (Volume Total) m3/yr	2098	5852	2013	671	883	3423	4673	2722	3754	1789	8479	5899	850	1793	970
Settling Zone															
Soil Hydrologic Group	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Volumetric runoff coefficient	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Settling Zone Volume	1124	3136	2663	888	473	1834	1953	888	2012	2367	2544	2840	456	1361	888
Sediment Pond Design															
Sediment Storage Volume	350	975	335	112	147	570	779	454	626	298	1413	983	142	299	162
Settling Zone Volume	1124	3136	2663	888	473	1834	1953	888	2012	2367	2544	2840	456	1361	888
Total Basin Volume (Type D)	1474	4111	2998	1000	620	2404	2732	1342	2638	2665	3957	3823	598	1660	1050
Basin volumes (m3)															
TYPE D (BATCH TREATMENT)	1474	4111	2998	1000	620	2404	2732	1342	2638	2665	3957	3823	598	1660	1050
TYPE A (HES BASIN)	1178	3300	2801	873	463	1810	2052	929	2114	2488	2182	2264	374	1081	757

PARAMETERS										
Control Type	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**	**Basin**
Chainage	**20700 - 20900**	**20900 - 21200**	**20700 - 21300**	**21300 - 21500**	**21500 - 21800**	**22000 - 22300**	**22000 - 22300**	**22400 - 22600**	**22600 - 23200**	**23300 - 23600**
Basin ID	**B20850R**	**B20900R**	**B21100R**	**B21500L**	**B21750L**	**B22300L**	**22350S**	**B22450L**	**B22850R**	**B23600L**
Site Catchment Areas										
Undisturbed (ha)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	
Disturbed (ha)	2.7	2.5	5.2	1.6	2.3	0.9	0.7	1.3	6.6	1.5
Total catchment area (ha)	2.70	2.50	5.20	1.60	2.30	0.90	0.70	1.30	9.30	1.50
Soil loss										
Soil Loss (Tonnge Rate) t/ha/yr	754	841	668	1269	1435	266	266	266	266	103
Soil Loss (Volume Rate) m3/ha/yr	580	647	514	976	1104	204	204	204	204	79
Soil Loss Class	6	6	5	6	6	3	3	3	3	1
Sediment Storage Volume (2mth storage)	**261**	**269**	**445**	**260**	**423**	**31**	**24**	**44**	**225**	**20**
Soil Loss (Volume Total) m3/yr	1567	1617	2672	1562	2540	184	143	266	1350	119
Settling Zone										
Soil Hydrologic Group	D	D	D	D	D	D	D	D	D	D
Volumetric runoff coefficient	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Settling Zone Volume	1598	1479	3077	947	1361	533	414	769	5503	888
Sediment Pond Design										
Sediment Storage Volume	261	269	445	260	423	31	24	44	225	20
Settling Zone Volume	1598	1479	3077	947	1361	533	414	769	5503	888
TYPE D (BATCH TREATMENT)	1859	1748	3522	1207	1784	564	438	813	5728	908
TYPE A (HES BASIN)	1367	1265	2640	808	1164	453	394	656	4186	849

APPENDIX A3 CONSTRUCTION SEDIMENT BASIN LAYOUT (INDICATIVE)

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:56:52 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 1 of 27

Project: CHB

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR

COORDINATE SYSTEM: MGA20 Zone 56

HEIGHT DATUM: A.H.D

SCALE 1:1700

PLOT DATE: Tue Sep 27 08:56:58 2022

LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 2 of 27

Project: CHB

Last Saved ISO A3 Rev 1

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:57:06 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 3 of 27

Project: CHB

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:57:16 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 4 of 27

Project: CHB

Last Saved ISO A3 Rev 1

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY	MATT WEIR
COORDINATE SYSTEM	MGA20 Zone 56
HEIGHT DATUM	A.H.D
SCALE	1:1700

PLOT DATE: Tue Sep 27 08:57:23 2022

LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 5 of 27

Project: CHB

Landscape ISO A3 Rev 1

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:57:29 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 6 of 27

Project: CHB

Landscape ISO A3 Rev 1

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:57:35 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 7 of 27

Project: CHB

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY	MATT WEIR
COORDINATE SYSTEM	MGA20 Zone 56
HEIGHT DATUM	A.H.D
SCALE	1:1700

PLOT DATE: Tue Sep 27 08:57:42 2022

LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 8 of 27

Project: CHB

Landscape ISO A3 Rev 1

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:57:48 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 9 of 27

Project: CHB

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:57:57 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 10 of 27

Project: CHB

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE 1:1700

PLOT DATE: Tue Sep 27 08:58:05 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 11 of 27

Project: CHB

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:58:12 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 12 of 27

Project: CHB

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:58:19 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 13 of 27

Project: CHB

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:58:25 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 14 of 27

Project: CHB

Last Saved ISO A3 Rev 1

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REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:58:32 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 15 of 27

Project: CHB

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

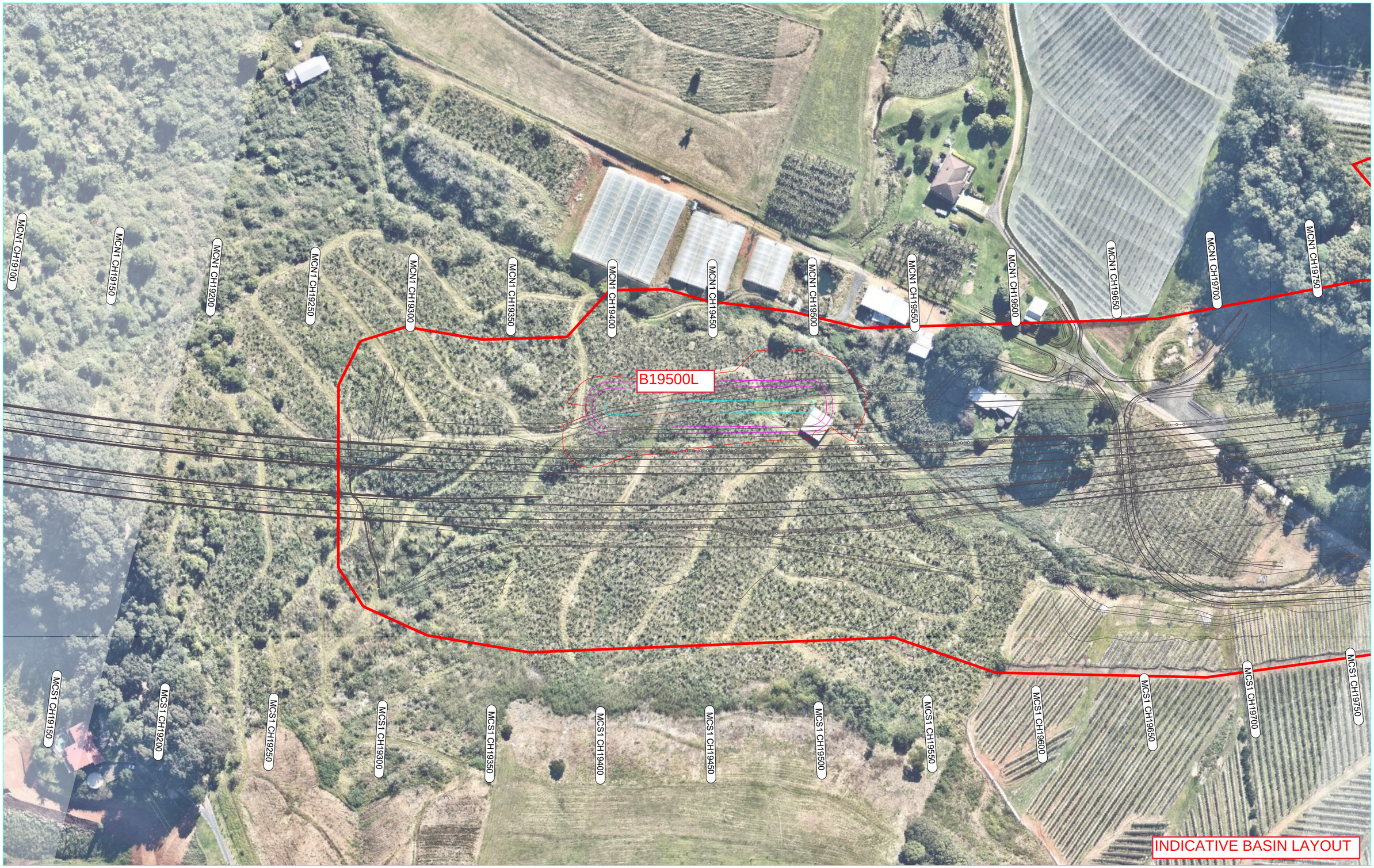
SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:58:39 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 16 of 27

Project: CHB



REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR

COORDINATE SYSTEM: MGA20 Zone 56

HEIGHT DATUM: A.H.D

SCALE 1:1700

PLOT DATE: Tue Sep 27 08:58:46 2022

LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 17 of 27

Project: CHB

Landscape ISO A3 (No.)

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

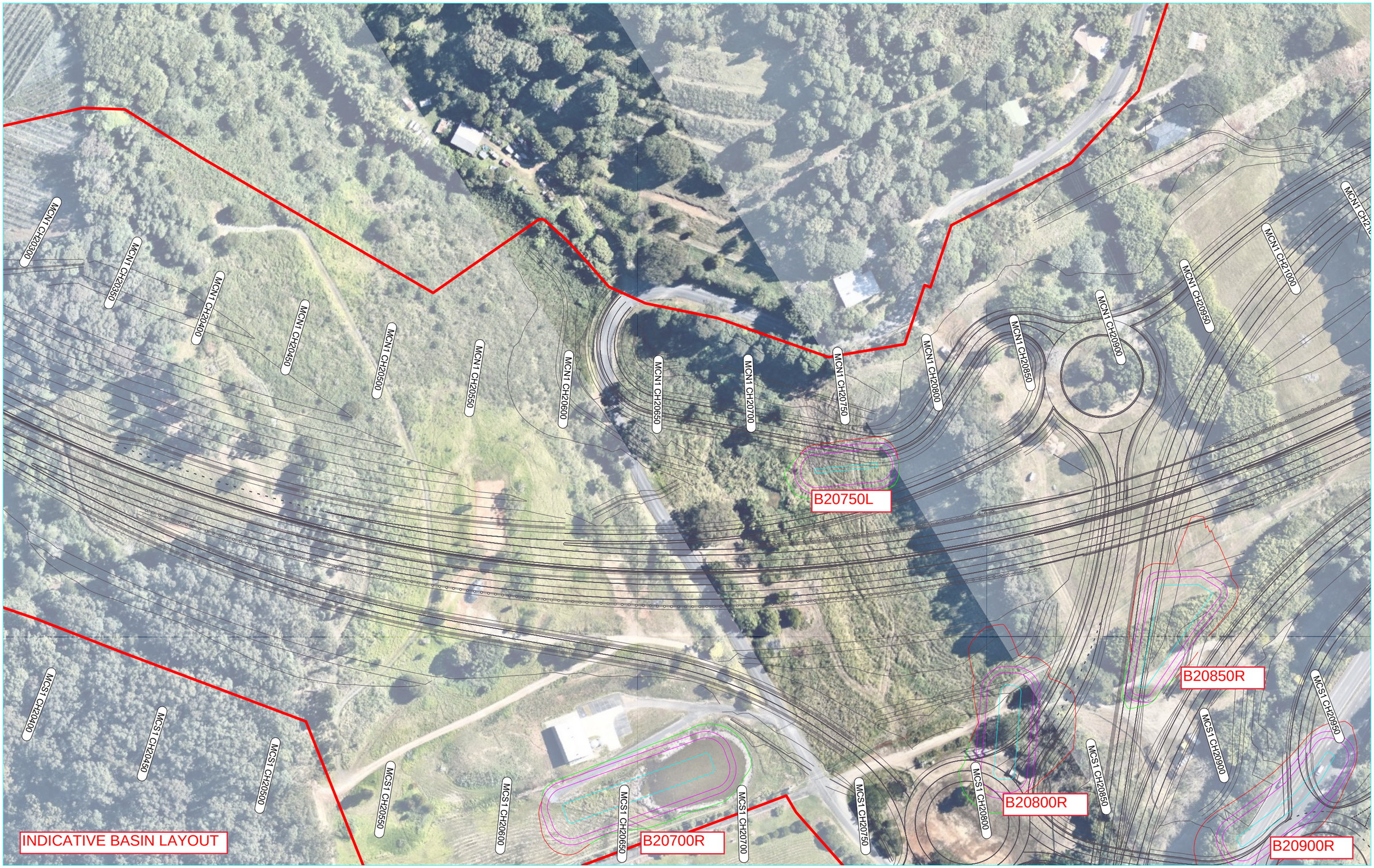
SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:58:53 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 18 of 27

Project: CHB



REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:59:00 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 19 of 27

Project: CHB

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:59:09 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 20 of 27

Project: CHB

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:59:17 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 21 of 27

Project: CHB

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REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:59:25 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 22 of 27

Project: CHB

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

PLOT DATE: Tue Sep 27 08:59:33 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 23 of 27

Project: CHB

Landscape ISO A3 Rev 1

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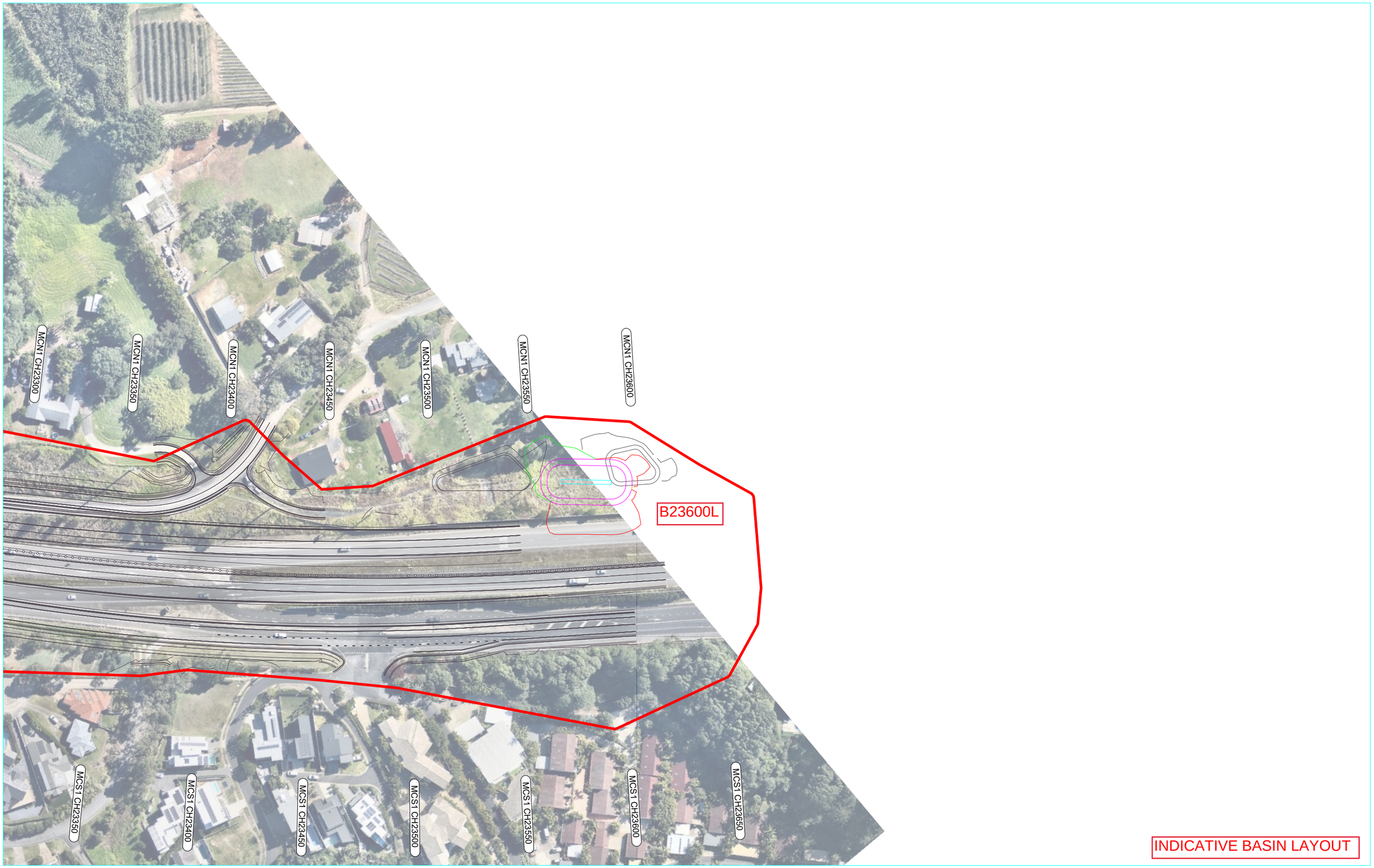


REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE: 1:1700

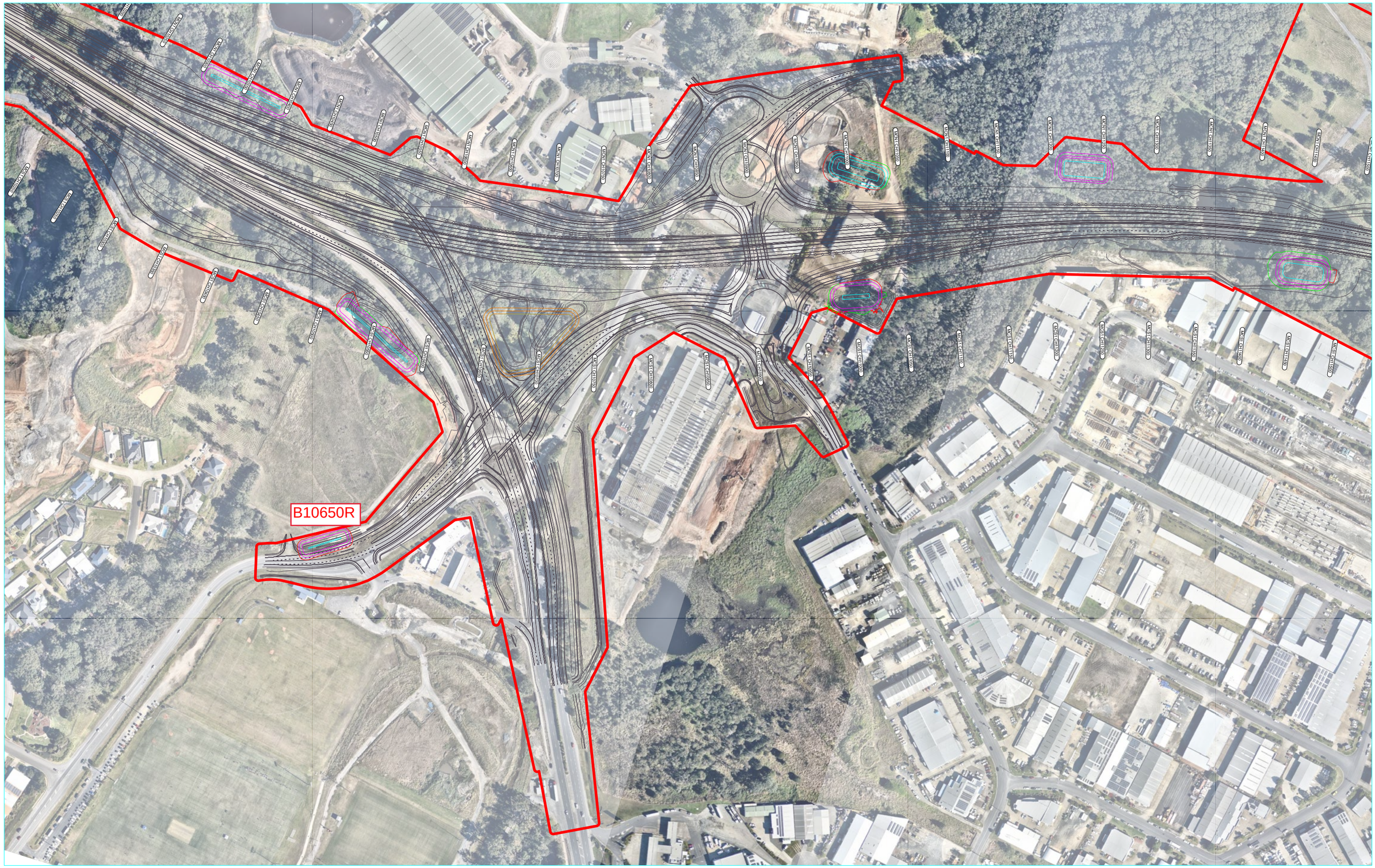
PLOT DATE: Tue Sep 27 08:59:52 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 24 of 27

Project: CHB

Landbase NSD_A3 Rev 1



REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR

COORDINATE SYSTEM: MGA20 Zone 56

HEIGHT DATUM: A.H.D

SCALE 1:3500

PLOT DATE: Tue Sep 27 09:00:00 2022

LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 25 of 27

Project: CHB

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR

COORDINATE SYSTEM: MGA20 Zone 56

HEIGHT DATUM: A.H.D

SCALE: 1:3000

PLOT DATE: Tue Sep 27 09:00:16 2022

LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

SHEET 26 of 27

Project: CHB

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

REV	ZONE	AMENDMENTS	APP'D	DATE

GENERAL NOTES / REFERENCES

COFFS HARBOUR BYPASS team

SURVEYED / DRAWN BY: MATT WEIR
COORDINATE SYSTEM: MGA20 Zone 56
HEIGHT DATUM: A.H.D
SCALE 1:3000

PLOT DATE: Tue Sep 27 09:00:30 2022
LOCATION:

TEMPORARY BASINS CONSTRUCTION FOOTPRINT

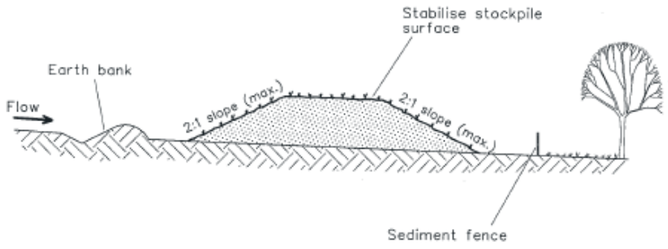
SHEET 27 of 27

Project: CHB

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

APPENDIX A4 TYPICAL DESIGN MEASURES

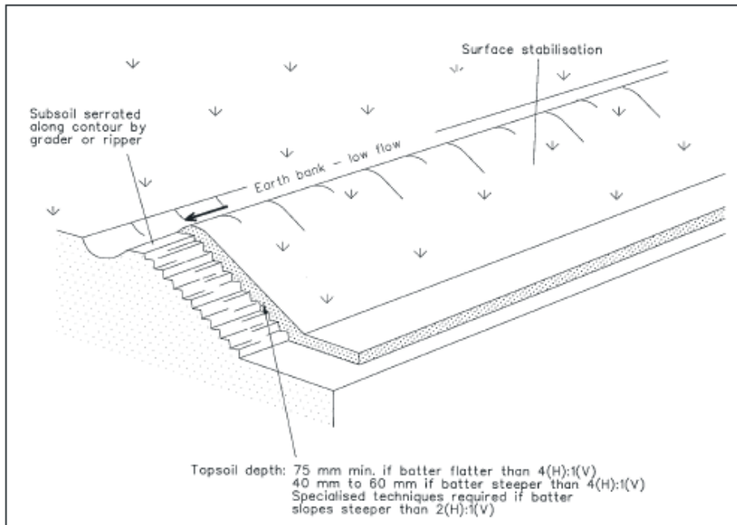
TYPICAL ESC DESIGNS (Landcom 2004)



Construction Notes

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

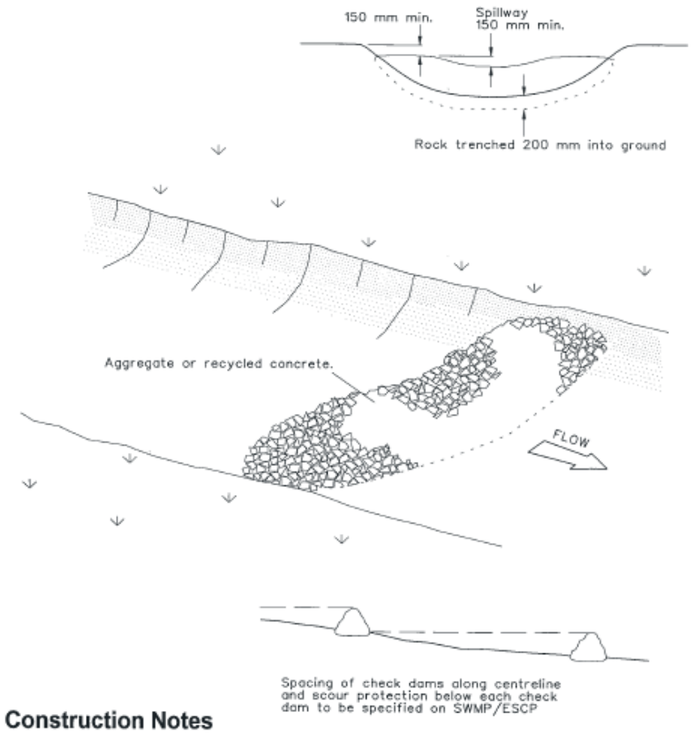
STOCKPILES SD 4-1



Construction Notes

1. Scarify the ground surface along the line of the contour to a depth of 50 mm to 100 mm to break up any hardsetting surfaces and to provide a good bond between the respread material and subsoil.
2. Add soil ameliorants as required by the ESCP or SWMP.
3. Rip to a depth of 300 mm if compacted layers occur.
4. Where possible, replace topsoil to a depth of 40 to 60 mm on lands where the slope exceeds 4(H):1(V) and to at least 75 mm on lower gradients.

REPLACING TOPSOIL SD 4-2



Construction Notes

1. Check dams can be built with various materials, including rocks, logs, sandbags and straw bales. The maintenance program should ensure their integrity is retained, especially where constructed with straw bales. In the case of bales, this might require their replacement each two to four months.
2. Trench the check dam 200 mm into the ground across its whole width. Where rock is used, fill the trenches to at least 100 mm above the ground surface to reduce the risk of undercutting.
3. Normally, their maximum height should not exceed 600 mm above the gully floor. The centre should act as a spillway, being at least 150 mm lower than the outer edges.
4. Space the dams so the toe of the upstream dam is level with the spillway of the next downstream dam.

ROCK CHECK DAM SD 5-4

Revision	Date	Drawn	Description
0	12/09/2022	TE	Draft

CERTIFIED PROFESSIONAL CPESC® IN EROSION AND SEDIMENT CONTROL

Tim Elder #4399

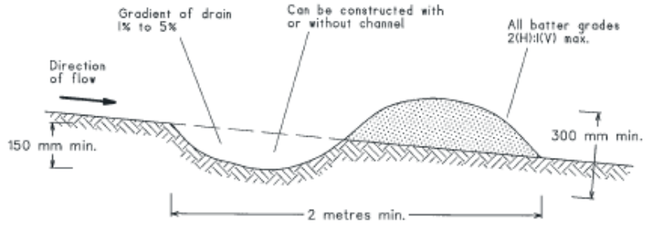
PREPARED BY:

PREPARED FOR:

COFFS HARBOUR BYPASS

TYPICAL ESC DESIGNS

NOT TO SCALE	DOC:	REVISION: 0

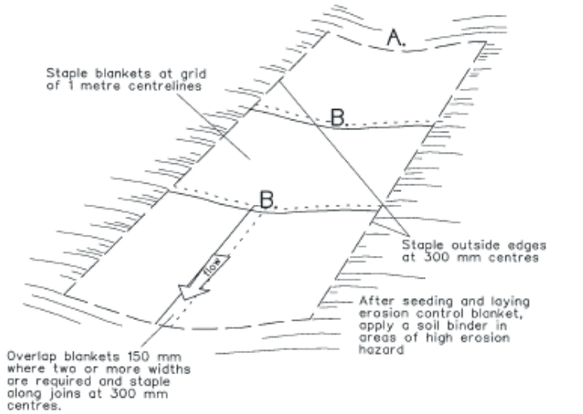


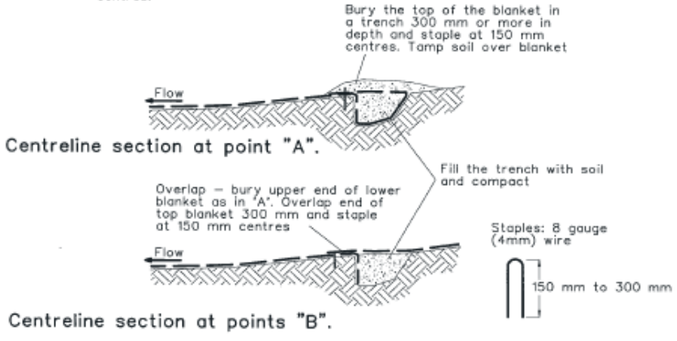
NOTE: Only to be used as temporary bank where maximum upslope length is 80 metres.

Construction Notes

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

EARTH BANK (LOW FLOW) **SD 5-5**

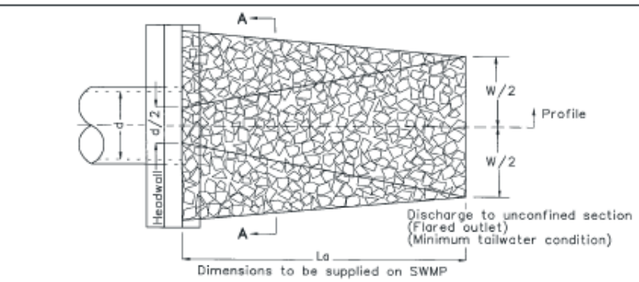




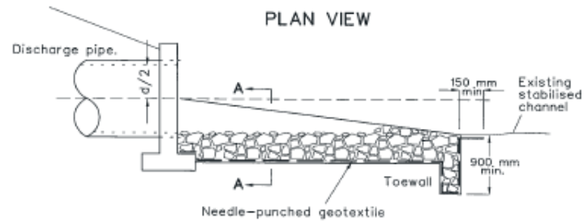
Construction Notes

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

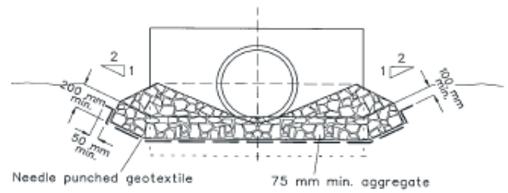
RECP : CONCENTRATED FLOW **SD 5-7**



PLAN VIEW



PLAN VIEW



CROSS SECTION AA

Construction Notes

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

ENERGY DISSIPATER **SD 5-8**

Revision	Date	Drawn	Description
0	12/09/2022	TE	Draft

CERTIFIED PROFESSIONAL IN EROSION AND SEDIMENT CONTROL CPESC®

Tim Elder #4399

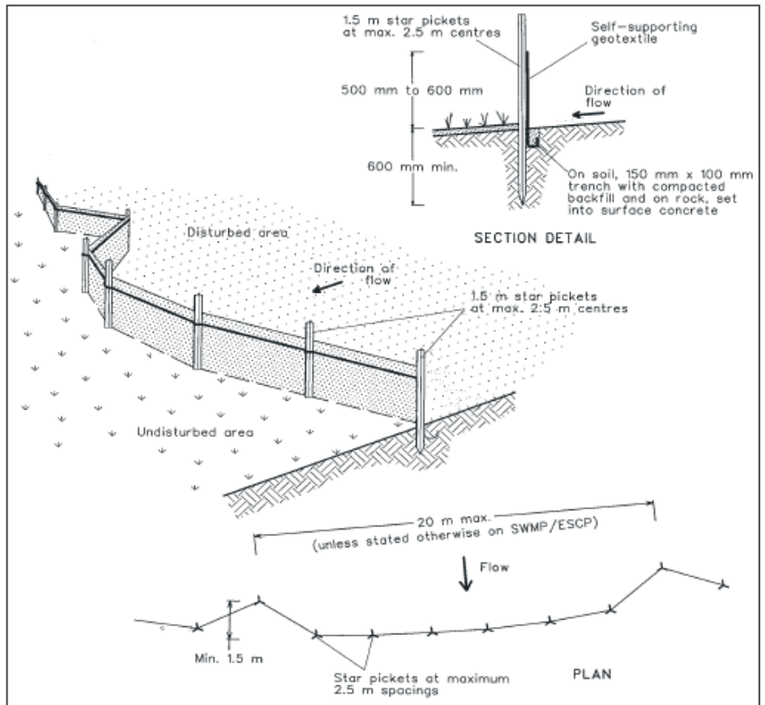
PREPARED BY:

PREPARED FOR:

COFFS HARBOUR BYPASS

TYPICAL ESC DESIGNS

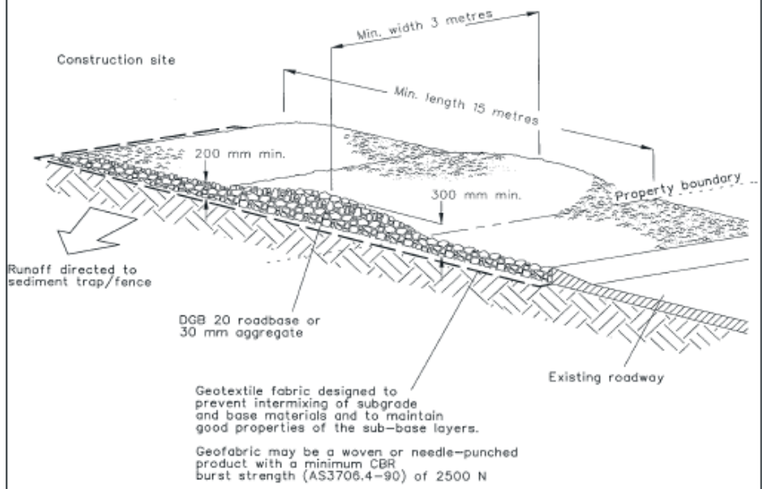
NOT TO SCALE	DOC:	REVISION: 0



Construction Notes

1. Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
2. Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.
4. Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.
5. Join sections of fabric at a support post with a 150-mm overlap.
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

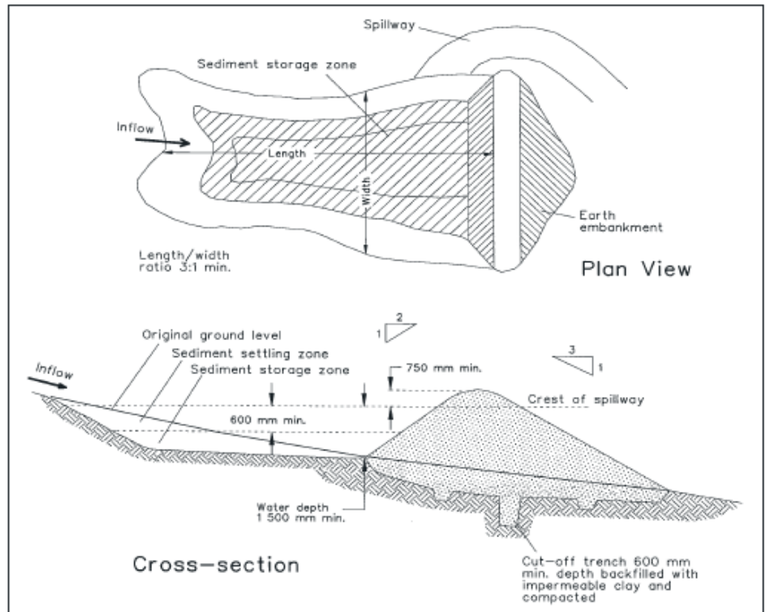
SEDIMENT FENCE **SD 6-8**



Construction Notes

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

STABILISED SITE ACCESS **SD 6-14**



Construction Notes

1. Remove all vegetation and topsoil from under the dam wall and from within the storage area.
2. Construct a cut-off trench 500 mm deep and 1,200 mm wide along the centreline of the embankment extending to a point on the gully wall level with the riser crest.
3. Maintain the trench free of water and recompact the materials with equipment as specified in the SWMP to 95 per cent Standard Proctor Density.
4. Select fill following the SWMP that is free of roots, wood, rock, large stone or foreign material.
5. Prepare the site under the embankment by ripping to at least 100 mm to help bond compacted fill to the existing substrate.
6. Spread the fill in 100 mm to 150 mm layers and compact it at optimum moisture content following the SWMP.
7. Construct the emergency spillway.
8. Rehabilitate the structure following the SWMP.

SEDIMENT BASIN – TYPE D **SD 6-4**

Revision	Date	Drawn	Description
0	12/09/2022	TE	Draft

CERTIFIED PROFESSIONAL IN EROSION AND SEDIMENT CONTROL CPESC®

Tim Elder #4399

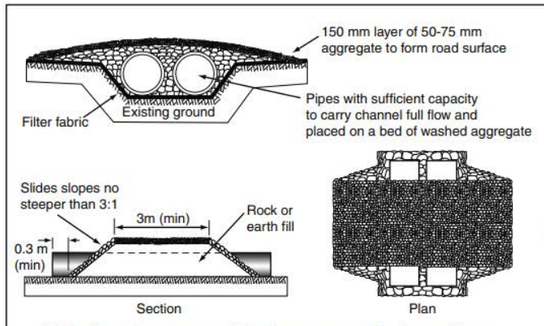
PREPARED BY:

PREPARED FOR:

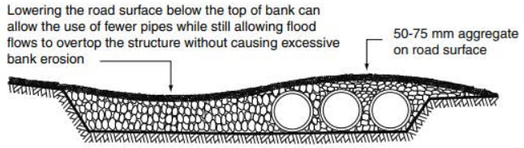
COFFS HARBOUR BYPASS
TYPICAL ESC DESIGNS

NOT TO SCALE | DOC: | REVISION: 0

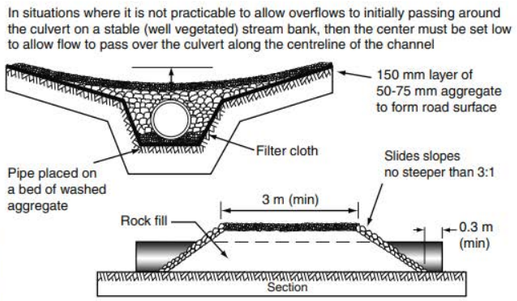
TYPICAL ESC DESIGNS (CATCHMENTS & CREEKS, Available at: https://austieca.com.au/publications/best-practice-erosion-and-sediment-control-bpesc-document)



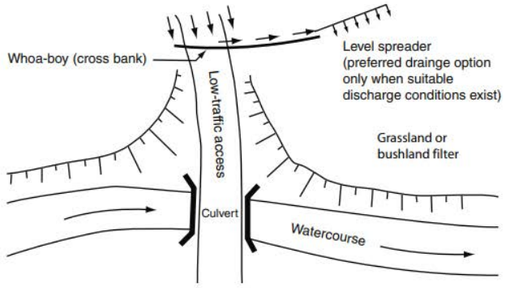
(a) Preferred arrangement for temporary culvert crossings



(b) Typical profile of temporary culvert crossings of wide channels



(c) Alternative layout for the crossing of confined channels



(d) Typical arrangement of surface runoff controls associated with approach ramps

Drawn:	Date:		
GMW	Dec-09	Temporary Culvert Crossing	TCC-01

MATERIALS

CULVERTS: ANY COMMERCIAL CONDUIT THAT IS SUITABLE FOR THE REQUIRED TRAFFIC LOADING.

ROCK: MINIMUM 150mm NOMINAL ROCK SIZE.

AGGREGATE: 50–75mm CLEAN AGGREGATE.

GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE-PUNCHED, NON-WOVEN FILTER CLOTH (MINIMUM BIDIM A34 OR EQUIVALENT).

INSTALLATION

1. PRIOR TO COMMENCING ANY WORKS, OBTAIN ALL NECESSARY APPROVALS AND PERMITS REQUIRED TO CONSTRUCT THE TEMPORARY WATERCOURSE CROSSING, INCLUDING PERMITS FOR THE DISTURBANCE OF BANK VEGETATION, AQUATIC VEGETATION (e.g. MANGROVES) AND ANY TEMPORARY INSTREAM FLOW DIVERSION BARRIERS OR SEDIMENT CONTROL MEASURES.

2. REFER TO APPROVED PLANS FOR LOCATION AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

3. ENSURE THAT THE LOCATION OF THE CROSSING WILL NOT INTERFERE WITH FUTURE CONSTRUCTION WORKS.

4. PRIOR TO SIGNIFICANT LAND CLEARING OR CONSTRUCTION OF THE APPROACH RAMPS, ESTABLISH ALL NECESSARY SEDIMENT CONTROL MEASURES AND FLOW DIVERSION WORKS (INSTREAM AND OFF-STREAM AS REQUIRED), CLEARING ONLY THOSE AREAS NECESSARY FOR INSTALLATION OF THESE MEASURES.

5. TO THE MAXIMUM DEGREE PRACTICABLE, CONSTRUCTION ACTIVITIES AND EQUIPMENT MUST NOT OPERATE WITHIN OPEN FLOWING WATERS.

6. MAINTAIN CLEARING AND EXCAVATION OF THE WATERCOURSE BED AND BANKS TO A MINIMUM. INITIALLY CLEAR ONLY THE AREA NECESSARY TO ALLOW ACCESS FOR CONSTRUCTION. CLEAR THE REMAINDER OF THE APPROACH RAMPS ONLY WHEN ADEQUATE DRAINAGE AND SEDIMENT CONTROLS ARE IN PLACE.

7. IF FLOW DIVERSION SYSTEMS CANNOT BE INSTALLED, THEN CONDUCT BANK EXCAVATIONS BY PULLING THE SOIL AWAY FROM THE CHANNEL.

8. WHERE PRACTICABLE, CONSTRUCT THE WATERCOURSE CROSSING PERPENDICULAR TO THE CHANNEL.

9. WHERE PRACTICABLE, THE APPROACH RAMPS SHOULD BE STRAIGHT FOR AT LEAST 10m AND SHOULD BE ALIGNED WITH THE CROSSING.

10. WHERE PRACTICABLE, DIRECT STORMWATER RUNOFF FROM THE APPROACH RAMPS INTO STABLE DRAINS, ADJACENT VEGETATION, OR APPROPRIATE SEDIMENT TRAPS TO MINIMISE THE RELEASE OF SEDIMENT INTO THE WATERCOURSE.

11. SHAPE THE CHANNEL, IF NECESSARY, TO RECEIVE THE PIPE/S.

12. IF HIGHLY EROSIVE SOILS ARE DETECTED, THEN APPROPRIATELY STABILISE SUCH SOILS AS SOON AS PRACTICABLE.

13. COVER THE CROSSING FOOTING WITH HEAVY-DUTY FILTER CLOTH.

14. COVER THE FILTER CLOTH WITH A MINIMUM 150mm OF CLEAN, 50 TO 75mm AGGREGATE.

15. PLACE THE SPECIFIED SIZE AND NUMBER OF CULVERT CELLS AND ALIGN THEM WITH THE DIRECTION OF THE DOWNSTREAM CHANNEL.

16. ENSURE THE PIPES EXTEND AT LEAST 300mm BEYOND THE PROPOSED EXTEND OF ROCK FILL.

17. FILL BETWEEN THE PIPE/S WITH 75 TO 100mm AGGREGATE.

18. COVER PIPE/S WITH SUFFICIENT ROCK (MINIMUM 300mm LAYER) TO SATISFY MANUFACTURER'S LOADING REQUIREMENTS TO AVOID DAMAGE TO THE PIPE/S RESULTING FROM THE EXPECTED TRAFFIC LOAD. SLOPE OF ROCK FACE UPSTREAM AND DOWNSTREAM OF THE CULVERT NO STEEPER THAN 3:1 (H:V).

19. FORM THE SHAPE OF THE ROAD SURFACE IN ACCORDANCE WITH THE PLANS AND/OR STANDARD DRAWINGS.

20. APPLY A SUITABLE COVER OF AGGREGATE OVER THE ROCK FILL TO FORM THE TRAFFICABLE ROAD SURFACE.

21. FINISH CONSTRUCTION AND STABILISATION OF THE APPROACH ROADS INCLUDING THE APPROACH RAMPS EACH SIDE OF THE BRIDGE CROSSING.

22. TAKE ALL REASONABLE MEASURES TO PREVENT EXCESS ROCK, DEBRIS AND CONSTRUCTION MATERIAL FROM ENTERING THE WATERCOURSE, ESPECIALLY ANY STILL OR FLOWING WATER.

23. IF IT IS NOT PRACTICABLE TO STABILISE THE ACCESS RAMPS AGAINST EROSION, THEN INSTALL FLOW DIVERSION BANKS ACROSS THE WIDTH OF EACH ACCESS RAMP ADJACENT THE TOP OF THE CHANNEL BANK, AND AT REGULAR INTERVALS DOWN THE RAMPS (AS REQUIRED) TO PREVENT OR MINIMISE SEDIMENT-LADEN RUNOFF FLOWING DIRECTLY INTO THE WATERCOURSE.

24. APPROPRIATELY STABILISE ANY DISTURBED WATERCOURSE BANKS.

25. STABILISE ALL DISTURBED AREAS THAT ARE LIKELY TO BE SUBJECTED TO FLOWING WATER, INCLUDING BYPASS AND OVERFLOW AREAS, WITH ROCK OR OTHER SUITABLE MATERIALS.

MAINTENANCE

1. TEMPORARY WATERCOURSE CROSSINGS SHOULD BE INSPECTED WEEKLY AND AFTER ANY SIGNIFICANT CHANGE IN STREAM FLOW.

2. DEBRIS TRAPPED ON OR UPSTREAM OF THE CROSSING SHOULD BE REMOVED.

3. REPAIR ANY DAMAGE CAUSED BY CONSTRUCTION TRAFFIC. IF TRAFFIC HAS EXPOSED BARE SOIL, STABILISED AS APPROPRIATE. MAINTAIN A MINIMUM 200mm COVER OVER THE CULVERTS.

4. CHECK FOR EROSION OF THE FORMED EMBANKMENT, CHANNEL SCOUR, OR ROCK DISPLACEMENT. MAKE ALL NECESSARY REPAIRS IMMEDIATELY.

5. CHECK THE BYPASS FLOODWAY MAKING SURE THE BANKS ARE STABLE.

6. CHECK FOR EXCESSIVE EROSION ON THE APPROACH ROADS.

7. CHECK THE CONDITIONS OF ANY FLOW DIVERSION CHANNELS/BANKS AND THE OPERATING CONDITIONS OF ASSOCIATED SEDIMENT TRAPS.

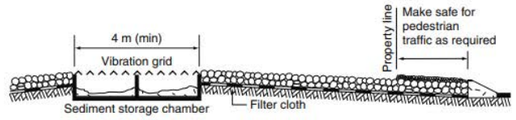
REMOVAL

1. TEMPORARY WATERCOURSE CROSSINGS SHOULD BE REMOVED AS SOON AS POSSIBLE AFTER ALTERNATIVE ACCESS IS ACHIEVED OR THE CULVERT IS NO LONGER NEEDED.

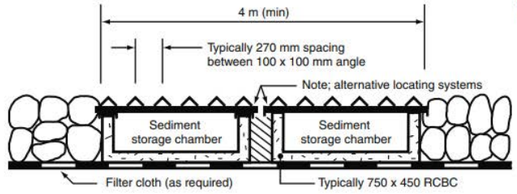
2. REMOVE ALL SPECIFIED MATERIALS AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. RESTORE THE WATERCOURSE CHANNEL TO ITS ORIGINAL CROSS-SECTION, AND SMOOTH AND APPROPRIATELY STABILISE AND REVEGETATE ALL DISTURBED AREAS.

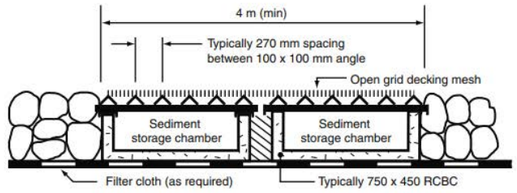
Drawn:	Date:		
GMW	Dec-09	Temporary Culvert Crossing	TCC-02



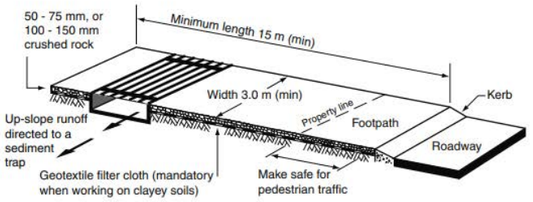
(a) Typical profile of a vibration grid



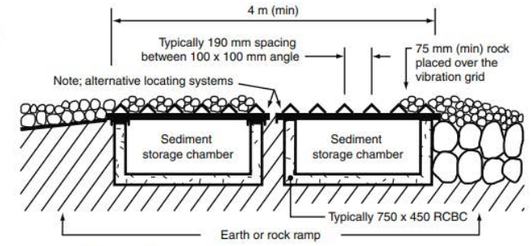
(b) Typical profile of the vibration panels



(c) Alternative, high travel speed arrangement (concept still under development)



(d) Typical layout of a vibration grid



(e) Alternative, medium travel speed arrangement (concept still under development)

Drawn:	Date:		
GMW	Dec-09	Construction Exit - Vibration Grid	Exit-04

MATERIALS

ROCK: WELL GRADED, HARD, ANGULAR, EROSION RESISTANT ROCK, NOMINAL DIAMETER OF 50 TO 75mm (SMALL DISTURBANCES) OR 100 TO 150mm (LARGE DISTURBANCES). ALL REASONABLE MEASURES MUST BE TAKEN TO OBTAIN ROCK OF NEAR UNIFORM SIZE.

FOOTPATH STABILISING AGGREGATE: 25 TO 50mm GRAVEL OR AGGREGATE.

GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE-PUNCHED, NON-WOVEN FILTER CLOTH ('BIDIM' A24 OR EQUIVALENT).

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND DIMENSIONAL DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, DIMENSIONS, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE LOCATION OF THE VIBRATION GRID, REMOVING STUMPS, ROOTS AND OTHER VEGETATION TO PROVIDE A FIRM FOUNDATION SO THAT THE ROCK IS NOT PRESSED INTO SOFT GROUND. CLEAR SUFFICIENT WIDTH TO ALLOW PASSAGE OF LARGE VEHICLES, BUT CLEAR ONLY THAT NECESSARY FOR THE EXIT. DO NOT CLEAR ADJACENT AREAS UNTIL THE REQUIRED EROSION AND SEDIMENT CONTROL DEVICES ARE IN PLACE.

3. GRADE THE LOCATION OF THE VIBRATION GRID SO THAT RUNOFF FROM THE UNIT WILL NOT FLOW INTO THE STREET, BUT WILL FLOW TOWARDS AN APPROPRIATE SEDIMENT-TRAPPING DEVICE.

4. ENSURE THAT THE INSTALLATION OF THE VIBRATION GRID HAS ADEQUATE SEDIMENT STORAGE VOLUME UNDER THE GRID. WHERE NECESSARY, INSTALL SUITABLE PRECAST SEDIMENT COLLECTION CHAMBERS.

5. PLACE A ROCK PAD/RAMP FORMING A MINIMUM 200mm THICK LAYER OF CLEAN, OPEN-VOID ROCK OVER THE ROADWAY BETWEEN THE VIBRATION GRID AND THE SEALED STREET TO PREVENT TYRES FROM PICKING UP MORE SOIL AFTER THEY HAVE BEEN CLEANED.

6. THE TOTAL LENGTH OF THE VIBRATION GRID AND ROCK RAMPS SHOULD BE AT LEAST 15m WHERE PRACTICABLE, AND AS WIDE AS THE FULL WIDTH OF THE ENTRY OR EXIT AND AT LEAST 3m. THE ROCK RAMP SHOULD COMMENCE AT THE EDGE OF THE OFF-SITE SEALED ROAD OR PAVEMENT.

7. FLARE THE END OF THE ROCK PAD WHERE IT MEETS THE PAVEMENT SO THAT THE WHEELS OF TURNING VEHICLES DO NOT TRAVEL OVER UNPROTECTED SOIL.

8. IF THE FOOTPATH IS OPEN TO PEDESTRIAN MOVEMENT, THEN COVER THE COARSE ROCK WITH FINE AGGREGATE OR GRAVEL, OR OTHERWISE TAKE WHATEVER MEASURES ARE NEEDED TO MAKE THE AREA SAFE

MAINTENANCE

1. INSPECT VIBRATION GRID PRIOR TO FORECAST RAIN, DAILY DURING EXTENDED PERIODS OF RAINFALL, AFTER SIGNIFICANT RUNOFF-PRODUCING RAINFALL, OR OTHERWISE AT FORTNIGHTLY INTERVALS.

2. IF SAND, SOIL, SEDIMENT OR MUD IS TRACKED OR WASHED ONTO THE ADJACENT SEALED ROADWAY, THEN SUCH MATERIAL MUST BE PHYSICALLY REMOVED, FIRST USING A SQUARE-EDGED SHOVEL, AND THEN A STIFF-BRISTLED BROOM, AND THEN BY A MECHANICAL VACUUM UNIT, IF AVAILABLE.

3. IF NECESSARY FOR SAFETY REASONS, THE ROADWAY SHALL ONLY BE WASHED CLEAN AFTER ALL REASONABLE EFFORTS HAVE BEEN TAKEN TO SHOVEL AND SWEEP THE MATERIAL FROM THE ROADWAY.

4. WHEN THE VOIDS BETWEEN THE ROCK BECOMES FILLED WITH MATERIAL AND THE EFFECTIVENESS OF THE ROCK RAMPS ARE REDUCED TO A POINT WHERE SEDIMENT IS BEING TRACKED OFF THE SITE, A NEW 100mm LAYER OF ROCK MUST BE ADDED AND/OR THE ROCK PAD MUST BE EXTENDED.

5. ENSURE ANY ASSOCIATED DRAINAGE CONTROL MEASURES ARE MAINTAINED IN ACCORDANCE WITH THEIR DESIRED OPERATIONAL CONDITION.

6. DISPOSE OF SEDIMENT AND DEBRIS IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. THE VIBRATION GRID SHOULD BE REMOVED ONLY AFTER IT IS NO LONGER NEEDED AS A SEDIMENT CONTROL DEVICE.

2. REMOVE MATERIALS AND COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. RE-GRADE AND STABILISE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.

Drawn:	Date:		
GMW	Apr-10	Construction Exit - Vibration Grid	Exit-05

Revision	Date	Drawn	Description
0	12/09/2022	TE	Draft

Tim Elder #4399

PREPARED BY:

PREPARED FOR:

COFFS HARBOUR BYPASS

TYPICAL ESC DESIGNS

NOT TO SCALE	DOC:	REVISION: 0

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE LOCATION FOR THE BANK, CLEARING ONLY THE AREA THAT IS NEEDED TO PROVIDE ACCESS FOR PERSONNEL AND EQUIPMENT.

3. REMOVE ROOTS, STUMPS, AND OTHER DEBRIS AND DISPOSE OF THEM PROPERLY. DO NOT USE DEBRIS TO BUILD THE BANK.

4. FORM THE BANK FROM THE MATERIAL, AND TO THE DIMENSION SPECIFIED IN THE APPROVED PLANS.

5. IF EARTH IS USED, THEN ENSURE THE SIDES OF THE BANK ARE NO STEEPER THAN A 2:1 (H:V) SLOPE, AND THE COMPLETED BANK MUST BE AT LEAST 500mm HIGH.

6. IF FORMED FROM SANDBAGS, THEN ENSURE THE BAGS ARE TIGHTLY PACKED SUCH THAT WATER LEAKAGE THROUGH THE BAGS IS MINIMISED.

7. CHECK THE BANK ALIGNMENT TO ENSURE POSITIVE DRAINAGE IN THE DESIRED DIRECTION.

8. THE BANK SHOULD BE VEGETATED (TURFED, SEEDED AND MULCHED), OR OTHERWISE STABILISED IMMEDIATELY, UNLESS IT WILL OPERATE FOR LESS THAN 30 DAYS OR IF SIGNIFICANT RAINFALL IS NOT EXPECTED DURING THE LIFE OF THE BANK.

9. ENSURE THE EMBANKMENT DRAINS TO A STABLE OUTLET, AND DOES NOT DISCHARGE TO AN UNSTABLE FILL SLOPE.

MAINTENANCE

1. INSPECT FLOW DIVERSION BANKS AT LEAST WEEKLY AND AFTER RUNOFF-PRODUCING RAINFALL.

2. INSPECT THE BANK FOR ANY SLUMPS, WHEEL TRACK DAMAGE OR LOSS OF FREEBOARD. MAKE REPAIRS AS NECESSARY.

3. CHECK THAT FILL MATERIAL OR SEDIMENT HAS NOT PARTIALLY BLOCKED THE DRAINAGE PATH UP-SLOPE OF THE EMBANKMENT. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.

4. DISPOSE OF ANY COLLECTED SEDIMENT OR FILL IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

5. REPAIR ANY PLACES IN THE BANK THAT ARE WEAKENED OR IN RISK OF FAILURE.

REMOVAL

1. WHEN THE SOIL DISTURBANCE ABOVE THE BANK IS FINISHED AND THE AREA IS STABILISED, THE FLOW DIVERSION BANK SHOULD BE REMOVED, UNLESS IT IS TO REMAIN AS A PERMANENT DRAINAGE FEATURE.

2. DISPOSE OF ANY SEDIMENT OR EARTH IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

3. GRADE THE AREA AND SMOOTH IT OUT IN PREPARATION FOR STABILISATION.

4. STABILISE THE AREA BY GRASSING OR AS SPECIFIED IN THE APPROVED PLAN.

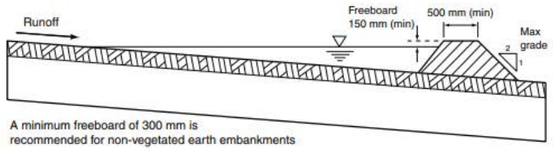


Figure 1 - Typical profile of flow diversion bank formed from earth

Table 1 - Recommended dimensions of flow diversion banks

Parameter	Earth banks	Vegetated banks	Compost berms	Sandbag berms
Height (min)	500 mm	500 mm	300 mm	N/A
Top width (min)	500 mm	500 mm	100 mm	N/A
Base width (min)	2500 mm	2500 mm	600 mm	N/A
Side slope (max)	2:1 (H:V)	2:1 (H:V)	1:1 (H:V)	N/A
Freeboard	300 mm	150 mm	100 mm	50 mm

Drawn:	Date:		
GMW	Dec-09	Flow Diversion Banks	DB-01

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MATERIALS

(i) MULCH MUST COMPLY WITH THE REQUIREMENTS OF AS4454.

(ii) MAXIMUM SOLUBLE SALT CONCENTRATION OF 5dS/m.

(iii) MOISTURE CONTENT OF 30 TO 50% PRIOR TO APPLICATION.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND EXTENT. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, MATERIAL TYPE, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. WHEN SELECTING THE LOCATION OF A MULCH FILTER BERM, TO THE MAXIMUM DEGREE PRACTICAL, ENSURE THE BERM IS LOCATED:

(i) TOTALLY WITHIN THE PROPERTY BOUNDARIES;

(ii) ALONG A LINE OF CONSTANT ELEVATION (PREFERRED, BUT NOT ALWAYS PRACTICAL);

(iii) AT LEAST 1m, IDEALLY 3m, FROM THE TOE OF A FILL EMBANKMENT;

(iv) AWAY FROM AREAS OF CONCENTRATED FLOW.

3. ENSURE THE BERM IS INSTALLED IN A MANNER THAT AVOIDS THE CONCENTRATION OF FLOW ALONG THE BERM, OR THE UNDESIRABLE DISCHARGE OF WATER AROUND THE END OF THE BERM.

4. ENSURE THE BERM HAS BEEN PLACED SUCH THAT PONDING UP-SLOPE OF THE BERM IS MAXIMISED.

5. ENSURE BOTH ENDS OF THE BERM ARE ADEQUATELY TURNED UP THE SLOPE TO PREVENT FLOW BYPASSING PRIOR TO WATER PASSING OVER THE BERM.

6. ENSURE 100% CONTACT WITH THE SOIL SURFACE.

7. WHERE SPECIFIED, TAKE APPROPRIATE STEPS TO VEGETATE THE BERM.

MAINTENANCE

1. DURING THE CONSTRUCTION PERIOD, INSPECT ALL BERMS AT LEAST WEEKLY AND AFTER ANY SIGNIFICANT RAIN. MAKE NECESSARY REPAIRS IMMEDIATELY.

2. REPAIR OR REPLACE ANY DAMAGED SECTIONS.

3. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SYSTEM TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED OR SPECIFIED.

4. REMOVE ACCUMULATED SEDIMENT IF THE SEDIMENT DEPOSIT EXCEEDS A DEPTH OF 100mm OR 1/3 THE HEIGHT OF THE BERM.

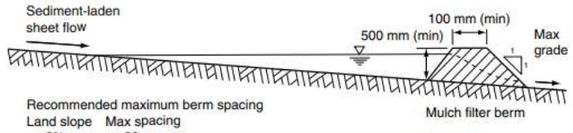
5. DISPOSE OF SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

REMOVAL (IF REQUIRED)

1. WHEN DISTURBED AREAS UP-SLOPE OF THE BERM ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE BERM MAYBE REMOVED.

2. REMOVE ANY COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. REHABILITATE/REVEGETATE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.



Recommended maximum berm spacing

Land slope	Max spacing
< 2%	30 m
5%	25 m
10%	15 m
20%	8 m

Figure 1 - Typical placement of mulch filter berm

Drawn:	Date:		
GMW	Apr-10	Mulch Filter Berms	MB-01

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Revision	Date	Drawn	Description
0	12/09/2022	TE	Draft

CERTIFIED PROFESSIONAL IN EROSION AND SEDIMENT CONTROL — CPESC®

Tim Elder #4399

PREPARED BY:

PREPARED FOR:

COFFS HARBOUR BYPASS
TYPICAL ESC DESIGNS

NOT TO SCALE	DOC:	REVISION: 0

TYPICAL ESC DESIGNS (Appendix B, IECA 2008)

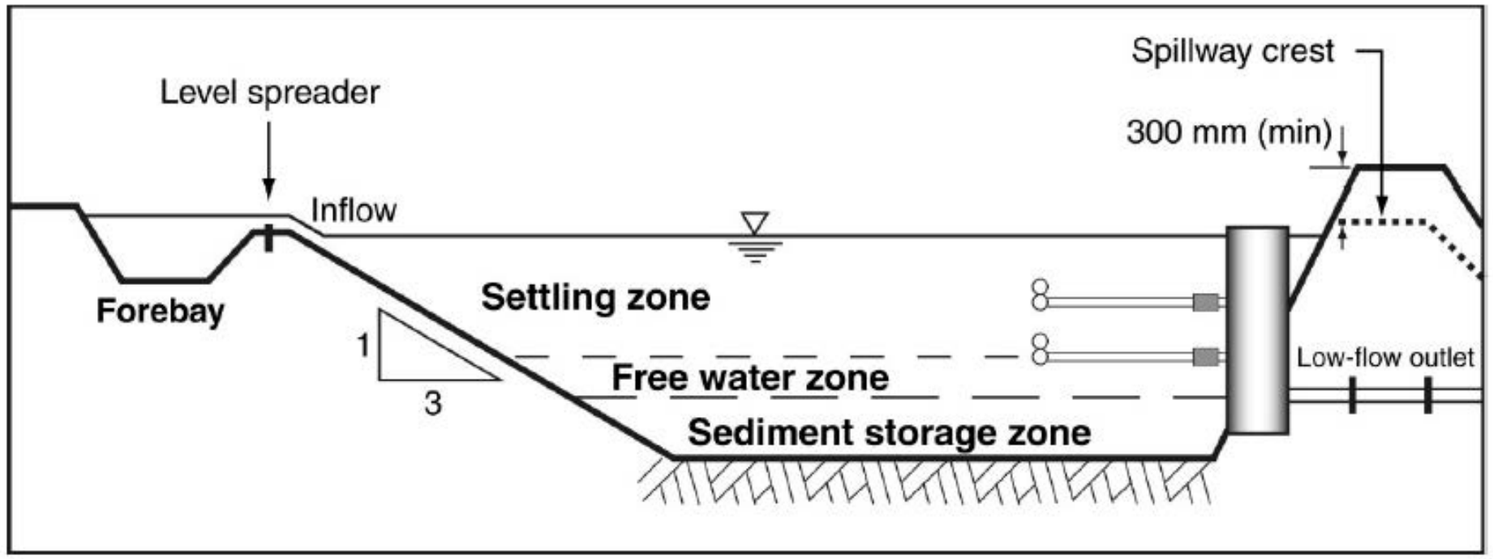

Figure B5 – Long-section of a typical Type A basin

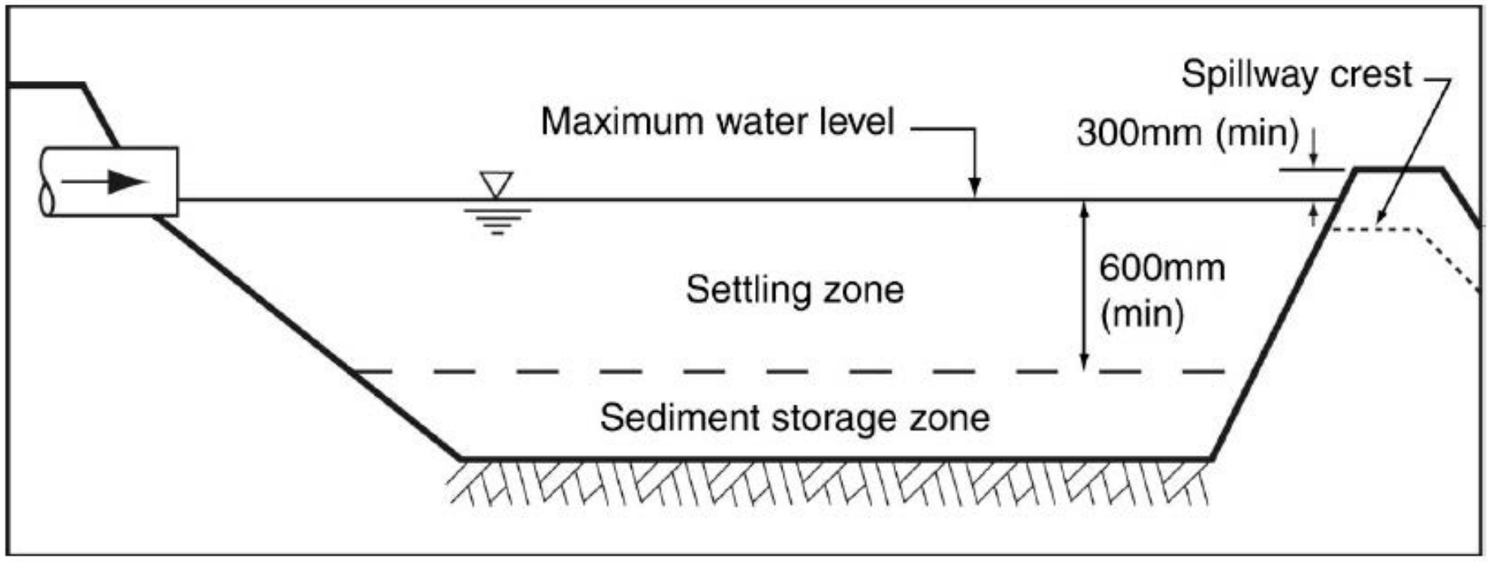

Figure B10 – Settling zone and sediment storage zone within a Type D basin

Revision	Date	Drawn	Description
0	12/09/2022	TE	Draft

Tim Elder #4399

PREPARED BY:

PREPARED FOR:

COFFS HARBOUR BYPASS
TYPICAL ESC DESIGNS

NOT TO SCALE	DOC:	REVISION: 0

APPENDIX B ACID SULFATE SOILS MANAGEMENT PLAN

Acid Sulfate Soils Management Plan

Revision C - Coffs Harbour Bypass

FERROVIAL GAMUDA JOINT VENTURE

DOCUMENT DETAILS

Document Title	Acid Sulfate Soils Management Plan
Project Name	Coffs Harbour Bypass
Client	Transport for New South Wales
Application No.	SSI-7666
Principal Contractor	Ferrovial Gamuda Joint Venture

DOCUMENT AUTHORISATION

	Name	Position	Signature	Date
Prepared by	Tim Elder	Environment Lead & CPESC		
Reviewed by	Erran Woodward	FGJV Approvals Lead		
Approved by	Hari Corliss	FGJV Environment & Sustainability Manager		
Approved by	Daniel Perez	FGJV Project Director		
Approved by	Scott Lawrence	TfNSW Representative		
Endorsed by	Duncan Thomas	Environmental Representative		

VERSION CONTROL

Revision	Date	Description	Approval
A	15/11/2022	Draft for ER Review	
B	06/12/2022	Updated to address ER review comments	
C	18/01/2023	Updated for ER Endorsement	

DISTRIBUTION OF CONTROLLED COPIES

This Acid Sulfate Soils Management Plan (ASSMP) is available to all personnel and sub-contractors via the project document control management system. An electronic copy can be found on the project website.

The document is uncontrolled when printed. One controlled hard copy of the ASSMP and supporting documentation will be maintained by the Quality Manager at the project office and on the project website.

Copy No.	Issued to	Version
1		
2		
3		
4		
5		

CONTENTS

TABLES

1 PURPOSE AND OBJECTIVES

1.1 PURPOSE

The Acid Sulfate Soil Management Plan (ASSMP) describes the acid sulphate management approach that will be utilised by FGJV during construction of the Project. The ASSMP has been prepared to reduce the potential for risk of environmental damage caused by acidic leachate from actual acid sulfate soil (ASS), potential acid sulfate soil (PASS), Monosulfidic Black Ooze (MBO) and acid sulfate rock (ASR) disturbance, if encountered.

1.2 SCOPE

The ASSMP outlines the mitigation and management to be used to address potential acid sulphate impacts during the construction of the Project, while complying with relevant approvals, statutory and contract requirements.

1.3 OBJECTIVES

A key objective of this ASSMP is to provide a framework outlining appropriate environmental controls and procedures to be implemented during construction activities to avoid or reduce potential adverse environmental impacts associated with ASS, PASS and ASR disturbance, handling, treatment or disposal.

2 BACKGROUND

2.1 TYPES OF ACID SULFATE SOIL

2.1.1 POTENTIAL ACID SULFATE SOILS (PASS)

PASS contain iron sulfides or sulfidic material which has not been exposed to air and oxidised. These soils are located in an oxygen deficient environment, typically below the water table. The field pH of these soils is typically 4 or higher, sometimes ranging into the alkaline. The sulfides/sufidic materials oxidise once exposed to air with the potential to generate sulfuric acid, and hence pose risks to the surrounding environment through acid run-off.

2.1.2 ACTUAL ACID SULFATE SOILS (ASS)

ASS are soils that contain highly acidic layers, this high acidity is a result of the oxidation of soil materials that are rich in iron sulfides. ASS soils can have field pH measurements of 4 or less in dry conditions and are typically characterised as possessing pale yellow mottling. This mottling is caused by the presence of the mineral Jarosite, a product of the oxidation of iron sulfides which generally requires a pH <3.7 to form. ASS may also contain dissolved metals such as aluminium, which can be toxic to aquatic animals and plants.

Where ASS is stockpiled there is potential that rain events could result in impact to surface waters if runoff is not managed.

2.2 MONOSULFIDIC BLACK OOZE

Monosulfides and Monosulfidic Black Ooze (MBO) are characterised by their black and often oily appearance, and when disturbed the release of hydrogen sulfide (rotten egg gas). They generally accumulate in low energy ASS environments such as waterways and lagoons and form thick ‘blankets’ of organic rich, gel like materials. When disturbed in significant quantities they can cause acidification of waterways and deoxygenation of waters. Where drains and wetlands are constructed MBO can continue to accumulate where favourable conditions exist, and present an ongoing management issue.

2.3 ACID SULFATE ROCK

Acid Sulfate Rock (ASR) includes geological rock units that contain sulfide and sulfate minerals (pyrite). All rock has the potential to contain varying quantities of sulfide / sulfate minerals. Elevated concentrations are generally associated with metalliferous ore deposits and coal units but can also occur in other forms such as uplifted marine sedimentary rocks and wind driven sediments containing pyrite.

Pyrite can either be present as a fine (microscopic/framboidal) or primary mineral (macroscopic). The particle size range will determine the rate and severity of reaction, with finer particles offering a higher proportional surface area to mass ratio and hence quicker oxidisation rate (Bannerman, 2005). ASR much like ASS, is generally not a hazard when left in anaerobic conditions (below water table or deep within fine grained units with low oxygen diffusion rates). When fresh pyrite containing rock is disturbed during road construction such as in deep cuttings, oxidisation can occur through exposure to air and water.

The oxidisation and weathering process can lead to the generation of acidity, which in turn increases the solubility of sulfates. The leaching of sulfates and increase in acidity can degrade construction materials such as steel and concrete and potentially pollute water resources (surface and groundwater).

Where rock units contain naturally elevated heavy metals concentrations, additional acidity may leach the currently bound metals into solution.

3 ENVIRONMENTAL REQUIREMENTS

3.1 LEGISLATION AND STANDARDS

The ASSMP has been developed consistent with the following legislation, regulations, guidelines and policy:

- Guidelines for the Management of Acid Sulfate Materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulphidic Black Ooze (Roads and Maritime, 2005);
- Acid Sulfate Soils Assessment Guidelines (Acid Sulfate Soil Management Advisory Committee, 1998);
- Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998);
- Acid Sulfate Soil and Rock Publication 655.1 (Environment Protection Authority Victoria (EPA Victoria), July 2009);
- Waste Classification Guidelines Part 4: Acid Sulfate Soils (EPA. 2014);
- Sulfate Specification for Structural Backfills (Reid, J M, Czerewko, M A & Cripps, J C, 2001);
- National Acid Sulfate Soils Guidance - National Acid Sulfate Soils Sampling and Identification Methods Manual (Department of Agriculture Water and the Environment 2022); and
- National Acid Sulfate Soils Guidance - National Acid Sulfate Soils Identification and Laboratory Methods Manual (Department of Agriculture Water and the Environment 2022).

3.2 APPROVALS

This ASSMP has been developed to satisfy the requirements of the approval conditions outlined within Table 3-1.

TABLE 3-1: CONDITIONS OF APPROVAL / MITIGATION MEASURES

Reference	Condition requirements
SC09 (REMM)	An Acid Sulfate Soils Management Plan will be prepared and implemented as part of the Soil and Water Management Plan. This plan will be prepared in accordance with the Guidelines for the management of Acid Sulfate Materials (RTA 2005)
GW01 (REMM)	Stockpiles containing PASS or ASS treatment areas will be lined and bunded in accordance with the Guidelines for the Management of Acid Sulfate Materials (RTA 2005) to prevent leachate contaminating groundwater.
SC01 (REMM)	Phase 2 contamination investigations will be undertaken in areas of potential contamination identified during the preliminary site investigation (RCA 2016). The investigation will be carried out in accordance with the Guideline for the management of Contamination (Roads and Maritime Services 2013d). This will include soil sampling from targeted areas including: • Areas of PASS within construction footprint to determine oxidised pH level

4 EXISTING ENVIRONMENT

Acid sulfate materials, including Acid Sulfate Soils (ASS) and Acid Sulfate Rock (ASR), are discussed in the following Project documents:

- Chapter 18 of the Project EIS
- Detailed Site (Contamination) Assessment Coffs Harbour Bypass (RCA 2021)
- CHB Contamination Assessment Contamination Report (GHD 2022)

Relevant information from these documents is reproduced below.

4.1 ACID SULFATE SOILS

4.1.1 ASSESSMENT FINDINGS

The ASS Risk Map (Naylor 1998) included within the Project EIS indicates the southern end of the project intersects areas with a low probability of ASS associated with Boambee Creek and Newports Creek and their tributaries. Areas of high ASS risk are located about 120 m east of the southern end of the project next to and within Boambee Creek. The northern end of the project intersects mapped high-risk acid sulfate risk near Pine Brush Creek. Locations are shown in Figure 4-1.

RCA Australia (RCA 2021) more recently undertook contamination assessments within the Project boundary, which included undertaking soil sampling of potential ASS areas including Newports Creek, Newports Creek South and Pine Brush Creek (RCA 2021). The RCA report identified acid sulfate soils at one site (APO18) around CH12550 (North Boambee). RCA findings are included within **Error! Reference source not found.**.

GHD (GHD 2022) considered the RCA assessment in further ASS assessments, including at creek crossing areas to 2 m deep at four locations. The GHD report concluded that soils tested at various locations along the alignment that were mapped as potential ASS are not considered to contain PASS and no further management relating to ASS is considered required in these areas.

TABLE 4-1. ASS SAMPLING AND ASSESSMENT UNDERTAKEN BY RCA (2021) AND GHD (2022)

Areas of Concern	ASS Mapping	RCA Comment
CH10500 - 10700 Stadium Drive (East of the round about)	Low probability of occurrence	If excavation works greater than 1 m below ground level are required in this area, ASS testing and management should be undertaken.
CH11100 to CH11400 APO15/16	Low probability of occurrence	If excavation works greater than 1 m below ground level are required in this area, ASS testing and management should be undertaken
CH11650 to CH12100 APO16/17	Low probability of occurrence	RCA (2021) completed two samples in this general area (including APO18 below).
CH12550 – CH12600 APO18	Not mapped	RCA (2021) completed two samples in this general area. Results showed ASS were present on APO18.
CH20300 – CH20350 (Existing Pacific Highway)	Not assessed	If excavation works greater than 1 m below ground level are required in this area, ASS testing and management should be undertaken
CH22300 to CH22800	High probability of occurrence	RCA (2021) completed one ASS sample in this location. While ASS were not identified, the sampling undertaken was considered limited and if excavation works are required in this area, ASS testing and management should be undertaken
CH22700 – CH22750 (east of alignment) APO104 Grass Mounds	High probability of occurrence	TfNSW identified three grass mounds (stockpiles) on APO104 that they requested ASS testing be undertaken on, down to natural ground level

4.1.2 CONCLUSIONS

The results indicate that soils tested at various locations along the alignment that were mapped as potential ASS were acidic, however the soils tested were not considered to contain PASS. The lack of PASS but presence of Acidic Soils means that the potential for environmental harm from acidic runoff or acidic changes to soils is greatly reduced but still present.

The soils tested at various locations along the alignment that were mapped as potential ASS are not considered to contain PASS and no further management relating to ASS is considered required in these areas.

Additional sampling in the APO18 area (CH12550) by GHD showed that soils were acidic but did not contain sulfur concentrations above the action criteria, indicating the soils analysed were not considered to be PASS. Based on acidic soils and previous results indicating PASS in this area, management of the soils is still considered necessary.

4.2 ACID SULFATE ROCK

A review of the preliminary Roads and Maritime ASR risk mapping indicates the construction footprint is located in areas of low and medium ASR risk. Medium risk areas are generally associated with the metasediment rock in the Coffs Harbour region; however, it should be noted the low risk designation does not necessarily rule out the presence of ASR requiring treatment in these areas. Unless proven otherwise, ASR should be treated as unknown (Bridgement 2017). Petrographic and acid base accounting laboratory testing was completed for selected rock samples collected along the project corridor to determine the presence of ASR. Test results indicate the rock samples have sufficient acid neutralising capacity to buffer acid produced by sulfides in the rock mass oxidising (RCA 2017a, 2017b and 2017c). Consequently, ASR is unlikely to be a risk to the project.

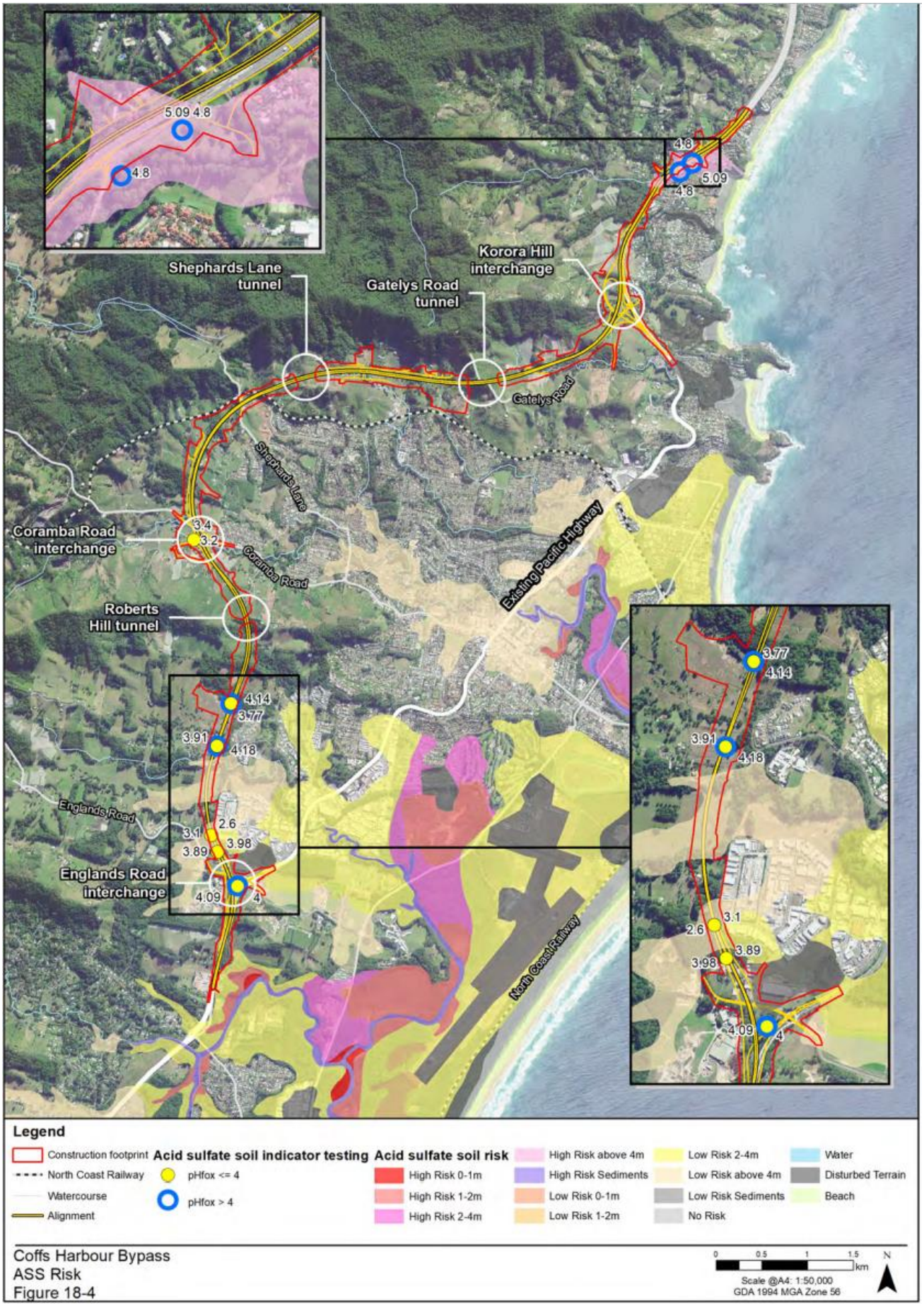

FIGURE 4-1. COFFS HARBOUR BYPASS ACID SULFATE SOILS RISK

5 ENVIRONMENTAL ASPECTS AND IMPACTS

5.1 CONSTRUCTION ACTIVITIES

The Project will involve a range of construction activities incorporating various heavy machinery, plant and equipment that will operate in several locations. An Environmental Work Method Statement (EWMS) will be prepared for each construction and work activity that potentially involves the disturbance of acid sulfate soils. Typically, this will include:

- Topsoil stripping
- Culvert and drainage
- Dewatering and clearing
- Earthworks
- Stockpiling
- Waterway crossings
- In-ground excavation.

5.2 ASPECTS

Construction activities can cause the exposure of ASR, ASS or oxidation of PASS material which in turn may result in environmental impacts. Some of the causes of exposure and/or oxidation are:

- Excavation and exposure of ASR, PASS and ASS material.
- Exposure of subsurface PASS material due to dewatering activities.
- Discharge of sub-surface water as a result of settlement and reduction in available pore space (during settlement water is ‘squeezed’ out of the soil material), producing acidic leachate where it flows through oxidised ASS.
- Embankment settlement can depress the underlying material with respect to the water table. In some circumstances heave at the toe of the embankment by displacement may raise PASS material above the water table.
- Oxidation of pyrite in site won (rock from cuttings) or imported fill material.

5.3 IMPACTS

The potential for impacts on acid sulphate will depend on several factors. Primarily impacts will be dependent on the nature, extent and magnitude of construction activities and their interaction with the natural environment. Should any of the above causes eventuate, the following impacts may result:

- Release of aluminium, nutrients and heavy metals (particularly arsenic) stored within the soil matrix
- Death or stunted growth of aquatic flora and fauna
- Deoxygenation of waterways leading to suffocation of fish and other aquatic animals
- Mass mortalities of microscopic organisms
- Increased light penetration due to water clarity
- Loss of habitat
- Persistent iron coatings
- Damage to infrastructure e.g. Corrosion of concrete, limestone.

6 ASS MANAGEMENT PROCEDURE

6.1 MANAGEMENT CONTROLS

The procedure for identification, assessment and management of potential impacts relating to acid sulfate soils is outlined in Table 6-1.

6.2 ON SITE IDENTIFICATION OF ASS

The following field procedures have been developed to determine whether the soils may contain acid generating potential to levels requiring treatment.

The following flow chart (Figure 6-1) should be used to assist in the initial identification process of soils which have not already been assessed as being ASS or PASS. Detailed ASS identification protocol and collection methodologies can be found in the following documents:

- National Acid Sulfate Soils Guidance - National acid sulfate soils identification and laboratory methods manual (June 2018)
- National Acid Sulfate Soils Guidance - National acid sulfate soils sampling and identification methods manual (June 2018)

Soil and water indicators for the presence or absence of ASS materials is included in Appendix A.

FIGURE 6-1. NEW FIND ASS IDENTIFICATION PROCESS

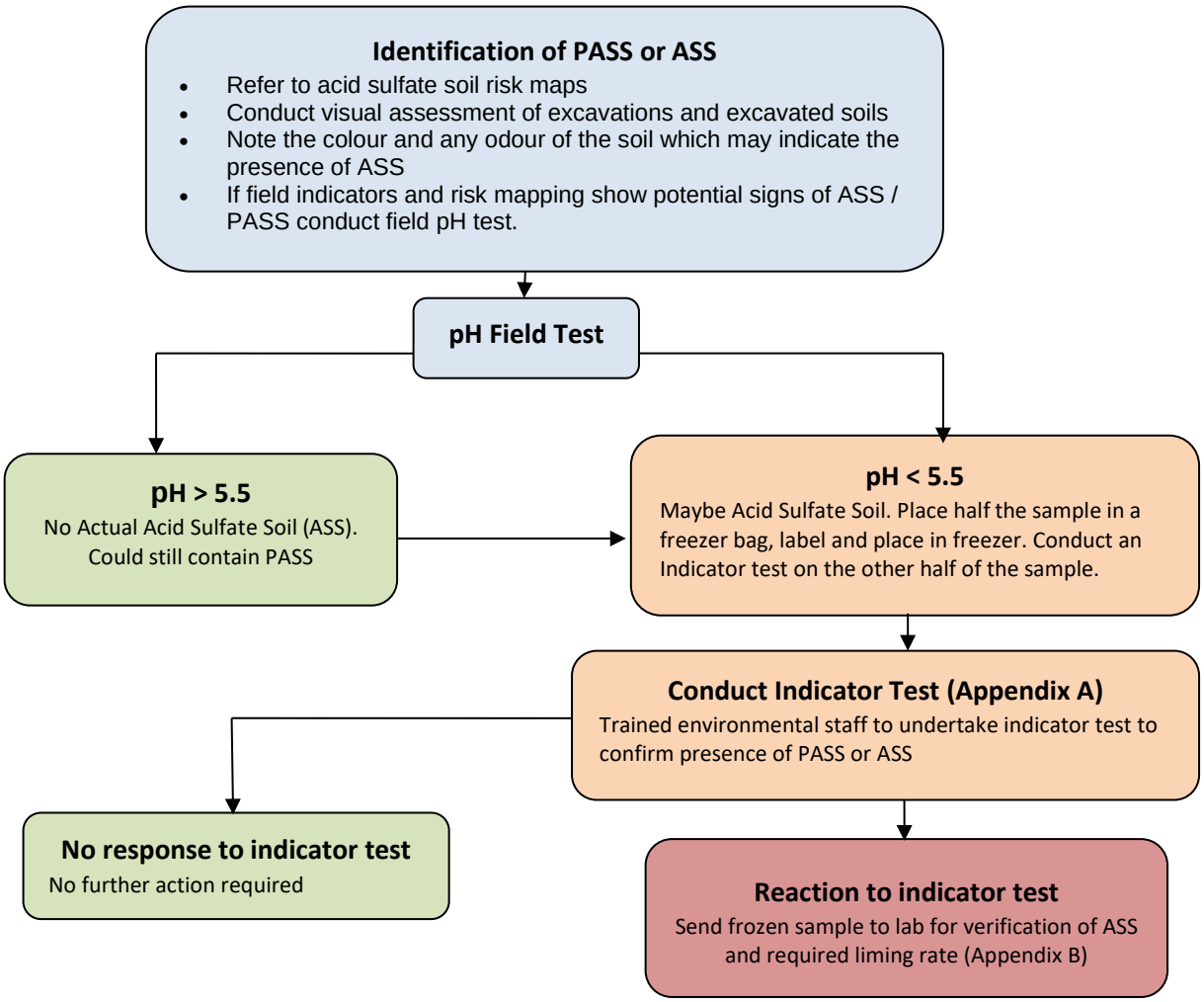

TABLE 6-1. ACID SULFATE SOIL MANAGEMENT

Reference	Task	When to implement	Responsibility	Reference
ASSMP01	**Environmental Work Method Statement (EWMS)** • Prior to working in an area of potential or actual acid sulfate soil an environmental work method statement (EWMS) will be prepared in accordance with the guidelines listed within Section 3.1. The EWMS will include maps where intrusive activities are taking place in suspected or confirmed acid sulfate material areas • The EWMS will refer to this plan for guidance on investigating, handling, treating and managing potential or actual acid sulfate soils. • The EWMS will provide a clear description of the supervision and monitoring requirements for all minor and major ground disturbance work in identified 'risk' areas or involving identified 'risk' activities	Pre-construction	Environment & Sustainability Manager Construction Manager	Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2005), Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998)
ASSMP02	**Pre-work sampling** • Prior to undertaking ground disturbance works (excavation) in areas of potential or actual acid sulfate soil as identified within Table 4-1, soils will be tested in accordance with National Acid Sulfate Soils Guidance - National acid sulfate soils identification and laboratory methods manual (June 2018) and the National Acid Sulfate Soils Guidance - National acid sulfate soils sampling and identification methods manual (June 2018) • The sampling results will be included in a report that: describes the sampling method and result; includes acid sulfate mapping; presents a risk assessment associated with each area; and provides a description of the treatment requirements to remove or reduce the risk associated with identified acid sulfate soils.	Pre-construction Construction	Environment & Sustainability Manager	Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2005) National Acid Sulfate Soils Guidance - National acid sulfate soils identification and laboratory methods manual (June 2018) and the National Acid Sulfate Soils Guidance - National acid sulfate soils sampling and identification methods manual (June 2018)
ASSMP03	**Immediate reuse** • In the case of immediate reuse on site (e.g. trenching and backfilling within a day), there is a reduced likelihood that PASS will be exposed long enough to oxidise and become ASS. • Immediate reuse (same day) may be appropriate if PASS are of low to moderate strength. It is recommended that lime application occur prior to backfilling as a precautionary measure. • backfill soil in the reverse order of excavation (i.e. last out first in). decision for immediate reuse can **ONLY** be made by the Environment & Sustainability Manager.	Construction	Environment & Sustainability Manager Construction Manager	Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2011)

ASSMP04	**Treatment onsite**
	• Establish ASS Treatment Area (ASSTA) prior to works that are likely to encounter ASS or PASS.
	• ASSTA is to be located in accordance with the Stockpile Management Protocol. Generally, the treatment area will be:
	  ○ As close as possible to the source of the material
	  ○ Located at a suitable elevation to be unlikely impacted by flooding
		Pre-construction
		Construction
			Environment & Sustainability Manager
			Construction Manager
				Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2011)

Reference	Task	When to implement	Responsibility	Reference
	○ Away from identified sensitive receivers • Where possible, prior to soil disturbance, add required amounts of lime over the area to be disturbed to ensure mixing occurs as early as possible ○ Note - **Error! Reference source not found.** provides further guidance on the amount of lime required ○ Note - Any laboratory analysis undertaken as per Appendix B will provide specific liming rates. • Transfer soil to treatment area.Soil shall be laid in 150mm to 300mm layers on a treatment pad (and lime added in accordance with the calculated liming rates if not already added during excavation). See Appendix D for typical treatment pad design. • If sufficient mixing did not occur during excavation and initial in situ lime addition, the soil shall be turned over/ mixed in a manner such that lime will be distributed throughout the soil matrix. • The material is then left on the treatment pad for approximately 4-5 days to allow neutralisation to occur (or less if neutralisation can be achieved sooner), turning the soils when the surface dries out, and so increasing the rate of oxidation. Effective drying and mixing of lime with clay is often very difficult. The drying rate is dependent on the temperature and in cooler climates the methods may be too slow to be practicable. • Water contained within the collection sumps will need to be sampled to assess requirements for treatment prior to discharge (Appendix C). • This material shall remain bunded until validation results are available and return concentrations less than the respective criteria (detailed in Appendix B). Should the stockpile validation results exceed the criteria, additional lime will be added as required and further validation samples collected.			
ASSMP05	**Reuse of ASS onsite** • Once stockpile validation results confirm the criteria described above has been complied with, reuse of the material on site is permitted. • If material cannot be reused onsite and off-site disposal is required, procedures outlined within the document Waste Classification Guidelines, Part 4: Acid Sulfate Soils (EPA 2014) shall be implemented, as detailed below	Construction	Environment & Sustainability Manager Construction Manager	Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2011)

Reference	Task	When to implement	Responsibility	Reference

ASSMP06	**Disposal of potential ASS offsite**
	• Keep PASS wet at all times during excavation and subsequent handling, transport and storage until they can be disposed of safely.
	• Material must be received at the disposal point within 16 hours of being dug up.
	• PASS may be disposed of in water below the permanent water table, provided:
	  ○ this occurs before they have had a chance to oxidise, i.e. within 24 hours of excavation
	  ○ they meet the definition of 'virgin excavated natural material' (VENM) under the Protection of the Environment Operations Act 1997, even though they contain sulfidic ores or soils.
	• Documentation shall be provided to the occupier of the landfill for each truckload of material received, indicating that the soil's excavation, transport and handling have been in accordance with the Acid Sulfate Soil Manual, thus preventing the generation of acid.
	• Soil that has dried out, undergone any oxidation of its sulfidic minerals, or which has a pH of less than 5.5 must be treated by neutralisation (as per below ASS disposal requirements) and disposed of at a landfill that can lawfully accept it.
	• The disposal site's licence will outline what documentation needs to be kept and for how long.
	• For any transport of PASS:
	  ○ Lime the bottom of the truck;
	  ○ Load PASS and coat top layer with lime; and
	  ○ Cover spoil load.
		Construction	Environment & Sustainability Manager
			Construction Manager
				Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2011)

ASSMP07	**Disposal of actual ASS** • ASS must be treated by the generator of the waste before it can be disposed offsite. Treatment should be in accordance with the neutralising techniques outlined above. • Following neutralisation, the generator of the waste must chemically assess the soil in accordance with Step 5 of the *Waste Classification Guidelines: Part 1 – Classifying waste* (DECCW 2008) (available at www.environment.nsw.gov.au/waste/envguidlns). • A review of the analytical results will be undertaken on a range of parameters (not AASS or PASS) that may impact on the waste classification for offsite disposal. • Once classified, the waste must be taken to a landfill licensed to accept that class of waste. • The landfill should be informed that the ASS has been treated in accordance with the neutralising techniques outlined in the NSW Acid Sulfate Soil Manual and that the waste has also been classified in accordance with Waste Classification Guidelines: Part 1 – Classifying waste (DECCW 2008). A copy of the analytical results will be required by the Landfill prior to disposal.	Construction	Environment & Sustainability Manager Construction Manager	Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2011)

Reference	Task	When to implement	Responsibility	Reference
ASSMP08	**Supervision** • The EWMS will provide a clear description of the supervisionrequirements for all minor and major ground disturbance work in identified 'risk' areas or involving identified 'risk' activities	Pre-construction Construction	Environment & Sustainability Manager	Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2011)

ASSMP09	**Monitoring**
	• With regard to potential ASS impacts to surface and groundwater, a Surface Water Quality Monitoring Program and Groundwater Quality Monitoring Program have been prepared and will be implemented by TfNSW.
	• Where surface water and/or leachate collects within bunded treatment areas or excavations in ASS or PASS areas, the water shall be tested as detailed in Appendix C of this plan.
	• Regular visual monitoring of PASS/ASS areas and surrounds shall be undertaken to identify signs of ASS oxidation. This monitoring should include detecting:
	  • Unexplained scalding, degradation or death of surrounding vegetation.
	  • Unexplained death or disease in aquatic organisms.
	  • Formation of the mineral jarosite and other acidic salts in exposed or excavated soils.
	  • Areas of green-blue water or extremely clear water indicating high concentrations of aluminium.
	  • Rust coloured deposits on plants and on the banks of drains, water bodies and watercourses indicating iron precipitates.
	  • Black to very dark coloured waters indicating de-oxygenation.
	  • Area of black ooze (potentially indicating monosulfidic black oozes) typically in drains and low lying areas.
		Construction	Environment & Sustainability Manager	Guidelines for the Management of Acid Sulfate Soils (Roads and Maritime, 2011)

L	**Low treatment level**: <0.1 t lime
M	**Medium treatment level:** >0.1 to 1 t lime
H	**High treatment level**: >1 to 5 t lime
VH	**Very High treatment:** >5 tonne lime

The tonnes (t) of pure fine lime required to fully treat the total weight/volume of acid sulfate soil can be read from the table at the intersection of the weight of disturbed soil (row) with the soil sulfur analysis (column). Where the exact weight or soil analysis figure does not appear in the heading of the row or column, use the next highest value (or calculate values exactly). Lime rates are for pure fine $CaCO_3$ using a safety factor of 1.5. A factor that accounts for Effective Neutralising Value is needed for commercial grade lime. An approximate volume (cubic m) can be obtained by dividing weight (tonne) by bulk density (t/m^3).

Disturbed soil	**Soil Analysis - Oxidisable Sulfur (S %)** or equivalent TPA/TAA													
(tonnes)	***0.03***	***0.06***	***0.1***	***0.2***	***0.4***	***0.6***	***0.8***	***1***	***1.5***	***2***	***2.5***	***3***	***4***	***5***
1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.2	0.2
5	0.05	0.05	0.05	0.05	0.1	0.1	0.2	0.2	0.4	0.5	0.6	0.7	0.9	1.2
10	0.05	0.05	0.05	0.1	0.2	0.3	0.4	0.5	0.7	0.9	1.2	1.4	1.9	2.3
15	0.05	0.05	0.1	0.1	0.3	0.4	0.6	0.7	1.1	1.4	1.8	2.1	2.8	3.5
20	0.05	0.1	0.1	0.2	0.4	0.6	0.7	0.9	1.4	1.9	2.3	2.8	3.7	4.7
25	0.05	0.1	0.1	0.2	0.5	0.7	0.9	1.2	1.8	2.3	2.9	3.5	4.7	5.9
35	0.05	0.1	0.2	0.3	0.7	1.0	1.3	1.6	2.5	3.3	4.1	4.9	6.6	8.2
50	0.1	0.1	0.2	0.5	0.9	1.4	1.9	2.3	3.5	4.7	5.9	7.0	9.4	11.7
75	0.1	0.2	0.4	0.7	1.4	2.1	2.8	3.5	5.3	7.0	8.8	10.5	14.0	17.6
100	0.1	0.3	0.5	0.9	1.9	2.8	3.7	4.7	7.0	9.4	11.7	14.0	18.7	23.4
200	0.3	0.6	0.9	1.9	3.7	5.6	7.5	9.4	14.0	18.7	23.4	28.1	37.5	46.8
500	0.7	1.4	2.3	4.7	9.4	14.0	18.7	23.4	35.1	46.8	58.5	70.2	93.6	117.1
750	1.1	2.1	3.5	7.0	14.0	21.1	28.1	35.1	52.7	70.2	87.8	105.3	140.5	175.6
1,000	1.4	2.8	4.7	9.4	18.7	28.1	37.5	46.8	70.2	93.6	117.1	140.5	187.3	234.1
2,000	2.8	5.6	9.4	18.7	37.5	56.2	74.9	93.6	140.5	187.3	234.1	280.9	374.6	468.2
5,000	7.0	14.0	23.4	46.8	93.6	140.5	187.3	234.1	351.2	468.2	585.3	702.3	936.4	1170.5
10,000	14.0	28.1	46.8	93.6	187.3	280.9	374.6	468.2	702.3	936.4	1170.5	1404.6	1872.8	2341.0

FIGURE 8-1. ASS NEUTRALISATION RATES

6.3 RESOURCES

For management or neutralisation of MBO, ASS and PASS soils, medium-fine Aglime will be used. Liquid lime may also be used to treat collected acid run-off and ASS throughout the project due to the extremely fine particle size (5 micron).

MBO will be managed in accordance with the ASS management checklist. If required, specialist advice will be sought from the project Soil Conservationist and external laboratory.

The Aglime purity should preferably be 90% or better, (that is, Neutralising Value [NV] > 90), unless there is a significant savings to be made by use of less pure Aglime. In the latter case, however, the individual lime dosing rates will need to be increased accordingly. The requirement for greater amounts of Aglime of lower purity should be borne in mind when assessing the supplies of this material, as the cost savings from less pure material may be offset by the need for more, and correspondingly higher total transport costs.

An Aglime store will be established at the compound or treatment site/s. Aglime is non-corrosive and requires no special handling – it will be necessary to cover the stockpile with a tarpaulin or cover the stockpile with plastic, to minimise dust generation and prevent wetting, since it is then more difficult to spread.

Lime storage shall be managed such that any runoff generated is captured, and treated to correct pH if necessary, to prevent alkaline runoff to waterways.

Availability of liquid lime and Aglime from local suppliers will be confirmed prior to ASS disturbance and lead time for deliveries established.

ASS MANAGEMENT WILL BE RECORDED ON AN ASS CHECKLIST WHICH IS PROVIDED BELOW AS FIGURE 8-2. ASS CHECKLIST: EXCAVATION OF ASS MATERIAL MIXING WITH NEUTRALISIUNG AGENT

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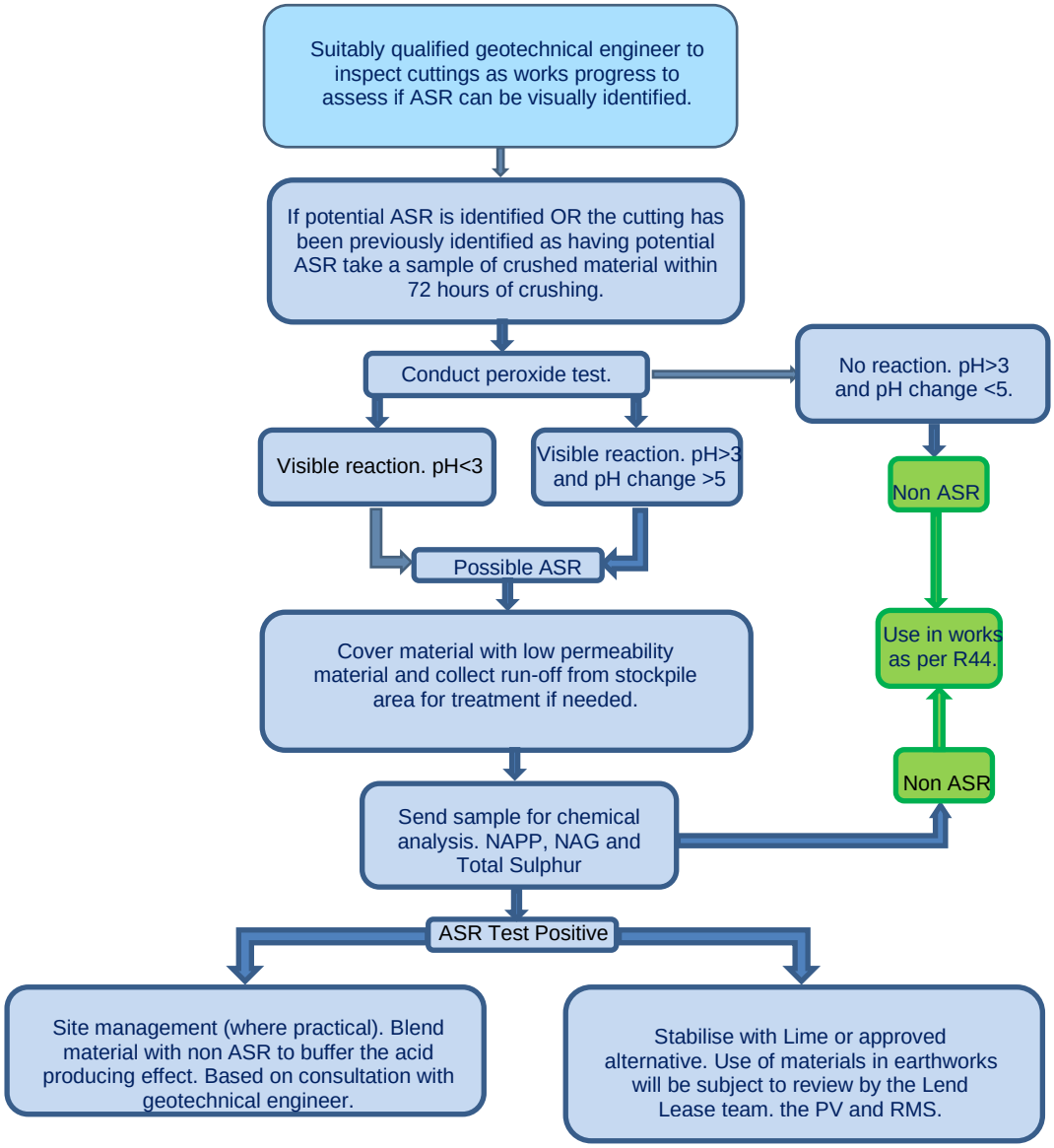
Coffs Harbour Bypass – ASS Management Checklist					
Inspection Date:		**Project Area:**			
Approximate Chainage:					
Construction Stage/Activity:					
#	**Control Measure**	**Yes**	**No**	**N/A**	**Comments / Corrective Action**
	Have adequate stockpile and treatment areas been constructed to contain excavated materials?				
	Have neutralisation rates been calculated based on the 'Net Acidity' of the materials being disturbed?				Liming Rate =
	Is there sufficient neutralising agent stored on site to apply to materials?				
	Is there sufficient neutralising agent ready to be applied to any 'open excavation' faces that require treatment?				
	Will there be any immediate water treatment required and is there sufficient containment and neutralising agents on site?				
	Will the mixing process be adequate to neutralise all acidity present? Does a higher safety factor need to be introduced?				
	Was the mixing process and containment adequate?				
	How many verification samples are required?				
	Have verification samples been sent to a laboratory for the correct testing suite?				
	Have verification samples passed?				
	Have materials been reused and where?				
	Has the original disturbance site and containment area been inspected for any acidity issues?				
Additional Comments:					
Completed By:		**Role:**			
Signature:		**Company:**			

FIGURE 8-2. ASS CHECKLIST: EXCAVATION OF ASS MATERIAL MIXING WITH NEUTRALISIUNG AGENT

7 ACID SULFATE ROCK MANAGEMENT

The risk of acid rock material impacting the local environment is assessed to be low. A strategy for the management of ASR has been developed and is described in the flow chart below:



When there is seepage from ASR rocks in a cut or from a stockpile, the water will be collected in a sedimentation pond or designated sump and where required, treated to neutralise the pH of the water prior to release. (See Appendix C for water treatment requirements).

ASR rocks will not be used for drainage blankets or in waterways.

8 CONTINGENCY PLANNING

8.1 UNEXPECTED FINDS

If ASS or PASS is suspected in unexpected areas, appropriate actions must be taken to ensure potential environmental damage is minimised. This shall include:

- Works potentially affecting the material are to cease and environmental staff notified immediately.
- If field test results indicate that PASS / ASS may be present then collect a sample for submission to a NATA accredited Laboratory for confirmation of PASS / ASS and to calculate the applicable liming rate.
- If PASS is believed or shown to occur in the vicinity of the work area, investigate an alternate construction method that avoids the need to disturb PASS.
- If avoidance is not possible, manage in accordance with Section 7.4

Note: *Until ASS is confirmed do not stockpile with confirmed ASS. Stockpile on impervious pad area separately.*

8.2 STORMWATER AND SEDIMENT RETENTION FEATURES OF TREATMENT PADS

If monitoring indicates that the storm water retention features around the treatment or stockpile areas are being breached or have the potential to be breached, a re-assessment of the construction and dimensions of the features will be made that includes:

- The height of the bunds
- The area and depths of the ponds
- The grade and drainage characteristics of the area surrounding the treatment areas

Based on this review, the appropriate changes to the design of the site stormwater retention features should be implemented.

8.3 TREATMENT OF EXCAVATED ASS

If treatment of excavated ASS regularly fails to meet the verification target, then a review of the treatment approach should be conducted. This may include a re-assessment of:

- The concentration of the total potential acidity in the soils
- The type and source of neutralising agent used
- The method of mixing the neutralising agent into the ASS.

The aspect considered to be causing the poor treatment results would then be amended accordingly. Treated soils should not be reused on or off site until the verification targets have been achieved.

8.4 DEWATERING

Where dewatering is found to be exposing PASS to an extent greater than necessary or desired and potentially having an adverse effect on groundwater quality, a review of the necessity and approach to dewatering activities should be undertaken. This may include:

- Use of a greater number of well points with lower extraction rates to minimise drawdown
- Use of hydraulic barriers
- Re-design of the structure to minimise or remove the need for dewatering

8.5 SURCHARGING

If surcharging is causing adverse effects on water quality, then excavation, treatment and reinstatement of the relevant material may be necessary as a last resort. Alternatively, a shallow groundwater treatment trench (containing neutralising agent) could be installed between the surcharge area and the down gradient receptors to prevent groundwater impacts.

9 REVIEW

This ASSMP will be reviewed annually and updated on an as-needed basis, including in the following circumstances:

- confirmed uncontrolled disturbance of acid sulfate soils
- confirmed release or generation of sulphuric acid or a resultant impact
- a change in legislation or permitting
- a major change in construction method.

APPENDIX A ACID SULFATE SOILS AND ROCK FIELD IDENTIFICATION PROTOCOL

Field pH of water	Water analysis SO_4^{2-}:Cl^- (by mass)	Field soil or water indicators	Typical soil reaction to 30% H_2O_2	Preliminary assessment
6–8	Approx. 0.14 but may be in the range 0.1–0.2	Nil	Nil reaction and no drop in pH	No PASS material present. Must be verified by laboratory chemical analysis
		PASS indicators present	Mild to strong effervescence and drop in pH	PASS present but has probably not been oxidised at any time. Must be verified by laboratory chemical analysis
< 5	Approx. 0.14 but may be in the range 0.1–0.2	Nil	Nil reaction and no drop in pH	No PASS present and low pH can be attributed to causes other than RIS oxidation. Must be verified by laboratory chemical analysis
		PASS indicators present	Mild effervescence and drop in pH	PASS present but probably has not been oxidised at any time. Existing low pH can be attributed to other causes. Must be verified by laboratory chemical analysis
6–8	0.2–0.5	Unclear indicators	Mild effervescence and drop in pH	Presence of PASS is uncertain. Must be verified by laboratory chemical analysis
	> 0.5	Indicators of AASS or PASS present	Mild to strong effervescence and drop in pH	Presence of PASS plus the presence of substantial Acid Neutralising Capacity. Must be verified by laboratory chemical analysis
< 5	0.2–0.5	Unclear indicators	Mild effervescence and drop in pH	Presence of PASS is uncertain. Must be verified by laboratory chemical analysis
< 5	> 0.5	Indicators of AASS or PASS	Mild to strong effervescence and drop in pH	Presence of PASS with little or no Acid Neutralising Capacity. Must be verified by laboratory chemical analysis

Table 5.3 Soil and water indicators for the presence or absence of ASS materials.

Field pH of water	Water analysis SO_4^{2-}:Cl^- (by mass)	Field soil or water indicators	Typical soil reaction to 30% H_2O_2	Preliminary assessment
6–8	Approx. 0.14 but may be in the range 0.1–0.2	Nil	Nil reaction and no drop in pH	No PASS material present. Must be verified by laboratory chemical analysis
		PASS indicators present	Mild to strong effervescence and drop in pH	PASS present but has probably not been oxidised at any time. Must be verified by laboratory chemical analysis
< 5	Approx. 0.14 but may be in the range 0.1–0.2	Nil	Nil reaction and no drop in pH	No PASS present and low pH can be attributed to causes other than RIS oxidation. Must be verified by laboratory chemical analysis
		PASS indicators present	Mild effervescence and drop in pH	PASS present but probably has not been oxidised at any time. Existing low pH can be attributed to other causes. Must be verified by laboratory chemical analysis
6–8	0.2–0.5	Unclear indicators	Mild effervescence and drop in pH	Presence of PASS is uncertain. Must be verified by laboratory chemical analysis
	> 0.5	Indicators of AASS or PASS present	Mild to strong effervescence and drop in pH	Presence of PASS plus the presence of substantial Acid Neutralising Capacity. Must be verified by laboratory chemical analysis
< 5	0.2–0.5	Unclear indicators	Mild effervescence and drop in pH	Presence of PASS is uncertain. Must be verified by laboratory chemical analysis
< 5	> 0.5	Indicators of AASS or PASS	Mild to strong effervescence and drop in pH	Presence of PASS with little or no Acid Neutralising Capacity. Must be verified by laboratory chemical analysis

Source: Modified from Ahern et al. (1998b).

(Source: National Acid Sulfate Soils Guidance: National acid sulfate soils sampling and identification methods manual)

APPENDIX B ASS SAMPLING AND CRITERIA

Table 6.1 Minimum soil sampling densities for ASS investigations.

Type of disturbance	Extent of site	Sample point frequency
Small volumes (≤ 1000 m^3) – prior to disturbance	Volume of disturbance (m^3)	Number of boreholes
	< 250	2
	251–500	3
	501–1000	4
Large volumes (> 1000 m^3) – prior to disturbance	Project area (ha)	Number of boreholes
	< 1	4
	1-2	6
	2-3	8
	3-4	10
	> 4	10 plus 2 per additional hectare
Linear	Width and volume	Intervals (m)
	Minor[1]	100
	Major[2]	50
Existing stockpiles & verification testing	Volume (m^3)	Number of samples
	< 250	2
	251-500	3
	1000	4
	> 1000	4 plus 1 per additional 500 m^3

[1] Minor Linear Disturbance – for example underground services, narrow shallow drains (less than 1 m below ground level).
[2] Major Linear Disturbance – for example roads, railways, canals, deep sewer, wide drains, deep drains and dredging projects[#].
[#] Further guidance is provided in the Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management (Simpson et al. 2017).
Source: EPA (2009) and DER (2015a).

(Source: National Acid Sulfate Soils Guidance: National acid sulfate soils sampling and identification methods manual)

APPENDIX C WATER SAMPLING AND TREATMENT

C1. Initial water sampling

Water collected in the sump of the treatment pad or excavation will initially be tested using a water quality monitoring probe to test pH and turbidity.

If this initial testing (prior to any neutralisation) shows pH of 6.5 to 8.5 and other parameters within EPL criteria, then no further testing is required and discharge may occur if required with approval from environmental personnel.

C2. Water treatment

If the water in the sumps has not been pre-treated (i.e. addition of a neutralising agent) and the pH is within the range of 6.5 – 8.5, the water is considered suitable for both discharge and reuse on site (provided other water quality parameters in the EPL are complied with).

If discharge is proposed and initial water sampling indicates pH below that allowed to discharge, neutralisation will occur in accordance with Figure C1.

If initial water sampling indicates pH above that allowed to discharge, then neutralisation will occur through pool acid or other suitable methods.

Water which has had a pre-treatment should also be tested for those parameters detailed in Appendix C3, and those parameters must be below relevant EPL or ANZECC guidelines prior to discharge or reuse on site.

C3. Neutralised water sampling

If the water in the sump of the treatment pad has been neutralised from a low pH (i.e. to treat acidity caused by ASS), then prior to discharge of the treatment pad sump water, samples will be collected and analysed to ensure EPL and ANZECC water quality guidelines are complied with and shall include the following suite of parameters:

- Total Suspended Solids (TSS).
- pH.
- Conductivity.
- Dissolved Iron.

Water samples to be sent for laboratory testing are to be collected using laboratory supplied bottles and immediately placed in an esky with ice. Water samples are to be collected in the morning so that they can be dispatched to the laboratory to arrive on the day of sampling. Water samples are to be collected by suitable trained and experience personnel.

Quantity of pure neutralising agent required to raise from existing pH to pH 7 for 1 megalitre of low salinity acid water.

Current Water pH	*$[H^+]$ {mol/L}*	*H^+ in 1 Megalitre {mol}*	*Lime to neutralise 1 Megalitre {kg pure $CaCO_3$}*	*Hydr. lime to neutralise 1 Megalitre {kg pure $Ca(OH)_2$}*	*Pure $NaHCO_3$/ 1 Megalitre {kg }*
0.5	.316	316,228	15,824	11,716	26,563
1.0	.1	100,000	5,004	3705	8390
1.5	.032	32,000	1,600	1185	2686
2.0	.01	10,000	500	370	839
2.5	.0032	3,200	160	118	269
3.0	.001	1,000	50	37	84
3.5	.00032	320	16	12	27
4.0	.0001	100	5	4	8.4
4.5	.000032	32	1.6	1.18	2.69
5.0	.00001	10	0.5	0.37	0.84
5.5	.0000032	3.2	0.16	0.12	0.27
6.0	.000001	1	0.05	0.037	0.08
6.5	.00000032	.32	0.016	0.12	0.027

Notes: 1 m3 = 1,000 litre = 1 Kilolitre = 0.001 Megalitre

- *Agricultural lime has very low solubility and may take considerable time to even partially react.*
- *Hydrated lime is more soluble than aglime and hence more suited to water treatment. However, as $Ca(OH)_2$ has a high water pH, incremental addition and thorough mixing is needed to prevent overshooting the desired pH. The water pH should be checked regularly after thorough mixing and time for equilibration before further addition of neutralising product.*
- *Weights of lime or hydrated lime are based on theoretical pure material and hence use of such amounts of commercial product will generally result in under treatment.*
- *To more accurately calculate the amount of commercial product required, the weight of lime from the table should be multiplied by a purity factor (100/ Neutralising Value for aglime) or (148/ Neutralising Value for hydrated lime).*
- Calculations are based on low salinity water acidified by hydrogen ion, H+ (acid) and do not take into account the considerable buffering capacity or acid producing reactions of some acid salts and soluble species of aluminium and iron. For example, as the pH increases towards 4, the precipitation of soluble ferric ion occurs, liberating more acid:

  $$Fe3+ + 3H_2O \square Fe(OH)_3 + 3H+$$

- If neutralising substantial quantities of acid sulfate soil leachate, full laboratory analysis of the water will be necessary to adequately estimate the amount of neutralising material required.

Figure C1 – Acidic water neutralisation guide

APPENDIX D TREATMENT PAD CONSTRUCTION

D1. Design

Treatment pad locations will be located in accordance with SWMP Appendix I: Stockpile management protocol . Treatment pads will be constructed as follows:

- The base of the pad is to be graded such that all surface water flows to one or multiple collection sumps. The treatment pad can be divided into cells (this may be required to minimise construction works to achieve adequate grade for water management (likely storm water and seepage water management from the material undergoing treatment);
- Appropriate sedimentation controls are to be constructed around each collection sump (if more than one).
- The base of the treatment pad will be constructed with a low permeable base.
- Crushed limestone will be placed over the low permeable material.
- A bund wall is to be constructed surrounding the treatment pad such the storm water flow outside the treatment pad is restricted from flowing into the treatment pad and storm water within the treatment pad is restricted from flowing beyond the collection sump/s.
- An example treatment pad design is provided below.

D2. Treatment pad dimensions

For each treatment pad, the estimated *in-situ* volume of ASS material will need to be calculated, the program of excavation/treatment determined; and the treatment pad designed to accommodate this volume/rate of material.

Following excavation of the ASS some bulking will occur. From this volume (including a bulking factor), and the rate expected to be excavated, the dimensions of the treatment pad can be calculated.

The treatment area dimensions are also dependent on the thickness of the treatment layer and whether multiple layers will be placed atop one another. Due to space constraints in the Project, it is likely that multiple layers will be used.

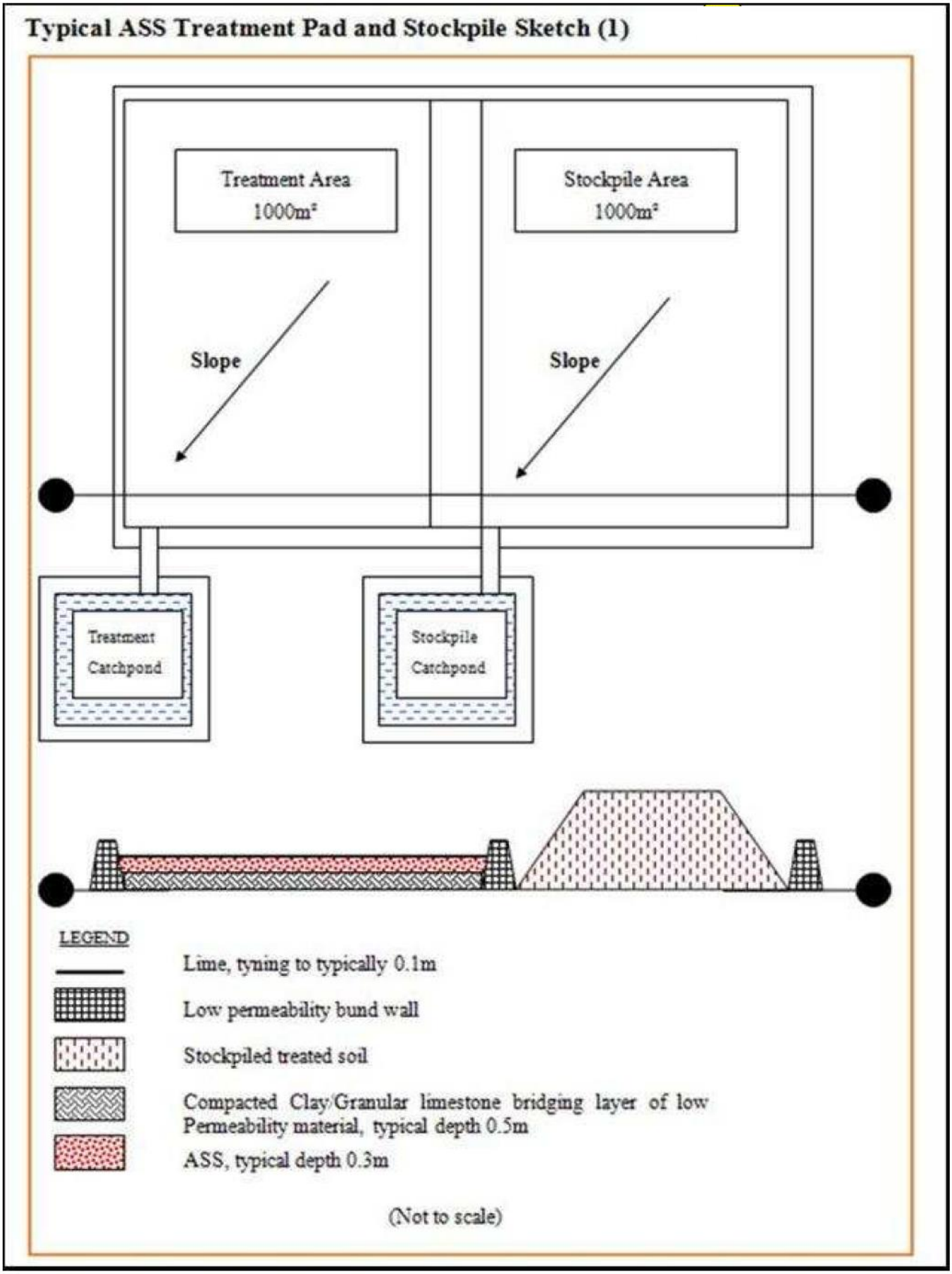


Figure D1 – Example treatment Pad Design

APPENDIX C UNEXPECTED CONTAMINATED LAND AND ASBESTOS FINDS PROCEDURE

COFFS HARBOUR BYPASS

Unexpected Contaminated Land and Asbestos Finds Procedure

April 2023

COFFS HARBOUR BYPASS
FERROVIAL GAMUDA JOINT VENTURE

CONTENTS

TABLES

GLOSSARY/ABBREVIATIONS

Abbreviation	Expanded Text
ACM	Asbestos Containing Material
ASS	Acid Sulfate Soil
CEMP	Construction Environmental Management Plan
CHB	Coffs Harbour Bypass
DPE	Department of Planning and Environment
EPA	Environmental Protection Authority
EWMS	Environmental Work Method Statement
PASS	Potential Acid Sulfate Soil
RAP	Remediation Action Plan
SWMS	Safe Work Method Statements
TfNSW	Transport for New South Wales
UCLAF	Unexpected Contaminated Lands and Asbestos Finds

1 INTRODUCTION

1.1 BACKGROUND

This Unexpected Contaminated Land and Asbestos Finds Procedure (UCLAFP) (the Procedure) provides management measures for unexpected potential contaminated land and asbestos finds during construction of the Coffs Harbour Bypass (CHB) Project (the Project).

This Procedure contains two sections which address:

- The unexpected discovery of contaminated land, and
- The management of asbestos (including unexpected asbestos finds).

This Procedure addresses the requirements of the Project Minister's Conditions of Approval (MCoA) as identified in Table 1.

TABLE 1 RELEVANT CONDITIONS OF APPROVAL

CoA No.	Condition Requirements	MCOA Addressed
E78	Prior to the commencement of construction that would result in the disturbance of potential or contaminated land and/or soil, a **Site Contamination Report** must be prepared and submitted to the Planning Secretary for Information. The report must be consistent with *Contaminated Land Management Act 1997* (NSW) and prepared by a suitably qualified and experienced person. Nothing in this condition prevents the Proponent from preparing individual Site Contamination Reports for separate sites. Under this condition Panama Disease is not considered to be a contaminant.	Site Contamination Report approved by DPE on 02/11/2022
E79	The Site Contamination Report must provide details on: a) the outcomes of Stage 1 and Stage 2 contamination assessments; b) nature and extent of any existing remediation (such as impervious surface cappings); c) measures to identify handle and manage potential contaminated soils, materials and groundwater; d) whether the land is suitable (for the intended final land use) or can be made suitable through remediation; and/or e) potential contamination risks from the CSSI to human health and receiving waterways.	Site Contamination Report approved by DPE on 02/11/2022
E80	Should remediation be required to make land suitable for the final intended land use, a Remediation Action Plan must be prepared and implemented and submitted to the Planning Secretary for information prior to undertaking remediation. The plan must detail how the environmental and human health risks will be managed during the disturbance, remediation and/or removal of contaminated soil or groundwater.	Remediation Action Plan(s)
E81	If remediation is required, a Section A Site Audit Statement and Site Audit Report, must be prepared by a Site Auditor accredited by the EPA under the Contaminated Land Management Act 1997 (NSW). Nothing in this condition prevents the Proponent from engaging the Site Auditor to prepare Site Audit Statements for individual work sites.	Site Audit Report(s)
E82	A Section A Site Audit Statement and its accompanying Section A Site Audit Report, which state that the contaminated land disturbed by the work has been made suitable for the intended	Site Audit Statement(s)

	land use, must be submitted to the Planning Secretary and Council after remediation and no later than prior to the commencement of operation of the CSSI. Contaminated land must not be used for the purpose approved under the terms of this approval until a Section A Site Audit Statement is obtained which states that the land is suitable for that purpose and any conditions on the Section A Site Audit Statement have been complied with.	
E83	An Unexpected Contaminated Land and Asbestos Finds Procedure must be prepared and submitted to the Planning Secretary before the commencement of work and must be followed should unexpected, contaminated land or asbestos (or suspected contaminated land or asbestos) be excavated or otherwise discovered. The requirements of Conditions E79 to E82 must be incorporated into this Procedure.	This procedure
E84	The Unexpected Contaminated Land and Asbestos Finds Procedure must be implemented throughout work.	This procedure

This document will form part of the Construction Soil and Water Management Plan and should be read in conjunction with that document.

1.2 PURPOSE

This Procedure details the actions to be taken when potential contaminated soil/material (which is taken, for the purpose of this document, to include asbestos containing material (ACM) or actual asbestos) is encountered; in the event that hazardous materials are discovered, this Procedure should be implemented.

This Procedure has been developed in accordance with best practice EPA contamination management guidelines and Transport for New South Wales (TfNSW) specifications.

1.3 SCOPE

This Procedure is applicable to all activities conducted by site personnel (including sub-contractors) for the Project. This Procedure is not applicable to the identification of soils suspected of being contaminated with plant pathogens.

2 UNEXPECTED DISCOVERY OF CONTAMINATED LAND OR ASBESTOS

The steps to be followed in the event that contaminated material is encountered during construction are outlined below. Indicators of contamination in soils include:

- Discolouration of the soil, including staining and horizontal layers of discolouration
- Odours
- Oily sheen on water leaving soils
- Asbestos containing material (e.g. sheeting, pipes and tiles).

Step 1 Potential contaminated soil/material encountered

- Cease work in the immediate affected area
- Immediately notify Foreman, Site Supervisor, and/or Environment Manager (or delegate)
- Install environmental controls around the area to contain the contaminated material, including diversion of upstream water to minimise interaction with the contamination, and capturing water coming from/off the contaminated area.
- Notify TfNSW Environmental Manager of the potential contamination find within 1 day of the find, preferably immediately.
- Environmental Manager will determine if there is a risk of environmental harm from the potential contamination, and if so will notify the EPA accordingly in accordance with the TfNSW Environmental Incident and Notification Procedure.

Step 2 Environmental and Work Health and Safety Management

Prior to any contamination investigations, management or remediation activities, appropriate Safe Work Method Statements (SWMS) and Environmental Work Method Statements (EWMS) will be prepared for review and approval by the Environment Manager.

All works should be done in accordance with the Project Safety Management Plan and associated asbestos specific management plans.

Personal Protective Equipment will be worn as per the relevant Material Safety Data Sheets, and may include:

- Goggles
- Face mask
- Rubber boots
- Rubber gloves
- PPE required for Asbestos Containing Materials

Step 3 Undertaken a contamination investigation

The Environment Manager (or delegate) will assess the situation and if considered necessary commission a suitably qualified contamination specialist to undertake a contamination investigation of the find.

If necessary, the Environment Manager will liaise with the TfNSW Environment Manager and relevant authorities to determine appropriate management options. The Environment Manager, in consultation with specialists, will determine the appropriate management measures to be implemented. This may include leaving contamination undisturbed, capping the contamination, treatment or off-site disposal.

Material to be disposed will be classified in accordance with the *Waste Classification Guidelines* (EPA, 2014) and will be disposed in accordance with the Waste and Resource Management Plan.

If material is determined to be Potential Acid Sulfate Soil (PASS) or actual Acid Sulfate Soil (ASS) the Project Acid Sulfate Soil Management Plan will be implemented.

Notify TfNSW Environmental Manager of confirmed contamination in accordance with the TfNSW Environmental Incident and Notification Procedure.

Step 4 Remedial action

Remedial actions will be incorporated into specific Remediation Actions Plans (RAPs), where required. RAPs will be prepared by a suitably qualified and experienced person and in accordance with all guidelines under the *Contaminated Lands Management Act* (NSW).

RAPs will be prepared by a Contaminated Land Specialist and the Environment Manager and will be submitted to DPE for information prior to the commencement of remediation, in accordance with CoA E80.

Following remediation, a Section A Site Audit Statement and its accompanying Section A Site Audit Report, which state the area has been made suitable for the intended land use must be submitted to DPE and Council prior to the commencement of operation, in accordance with CoA E82.

Relevant EWMS and SWMS will be updated when required.

Step 5 Recommence Work

Once remedial works have been implemented and validated that the remediation strategy has been successful, the Environment Manager will grant approval to recommence work.

3 ASBESTOS MANAGEMENT

Asbestos/ACM fragments that are remnants from previous activities may be scattered throughout the project area, or present in stockpiled material. Asbestos contamination may be encountered when undertaking excavation for road works and/or property adjustments, disturbance of ground and/or pits associated with utilities, during demolition works or removal of structures.

This document has been developed in accordance with relevant legislation, EPA endorsed guidelines (including the waste guideline), industry codes of practice, Roads and Maritime draft *Asbestos management procedure* (Coffey, 2018) and TfNSW specifications.

3.1 ASBESTOS MANAGEMENT PRINCIPLES

3.1.1 RISK CONTROL

ACM encountered during Project works will be identified, managed, encapsulated on site, or removed and disposed of at an appropriately licensed facility. Only appropriately licensed, accredited and insured asbestos removalists will be used to for asbestos management works.

All asbestos management works will be undertaken in accordance with the Project Safety Management Plan and any specific asbestos removal documentation prepared (i.e. Asbestos Removal Control Plan), including the implementation of signage, control of airborne asbestos and monitoring.

3.1.2 MANAGEMENT OF ACM

Factors that influence how ACM in soil is managed include:

- The form of the ACM and the likelihood that it will release fibres into the air
- The location, lateral extent and depth of ACM impacts
- The current and future land use and whether these uses could affect the risk posed by ACM

The Environment Manager will seek guidance from a specialist Contaminated Lands Consultant and/or Occupational Hygeinist to assess these factors.

3.1.3 SOURCE REMOVAL AND OFFSITE DISPOSAL

Table 2 outlines the techniques which may be used to remove ACM in soil.

TABLE 2 ACM REMOVAL TECHNIQUES, APPLICATIONS AND LIMITATIONS

Removal Technique	Applicability and Limitations
Hand Picking	• Suitable for bonded ACM in near surface soils only (i.e., <10 cm); • Raking may enhance removal, although only in sandy soils; • Not applicable for friable asbestos: and • Less effective in areas of dense vegetation.
Tilling	• Mechanical tilling to turn over soil followed by hand picking; • Suitable for bonded ACM in soils to approx. 30 cm in sandy soils; • Not applicable for friable asbestos; and

	• Less effective in areas of dense vegetation, or clayey soils.
Mechanical Screening	• Suitable for large volumes of soil impacted by Bonded ACM; • Susceptible to generate fibres requiring effective dust/fibre control; and • Not applicable for friable asbestos.
Mechanical Excavation	• Physical excavation of soil containing ACM where impact extends beneath surface soils; and • Generates larger volumes of soil that requires further management (i.e., off-site disposal, screening, and hand picking/tilling).

A licensed asbestos removalist will be required for removal works where there is friable asbestos or the contaminated area is great than 10m2. There are two types of asbestos removal licesnses: Class A and Class B. The type of license required depends on the type and quantity of asbestos or ACM to be removed, as outlined in Table 3.

TABLE 3 ASBESTOS REMOVAL LICENSE CLASSES

Licence Type	What Asbestos Can Be Removed
Class A	Can remove any amount or quantity of asbestos or ACM, including; • Any amount of friable asbestos or ACM; • Any amount of asbestos-contaminated dust or debris (ACD); and/or Any amount of non-friable asbestos or ACM.
Class B	Can remove: • Any amount of non-friable asbestos or ACM. Note: A Class B licence for removal of more than 10 m² of non-friable asbestos or ACM but the licence holder can also remove up to 10 m² of non-friable asbestos or ACM. • ACD associated with the removal of non-friable asbestos or ACM. Note: A Class B licence is required for of ACD associated with the removal of more than 10 m² of non-friable asbestos or ACM but the licence holder can also remove ACD associated with the removal of up to 10 m² of non-friable asbestos or ACM.
No License Required	Can remove: • Up to 10 m² of non-friable asbestos or ACM; and • ACD that is; – Associated with the removal of less than 10 m² of non-friable asbestos or ACM; and/or Not associated with the removal of friable or non-friable asbestos and is only a minor contamination.

Removal works will be undertaken in accordance with an Asbestos Removal Control Plan, prepared by the licensed asbestos removalist. If the works is to be undertaken in the vicinity of occupied residence of businesses, notification will be undertaken as required.

The asbestos removal plan will include waste disposal methodology, including method of transport and location of disposal.

More detail on asbestos/ACM disposal can be found in the Project Waste Management Plan.

3.1.4 CLEARANCE

Following removal, the licensed asbestos removalist will arrange for a clearance inspection to facilitate the issue of a clearance certificate and allow construction to recommence in the area. The clearance inspection is conducted by:

- An independent licensed asbestos assessor, for work that was carried out by a Class A licensed asbestos removalist
- An independent competent person, for asbestos work that is not required to be carried out by a Class A licensed asbestos removalist.

A clearance certificate will be issued once the assessor or competent person is satisfied that the asbestos removal area and immediate area are free from visible asbestos contamination. Entry to the area will be permitted following confirmation of certification.

3.1.5 DECONTAMINATION

Decontamination of site personnel, PPE and tools used in asbestos removal work will minimise exposure and spread of asbestos outside the removal area.

Personal decontamination will occur every time a worker leaves the asbestos removal work area. Details of decontamination and disposal of contaminated material will be included in the asbestos removal control plan and requirements for decontamination and safe asbestos handling will be detailed in the Project Safety Management Plan.

4 RECORDS

The Project will maintain a register of any unexpected contamination finds.

An asbestos waste register will be maintained that documents all identified ACM in the Project area, as follows:

- Location, type and condition
- Date of find
- Date of confirmation of ACM
- Maps, photographs or diagrams detailing the location of the area
- Reference to clearance reports for each cleared area

Clearance certificates will be maintained for all asbestos/ACM contaminated areas, while other confirmation of contamination removal/management will be evidenced through Site Auditor Statements as described above.

5 CONTAMINATION MANAGEMENT

5.1 INDUCTION/TRAINING

Where required, all site personnel (including sub-contractors) are to be inducted on the identification of potential contaminated soil/material, along with the requirements of this Procedure during inductions or specific training or regular toolbox talks. More detail on the training of personnel can be found in the Project Construction Environmental Management Plan (CEMP).

Site personnel should be informed of the potential sources of contamination within the project boundary, and indications of contamination in soil and groundwater, such as:

- Odour
- Discolouration
- Evidence of landfilling/ discarded drums
- Visible evidence of asbestos

5.2 ROLES / RESPONSIBILITY

The Project Environment Manager will ensure this Procedure is effectively implemented and all site personnel are aware of the requirements of this Procedure.

The Site Supervisor will be responsible for ensuring that in the event of unexpected finds, site personnel are informed immediately and all work in the vicinity of the find ceases. The Site Supervisor will be informed of

ay required actions for the control of the discovery, such as implementation of exclusion barriers or signage, and will be responsible for ensuring the actions are undertaken.

The Environment Manager will liaise with the relevant authorities (such as EPA, DPE and a Contaminated Land Specialist) where required, and will approved the recommencement of work following any remediation undertaken.

6 REVIEW

Review of this document will be undertaken as part of the Construction Soil and Water Management Plan. Please refer to the CEMP for details about CEMP reviews.

COFFS HARBOUR BYPASS team

APPENDIX D CONSTRUCTION WATER REUSE STRATEGY

Construction Water Reuse Strategy

Revision A - Coffs Harbour Bypass

FERROVIAL GAMUDA JOINT VENTURE

DOCUMENT DETAILS

Document Title	Primary Erosion and Sediment Control Plan
Project Name	Coffs Harbour Bypass
Client	Transport for New South Wales
Application No.	SSI-7666
Principal Contractor	Ferrovial Gamuda Joint Venture

DOCUMENT AUTHORISATION

	Name	Position	Signature	Date
Prepared by	Tim Elder	Environment Lead & CPESC		
Reviewed by	Erran Woodward	FGJV Approvals Lead		
Approved by	Hari Corliss	FGJV Environment & Sustainability Manager		
Approved by	Daniel Perez	FGJV Project Director		
Approved by	Scott Lawrence	TfNSW Representative		
Endorsed by	Duncan Thomas	Environmental Representative		

Version Control

Revision	Date	Description	Approval
A	16/11/2022	Draft for ER Review	

1 PURPOSE AND OBJECTIVES

1.1 PURPOSE

This Construction Water Reuse Strategy (CWRS or Strategy) forms part of the Construction Soil and Water Management Plan (CSWMP) for the Coffs Harbour Bypass (the Project).

This CWRS has been prepared to address the water reuse requirements of the Minister's Conditions of Approval (MCoA), the environmental management measures listed in the Coffs Harbour Bypass Environmental Impact Statement (EIS), Infrastructure Sustainability Council (ISC) Infrastructure Sustainability (IS) Rating Tool requirements, Submissions and Amendment Report and all applicable legislation.

The CWRS outlines the measures FGJV will use to address water usage during the construction of the Project, while complying with relevant approvals, statutory and contract requirements.

1.2 OBJECTIVES

The key objectives of this Strategy are to ensure that potable water use is minimised, and non-potable alternatives are utilised whenever possible, in accordance with the Ministers Conditions of Approval (CoA), Revised Environmental Mitigation Measures (REMMs) and ISC's ISv1.2 Rating Tool Credits. The relevant requirements are provided in Table 1-1.

TABLE 1-1: REQUIREMENTS RELEVANT TO WATER REUSE

Requirements Reference	Description	Reference
MCoA C11	The Soil and Water Management Sub-plan must include: a) details of enhanced erosion sediment controls in catchments that flow directly to the Solitary Islands Marine Park;	CSWMP
	b) **a construction water reuse strategy**; and	This plan
	c) a groundwater management plan	CSWMP
WM06	Where reasonable and feasible, water captured within the construction footprint will be prioritised for reuse as construction water or dust suppression.	Section 3
GW03	Captured groundwater from tunnelling will be treated using temporary water treatment plants and transferred to storage dams for reuse during construction as a source of non-potable water.	Section 4.1.3
GW04	Unless used as a source of non-potable water for the project, groundwater captured by cuttings and tunnels will be returned into the aquifer down gradient and within the same catchment from where it was intercepted where reasonable and feasible.	Section 2.3
GW05	Engineering measures for long-term management of groundwater inflow to cuttings and tunnels will be designed and constructed to ensure groundwater is recharged downgradient of the cutting or tunnel from where it is captured and within the same catchment where reasonable and feasible. This will be facilitated by, but not limited to, absorption trenches, infiltration galleries/pits, sediment basins and grassed swales.	Section 2.3
GW06	Where groundwater recharge downgradient of the cutting or tunnel is not reasonable and feasible, measures will be designed and implemented that transfer seepage water downstream via water quality basins before being discharged into a downstream drainage channel or creek, within the same catchment.	Section 2.3

2 WATER SOURCES

2.1 POTABLE WATER (MAINS)

Potable water will be provided to the project from the Coffs City Council supply network. This supply is metered and is the cleanest and safest water to use from a human health perspective.

The primary use of potable water is for welfare purposes such as drinking and handwashing. Potable water will also be used in construction activities where use of alternative water sources is not feasible such as Panama Disease Washdown measures.

2.2 SURFACE WATER

Due to the project footprint and high rainfall, there will be opportunities to capture surface water in significant volumes. Surface water runoff will be captured in Type D construction sediment basins throughout the construction footprint. Captured surface water will be treated to achieve discharge criteria specified within an Environment Protection Licence (EPL) to be issued to the Project. Construction water quality discharge criteria will be assessed through the development of the CWQIR in consultation with NSW EPA and documented within the Project EPL. In order to comply with EPL requirements, the design capacity must be reinstated within Type D sediment basins within 5 days of the cessation of rainfall. Surface water that remains within the sediment basin, while maintaining the design capacity, would be re-used for construction purposes.

Where reasonable and feasible, construction phase sediment basins will be oversized to increase the availability of storage of captured stormwater.

Additionally, the Project will investigate the implementation of High Efficiency Sediment (HES) basins to treat surface water runoff. Where these basins are used, the Project would potentially be able to retain more water for construction purposes. The use of HES Basins is subject to approval through the Construction Water Quality Impact Review (CWQIR) required under MCoA E104 and the EPL to be issued to the Project.

2.3 GROUNDWATER

Treated groundwater presents the greatest opportunity amongst the water source options for water reuse due to the consistency and volume of supply.

On the Project, groundwater will enter the tunnel construction areas from the surrounding water table. Groundwater ingress and any residual construction water (from rock bolting activities, for example), along with any rainwater collected in excavations, will be treated using temporary water treatment plants and transferred to storage dams. The following order of precedence will be followed for treated groundwater:

1. Reuse during construction as a source of non-potable water;
2. Re-injection into the groundwater table via infiltration pits, basins and or grass swales; and
3. Discharged according to discharge criteria as detailed within the EPL issued to the Project, and assessed in the CWQIR required under MCoA E104.

Groundwater will be prioritised as a source of non-potable water for the project. Where this is not reasonable and feasible, groundwater captured by cuttings and tunnels will be returned into the aquifer down gradient and within the same catchment from where it was intercepted. This will be achieved through an appropriate methodology in consultation with the Project Construction Manager and will consider volumes of groundwater to be returned, and efficacy of different strategies. Options may include passive absorption or active drilling and/or injection activities (which would be the subject of additional approvals where required).

Where the return of all other options are deemed unsuitable, groundwater may be treated by Water Treatment Plants and released in accordance with the Environmental Protection License (EPL).

Engineering measures for long-term management of groundwater inflow to cuttings and tunnels will be designed and constructed to ensure groundwater is recharged downgradient of the cutting or tunnel from where it is captured and within the same catchment where reasonable and feasible. This will be captured as part of the detailed design preparation. This will be facilitated by, but not limited to, absorption trenches, infiltration galleries/pits, sediment basins and grassed swales.

Where groundwater recharge downgradient of the cutting or tunnel is not reasonable and feasible, measures will be designed and implemented that transfer seepage water downstream via water quality basins before being discharged into a downstream drainage channel or creek, within the same catchment. These measures will be included as part of the Erosion and Sediment Control Plan where appropriate.

2.4 RAINWATER – CONSTRUCTION COMPOUNDS

The Project's natural landscape allows for large volumes of rainwater to be captured during construction. Rainwater runoff from building roofs is considered a relatively clean source of water. Despite the variable nature of rainfall, there will be rainwater capture carried out at construction compounds with rainwater tanks connected to roofs on site sheds wherever practical. This water would be re-used for non-potable uses, i.e. dust suppression, toilet flushing etc.

2.5 OTHER WATER SOURCES

Where there are recycled water networks available these will be considered depending on water quality.

Alternative water sources such as blackwater (wastewater from toilet systems), greywater (wastewater from basins and sinks), and sewage are known to contain high microbial quality. As a result, these sources are not considered feasible for reuse.

3 EVALUATION OF WATER REUSE OPTIONS

FGJV understands the value of optimal water management on the Project. The use of captured water will be prioritised over the use of potable water on all sites where suitable quality and quantity is available. The supply of captured water will be dependent on rainfall, groundwater inflow, construction activities, and storage capacity at each site.

3.1 CONSIDERATIONS FOR WATER REUSE

The following water reuse considerations are based on best practice and advice has been sought from relevant agencies websites, as required.

3.1.1 WATER RESTRICTIONS

The current status of water restrictions across New South Wales is displayed in the Bureau of Meteorology's Water Restrictions website: Water Wise Guidelines (sydneywater.com.au). Water restrictions, their applicability to the project, should be reviewed during each water restrictions event. Guidance can be sought from Coffs Harbour City Council and regulatory agencies as required.

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3.1.2 PUBLIC HEALTH

According to the NSW Health, all forms of household wastewater may pose a risk to human health and the environment: https://www.health.nsw.gov.au/environment/water/Pages/wastewater.aspx

Because of the risk associated with these household types of wastewaters, these streams will not be reused on the Project.

3.1.3 EMERGENCY RESPONSE SYSTEMS

To ensure the protection of human health, some emergency response systems, such as fire sprinkler systems and personal protection equipment (e.g., eye baths), are subject to specifications and standards (e.g., AS 2118.1:2017), Generally, these systems require potable water inputs to ensure there are no potential issues such as corrosion of lines, etc.

3.2 EVALUATION OF REUSE OPTIONS

Non-potable water source	Evaluation of reuse option	Justification
Groundwater	Preferred	Due to the volume and consistency of supply there is good opportunity for reuse of groundwater for some site activities. Groundwater would be treated by a site-specific water treatment plant prior to any reuse.
Rainwater (Compounds)	Possible	The reuse of harvested rainwater from site roofs is possible on the Project. However, the supply of rainwater is highly variable and not a reliable source of reuse water. Rainwater tanks will be installed where there is sufficient space on site.
Surface Water	Possible	There will be opportunities to capture surface water using the construction phase sediment basins throughout the alignment. Captured water from basins can be treated then used as a non-potable water source for dust suppression, earthwork fill conditioning and compaction, and/or landscaping consistent with .
Washdown Water	Possible	Washdown water, from the washdown of plant and equipment, will be captured at designated wash down areas where there is space on site to establish these. An example of where this may be feasible is at the asphalt batching plant where there is likely to be an on-going need for washdown. Panama disease washdown water would be re-used for dust suppression in areas labelled as being Panama disease impacted work areas. I.e. where the machinery was working that was washed down.
Wastewater	Unsuitable	Not being used. Other water sources such as greywater (wastewater from basins and sinks) and sewerage water (wastewater from toilet systems) are not suitable because of the high microbial levels associated with these water streams. The treatment of this water is too expensive for reuse on the project and the health risks are too great.

4 IMPLEMENTATION AND MONITORING

The system of water reuse and the monitoring proposed for the Project construction works is detailed in this section.

4.1 IMPLEMENTATION

4.1.1 RAINWATER HARVEST

Where practicable, rainwater will be harvested off the roofs of all temporary site sheds and offices.

Storage tanks will be installed at all compounds to facilitate reuse.

4.1.2 SURFACE WATER CAPTURE

Sediment basins will be constructed throughout the alignment which will allow capture of surface water.

They will be designed in accordance with the Blue Book and other industry best practice guidelines (White Book). The exact location, size and management of each sediment basin will be detailed in progressive erosion and sediment control plans (ESCP).

4.1.3 GROUNDWATER REUSE

Groundwater ingress during tunnelling will be collected and pumped to a specific water treatment plant. The groundwater will then be treated for use of the following activities:

- Dust suppression during rock cutting
- Dust suppression and lubrication for underground activities
- Fill conditioning and compaction
- General surface and equipment washing
- Wheel washing, and
- Toilet flushing (if practical).
- Recharge into the groundwater table
- Discharge in accordance with EPL criteria

Groundwater use will be evaluated and monitored to ensure that adverse impacts are avoided or minimised. Any adverse impacts to water table or groundwater users will be managed as per Section 6 of the Groundwater Management Plan.

4.2 WATER USAGE MONITORING

To measure consumption of potable water and ensure compliance, FGJV will utilise existing mains connections and install additional smart metering devices at sites as detailed design develops. The Project will investigate metering mains supply, rainwater tanks, water treatment plant reuse tanks, batch plant operations.

FGJV will avoid misuse of recycled water on the site through taking the following actions:

- Toolbox awareness training to inform work crews of the water reuse system
- Ensure that water connections are labelled, and any recycled lines are clearly identified (e.g., different coloured pipes).
- Smart metering will be undertaken, and data will help determine flow rate trends, and determine water recycle rates. If unexpected trends occur, these will be investigated.

5 MITIGATION MEASURES

5.1 WATER MINIMISATION

FGJV will reduce the amount of water required for construction works wherever possible to ensure sustainable water management. This will be achieved through implementing a range of initiatives throughout design and construction with the aim to reduce overall water use, including:

- Optimised design or scope to reduce water requirements during construction
- Utilising polymer/soil binding products for dust suppression to minimise water required to spray down stockpiles and dusty areas
- Installation of water efficient fittings such as taps, toilets, showers, and appliances

6 COMPLIANCE MANAGEMENT

6.1 ROLES AND RESPONSIBILITIES

Roles	Authority and Responsibilities
Environment and Sustainability Manager	• Develop and implement this Strategy • Oversee water usage monitoring • Oversee compliance tracking and reporting • Oversee the keeping of all water usage records • Engage suitably qualified consultants to support implementation • In consultation with the Construction Manager, drive the sustainability agenda, and oversee the investigation and reporting of incidents arising from water usage

Sustainability Lead / Sustainability Advisors	• Complete inspections and monitoring • Complete reporting • Respond to water use incidents and non-conformances • Review and improve water use practices • Educate the project team about resource scarcity and why it is relevant on the Project
Project Manager/s	• Ensure resources and directions are provided to workforce to implement water reuse options and measures described in this strategy
Supervisor/s	• Ensure teams are aware of the water network available on site (i.e., potable, and non-potable) and the safe and suitable uses of each water source.
Plant Manager/s	• Ensure that water connections are labelled, and any recycled lines are clearly identified (e.g., different coloured pipes). • Ensure that water recycling is undertaken safely, and the appropriate metering is in place.
All personnel	• Notify Site Supervisor of any observations of water leakages, irregularities of water treatment plants including physical deformities, irregular odour, or visual difference in water quality of used water. • Identify further opportunities for water reuse.

6.2 REPORTING REQUIREMENTS

To ensure compliance with this Strategy and the Project sustainability commitments, FGJV will prepare monthly progress reports which include total potable and non-potable water consumed during the period.

Throughout construction, water consumption and reuse will be reviewed as part of quarterly internal sustainability audits.

Data collected will form evidence for ISC sustainability ratings for the Project.

7 REVIEW AND IMPROVEMENT

7.1 CONTINUOUS IMPROVEMENT

Continuous improvement of this Plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

Identify areas of opportunity for improvement of environmental management and performance

- Determine the cause or causes of non-conformances and deficiencies
- Allow for updates to the CEMP, Sub-plans and associated management documents to occur to reflect the outcomes of ongoing risk analysis of construction activities
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies
- Verify the effectiveness of the corrective and preventative actions
- Document any changes in procedures resulting from process improvement
- Make comparisons with objectives and targets.

7.2 CWRS UPDATE AND AMENDMENT

The processes described above may result in the need to update or revise the document. This will occur as needed and may only be approved by the Environment and Sustainability Manager, or delegate.

APPENDIX E INCIDENT RESPONSE PROTOCOL

COFFS HARBOUR BYPASS

Incident Response Protocol

Revision B - Coffs Harbour Bypass

FERROVIAL GAMUDA JOINT VENTURE

VERSION CONTROL

Revision	Date	Description	Approval
A	11/11/2022	FGJV version for review	
B	16/11/2022	Draft for ER Review	
C			
D			
E			

CONTENTS

TABLES

1 PURPOSE AND SCOPE

The purpose of this Incident Response Protocol (the Protocol) is to detail the actions to be taken in response to environmental spills and environmental incidents that occur during construction of the Coffs Harbour Bypass Project (the Project).

This Protocol forms part of the Construction Environmental Management Plan (CEMP) for the Project and has been developed in accordance with the requirements of the Minister's Conditions of Approval (MCoA), the revised environmental management measures (REMMs) listed in the Coffs Harbour Bypass Environmental Impact Statement (EIS) and Submissions and Amendment Report, and all applicable legislation. The applicable MCoA and REMMs are provided in Table 1 and Table 2, respectively.

This Protocol applies to the Ferrovial Gamuda Joint Venture (FGJV) and its subcontractors during the construction phase of the Project.

TABLE 1 MCOA APPLCIABLE TO THE INCIDENT RESPONSE PROTOCOL

MCoA	Condition	Reference
A39	The Department must be notified in writing via the Major Projects Website immediately after the Proponent becomes aware of an incident. The notification must identify the CSSI (including the application number and the name of the CSSI if it has one) and set out the location and nature of the incident.	Section 4.2
A40	Subsequent notification must be given and reports submitted in accordance with the requirements set out in Appendix A.	Section 4.2
C2 (f)	The CEMP must provide: (f) a protocol for managing and reporting any: (i) incidents;	This Protocol

TABLE 2 REMMS APPLICABLE TO THE INCIDENT RESPONSE PROTOCOL

REMM	Condition	Reference
SC04	A Soil and Water Management Plan will be prepared in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom 2004) and *Appendix B, Updated erosion and sediment management report of the Submissions Report* and implemented as part of the CEMP. The plan will identify all reasonably foreseeable risks relating to soil erosion and water pollution associated with carrying out the activity and describe how these risks will be managed and minimised during construction. The plan will include arrangements for managing pollution risks associated with spillage or contamination on the site and adjoining areas.	This Protocol
SC08	A site-specific emergency spill response procedure will be developed as part of the Soil and Water Management Plan and include spill management measures in accordance with the Roads and Maritime Code of Practice for Water Management and relevant EPA guidelines. The procedure will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities.	This Protocol
HZ05	Appropriate spill containment equipment will be provided on-site and located at strategic, accessible locations.	This Protocol, Erosion and Sediment Control Plans, Environmental Control Maps

2 REQUIREMENTS

This Protocol is applicable to a range of environmental incidents, report-only events, non-compliances and regulatory action that may occur during activities undertaken by FGJV or sub-contractors. Each of these events and their reporting requirements are described further in the TfNSW Environmental Incident Procedure (EMF-EM-PR-0001), which should be read in conjunction with this Protocol.

2.1 NOTIFICATION

As required by Protection of the Environment Operations Act 1997 (POEO) Regulation clause 101, a pollution incident that is required to be notified under section 148 of the POEO Act will be notified verbally to each regulatory authority, and followed by written notification within 7 days of the date on which the incident occurred. If information becomes known between the immediate notification given verbally and the time when written notification is required to be given, that new information will be required to be notified immediately after it becomes known and to be included in the written notification.

As required in section 148 of the POEO Act, the MCoA A39 and the TfNSW Environmental Incident Procedure (EMF-EM-PR-0001), the following information is to be collected to communicate during immediate EPA, DPE and TfNSW notification, as required, as well as for inclusion in any subsequent follow up reporting required in the event of a pollution incident:

- the time, date, nature, duration and location of the incident
- the location of the place where pollution is occurring or is likely to occur
- the nature, the estimated quantity or volume and the concentration of any pollutants involved, if known
- the circumstances in which the incident occurred (including the cause of the incident, if known)
- the action taken or proposed to be taken to deal with the incident and any resulting pollution or threatened pollution, if known
- other information prescribed by the regulations.

3 EMERGENCY CONTACTS

In the event of an environmental spill or environmental incident, the below contact list may be used as a reference of required contacts, as required.

TABLE 3 EMERGENCY CONTACTS

Contact / Position	Name / Company	Contact Details / Phone Number
Emergency Services if the incident presents an immediate threat to human health or property	Police, Fire & Rescue, Ambulance, HAZMAT	000
NSW Environmental Protection Agency (NSW EPA) Pollution Hotline	N/A	131 555
NSW Department of Fisheries (Solitary Islands Marine park)	N/A	6691 0600 solitary.islands@dpi.nsw.gov.au
Fire & Rescue NSW	N/A	1300 729 579
Coffs Harbour Fire Station	N/A	02 6690 6157
SafeWork NSW	N/A	13 10 50
Coffs Harbour City Council	N/A	(02) 6648 4000
FGJV Project Director	Daniel Perez	0437 332 451

FGJV Environment and Sustainability Manager	Hari Corliss	04191 242 27
FGJV General Superintendent	Daryl Faithfull	0424 019 193
TfNSW Environment Team Representative	Scott Lawrence	0419 248 583
Environmental Representative	Duncan Thomson	0419 237 075

4 INCIDENT AND SPILL RESPONSE

In the event of an environmental incident or spill, the following process should be implemented to prevent or minimise potential impact on the environment.

4.1 IDENTIFICATION AND CONTAINMENT

TABLE 4 INCIDENT SPILL RESPONSE PROCEDURE

Procedure	Details	Responsibility
Stop Works and isolate	• Cease all works in the vicinity of the incident, if safe to do so • Initiate barricading or flagging around the incident to isolate the area and limit access to the immediate area around the incident	All site personnel
Identify the material or classify the incident	• Immediately inform the Supervisor and / or Environmental Team of incident / spilt material • Where possible, identify the spilt product and take precautions as per the safety data sheet (SDS) • If the material presents a significant explosion threat (e.g. petrol or kerosene) or another serious hazard to workers, undertake all safe and practical means to remove any ignition sources and shut off or control the source of the spillage	FGJV Site Supervisor / FGJV Environment Manager
Contain and absorb the spill – On land	• If possible, prevent more material from being spilt (e.g. turn off taps, plug up leaks, turn container upright) • Construct bunding around the immediate area to prevent the flow reaching stormwater systems • Blocking off inlets to drainage lines, nearby waterbodies and the stormwater system and bunding of table-drains within the proximity of the spillage • Where possible absorbent spill kits and other specific absorbent products should be used • Different absorbents absorb different materials (e.g. some are designed for hydrocarbon, some are designed for acids) – make sure you use the right kind of absorbent (refer to the SDS)	FGJV Site Supervisor
Contain and absorb the spill – On water	• If possible, prevent more material from being spilt (e.g. turn off taps, plug up leaks, turn container upright) • Place an absorbent boom downstream of the spill and progress back towards the source of the spill, and/or construct a bund using clean fill material • Ensure that the length of floating (hydrophobic) absorbent boom and pad is at least 1.5 times the width of the waterway • Only those absorbents designed specifically for use in water should be used	FGJV Site Supervisor
External agency notification	• Determine classification of the incident in accordance with TfNSW Environmental Incident Procedure (EMF-EM-PR-0001) • Major spills or those impacting public safety – contact Emergency Services & provide details of the material, quantity and environment (water, drains, etc.) • Contact the NSW EPA pollution hotline	FGJV Environment Manager

4.2 SITE CLEAN UP AND REPORTING

TABLE 5 SPILL CLEANUP

Procedure	Details	Responsibility
Liquid spills	• Use a suitable absorbent to soak up the spilt liquid • Work the absorbent into the liquid using a broom or rake • Allow sufficient time for the liquid to be soaked up by the absorbent • Sweep up the absorbent or pick up using a shovel or front end loader / excavator • Place the absorbent in a leak proof container for disposal • If the liquid has soaked into the ground, the contaminated soil may have to be removed as waste or treated using in-situ bioremediation	FGJV Site Supervisor
Solid spills	• Sweep up the spilt material or pick up using a shovel or front end loader / excavator and then sweep up any remaining residue • Do not wash the spill away or bury it	FGJV Site Supervisor
Spills on water	• Cast absorbent net or absorbent boom over the surface of the spill • If using a boom, spread the absorbent while drawing in the booms to reduce the surface area of the spill • Caution must be taken to ensure the spill remains contained at all times • If the shoreline is contaminated the area must be treated using in-situ bioremediation	FGJV Site Supervisor
Disposal / reuse of material	• If unsuitable for reuse, arrangements should be made for the material to be promptly disposed of in accordance with the waste classification guidelines at a facility licenced to receive the material • Material awaiting disposal is to be stored in a way that prevents or minimises the likelihood of contaminants re-entering the environment • Examples include storing in suitably labelled drums/containers; bunding and covering contaminated stockpiles with geotextile fabric or plastic	FGJV Site Supervisor / FGJV Environment Manager
Incident investigation and reporting	• Investigation into causes and actions to prevent recurrences • Undertake appropriate incident reporting in accordance with Appendix A of the MCoA and TfNSW Environmental Incident Procedure (EMF-EM-PR-0001)	FGJV Environment Manager

APPENDIX F GROUNDWATER MANAGEMENT PLAN

Groundwater Management Plan

Revision D - Coffs Harbour Bypass

FERROVIAL GAMUDA JOINT VENTURE

DOCUMENT DETAILS

Document Title	Groundwater Management Plan
Project Name	Coffs Harbour Bypass
Client	Transport for New South Wales
Application No.	SSI-7666
Principal Contractor	Ferrovial Gamuda Joint Venture

DOCUMENT AUTHORISATION

	Name	Position	Signature	Date
Prepared by	Tim Elder	Environment Lead & CPESC		
Reviewed by	Erran Woodward	FGJV Approvals Lead		
Approved by	Hari Corliss	FGJV Environment & Sustainability Manager		
Approved by	Daniel Perez	FGJV Project Director		
Approved by	Scott Lawrence	TfNSW Representative		
Endorsed by	Duncan Thompson	Environmental Representative		

VERSION CONTROL

Revision	Date	Description	Approval
A	15/11/2022	Draft for ER review	
B	31/01/2023	Address DPE Water comments	
C	21/03/2023	Address DPE Water comments	
D	13/04/2023	Address DPE Water comments	

DISTRIBUTION OF CONTROLLED COPIES

This Groundwater Management Plan (GMP) is available to all personnel and sub-contractors via the project document control management system. An electronic copy can be found on the project website.

The document is uncontrolled when printed. One controlled hard copy of the GMP and supporting documentation will be maintained by the Quality Manager at the project office and on the project website.

Copy No.	Issued to	Version
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1.1 PURPOSE

This Groundwater Management Plan (GMP) details the requirements for the management of groundwater and any potential impacts that may arise as a result of construction of the Project in accordance with the Ministers Condition of Approval (CoA) and Revised Environmental Management Measures (REMMs).

1.2 SCOPE

The GWP outlines the mitigation and management to be used to address groundwater resources potentially affected by construction of the Project, while complying with relevant approvals, statutory and contract requirements.

1.3 OJECTIVES

The objectives of this GMP are to:

- Describe and identify groundwater resources potentially affected by the project based on baseline groundwater monitoring undertaken by TfNSW
- Identify surrounding licensed bores, dams or other water supplies and groundwater dependant ecosystems and potential groundwater risks associated with the construction of the project on these groundwater ecosystems
- Identify measures to manage identified impacts on water table, flow regimes and quality and to groundwater users and ecosystems
- Detail the methods to manage groundwater inflow control, handling, treatment and disposal.

2 ENVIRONMENTAL REQUIREMENTS

2.1 LEGISLATION AND STANDARDS

This GMP has been developed consistent with the following legislation, regulations, guidelines and policy:

- Guideline for the Management of Contaminated Land (Roads and Maritime, 2013)
- Guidelines for Assessment and Management of Contaminated Groundwater (Department of Environment and Conservation (DEC 2007)
- National Environment Protection (Assessment of Site Contamination) Measure April 2011 Schedule B1 Guideline on Investigation Levels for Soil and Groundwater
- Environment Protection Authority: Sampling design part 1 - application, Contaminated Land Guidelines 2022
- Environment Protection Authority: Sampling design part 2 - interpretation, Contaminated Land Guidelines 2022
- NSW Water Management Act 2000
- NSW Aquifer Interference Policy 2012
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems 2012
- NSW State Groundwater Policy Framework Document 1997.

2.2 APPROVALS

This GWP has been developed to satisfy the requirements of the approval conditions outlined within Table 2-1.

TABLE 2-1. CONDITIONS OF APPROVAL / MITIGATION MEASURES

Reference	Condition requirements
B9	A **Complaints Register** must be maintained recording information on all complaints received about the CSSI during the carrying out of any work and for a minimum of 12 months following the completion of construction. The **Complaints Register** must record the: (a) number of complaints received; (b) the date and time of the complaint; (c) the method by which the complaint was made; (d) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a **note** to that effect (e) nature of the complaint; (f) means by which the complaint was addressed and whether resolution was reached, with or without mediation; and (g) if no action was taken, the reason(s) why no action was taken.
B10	The **Complaints Register** must be provided to the Planning Secretary upon request, within the timeframe stated in the request. ***Note**: Complainants must be advised that the Complaints Register may be forwarded to Government agencies to allow them to undertake their regulatory duties.*
C11	The **Soil and Water Management Sub-plan** must include: (a) details of enhanced erosion sediment controls in catchments that flow directly to the Solitary Islands Marine Park; (b) a construction water reuse strategy; and (c) a groundwater management plan.
E110	Operational groundwater inflows into each tunnel must be no greater than one litre per second across any given kilometre (1L/s/km). Compliance with this condition cannot be determined by averaging groundwater inflows across the length of the tunnel(s).
E111	The Proponent must identify and commit to the implementation of 'make good' provisions for groundwater users in the event of a material decline in water supply levels, quality and quantity from existing registered bores associated with groundwater changes from either construction and/or ongoing operational dewatering caused by the CSSI.
GW01 (REMM)	Stockpiles containing PASS or ASS treatment areas will be lined and bunded in accordance with the Guidelines for the Management of Acid Sulfate Materials (RTA, 2005) to prevent leachate contaminating groundwater.

GW02 (REMM)	Additional groundwater monitoring standpipes will be included for Type A cuts for alluvial aquifers along the project and in the areas around the major embankments to supplement existing data.
GW03 (REMM)	Captured groundwater from tunneling will be treated using temporary water treatment plants and transferred to storage dams for reuse during construction as a source of non-potable water.
GW04 (REMM)	Unless used as a source of non-potable water for the project, groundwater captured by cuttings and tunnels will be returned into the aquifer down gradient and within the same catchment from where it was intercepted where reasonable and feasible.
GW05 (REMM)	Engineering measures for long-term management of groundwater inflow to cuttings and tunnels will be designed and constructed to ensure groundwater is recharged downgradient of the cutting or tunnel from where it is captured and within the same catchment where reasonable and feasible. This will be facilitated by, but not limited to, absorption trenches, infiltration galleries/pits, sediment basins and grassed swales.
GW06 (REMM)	Where groundwater recharge downgradient of the cutting or tunnel is not reasonable and feasible, measures will be designed and implemented that transfer seepage water downstream via water quality basins before being discharged into a downstream drainage channel or creek, within the same catchment.
GW07 (REMM)	Additional geotechnical and hydrogeological investigations and modelling will be carried out for the Gatelys Road tunnel during detailed design to improve predictions of likely groundwater inflows, inform construction methodologies and develop engineering measures to reduce groundwater ingress where inflow rates are still anticipated to exceed 1 L/s per kilometre. Investigations and modelling will be undertaken in consultation with Water Group, DPIE.
GW08 (REMM)	Monitoring of groundwater levels and quality will be included in the Water Quality monitoring program SW01
GW09 (REMM)	Monitoring of seepage into cuttings will be carried out and evaluated against the predictions of the numerical modelling undertaken during detailed design.
GW11 (REMM)	Additional ground truthing and site inspections will be undertaken for potentially impacted groundwater bores/supply wells (including supply well GW068986), springs, Jordans Creek (near Cut 20) and agricultural dams within and immediately surrounding the zone of drawdown. The purpose of the ground truthing and site inspections is to confirm predicted impacts and develop make good provisions where required in consultation with affected property owners.
GW12 (REMM)	Sites used for stockpiles, washdown areas, refuelling and chemical storage will be located away from areas of shallow groundwater or appropriately lined and bunded to protect groundwater.

3 EXISTING ENVIRONMENT

An assessment of the impacts of the Project on groundwater and identification of mitigation and management measures to minimise and reduce these impacts is discussed in Chapter 20 of the EIS. Relevant content from Chapter 20 is reproduced in the sections below.

3.1 HYDROGEOLOGY

Groundwater presents in three distinct strata within the Project area - shallow surficial deposits, alluvial deposits and fractured bedrock. There is a fourth system that was considered in the EIS hydrogeological model, the coastal sands aquifer, but this was sufficiently far enough away not to be considered relevant for this project.

3.1.1 SURFICIAL / PERCHED GROUNDWATER

The distribution of surficial materials in the Project area is highly variable and is unlikely to act as a single groundwater body, instead presenting as a series of disconnected local perched systems (i.e. shallow groundwater that sits above the regional water table).

It is anticipated that this aquifer is often unsaturated, with groundwater temporarily perching in this unit following rainfall recharge events. The perched groundwater is expected to infiltrate to the underlying fractured bedrock aquifer and/or move downgradient towards drainage lines and creeks in the surrounding topography. These features are not considered aquifers in the normal sense as they are not a reliable groundwater source. The quantity of groundwater that is stored and flowing through these units is likely to be small but may be locally important for some vegetation.

3.1.2 ALLUVIAL AQUIFERS

Alluvial aquifers occur along drainage lines which integrate topographically higher areas. The alluvial aquifer units are separated into two types: a shallow up-river alluvial aquifer and a coastal floodplain alluvial aquifer.

Recharge to these aquifers is anticipated from two sources. The first source is from rain over alluvial areas which is recharged to the aquifer through shallow surface runoff. The second is surface water within the creek lines. Based on geological mapping, the project intersects alluvial deposits at several locations and the water sharing plan indicates that these deposits are all part of the up-river alluvial deposits.

3.1.3 FRACTURED BEDROCK AQUIFER

The EIS considered that groundwater flows in the shallower fractured bedrock are generally expected to follow the topographical features of the area which are broadly towards the east, except locally at ridge lines. Groundwater flow within the deeper regional bedrock is less likely to be affected by local topographic variation with flow anticipated to be eastwards towards the coast, potentially exhibiting strong vertical gradients.

3.2 GROUNDWATER DEPENDENT ECOSYSTEMS

The project intercepts several low potential GDEs and native vegetation communities, which may be intermittently groundwater dependent. The anticipated zone of drawdown from cuttings where the design is anticipated to extend below the groundwater table, potentially leading to localised lowering of groundwater levels (Type A cuttings) and tunnels also extends to some low potential GDEs outside of the construction footprint. No moderate or high potential GDEs are anticipated to be within the zone of drawdown. There are no mapped Coastal Management SEPP wetlands within the expected long-term zone of drawdown around any of the cuttings or drained tunnels.

The EIS identified that Paperbark swamp forest vegetation present in the vicinity of the Newports Creek floodplain, south of Englands Road, is the only area of High probability Groundwater Dependent Ecosystem (GDE) within the study area (from regional studies) (Figure 3-1). No GDE fauna species are recorded as occurring within the study area.

3.3 GROUNDWATER LEVELS

Groundwater levels within the fractured bedrock aquifer across the study area range from between 11 m AHD to 117 m AHD. Groundwater levels below ground level vary from less than five metres to about 43 m, with the deepest groundwater generally corresponding to topographically higher areas (i.e. around Shephards Hill and Gatelys Road).

Groundwater level monitoring undertaken between July 2017 and February 2019 indicated that groundwater is affected by seasonal climatic variations and rainfall events. Between the wetter period from November to April, levels were generally elevated at most of the monitoring locations compared to the period between May and October when they were typically in recession.

Groundwater levels indicated variations of between less than one metre and up to 12 m. Changes in groundwater level indicate that there is variable response in the fractured bedrock aquifer to rainfall events.

Groundwater within the alluvial deposits was encountered in several test pits along the project. Of those which encountered groundwater, standing groundwater levels varied from 0.9 m below ground level (mbgl) to 1.9 mbgl. This indicates that groundwater is close to ground surface within alluvial deposits. Given the expected connection between creek flow and groundwater in the underlying alluvium, these shallow groundwater levels are in line with the anticipated conditions in these areas.

3.4 PRE-CONSTRUCTION PHASE MONITORING

Pre-construction phase groundwater quality monitoring for the Project was undertaken for the 12-month period to September 2022. The purpose of this monitoring was to establish baseline groundwater quality data for the Project, support assessment of potential impacts, and refine mitigation measures to be implemented during construction and operation phases.

The monitoring included a range of parameters including physio-chemical properties and metals.

Results from pre-construction groundwater quality monitoring are provided within Groundwater Monitoring Data Reports for each round of monitoring.

Groundwater level monitoring for the project is ongoing.

3.5 GROUNDWATER QUALITY

Groundwater quality testing has been conducted as part of an ongoing groundwater monitoring program. Collected samples were tested for a range of quality parameters and evaluated using the 95th percentile values of the Bellinger River and Coffs Harbour Catchment Water Quality Objectives (WQO) and the aquatic ecosystem protection guidelines for moderately disturbed systems in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018).

The results of the testing are summarised below:

- The pH of the groundwater is generally slightly acidic to slightly alkaline;
- Dissolved oxygen was between 75 per cent and 110 per cent except for one sample (which was lower);
- Turbidity of groundwater samples was generally low;
- Concentrations of trace metals were above the ANZG aquatic ecosystem guideline values;
- The six samples tested for zinc all had concentrations slightly elevated above guideline values; and
- Of the 26 samples tested for aluminium, 24 also had concentrations above the guideline value.

The EIS concluded that there did not appear to be a trend in the location of exceedances within the Project area as concentrations in the fractured bedrock did not generally correspond with any particular source, and elevated concentrations of some metals are likely to be naturally occurring and indicative of regional water quality.

Groundwater in alluvial aquifers has a short residence time and strong connection to surface waters. The quality of the alluvial groundwater is therefore expected to be similar to that of the surface water within the creeks.

Total dissolved solid concentration (salinity) of the groundwater is low (less than 450 mg/l) and is generally of freshwater quality (with the exception of two samples registering as slightly brackish - located at Gatelys Road and near the waste facility at the southern end of the Project).

3.6 GROUNDWATER USERS

3.6.1 BORES AND WELLS

There are numerous licenced groundwater wells within close proximity to the alignment (as indicated by the Department of Primary Industry Water database), most of which extract from the fractured bedrock aquifer. The location of these groundwater bores and wells to be monitored is presented in Appendix A (reproduced from Volume 9, Appendix N of the EIS (Groundwater Assessment)).

3.6.2 AGRICULTURAL DAMS

NSW Hydrographic mapping (NSW 2016) indicates that there are about 70 agricultural dams within one kilometre of the Project. The source of water for these agricultural dams is not known however it is typical that they would be maintained by a combination of surface run off, top up from nearby creeks or groundwater fed (through processes of spring discharge and or direct connection with the underlying water table).

3.6.3 SPRINGS

The EIS reports that springs are most likely to occur during and following the wet season when groundwater levels are highest. They may also occur in areas of steep topographic variation such as the three main ridge lines. The nature of spring emergence will be affected by topographic variation, underlying geological profile and recharge dynamics. The presence of springs is likely to vary both spatially and seasonally. NSW Hydrographic mapping (NSW, 2016) indicates no mapped springs in the study area.

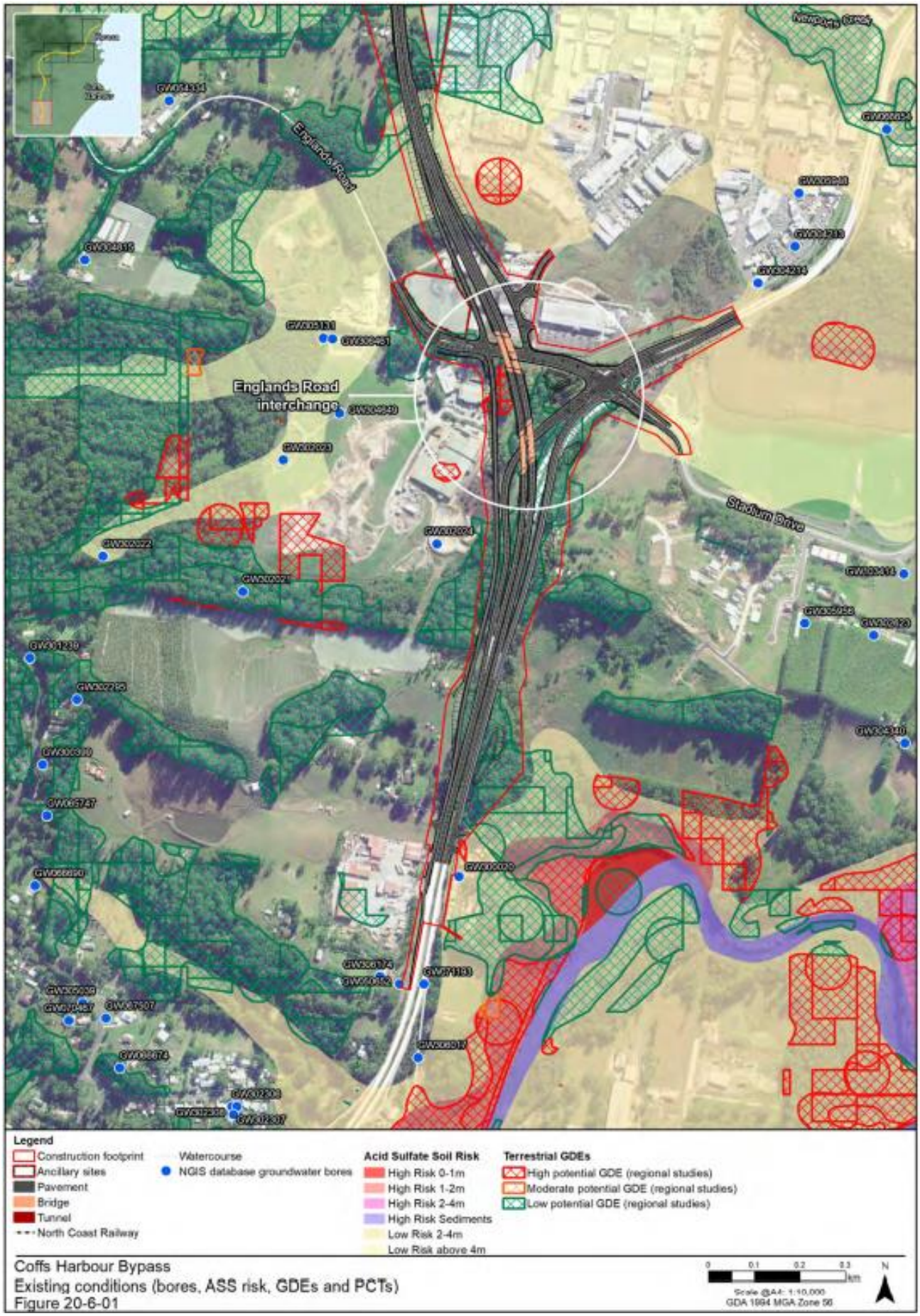


FIGURE 3-1. MAP SHOWING POTENTIAL FOR GDE WITHIN PROJECT AREA

4 GROUNDWATER MODELLING

Groundwater modelling is discussed in detail within Chapter 20 of the EIS. Key points are provided below.

- Cuttings and drained tunnels have the potential to impact groundwater levels where they extend below the existing groundwater surface.
- The extent of drawdown and seepage rates into the cuttings/tunnels depends on the depth below groundwater levels which the elements extend, the length over which seepage occurs and the local hydrogeological conditions at each of the cuttings.
- Maximum potential drawdown which could occur at each cutting or tunnel are classified into three types:
    - Type A (moderate to high impact) – where the design is anticipated to extend below the existing groundwater table, potentially leading to localised lowering of water levels
    - Type B (negligible to low impact) – where the design level is within five metres of the groundwater table, where there is not expected to be an adverse impact to the groundwater regime and engineering mitigation measures are not expected to be required
    - Type C (no impact) – where groundwater levels are greater than five metres below the design cut level with no anticipated impact.

5 ENVIRONMENTAL ASPECTS AND IMPACTS

5.1 CONSTRUCTION ACTIVITIES

The Project will involve a range of construction activities incorporating various heavy machinery, plant and equipment that will operate in several locations. An Environmental Work Method Statement (EWMS) will be prepared for each construction and work activity that potentially involves the disturbance of groundwater resources. Typically, this will include:

- Earthworks (cut and fill)
- Tunnelling
- Culvert and drainage
- Stockpiling
- Waterway crossings
- In-ground excavation.

5.2 ENVIRONMENTAL ASPECTS

The key aspects of the Project that could result in impacts to groundwater resources and/or groundwater dependent ecological communities include:

- Interception of groundwater flow paths through embankment placement
- Drawdown of groundwater table through the excavation of cuttings
- Spills of construction related chemicals
- Exposure of acid sulphate materials
- Exposure of saline soils.

5.3 POTENTIAL IMPACTS

The potential groundwater impacts that may result from construction include:

- Changes to groundwater flows, surface flows and connectivity due to lowering of the groundwater level as a result of cuttings and tunnels being below groundwater level
- Construction of large fill embankments which may concentrate runoff and recharge to groundwater systems
- Impact to GDEs, water supply wells, agricultural dams and creeks from changes to groundwater levels and throughflow along the project
- Groundwater contamination, which may occur during construction if construction activities are not adequately managed (infiltration of contaminated surface water runoff, infiltration of captured groundwater from excavations during construction, hydrocarbon contamination from potential fuel and chemical spills)
- Changes to groundwater quality due to the oxidation of acid sulfate materials, caused either by exposure of rock due to construction activity or lowering of groundwater levels
- Changes in groundwater quality due to exposure and leaching of saline soils along the project.

Potential impacts on the hydrogeological environment are compared to the requirements of the NSW Aquifer Interference Policy in

Table 5-1.

TABLE 5-1. IMPACT ASSESSMENT AGAINST THE REQUIREMENTS OF THE NSW AQUIFER INTERFERENCE POLICY

	Requirement	Comment
Water table	Level 1 Less than or equal to 10% cumulative variation in the water table, allowing for typical 'post water sharing plan' variations, 40 m from any: a) High priority groundwater dependent ecosystem; or b) High priority culturally significant site listed in the schedule of the relevant water sharing plan. A maximum of a 2 m decline cumulatively at a water supply work. Level 2 If more than 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, 40 m from any: a) High priority groundwater dependent ecosystem; or b) High priority culturally significant site listed in the schedule of the relevant water sharing plan, If appropriate studies demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than a 2 m decline cumulatively at any water supply work, then make good provisions should apply.	No high priority GDEs or culturally significant sites are within Water Sharing Plans for the Coffs Harbour Area Unregulated and Alluvial Water Sources, 2009 or the North Coast Fractured and Porous Rock Groundwater Sources, 2016 are listed in the study area. The project would not result in impacts to a culturally significant site or high priority GDE
Water Pressure	Level 1 A cumulative pressure head decline of not more than a 2 m decline, at any water supply work. Level 2 If the predicted pressure head decline is greater than requirement 1 above then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.	Predictive modelling indicates that most of the project meets the minimal impact consideration of less than 2 m pressure head decline at any water supply work. The exception to this is at Gatelys Road tunnel where predictions indicate one groundwater supply well may experience a pressure head decline of more than 2 m. GW068986 has a predicted drawdown of around 4 m.
Water Quality	Level 1 Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity. Level 2 If condition 1 is not met then appropriate studies will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the longterm viability of the dependent ecosystem, significant site or affected water supply work.	Groundwater inflows to cuttings will be captured and discharged via water quality basins or absorption trenches, infiltration pits or swales. Captured water during tunnelling will be treated using construction water treatment plants. Water will be discharged in accordance with EPL and DPIE (water) quality requirements. The risk of contamination on site and potential for discharge of pollutants will be managed on site using standard construction management procedures. The project is therefore not anticipated to change the beneficial use category of the groundwater source beyond 40 m from the activity.

6 ENVIRONMENTAL CONTROL MEASURES

6.1 WATER TREATMENT AND RE-USE

Water treatment and re-use forms a key environmental control measure. Groundwater captured during construction of the Project will be treated at Water Treatment Plants (WTPs), located at each of the three tunnel sites. Following treatment, water will be transferred to storage dams and tanks where it will provide a source of non-potable water for the project. Where reuse is not reasonable and feasible, groundwater captured by cuttings and tunnels will be returned into the aquifer down gradient and within the same catchment from where it was intercepted. This will be achieved through development of an appropriate methodology as part of detailed design preparation, with consideration of volumes of groundwater to be returned. Options to be considered include passive absorption (e.g. absorption trenches, infiltration galleries/pits, sediment basins and grassed swales) and active drilling and/or injection activities (which would be the subject of additional approvals where required).

Where groundwater recharge downgradient of the cutting or tunnel is not reasonable and feasible, measures will be designed and implemented that transfer seepage water downstream via water quality basins before being discharged into a drainage channel or creek within the same catchment in accordance with the Environmental Protection License (EPL).

Procedures relating to the management of WTPs and cuttings will be documented within an EWMS and included within Progressive Erosion and Sediment Control Plans where appropriate. Water treatment and reuse is further detailed within the CSWMP Appendix D – Construction Water Reuse Strategy.

6.2 MONITORING AND MANAGEMENT

6.2.1 MONITORING LOCATIONS

Monitoring of groundwater levels (and quality) is detailed within the Groundwater Monitoring Program managed by TfNSW. The Groundwater Monitoring Program includes details of each of the wells to be monitored, sampling procedures, and parameters to be measured to assess groundwater levels and quality at locations of proposed tunnels and priority cuttings on the CHB project.

These monitoring wells have been installed using a risk-based approach based on the classifications applied to each of the tunnels and cuttings into one of the three types (A, B or C) discussed in Section 5. TfNSW has also installed additional monitoring wells near alluvial aquifers and areas near major fill embankments to address REMM GW02. These additional monitoring wells will be monitored during the construction phase (refer to REMM GW08).

Locations to be monitored under the GWMP are identified within Appendix A of this report (from Volume 9, Appendix N of the EIS). This mapping also includes locations of agricultural / stock dams, licensed groundwater bores and monitoring wells included within the National Groundwater Information System (NGIS) database.

The distribution of groundwater monitoring wells is considered to be sufficiently distributed to provide representative information of potential impacts to the groundwater supply associated with construction activities. This includes impacts to bores, wells, springs, Jordans Creek and / or agricultural dams.

6.2.2 ANALYSIS OF MONITORING DATA

Data analysis and interpretation is discussed in detail within Section 8 of the Groundwater Monitoring Program.

Reporting from the Groundwater Monitoring Program (quarterly data reports and annual interpretative reports) and results of statistical analysis of data from each sampling event will inform any groundwater

supply impacts potentially resulting from construction activities. This will trigger requirements for further investigation, assessment of management measures and identification of make good provisions where required. The approach to be adopted is as follows:

- Step 1 - Compare down gradient construction/operational sampling result with the corresponding 80th percentile figure (P80 figures) from the baseline:
    - If down gradient groundwater data is greater than the corresponding P80 baseline figure, this highlights a possibility of the CHB project impacting on the groundwater hydrology (or water quality) requiring further investigation as per Step 2.
    - If a down gradient data is less than or equal to the corresponding P80 baseline figure, then no further action is required with respect to the subject parameter.
- Step 2 - If a down gradient groundwater hydrology (or water quality data) is greater than the corresponding P80 baseline figure, then compare the down gradient and upgradient data at that location for that event:
    - If the down gradient sampling result is greater than the upgradient result, then this further highlights a possibility of the CHB project impacting on hydrology (and/or water quality) requiring further investigation as per Step 3.
    - If down gradient data is less than or equal to the up-gradient result, then no further action is required with respect to the subject parameter or groundwater level data.
- Step 3 - If a down gradient groundwater hydrology or water quality data is greater than the corresponding upgradient result, then undertake statistical analysis of the data to assess for significant variations, including review of baseline upgradient and down gradient standing water levels and corresponding climatic condition data to eliminate potential impacts to groundwater levels from project works.
    - If the statistical analysis shows significant variations in data, then this further highlights a possibility of the CHB project impacting on hydrology and/or water quality requiring investigation of existing control measures. TfNSW shall be notified of the issue within 24 hours of the contractor completing the statistical analysis.
    - If the statistical analysis shows there are no significant variations, then no further action is required with respect to the subject parameter or groundwater level data.

This approach is presented in Figure 6-1.

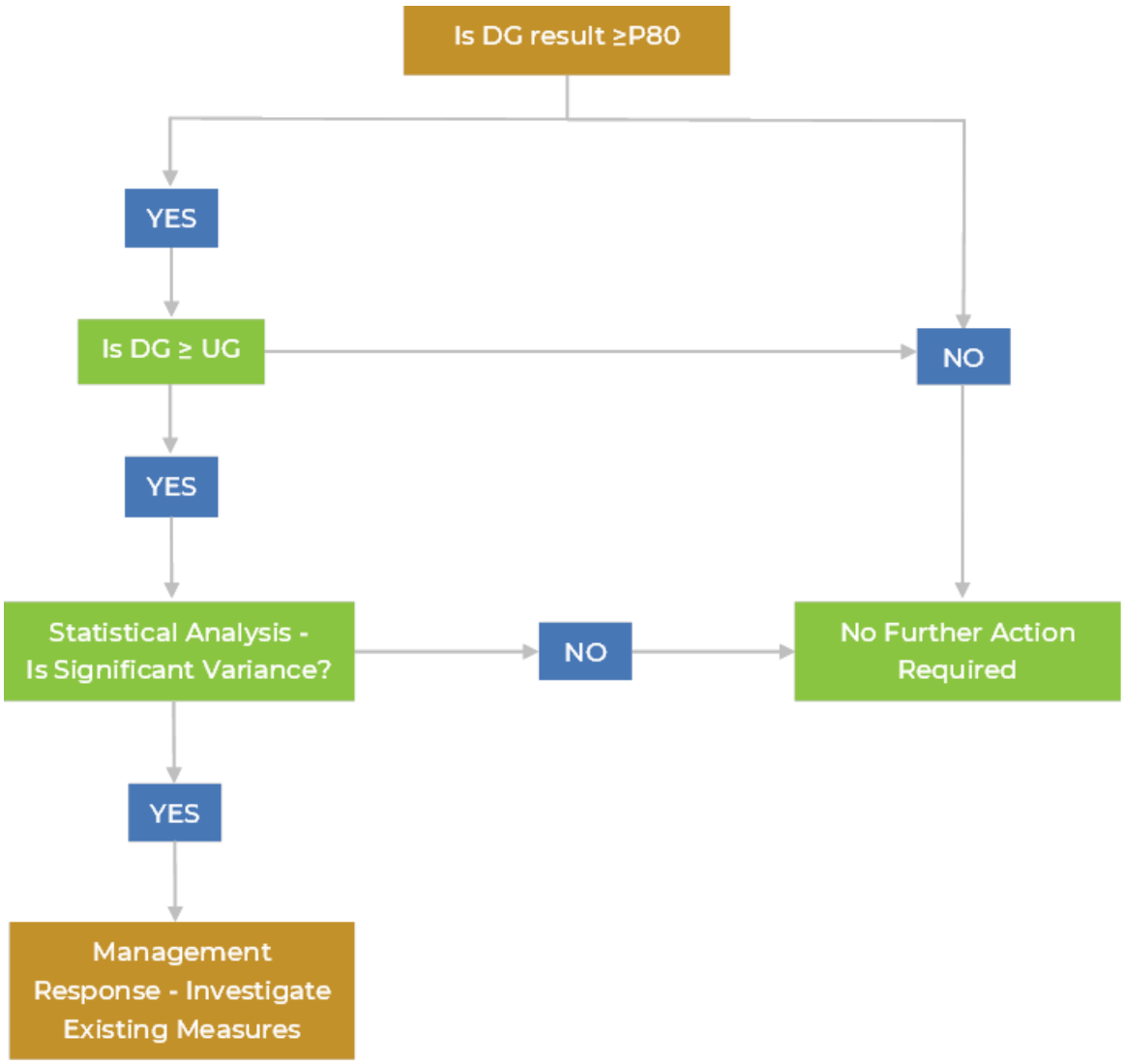


FIGURE 6-1. MONITORING DATA ANALYSIS AND MANAGEMENT RESPONSE TRIGGER

6.2.3 MANAGEMENT OF POTENTIAL IMPACTS

Where statistical analysis (as described above) and/or feedback from affected property owners identifies potential impact to groundwater hydrology from project activities, further investigation will be initiated. In the case of sampling data analysis, this will be assessed quarterly (in line with sampling frequency). Where concerns are raised by impacted property owners, these will be investigated on a case-by-case basis within two weeks of the FGJV being notified.

Further investigation will include ground truthing, site inspections and monitoring of impacted property owner's groundwater supply (in addition to ongoing monitoring of the existing monitoring well network). This will inform impact of construction activities on the long-term viability of the groundwater supply (ie. well - including supply well GW068986, spring, Jordans Creek and / or agricultural dam) within the zone of drawdown.

Where groundwater level drawdown impacts are attributed to construction activities, make good provisions will be negotiated with affected groundwater users to ensure access to an equivalent supply of water through enhanced infrastructure or other means including:

- Provision of water supply, consistent with the required replacement volume and timing of water supply demand
- Provision of an alternative water supply / well
- Changing the bore pump so that it is better suited to the decreased water level within the bore
- Deepening the bore to allow it to draw water from a greater length of the aquifer
- Reconditioning of the water bore to improve its hydraulic efficiency

- Increased monitoring of the bore water levels to provide a level of confidence to the landholder that the impacts are managed appropriately
- Pumping from alternative source to supplement the water supply
- Investigate and implement reasonable and feasible engineering options to ensure groundwater is recharged downgradient of the cutting or tunnel from where it is captured, and within the same catchment where reasonable and feasible (as described within REMM GW05. eg. absorption trenches, infiltration galleries/pits).

Management of potential groundwater supply impacts, and the relationship of the Groundwater Monitoring Program with identification and implementation of make-good provisions for impacted water users, is summarised within **Error! Reference source not found.**.

TABLE 6-1. MANAGEMENT OF POTENTIAL GROUNDWATER SUPPLY IMPACTS

	Stage	Description	Action	Timing	Responsibility
1	Quarterly Monitoring as per the GWMP	Analysis of monitoring data identifies potential groundwater drawdown	TfNSW notifies FGJV	Quarterly (in line with GWMP)	TfNSW
2	Additional investigation	Further investigation triggered where: • analysis of monitoring data identifies potential groundwater drawdown, and/or • landholder raises concern about potentially impacted groundwater supply	Further investigation including ground truthing, site inspections and monitoring of impacted property owner(s) groundwater supply.	• Within 2 wks of provision of GWMP analysis data, or • Within 2 wks of receiving landholder enquiry	FGJV
3	Impact to long-term viability of groundwater supply	Further investigation verifies that long-term viability of the groundwater supply is impacted by construction activities	Provide make-good provisions to impacted groundwater users	Negotiated with impacted groundwater users to meet identified water supply volume and timing	FGJV

Error! Reference source not found.

6.3 ENVIRONMENTAL MANAGEMENT MEASURES

Environmental management measures to mitigate the risk of groundwater impacts during construction of the Project on surrounding infrastructure, people and the environment are presented in **Error! Reference source not found.**. This table also outlines responsibilities, evidence of action, and the relevant CoA (Condition of Approval) and Revised Environmental Management Measure(s) (REMMs).

TABLE 6-2. GROUNDWATER MANAGEMENT AND MITIGATION MEASURES

Reference	Requirements / Actions	When to implement	Responsibility	Reference	Evidence
GWMM01	Stockpiles containing PASS or ASS treatment areas will be lined and bunded in accordance with the Guidelines for the Management of Acid Sulfate Materials (RTA, 2005) to prevent leachate contaminating groundwater.	Construction	Environment Manager Foreman / Site Supervisor	GW01 (REMM)	Site inspection reports
GWMM02	Groundwater intercepted during construction will be recaptured and treated.	Construction	Construction Manager	GW03 (REMM)	WTPs, tanks and basins established

Reference	Requirements / Actions	When to implement	Responsibility	Reference	Evidence
			Environment Manager	GW04 (REMM)	Groundwater discharge records
GWMM03	Water treatment plants will be designed so that the tunnel groundwater effluent will be of suitable quality for discharge to the receiving environment in compliance with the discharge criteria and EPL.	Pre-construction	Construction Manager Environment Manager Design Manager	GW03 (REMM)	WTP design specifications WQ monitoring records
GWMM04	Following treatment by WTPs, tunnel water will be transferred to storage dams and tanks where it will provide a source of non-potable water for the project.	Construction	Construction Manager Environment Manager	GW03 (REMM)	WTPs, tanks and basins in established
GWMM05	Unless used as non-potable water for the Project, groundwater captured by cuttings and tunnels will be returned into the aquifer down gradient and within the same catchment from where it was intercepted. Engineering measures to ensure groundwater is recharged down gradient of the area of capture will be developed (where practical and feasible). Options include passive absorption (e.g. absorption trenches, infiltration galleries/pits, sediment basins and grassed swales) and active drilling and/or injection.	Pre-construction / Construction	Construction Manager Environment Manager Design Manager	GW05 (REMM)	Site inspection reports
GWMM06	Drainage measures will be designed and implemented that transfer seepage water into water quality basins (where groundwater recharge downgradient of the cutting or tunnel is not reasonable and feasible). Basins will be discharged in compliance with the EPL into a downstream drainage channel or creek, within the same catchment. Control measures will be documented within Progressive ESCPs.	Pre-construction / Construction	Construction Manager Environment Manager Design Manager	GW06 (REMM)	WTPs, tanks and basins established Site inspection reports Basin discharge records
GWMM07	Geotechnical and hydrogeological investigations and modelling will be carried out in consultation with DPE Water and DPE for all tunnels during detailed design to improve predictions of likely groundwater inflows. This will inform construction methodologies and the development of engineering measures to reduce groundwater ingress and ensure operational groundwater inflows into each tunnel are no greater than one litre per second across any given kilometre (1L/s/km). The groundwater model for the Gatelys Road Tunnel will be provided to DPE Water once completed. A revision of this Groundwater Management Plan (Appendix F to the Construction Soil and Water Management Plan) will be completed in accordance with Section 7. Compliance monitoring with regard to the 1L/s/km requirement will be detailed	Pre-construction	Construction Manager Design Manager	E110 GW07 (REMM)	Geotechnical modelling Hydrogeological monitoring reports

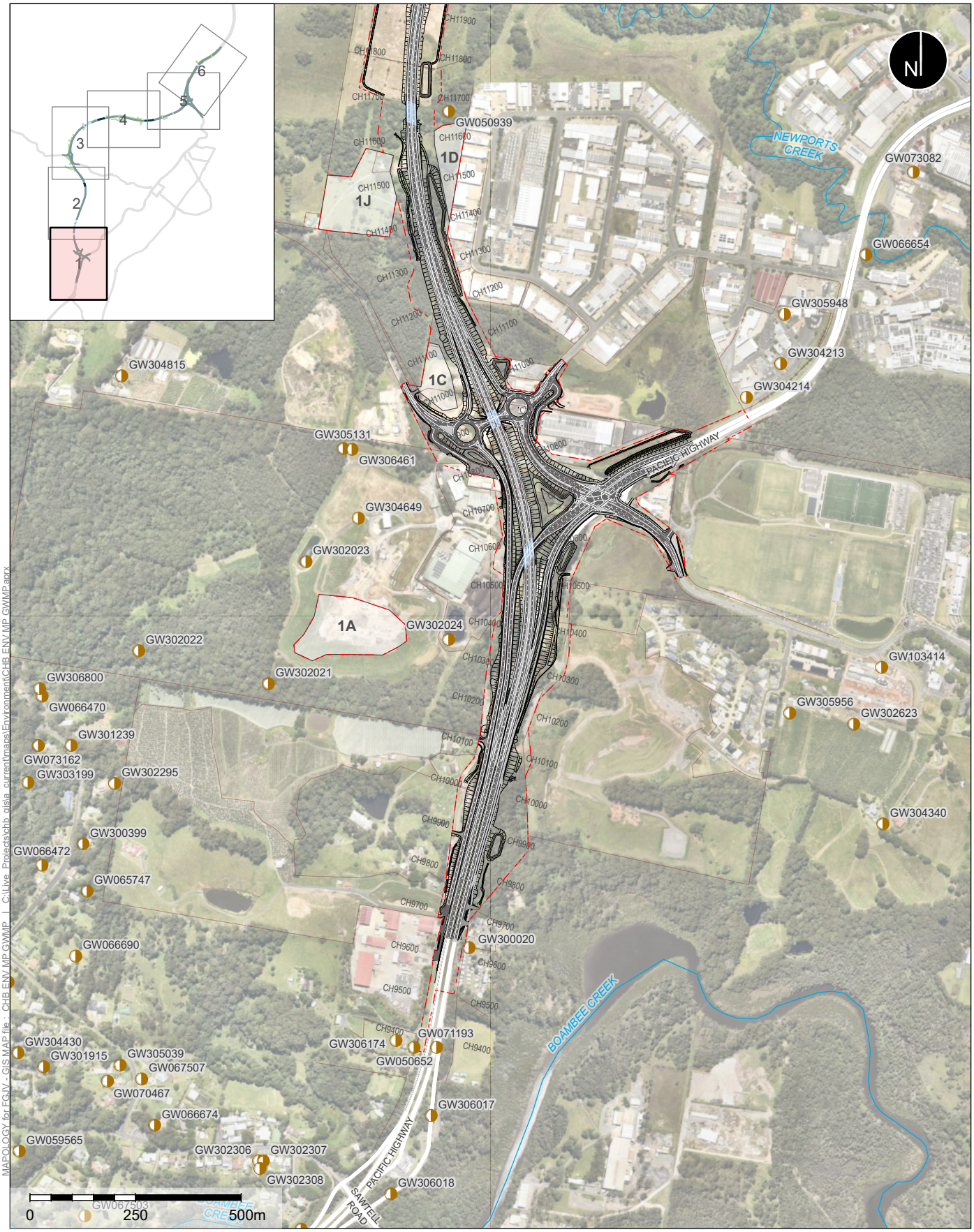
Reference	Requirements / Actions	When to implement	Responsibility	Reference	Evidence
	within the Operational Environmental Management Plan (OEMP) or the TfNSW EMS management system as permitted under MCoA D2.				
GWMM08	Monitoring of groundwater levels and quality will be undertaken as per the Groundwater Monitoring Program to be undertaken by TfNSW.	Pre-construction / Construction / Operation	TfNSW	GW08 (REMM)	TfNSW Groundwater Monitoring Reports
GWMM09	Seepage into cuttings will be visually monitored and evaluated against the predictions of the numerical modelling.	Construction	Construction Manager Environment Manager	GW09 (REMM)	Site inspection reports
GWMM10	Reporting from the Construction & Operation Groundwater Monitoring Program (quarterly data reports and annual interpretative reports) will be used to confirm potential impacts (through statistical analysis of data), along with enquiries from nearby groundwater users. This will inform further investigation of management measures and identify make good provisions where required, in consultation with affected property owners adjacent to Type A cuts and tunnels and shown in Appendix A. **Trigger:** Along with enquiries from groundwater users, quarterly hydrograph reporting (GWMP) and statistical analysis of monitoring data will be used to assess material impacts to standing water levels in monitoring wells resulting from construction activities, as described within Section 7.2.2. This will trigger the requirement for further investigations as described within Section 7.2.3. **Response:** Further investigations will include ground truthing and site inspections to supplement monitoring of the existing monitoring bore network to verify predicted impacts and assess groundwater level drawdown and associated potential to impact the long-term viability of the groundwater *supply (*well - including supply well GW068986, spring, Jordans Creek and / or agricultural dam) within the zone of drawdown. **Timing**: Commencement of additional investigation will occur within 2 weeks of receiving GWMP data analysis and/or landholder enquiry (unless otherwise agreed with impacted groundwater user) **Action:** Where further investigation verifies groundwater level drawdown impacts are attributed to construction activities, make good provisions will be negotiated with affected groundwater users to ensure access to an equivalent supply of water through enhanced infrastructure or other means including: • Volume and timing of water supply requirement	Construction	Construction Manager Environment Manager	E111 GW11 (REMM) B9 B10	Site inspection reports Groundwater Monitoring Reports Complaints Register Further investigations

Reference	Requirements / Actions	When to implement	Responsibility	Reference	Evidence
	• Provision of an alternative water supply/well • Changing the bore pump so that it is better suited to the decreased water level within the bore • Deepening the bore to allow it to draw water from a greater length of the aquifer • Reconditioning of the water bore to improve its hydraulic efficiency • Increased monitoring of the bore water levels to provide a level of confidence to the landholder that the impacts are managed appropriately. • Pumping from alternative source to supplement the water supply **Reporting:** Reporting of groundwater user enquiries and complaints will be in accordance with MCoA B9 and B10 (Table 2-1). Reporting of further investigations will include, where required, the validation of groundwater impact predictions**,** and may include model updates and revised predictions. Revised predictions may inform revisions of the monitoring program, trigger levels, management measures and water licence entitlement.				
GWMM11	Sites used for washdown areas, refuelling and chemical storage will be located away from areas of shallow groundwater or appropriately lined and bunded to protect groundwater. These sites will be identified within specific EWMS and Progressive ESCPs where appropriate.	Construction	Environment Manager Foreman / Site Supervisor	GW12 (REMM)	Site inspection reports EWMS ESCPs

7 REVIEW

This document will be reviewed as part of the Construction Soil and Water Management Plan and following completion of the groundwater model for the Gatelys Road Tunnel.

APPENDIX A LOCATION OF GROUNDWATER MONITORING WELLS AND WATER SUPPLY BORES AND AGRICULTURAL / STOCK DAMS



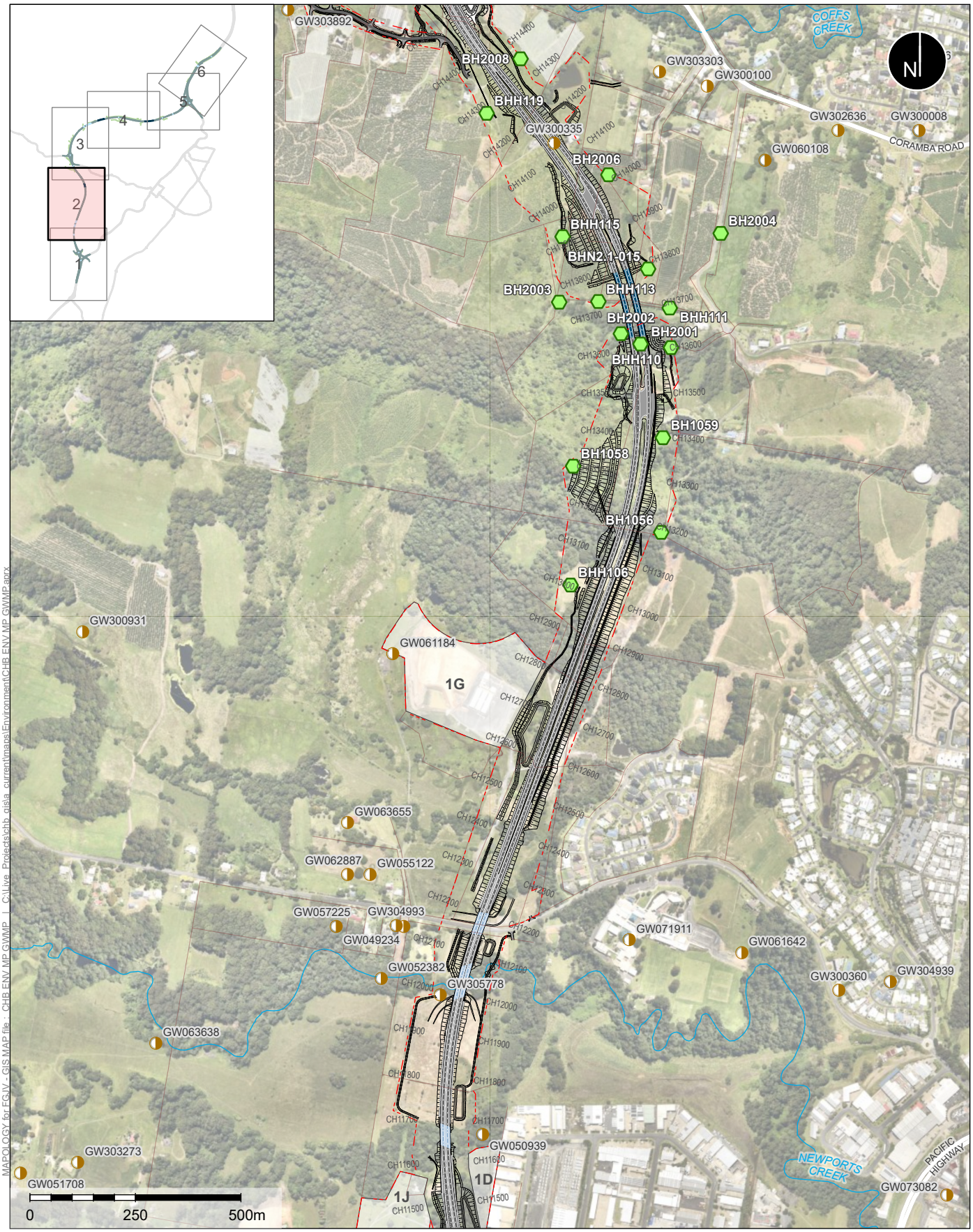
MAPOLOGY for FGJV - GIS MAP file : CHB ENV MP GWMP | C:\Live_Projects\chb_gis\a_current\maps\Environment\CHB ENV MP GWMP.aprx

Approved Construction Boundary – EIS (ARUP, 19/12/2019 as defined in the MCoA)

Ancillary Facilities

Existing groundwater bores (BoM, 1/8/2017)

Figure A-1 | **TfNSW groundwater monitoring locations and corresponding water users/features**



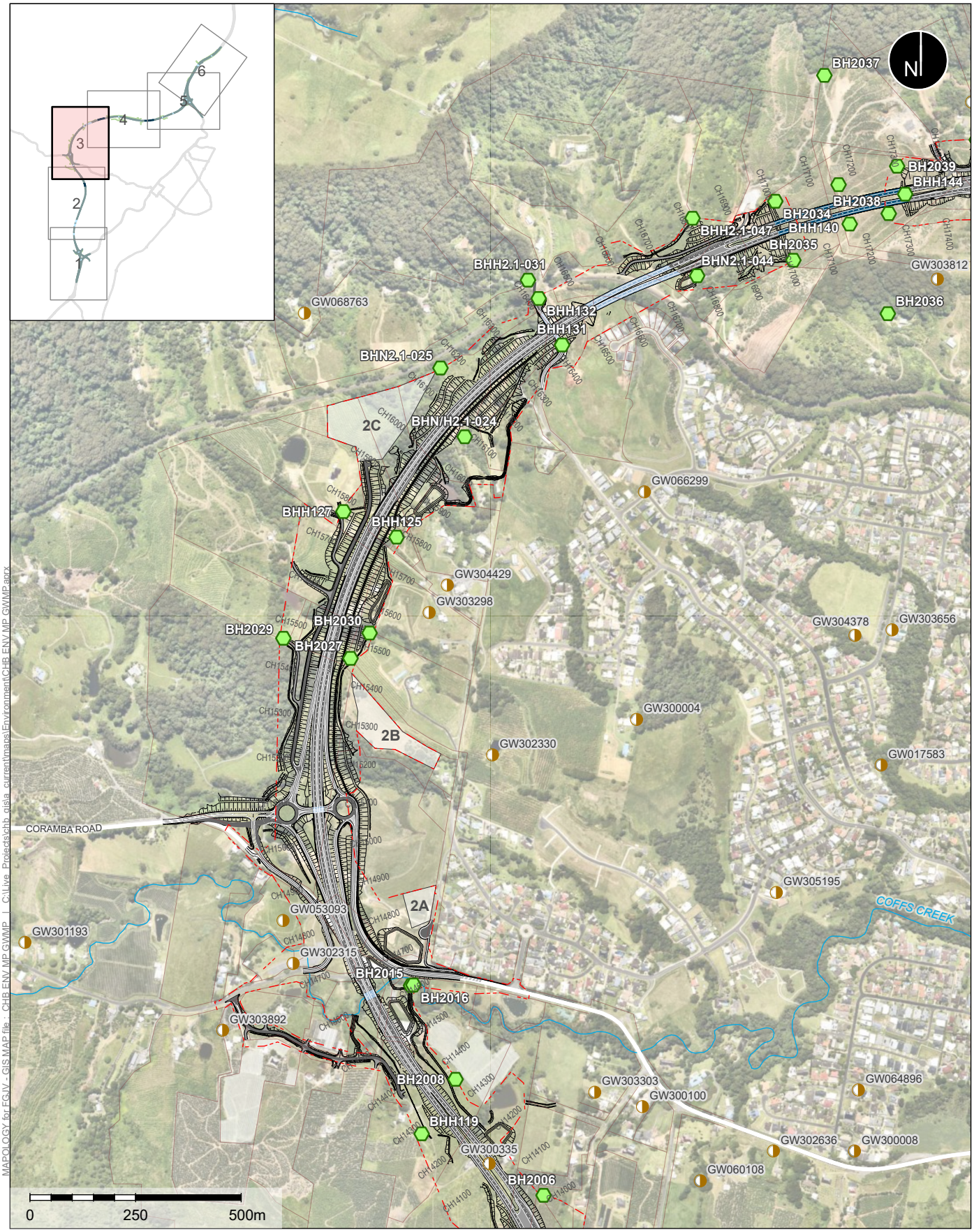
Approved Construction Boundary – EIS (ARUP, 19/12/2019 as defined in the MCoA)

Ancillary Facilities

TfNSW GW Monitoring Locations (compiled 2023.03.29)

Existing groundwater bores (BoM, 1/8/2017)

Figure A-2 | **TfNSW groundwater monitoring locations and corresponding water users/features**



MAPOLOGY for FGJV - GIS MAP file : CHB ENV MP GWMP | C:\Live_Projects\chb_gis\a_current\maps\Environment\CHB ENV MP GWMP.aprx

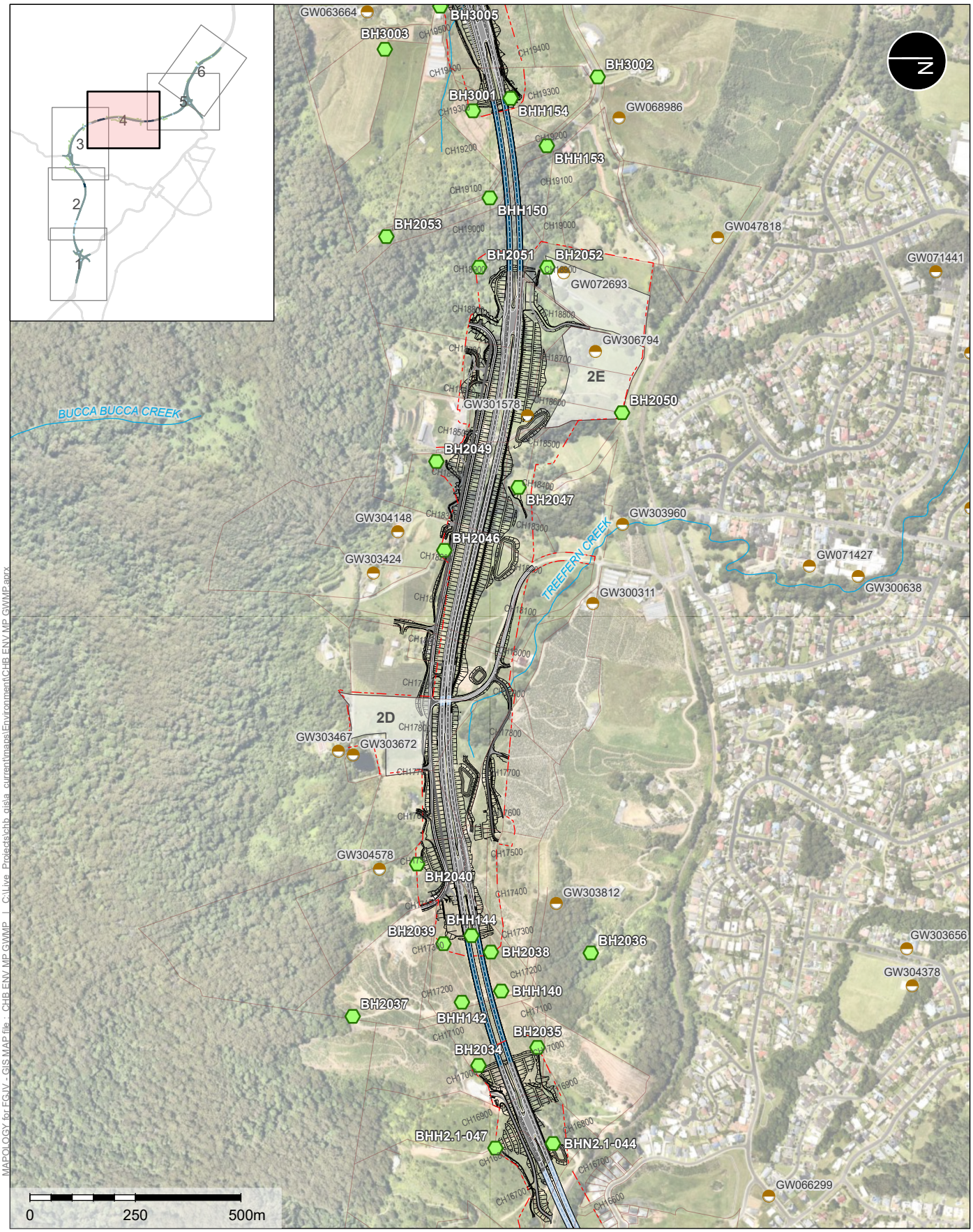
Approved Construction Boundary – EIS (ARUP, 19/12/2019 as defined in the MCoA)

Ancillary Facilities

TfNSW GW Monitoring Locations (compiled 2023.03.29)

Existing groundwater bores (BoM, 1/8/2017)

Figure A-3 | **TfNSW groundwater monitoring locations and corresponding water users/features**



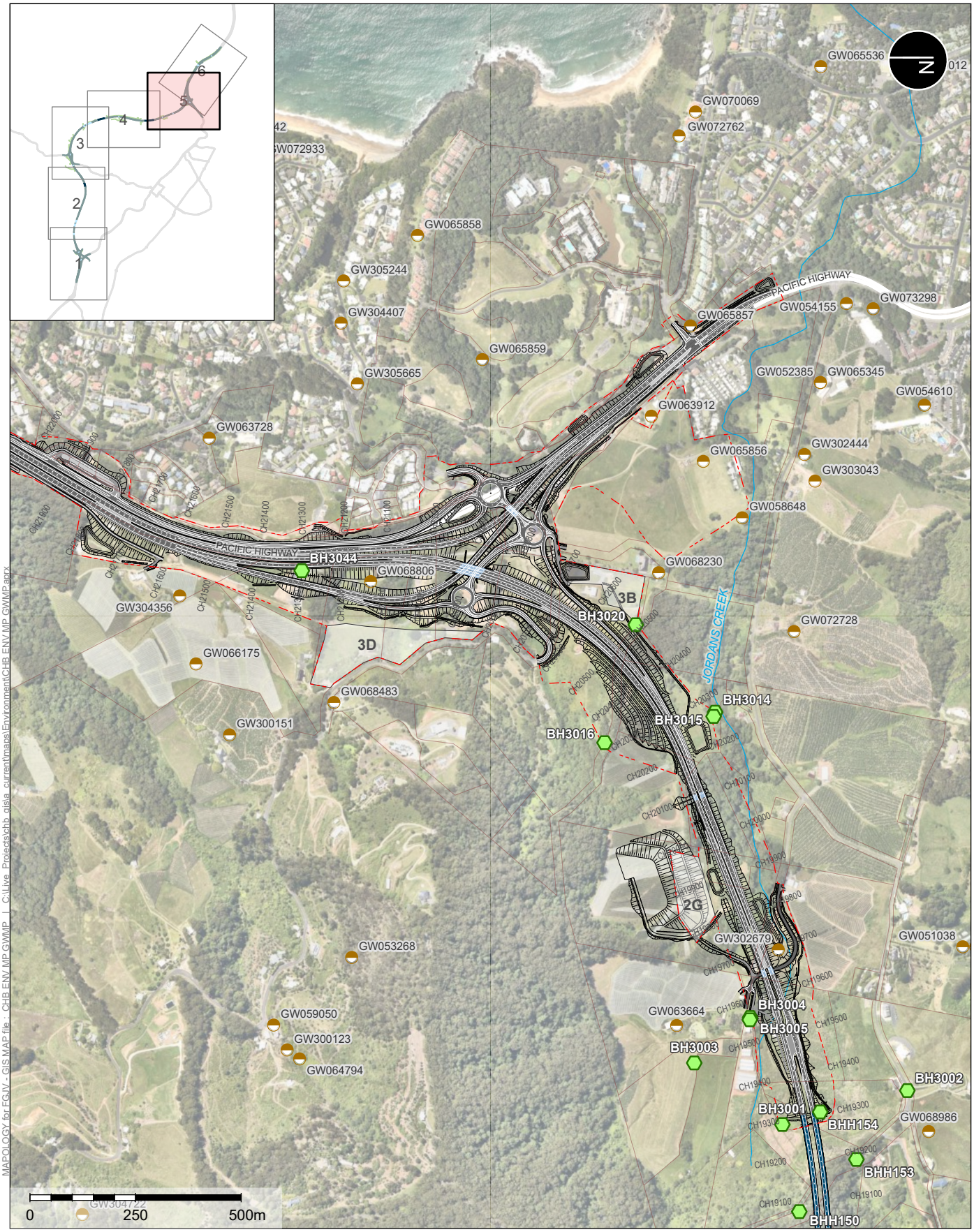
Approved Construction Boundary – EIS (ARUP, 19/12/2019 as defined in the MCoA)

Ancillary Facilities

TfNSW GW Monitoring Locations (compiled 2023.03.29)

Existing groundwater bores (BoM, 1/8/2017)

Figure A-4 | **TfNSW groundwater monitoring locations and corresponding water users/features**



Approved Construction Boundary – EIS (ARUP, 19/12/2019 as defined in the MCoA)

Ancillary Facilities

TfNSW GW Monitoring Locations (compiled 2023.03.29)

Existing groundwater bores (BoM, 1/8/2017)

Figure A-5 | **TfNSW groundwater monitoring locations and corresponding water users/features**

Approved Construction Boundary – EIS (ARUP, 19/12/2019 as defined in the MCoA)

Ancillary Facilities

TfNSW GW Monitoring Locations (compiled 2023.03.29)

Existing groundwater bores (BoM, 1/8/2017)

Figure A-6 | **TfNSW groundwater monitoring locations and corresponding water users/features**

COFFS HARBOUR BYPASS

Unexpected Contaminated Land and Asbestos Finds Procedure

April 2023

COFFS HARBOUR BYPASS
FERROVIAL GAMUDA JOINT VENTURE

CONTENTS

TABLES

GLOSSARY/ABBREVIATIONS

Abbreviation	Expanded Text
ACM	Asbestos Containing Material
ASS	Acid Sulfate Soil
CEMP	Construction Environmental Management Plan
CHB	Coffs Harbour Bypass
DPE	Department of Planning and Environment
EPA	Environmental Protection Authority
EWMS	Environmental Work Method Statement
PASS	Potential Acid Sulfate Soil
RAP	Remediation Action Plan
SWMS	Safe Work Method Statements
TfNSW	Transport for New South Wales
UCLAF	Unexpected Contaminated Lands and Asbestos Finds

1 INTRODUCTION

1.1 BACKGROUND

This Unexpected Contaminated Land and Asbestos Finds Procedure (UCLAFP) (the Procedure) provides management measures for unexpected potential contaminated land and asbestos finds during construction of the Coffs Harbour Bypass (CHB) Project (the Project).

This Procedure contains two sections which address:

- The unexpected discovery of contaminated land, and
- The management of asbestos (including unexpected asbestos finds).

This Procedure addresses the requirements of the Project Minister's Conditions of Approval (MCoA) as identified in Table 1.

TABLE 1 RELEVANT CONDITIONS OF APPROVAL

CoA No.	Condition Requirements	MCOA Addressed
E78	Prior to the commencement of construction that would result in the disturbance of potential or contaminated land and/or soil, a **Site Contamination Report** must be prepared and submitted to the Planning Secretary for Information. The report must be consistent with *Contaminated Land Management Act 1997* (NSW) and prepared by a suitably qualified and experienced person. Nothing in this condition prevents the Proponent from preparing individual Site Contamination Reports for separate sites. Under this condition Panama Disease is not considered to be a contaminant.	Site Contamination Report approved by DPE on 02/11/2022
E79	The Site Contamination Report must provide details on: a) the outcomes of Stage 1 and Stage 2 contamination assessments; b) nature and extent of any existing remediation (such as impervious surface cappings); c) measures to identify handle and manage potential contaminated soils, materials and groundwater; d) whether the land is suitable (for the intended final land use) or can be made suitable through remediation; and/or e) potential contamination risks from the CSSI to human health and receiving waterways.	Site Contamination Report approved by DPE on 02/11/2022
E80	Should remediation be required to make land suitable for the final intended land use, a Remediation Action Plan must be prepared and implemented and submitted to the Planning Secretary for information prior to undertaking remediation. The plan must detail how the environmental and human health risks will be managed during the disturbance, remediation and/or removal of contaminated soil or groundwater.	Remediation Action Plan(s)
E81	If remediation is required, a Section A Site Audit Statement and Site Audit Report, must be prepared by a Site Auditor accredited by the EPA under the Contaminated Land Management Act 1997 (NSW). Nothing in this condition prevents the Proponent from engaging the Site Auditor to prepare Site Audit Statements for individual work sites.	Site Audit Report(s)
E82	A Section A Site Audit Statement and its accompanying Section A Site Audit Report, which state that the contaminated land disturbed by the work has been made suitable for the intended	Site Audit Statement(s)

	land use, must be submitted to the Planning Secretary and Council after remediation and no later than prior to the commencement of operation of the CSSI. Contaminated land must not be used for the purpose approved under the terms of this approval until a Section A Site Audit Statement is obtained which states that the land is suitable for that purpose and any conditions on the Section A Site Audit Statement have been complied with.	
E83	An Unexpected Contaminated Land and Asbestos Finds Procedure must be prepared and submitted to the Planning Secretary before the commencement of work and must be followed should unexpected, contaminated land or asbestos (or suspected contaminated land or asbestos) be excavated or otherwise discovered. The requirements of Conditions E79 to E82 must be incorporated into this Procedure.	This procedure
E84	The Unexpected Contaminated Land and Asbestos Finds Procedure must be implemented throughout work.	This procedure

This document will form part of the Construction Soil and Water Management Plan and should be read in conjunction with that document.

1.2 PURPOSE

This Procedure details the actions to be taken when potential contaminated soil/material (which is taken, for the purpose of this document, to include asbestos containing material (ACM) or actual asbestos) is encountered; in the event that hazardous materials are discovered, this Procedure should be implemented.

This Procedure has been developed in accordance with best practice EPA contamination management guidelines and Transport for New South Wales (TfNSW) specifications.

1.3 SCOPE

This Procedure is applicable to all activities conducted by site personnel (including sub-contractors) for the Project. This Procedure is not applicable to the identification of soils suspected of being contaminated with plant pathogens.

2 UNEXPECTED DISCOVERY OF CONTAMINATED LAND OR ASBESTOS

The steps to be followed in the event that contaminated material is encountered during construction are outlined below. Indicators of contamination in soils include:

- Discolouration of the soil, including staining and horizontal layers of discolouration
- Odours
- Oily sheen on water leaving soils
- Asbestos containing material (e.g. sheeting, pipes and tiles).

Step 1 Potential contaminated soil/material encountered

- Cease work in the immediate affected area
- Immediately notify Foreman, Site Supervisor, and/or Environment Manager (or delegate)
- Install environmental controls around the area to contain the contaminated material, including diversion of upstream water to minimise interaction with the contamination, and capturing water coming from/off the contaminated area.
- Notify TfNSW Environmental Manager of the potential contamination find within 1 day of the find, preferably immediately.
- Environmental Manager will determine if there is a risk of environmental harm from the potential contamination, and if so will notify the EPA accordingly in accordance with the TfNSW Environmental Incident and Notification Procedure.

Step 2 Environmental and Work Health and Safety Management

Prior to any contamination investigations, management or remediation activities, appropriate Safe Work Method Statements (SWMS) and Environmental Work Method Statements (EWMS) will be prepared for review and approval by the Environment Manager.

All works should be done in accordance with the Project Safety Management Plan and associated asbestos specific management plans.

Personal Protective Equipment will be worn as per the relevant Material Safety Data Sheets, and may include:

- Goggles
- Face mask
- Rubber boots
- Rubber gloves
- PPE required for Asbestos Containing Materials

Step 3 Undertaken a contamination investigation

The Environment Manager (or delegate) will assess the situation and if considered necessary commission a suitably qualified contamination specialist to undertake a contamination investigation of the find.

If necessary, the Environment Manager will liaise with the TfNSW Environment Manager and relevant authorities to determine appropriate management options. The Environment Manager, in consultation with specialists, will determine the appropriate management measures to be implemented. This may include leaving contamination undisturbed, capping the contamination, treatment or off-site disposal.

Material to be disposed will be classified in accordance with the *Waste Classification Guidelines* (EPA, 2014) and will be disposed in accordance with the Waste and Resource Management Plan.

If material is determined to be Potential Acid Sulfate Soil (PASS) or actual Acid Sulfate Soil (ASS) the Project Acid Sulfate Soil Management Plan will be implemented.

Notify TfNSW Environmental Manager of confirmed contamination in accordance with the TfNSW Environmental Incident and Notification Procedure.

Step 4 Remedial action

Remedial actions will be incorporated into specific Remediation Actions Plans (RAPs), where required. RAPs will be prepared by a suitably qualified and experienced person and in accordance with all guidelines under the *Contaminated Lands Management Act* (NSW).

RAPs will be prepared by a Contaminated Land Specialist and the Environment Manager and will be submitted to DPE for information prior to the commencement of remediation, in accordance with CoA E80.

Following remediation, a Section A Site Audit Statement and its accompanying Section A Site Audit Report, which state the area has been made suitable for the intended land use must be submitted to DPE and Council prior to the commencement of operation, in accordance with CoA E82.

Relevant EWMS and SWMS will be updated when required.

Step 5 Recommence Work

Once remedial works have been implemented and validated that the remediation strategy has been successful, the Environment Manager will grant approval to recommence work.

3 ASBESTOS MANAGEMENT

Asbestos/ACM fragments that are remnants from previous activities may be scattered throughout the project area, or present in stockpiled material. Asbestos contamination may be encountered when undertaking excavation for road works and/or property adjustments, disturbance of ground and/or pits associated with utilities, during demolition works or removal of structures.

This document has been developed in accordance with relevant legislation, EPA endorsed guidelines (including the waste guideline), industry codes of practice, Roads and Maritime draft *Asbestos management procedure* (Coffey, 2018) and TfNSW specifications.

3.1 ASBESTOS MANAGEMENT PRINCIPLES

3.1.1 RISK CONTROL

ACM encountered during Project works will be identified, managed, encapsulated on site, or removed and disposed of at an appropriately licensed facility. Only appropriately licensed, accredited and insured asbestos removalists will be used to for asbestos management works.

All asbestos management works will be undertaken in accordance with the Project Safety Management Plan and any specific asbestos removal documentation prepared (i.e. Asbestos Removal Control Plan), including the implementation of signage, control of airborne asbestos and monitoring.

3.1.2 MANAGEMENT OF ACM

Factors that influence how ACM in soil is managed include:

- The form of the ACM and the likelihood that it will release fibres into the air
- The location, lateral extent and depth of ACM impacts
- The current and future land use and whether these uses could affect the risk posed by ACM

The Environment Manager will seek guidance from a specialist Contaminated Lands Consultant and/or Occupational Hygeinist to assess these factors.

3.1.3 SOURCE REMOVAL AND OFFSITE DISPOSAL

Table 2 outlines the techniques which may be used to remove ACM in soil.

TABLE 2 ACM REMOVAL TECHNIQUES, APPLICATIONS AND LIMITATIONS

Removal Technique	Applicability and Limitations
Hand Picking	• Suitable for bonded ACM in near surface soils only (i.e., <10 cm); • Raking may enhance removal, although only in sandy soils; • Not applicable for friable asbestos: and • Less effective in areas of dense vegetation.
Tilling	• Mechanical tilling to turn over soil followed by hand picking; • Suitable for bonded ACM in soils to approx. 30 cm in sandy soils; • Not applicable for friable asbestos; and

	• Less effective in areas of dense vegetation, or clayey soils.
Mechanical Screening	• Suitable for large volumes of soil impacted by Bonded ACM; • Susceptible to generate fibres requiring effective dust/fibre control; and • Not applicable for friable asbestos.
Mechanical Excavation	• Physical excavation of soil containing ACM where impact extends beneath surface soils; and • Generates larger volumes of soil that requires further management (i.e., off-site disposal, screening, and hand picking/tilling).

A licensed asbestos removalist will be required for removal works where there is friable asbestos or the contaminated area is great than 10m2. There are two types of asbestos removal licesnses: Class A and Class B. The type of license required depends on the type and quantity of asbestos or ACM to be removed, as outlined in Table 3.

TABLE 3 ASBESTOS REMOVAL LICENSE CLASSES

Licence Type	What Asbestos Can Be Removed
Class A	Can remove any amount or quantity of asbestos or ACM, including; • Any amount of friable asbestos or ACM; • Any amount of asbestos-contaminated dust or debris (ACD); and/or Any amount of non-friable asbestos or ACM.
Class B	Can remove: • Any amount of non-friable asbestos or ACM. Note: A Class B licence for removal of more than 10 m² of non-friable asbestos or ACM but the licence holder can also remove up to 10 m² of non-friable asbestos or ACM. • ACD associated with the removal of non-friable asbestos or ACM. Note: A Class B licence is required for of ACD associated with the removal of more than 10 m² of non-friable asbestos or ACM but the licence holder can also remove ACD associated with the removal of up to 10 m² of non-friable asbestos or ACM.
No License Required	Can remove: • Up to 10 m² of non-friable asbestos or ACM; and • ACD that is; – Associated with the removal of less than 10 m² of non-friable asbestos or ACM; and/or Not associated with the removal of friable or non-friable asbestos and is only a minor contamination.

Removal works will be undertaken in accordance with an Asbestos Removal Control Plan, prepared by the licensed asbestos removalist. If the works is to be undertaken in the vicinity of occupied residence of businesses, notification will be undertaken as required.

The asbestos removal plan will include waste disposal methodology, including method of transport and location of disposal.

More detail on asbestos/ACM disposal can be found in the Project Waste Management Plan.

3.1.4 CLEARANCE

Following removal, the licensed asbestos removalist will arrange for a clearance inspection to facilitate the issue of a clearance certificate and allow construction to recommence in the area. The clearance inspection is conducted by:

- An independent licensed asbestos assessor, for work that was carried out by a Class A licensed asbestos removalist
- An independent competent person, for asbestos work that is not required to be carried out by a Class A licensed asbestos removalist.

A clearance certificate will be issued once the assessor or competent person is satisfied that the asbestos removal area and immediate area are free from visible asbestos contamination. Entry to the area will be permitted following confirmation of certification.

3.1.5 DECONTAMINATION

Decontamination of site personnel, PPE and tools used in asbestos removal work will minimise exposure and spread of asbestos outside the removal area.

Personal decontamination will occur every time a worker leaves the asbestos removal work area. Details of decontamination and disposal of contaminated material will be included in the asbestos removal control plan and requirements for decontamination and safe asbestos handling will be detailed in the Project Safety Management Plan.

4 RECORDS

The Project will maintain a register of any unexpected contamination finds.

An asbestos waste register will be maintained that documents all identified ACM in the Project area, as follows:

- Location, type and condition
- Date of find
- Date of confirmation of ACM
- Maps, photographs or diagrams detailing the location of the area
- Reference to clearance reports for each cleared area

Clearance certificates will be maintained for all asbestos/ACM contaminated areas, while other confirmation of contamination removal/management will be evidenced through Site Auditor Statements as described above.

5 CONTAMINATION MANAGEMENT

5.1 INDUCTION/TRAINING

Where required, all site personnel (including sub-contractors) are to be inducted on the identification of potential contaminated soil/material, along with the requirements of this Procedure during inductions or specific training or regular toolbox talks. More detail on the training of personnel can be found in the Project Construction Environmental Management Plan (CEMP).

Site personnel should be informed of the potential sources of contamination within the project boundary, and indications of contamination in soil and groundwater, such as:

- Odour
- Discolouration
- Evidence of landfilling/ discarded drums
- Visible evidence of asbestos

5.2 ROLES / RESPONSIBILITY

The Project Environment Manager will ensure this Procedure is effectively implemented and all site personnel are aware of the requirements of this Procedure.

The Site Supervisor will be responsible for ensuring that in the event of unexpected finds, site personnel are informed immediately and all work in the vicinity of the find ceases. The Site Supervisor will be informed of

ay required actions for the control of the discovery, such as implementation of exclusion barriers or signage, and will be responsible for ensuring the actions are undertaken.

The Environment Manager will liaise with the relevant authorities (such as EPA, DPE and a Contaminated Land Specialist) where required, and will approved the recommencement of work following any remediation undertaken.

6 REVIEW

Review of this document will be undertaken as part of the Construction Soil and Water Management Plan. Please refer to the CEMP for details about CEMP reviews.

COFFS HARBOUR BYPASS team

APPENDIX G STOCKPILE MANAGEMENT PROTOCOL

COFFS HARBOUR BYPASS

Stockpile Management Protocol

Revision B - Coffs Harbour Bypass

FERROVIAL GAMUDA JOINT VENTURE

VERSION CONTROL

Revision	Date	Description	Approval
A	11/11/2022	FGJV version for review	
B	16/11/2022	Draft for ER Review	
C			
D			
E			

CONTENTS

TABLES

1 OBJECTIVES

The objective of this Stockpile Management Protocol (the Protocol) is to provide specific control measures so as to ensure that stockpiles are managed in accordance with the Minister's Conditions of Approval, and revised environmental management measures (REMMs) listed in the Coffs Harbour Bypass Environmental Impact Statement (EIS) and Submissions and Amendment Report. This Protocol ensures that impacts from the Project are managed correctly so that the material stockpiled is preserved and does not cause environmental harm or nuisance.

This Protocol is subject to endorsement from the Environmental Representative (ER) and the approval of the Secretary as a part of the CEMP, which will then ensure that material stockpile areas located within the construction boundary are not considered to be an ancillary facility. The specific REMMs applicable to stockpile management are provided in Table below.

TABLE 1 REMMS APPLICABLE TO STOCKPILE MANAGEMENT

REMM	Condition	Reference
UD04	Project work sites, including construction areas and supporting facilities (such as ancillary sites) will be managed to minimise visual impacts, including appropriate storage of equipment, parking, stockpile screening and arrangements for the storage and removal of rubbish and waste materials.	Stockpile Management Protocol, Section 4 and Attachment A
SW05	Mulch stockpiles and the potential generation of tannin leachates will be managed through the implementation of a Management of Tannins from Vegetation Mulch Procedure. The procedure will be prepared in accordance with the Environmental Direction for the Management of Tannins from Vegetation Mulch (Roads and Maritime Services 2012). The procedure will include but not be limited to: • Planning and staging vegetation processing activities • Management of temporary mulch stockpiles (less than one week) • Stockpile location and management to minimise the production and release of tannins including use of impermeable bunds and sumps to capture tannin leachate • Monitoring the stockpiles for the production of tannin leachate including post-rainfall inspection requirements • Response(s) to tannin leachate production.	CEMP – Appendix I (Environmental Direction for the Management of Tannins from Vegetation Mulch)
GW01	Stockpiles containing PASS or ASS treatment areas will be lined and bunded in accordance with the Guidelines for the Management of Acid Sulfate Materials (RTA 2005) to prevent leachate contaminating groundwater	Stockpile Management Protocol, Section 4 (SMP09)
GW12	Sites used for stockpiles, washdown areas, refuelling and chemical storage will be located away from areas of shallow groundwater or appropriately lined and bunded to protect groundwater.	Stockpile Management Protocol, Section 4 (SMP10)
WM05	If the hazardous assessment investigations identify asbestos containing materials, an Asbestos Management Plan will be developed and implemented as part of the CEMP. The plan will include: • Identification of potential asbestos on site procedures to manage and handle any asbestos, including potential areas where asbestos may be found within soils • Procedures to manage asbestos if encountered during construction • Measures to minimise the total volume of asbestos contaminated material that is generated. These will include separate stockpiling to ensure that asbestos contaminated material is not mixed with clean stockpile material • Procedures for disposal of asbestos in accordance with NSW EPA guidelines, Australian standards and relevant industry codes of practice.	Asbestos Management Plan

2 PURPOSE AND SCOPE

The purpose of this Protocol is to detail the planning, placement and management of all stockpiles during construction of the Coffs Harbour Bypass Project (the Project). The Protocol will outline the locational criteria used to guide the placement of temporary stockpiles and provides both standard and site-specific mitigation measures to be implemented to minimise impacts on the environment. Stockpile sites may typically be required to store material including, but not limited to:

- Temporary storage of excavated material to be reused in fill embankments and other design features
- ASS subject to treatment prior to reuse
- Temporary storage of excavated material unsuitable for reuse on the Project
- Excess concrete, pavement, rock, steel and other material stored for either future use on the Project or prior to removal from site
- Topsoil, mulch, excess timber for landscaping and revegetation works
- Gravels, fill and asphalt profiling's.

3 REQUIREMENTS

3.1 STOCKPILE LOCATION CRITERIA

Stockpile sites are proposed at all construction ancillary facilities, as well as other areas within the construction footprint. Potential stockpile areas will be required for mulch, topsoil and unsuitable spoil. Potential stockpile areas would also be suitable for the temporary storage of other materials such as unsuitable material, cleared vegetation mulch, rock and excess concrete.

Stockpiles on the Project will apply the following stockpile location criteria, which have been derived from guidance in the EIS and Submissions Report, best practice on previous projects applicable TfNSW Specifications:

a) Be located within an active construction zone within the construction footprint
b) Have minimal amenity impacts to surrounding sensitive receivers, with consideration of noise and vibration impacts, traffic and access impacts, dust and odour impacts, and visual impacts
c) Have minimal impact in respect to waste management and no impacts on flora and fauna, soil and water, and heritage beyond those assessed in the EIS
d) Have environmental and amenity impacts that can be managed through the implementation of the CEMP and CEMP Sub-plans
e) Be located at least 5 metres clear of all areas of possible concentrated water flow
f) Be located at least 50 metres from a defined waterway, including Pine Brush Creek, Jordans Creek, Treefern Creek, Coffs Creek, Newports Creek
g) Be located at least 10 metres from a drainage line
h) Be located on land with slopes less than 10%
i) Not be located within flood prone areas as far as possible.

Where the stockpile location is proposed either outside of the approved clearing limit, Project corridor, or does not meet all of the stockpile criteria, an environmental assessment or environmental review of the proposed stockpile location would be undertaken. This would be submitted to the ER for comment and to TfNSW for approval. Where heritage, threatened species, or endangered ecological communities are affected, a Consistency Assessment or other type of assessment may be required and the Secretary's approval may be required. This assessment will include as a minimum a review of heritage, ecological and water quality issues, distance from receivers, noise, dust issues and may also detail land ownership and lease agreements, and measures to manage or mitigate potential environmental impacts.

4 STOCKPILE MANAGEMENT

Prior to the establishment of any stockpile are for the Project, ensure that:

1. The location of the stockpile is considered against the site selection criteria in Section 3.1
2. The Stockpile Location Register is complete, which has been provided as a draft in Attachment A

3. Site-specific mitigation measures, where they are necessary to further reduced impacts, are identified and detailed in the Stockpile Location Register
4. Mitigation measures for each stockpile site include as a minimum are detailed below in Table 2.

TABLE 2 STOCKPILE MITIGATION MEASURES

ID	Mitigation Measure	Responsibility
SMP01	The perimeter of the stockpile (excluding vehicle access points) will be delineated with a bund (made out of earth/rock or similar) or other type of fencing or barrier such as sediment fence.	FGJV Site Supervisor
SMP02	Be located at least 5 metres clear of all areas of possible concentrated natural water flow It will be avoided where reasonable and practicable that materials will not be stockpiled under the drip lines trees or native vegetation to be retained, and never pushed up around the base of trees. Mulch stockpiles are exempt from this requirement as they do not erode and are light, so as to have minimal impact on compaction of the root systems.	FGJV Site Supervisor
SMP03	Erosion and sedimentation controls will be erected between the site and any drainage lines or down-slope areas.	FGJV Site Supervisor / FGJV Environment Manager
SMP04	A diversion bund will be installed on the uphill side of the stockpile to divert water around the site.	FGJV Site Supervisor
SMP05	Short-term stockpiles will be covered with plastic or kept damp to control dust where required. Longer-term stockpiles (i.e. to remain for greater than 20 days) will be stabilised with cover crop or similar	FGJV Site Supervisor
SMP06	Where stockpiles are located within 200 metres of residences, these stockpile areas will be monitored for odour. If nuisance odours are generated and are impacting sensitive receivers, odour control measures will implemented, if feasible and reasonable. If this is not possible, material found to be emitting odours will be relocated to an alternative stockpile location away from residences.	FGJV Environment Manager
SMP07	Be clearly signed with vegetation community type, soil horizon, waste classification, collection area (by chainage) and date of stockpiling	FGJV Site Supervisor / FGJV Environment Manager
SMP08	Be stockpiled in areas separate from all other stockpiled material to minimise the potential for cross contamination.	FGJV Site Supervisor
SMP09	Stockpiles containing PASS or ASS treatment areas will be lined and bunded in accordance with the Guidelines for the Management of Acid Sulfate Materials (RTA 2005) to prevent leachate contaminating groundwater	FGJV Site Supervisor / FGJV Environment Manager
SMP10	Stockpile areas will be located away from areas of shallow groundwater or appropriately lined and bunded to protect groundwater.	FGJV Site Supervisor / FGJV Environment Manager

5 TRAINING

Personnel involved in planning or managing stockpiles will be trained in the requirements of this Protocol. Training will also include inductions, toolbox talks, pre-starts and targeted training as required.

6 PROTOCOL UPDATE AND AMENDMENT

The processes described in Section 8 and Section 9 of the CEMP may result in the need to update or revise this Plan. This will occur as needed.

Only the Environment Manager, or delegate, has the authority to change any of the environmental management documentation with approval from the Environmental Representative for minor changes to the CEMP/Sub-plans in accordance with CoA D25(i). Where relevant the Acoustic Advisor will also provide approval of minor updates where they pertain to noise and vibration impacts, in accordance with MCoA A30(g).

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the CEMP.

APPENDIX A - STOCKPILE LOCATION REGISTER

Ref no.	Location	Purpose	Stockpile Location Criteria (as per Section 3.1 of the Protocol)								Site Specific Mitigation measures
			a. Within construction footprint	b. Amenity impacts	c. Impacts in accordance with EIS / Submissions Report	d. Can be managed by the Project CEMP	e. Located 5m from concentrated water flow	f. Located 50m from defined waterways	g. Located 10m from drainage line	h. On land with slopes <10%	

APPENDIX H CONTAMINATED LAND MANAGEMENT PLAN

COFFS HARBOUR BYPASS

Contaminated Land Management Plan

Revision B - Coffs Harbour Bypass

FERROVIAL GAMUDA JOINT VENTURE

CONTENTS

TABLES

1 OBJECTIVES

The objective of this Contaminated Land Management Plan is to provide a framework for the management of contamination in compliance with the Minister's Conditions of Approval (MCoA) and revised environmental management measures (REMMs) listed in the Coffs Harbour Bypass Environmental Impact Statement (EIS) and Submissions and Amendment Report.

This Protocol is subject to endorsement from the Environmental Representative (ER) and the approval of the Secretary as a part of the Construction Soil and Water Management Plan (CSWMP) which forms part of the Project Construction Environmental Management Plan (CEMP). The specific REMMs which apply to the preparation of this document are provided in Table 1

It should be noted that this document is not intended to duplicate content. Duplication leads to inconsistencies and errors and can result in issues of non-compliance or miscommunication of Project obligations. Where content is mandated to be included in other documentation, this document will provide a reference to that location which it is more appropriately located.

2 REQUIREMENTS

The following content is required to be addressed by this Contaminated Land Management Plan.

TABLE 1 REMMS APPLICABLE TO THE PREPARATION OF THIS DOCUMENT

REMM	Condition
SC02	A Contaminated Land Management Plan will be prepared and implemented as part of the CEMP for any areas of existing contaminated land or to address land contamination likely to be caused by the activity. The plan will be prepared in accordance with relevant requirements of the Guideline for the Management of Contamination (Roads and Maritime Services 2013d). As a minimum the plan will address the following matters: • Control measures to divert surface runoff away from the contaminated land • Capture and manage of any surface runoff contaminated by exposure to the contaminated land • Further investigations required to determine the extent, concentration and type of contamination, as identified in the Phase 2 contamination investigations • Manage the remediation and subsequent validation any certification land, including any certification required • Measures to ensure the safety of site personnel and local communities during construction • Procedures to identify and manage any unexpected contamination finds during construction.

Table 2lists the requirements of REMM SC02 and identifies the key location or process for the management and source of content of that requirement.

TABLE 2 CONTAMINATION MANAGEMENT FRAMEWORK

Requirement	Location of management detail
Control measures to divert surface runoff away from the contaminated land	The measures to manage surface water, including the diversion of 'upstream' or oncoming water, are described in the Primary Erosion and Sediment Control Plan which forms part of the Project's Construction Soil and Water Management Plan, and will be documented for each site in the Progressive Erosion and Sediment Control Plans (ESCPs), as described in the CSWMP. Appendix OO of the Site Contamination Report (GHD, 2022) details management measures applicable to controlling surface run off that will be incorporated into ESCPs where contaminated materials have been identified. This has been included as Appendix A1.
Capture and manage of any surface runoff contaminated by exposure to the contaminated land.	The measures to control and capture surface water runoff are described in the Primary Erosion and Sediment Control Plan which forms part of the Project's CSWMP, and will be documented for each site in the Progressive Erosion and Sediment Control Plans, as described in the CSWMP. This will include the specific requirement for:

	• Preventing or minimising generation of potentially contaminated surface water runoff through covering, diversions, or otherwise protecting exposed areas of contamination, and • separation of surface water runoff from actual or potentially contaminated areas, for disposal as liquid waste, or treatment and discharge in accordance with the Project Environmental Protection License.
Further investigations required to determine the extent, concentration and type of contamination, as identified in the Phase 2 contamination investigations.	Contamination investigations and findings are described in the Site Contamination Report required by CoA E78 and E79, prepared by GHD and approved by the Department of Planning and Environment on 2nd November 2022.
Manage the remediation and subsequent validation any certification land, including any certification required.	The Site Contamination Report (GHD, 2022) identifies all sites within the construction footprint that require remediation in accordance with CoA E79 and E80. The management of remediation will be through the implementation of a Remediation Action Plan required under CoA E80, which will be subject to review and endorsement by an independent EPA Accredited Site Auditor. The remediation requirements will be site specific and determined on a case-by-case basis in consideration of: • the type of contamination • the final proposed land use of the contaminated area • the potential source receiver pathways available at the completion of construction • the actions required to intercept the source receiver pathways. On completion or remediation, a Section A Site Auditor Statement will be obtained from the independent Site Auditor, as required under CoA E81.
Measures to ensure the safety of site personnel and local communities during construction.	The controls and measures required to be implemented to ensure the safety of personnel and local communities are described in the Project's Safety Management Plan.
Procedures to identify and manage any unexpected contamination finds during construction.	The procedures for the management of unexpected finds of contaminations are described in the Unexpected Contaminated Land and Asbestos Finds Procedure which forms an appendix to the CSWMP.

APPENDIX A1 MANAGEMENT MEASURES

APPENDIX I MANAGEMENT OF TANNINS FROM VEGETATION MULCH

Appendix I – RMS Technical Direction: Management of Tannins from Vegetation Mulch

Transport Roads & Maritime Services

NSW GOVERNMENT

ENVIRONMENTAL DIRECTION

Management of Tannins from Vegetation Mulch

JANUARY 2012

ABOUT THIS RELEASE

Environmental Direction number	25
Environmental Direction title	Management of Tannins from Vegetation Mulch
Author	Environment Branch (Environmental Policy)

Issue	Date	Revision description
1	December 2011	Final draft
2	January 2012	Final

CONTENTS

1 PURPOSE

The purpose of this environmental direction is to set RMS's minimum management measures to minimise the generation and discharge of tannins from vegetation mulch on Roads and Maritime Services (RMS) construction projects. Additional background information on tannins and the use of mulch on construction sites is included in section 3 of this direction.

2 MANAGEMENT MEASURES

The primary focus must be to minimise tannin generation on construction sites.

2.1 General mulch management measures

These general mulch management measures are to be followed for all RMS construction projects.

2.1.1 Planning and works staging

The first step in planning and works staging is to identify the amount of mulch to be generated. With this information, a strategy can be prepared to manage mulch on site. Staging of chipping, tub grinding and/or mulching activities should be planned to reduce the volume of mulch to be managed at any one time. The volume of excess mulch can then be assessed and plans made to dispose of this off site.

Other general considerations at the planning and works staging phase are as follows:

- Mulch stockpile sites should be established with appropriate controls in place before the main site clearing activities commence. Limited clearing may be required earlier for establishment of stockpile areas and access.
- Stage the mulching of cleared vegetation to ensure that mulch can be progressively moved to elevated, or otherwise suitable, stockpile locations. It is preferred that mulch should be transferred to a stockpile or reused on the day of mulching.
- Plan to efficiently reuse mulch in progressive works to reduce the time that mulch is concentrated in stockpile locations.
- Excess mulch can be managed by community giveaway. This takes considerable time and mulch needs to be suitably located and managed as this occurs. The conditions for community giveaway of mulch are included as Appendix 3.
- Any other form of bulk offsite mulch disposal (eg to Council parkland or a development site) must be assessed to ensure waste management provisions are adhered to for off site disposal.

2.1.2 Stockpile location and management

- Mulch stockpile sites should be established on elevated ground where possible.
- Stockpile sites with a duration of not more than 1 month should be constructed not less than 20 metres from a watercourse, including floodplains.
- Stockpile sites with a duration of more than 1 month should be constructed not less than 50 metres from a watercourse, including floodplains.
- Mulch stockpiles should be designed and constructed to divert upgradient water to prevent it from entering the stockpile site.

2.1.3 Management measures for the use of mulch on site

- Do not use mulch for surface cover or sedimentation controls in any low lying areas of the site that remain consistently wet. Alternative controls such as geofabric (for surface protection) or sediment fence will be required in these areas.
- Do not spread surface mulch in thicker than 100mm layers. Mixing mulch with topsoil is encouraged for batters to prevent loss of topsoil during initial stabilisation. It should be noted that mulch will generally cause nitrogen draw down which may inhibit plant growth, unless mulch has been composted first.
- Care is to be taken to ensure that excessive mulch is not applied for sedimentation controls such as perimeter bunds or catch dams.

2.1.4 Monitoring and response

- Monitor the site for generation of tannins. Tannin impacts can be readily identified visually as dark coloured ponded water. Site staff should be trained to identify and report potential impacts to the site project management or environment staff.
- Review management practices where required to prevent the generation of tannins in identified problem areas.

2.2 Mulch management methods for high risk sites

2.2.1 High risk sites

High risk sites, where additional management measures may be required, include:

- where large quantities of mulch will be generated and stockpiled.
- where high tannin generating vegetation types are to be mulched (see 3.1).
- where the receiving environment is identified as sensitive (eg Marine Park, threatened aquatic species habitat).
- where tannins have been observed to be generated or discharged from an operating site with standard management controls.

2.2.2 Stockpile management measures for high risk sites

- Mulch stockpiles for high tannin generating vegetation types should incorporate an impermeable bund to capture stockpile leachate or tannin impacted water. Impervious bunds must be a minimum of 300 mm high, preferably higher to capture tannin impacted water. All bunded stockpiles that are in place for a period longer than one month must include a lined discharge point for overflow in extreme rainfall events.
- Stockpiles established on sloping sites must be designed to provide temporary stormwater containment equivalent to a 300 mm minimum height bund on a flat site.
- Tannin impacted water should be pumped out of bunded stockpiles within 5 days of the end of a rainfall event to maintain the storage capacity. This water should be used for on site purposes including dust suppression and landscape watering. These activities must be managed to prevent any pooling or runoff of tannin impacted water.
- Bunded stockpiles must be inspected within 24 hours of cessation of any rainfall event greater than 10mm to ensure tannin impacted water does not overflow.

2.3 Site management procedures

Site management procedures must be prepared for all sites where tannins are identified as a potential issue. Site management procedures should be based on the management measures provided in this Environmental Direction.

3 BACKGROUND

3.1 Tannin generation from vegetation mulch

See Plates 1 – 3 in Appendix 1.

Tannins are naturally occurring plant compounds. Tannin generation from vegetation mulch is likely to be highest from low-lying coastal floodplain areas. The species of vegetation (eg *Melaleuca*) will have a major impact on the likelihood of tannin generation.

Tannin generation is generally highest from mulched vegetation that is stockpiled in areas that are subject to inundation. Placement in wet areas will result in accelerated leaching of tannins into water, concentration of tannins in pooled water, and greater impacts on water quality.

3.2 Tannin impacts on water quality

See Plates 4 – 5 in Appendix 1.

The main concern with the discharge of water that is high in tannins is that it may increase the biological oxygen demand (BOD) of the receiving environment. Increases in BOD may result in a decrease in available dissolved oxygen. A lack of dissolved oxygen is identified as the main cause of about 80 percent of fish kills in NSW rivers and estuaries.

Tannin impacts may result in dark coloured water discharge from construction sites. This impact can be obvious and may raise the concern of the community and other stakeholders including regulatory authorities. Once discharged to the environment, tannins may reduce visibility and light penetration and change the pH of receiving waters. These impacts may affect aquatic ecosystems in receiving environments.

Tannins cannot be readily treated with standard construction site water quality controls. Once water on site is impacted with tannins it is not possible to treat effectively with currently approved flocculants. Minimisation of tannin generation in the first place is the management strategy that must be applied.

3.3 Use of mulch on construction sites

See Plates 10 – 16 in Appendix 2.

The RMS Biodiversity Guidelines provide guidance on the benefits of reusing various sizes of vegetation for different purposes. Mulch is a readily available and cheap source of material for temporary site stabilisation and sedimentation control. The re-use of mulch reduces the need to transport this material off-site and reduces handling and disposal costs for construction contracts.

Unprotected mulch sedimentation controls should not be placed in concentrated flow lines where mulch may be washed away. Mulch may be protected by wrapping it with geofabric or other materials to provide a stable control. All temporary catch dams constructed from mulch must have a stable outlet to minimise the washing away of mulch in high rainfall events, and the possible failure of the control.

4 ADDITIONAL RESOURCES

- RTA Biodiversity Guidelines- Protecting and Managing Biodiversity on RTA Projects, 2011
- Pacific Highway Mulch Protocol 2011

5 APPENDICES

Appendix 1: Plates showing tannin generation & water quality impacts

Plate 1: Melaleuca vegetation community – mulch from this vegetation type will generally produce high amounts of tannins.

Plate 2: Vegetation mulching activity – mulch should be progressively moved into prepared stockpile areas.

Plate 3: Tannin generation from recently felled and partially mulched vegetation in an area subject to localised inundation. Mulched vegetation should be progressively moved to prepared stockpiles to manage tannin impacted water.

Plate 4: Tannin impact in stormwater at the discharge point from a road construction site. The discharge of impacted water may be obvious to community and other stakeholders.

Plate 5: Tannins in a drainage line generated from very thickly applied mulch on the batter above. Note that the sedimentation fence is not effective in treating the tannins.

Appendix 2: Plates showing the use of mulch for erosion & sedimentation controls

Plate 6: Mulched vegetation stockpiled in a low-lying area subject to inundation. This is not an appropriate stockpile location and may increase the generation of tannins from stockpiled mulch.

Plate 7: Mulch being placed as batter erosion control. Mulch should not be applied in layers more than 100 mm thick for surface stabilisation.

Plate 8: Site showing recent application of a mulch/topsoil mix on batters (40% mulch to 60% topsoil). Mulch mixes are used to provide temporary stabilisation to prevent the loss of topsoil from batters in heavy rainfall events. Mulch use is also shown as a mounded sedimentation control to prevent sediment entering the median drain.

Plate 9: A mulch/topsoil mix used to provide temporary batter stabilisation and to assist cover crop establishment.

Plate 10: Successful establishment of cover crops on batters where mulch has been used with topsoil to assist temporary stabilisation.

Plate 11: Geofabric wrapped mulch bunds used for sedimentation control

Plate 12: Mulch used as a bund for a temporary sedimentation catch dam. Mulch is effective as it can provide both containment and filtering of site water. Mulch should not be used as a control in areas of concentrated flow where it may be washed away. Any mulch containment control should have a defined and lined outlet that allows discharge from the control without washing mulch away. Note that this control does not have a defined discharge outlet which should be installed to prevent failure of the control in heavy rainfall events.

Appendix 3: Minimum requirements for community mulch giveaways

The purpose of community mulch giveaways is to provide mulch for residential landscaping purposes.

The activities of a community mulch giveaway are permissible under the *Protection of the Environment Operations (Waste) Regulation 2005 – General Exemption Under Part 6, Clause 51 and 51A* (the Raw Mulch Exemption 2008). However, the activities remain subject to other relevant environmental regulations within the Act and Regulations. The Raw Mulch Exemption 2008 is subject to the following conditions:

- The raw mulch can only be applied to land for the purposes of filtration or as a soil amendment material or used either singularly or in any combination as input material(s) to a composting process.
- The consumer must land apply the raw mulch within a reasonable period of time.

Further information can be found at: www.environment.nsw.gov.au/resources/waste/ex08mulch.pdf

It is the mulch generators responsibility to ensure that the mulch is reused in an environmentally responsible manner.

A safe work method statement (SWMS) must be prepared that identifies potential OHS risks and all prevention and mitigation measures. The SWMS must apply to both the community and site workers involved in the mulch giveaway.

Each member of the community who participates in the mulch giveaway must read and understand a site specific information sheet. A template information sheet is attached as Appendix 4.

The site occupier must maintain written records for each load of mulch that is taken away and to ensure that each community participant understands the conditions of the community mulch giveaway information sheet. A suggested template to record this information is attached as Appendix 5.

Appendix 4: Community mulch giveaway information sheet

The following community mulch giveaway information sheet must be populated with site specific information.

Community Mulch Giveaway
Information Sheet

Details of Mulch Supply	
Site Occupier	<insert name of contractor / alliance etc>
Project Name	<insert project name>
Location	<insert location of mulch stockpile>
Mulch stockpile access directions	<insert adequate directions for community members to find the stockpile location>

Background

- This information sheet supports the non-commercial giveaway of mulch for local residents.
- The product is raw vegetation mulch from <insert project location / name>.

Conditions

- Any one individual may only take a maximum of 5 trailer loads from this project.
- The mulch may only be used for residential landscaping purposes.
- Mulch must not be placed in or immediately adjacent to waterways.
- The raw mulch can only be applied to land for the purposes of filtration or as a soil amendment material or used either singularly or in any combination as input material(s) to a composting process.
- The consumer must apply the raw mulch to land within a reasonable period of time.

Community Safety Requirements

- <add in any safety requirements or mitigation measures from the SWMS that apply to the community>
- <add in any safety requirements or mitigation measures from the SWMS that apply to the community>
- <add in any safety requirements or mitigation measures from the SWMS that apply to the community>
- <add in any safety requirements or mitigation measures from the SWMS that apply to the community>

Appendix 5: Records template for community mulch giveaway

The records in the following suggested template must be kept as a minimum.

Community Mulch Giveaway Record Sheet				
Date	**Car Registration**	**I have read and understand the 'Community Mulch Giveaway Information Sheet'**	**Name**	**Signature**
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		
		❑ Yes		