Concept Erosion and Sediment Control Plan

White Patch Esplanade

BASE/

Client:	Moreton Bay Regional Council
Reference:	J210

Document Control

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Issue	Date	Prepared By
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1.0 Pramble

This Concept Erosion and Sediment Control Plan (CCESCP) has been prepared and endorsed by Certified Professional in Erosion and Sediment Control (CPESC) based on documentation and assumptions as provided by the Client. If any of the Project elements differ including, but not limited to; Project design, rehabilitation type and methodology and final site conditions, this plan will be reviewed to determine suitability and, where required, updated to reflect, and manage these changes. This review process will be completed via a site inspection, updating of document to ensure any new potential environmental risks have been appropriately addressed.

Risks and the nominated mitigation management need to be based on up-to-date information which may need to be updated within the working ESC design used onsite. If site conditions differ, additional testing or analysis may also be required to meet legislative requirements and best practice guidelines for the management of soils, erosion, and sediment-laden water during the operational phase.

Supplementary documentation such as maps and drawings, appended to or contained within this plan, have been developed by an appropriately qualified CPESC, and are not to be separated or read in isolation from this plan or modified by third parties.

The location of the individual ESCs when nominated in any drawings appended to this plan are indicative only. The exact location of each ESC will be determined onsite by the construction contractor in consultation with the relevant site personnel. The process for revision of this document is outlined within section 3.3 below.

Table 1-1: Abbreviations

Abbreviation / Acronym	Description
ARI	Average Return Interval
CEMP	Construction Environmental Management Plan
CESCP	Concept Erosion and Sediment Control Plan
CG	Coordinator General
CPESC	Certified Practitioner in Erosion and Sediment Control
DES	Department of Environment and Science (QLD)
EP Act	*Environmental Protection Act 1994*
EP Regs	Environmental Protection Regulation 2008
EPP (Water)	Environmental Protection (Water) Policy 2018
ESC	Erosion and Sediment Control
ESCP	Erosion and Sediment Control Plan
GED	General Environmental Duty
IECA	International Erosion Control Association (Australasia)
IECA Guidelines	Best Practice Erosion and Sediment Control Guidelines 2008 (IECA)
NATA	National Association of Testing Authorities
RUSLE	Revised Universal Soil Loss Equation

2.0 Introduction

2.1 Project Background

The project is located on western side of Bribie Island at White Patch Esplanade approximately four kilometres north of the Bribie Island bridge. The road crosses Wrights Creek and acts as the solitary link between the community of White Patch to the north to the remainder Bribie Island to the south. Bribie Island National Park adjoins the road to the north east of the crossing. Pumicestone Passage is located to the west of the project and forms part of the greater Moreton Bay area. Refer to Figure 1 below.

Previous to the flood event in February 2022 the crossing consisted of a causeway with a series of steel pipes which allowed continuous tidal flow through to Wrights Creek. The flood event saw the washout of these pipes under the road along with the surrounding rock material and public utility services. A temporary road crossing was established in the same location with pipes, and a combination of concrete and rock fill. The temporary crossing is currently in operation and open to traffic until the permanent structure is built.

2.2 Proposed Development Details

All works on the project are to be undertaken within the existing road reserve for White Patch Esplanade. No work shall be conducted on the north eastern side of the road near the Bribie Island National Park. The work for the project includes construction of:

- A bridge structure on an alignment immediately to the west of the existing road to accommodate two lanes and a shared path. This includes the construction of bridge abutments on the bank of either side of Wrights Creek.
- The northern approach of White Patch Esplanade is required to be moved to the west of the existing road to align with the new bridge and will involve clearing of native vegetation.
- The southern approach to be moved to the west onto the road verge.
- Removal of a section of the existing causeway structure in Wrights Creek.
- New shared paths either side of the bridge to connect to existing network
- Stormwater drainage on either side of the road
- Temporary construction areas such as site office and parking, laydown yard and access tracks

3.0 Scope

The Project has nominated to develop, implement and maintain an CESCP in accordance with the International Erosion Control Association (IECA) Australasia Best Practice Erosion and Sediment Control Guidelines 2008. This CESCP has been prepared taking into consideration the Project's proposed methodology and as required, will be updated prior to and during the construction period to suit the current construction activities.

This CESCP has been developed as the overarching document to identify and manage the Project's erosion and sediment control aspects and risks. It outlines the key ESC principles, objectives, and targets as well as overarching management requirements. The CESCP will be updated prior to construction commencing and then reviewed annually and/or as key Project construction milestones are achieved that had not been considered at the time of preparing this plan.

The CESCP also contains an ESC design information. The ESC design includes site specific revised universal soil loss equation (RUSLE) calculations and ESC design types (1, 2 and 3) techniques nominated for each catchment and or sub-catchment. The ESCP is considered a live document and updated to reflect and manage key phases of the Project including:

- Clearing and grubbing and preliminary earthworks;
- In stream works including abutment and bridge works; and
- Final form including removal of the sections of the existing causeway.

3.1 Purpose

The purpose of this plan is to demonstrate:

- Erosion and sediment management is in accordance with IECA's Best Practice Erosion and Sediment Control (2008) Guidelines with the outcome of achieving the water quality objectives detailed within the conditions of Environmental Approvals from relevant authorities; and
- Provide an outline of the management requirements pertaining to Project-wide ESC. This will be completed by the provision of site-specific CESCPs for all stages of construction and rehabilitation within the construction footprint around sensitive receptors.

3.2 Objectives

The key objectives of this CESCP are to:

- Comply with Queensland legislative requirements related to ESC;
- Reduce the potential for erosion and subsequent sedimentation across the Project site;
- Minimise the potential for sediment loss from work areas; and
- Minimise the potential impacts on water quality, water courses and aquatic flora and fauna resulting from construction of the Project.

3.3 Document Revision and Distribution

This CESCP will be amended and redistributed following the onboarding of the construction contractor and updating of the CESCP into a detailed ESCP to suit their construction methodology. The plans would contain site-specific controls, based on catchment and contour information, which would then be used in the field to manage the construction works. The plans provided in Appendix C of this document provide guidance as to typical controls that would be used to manage the works.

Based on this document Progressive Erosion and Sediment Control Plans (PESCPs) shall be completed by the construction contractor for each project area prior to works commencing. The PESCPs shall contain site-specific controls, based on catchment and contour information, and these documents will be used in the field to construct the controls.

4.0 Site Description

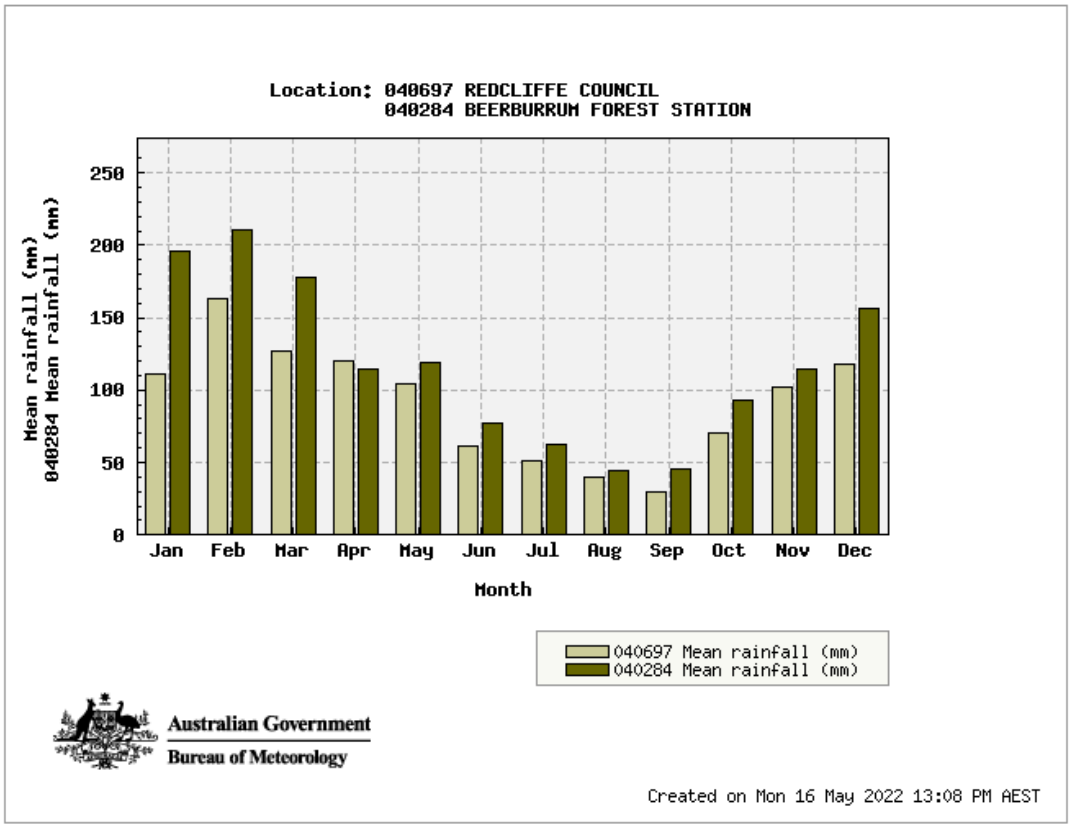
4.1 General

White Patch Esplanade consists of road reserve parcels either side of the waterway which also include adjoining land that is currently vegetated. To the northeast is the Bribie Island National Park on Lot105 AP22462. On the southern side the area is open space parkland on both sides of White Patch Esplanade (Lot2 SP177807, 3SP 177807 and Lot201 RP209320) with residential dwellings further to the south on Flamingo Drive and Solander Esplanade. The remaining tidal and waterway area outside of the land parcels which is below the Highest Astronomical Tide (HAT) line is unallocated State Land.

4.2 Climate

Figure 4 below presents the BOM data for nearby locations which show that the summer months have higher mean rainfall than the winter months. Based on the BOM data, total mean rainfall across both stations ranges from less than 100mm/month in the drier months, to over 200mm/month in the wetter months.

Figure 1 Monthly Rainfall Data



4.3 Waterways and Water Quality

The project area spans Wrights Creek which is a tidal waterway that connects wetland areas of central Bribie Island and Pumicestone Passage.

Under the *Environmental Protection (Water and Wetlands Biodiversity) Policy 2019*, environmental values and water quality objectives for Pumicestone Passage include waters on Bribie Island, including both fresh (non-tidal) waters and tidal waters. The study area intersects Wrights Creek, which is mapped as enclosed coastal/lower estuary at the mouth and middle estuary upstream. Both ecological and human use environmental values are nominated as applicable to the waters in the study area, including:

- Aquatic ecosystems – moderately disturbed
- Seagrass
- Aquaculture
- Human consumer
- Oystering
- Primary recreation
- Secondary recreation
- Visual recreation
- Cultural and spiritual values.

The most stringent water quality objectives to protect assigned environmental values for the study area are for aquatic ecosystems and are presented in Table 7.

Table 4-1 Water Quality Objectives

Parameter	Objective
Turbidity	<6 NTU
Suspended solids	<16 mg/L
Chlorophyll a	<2.5 µg/L
Total nitrogen	<220 µg/L
Oxidised N	<3 µg/L
Ammonia N	<6 µg/L
Organic N	<210 µg/L
Total phosphorus	<25 µg/L
Filterable reactive phosphorus (FRP)	<7 µg/L
Dissolved oxygen	90 – 150% saturation
pH	8.0 – 8.3
Secci depth	> 1.4m

The Healthy Land and Water Report Card for the Pumicestone Passage area assigned the waterway a B+ with the catchment declining from excellent to good condition over the period of assessment. Key factors affecting water quality in the passage are:

- Tidal flushing of the southern passage from Deception Bay with a net northern movement of water through the passage; and
- During flood events catchment runoff.

Water quality monitoring is regularly conducted by DES in Pumicestone Passage with the nearest monitoring site approximately 1800m to the south of the project. Refer to Table 8 below:

Location: Pumicestone Passage EHMP E01301

Latitude, Longitude: -27.05273, 153.13202

Date / Time: 10 March 2022 / 17:05

Table 1 DES Water Quality Monitoring

Indicator	Data Value
Temperature	26.7 ºC
Conductivity	27.66 mS/cm
Salinity	16.96 g/L
pH	8.25
Dissolved Oxygen Saturation	102.1 %
Dissolved Oxygen	7.44 mg/L
Turbidity	2.35 NTU
Chlorophyll a	4.60877 ug/L
Nitrogen Total	0.46 mg/L
Nitrogen Ammonia (NH3)	0.070 mg/L
Nitrogen Oxidised (NOx)	0.045 mg/L
Phosphorus Total	0.017 mg/L
Phosphorus Filterable Reactive (FRP)	0.013 mg/L

Additional to this, mapping under the Moreton Bay Regional Council (MBRC) planning scheme identifies the study area contains the following constraints regarding water quality:

- Area is within the coastal hazard erosion prone area;
- Area is mapped as a high-risk storm tide inundation area;
- Area is partially mapped as high probability of acid sulfate soils (ASS).

4.4 Flora and Fauna

A series of desktop and field based assessments were undertaken to identify the current status of the project site with respect to significant flora, fauna and ecological communities. The Survey Area incorporates three (3) distinct vegetation communities including:

- non-remnant mown parklands and road verges (2.2 ha);
- remnant open forest to woodland vegetation dominated by *Corymbia intermedia, Lophostemon confertus* and locally dominant *Callitris columellaris* (2.0 ha); and
- low closed mangrove forest dominated by *Avicennia marina* covered 1.1 ha of the Survey Area.

Additionally there are intertidal mudflats adjacent the low closed mangrove forest and deeper water associated with Wrights Creek and the culvert under White Patch Esplanade (0.6 ha).

4.5 Topography, Geology and Soils

Bribie Island is a large sand island separated from the mainland by Pumicestone Passage. The project area is located on the western side of the island, at the mouth of Wrights Creek. Across the project there is negligible change in elevation along the length of the area. At the most western point the elevation is 5 mAHD, lowering to 1.8 mAHD at the most eastern extent of the study area, which measures approximately 710m from west to east.

The study area is within a unit mapped as low-lying coastal plain consisting of freshwater swampland behind the modern beach dunes, mud flats and saline marshes. The chief soils are acid peats of the swamplands, with subsoil consisting of coarse sands and leached sands. The project waterway area is surrounded by tidal sand and mudflats.

Investigations recently undertaken by Unity Water indicated that the project area consists of sand in the form of alluvium or coffee rock down to 15m (Geotechnical & Acid Sulfate Soils Investigation Report – Watermain Replacement White Patch Esplanade, Bribie Island, Core Consultants, May 2022). The topsoil onsite was found to consist of a shallow layer of silty sand.

State Planning Policy 2/02 Planning and Managing Development Involving Acid Sulfate Soils (Spp 2/02) designates a that if surface elevation is at or below 5mAHD, further assessment is required. As the study area is wholly within an area below 5mAHD, a review of the Soil and Land Information (SALI) database was undertaken to assess the likelihood of ASS in the study area.

The presence of acid sulfate soils was confirmed through recent testing undertaken on behalf Unity Water in the vicinity of the project. Three boreholes were located along the White Patch Esplanade corridor either side of the crossing but not within Wrights Creek. Testing indicated that either existing acidity or potential acid sulfate soils were consistently present below 2-3m in all locations down to 15m. (Geotechnical & Acid Sulfate Soils Investigation Report – Watermain Replacement White Patch Esplanade, Bribie Island, Core Consultants, May 2022).

4.6 Cultural Heritage

The Project is located within the Kabi Kabi First Nation Traditional Owners Native Title Claim Group (QC13/03 – QUD280/2013) (Kabi Kabi People). A cultural heritage assessment report has been prepared by Converge Heritage consultants on behalf of Moreton Bay Regional Council.

A site inspection was undertaken of the project area with no material items found although this is due to poor Ground Survey Visibility. Mature trees were also inspected for culturally derived scarring and none were found. One DATSIP registered shell midden site was found in the vicinity of the project area on the southern side of Wrights Creek to the west of the tidal drainage line in front of the parkland.

4.7 Surrounding Land Uses and Tenure

White Patch Esplanade consists of road reserve parcels either side of the waterway which also include adjoining land that is currently vegetated. To the northeast is the Bribie Island National Park on Lot105 AP22462. On the southern side the area is open space parkland on both sides of White Patch Esplanade (Lot2 SP177807, 3SP 177807 and Lot201 RP209320) with residential dwellings further to the south on Flamingo Drive and Solander Esplanade. The remaining tidal and waterway area outside of the land parcels which is below the Highest Astronomical Tide (HAT) line is unallocated State Land.

5.0 Legal Requirements

5.1 General Environmental Duty

Under the *Environmental Protection Act 1994* (Qld) (EP Act), stormwater run-off from land development and infrastructure development sites has a high potential to cause water contamination and/or environmental harm.

Key sections of the EP Act referencing water contamination include:

- Under s.440ZG it is an offence to unlawfully deposit a prescribed water contaminant to waters. Prescribed contaminants are listed in Schedule 9 of the *Environmental Protection Regulation 2009* (Qld) (EP Regulation).
- Under s.319 persons in Queensland carrying out activities which may cause environmental harm must comply with the general environmental duty (GED). This requires that all reasonable and practicable measures must be adopted to prevent and minimise environmental harm. Although not being able to demonstrate compliance against GED is not an offence, demonstrating that all reasonable and practicable measures have been adopted is a defence for offences such as water contamination. For instance, under s.493A being able to demonstrate compliance with GED would provide a defence against unlawful environmental harm caused by a prescribed water contaminant being released. Demonstrating that all reasonable and practicable measures have been conceived and implemented should encompass:
    - Thorough and ongoing site assessments.
    - Consideration of, and adaptation for, site-specific erosion risk factors including topography, soil type, climate, and season.
    - Incorporation in the design, installation, operation, management, maintenance and monitoring of control measures which are consistent with the measures set out below.
- Reference must be made to s.493A when a decision is made about the unlawfulness of water contamination, for instance where the release is authorised under a development approval.
- The *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (Qld) (EPP Water) provides a process for protecting Queensland waters by establishing environmental values (EV) and water quality objectives (WQO) for Queensland waters (see Schedule 1 of the EPP Water). For waters not included in Schedule 1, the EPP Water provides a process for determining the EVs and WQOs.

5.2 Duty to Notify

At a minimum, all sediment, erosion, and surface water quality incidents should be reported to the relevant Project Supervisor as soon as practical. Examples of incidents to report include:

- Degradation of surface water quality on and offsite
- Build-up of sediment in sediment control devices
- Uncontrolled discharge from the site
- Damaged or failed erosion control devices

Where exceedances of the criteria occur, The Project shall notify the nominated Regulatory Agency immediately. The Project shall complete an interim investigation report outlining the breach of water quality performance requirements and the corrective actions being implemented because of the breach. As soon as practicable, The Project shall complete an investigation into the potential for environmental harm and provide a written report outlining:

- Details of the investigation carried out; and
- Actions taken to prevent environmental harm.
- All water quality data shall be kept onsite and be available on request.

Should site personnel become aware that environmental harm has or is occurring or likely to occur, action must be taken to report such an occurrence. Incidents or potential incidents will be reported to the Project Manager who will, in turn, review and notify the administering authority as necessary to satisfy reporting requirements obligation (the ‘Duty to Notify’).

6.0 Roles and Responsibilities

6.1 General

All Project personnel including subcontractors have an environmental duty to prevent environmental harm. Responsibilities include:

- Familiarising themselves with their responsibilities within this plan and environmental management systems;
- Attending all Site Inductions and Pre-Start talk and Site Attendance Record;
- Participate in site inspections, audits, environmental meetings, Toolbox Talks, environmental forums etc. where requested/required;
- Compliance with all site environmental rules;
- Using and following all controls established for eliminating or controlling environmental risks including those found in environmental documentation e.g. Work Method Statement (WMS), plans, work instructions, standard operating procedures etc.;
- Stopping work if the environment is placed at risk and discussing strategies to rectify environmental concern(s) immediately with the Site Foreman. If it is not resolved satisfactorily, the Project Manager is to be contacted;
- Reporting all hazards, incidents, near misses immediately to the Site Foreman as soon as it is safe to do so and prior to leaving the site;
- Actively participate in reviews of the risk assessments eg Job Hazard Assessment (JHA), Work Method Statements (WMS) etc. for task(s) where the environment is to be directly affected.
- When the circumstances of a work activity change, the site personnel must notify the Site Foreman. Should the change result in necessary changes to the JHA, WMS or any other environmental documentation, then these documents must be revised and approved by the relevant Project Engineer and Environmental Representative and communicated at the following Toolbox Talk to the necessary personnel;
- All site personnel who sign onto a WMS are empowered to identify, implement and advise of adjustments to the WMS;
- Complying with all environmental responsibilities assigned in relevant legislation, approvals, permits procedures, WMS, plans, job descriptions or any other environmental documentation;
- Raising any environmental issues or concerns immediately or during meetings with Environmental Representative or Project Manager; and
- Upholding an active interest in workplace environmental conditions and practices.

6.2 CPESC

The Site CPESC reports to the Environmental Manager and is responsible for the following:

- Ensuring this plan is implemented to meet the requirements for the Project;
- Technical development of plans as per required standards and legislation;
- Provision of adequate environmental training to all staff, subcontractors and visitors to the site;
- Liaising with the Project Manager and Client on remedial and corrective actions in response to non-conformances of this plan;
- Familiarising themselves with their responsibilities within this plan;
- Distributing to relevant personnel any revisions or amendments of this;
- Ensuring that all personnel employed or engaged on site understand and observe the requirements of this plan;
- Participating in site inspections, audits, reviews etc.;
- Monitoring the implementation of this plan; and
- Informing the Project Manager immediately of any situations that may place The Project, the Client, employees or others at serious risk where policies and procedures have failed to rectify the risk.

7.0 Potential Impacts During Construction

There are a number of potential environmental impacts associated with general construction activities causing increased soil erosion and subsequent sedimentation loss into the surrounding environment. Soil erosion can be defined as the wearing away of the earth surfaces by the action of external forces such as rainfall, running water or wind. Sedimentation is the deposition of sediment displaced by various erosion processes.

If not managed correctly during construction, soils are prone to excessive erosion, compaction and structural degradation. This can lead to downstream sedimentation of waterways and associated aquatic environments, mobilisation of pollutants, increased susceptibility to dust generation and reduced rehabilitation success.

Transport of sediment off site by construction vehicles and machinery can also result in increased nutrient, sediment and other contaminants in receiving waters as well as the deterioration of water quality and of aquatic environmental health.

The construction phase of the Project will require initial vegetation clearing and grubbing, earth works in the form of cut and fills activities as well as the formation of batter slopes and embankments, resulting in localised changes to landform contours and topography. Additionally, activities associated with construction of the Project have the potential to alter or impede overland surface flow and drainage patterns.

Soil erosion presents a high risk during the construction phase of the Project due to the removal of vegetation and the proximity to waterways. The potential for acid sulfate soils within the Project footprint are also being investigated further to determine specific locations and management requirements.

7.1 Clearing and Ground Disturbance

The activities and aspects of the works that have potential to lead to erosion, sediment transport, siltation and potential contamination of natural waters may include:

- Removing existing vegetation;
- Disturbing non-erodible surfaces to expose erodible material;
- Stockpiling of excavated or erodible materials;
- Conducting earthworks within or adjacent to drainage paths;
- Inappropriate construction techniques;
- Inadequate or ineffective erosion controls;
- Ineffective sediment control measures; and
- Inadequate resources for the operation and maintenance of environmental control measures

7.2 Work in Waterways

Construction of temporary and permanent works within the waterway poses a significant risk to water quality for the project. Activities include:

- Removal of vegetation on the banks of the waterway
- Construction of temporary piling pads within the waterway
- Piling for bridge piers
- Construction of abutments and placement of fill material
- Placement of rock scour material in waterway around new bridge structure
- Removal of existing causeway structure and remediation of banks

7.3 Flora and Fauna

Removal of vegetation onsite will include:

- Terrestrial vegetation on the western side of the northern approach to realign the road onto the new bridge structure

- Removal of marine plants on the banks of Wrights Creek to the west of the existing structure on the new bridge alignment
- Disturbance to grassed areas on the southern side of the waterway for construction access tracks, laydown areas, office establishment and parking areas.

8.0 Erosion Risk and Hazard Level

8.1 Seasonal Erosion Risk

Seasonal erosion risk ratings, based on monthly rainfall erosivity and monthly rainfall depths for Caboolture are presented in Table 6-1 and Table 6-2.

Table 8-1 Erosion risk ratings based on monthly rainfall erosivity (Table 4.4.5, IECA 2008)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Risk Rating	H	H	H	H	M	M	M	L	L	M	H	H

Key: E = Extreme, H = High, M = Moderate, L = Low, VL = Very low erosion risk

(Source: IECA Table 4.4.5)

Table 8-2 Average monthly rainfall depth (mm) for Caboolture (Table 4.4.6, IECA 2008)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Risk Rating	196	198	187	111	85	67	61	39	43	83	101	142

(Source: IECA Table 4.4.6)

8.2 Erosion Hazard Assessment

The soil erosion hazard and risk assessment is important when trying to determine the appropriate controls for a site. These two elements are defined as:

- Soil erosion hazard: the susceptibility of a parcel of land to the main causes of erosion (rainfall erosivity, slope, soil type, flow concentration and ground cover); and
- Soil erosion risk: the likelihood of environmental harm occurring because of erosion.

Conducting an erosion hazard and risk assessment provides important information to determine the ESC standards to be applied to a site. The Revised Universal Soil Loss Equation (RUSLE) from IECA 2008, Appendix E, page E.3. The full RUSLE calculations for the Project are provided in Appendix 2. The formula is as follows:

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

Where:

A: is the predicted soil loss per hectare per year

K: is the soil erodibility factor

R: is the rainfall erosivity factor

LS: is the slope length/gradient factor

P: is the erosion control practice factor

C: is the ground cover and management factor

8.2.1 Catchment Identification

To form the basis of the RUSLE calculations, the Project area has been divided into sub catchments based on landform, including existing waterways, and surface water flow directions. Refer to Appendix 1 for each catchment which identifies catchment size, slope length and overall gradient. All catchment details have been summarised and included in Appendix 2.

8.2.2 Soil Texture (K-factor)

Table E4 in the IECA Guidelines has been referenced with a K-factor of 0.030 being adopted across the site for soil loss calculations. Geotechnical investigations onsite observed a shallow topsoil layer of silty sand with a subsoil layer of sand (alluvium).

8.2.3 Rainfall Erosivity (R-factor)

Rainfall erosivity (R factor) is a measurement of the energy associated with rainfall events. The annual R factor for Brisbane that has been adopted by the project is 3705 as per IECA Table E1.

8.2.4 Slope Length (LS)

Slope length and steepness (grade) influence the rate of both sheet and rill erosion. To effectively assess and plan erosion and sediment control, assessment of slope length and steepness is required on a site-by-site basis. Slope is included in the RUSLE as the LS-factor. Refer to Appendix 2 for the Project's LS factors.

8.2.5 Cover (C-factor)

A C-factor of 1 (IECA Table E9) has been applied to each of the sub-catchments, refer to Appendix 2.

8.2.6 Erosion Control Practice (P-factor)

A P-factor of 1.3 (IECA Table E11) has been applied to each of the sub-catchments. This is for compacted and smooth surfaces and is the default construction phase condition.

9.0 Management Measures

9.1 Erosion and Sediment Control Principals

The primary purpose in installing erosion and sediment controls is to prevent causing environmental harm or depositing prescribed water contaminants in waterways as per the EP Act.

In addition, appropriate erosion control can have the benefit of decreasing soil degradation hence improving asset protection and decreasing maintenance costs during and post construction.

ESC for Project shall be designed, installed, maintained and decommissioned in accordance with the following principles:

- ESCs are integrated with construction planning;
- Effective and flexible ESCs are developed based on soil, weather, construction conditions and the receiving environmental considerations;
- The extent and duration of soil exposure is minimised;
- Water movement is controlled - in particular clean water is diverted around the site;
- Soil erosion is minimised;
- Disturbed areas are promptly stabilised;
- Sediment retention on site is maximised;
- Controls are maintained in proper working order at all times; and
- The site is monitored and ESC practices adjusted to maintain the required performance standard.

9.2 Management Strategies

The management measures provided below will be implemented by the Project to minimise the potential erosion risk. These management measures are additional to any measures that have been nominated in the ESC design.

9.2.1 Pre-construction Management Measures

Pre construction erosion and sediment control measures:

- All relevant environmental approvals must be in place prior to any works being undertaken. This includes all required EMP, Sub-plans, procedures and other documentation;
- There must be clear delineation of ‘No Go Zones’ on the ESC Design Drawing and on site prior to any clearing;
- ESC awareness shall be included as part of the Project induction. All relevant personnel shall be informed of the requirements of the most current ESCP; and
- Installation of perimeter ESCs must be done prior to any clearing and grubbing works where appropriate and where suitable access can be achieved.

9.2.2 Construction Phase Management Measures

During the construction phase the following measures including:

- Offsite surface water should be diverted around the perimeter of work areas as much as possible;
- Prior to significant changes to drainage flow or sediment treatment locations, the ESC design package will be assessed and updated to manage any new potential environmental risks;
- All reasonable and practicable measures should be implemented to control flow velocities in such a manner that prevents soil erosion along drainage paths and at the entrance and exit of all drains; and
- If visible dust is observed from site, dust suppression measures should be implemented. This may include but not be limited to the use of water trucks, fine mists or spraying stockpiles with suitable soil binders.

9.2.3 Post-Construction Management and Maintenance Measures

Post construction management and maintenance measures:

- ESC devices should remain in place, and maintained to ensure effectiveness until the area has been effectively rehabilitated following completion of construction.
- ESCs should be routinely inspected and maintained to ensure they remain effective (i.e. removal of silt build up from sediment traps), particularly before the completion of work prior to the commencement of wetter months, and also after high intensity rainfall or run-off events;
- Clear access should be maintained at all times to ESC devices to enable maintenance;
- ESC devices should be cleared, repaired or replaced whenever maintenance inspections show signs of non-compliance or ineffective capability or capacity; and
- Once the site has stabilised, all temporary ESC devices are to be removed from the site at the end of the Defects Liability Period.

9.3 Site Specific Control Measures

Site specific controls and locations are still to be nominated and will be completed as part of the detailed ESCP. There will be a variety of temporary ESCs in place that will control and manage the flow of water across the site and minimise the risk of uncontrolled discharge from the site.

If an alternative control type is nominated based on material availability, these controls can be utilised following confirmation that the new structure meets the required type, either 1, 2 or 3, capacity and is suitable for the location. If the design life of any of the ESCs nominated in the drawings are expected to be exceeded, a review of the controls will be required to determine their adequacy and upgrading if required.

9.4 Drainage Controls

Drainage control measures aim to prevent or reduce soil erosion caused by concentrated flows, including the management of rill and gully erosion, and to appropriately manage the movement of ‘clean’ water and ‘dirty’ water through the site.

Nominated drainage design standards and ARIs are outlined in Table 9-1 below.

Table 9-1 Drainage design standard for temporary drainage works

Drainage Structure	Anticipated Design Life		
	<12 months	12-24 months	>24 months
Temporary drainage structures in Queensland, Northern Territory and northern Western Australia	1 in 2 year	1 in 5 year	1 in 10 year
Temporary culvert crossing	Minimum 1 in 1 year ARI hydraulic capacity wherever reasonable practicable.		

9.4.1 Clean Water Diversion Drains

Where required clean water diversion drains are to be designed in the detailed ESC phase. This design process will be informed by the catchment flow velocities presented in Appendix 5. These will be sized to carry the required storm event as per the IECA Guidelines.

9.4.2 Clean Water Diversion Bunds

As required clean water diversions bunds are to be constructed across the Project site upstream of work areas and diverted through designated drainage structures. This is to convey clean water around disturbed areas and to prevent clean water from entering active areas. Clean water runoff will be diverted into nearby waterways or stormwater infrastructure.

The clean water diversion bund locations are to be design and located in the detailed ESC design phase. These will be sized to carry the nominated storm event as required under the Project's permanent design details.

9.5 Erosion Control Measures

Erosion control measures aim to prevent or reduce soil erosion caused by raindrop impact and sheet flow (i.e., the control of splash or sheet erosion). Nominated erosion control will be identified in the detailed ESC design phase which will then be adopted by the Project.

9.5.1 Erosion Risk Rating

An erosion risk rating has been determined for each sub-catchment based on the predicted soil loss rate with the criteria presented in Table 9-2. These ratings have been used to identify high risk areas across the Project site and in nominating required management measures in the ESCP.

Table 9-2: Erosion risk rating based on soil loss and required management

Erosion Risk	Soil Loss Rate	Weeks (clearing can be prior to earth works)	Max no days to re-vegetate	Ensure staged construction	Stockpiles need to be stabilised
Very Low	0 to 150	8	30	-	-
Low	150 to 225	8	30	-	-
Moderate	225 to 500	6	20	Yes	-
High	500 to 1500	4	10	Yes	Yes
Extreme	> 1500	2	10	Yes	Yes

There are a number of different methodologies available to assess erosion hazard however no single method considers all the parameters which may influence the erosion hazard. These parameters include soil characteristics, slope, and seasonal changes in rainfall erosivity, flow concentration, ground cover, and susceptibility to dust generation. To address all the factors affecting the overall erosion hazard of the site, the parameters above have been assessed by adopting several methodologies from IECA (2008) Guidelines.

9.5.2 Dust Control

Dust generation associated with wind erosion is to be controlled using the following methods:

- Maintaining moist soil conditions using water trucks as required
- Chemical sealants placed over the soil surface (soil binders)
- Surface roughening
- Revegetation (short- and long-term ground cover)
- Windbreak (i.e., retention of existing vegetation)
- Other general dust problems can also be reduced by the following activities

- Limiting the area of disturbance at any given time
- Replacing topsoil after completion of earthworks
- Programming works to minimise the life of soil stockpiles
- Temporarily stabilising long term stockpiles
- Gravelling unsealed access and haul roads
- Minimising traffic movements on exposed surfaces
- Limiting vehicular traffic to the Project nominated speed limit

9.6 Sediment Control Measures

Sediment control measures aim to trap and retain sediment either moving along the land surface (bed load) or contained within flowing water (suspended sediment).

The minimum sediment control techniques required have been identified in Table 9-3 below based on the estimated soil loss rates per year. Control types, sizing and locations would require further review based on site specific maintenance requirements.

Table 9-3 Minimum sediment control standards based on soil loss

Soil Loss Rate (t/ha/year)	Sediment Control Technique	Default Sediment Control Treatment Measure
0 to 75	Type 3	Sediment fence, sediment trap
75 to 150	Type 2	Filter tube dam, rock filter dam, sediment trench, sediment weir, compost/mulch berm
> 150	Type 1	Sediment basin (sized in accordance with design standard)

9.6.1 Sediment Basins

Sediment basins are not required or planned to be used onsite due to the small subcatchment sizes and the lack of space to construct them within the project footprint.

9.6.2 Rock Filter Dams

Rock filter Dams are a ‘Type 2” control used at the end of drainage lines prior to the release of stormwater into waterway. These are constructed from geofabric and different sized rocks to filter larger sediment particles. These should be arranged such that water flow spills through the centre of the structure and not around the outside. These shall be regularly monitored and maintained to ensure retention capacity behind the structure.

9.6.3 Check Dams

The use of check dams, either rock or sandbags, can be utilised as an option for the short term drain design if required for any maintenance works. The initial drain sizing and flows should be designed assuming a geofrabric lining or other suitable material will be installed in the drain to manage velocities and potential erosion.

Any temporary check dam structures would need to be regularly monitored, or after any rain event, by the site Environmental Manager or other nominated person to identify any potential scouring issues. If scouring is identified, then a revised drain design will be determined

9.6.4 Sediment Fences

Sediment fences are to be located downstream of any active work areas where sheet flow is expected to occur. This includes any stockpile areas.

9.6.5 Stabilised Exit Points

Vehicular sediment mobilisation can be problematic if control measures are not in place to prevent sediment tracking off-site. The Project shall establish rumble pads and clearly signed entry and exit points to ensure all vehicles only enter/exit the site at the designated points.

Location and type of stabilised access points will be determined onsite by the contractor in consultation with the sites CPESC.

9.6.6 In Stream Controls

In stream works and works within watercourses may need to take place, including removal of riparian vegetation. Works within these zones must only commence after the necessary approvals have been sought. All clearing operations within watercourses shall not include the removal of stumps and roots below ground level wherever possible. Where work is conducted on the banks and the area is temporarily left exposed or unstable, geofabric and rock shall be used as a control to prevent erosion.

Construction of bridge abutments will require works to be undertaken in Wrights Creek which is a tidal waterway. Prior to the placement of rock or other construction materials within the waterway, a sediment curtain shall be installed around the abutment area. This will be established to form a U shaped curtain around the workzone on each side of the creek allowing for a gap between the two curtains that allows for tidal flow and fish passage.

Similarly when the work is undertaken to remove parts of the existing causeway, a sediment curtain shall be placed around the work zone. Installation of sediment curtains should be offset from the upstream side of causeway structure that tie into the bank and the corner of the new bridge opening.

9.6.7 Other Temporary Controls

Other temporary controls will be installed across the site as works progress. These controls include things such as sediment fences, rock check dams and any other sediment control measures nominated in the IECA Guidelines. These will be installed in locations to prevent sediment laden water leaving the site and entering any waterways.

The temporary controls are to be designed in accordance with the IECA Guidelines.

10.0 General ESC Management Strategies

10.1 Construction Program

When preparing the short-term construction program, the Project will consider forecasted weather events when planning the type and location of construction activities. Where heavy or sustained rain events are predicted, the Project will determine if works within or adjacent to a sensitive or high-risk area, including works within or directly adjacent to a watercourse or wetland, can be undertaken with minimal risk to the environment. If it is determined the risk cannot be suitably managed, then the work will not commence until after the event.

If works have already commenced and heavy or sustained rain is forecasted posing environmental risk, then the works will cease and the area suitably stabilised until the rain event passes and it is safe to work in the area again.

10.2 Disturbance Minimisation

Mitigation measures to limit the impacts of land disturbance include the following:

- Establishing clearly defined boundaries of areas to be cleared with 'No Go Zones' clearly signposted and fenced to prevent unauthorised clearing and vehicle and/or pedestrian traffic;
- Designation of areas for temporary disturbance (i.e. construction laydown areas, stockpiles) to be positioned away from the waterway;
- Vehicle movements will be restricted to nominated construction roads and access tracks to minimise ground and vegetation disturbance;
- Works will be scheduled to minimise the area of active disturbance at any one time, in accordance with construction timeframes; and
- Nominated ESCs will be installed in predetermined locations around the site in particular downslope of any disturbed lands. The installation of effective ESC measures will assist in minimising impact on the surrounding environment and prevent environmental harm.

10.3 Vegetation Clearing

All works involving the clearing or interference with on-site vegetation should conform to the following requirements:

- No clearing or any other form of disturbance is to be conducted beyond the maximum specified clearing limits;
- The extent of clearing shall be marked on the ground by the Contractor prior to any earthworks. Marking material will be high visibility that will last for the duration of the Project. Only the Administrator can approve Contractor requests to change clearing limits.
- Cleared native vegetation (mulched) should be stockpiled for re-use in erosion and sediment control;
- Vegetation should be progressively cleared, where possible, to minimise the area of soil exposed;
- Identify, isolate, and protect all mature native vegetation where appropriate. Protected vegetation areas should be identified and clearly marked out on site before commencing clearing works; and
- The Project should not undertake any clearing or construction work outside of the approved clearing boundary.

10.4 Earthworks

All earthworks and ground disturbance works should conform to the following minimum standards:

- Clearing through riparian vegetation must be minimised;
- Construction activities in watercourses must cease if a risk assessment indicates that any forecast rainfall event could cause unacceptable environmental harm or impact on safety; and
- Diverting uncontaminated stormwater run-off around areas disturbed by construction activities and/or other potentially contaminating activities.

10.5 Access Tracks and Laydown Areas

Existing tracks or final access road alignments are to be used whenever possible. The duplication of parallel / multiple tracks or turnouts shall be avoided;

- Access track drains should discharge runoff water in a manner which does not lead to erosion or movement of sediment to surface waters;
- Suitable sheeting material/rock rumble will be placed at the entry/exit points on any internal access and construction road or laydown area that joins onto any public road;
- Ensure site vehicles adhere to the nominated speed limits;
- Stabilisation of access tracks and laydown areas that are to be exposed for prolonged periods should be considered. This may include use of chemical surface stabilisers or physical alternatives such as crushed rock;
- All construction vehicles are only permitted within designated construction areas, and are not allowed within any “No-Go Zones” or “Protected Areas” (i.e. Fauna habitat areas). Vehicle movement within the site must remain on designated site access routes; and
- Suitable ESCs must be installed and maintained for all entrance and exits points nominated for the site that enter onto public roads.

10.6 Topsoil Management

Any stripped topsoil that is to remain on site should be handled in a manner that maintains the integrity of the soils and then stockpiled for re-used in final rehabilitation. Compaction, because of handling wet soils or stockpiling soils for extended periods of time, may greatly reduce soil quality. The following mitigation measures related to soil handling should be implemented:

- Topsoil stockpiles will be maintained at a height no greater than 3m in height and less than 10m wide at the base;
- Topsoil stockpiles should be placed with suitable batter slopes and covered with suitable protective cover to maximise stability;
- Drainage controls should be placed around the toe of the stockpiles to reduce potential for erosion;
- The life of a stockpile should be limited to the minimum practical time;
- Herbicide spraying or other treatment of the stockpile should be completed at intervals required to prevent weed growth and ensure the stockpile faces are weed-free prior to use.

10.7 Stockpile Management

The following apply to stockpile management on the project:

- Where possible, stockpiles should be located at least 2m from any hazardous area, retained vegetation, or concentrated drainage line;
- Stockpiles are to be suitably stabilised within: 10 days during the months from November to April; 20 days for the months May, June, July and October; and 30 days for August and September;
- Excavated soil must be stockpiled separately from other materials (e.g. vegetation), where it can be readily recovered for reuse; and
- Stockpiles should not impede natural or constructed surface drainage channels or access tracks.

Wherever practical, topsoil shall be transferred directly to placement as planting media. Where stockpiling of topsoil is required, it shall be carried out in a manner which ensures that the properties of the topsoil are not permitted to degrade such that it becomes unsuitable as planting media. To assist preservation of planting media, the Contractor shall include the following provisions in the management of topsoil stockpiles:

- limiting the height of stockpiles to 3 metres;
- limiting the width of the base of stockpiles to 10 metres;
- adopting batter slopes, protective covers and drainage which reduce potential for erosion and/or segregation;
- limiting the period of stockpiling to a minimum practical time; and

- carrying out herbicide spraying or other treatment of the stockpile at intervals required to prevent weed growth and ensure the stockpile faces are weed-free prior to use.

10.8 Soil Treatment

For areas of exposed soil that require immediate cover or needs temporary protection until the stage of works is completed, a polymer-based soil binder may be used to provide adequate cover. These areas will be monitored on an ongoing basis with reapplication of the soil binder to be applied on an as-needs basis but no longer than a 3-month period from the initial application.

In areas where there is little topsoil, topsoil may be ameliorated with nutrients, or another approved ameliorant (i.e.; gypsum) to facilitate revegetation.

10.9 Surface Water Management

The following measures are provided to specifically manage impacts to local waterways:

- Maintain average slope gradients as close as possible to pre-existing slope gradients, whilst allowing for natural drainage;
- The use of suitably lined catch drains will be nominated for the site to direct surface water to suitably sized sediment controls, either sediment traps and or sediment basins;
- Minimise slopes gradients adjacent to waterways;

Earthworks that are being carried out adjacent to a water course will:

- Be revegetated and stabilised immediately on completion of the work wherever possible;
- Minimise slope gradients while maintaining appropriate drainage requirements in areas adjacent to creeks; and
- Have appropriate controls installed at the top of bank, diverting dirty water away from the watercourse and into vegetated areas; and
- Where it is not possible to maintain riparian vegetation, any vegetation that has been cleared near waterways should be removed from the area and stockpiled away from the watercourse with appropriate erosion controls.

10.10 Revegetation

Disturbed areas are to be revegetated as soon as practicable after the completion of any earth disturbance works. All revegetation efforts and construction work therefore should conform to the Project agreed Landscape Design Plans.

Inspect the disturbance areas and maintain ESC measures as necessary during and after construction, until stabilisation is achieved. Stabilisation is achieved when there is at least 70% cover within 10 days following completion of works as per IECA Table 4.4.7.

11.0 Monitoring and Reporting

11.1 Inspections

Weekly inspection of erosion and sediment controls shall be undertaken as part of the routine environmental management inspections for the project. Additionally Pre-rainfall Inspections shall be conducted within 48hours of an anticipated rainfall event with an expected total of greater than 10mm. Similarly a Post-rainfall Inspection shall be conducted immediately following rainfall event greater than 10mm or that resulted in runoff from the project site.

These shall be recorded on the project inspection forms and actioned accordingly.

11.2 Water Quality Monitoring

A surface water monitoring program will be developed and implemented as part of the detailed planning stage. The nominated water quality criteria will also be confirmed at this stage. An indicative surface water monitoring program has been set out in table below.

Table 11-1: Surface Water Monitoring Program

Monitoring Action	Criteria	Frequency	Record	Responsibility
Weather Forecast – monitoring short and long-term rainfall forecasts to inform monitoring events	NA	Weekly	NA	Contractor
Visual inspection of waterways in the vicinity of the Project alignment for signs of contamination	NA	Daily	Inspection Form	Contractor
Water quality of representative waterways-Parameters		Event trigger >25mm forecast in 24-hour period	Surface Water Monitoring Form (TBC)	Contractor
Temperature	N/A – monitor only			
pH	Range 6.5-8.5 or downstream within 10% of upstream where it is outside this range			
Dissolved Oxygen (mg/L)	Downstream result is within 10% of upstream within approximately 100m of downstream boundary			
Turbidity (NTU)	Downstream result is within 10% of upstream within approximately 100m of downstream boundary			
Electrical Conductivity (mS/cm)	Downstream result is within 10% of upstream within approximately 100m of downstream boundary			
Litter or other waste (visual)	Nil litter or waste			

Monitoring Action	Criteria	Frequency	Record	Responsibility
Hydrocarbons (visual)	Nil evidence			

11.2.1 Monitoring Procedures

Exact water quality monitoring locations are to be confirmed prior to construction works commencing. Locations shall be in the waterway at accessible points upstream and downstream of the project works for parameters detailed in the Environmental Management Plan.

Water quality monitoring is to be undertaken as per QLD Water Quality Monitoring and Sampling Manual (2018). Field samples to be taken utilising calibrated equipment with samples for laboratory testing to be undertaken at NATA approved laboratory.

11.2.2 Contingency Actions

As a result of surface water quality monitoring should a trigger be exceeded, a decision-making process will be followed to determine if the trigger event is considered a result of operations and whether a contingency action is required to be implemented as per **Table 11-2** below.

Table 11-2: Triggers and Contingency Actions

Triggers	Potential Contingency Action
Degradation of water quality downstream relative to upstream values particularly turbidity, DO and pH	Review ground stabilisation and ground coverage within rail corridor within catchment of waterway being monitored and investigate potential source of impacted runoff
Levels of waste matter and litter identified	Confirm waste management practices of operations and personnel training – waste disposal techniques
Visual inspection indicates hydrocarbons on surface water	Confirm provisioning procedures regarding rail line and train set maintenance at online servicing Review train set servicing records

11.3 Reporting

At a minimum, all sediment, erosion, and surface water quality incidents should be reported to the relevant Project Manager as soon as practical. Examples of incidents to report include:

- Degradation of surface water quality on and offsite;
- Build-up of sediment in sediment control devices;
- Uncontrolled discharge from the site;
- Damaged or failed erosion control devices.

Should site personnel become aware that environmental harm has or is occurring or likely to occur, action must be taken to report such an occurrence. Incidents or potential incidents will be reported to the Environmental Manager who will, in turn, review and notify the administering authority as necessary to satisfy reporting requirements obligation (the ‘Duty to Notify’).

Where exceedances of the criteria occur, the Project shall, in coordination with the Client, notify the nominated Regulatory Agency immediately. The Project shall complete an interim investigation report outlining the breach of water quality performance requirements and the corrective actions being implemented because of the breach. Within 14 days the Project shall complete an investigation into the potential for environmental harm and provide a written report outlining:

- Details of the investigation carried out; and
- Actions taken to prevent environmental harm.

All water quality data shall be kept onsite and be available on request.

Appendix A

Catchments

Catchment 1

Catchment 2

Catchment 3

Appendix B

Soil Loss Calculations

Soil Loss Calculations

Design Assumptions

- Total construction duration >12 months
- P-factor assumes compacted areas for construction – 1.3
- K-factor soil erodibility assumed to be 'loamy sand 0.020' based on Silty Sand (topsoil) layer and Sand (alluvium) subsoil layer present onsite
- C-factor assumed to be 1.0. A modified C-factor 0.7 has been assumed for Catchment 2 of 0.7 based on some retained groundcover
- Drainage design life 12-24 months (1 in 5 year ARI)
- x-day, y-percentile rainfall event (mm) - Caboolture 85th%ile - 46.5mm
- R-factor: Brisbane 3705

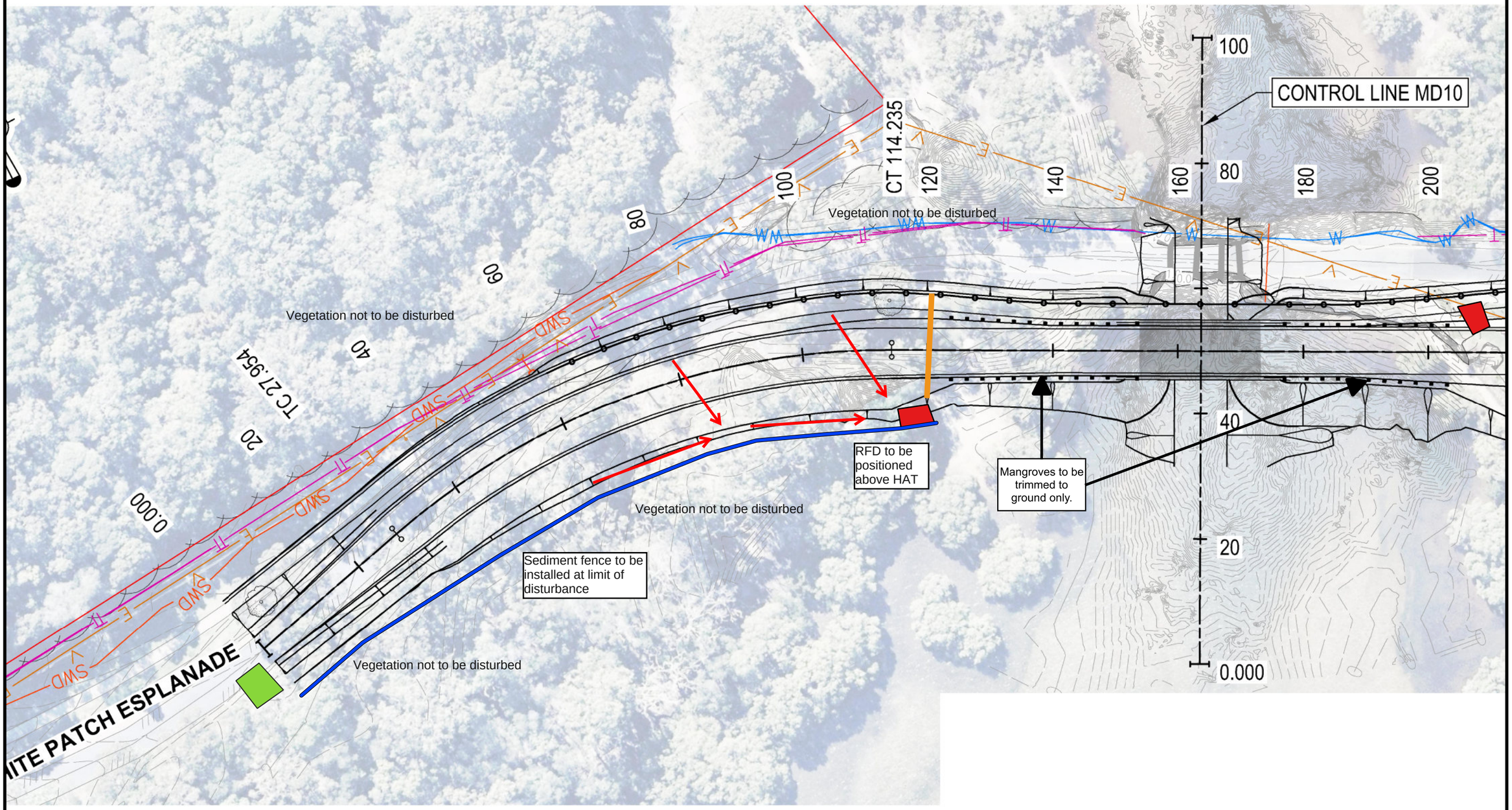
Estimated Soil Loss

SITE				IECA Reference
Catchment ID	1	2	3	
Catchment Area (ha)	2.21	2.00	2.33	
SOILS				
Sediment Type (C,F,D)	D	D	D	
RAINFALL				
Design Rainfall Depth (no. of days)	5	5	5	
Design Rainfall Depth (%ile)	85	85	85	
x-day, y-percentile rainfall event (mm)	46.5	46.5	46.5	5 day, 85th percentile - IECA Table B5 (page B.16)
Rainfall R-factor	3705	3705	3705	IECA Table E1 and E2 (pages E.4 and E.5)
RUSLE				
Rainfall erosivity (R-factor)	3705	3705	3705	
Soil erodibility (K-factor)	0.03	0.03	0.03	IECA Table E4 and E5 (pages E.7)
Slope length (m)	120	70	160	
Slope gradient (%)	0.42	0.71	0.31	
Length/gradient (LS-factor)	1.98	1.81	0.81	IECA Table E3 (page E.6)
Erosion control practice (P-factor)	1.3	1.3	1.3	IECA Table E11 (page E.10)
Ground Cover (C-factor)	1	0.7	1	IECA Table E6 - Table E10 (pages E.8 and E.9)
SOIL LOSS				
Soil loss (t/ha/yr)	190.7	122.1	78.0	
Soil loss class	2	1	1	IECA Table 3.1 (page 3.4)
Minimum sediment control type	2	2	2	IECA Table 4.5.1 and Table 4.5.2 (page 4.24)

Appendix C

Concept Erosion and Sediment Control Plans

White Patch Concept Erosion and Sediment Controls: Clearing Phase (1 of 2)



Date: 08/11/2022
Job: J0210
Drawn: Josh T

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DATA SOURCE:
QSPATIAL 2022;
The State of Queensland (Department of Resources) 2022;
Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community;

- Sediment Fencing
- Rock Filter Dam
- Stabilized Entry / Exit Points
- Diversion Bund

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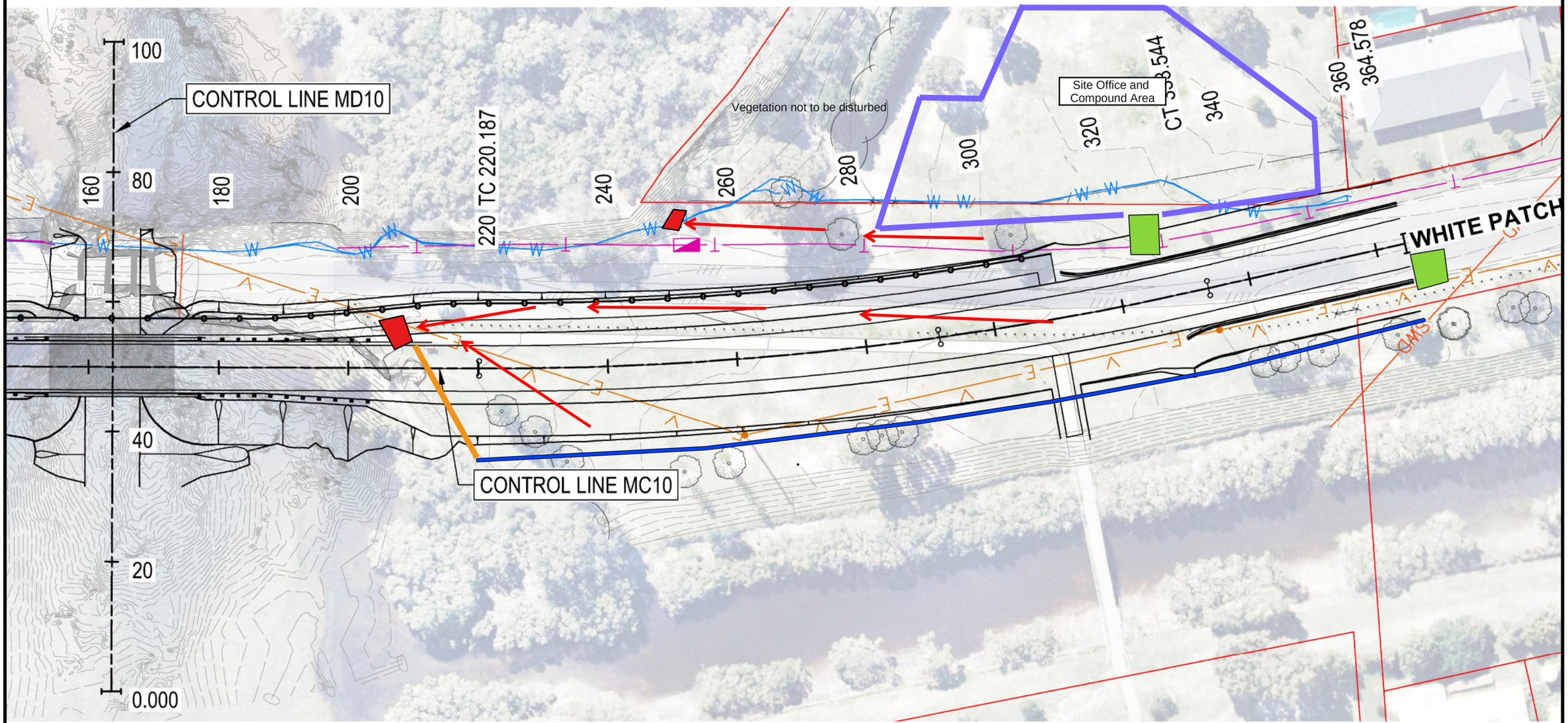

White Patch Concept Erosion and Sediment Controls: Clearing Phase (2 of 2)

Date: 08/11/2022
Job: J0210
Drawn: Josh T

DATA SOURCE:
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The State of Queensland (Department of Resources) 2022;
Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community;

- Sediment Fencing
- Rock Filter Dam
- Stabilized Entry / Exit Points
- Diversion Bund

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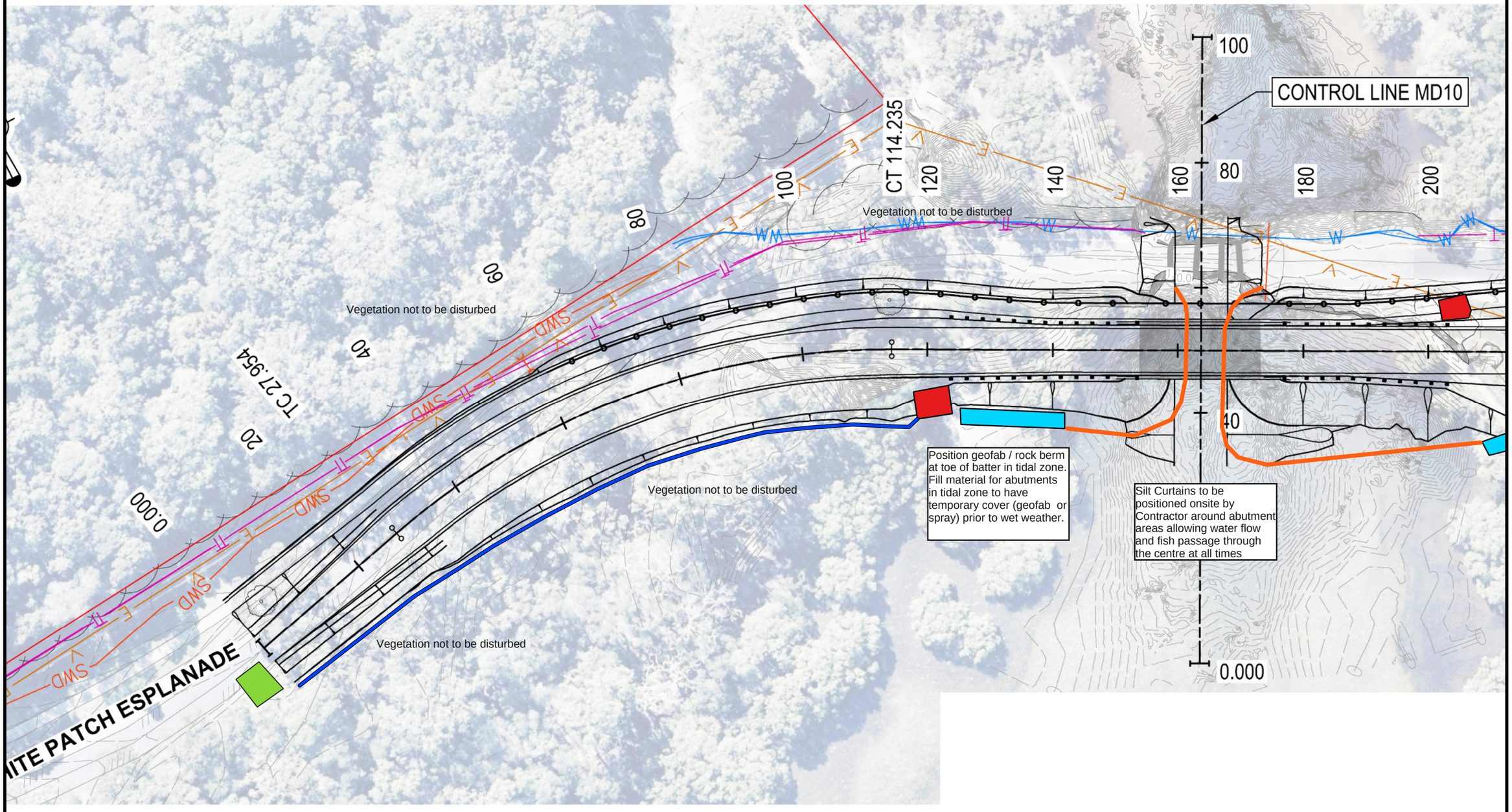
White Patch Concept Erosion and Sediment Controls: Bridge Structures and Roadworks Phase (1 of 2)



Date: 08/11/2022
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- Sediment Fencing
- Silt Curtains
- Rock Filter Dam
- Geofab Rock Berm in Tidal Zone
- Stabilized Entry / Exit Points

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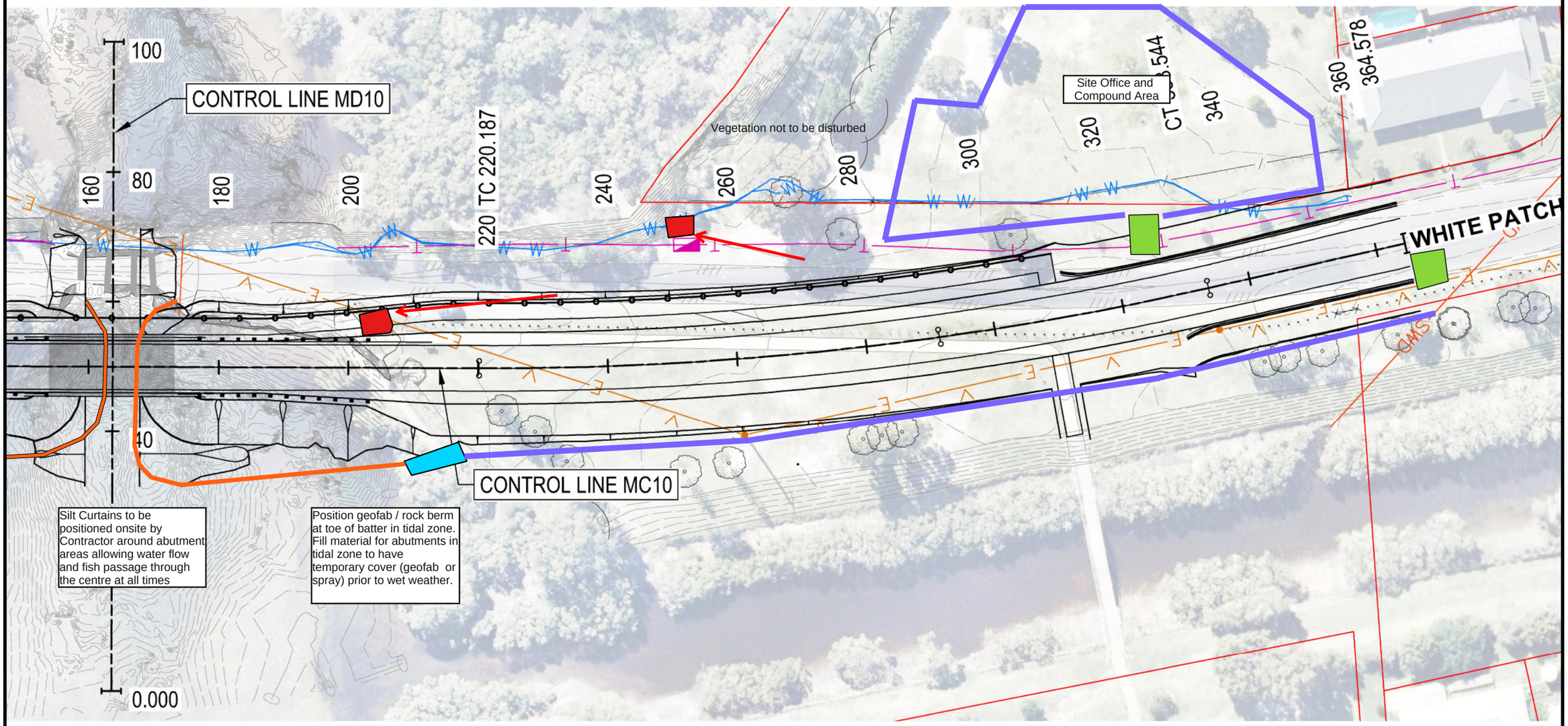

White Patch Concept Erosion and Sediment Controls: Bridge Structures and Roadworks Phase (2 of 2)

Date: 08/11/2022
Job: J0210
Drawn: Josh T

DATA SOURCE:
QSPATIAL 2022;
The State of Queensland (Department of Resources) 2022;
Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community;

- Sediment Fencing
- Silt Curtains
- Rock Filter Dam
- Geofab Rock Berm in Tidal Zone
- Stabilized Entry / Exit Points

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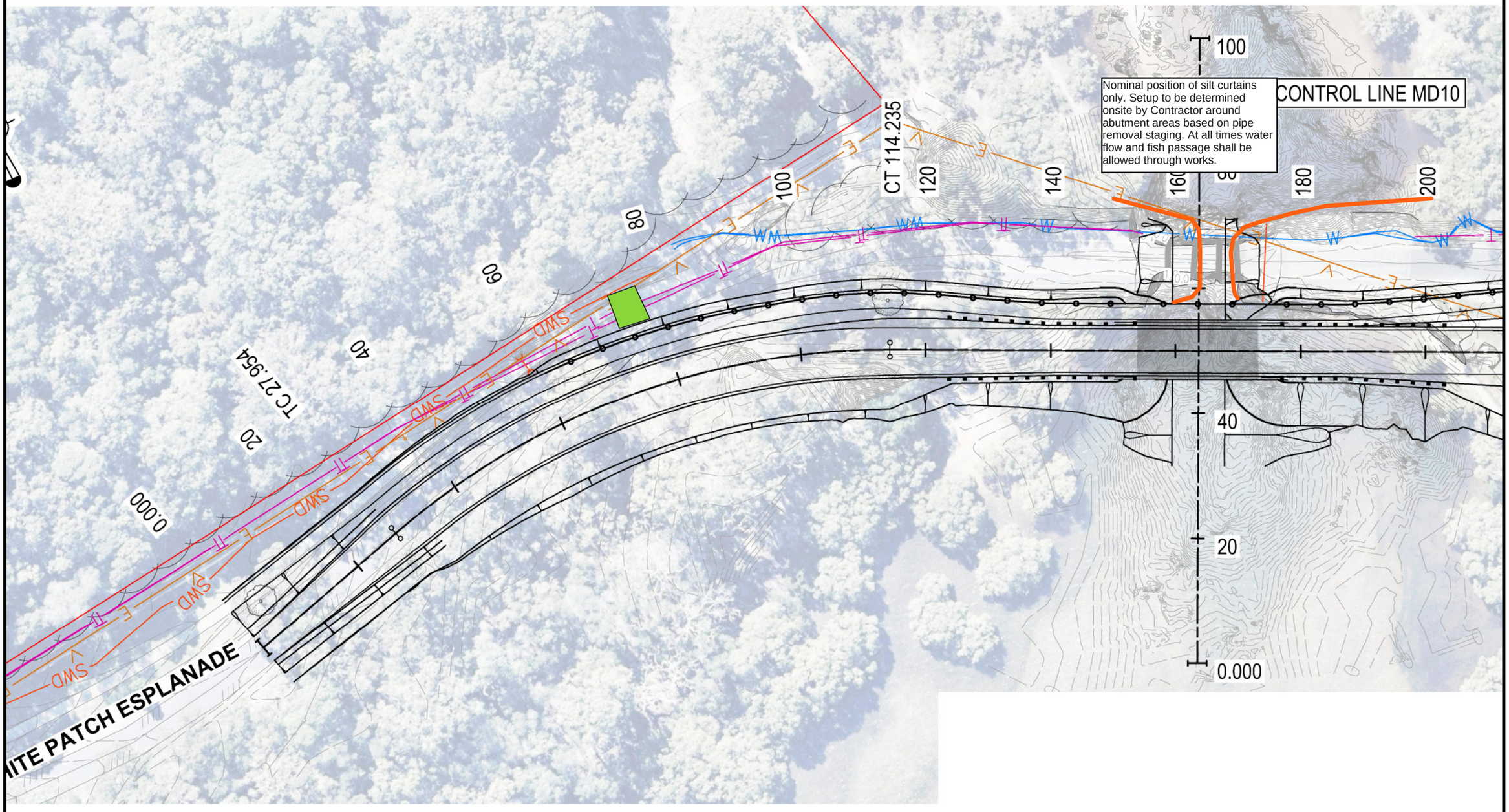

White Patch Concept Erosion and Sediment Controls: Causeway Removal Phase (1 of 2)

Silt Curtain

Stabilized Entry / Exit Point

Date: 08/11/2022
Job: J0210
Drawn: Josh T

DATA SOURCE:
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The State of Queensland (Department of Resources) 2022; Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community;

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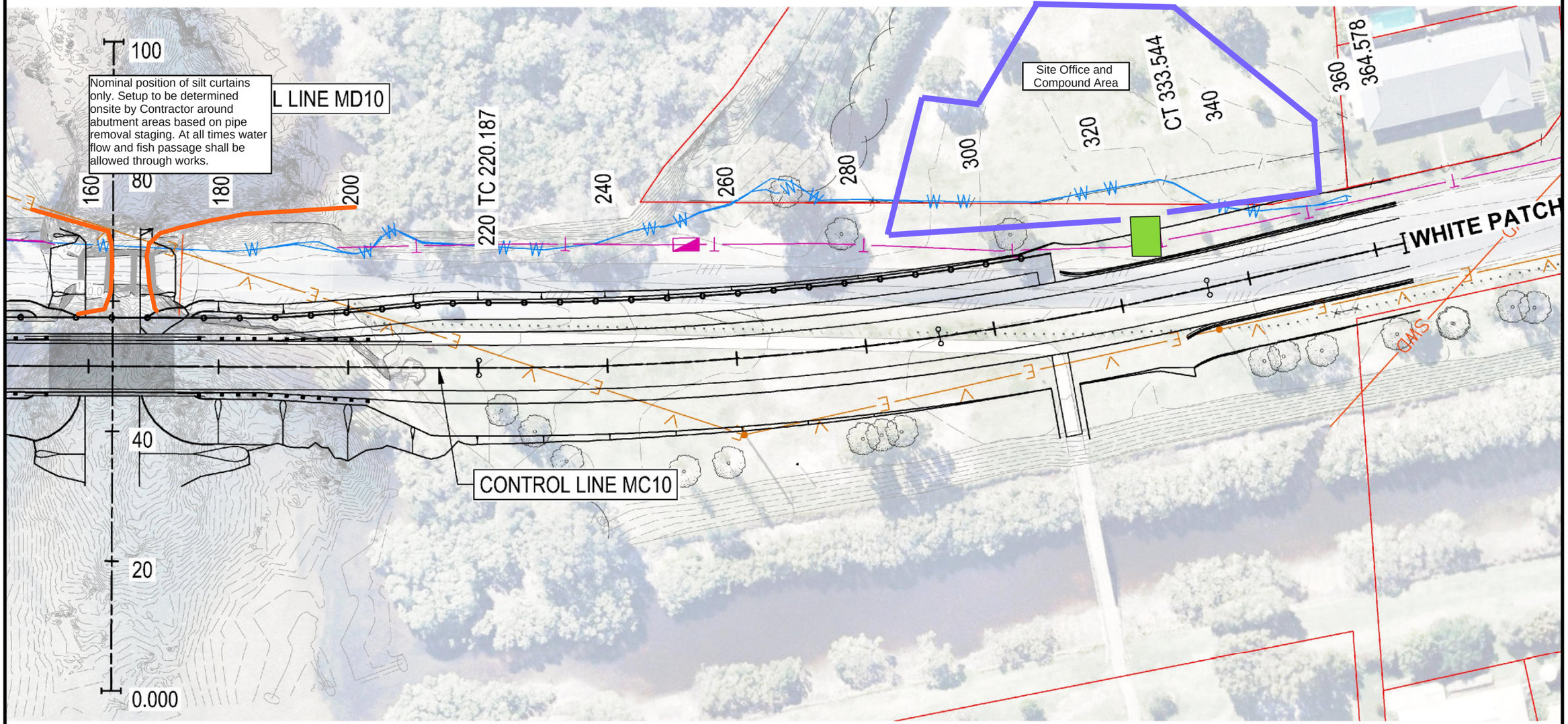

White Patch Concept Erosion and Sediment Controls: Causeway Removal Phase (2 of 2)

Date: 08/11/2022
Job: J0210
Drawn: Josh T

DATA SOURCE:
QSPATIAL 2022;
The State of Queensland (Department of Resources) 2022;
Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community;

- Silt Curtain
- Rock Filter Dam
- Sediment Fence
- Stabilized Entry / Exit Point

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