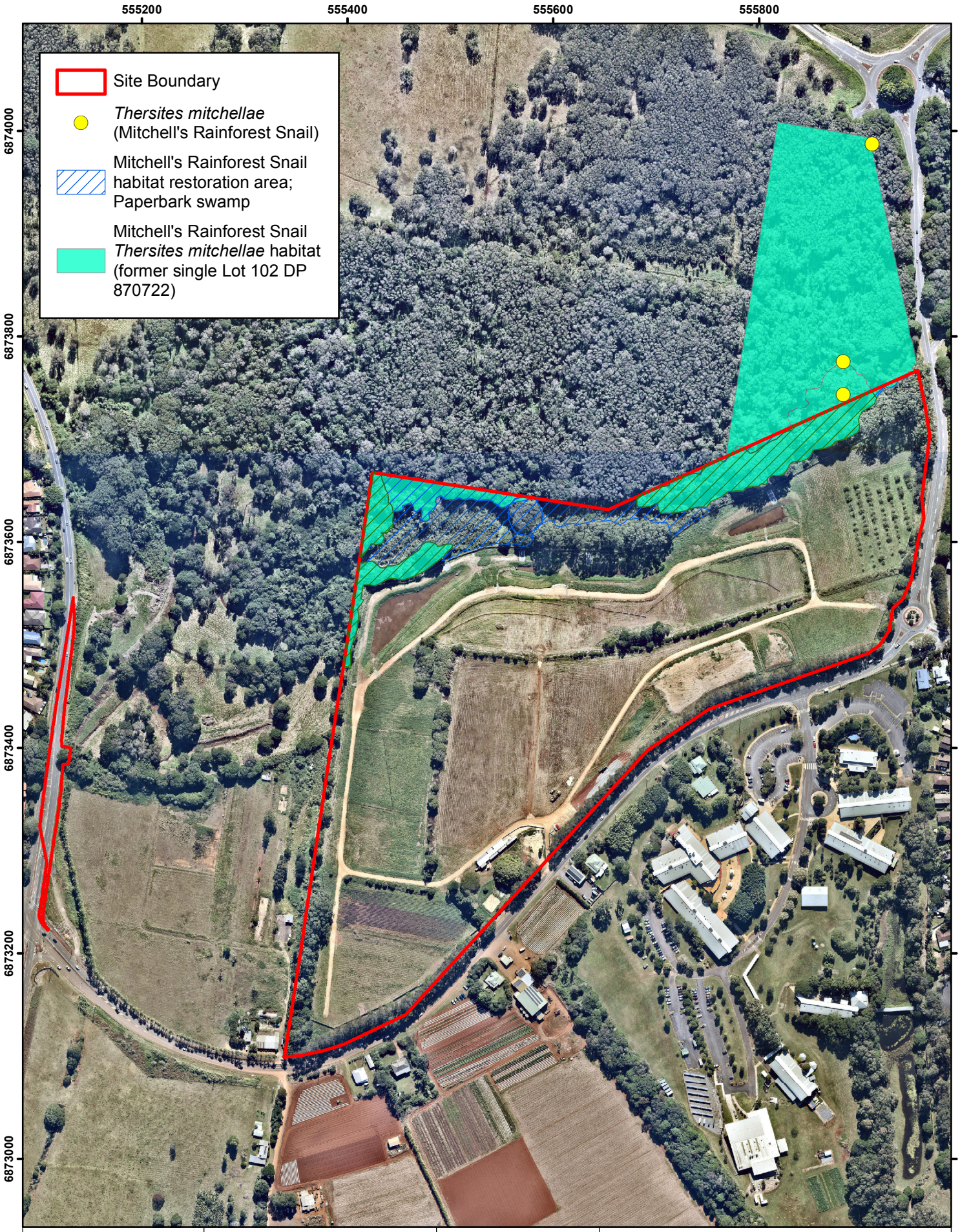


Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,750	**Mitchells Rainforest Snail Habitat and Survey Results – Stage 2**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (7.5 m) Nearmap 2019*	Tweed Valley Hospital BMP 771 Cudgen Road Cudgen NSW	**Figure 10**
Date: 8/08/2019	*Vegetation mapping: Greencap (2018)*		
GREENCAP			

Doc Path: \\ser2bne1\Brisbane_Projects\C107778_Health Infrastructure\J156455_Tweed Valley Hospital\3. Job Folder\GIS\J156455_13_TVHs2\BMPs2\mxd\J156455_13_BMPs2_F10_species_polygons_fauna_190801.mxd

4. WATER QUALITY MANAGEMENT PLAN

4.1 Water quality management aims and objectives

The aim of this WQMP is to avoid or mitigate any impacts from Stage 2 of the Project on water quality, water bodies and hydrological process that sustain threatened species and threatened ecological communities (TECs). Particular attention is drawn to the downstream forested wetlands and pH dependent amphibians, namely; Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis*. Notably, the northern section of the Site is part of an important wetland mapped under the Coastal Management SEPP (**Figure 11**). In order to achieve this, several activities will be undertaken at different phases of the Project during Stages 1 and 2 as outlined in **Table 12**.

These measures will mitigate the residual impacts of the Project as outlined in the BDAR (Greencap 2019b; Appendix I, J). Based on the civil design for stormwater and the application of erosion and sediment controls, the Project is likely to result in improved water quality as the previous land use was agricultural with no stormwater management system. This WQMP refers to the MZ as shown in **Figure 6**.The previous land use was agricultural, site observations indicated that the cultivated fields were ploughed across the topographic contours (Greencap 2019). Under this cultivation regime, sediment-laden stormwater was encouraged to run downhill through ploughed furrows. Observations during site inspections also indicated frequent use of pesticides on the crops. Apart from a bund that has been constructed along the western boundary of the Site which adjoins an open drain, there is currently no stormwater management system in place. In the western section of the Site the aspect of the land is roughly west to north-west and the bund currently directs untreated stormwater flows to three discharge points that have been bulldozed through the bund wall. The aspect of the rest of the Site is roughly north and the ploughing regime directs sediment-laden stormwater to discharge directly into the receiving catchment and wetland located to the north of the Site. Furthermore, a Council owned drain carrying untreated stormwater flows from Turnock Street discharges directly into the receiving catchment.

4.1.1 Proposed stormwater management

The proposed stormwater measures will collect stormwater from the new impermeable areas of the site, including buildings, roads, car parks and other hard standings. Treated water will be discharged at a controlled rate to the existing wetland (ecological receptor) to the north of the site (RBG 2019).

As described in the SWMP (RBG 2019), the Project's stormwater detention measures have been designed in accordance with the relevant guidelines (OEH 2013 and TSC 2016). The storage volumes of the converted basins were modelled to ensure that the combined post development discharge from the basins is no greater that the pre-development flow. The preliminary DRAINS model confirms that there is no increase in the total site discharge rate in the 5 year and 100 year ARI storm events. For details of how soil and stormwater quality will be managed refer to the SWMP (RBG 2019).

4.1.1.1 Stormwater Quality Model

Stormwater quality outcomes were modelled by RBG using MUSIC Version 6.2.1 software, the results of which are included in the SWMP (RBG 2019).

The Projects SWMP (RBG 2019) summarises the results of the MUSIC model that demonstrate compliance of the system with the WSUD objectives developed for the site, including the relevant guidelines (OEH 2013; TSC 2016).

The MUSIC model assesses water quantity and water quality under the existing land use, across the following parameters:

- Flow;
- Total suspended solids;

- Total phosphorus;
- Total nitrogen; and
- Gross pollutants.

In summary, based on the SWMP (RBG 2019), predicted stormwater discharge water quality parameters will meet the water quality objectives in **Table 10**. These will be achieved by employing WSUD features that are described in more detail in **Section 4.1.2.2.**

Table 10 Water quality objectives

Pollutant	Minimum reductions in mean annual load from unmitigated development
Total Suspended Solids (TSS)	80% reduction
Total Phosphorous (TP)	60% reduction
Total Nitrogen	45% reduction
Gross pollutants .5mm (GP)	90% reduction

4.1.2 Stormwater Quality Mitigation

Mitigation measures to manage stormwater discharge quality during the construction phase will be in the form of Erosion and Sediment Control (ESC) and surface water management measures in accordance with the relevant guidelines (Landcom 2004; TSC 2016). The Sites SWMP (RBG 2019), ESCP (RBG 2019), CEMP and associated Stormwater, Erosion and Sedimentation Management Sub-plan (LLB 2019) provides strategies and mitigation measures to manage disturbed areas of the site and ensure that activities including excavated soil, stormwater, erosion, and sedimentation are managed appropriately during construction of the project. These plans set out the key items to manage stormwater runoff, as follows:

- Installation of four adequately sized sediment basins with a total capacity of 7,562 m^3 volume were constructed as part of Preliminary Works package to capture flows (Bonacci 2019). The receiving catchment will be protected by providing diversion stormwater drainage lines that bypass the construction site. Sediment basins will be appropriately monitored and managed in accordance with an erosion and sediment control plan (ESCP) as outlined in **Section 4.1.2.1**.
- Regular inspections of basins.
- Retained capacity in detention basins
- Test, treat and discharge collected stormwater off-site if it cannot be reused on site.
- No discharge of non-compliant water or off-site pollution.

The Site's CEMP will incorporate all relevant safeguards and mitigation measures detailed in the EIS and any requirements detailed in the development consent conditions. All construction staff and site personnel will be made aware of their environmental responsibilities and safeguard measures within the CEMP to avoid and minimise environmental impacts. The CEMP will be submitted to the DPIE for review and approval prior to commencement of works.

4.1.2.1 Sediment basins

Sediment basins will minimise the impact of any change in water quality and protect the TEC in the wetland area. Sediment basins (MZ 2.3) have been constructed as part of preliminary works which will capture and treat stormwater on the Site during the pre-construction and construction phases of the project.

Sediment basins were constructed as part of preliminary works which will capture and treat stormwater on the Site during the pre-construction and construction phases of the project. Sediment basins will minimise the impact of any change in water quality and protect the TEC in the wetland area.

A series of bunds and swales will be installed to direct runoff from the majority of the earthworks areas to the four existing basins in the northern portion of the site. Any runoff from areas or earthworks which cannot be directed to the sediment basins will be treated by means of grass buffer strips and sediment fences (RBG 2019).

The sediment basins function by providing a large, standing body of water such that stormwater runoff entering the basins, which is laden with sediments, has a chance to settle to the base of the basin before it overflows via the weir into the receiving watercourse. The weir and headwalls have been constructed with rock scour protection which will dissipate the water via sheet flow across the land to mitigate any direct impact on native vegetation directly within the discharge area. The size of the sediment basins has been designed in accordance with the NSW Managing Urban Stormwater "Blue Book" (Landcom 2004). The basins have been designed for five-day rainfall, and adequate settling is required four days from the conclusion of each storm event. Sediment basins will be designed and managed in accordance with the SWMP (RBG 2019), as described below;

- Each sediment basin is lined so water should only be able to escape by overtopping the weir or through evaporation or pumping following flocking and testing pH and TSS (Total Soluble Solids);
- Each basin will be dosed with flocculent per rain event and the sediment will typically settle and water quality will be confirmed by site specific testing prior to being pumped out within five days from the conclusion of a rainfall event; and
- In the event of an uncontrolled discharge, a monitoring event will be triggered to assess potential impacts resulting from surface water discharges on the receiving environment as described in **Section 4.1.1**.

The sediment basins will be converted to bio-detention basins during Stage 2 works, once the site excavation works and roads have been completed and all surfaces have been stabilised with appropriate ground cover.

Management of Cane toad *Rhinella marina* around sediment basins is addressed in the FMP, **Section 3.4.**

Monitoring the sediment basins for aquatic weeds in (particularly salvinia *Salvinia molesta*) must be undertaken and is addressed in **Section 2.3.2.6.**

Plant selection for revegetation around the basins should consider the different species which are suitable for growing in different zones of the sediment and bio-detention basins. Plant selection for the sediment and bio-detention basins is addressed in **Section 2.3.3.3** and **Section 2.4.2.**

4.1.2.2 Bio-detention basins

The WSUD measures proposed for the final development are designed to provide a reduction in nutrient levels of stormwater discharged from the Site which would potentially be beneficial to ecological receptors in the wetlands.

Bio-detention systems improve stormwater water quality via nutrient uptake and denitrification. The bioretention system will be made up of three sub-surface layers: filtration, transition and drainage layer. The stormwater pools on the surface which is densely planted with grasses, sedges and select shrub or tree species, and filters down through the soil filter media (RBG 2019).

The compactly vegetated surface of bioretention systems physically controls the flows across the filter media. Beneath this, the root zone of the plants is very biologically effective as sediments and nutrients in stormwater are caught or utilised by the plants, bacteria and fungi. As part of an integrated living system, the plant life cycle maintains the soil structure and hydraulic conductivity of the natural filter (RBG 2019).

Bio-detention systems require regular routine maintenance, including inspections every three to six months or after heavy rain, cleaning and inspections and replacement of filter media every five to seven years. The proprietary pit filter baskets (i.e. enviropods) in the stormwater pits also require routine monitoring and cleaning. An indicative maintenance plan for the bio-detention systems is provided in the SWMP (RBG 2019). As healthy vegetation is vital to the effective functioning of bio-detention basins, regular inspections and maintenance of vegetation is required as per **Sections 2.4.2, 2.3.4** and **2.3.5**.

Post development, the Manager Capital Assets and Resources (or similar role) at LHD will be responsible for managing the regular routine maintenance of the bio-detention systems undertaken by external subcontractor/s.

4.1.2.3 Erosion and sediment controls

During construction, mitigation measures will be undertaken to minimise the risk of erosion and of sediment-laden stormwater being discharged into the receiving catchment and wetland located to the north of the site. The impact of erosion and sedimentation during the construction phase will be managed in accordance with an ESCP (RGB 2019; LLB 2019). Measures include a sediment fence/catch drain (or diversion bund) around the Site and around stockpile areas. Stockpiles will be located out of water flow paths and will be protected by earth banks/drains as required.

The impact of erosion and sedimentation during the construction phase will be managed in accordance with an ESCP prepared for the Site to effectively manage erosion and subsequent sediment mobilisations. The ESCP will be implemented prior to the commencement of construction works, especially prior to the onset of each wet season (from late February to late April). The ESCP is reviewed and updated as required, and at least annually prior to the onset of the wet season to reflect changes in site conditions as construction progresses.

An erosion assessment will be conducted on these areas by a CPESC during the planning phase of the ESCP development. ESC design should be in accordance with the guidelines in Best practice erosion and sediment control (IECA 2008), the NSW Managing Urban Stormwater "Blue Book" (Landcom 2004) and the *Tweed Shire Council Development Design Specification - D7* (TSC 2016). The Site ESCP is to be submitted to and approved by the consent authority on the advice of an independent suitably qualified expert in accordance with any conditions of approval.

The ESC management strategy aims to minimise offsite impacts by diverting overland surface flows to sediment controls, and to manage any active discharge so that it meets the applicable water-quality criteria, such as the *Tweed Shire Council Development Design Specification - D7* (TSC 2016). Key erosion and sediment control activities are outlined in **Table 12**.

4.1.3 Wetland hydrology

In respect of the TECs located within the wetland area, it is noted that these species are generally located in areas subject to periodic inundation (NSW Scientific Committee, 2004). The sediment basins will function to allow the wetland area to continue to occur in line with the pre-construction land use. The quality of the water entering the downstream wetland environment will be managed under the approved CEMP, SWMP and ESCP as described in **Section 4.1.1**.

The location of the development footprint on the Site seeks to minimise interference with hydrological flows through the wetlands, including contributions from groundwater. As described in **Section 4.2.1**, due to the construction design, it is not anticipated that piles will create a barrier to any shallow or perched groundwater flow that currently occurs within the Project footprint, minimising the potential for the development to impact groundwater contributions to the wetlands.

The storage volumes of the converted basins were modelled to ensure that the combined post development discharge from the basins is no greater than the pre-development flow. The DRAINS model comparing pre-development and post-development flow confirms that there is no increase in the total site discharge rate in the 5-year and 100-year ARI storm events (RBG 2019). However, the discharge from the bio-detention basins will be via four surface headwalls, which would therefore not produce an exact match to the existing flow regime. This may result in an amount of concentrated flow rather than the existing sheet flows (RBG 2019). However, rock scour protection which will dissipate the water via sheet flow across the land to mitigate any direct impact on native vegetation directly within the discharge area.

An assessment of the potential ecological impact on the coastal wetlands to the north of the site as a result of any changes to hydrology (flow regimes) caused by the Project was undertaken by SMEC (2019). The assessment considered EECs, TECs, threatened species and the overall biophysical, hydrological and ecological integrity. The modelling conducted as part of the assessments predicts an mean total annual flow from site to increase by almost 50% from 90.6 ML/yr pre-development to 140 ML/yr post development. This volume increase is due to: a predicted greater frequency of minor runoff events into the wetland, more frequent than the 20% AEP; approximately 10 to 20mm of additional inflow from the developed site during significant events for parts of the wetland; and 10 to 50mm within the dam. Modelling results indicated that the Project will have minimal impact on the coastal wetland estimated water levels. For detailed results on the hydrology (flow regimes) modelling please refer to SMEC 2019.

The potential impacts of these additional flows on the EEC's identified on the Site, MRS and two pH dependent threatened species (i.e. Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis*) were assessed by Jon Alexander, an ecologist and suitably qualified professional (SMEC 2019). In summary, the assessment found that the predicted minor increases in flow are unlikely to result in any apparent or significant impacts due to;

- The coastal wetlands to the north of the site are dominated by Broad-leaved Paperbark *Melaleuca quinquenervia.* Although this species cannot survive permanent inundation, it has adaptations such as fibrous roots around their lower trunk that are understood to allow the plant to respire during long periods of submersion. Furthermore, the mid- and understory species such as rushes, sedges, ferns and grasses are also adapted to periodic inundation.
- Predicted change in flood level from the Projects outflows is expected to be very small (<50mm). When compared to the existing flooding from the Tweed River (BMT 2018) which indicates inundation depths for the wetland of approximately 2m for the 5% AEP event and 3m for the 1% AEP event. Suggesting that the Paperbark swamp forest present are naturally resilient to large scale flood events in excess of the inflows likely to be a result of the Project;
- White Booyong – Fig subtropical rainforest community appears to be limited to the slightly elevated fringes of the Paperbark swamp forest and therefore is unlikely to be materially impacted by the additional inflows expected;
- The available information on MRS habitat suggests the species is dependent on high moisture levels, low fire frequency, and a well-developed leaf litter layer and are typically found on somewhat elevated ground around the edges of wetlands (DEE 2019; OEH 2019). It was assessed that the predicted change in inflow levels is unlikely to negatively impact or reduce the existing MRS habitat to the north of the site through permanent inundation;
- The Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis* prefer areas of generally different habitat such as inundated habitat with emergent sedge species. If present, there is no apparent likelihood that the additional inflows expected would negatively impact these species; and
- Additionally, if the above species are present, the expected improvement in water quality as a result of the Projects stormwater management system could potentially be of benefit. However, additional data from long term monitoring of these species would be required to assess any potential impacts as a result of the Project in greater detail.

To reduce the modelled higher frequency flows (more frequent than the 20% AEP), mitigation measures recommended by SMEC (2019) will further minimise the impact on the coastal wetland, including additional assessment to be carried out to inform potential modification(s) in the basin outflow design, such as staging the basin outlets to reduce peak discharges and by removing the proposed bio-basin lining and providing additional infiltration downstream of the basins.

4.1.4 Aquatic fauna

During the development of the BDAR, two pH dependent amphibians were identified by the BAM Calculator as candidate threatened species, namely, Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis* (Greencap 2019b). There are records for these species within the 1,500 m assessment area and within the receiving catchment. The use of gypsum as a flocculent in the sediment basins to quickly settle sediment-laden stormwater runoff during construction may impact the threatened amphibian species Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis* upon discharge from basins to the downstream receiving wetland environment. To avoid any potential changes in pH and impacts on these threatened species, other commercially available flocculants (i.e. Turbiclear) that work as effectively as a gypsum replacement yet do not create the large changes in pH will be used to treat stormwater prior to discharge.

Greencap has reviewed information provided by the supplier of the proposed flocculent (Turbiclear), including the product's Safety Data Sheet (SDS), ecological reports and emails provided by the supplier verifying the product's history of use on other projects with similar ecological constraints. Based on the information that has been provided, when used in accordance with both the manufacturer's recommendations and in accordance with the proposed ESCP the use of Turbiclear as a flocculant in the onsite sediment basins during construction works is not expected to be detrimental to downstream ecological receptors in the wetlands.

As part of the surface water quality monitoring program as outlined in the WQMP in **Section 4.4**, physico-chemical parameters including pH will be monitored in water discharged from sediment basins and in the downstream wetland environment.

4.1.5 Cane toad *Rhinella marina* management

Sediment basins and WSUD features have the potential to attract cane toads *Rhinella marina* and provide breeding habitat which could impact native fauna species, in particular the Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis* or other reptiles and birds that prey on cane toad *Rhinella marina*. Measures to mitigate the impacts of cane toad *Rhinella marina* on the Project Site are described in the FMP, **Section 3.4.**

4.1.6 Sediment basin discharge criteria

Assessment of the relevant discharge parameters will be carried out prior to active discharge offsite from sediment detention basins, excavations or other areas of collected water. Monitoring of the parameters will be conducted using calibrated hand-held monitoring devices and/or sample collection for laboratory analysis. Active discharge of water from a sediment basin into the off Site receiving environment will require approval from a Project Environmental Representative/Manager.

At a minimum, stormwater actively discharged from a controlled sediment basin to receiving waters must comply with Tweed Shire Council stormwater discharge criteria (TSC 2016), the Sites approved ESCP and CEMP.

The Tweed Shire Council specifications (TSC 2016) require that stormwater discharge monitoring must take place at all surface water locations leaving the Site for the following parameters:

- suspended solids and non-filterable residue (NFR) – monthly or during a discharge event (defined as >25mm in any 24 hour period);
- pH – monthly or during a controlled discharge event; and
- Total phosphorus and Total nitrogen – every three months.

Furthermore, a monthly water quality monitoring program will monitor water quality at sediment basin discharge points (near the outlet) and in the wetland received environment as described in **Section 4.4.**

4.2 Contamination pathways

As per Condition 3 B25, all Stage 2 works and associated activities are to be delivered in accordance with an approved groundwater management plan including measures to prevent groundwater contamination in order to avoid any impacts on groundwater, particularly during piling and excavation activities. Contamination risk mitigation will be managed under the SWMP (RBG 2019) and CEMP Sub-plans (CAQMADM , CTPMSP and CSWMSP).

Contaminated land investigations in the form of a Preliminary Site Investigation (PSI) and Detailed Site investigation (DSI) were undertaken at the Site as described in the Stage 1 BMP (Octief 2018). The investigations concluded that based on the conceptual site model presented in the report, exposure pathways of identified soil and groundwater contamination to ecological receptors were unlikely to be complete.

Furthermore, for the additional Soil and Groundwater Investigation Report, required by condition B10 of Schedule 3, a groundwater and intrusive soil investigation was undertaken by Cavvanba Consulting Pty Ltd (Cavvanba) in November and December 2018, and July (Cavvanba 2019) focusing on specific areas of the site including the Farm Dump, Farm Pit (dip), Residential Home and Farm Shed, Farm Dam (all of which are anecdotal descriptions only) and groundwater at the site. These investigations determined that:

- Exceedances of ecological criteria in soil samples were reported, however, these were noted as likely to be localised and not considered to be significant. This is consistent with the previous assessment (Octief 2018) which found no widespread contamination-related ecological issues on the Site.
- The Cudgen Creek off-site environmental receptor and associated creeks are unlikely to be exposed to contamination as the contamination pathways are unlikely to act as a conduit, i.e. extensive distance between the source area and receptor; and depth of the groundwater. These conclusions are consistent with the previous report.

Remediation works are currently underway and will be completed during Stage 1. It is understood that JBS&G have been engaged to provide a Site Audit Report and Site Audit Statement to support the Stage 2 SSD Application.

4.2.1 Groundwater

The location of the Project's development footprint on the Site seeks to minimise interference with hydrological flows, including contributions from groundwater.

Other than what may be required for piling, subsurface excavations will be at a shallower depth than measured depth to groundwater on the Site. The geotechnical investigations undertaken by Morrison Geotechnical (2018) identified that the water table sits at approximately RL 11.0.

Many of the piles will not extend below RL 11.0. The proposed less intrusive method of pile construction using a continuous flight auger (CFA) or Bore Pile type should remove the requirement to de-water from groundwater table during piling activities (Darren Chow, Lendlease Building Pty Ltd, pers. comm. 25 June 2019). Piles will be between 600 mm and 1,200 mm in diameter (generally 900 mm) and will typically be spaced 8.4 m apart. As the piles are not continuous it is not anticipated that they will create a barrier to any

shallow or perched groundwater flow that currently occurs within the Project footprint, therefore the design will not have any significant impacts to groundwater flow or on groundwater contributions to base flow in the wetlands.

While no site specific groundwater modelling data is currently available for the Site, the level that groundwater has been encountered in the bores which are situated upslope from the wetlands is at a higher elevation that the wetlands, indicating that there is potential for groundwater to influence the wetlands and provide some base flow. However, the extent to which groundwater influences flows and water quality within the wetlands is unknown based on available site information.

There is a very low risk of any reduction of groundwater recharge during Stage 2 works.

4.3 Spill management

A spill prevention and response management plan along with supporting documentation will be produced as part of the Project's CEMP and sub-plans and their prescriptions will be implemented to minimise the risk of surface water or groundwater contamination.

Material safety data sheets (MSDS) will be available on all chemical products brought onto Site to aid in the identification of appropriate spill clean-up and disposal methods.

Chemicals and hazardous substances used during all phases of the Project will be selected and managed to minimise the potential adverse environmental impact associated with their transport, transfer, storage, use and disposal.

Spill response materials and equipment (including personal protective equipment) will be available during all project phases and will contain equipment to remediate or contain both chemical and hydrocarbon spills. All spills will be reported to management and recorded in the incident register as per the Project's CEMP procedures.

4.4 Surface water quality monitoring program

The surface water monitoring objectives for the Site are to detect changes during construction and operations in receiving water quality resulting from the Project, with stormwater discharges potentially containing increased sediment loads, nutrients, total and dissolved metals, hydrocarbons or other contaminants such as pesticides.

Surface water monitoring results and trends will be reported in monthly factual report and an annual interpretative report. Water quality results shall be compared against water quality guidelines for ecosystem health. Monitoring parameter exceedances which indicate increasing trends and/or results that are not generally consistent with background data will trigger investigation and adaptive management actions.

As part of the adaptive management approach, the water quality monitoring program will be reviewed periodically once sufficient data is available to ensure alignment with any changes in Site activities and potential impact pathways and determine whether any parameters should be excluded from further monitoring rounds. Based on the seasonality of rainfall in the region, it is anticipated that 12 months of monitoring data would be required to adequately assess all parameters, as such it is proposed that this is undertaken as part of the annual reporting process with recommendations for any change in parameters included in the report.

4.4.1 Background data

Water quality monitoring

In addition to the modelling undertaken by Bonacci (2019) as described above, Greencap conducted three surface water sampling events on 19 and 26 November and 19 December 2018 to record water quality conditions under the existing land use. The intention of this sampling was to create some indicative background data to enable detection of potential changes during construction and operation in receiving water quality resulting from the Project. The water quality monitoring program collected water quality data over two sampling events on existing stormwater which flows into the downstream forested wetland and the east-flowing floodplain drain receiving environment. Sample locations were selected to allow a best possible indication of stormwater runoff quality upstream and downstream of the Site and the receiving environment (wetland).

Given the objective for detection of changes to water quality in receiving water bodies during construction and operation of the Project, specific contaminants of concern were selected as listed above. Organochlorine Pesticides (OCP) and Organophosphorus Pesticides (OPP) as a result of the historic and current agricultural land-use. Physico-chemical parameters were also monitored for pH dependent threatened species such as the Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis*.

4.4.2 Sampling locations

Sample locations have been selected to allow a best possible indication of stormwater runoff quality upstream and downstream of the Site and the receiving environment (wetland). It is noted that under pre-construction conditions the majority of stormwater run-off from the site would be sheetflow heading in a northerly direction. As sheetflow cannot be readily sampled, the locations detailed below are considered the most appropriate to obtain relevant site data.

To effectively assess the water quality of stormwater discharge and its impact on the receiving environment, particularly the wetlands, five sampling locations are proposed (**Figure 12**) for monthly sampling:

- Dam and Dam Drain:
    - Dam drain: to assess water entering the dam - upstream/paddock run off*
    - Dam: catchment for on Site/off Site drains, water diverted from wetland*

      *These locations will only be monitored in the pre-construction and early stages of construction works in the event the dam is decommissioned during the construction phase. This is further detailed in the Vegetation Management Plan (**Section 2.3**) as a control measure for the *Salvinia molesta* infestation.
- Upstream and Receiving Environment:
    - Upstream West: upstream of the wetland stream/drain to the west, along Tweed Coast Rd (background quality).
    - Downstream East: upstream of the wetland stream/drain, to the east along Turnock street (background quality).
    - Upstream North West; water flowing through the wetland stream/drain from the river and urban catchment.
- In addition to the nine sampling locations listed above, event-based sampling will also include three drains around the perimeter of the site:
    - Cudgen Road Drain - to assess stormwater runoff entering the Site (upstream, background quality).
    - Lowest paddock drain - to assess runoff from the site.
    - Turnock St Drain - assess upstream water entering the wetland.

- Prior to a discharge event, the four sediment basin will be sampled at the discharge points (near the outlet) to ensure the quality of water released is consistent with the water quality objectives.

4.4.3 Sampling frequency

Ongoing monitoring will be undertaken during Stage 2 construction and operations in accordance with the following regime:

- Monthly;
- Controlled Event-based – prior to controlled discharge from one or more of the existing sediment basins.
- Uncontrolled Event-based – in the event of an uncontrolled release from one or more of the existing sediment basins (within 24-48hrs of notification).

4.4.4 Sampling parameters and performance criteria

The list of proposed sampling analytes, field parameters and the trigger criteria they will be assessed against are based on the following guidelines:

1. NSW Water Quality Objectives for the Tweed River Catchment for Aquatic Ecosystems (Tweed 2006);
2. Australian and New Zealand guidelines for fresh and marine water quality (ANZECC 2000).

A summary of the proposed sampling analytes is provided in **Table 11.**

Table 11 Surface Water Quality Monitoring Parameters

Analyte	Trigger Criteria		
In-Field	Unit	Tweed (2006)	ANZECC (2000) 95% species protection
pH	pH Units	7.0 - 8.5	6.5 - 8.5
Turbidity	NTU	0.5 - 10	6.0 - 50
Electrical Conductivity (EC)	mS/cm	30 - 2,200	N/A
Dissolved Oxygen (DO)	%	80 - 110	85 - 110
Temperature	^{O}C	N/A	N/A
Oxidation Reduction Potential (ORP)	mV	N/A	N/A
Oil and grease	Visual observation	N/A	N/A
Laboratory			
Total Suspended Solids (TSS)	mg/L	N/A	N/A
Total Dissolved Solids (TDS)	mg/L	N/A	N/A
Ammonia	µg/L	15	20
Chlorine	mg/L	N/A	N/A
Chlorophyll-a	µg/L	4	5
Filterable Reactive Phosphorus	µg/L	N/A	20
Nitrate	µg/L	N/A	N/A
Oxides of Nitrogen	µg/L	15	40
Total Nitrogen	µg/L	300	350
Total Phosphorus	µg/L	30	25

Analyte		Trigger Criteria	
Aluminium (pH >6.5)	µg/L	N/A	55
Arsenic (filtered)[2]	µg/L	N/A	24
Boron (filtered)	µg/L	N/A	370
Cadmium (filtered)	µg/L	5.5	0.2
Chromium (filtered)[2]	µg/L	4.4	1.0
Copper (filtered)	µg/L	1.3	1.4
Cobalt (filtered)	µg/L	1.0	N/A
Lead (filtered)	µg/L	4.4	3.4
Manganese (filtered)	µg/L	N/A	1,900
Mercury (filtered)	µg/L	0.4	0.6
Nickel (filtered)	µg/L	70	11
Selenium (filtered)	µg/L	5	11
Silver (filtered)	µg/L	1.4	0.05
Zinc (filtered)	µg/L	15	8.0
Benzene	mg/L	N/A	0.95
Toluene	mg/L	N/A	N/A
Ethylbenzene	mg/L	N/A	N/A
Xylene - Total	mg/L	N/A	0.95
Naphthalene	mg/L	N/A	0.016
Total Recoverable Hydrocarbons (TRH)	mg/L	N/A	N/A
TRH Silica-gel Clean-up[1]	mg/L	N/A	N/A
Organochlorine Pesticides (OCP)			
4.4'-DDE	µg/L	N/A	0.03
4.4'-DDT	µg/L	N/A	0.01
Aldrin	µg/L	N/A	0.001
g-BHC (Lindane)	µg/L	N/A	0.2
Chlordane	µg/L	N/A	0.08
Dieldrin	µg/L	N/A	0.01
Endosulfan	µg/L	0.01	0.2
Endrin	µg/L	0.02	0.02
Heptachlor	µg/L	N/A	0.09
Toxaphene	µg/L	N/A	0.2
Organophosphorus Pesticides (OPP)			
Azinphos-methyl	µg/L	N/A	0.02
Chlorpyrifos	µg/L	0.009	0.01
Demeton-S	µg/L	N/A	0.04

Analyte		Trigger Criteria	
Diazinon	µg/L	N/A	0.01
Dimethoate	µg/L	N/A	0.15
Fenitrothion	µg/L	N/A	0.2
Malathion	µg/L	N/A	0.05

[1]TRH silica gel clean-up provides an indication of whether reported hydrocarbons are petroleum based or non-petroleum based.

[2] If a sample returns detectable concentrations of these analytes, additional analyses (speciation) may be required to enable comparison against additional trigger criteria or trace potential sources of contaminants.

4.4.5 A suitable number of QA/ Quality control

QC samples will be collected in accordance with AS4482.1-2005 which stipulates a minimum of one duplicate sample, as well as a field and trip blank.

Surface water samples will be collected using industry standard practices for surface water sampling and in general accordance with:

- AS/NZS 5667.1:1998 Water Quality – Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples (AS/NZS 5667.1);
- AS/NZS 5667.4:1998 Water Quality – Sampling Part 4: Guidance on sampling from lakes, natural and man-made (AS/NZS 5667.4); and
- AS/NZS 5667.6:1998 Water Quality – Sampling Part 6: Guidance on sampling of rivers and streams (AS/NZS 5667.6).

4.4.6 Report and review

A brief summary letter report will be prepared for each monthly and event-based sampling round that will include:

- Site details;
- Sampling objective and monitoring methodology; and
- Sample and monitoring results, exceedances of the adopted trigger values will be highlighted.

An annual report will be submitted providing interpretation of water quality data, evaluating water quality exceedances and trends and a review of the water quality monitoring program following the completion of the 12-month period of monitoring. The report may include recommendations for any future monitoring parameters and frequencies based on the previous 12 months monitoring results, or changes in site conditions.

4.5 Summary of water quality mitigation measures

Table 12 summaries the various activities, timing and responsibilities required to achieve the water quality management aims and objectives.

Table 12 Water quality mitigation measures

Item #	Management zone	Activity Description	Project Phase[1]	Responsibility	Outcome	Performance criteria
Stormwater Management - Construction						
87	All areas	All construction works will be delivered in accordance with a CEMP including an ESCP.	Stage 2 C	Management, all construction staff and site personnel	Mitigate any impacts from the Project on water quality/ hydrological processes that sustains threatened species and TECs	As per approved CEMP and ESCP
88	All areas	All construction staff and site personnel will be made aware of their environmental responsibilities and safeguard measures within the CEMP to avoid and minimise environmental impacts. The CEMP will be submitted to the DPE for review and approval prior to commencement of works.	Stage 2 C	Management, all construction staff and site personnel	Mitigate any impacts from the Project on water quality/ hydrological processes that sustains threatened species and TECs	Adherence to water quality management policies
89	All areas	The CEMP will be submitted to the DPIE for review and approval prior to commencement of Stage 2 construction works.	Stage 2 C (planning)	Management	Mitigate any impacts from the Project on water quality/ hydrological processes that sustains threatened species and TECs	Approved Project CEMP
90	All areas	The ESCP will be implemented prior to the commencement of construction works, especially prior to the onset of each wet season (from late February to late April).	Stage 2 C	Management and all contractors	Mitigate any impacts from the Project on water quality/ hydrological processes that sustains threatened species and TECs	Approved Project ESCP criteria
91	All areas	The ESCP is reviewed and updated, as required, and at least annually prior to the onset of the wet season to reflect changes in site conditions as construction progresses.	Annually / Stage 2 C	Management	ESCP will reflect changes in site conditions as construction progresses	Approved Project ESCP criteria
92	All areas	An erosion assessment will be conducted by a CPESC during the planning phase of the ESCP development.	Stage 2 C (planning)	Management and all contractors	Mitigate any impacts from the Project on	CPESC erosion assessment undertaken

Item #	Management zone	Activity Description	Project Phase[1]	Responsibility	Outcome	Performance criteria
					water quality that sustains threatened species and TECs	
93	All areas	ESC design should be in accordance with the guidelines in Best practice erosion and sediment control (IECA 2008), the Tweed Shire Council Development Design Specification - D7 (TSC 2016), guidelines for development adjoining land and water managed by DECCW (OEH, 2013) and the Managing Urban Stormwater "Blue Book" (Landcom 2004).	Stage 2 C	Management and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Approved Project ESCP criteria
94	All areas	The ESCP will include a sediment barrier (or diversion bund) around the Site and sediment ponds to control the quality of water released from the Site into the receiving environment.	Stage 2 C	Management and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Approved Project ESCP criteria
95	All areas	Erosion and sediment control management of stockpiles is to be consistent with relevant guidelines and the most recent ESCP.	Stage 2 C	Management and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Approved Project ESCP criteria & industry guidelines
96	All areas	Erosion and sediment control measures including sealed areas will be inspected regularly to check for compliance and that they are maintained and are in good working order.	Monthly/ Stage 2 C	Project Environmental Representative	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Compliance with approved Project ESCP criteria
97	All areas	ESC compliance inspection reports shall be provided to Project Management (TSA).	Monthly/ Stage 2 C	Management, Project Environmental Representative and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Reporting of all ESCP non-compliances
98	All areas	In the event that an ESCP non-compliance is identified, Management shall be notified as soon as practical.	As required/ Stage 2 C	Management, Project Environmental Representative and all contractors	Mitigate any impacts from the Project on water quality that	Compliance with approved Project ESCP criteria

Item #	Management zone	Activity Description	Project Phase[1]	Responsibility	Outcome	Performance criteria
					sustains threatened species and TECs	
99	All areas	All erosion and sediment controls must be maintained, e.g. restoring capacity of the sedimentation basins and rock filter dams through desilting as necessary after rainfall events, subject to daily inspections and when weather conditions permit, in accordance with the Managing Urban Stormwater "Blue Book" (Landcom 2004). Temporary sediment traps will be retained until after the lands they are protecting are completely rehabilitated.	Stage 2 C	Management and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Compliance with approved Project ESCP criteria Evidence of ESCP onsite audits
100	All areas	If soil erosion is evident, exposed surfaces at the affected area will be stabilised with whatever means is considered practicable and satisfactory (e.g. matting, soil stabiliser, mulching) to mitigate and stabilise the area in accordance with the relevant ESCP and guidelines.	Stage 2 C	Management and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Compliance with approved Project ESCP criteria
101	All areas	The Site manager will keep a logbook making entries at least weekly, immediately before forecast rain or after rainfall. Entries will include: Volume and intensity of rainfall events, the condition of any soil and water management works, the condition of vegetation and any need to irrigate, the need for dust prevention strategies any remedial works to be undertaken.	Stage 2 C	Site manager and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Compliance with approved Project ESCP criteria
102	Project footprint and sediment basins (MZ 2.3)	The following events must be reported to Project Management (TSA); ESC measures have not been fully implemented prior to the commencement of earthworks/construction, inspections not conducted at the required frequency, failed ESC during a rain event that it was design to withstand and sediment controls have not been restored in accordance with IECA guidance timeframes following rain events.	Stage 2 C	Construction contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Compliance with approved Project ESCP criteria

Item #	Management zone	Activity Description	Project Phase[1]	Responsibility	Outcome	Performance criteria
103	Project footprint and sediment basins (MZ 2.3)	Personnel who are involved in maintenance of erosion and sediment controls, and dewatering activities will be suitably trained in the appropriate installation and operation of controls, discharge water-quality requirements, treatment processes and incident reporting procedures.	Stage 2 C	Management and contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Qualification review of suitably qualified contractors engaged to undertake activities
104	All areas	Contaminated soils (i.e. sediment removed from basins that could potentially be contaminated) will be managed in accordance with the Sites CWMSP (LLB 2019). The WMP will outline the waste management strategies including the process for waste identification, characterisation, storage, labelling, inspection, transport onsite and transfer to the appropriate waste vendor, including completion of all required waste disposal documentation.	Stage 2 C	Management and contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Adherence to all Site Waste Management Procedures
105	Sediment basins (MZ 2.3)	Assessment of the relevant discharge parameters will be carried out prior to active discharge offsite from sediment detention basins, excavations or other areas of collected water.	Stage 2 C	Management, Project Environmental Representative and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Compliance with approved Project ESCP discharge water criteria
106	Sediment basins (MZ 2.3)	Active discharge of water from a sediment basin into the off Site receiving environment will require approval from a Project Environmental Representative/ Manager.	Stage 2 C	Project Environmental Representative/ Manager and contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Compliance with approved Project ESCP discharge water criteria
107	Sediment basins (MZ 2.3)	Stormwater actively discharged from a controlled sediment basin, excavations or other areas of collected water to off Site receiving waters must comply with the *Tweed Shire Council Development Design Specification - D7* (TSC 2016) stormwater discharge criteria and the guidelines for development adjoining land and water managed by DECCW (OEH, 2013).	Stage 2 C	Management, Project Environmental Representative and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Compliance with approved Project ESCP discharge water criteria and TSC D7 Criteria: pH monthly or during a controlled discharge event and Total Phosphorus and Total nitrogen every three

Item #	Management zone	Activity Description	Project Phase[1]	Responsibility	Outcome	Performance criteria
						months (TSC 2016) as per **Section 4.4.4.**
Stormwater Management - Operation						
108	Project footprint and receiving environment	The stormwater management system for operation of the Project will be designed in accordance with the locally appropriate standard (TSC 2016) and guidelines for development adjoining land and water managed by DECCW (OEH, 2013) as per the SWMP (RBG 2019).	Stage 2 (design phase)	Management and contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Maintain or improve the quality of stormwater that is discharged from the Site.
109	Project footprint and receiving environment	The stormwater design for the site is designed on the basis of ensuring that the post development discharge rate does not exceed the pre-development rate in the 100 year and 5 year ARI storms (RBG 2019). In regards to water quality, the system will also be designed to meet water quality performance criteria detailed in **Section 4.4.4.**	Stage 2 (design phase)	Management and contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	No decrease in the quality of stormwater that is discharged from the Site.
Water Sensitive Urban Design Measures						
110	Farm dam in MZ 1.4	The management of the farm dam located at the north of the site will be decommissioned to control the current infestation of *Salvinia molesta* as described in **Section 2.3.2.7.**	Stage 2 C	Manager and contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Maximum 5% weed cover following weed control activities Vegetation condition Monitoring performance criteria as per **Section 2.3.5.** As per the water quality criteria outlined in the **Section 4.4.4.**
111	MZ 2.3	As part of the SWMP (RBG 2019), a transition plan will be developed outlining the stages of activities and timing for converting the sediment basins into bio-detention basins.	Stage 2 C	Management, Wetland design Contractor	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Sediment basin/ Bio-detention basin transition plan

Item #	Management zone	Activity Description	Project Phase[1]	Responsibility	Outcome	Performance criteria
112	Project footprint, MZ 2.3 and 5	WSUD measures (i.e. swales, bioretention basins and extended detention basins) will maintain flows to the wetlands and maintain or improve water quality.	Stage 2 O	Management, Project Environmental Representative and all contractors	Maintain natural flows to the wetlands and maintain or improve water quality.	As per the water quality criteria outlined in the **Section 4.4.4.**
113	Project footprint	The roof runoff will be directed into the bio-detention basin by a pit and pipe system while hardstand runoff will be first treated by enviropods, and then either swales that discharge to the bioretention system or directly into the bioretention systems.	Stage 2 O	Management, Project Environmental Representative and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	As per approved SWMP
114	Project footprint, MZ 2.3 and 5	The bulk of the stormwater will end up in bio-retention basins and then discharge to the receiving catchment in a controlled manner.	Stage 2 O	Management, Project Environmental Representative and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	As per approved SWMP
115	MZ 2.3	A bio-detention basin hydrodynamic design will be created by suitably qualified and experienced environmental engineers with experience in wetland design. The design will outline technical specifications for the bioretention basins, including; zonal design (i.e. inlet zone, macrophyte zone and embankment (littoral) zone), cane toad and mosquito deterrents, weed control, vegetation types and planting densities for each zone within the basin.	Stage 2 O	Management, Wetland design Contractor	Functional and effective bioretention basins that meet hydrological and stormwater quality requirements	As per the approved SWMP and water quality criteria outlined in the **Section 4.4.4.**
116	MZ 2.3	Bio-detention basin operational and plan including maintenance procedures.	Stage 2 O	Management, Wetland design Contractor	Functional and effective bioretention basins that meet hydrological and stormwater quality requirements	Bioretention basin operational plan. As per the approved SWMP and water quality criteria outlined in the **Section 4.4.4.**
117	MZ 2.3	Bioretention basin routine maintenance.	Monthly Stage 2 O	Manager Capital Assets and Resources (or similar	Functional and effective bioretention basins that	As per the approved SWMP and water quality

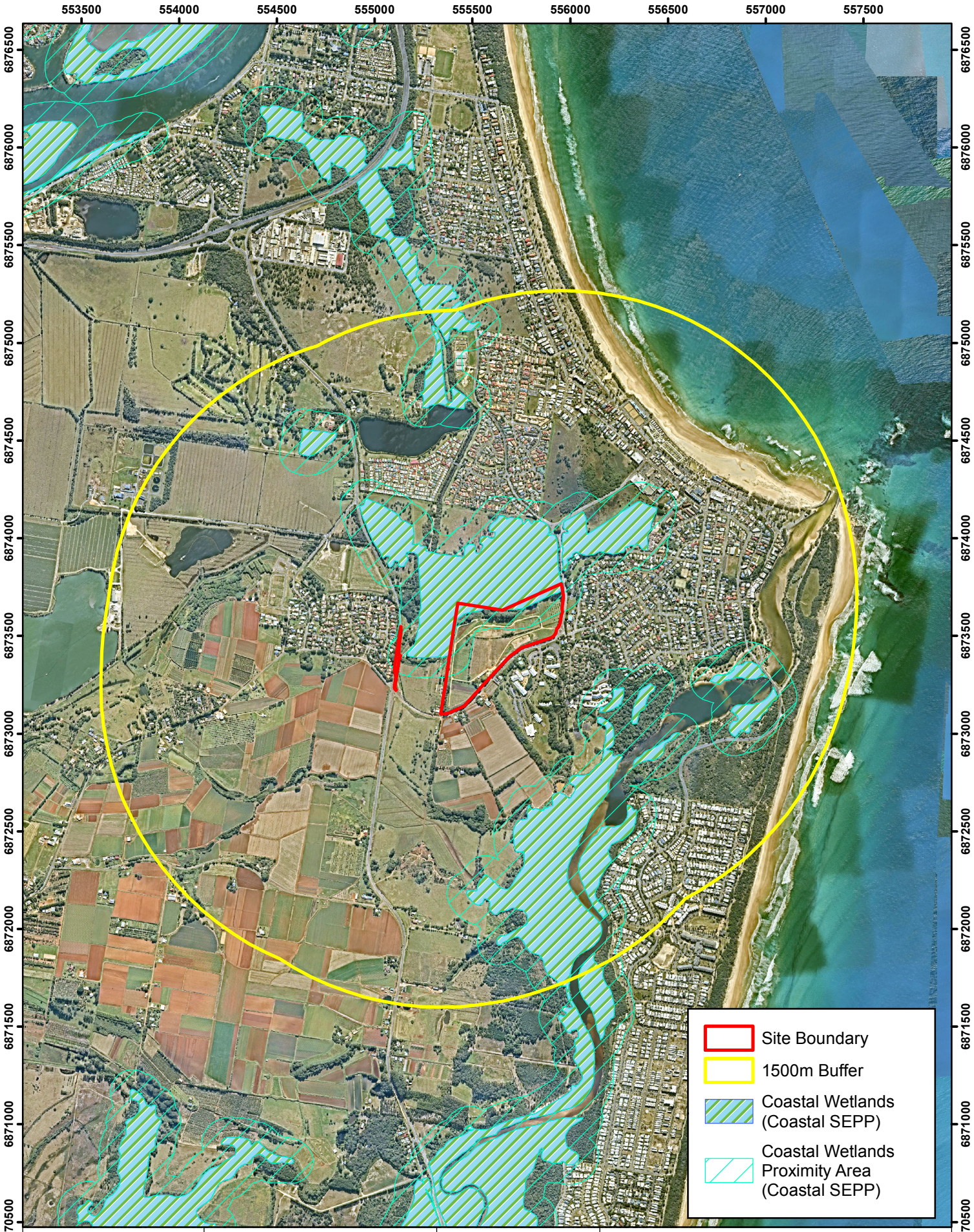
Item #	Management zone	Activity Description	Project Phase[1]	Responsibility	Outcome	Performance criteria
				role), LHD with works undertaken by external subcontractor/s.	meet hydrological and stormwater quality requirements	criteria outlined in the **Section 4.4.4.**
Groundwater						
118	Project footprint	Other than what may be required for piling, subsurface excavations will be at a shallower depth than measured groundwater depths on the Site. Piles will be between 600 mm and 1200 mm in diameter and will typically be spaced 8.4 m apart, except under lift and/or stairwell cores where they will be not less than 2 m apart. As the piles are not continuous, it is not anticipated that they will create a barrier to any shallow or perched groundwater flow that currently occurs within the Project footprint.	Stage 2 (design phase)	Management and contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Maintain shallow or perched groundwater flow that currently occurs within the Project footprint
119	Project footprint	Any reduction of groundwater recharge due to the Project footprint will be mitigated through recharge that will occur through the proposed WSUD measures such as: swales and car park plantings to reduce impervious surfaces.	Stage 2 O	Management, Project Environmental Representative and all contractors	Maintain natural flows to the wetlands and maintain or improve water quality.	WSUD measures installed and maintained
Wildlife						
120	MZ 2.3	To avoid any potential changes in pH and impacts on threatened aquatic species, other commercially available flocculants that work as effectively as a gypsum replacement yet do not create the large changes in pH will be used on the Site.	Stage 2 C	Management and contractors	Threatened aquatic species conservation	No change to pH in receiving environment waters pH meets water quality criteria outlined in the approved Site ESCP and **Section 4.4.4.**
121	MZ 2.3	A cane toad *Rhinella marina* exclusion fencing will be installed around sediment basins and bio-detention basins.	Stage 2 C	Manager and contractors	Mitigate any impacts from the Project that sustains threatened species and TECs	Cane toad *Rhinella marina* exclusion fencing installed

Item #	Management zone	Activity Description	Project Phase[1]	Responsibility	Outcome	Performance criteria
122	MZ 2.3	Bio-detention/sediment basin perimeters will be planted out with an edge of *Lomandra longifolia* at a density of three rows, 0.5 to 1 m apart with staggered spacing's of 50cm to exclude cane toad Rhinella marina. Once this dense edge *of Lomandra longifolia* is established the cane toad fencing will be removed.	Stage 2 C	Manager and contractors	Mitigate any impacts from the Project that sustains threatened species and TECs	As per the VMP Performance criteria for revegetation in **Section 2.3.5**. No more than 5% weed cover following weed control activities A minimum of 90% survival rate of all revegetation
Spill prevention and response management						
123	All areas	A spill prevention and response management plan and supporting documentation will be produced as part of the Projects CEMP and their prescriptions will be implemented to minimise the risk of surface water or groundwater contamination.	Stage 2 C	Management, Project Environmental Representative and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Adherence to spill prevention and response management procedures Water quality criteria outlined in the approved Site ESCP and **Section 4.4.4**
124	Project footprint	MSDSs will be available on all chemical products brought onto Site to aid in the identification of appropriate spill clean-up and disposal methods. Chemicals and hazardous substances used during all phases of the Project will be selected and managed to minimise the potential adverse environmental impact associated with their transport, transfer, storage, use and disposal.	Stage 2 C	Management, Project Environmental Representative and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Adherence to spill prevention and response management procedures.
125	Project footprint	Spill response materials and equipment (including personal protective equipment) will be available during all project phases and will contain equipment to remediate or contain both chemical and hydrocarbon spills.	Stage 2 C	Management, Project Environmental Representative and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Adherence to spill prevention and response management procedures.

Item #	Management zone	Activity Description	Project Phase[1]	Responsibility	Outcome	Performance criteria
126	Project footprint	All spills will be reported to management and recorded in the incident register as per the Projects CEMP procedure.	Stage 2 C	Management, Project Environmental Representative and all contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Adherence to spill prevention and response management procedures. All spills recorded in the incident register.
Surface Water Quality Monitoring						
127	Receiving environment (wetland) and sediment basins	The surface water monitoring objectives for the Site are to detect changes in receiving water quality resulting from the Site activities and discharges offsite of water potentially containing nutrients, dissolved metals, hydrocarbons or other contaminants such as Organochlorine Pesticides (OCP) and Organophosphorus Pesticides (OPP)	Stage 2 C & O Monthly NB: this monitoring program will be reviewed to be in line with any conditions of approval.	Management and contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	NSW Water Quality Objectives for the Tweed River Catchment for Aquatic Ecosystems (Tweed 2006); Australian and New Zealand guidelines for fresh and marine water quality (ANZECC 2000). Water quality criteria outlined in **Section 4.4.4.**
128	Receiving environment (wetland) and sediment basins	Surface water monitoring results will be reported in monthly factual report and an annual interpretative report evaluating water quality exceedances and trends and a review of the water quality monitoring program.	Monthly/Annual Stage 2 C & O	Management and contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Monthly/ Annual water quality reports submitted. Water quality criteria outlined in **Section 4.4.4.**
129	Receiving environment (wetland) and sediment basins	Monitoring parameter exceedances which indicate increasing trends and are not generally consistent with background data will trigger investigation and adaptive management actions.	Stage 2 C & O	Management and contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Water quality criteria outlined in **Section 4.4.4.**
130	Receiving environment (wetland) and sediment basins	A suitable number of QA/QC samples will be collected in accordance with AS4482.1-2005 which stipulates a minimum of 1 duplicate sample, as well as a field and trip blank.	Stage 2 C & O	Cntractors	Mitigate any impacts from the Project on water quality that	Adherence to industry standard practices for sampling QA/QC

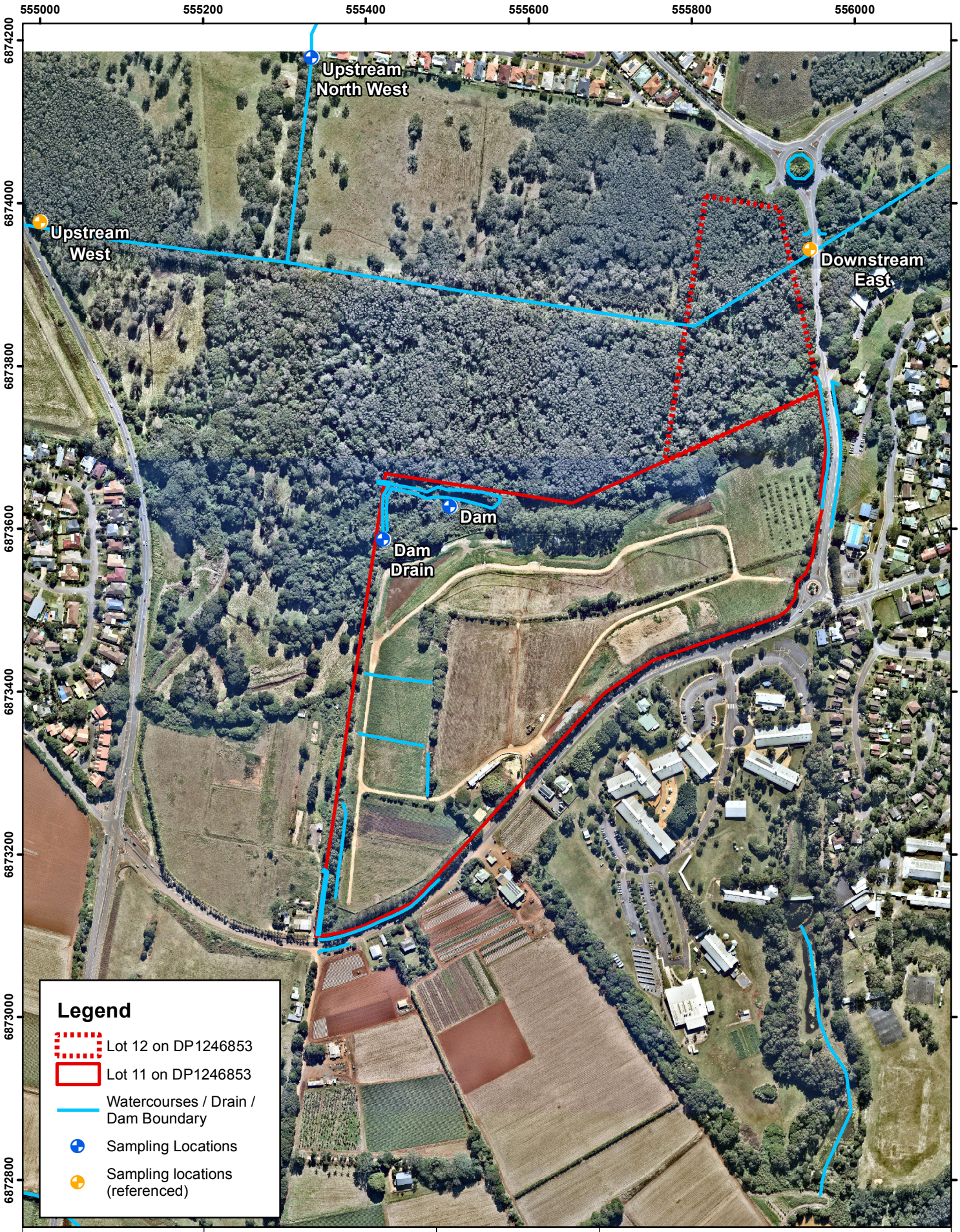
Item #	Management zone	Activity Description	Project Phase[1]	Responsibility	Outcome	Performance criteria
					sustains threatened species and TECs	
131	Receiving environment (wetland) and sediment basins	Surface water samples will be collected using industry standard practices for surface water sampling and in general accordance with: • AS/NZS 5667.1:1998 • AS/NZS 5667.4:1998; and • AS/NZS 5667.6:1998	Stage 2 C & O	Contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Adherence to industry standard practices for surface water sampling
132	Receiving environment (wetland) and sediment basins	Physico-chemical parameters including pH will be monitored in water discharged from sediment basins and in the downstream wetland environment to protect aquatic wetland fauna.	Stage 2 C & O	Management and contractors	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	No change to pH in receiving environment waters. Water quality criteria outlined in **Section 4.4.4**
133	All areas	Should water quality monitoring results indicate performance criteria non-compliance, increasing trends in metals/nutrient concentrations and results are not generally consistent with background data, or impacts from Project activities are identified which could result in an increase in frequency of non-compliance it will trigger investigation and adaptive measures will be implemented to mitigate any impacts.	At all times	Management and consultants	Mitigate any impacts from the Project on water quality that sustains threatened species and TECs	Non-compliance to performance criteria will trigger investigation and adaptive management measures will be implemented

[1] [1] Project phases: Stage 2: Construction (C) and Operation (O)



Client: C107778	N 0 350 700 m	Scale (@A4): 1:25,000	**Wetlands – Stage 2**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (1.2 m) © Nearmap 2019*	Tweed Valley Hospital BMP 771 Cudgen Road Cudgen NSW	**Figure 11**
Date: 1/08/2019	*Coastal SEPP mapping © Department of Planning and Environment (DPE) 2018*		
GREENCAP			

Doc Path: R:_Projects\C107778_Health Infrastructure\J156455_Tweed Valley Hospital\3. Job Folder\GIS\J156455_13_TVHs2\BMPs2\mxd\J156455_13_BMPs2_F11_wetlands_location_190801.mxd



Client: C107778	N 0 70 140 m	Scale (@A4): 1:6,000	**Surface Water Sampling Locations – Stage 2**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Note: All data is approx only & subject to survey.* *Imagery 15th July 2019 (7.5 cm) @ Nearmap 2019* *Hydrolines and Hydroarea (NSW Hydrography) © Department of Finance, Services and Innovation (2018)*	Tweed Valley Hospital BMP 771 Cudgen Road Cudgen NSW	**Figure 12**
Date: 1/08/2019			
GREENCAP			

Doc Path: R:_Projects\C107778_Health Infrastructure\J156455_Tweed Valley Hospital\3. Job Folder\GIS\J156455_13_TVHs2\BMPs2\mxd\J156455_13_BMPs2_F12_WQ_locations_190801.mxd

5. REVIEW AND EVALUTATE

This Stage 2 BMP will be reviewed on an annual basis to assess whether objectives are being been achieved and in accordance with changes in conditions. If required, revisions will be made to this Stage 2 BMP to improve proficiency the following year. In the long term, it is important to keep track of control efforts and ensure that the activities being undertaken are contributing to the objectives of this Stage 2 BMP.

6. REFERENCES

ArborSafe (2018) *Preliminary Arboricultural Report Tweed Valley Hospital Project.*

Aviation SEARS response: Tweed Valley Hospital (AviPro), September 2018.

AviPro (2019) *Aviation State Significant Development Report: Tweed Valley Hospital SSD-9575*.

Australian Transport Safety Bureau (2017) *The Australian aviation wildlife strike statistics report (2006 to 2015)*, https://www.atsb.gov.au/media/5772313/ar2016063_final-report.pdf

Allen, C. and Phillips, S. (2008). *Grid-based SAT (RGB-SAT) sampling for the purposes of identifying areas being utilized by koalas in the South-east Forests of NSW*. Project update & future directions. Unpublished report to NSW Department of Environment and Climate Change.

Biodiversity Conservation Act 2016 (NSW).

BMT (2018) *Tweed Valley Hospital – Flooding Component DRAFT.*

Bonacci (2018), *Tweed Valley Hospital Development – Design Report Civil & Structural, Revision B*. Bonacci Group (NSW) Pty Ltd, Sydney.

Bonacci (2019), *Tweed Valley Hospital Development – Design Report Civil & Structural, Addendum 1 to Design Report, Revision* E. Bonacci Group (NSW) Pty Ltd, Sydney.

Bushland Restoration Services (2016) *Weed Reduction Strategy Mitchell's Rainforest Snail Habitat At specified section of Lot 13 DP871753 Kingscliff, New South Wales.*

Bitzios (2019*) Tweed Valley Hospital Project Stage 2 Traffic Impact Assessment,* Rev 3. Gold Coast, QLD.

Bushland Restoration Services (January 2016) *Weed Reduction Strategy Mitchell's Rainforest Snail Habitat At specified section of Lot 13 DP871753 Kingscliff, New South Wales*. South Murwillumbah, NSW.

Byron Shire Council (BSC) (2013). *Excluding cane toads from water bodies*. Mullumbimby.

Big Scrub Rainforest Landcare Group (BSRLG) (2005). *Subtropical Rainforest Restoration: A practical manual and data source for landcare groups, land managers and rainforest regenerators.* Second Edition. Big Scrub Rainforest Landcare Group, Bangalow, NSW.

Catterall, C.P. and Kanowski, J. (2010) *Rainforest restoration: approaches, costs and biodiversity outcomes*. Reef & Rainforest Research Centre Ltd, Cairns.

Cavvanba (2019) Data quality objectives and sampling, analysis and quality plan - Groundwater and soil investigation, Byron Bay, NSW.

Clarke, S. A (2019a) *Targeted survey for Thersites mitchellae (Cox, 1864) (Mitchell's Rainforest Snail) at 771 Cudgen Rd, Cudgen, NSW, site for the proposed Tweed Valley Hospital*, Prepared for Herbert Smith Freehills LLP by Invertebrate Identification Australasia, Faulconbridge NSW.

Clark, S. A (2019b) Management Plan for the Mitchell's Rainforest Snail *Thersites mitchellae* (Cox, 1864) at 771 Cudgen Rd, Cudgen, New South Wales by Invertebrate Identification Australasia, Faulconbridge NSW.

Clark, S. A (2019c) Pre-construction baseline survey of *Thersites mitchellae* (Cox, 1864) (Mitchell's Rainforest Snail) at 771 Cudgen Rd, Cudgen, New South Wales by Invertebrate Identification Australasia, Faulconbridge NSW.

DECCW (2010), *Far North Coast Regional Conservation Plan*, Department of Environment, Climate Change and Water, Sydney.

DEE (2019) Advice to the Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on Amendments to the list of Threatened Species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Viewed on 11 August 2019.
http://www.environment.gov.au/biodiversity/threatened/conservation-advices/thersites-mitchellae

DPI (2018) Decontamination of vehicles and equipment v2. Viewed on 30 July 2019.
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0010/545554/procedure-decontamination-vehicles-and-equipment.pdf

Ecosure (2018), *Tweed Flying-fox Camp Management Plan - Final Report to Tweed Shire Council*, Ecosure, Burleigh Heads, Queensland.

GeoLINK (2019) *Bushfire Hazard Assessment - Tweed Valley Hospital V3.* Lennox Head, NSW.

Greencap (2019a), *Matters of National Environmental Significance Report – Tweed Valley Hospital*. Greencap Pty Ltd, Brisbane.

Greencap (2019b), *Biodiversity Development Assessment Report – Tweed Valley Hospital*. Greencap Pty Ltd, Brisbane.

Greencap (2019c) *Stage 1 Biodiversity Management Plan – Tweed Valley Hospital*. Greencap Pty Ltd, Brisbane.

Healthy Waterways (2006), *Water Sensitive Urban Design: Technical design guidelines for south east Queensland.* Brisbane City Council and Moreton Bay Waterways and Catchments Partnership, Brisbane.

IECA (2008) *Best Practice Erosion & Sediment Control*. International Erosion Control Association (IECA) Australasia Chapter, Picton, NSW. ISBN: 978-0-9806146-0-2

Interim Construction Noise Guidelines (2009)

JHA (2019) *Noise and Vibration Impact Assessment Rev C*, Tweed Valley Hospital Stage 2, North Sydney

Keith, D.A. (2004), *From ocean shores to desert dunes: the vegetation of New South Wales and the ACT*, Department of Environment and Conservation, Hurstville.

Koala Response Strategy (2009), Koala Safety Fencing and Measures Guideline: A Guidelines for the draft South East Queenlsand Koala Conservation State Planning Regulatory Provisions. Queensland Government.

LCI (2019) *External Lighting Strategy Report Tweed Valley Hospital*, North Sydney.

Lendlease Building Pty Ltd (LLB) (2019) *Project Construction Environmental, Health & Safety Management Plan- Main Works (CEMP)*. Rev 5.0.

Landcom (2004), *Managing Urban Stormwater: Soils and Construction Volume 1*, Fourth Edition. Landcom, Parramatta.

Land & Fire Assessments (2018) *Bushfire Assessment for Proposed State Significant Development at Lot 102 DP870722 Revision No. 05.*

NSW National Parks and Wildlife Service (NPWS) (2001) Mitchell's Rainforest Snail *Thersites mitchellae* Recovery Plan. NPWS, Hurstville, NSW.

Nature Conservation Council (NCC) of NSW, Creating bird-friendly gardens in bush fire prone areas: Fact Sheet. Viewed 24 March 2019: https://www.nature.org.au/media/1794/bird-friendly-garden-factsheet.pdf

Niche Environment and Heritage (2018) *Tweed Valley Hospital Historical Heritage Assessment Report*. Parramatta NSW.

Noise Policy for Industry (2017) NSW EPA

NSW DPI Salvinia Control Manual (2006) Viewed 10 June 2019
https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/89554/salvinia-control-manual.pdf

NSW Scientific Committee (1999), *Lowland rainforest on floodplain in the NSW North Coast Bioregion – endangered ecological community listing*. NSW Scientific Committee final determination.

NSW Rural Fire Service (RFS) (2006). Planning for Bushfire Protection. NSW Rural Fire Service and Department of Planning, Sydney.

NSW Rural Fire Service (RFS) (2010). Addendum: Appendix 3, Planning for Bushfire Protection. NSW Rural Fire Service and Department of Planning, Sydney.

NSW Rural Fire Service (RFS) (2018). Planning for Bushfire Protection (Pre-release Issue). NSW Rural Fire Service, Sydney.

NSW Weed Wise *https://weeds.dpi.nsw.gov.au/.* Viewed 25 February 2019.

Octief (2018) Preliminary and Detailed Site Investigation (Contamination) Report, Yatala QLD.

OEH (2013) Guidelines for Development Adjoining Land Managed by the Office of Environment and Heritage. https://www.environment.nsw.gov.au/research-and-publications/publications-search/guidelines-for-developments-adjoining-land-managed-by-the-office-of-environment-and-heritage

OEH (2018) Mitchell's Rainforest Snail - profile. Viewed 6 March 2019:
https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10801

Robert Bird Group (RBG) (2019) *Stormwater Management Plan Tweed Valley Hospital.* Prepared for Stage 2 State Significant Development Application, Issue C.
SMEC (2019) Tweed Valley Hospital Hydrology Assessment – Draft Rev 2. Fortitude Valley, QLD.

STH Batessmart (2019) Tweed Valley Hospital Masterplan Series, AR-SKE-20, 6 June 2019 (Masterplan)
STH Batessmart (2019) Tweed Valley Hospital Proposed Site Plan, STB-AR-SKE-PRW-1000015A, 6 September 2019

Standards Reference Group SERA (2017) National Standards for the Practice of Ecological Restoration in Australia. Second Edition. Society for Ecological Restoration Australasia. Available from URL: www.seraustralasia.com

Tim Fitzroy & Associates (2018) *Land Use Conflict Risk Assessment Mixed Agricultural Use on Proposed Tweed Valley Hospital Lot 102 DP 870722 Cudgen Road, Cudgen*. Prepared for: Health Infrastructure. REVISED FINAL V7.0.

TSC (2019), *Tweed Shire Council Native Species Planting Guide*. Viewed 25 February 2019. *https://www.tweed.nsw.gov.au/NativeSpeciesPlantingGuide/Tweed*

The Hills Shire Council, 2015. Vegetation Management Plan Guideline

TSA Management. (2018), *Tweed Valley Hospital Concept Proposal and Design*.

TSC (2016), *Tweed Shire Council – Development Design Specification D7 Stormwater quality*, Tweed Shire Council, Murwillumbah.

Turf (2019) *Tree Removal and Preservation Plan* Drawing No LS-DWG-02-001 Rev 5, 27th August 2019. Turf Design Studio, Cronulla.

Turf (2019) *Stage 2 Landscape Zonal Plan* Drawing No LS_DWG-10-003. Rev 8, 6th September 2019. Turf Design Studio, Cronulla.

Tweed Shire Council (2018), *Kingscliff Locality Plan Volume 1 Context and locality wide strategies*, Tweed Shire Council, Murwillumbah.

Water by Design (2014), *Bioretention Technical Design Guidelines (Version 1.1).* Healthy Waterways Ltd, Brisbane.