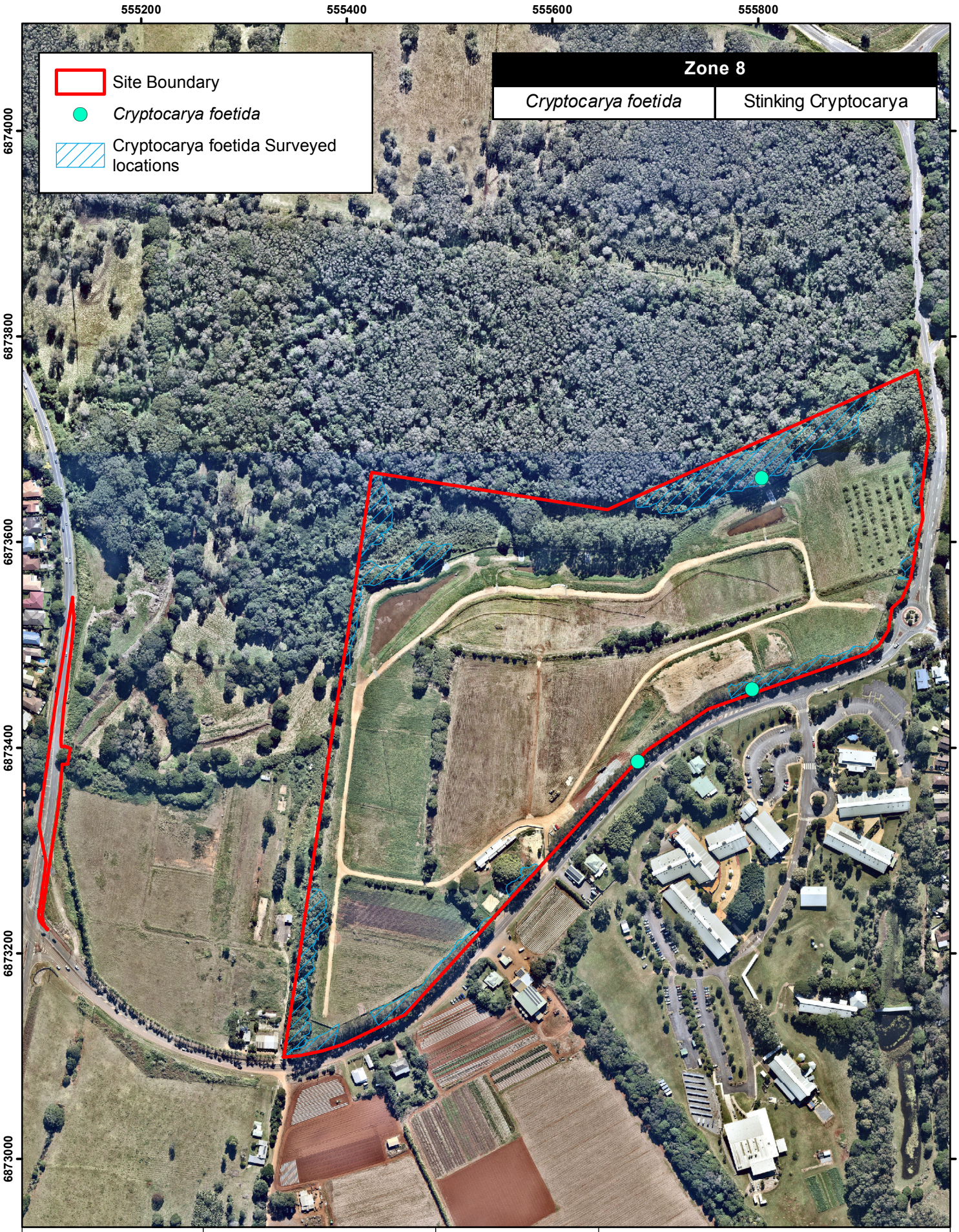
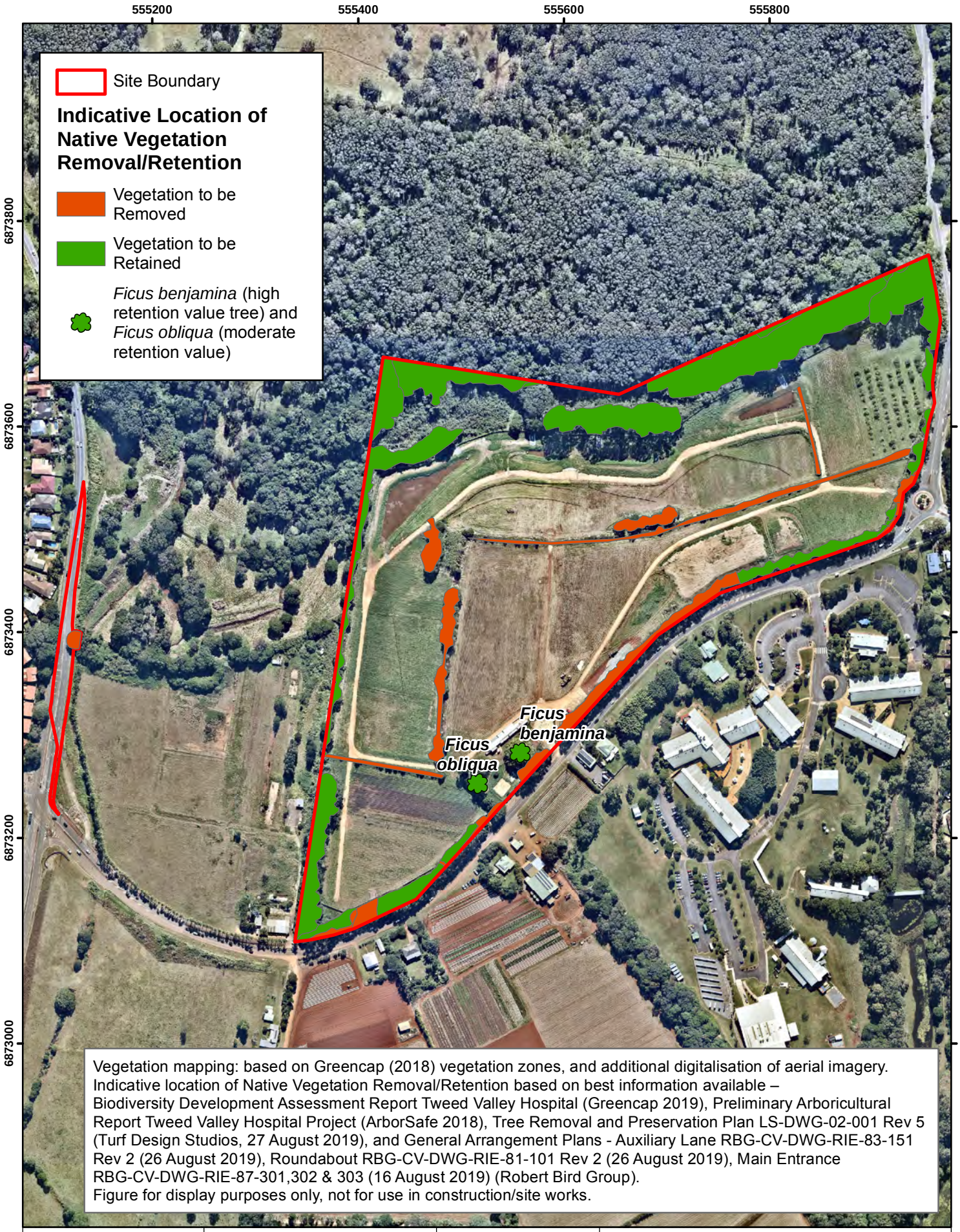



| | | | |
|---|---|---|---|
| Client: C107778 | N 0 50 100 m | Scale (@A4): 1:4,750 | **Threatened Flora - Three-veined laurel *Cryptocarya foetida* plants – Stage 2** |
| Job #: J156455-13 | | | |
| Author: D. Correa | Coordinate System: GDA 1994 MGA Zone 56 | | |
| Checked: C. Maloney | *Imagery 15th July 2019 (7.5 cm) @ Nearmap 2019* | Tweed Valley Hospital BMP<br>771 Cudgen Road<br>Cudgen NSW | **Figure 4** |
| Date: 1/08/2019 | *Vegetation mapping: Greencap (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_F04_Threatened_species_locations_190801.mxd*




Vegetation mapping: based on Greencap (2018) vegetation zones, and additional digitalisation of aerial imagery. Indicative location of Native Vegetation Removal/Retention based on best information available – Biodiversity Development Assessment Report Tweed Valley Hospital (Greencap 2019), Preliminary Arboricultural Report Tweed Valley Hospital Project (ArborSafe 2018), Tree Removal and Preservation Plan LS-DWG-02-001 Rev 5 (Turf Design Studios, 27 August 2019), and General Arrangement Plans - Auxiliary Lane RBG-CV-DWG-RIE-83-151 Rev 2 (26 August 2019), Roundabout RBG-CV-DWG-RIE-81-101 Rev 2 (26 August 2019), Main Entrance RBG-CV-DWG-RIE-87-301,302 & 303 (16 August 2019) (Robert Bird Group).
Figure for display purposes only, not for use in construction/site works.

| | | | |
|---|---|---|---|
| Client: C107778 | N 0 50 100 m | Scale (@A4): 1:4,750 | **Indicative location of Native Vegetation Removal/Retention** |
| Job #: J156455-13 | | | |
| Author: D. Correa | Coordinate System: GDA 1994 MGA Zone 56 | | |
| Checked: C. Maloney | *Imagery 15th July 2019 (7.5 cm) @ Nearmap 2019* | Tweed Valley Hospital BMP<br>771 Cudgen Road<br>Cudgen NSW | **Figure 5** |
| Date: 29/08/2019 | | | |
| GREENCAP | | | |



Doc Path: R:_Projects\C107778_Health Infrastructure\J156455_Tweed Valley Hospital\3. Job Folder\GIS\J156455_13_TVHs2\BMPs2\mxd\J156455_13_BMPs2_F05_direct_impacts_190829.mxd

## 2.3 Vegetation management overview

To enable effective vegetation management throughout the life of the project this Stage 2 BMP identifies vegetation management zones (MZ) in **Figure 6**. The MZs reflect the landscape zones that have been identified in the landscape zonal plan (LZP) (Turf 2019) and MZs broadly reflect the BDAR Vegetation Zones (Greencap 2019b) as shown in **Table 4**.

A range of vegetation management activities will be implemented on the Site throughout Stage 2 of the project including:

- Weed control (biosecurity risk);
- Native vegetation protection measures;
- Regeneration (i.e. assisted regeneration that includes supplementary planting);
- Revegetation;
- Maintenance; and
- Monitoring and reporting.

A range of general vegetation management and biosecurity controls to mitigate the impact of Stage 2 Project activities on biodiversity are identified in (**Table 5**). Vegetation management activities including; Weed control (biosecurity risk), Native vegetation protection measures (tree protection zones), monitoring and reporting have been addressed in the Stage 1 BMP and these activities will continue into the Stage 2 program.

**Table 4 BMP Vegetation Management Zones**

| BMP MZ | BMP Management Zone (MZ) Description | Schematic LZP (Turf, 11 June 2019) |
|---|---|---|
| 1.1 | Remnant paperbark swamp forest | Retained undisturbed forest |
| 1.2 | Remnant and regrowth white booyong – fig subtropical rainforest | |
| 1.3 | Flooded Gum tall open forest planted windrow | |
| 1.4 | Exotic vegetation – barner grass *Cenchrus purpureus* | |
| 1.5 | Exotic vegetation – camphor laurel *Cinnamomum camphora* with understorey of small-leaf privet *Ligustrum sinense* | |
| 1.6 | Flooded Gum and Tallowwood - dominated tall open forest planted windrow | |
| 2.1 | Low maintenance Native Landscape | 13. Lawn with clusters of native planting (min 20m apart)<br>*Note: All zones vegetated in accordance with Asset Protection Zone (APZ) guidelines where required. Refer to 'Bushfire Constraints Assessment'. |
| 2.2 | Self-sown native rainforest and exotic windrow with barner grass *Cenchrus purpureus* | |
| 2.3 | Sediment basins | 2. Bio-detention planting |
| 3 | Hospital Footprint Landscaping | 3. Hospital Landscape 4. Green spine 7. Landscaped courtyards within hospital envelope |
| 4 | Hydromulched/drill seeded lawn (exotic grass-mowing maintenance e.g. couch) | 11. Hydromulched/drill seeded lawn (exotic grass-mowing maintenance e.g. couch) with clusters of native planting (min 20m apart) |

| BMP MZ | BMP Management Zone (MZ) Description | Schematic LZP (Turf, 11 June 2019) |
|---|---|---|
| 5 | WSUD car park and roadway planting | WSUD car park and roadway planting[1] |
| 6 | 10 m wide vegetated buffer | 8. Vegetated buffer (10 m) and 10. Embellished buffer. Retain and augment existing vegetation. Staged replacement of pine trees and understorey with native species. |
| 7 | 30 m wide vegetated buffer | 9. Vegetated buffer (30 m) |
| 8 | Farm Dam | N/A |

**Table 5 General vegetation management controls**

| Item | Task | Description/method | Outcome | Performance measure | Project Phase[1] | Who |
|---|---|---|---|---|---|---|
| **Protection of trees during pre-construction and construction** | | | | | | |
| 1 | Maintain tree protection zone (TPZ) around retained native vegetation inside the temporary boundary fence, including the two high and moderate retention value *Ficus sp.* Trees and one *Cryptocarya foetida*.<br><br>Establish a TPZ at the Tweed Coast Road/Cudgen Road Intersection. | • During Stage 1, a TPZ has been defined around all native trees and vegetation to be retained in accordance with AS4970 – 2009 to protect retained vegetation during construction works and must be maintained throughout Stage 2 construction works;<br>• The TPZ must not be less than 2 m nor greater than 15 m (except where crown protection is required).<br>• As per the *preliminary arboricultural report* (ArborSafe, October 2018), the TPZ for the high retention value tree weeping fig *Ficus benjamina* is 15m and the SRZ is 3.9m and the TPZ for the moderate retention value tree small leafed Fig *Ficus obliqua* identified for retention within the development footprint area is 12m, and the SRZ is 4.4m, measured at a radial distance from the centre of the trunk. The average TPZ for the regenerating native trees in the windrow along Cudgen Road boundary is 2m, as per Section 5.4.12 of the preliminary arboricultural report (ArborSafe, October 2018).<br>• Due to the limited space available for the proposed construction and the radial size of the TPZ's, construction works may be required within the TPZ's. If the proposed encroachment is greater than 10% of the TPZ or inside the SRZ the project arborist must demonstrate that the trees would remain viable post construction (ArborSafe 2018).<br>• During Stage 2 works, a TPZ must be installed to protect early regrowth rainforest adjacent to the *Guioa semiglauca* to be cleared which is surrounded by dense grass and woody weeds at the Tweed Coast Road / Cudgen Road intersection upgrade site and at the farm dam during infilling works. An indicative TPZ of 5m is shown in **Figure 7,** however this is indicative only and an arborist needs to assess the native vegetation and determine exact TPZ requirements in accordance with AS4970 – 2009 before the fencing is installed. | • Retained trees and native vegetation are protected from construction related activity.<br>• Activity that is excluded from the TPZ includes: excavation (including trenching), parking of vehicles/plant, refuelling, cleaning/wash down, placement of fill and soil level changes (refer to AS4970 – 2009 for a comprehensive list of exclusions. | • Construction activity is excluded from the TPZ of retained vegetation. | Stage 2 C | Management, Construction Contractor |
| 2 | Maintain protective fencing and signage | • Maintain temporary fencing and signage around the tree protection zone of any retained trees and vegetation as per **Figure 7**, including at the Tweed Coast Road/Cudgen Road Intersection upgrade.<br>• Fencing is to only be removed upon approval and the completion of all construction activities. | • Retained trees and native vegetation are protected from construction related activity.<br>• Activity that is excluded from the TPZ includes: excavation (including trenching), parking of vehicles/plant, refuelling, cleaning/wash down, placement of fill and soil level changes (refer to AS4970 – 2009 for a comprehensive list of exclusions. | • Temporary fencing 1.8 m high is to be erected before machinery and materials are brought onto Site and before commencement of works.<br>○ Once erected, temporary fencing must not be removed or altered without approval.<br>○ Shade cloth or similar material may be attached to reduce the transport of dust.<br>• Install signage that is visible from within the construction footprint to identify the TPZ. | Stage 2 C | Management, Construction Contractor |
| **Engagement of suitably qualified contractors** | | | | | | |
| 3 | Vegetation management works within areas containing native vegetation must be undertaken by a suitably qualified and experienced bush regeneration contractors | • Bush regeneration contractors must be members of the Australian Association of Bush Regenerators or fulfil the membership criteria.<br>• Team leaders should hold a Certificate III in Conservation & Land Management or possess equivalent field experience and certification.<br>• For bush regeneration works to be conducted in MZ 1.1-1.6 it is highly desirable that the contractor has demonstrated experience working in Mitchell's rainforest snail *Thersites mitchellae* (MRS) habitat.<br>• Bush regeneration contractors are not required to undertake vegetation clearing works within the areas of vegetation to be removed as depicted in **Figure 5** or to undertake hydro mulching.<br>• The bush regeneration contractor would have been engaged in Stage 1 and provided a detailed schedule of prioritised management actions for the site in consideration of the strategies outlined in | • Bush regeneration contractors carry out best practice bush regeneration techniques in accordance with relevant legislation and/or guidelines. | • Evidence of membership, certification and experience is provided by contractors prior to engagement. | Stage 2 C & O | Management, Bush Regeneration Contractor |

| Item | Task | Description/method | Outcome | Performance measure | Project Phase[1] | Who |
|---|---|---|---|---|---|---|
| | | **Section 3.2.2.** The detailed schedule of prioritised management actions is to be updated prior to the commencement of Stage 2 works. | | | | |
| 4 | Suitably qualified and experienced arborists must be engaged to undertake vegetation clearing works | • Arborist contractors must be members of Aboriculture Australia or fulfil the membership criteria.<br>• Team leaders should hold Diploma of Arboriculture (Level 5) or possess equivalent filed experience and certification. | • Arborist contractors conduct vegetation clearing works in accordance with industry best practice. | | Stage 2 C | Management, Arborist Contractor |
| **Managing biosecurity risk** | | | | | | |
| 6 | Implement inspection and wash-down procedures | • The vehicle inspection and wash-down facility and signage should be maintained throughout Stage 2 construction works to enable the washdown of vehicles, plant and equipment for seeds.<br>• Washdown of vehicles, plant and equipment for seeds will be implemented based upon a risk evaluation, including visual inspection, based upon the activities being conducted (See item 5).<br>• Vehicles, plant and equipment cannot leave the Site without being clean and free from weed and seed material.<br>• Vehicles will be cleaned in accordance with the 'Decontamination of vehicles and equipment guide' prepared by the NSW Department of Primary Industries available at: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0010/545554/procedure-decontamination-vehicles-and-equipment.pdf | • All personnel working on site are take reasonable measures to prevent, eliminate or minimise biosecurity risks. | • The facility is inspected at least quarterly for weed seedlings which may have germinated from seeds washed off vehicles.<br>• Any weeds should be immediately controlled.<br>• Vehicle inspection and wash-down procedures are implemented. | Stage 2 C<br>Stage 2 C | Management, Construction Contractor<br>All Site Personnel |
| 7 | Top soil management | • Topsoil stripped from areas containing high densities of weed will be managed appropriately to ensure that weed impacted top soil does not contribute to the spread of weeds across the Site. Weed inspections undertaken throughout preconstruction/construction including of topsoil stockpiles will identify the likely density of weed seeds expected to be in topsoil. | | • Contaminated/ potentially contaminated topsoil identified and managed appropriately. | Stage 2 C | Management, Contractor |
| 8 | Implementation of wash-down procedures to keep entering/ exiting vehicles free of weeds | • To prevent spreading weeds, all site personnel entering/exiting the site have a general biosecurity duty to keep their vehicle free of weeds by:<br>○ Ensuring as far as is reasonably practicable that all plant equipment and vehicles are free of plant material before entering the Site;<br>○ Avoiding driving through weedy areas;<br>○ Vehicles, plant and equipment that may have been exposed to weeds or weed seed (i.e. driven in areas off designated construction roads) shall be inspected and washed down on entering and exiting the site, it is the driver's responsibility to ensure a wash-down is completed; and<br>○ Checking clothing, footwear and vehicle (including floor mats) on the completion of works. Plant material found in these items should be removed and appropriately disposed of in order to mitigate the biosecurity risk. | | • Vehicles, plant and equipment entering/existing Site are free of weeds. | Stage 2 C | Management, Contractor |
| 9 | Communicate biosecurity risk management to all personnel | • Training on biosecurity risk and vehicle inspection and wash-down procedures is undertaken during site induction. | | • Personnel understand their obligations regarding biosecurity risks. | Stage 2 C | Management, All Site Personnel |
| 10 | Disposal of weed contaminated material | • Vegetation that has been cleared is to be disposed of at an approved green waste facility | | • Contractors to provide documentation as evidence that weed contaminated material has been disposed of appropriately.<br>• It is an acceptable solution for weeds that have been treated with herbicide to be left *in situ*. | Stage 2 C & O | Management, Contractor |
| **Clearing of vegetation** | | | | | | |
| 11 | Approved vegetation clearing at the Tweed Coast Road/Cudgen Road Intersection upgrade | • Prior to the commencement of any clearing:<br>○ Areas of vegetation approved to be cleared will be surveyed and the extent of the area will be marked on-ground with survey pegs.<br>○ Areas of vegetation approved to be cleared will be identified on clearing plans that can be easily interpreted by clearing contractors. | • Only vegetation that is approved to be cleared is removed. | • Clearing of vegetation is only conducted within the surveyed clearing area. | Stage 2 C | Management, Contractor |

| Item | Task | Description/method | Outcome | Performance measure | Project Phase[1] | Who |
|---|---|---|---|---|---|---|
| | | ○ Clearing plans are to be provided to contractors responsible for clearing prior to commencing works.<br>○ All personnel involved in the clearing works will be made aware of the clearing boundary on both the clearing plans and on ground. | | | | |
| 12 | Weed control measures | • Exotic vegetation - camphor laurel *Cinnamomum camphora* with understorey of small-leaf privet *Ligustrum sinense* and barner grass *Cenchrus purpureus* monocultures in MZ 1.4 and 1.5 are adjacent to the Subtropical rainforest vegetation which is habitat for the MRS, therefore a staged approach to remove this vegetation should be employed to mitigate any potential impacts of habitat desiccation. | • Exotic plant monocultures removed with no impact on adjacent threatened species habitat | • MRS monitoring criteria as per **Section 3.2.2** | Stage 2 C | Management, Bush Regeneration Contractor |
| 13 | Translocation of threatened plant *Cryptocarya foetida* | • Prior to vegetation clearing during Stage 1, the single stinking Cryptocarya *Cryptocarya foetida* plant (sapling) along the Cudgen Road boundary windrow will be translocated for conservation, see **Figure 4.**<br>• Ongoing care and maintenance including regular checks, watering and weeding is required during Stage 2.<br>• Maintain the temporary protective barrier around the sapling during Stage 2 construction. | • No avoidable loss of threatened plant species | • Successful translocation and survival of the *Cryptocarya foetida* plant | Stage 2 C | Management, Specialist Ecologist Contractor |
| 14 | Contractor awareness | • Information on this Stage 2 BMP including biodiversity values that are to be retained and protected are to be provided to all contractors during an induction prior to commencing works. Including, but not limited to;<br>○ All personnel involved in the clearing works will be made aware of the clearing boundary on both the clearing plans and on ground;<br>○ Biosecurity measures (i.e weed control);<br>○ Exclusion zones (i.e. TPZ and areas of conservation significance);<br>○ Fauna interaction protocols and Fauna Management Procedure; and<br>○ Waste management protocols. | • Information outlining biodiversity values that are to be retained and protected to be included in the Site induction | • No avoidable loss of threatened plant or animal species | Stage 2 C | Management, Contractors |
| **Heritage and archaeological considerations** | | | | | | |
| 15 | Weed control measures | • Avoid removing trees and vegetation which may be supporting Walls 2 and 5.<br>• Weed control activities undertaken during Stage 2 should only employ methods which do not damage rock heritage stone walls (e.g. herbicide application through spot spraying, cut and paint or stem injection).<br>• No stump removal or manual removal techniques are to be undertaken along the heritage stone walls. | • Identified Heritage and Archaeological items are managed appropriately during the construction phase | • Measures taken to minimise damage to the heritage stone walls on the Site (LLB 2019) | Stage 2 C & O | Management, Bush Regeneration Contractor |

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

### 2.3.1 Vegetation protection measures

For the duration of the construction works all trees on the Site that are not approved for removal must be suitably protected during construction as per recommendations of the BMP required by Conditions B33 and C25 of Schedule 3.

All vegetation protection exclusion fences (temporary boundary fence or TPZ) have been installed during Stage 1 works in accordance with TPZ guideline and AS4970 – 2009 (**Table 5** and **Figure 7**). Vegetation protection exclusion fences include around the trees identified for retention in the *preliminary arboricultural report,* namely; weeping fig *Ficus benjamina* and small leafed Fig *Ficus obliqua* (ArborSafe 2018) as well as the MZ 6 windrow along Cudgen Road, opposite the Kingscliff TAFE. All vegetation protection exclusion fences must be maintained throughout the Stage 2 construction works, and for any encroachment the project arborist must demonstrate that the trees would remain viable post construction (ArborSafe 2018).

As detailed in **Table 5** and **Figure 7** the average TPZ for the regenerating subtropical rainforest in the windrow along Cudgen Road boundary (MZ 6) is 2 m, as per Section 5.4.12 of the *preliminary arboricultural report* (ArborSafe, October 2018), however, all vegetation protection exclusion fences should be installed to allow for any revegetation works which will occur in the 10 m or 30 m wide vegetated buffers (MZ 6 and 7).

TPZ fencing will be installed in Stage 2 works to protect early regrowth rainforest adjacent to the *Guioa semiglauca* to be cleared at the Tweed Coast Road / Cudgen Road intersection upgrade site and at the farm dam during the decommissioning/infilling works. Due to the limited space available and the impracticality of installing high fences in these two areas, a temporary barricade fence constructed from high-vis mesh and steel posts should be installed alongside the native vegetation to be retained.

As per Schedule 3 Condition C25, if access to the area within the tree protection exclusion fence (temporary boundary fence or TPZ) is required during the works, it must be carried out under the supervision of a qualified arborist with alternative tree protection measures installed (or retrofitted) as required. Temporary fencing should also consider fauna connectivity measures discussed in **Section 3.3.1.** Following completion of the construction works, the removal of vegetation protection exclusion fences must be carried out under the supervision of a qualified arborist.

### 2.3.2 Weed management

#### 2.3.2.1 Weeds identified on the Site

A total of 51 exotic plant species were recorded on Site including 18 species classified as High Threat Exotic (HTE) species under the BAM. Three of these HTE species are also classified as Weeds of National Significance (WONS), namely: ground asparagus *Asparagus aethiopicus*, bitou bush *Chrysanthemoides monilifera and* lantana *Lantana camara.* Exotic and HTE species that were recorded on the Site are detailed by MZ in **Appendix A**.

Several classes of weeds are defined under the *Biosecurity Act 2015*. No high priority weeds were detected during plot-based vegetation surveys undertaken as part of the BDAR, however, the regional priority weeds giant devil's fig *Solanum chrysotrichum* (MZ 1.1 and 1.2) and the State priority weed bitou bush *Chrysanthemoides monilifera* (MZ 1.6) were recorded.

Field assessment of the existing farm dam located at the north of the Site (MZ 1.4) recorded dense mature infestations of salvinia *Salvinia molesta* (Greencap 2019). Salvinia is a WONS and is regulated

under the *Biosecurity Act 2015* with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk. The presence of salvinia *Salvinia molesta* has substantially degraded this microhabitat. Management of this weed is discussed below in **Sections 2.3.2.6** and **2.3.2.7.**

### 2.3.2.2 Stages of weed control

In order to ensure efficient and effective use of resources weed control will be undertaken by suitably qualified contractors using best-practice methods in three stages:

- Primary weed control;
- Secondary; and
- Maintenance.

Primary weed control refers to the initial control of weed species on the Site that will be undertaken in accordance with published guidelines (i.e. BSRLG 2005; DPI 2018).

Secondary weed control will; be conducted 6-8 weeks following primary weed control and aims to control weeds that have regrown following primary treatment, new weeds that have germinated in response to the availability of resources (e.g. light, nutrients) and allow native plant species to re-establish.

Regular and ongoing maintenance of areas that have undergone primary and secondary weed control is critical to ensuring long term success and will be undertaken during Stage 2 construction and operations phases. Weeds can re-establish through natural dispersal or from weed propagules remaining in the soil. Undertaking maintenance activity to control the movement of weeds on and off a site can be considered a reasonable measure for a landholder to undertake that is in accordance with the general biosecurity duty identified in the *Biosecurity Act 2015.*

The frequency of weed control activities including maintenance, monitoring and reporting is summarised in **Table 4**.

### 2.3.2.3 Weed Control Techniques

It is anticipated that weed control will employ a range of techniques depending upon factors such as the species and life-stage of the weed and may include:

- Hand weeding
- Mechanical removal (e.g. slashing, cutting)
- Herbicide application (e.g. spot spraying, cut and paint, stem injection)
- Mulching
- Hydro mulching of cleared land
- Natural shading techniques (revegetation)

As noted in Item 3 in **Table 5** above, a detailed schedule of prioritised management actions for the site is to be updated by the bush regeneration contractor prior to the commencement of Stage 2 and will be revised on an annual basis as per **Table 6**.

### 2.3.2.4 Hydro mulching

The majority of land in MZ's 2.1 and 2.3 was treated with hydro mulch in the pre-construction phase, and ongoing maintenance throughout Stage 2 will need to be undertaken to control weed growth in areas of bare or disturbed soil as required. Marcus Koolen from Perfect Earth (2019, pers. comm. 27

February) in a personal conversation outlined the following recommended process for the most efficient establishment and effective long term weed control for hydro mulch:

- Prior to achieving successful weed control and full coverage with hydro mulch, irrigation should cease in all areas to reduce weed growth and allow greater sunlight access to soil surfaces which should assist desired grass germination;
- Slashing can be undertaken prior to herbicide treatment to remove weed flowers, prevent development of weed seed and to maintain sunlight access to topsoil to enable cover crop/native seed germination.
    - During months where flower and seed is not visible slashing will not be required.
    - For areas that cannot be mechanically slashed these will need to be managed through hand slashing or brush cutting;
- Apply primary weed control with an appropriate herbicide (e.g. broad-acre glyphosate);
- Leave treated areas for approximately 4 weeks to allow weed seeds germinate;
- Apply secondary weed control with an appropriate herbicide;
- 24 hours after secondary weed control, cultivate land running parallel to contour lines to prepare for hydro mulching;
    - Cultivation is more effective if weeds are ploughed-in before flowering and under reasonably dry conditions;
- Hydro mulch with grass seed mix;
    - Depending upon the season that hydro mulching is being conducted, it is recommended to use either a millet or a rye cover crop to suppress weed growth and improve soil condition (BSRLG 2005);
    - Grass seed varieties must be suitable for use within an APZ and must meet the requirements of Appendix 4 of Planning for Bushfire Protection (PBP) (RFS 2017);
    - Stabilisation of sediment basin banks is a high priority for hydro mulching and has been undertaken in pre-construction works;
- Establishment of grasses;
    - Maintenance to control weeds is undertaken by slashing and/or spot spraying;
    - Upon inspections following the primary and secondary weed control measures and hydro mulching, should any notable or dense areas of weed species be observed, then these areas should be slashed/brush cut to remove flower heads and prevent weed seed formation.

#### 2.3.2.5 Heritage and archaeological considerations

In accordance with the Heritage and Archaeological Management Plan (LLB 2019), measures must be taken to minimise damage to the heritage stone walls 2 and 5 (MZ's 1.2, 1.3, 1.4 and 1.6), as shown in **Figure 6** below and Figure 12 in the Historical Heritage Assessment Report (Niche 2018). These measures include avoiding removal of trees and vegetation which may be supporting the walls. Weed control activities undertaken during bush regeneration activities in Stage 1 should only employ methods which do not damage to rock walls (e.g. herbicide application through spot spraying, cut and paint or stem injection). No stump removal or manual removal techniques are to be undertaken along the heritage stone walls.

#### 2.3.2.6 *Salvinia molesta* control

Aquatic weed infestations are common within the agricultural drains that are prevalent in the wetland area to the north of the site. Monitoring the sediment/bio-detention basins for aquatic weeds in (particularly salvinia *Salvinia molesta*) must be regularly undertaken.

Early detection is critical to eradicate an infestation before it has time to establish. Should *Salvinia molesta* be detected in the basins, eradication of new infestations can be undertaken as per methods outlined below.

Kim Kurtis from Rous County Council Weed Services (2019, pers. comm. 7 June 2019) in a personal conversation provided the following recommendations for *Salvina molesta* control options:

- Manual removal (for large areas a 'weed harvester' can be used, for small areas such as the basins, pool scoops, nets, mesh etc are the most appropriate methods to use);
- Biological control with salvinia weevil (*Cytobagous salviniae*); and
- Herbicide – 'frog-friendly' surfactant free glyphosate is a potential option. Further advice on herbicides and other salvinia control measures is provided in the Salvinia Control Manual (NSW DPI 2006). It is recommended that a specialist weed control contractor with experience in salvinia *Salvina molesta* control is engaged to provide specific advice on which specific herbicide would be most successful as there are many site-specific factors that need to be considered.

Should *Salvina molesta* spread to the sediment/bio-detention basins, the suggested method for this situation is to remove the bulk of the salvinia *Salvina molesta* vegetation by manual methods (winter is the best time of year), followed by releasing the salvinia weevil (i.e. biological control) in Spring. Biological control insects require one third of the water surface to be clear, fresh young growth and sun. Because they will only remove young growth, they cannot be effectively applied to dense, mature infestations, therefore manual removal prior to releasing the insects is required. Areas around the edge of the basins can be treated with 'frog-friendly' surfactant free glyphosate sprayed directly onto the salvinia *Salvina molesta*. A swimming pool scoop or similar device can be used to manually remove salvinia *Salvina molesta* plants on a regular basis until eradication is achieved. Regular follow up treatment is vital because a single remaining leaf can reinfest the area in a relatively short period of time.

Once manually removed, salvinia *Salvina molesta* can be disposed of on site in an appropriate dry contained area and left to dry out and die. Controls measures should be in place to mitigate the risk of any removed weeds, or water removed from the dam, infesting the sediment basins if disposed of on site.

Ongoing long-term monitoring and treatment (i.e. manual removal) will be required in order to target re-infestations which are very likely to occur as a result of spreading by natural means such as during flood events or by fauna.

#### 2.3.2.7 Rehabilitation of the farm dam

The BDAR for the approved Stage 1 Tweed Valley Hospital (SSD 18_9575) recommended that decommissioning the dam would remove the requirement for ongoing monitoring and treatment of salvinia *Salvina molesta* in this zone.

The dam will be incrementally infilled without dewatering in a monitored and staged approach to ensure gradual displacement of water so that the impact of the process on native aquatic fauna is mitigated. Advice was sought from a local fauna ecologist with experience dam decommissions (Ben

Gunston, 2019, pers. comm. 26 June) on the best practice process to mitigate impacts on native fauna. The following best practice method will be employed to decommission the dam and mitigate impacts on native flora and fauna:

- **Overarching Process**
    - A suitably qualified and experienced fauna rescue person shall be present for the dam decommissioning, including the removal of any vegetation around the dam (i.e. the tall dense barner grass *Cenchrus purpureus* in MZ 1.4), as native frogs may use these areas as habitat (likelihood of frogs species present to be determined during the initial frog survey).
    - If any fauna is found during vegetation clearing or dam infilling works, where possible, uninjured native fauna detected will be caught by the fauna rescue personnel and released at a predetermined location of appropriate nearby habitat, but outside of the Project footprint.
- **Stage 1 – Site Preparation**
    - Nocturnal frog survey (on a rainy night, any time of year) to assess if frogs are in the area.
    - Install tree protection fences to protect adjacent native vegetation prior to commencement of works (See **Section 2.3.1**).
    - Install sediment and erosion control measures downstream/gradient of the works.
    - Establish sediment control to surface stormwater pathways upstream/gradient of the works.
    - Clear exotic vegetation around the from the southern and western side of the dam to Create access into the dam remediation area to allow machine and truck access and movement. This would not require any topsoil stripping. Clearing native vegetation around the dam will be avoided.
- **Stage 2 – Incremental Infill**
    - Conduct civil works as required.
    - Efforts will be made to rescue and relocate any native fauna which may currently be in the dam, this could potentially include fish, eels, turtles, yabbies and tadpoles:
        - 1st Sweep – Electrofish/ gill net to capture the majority of aquatic fauna.
        - Remove the bulk of the floating weed salvinia *Salvinia molesta* from surface of dam vegetation (using an excavator bucket or similar).
        - 2nd Sweep – Electrofish/gill net to capture the remaining aquatic fauna.
        - Incrementally infill dam from one end by tipping re-use rock (up to 150mm diameter) and topsoil from site into the dam from a dump truck without pumping the water out.

- Opportunistic Sweeps – Hand net the decreasing sections of remaining water to capture any remaining fauna as it is incrementally infilled.

- **Stage 3 – Post-Infill**
    - Install geofabric to reduce the bogginess of the area.
    - Install topsoil and planting
    - Upon completion of the works, vegetation restoration, maintenance, weed management activities and monitoring and reporting will be undertaken around the decommissioned dam (MZ 1.1 and 1.4) in accordance with Sections **0**, **2.3.4** and **2.3.5**.

An Acid Sulfate Soil management plan will not be required because the soil is not being disturbed.

An analysis of the impact of any change in hydrological flows on the wetland as a result of infilling the dam was undertaken by SMEC (2019) as described in **Section 4.1.3**. The assessment identified that filling the dam back to natural ground level will have no impact on the 1% AEP (100 year ARI), the 20% AEP (5 year ARI) flood levels and no material impact from more frequent events post development. The report recommends that the detailed design of the dam infilling incorporate a minimal downhill grade, low flow channel or path to allow flows to travel from the upstream to the downstream side of the decommissioned dam and minimise the amount of ponding water that could become reinfested with *Salivina molesta* (SMEC 2019).

### 2.3.3 Restoration

An overview of vegetation management monitoring and performance criteria is outlined in **Table 6** and revegetation activities including MZ, timing, and responsibility is outlined in **Table 8**.

The restoration approaches for the Site that set out in this Stage 2 BMP include:

- Natural regeneration
- Assisted regeneration
- Revegetation

#### 2.3.3.1 Site preparation

Revegetation is to be undertaken by a suitably qualified and experienced bush regeneration contractor. The bush regeneration contractor engaged in Stage 1 would have undertaken initial works involving project initiation meetings, inductions, site familiarisation and preparation of a detailed schedule of prioritised management actions including a schedule, revegetation works, methods, resources required, and cost with start and finish times and milestones. This schedule will need to be updated before the commencement of the Stage 2 works. Foremost, it is recommended that primary and follow up weed control be conducted two to three months prior to planting or at a minimum of four weeks, as described in **Section 2.3.2**. Vegetation protection fencing should be established using temporary fencing around all remnant vegetation and revegetation areas (buffer zones) as per **Section 2.3.1** and **Section 3.3.1.**

Buffer zones MZ 6 and 7 will contain areas of revegetation over previously cultivated land or access tracks. Soil compaction may be severe in some cleared areas, particularly along internal tracks. Once the buffer zone areas for revegetation have been defined, site assessment by bush regenerators will determine whether it is deemed necessary to prepare the soil in these areas with deep ripping.

If ripping is required is should preferably be carried out at least six months prior to planting to allow the soil to settle and reconsolidate. However, ripping should be avoided where practical as it will encourage weed growth. All areas of plantings will require mulching, including; *in situ* sprayed grass, leaf litter, straw, woodchips and bark (BSRLG 2005).

#### 2.3.3.2 Planting considerations

Following site preparation, timing for revegetation will be influenced by a number of factors, however ideally the best time to plant is following the onset of the wet season, from late February to late April, preferable when raining or overcast. Planting should be avoided from November to late January when days are long and hot (BSRLG 2005). These factors will be taken into consideration by the bush regeneration contractor as they prepare a schedule for the main planting activities.

Water, at a rate of about 2 to 5 litres per tree will be required for planting unless it is undertaken during rain in late autumn (BSRLG 2005). Depending on rainfall, watering may be required for a period of about six weeks. It is also recommended that seedlings are planted with saturated water storage crystals and a slow release fertiliser that is suitable for native plants around the root ball to assist in plant establishment. At the discretion of the bush regeneration contractor, plant guards may be required for plantings in areas that are at risk from herbivory by native animals (e.g. MZ 1.1-1.6).

#### 2.3.3.3 Plant species selection

Plant species proposed for assisted regeneration and revegetation on the Site have been selected using with Tweed Shire Council guidelines (TSC 2019).

To filter species selection, the 'late succession planting- mixed species' model was broadly adopted (Kooyman 1996). This model aims to achieve fast site domination by rainforest tree species (12-24 months), with maintenance reduced to low levels in that time. This model ideally suited to sites which have small seed sources, including cleared ex-rainforest agricultural land sites (Kooyman 1996). Some pioneer species were recommended for MZ 1.1 to 1.6. These management zones are adjacent to remnant rainforest that can provide seed sources for natural recruitment (Kooyman 1996).

Recommended pioneer, secondary, mature and edge plant species have been selected based on habit (i.e. tree, shrub or palm) and in consideration of local environmental variations on either: Lowland rainforest on floodplain (MZ 1.2 to 1.6); or Sub-tropical/Warm Temperate Rainforest on bedrock substrates (buffer MZ 6 and 7). With the exception of edge planting, groundcovers are not recommended as these species lists will establish on most sites naturally if the site is well maintained to control exotic grasses, herbs and woody weeds.

Ideally, a wide variety of species from each growth form group should be planted to achieve structural complexity, species diversity and enhance habitat values. As a general guide, it is recommended that 20 to 50 different species are planted in order to achieve ecological restoration objectives (Catterall and Kanowski 2010). Recommended plant species lists for revegetation is provided in **Appendix B**.

It is recommended that any native Subtropical Rainforest species identified during vegetation surveys undertaken on the Site in 2018 to inform the Biodiversity Development Assessment Report (BDAR; Greencap 2019b) are considered as a priority when selecting species for planting. These surveys were undertaken using the plot-based method as detailed by the Biodiversity Assessment Method (BAM). As a result, the list of native species compiled from these vegetation surveys does not represent a complete Site inventory of native plant species, but is considered an indicative native species list for the site (**Appendix A**).

It is also recommended that planting should consist of tube-stock (most preferred for tree and shrub species,) or Hiko and Viro cells (grasses and other groundcover species). Bush regeneration contractors must ensure that all planting is done effectively to minimise any defects or loss through incorrect planting. For example, plants must be buried in the topsoil with saturated water storage crystals, slow release fertiliser, no air gaps or roots left exposed to dry out and mulch must not smother any plants.

For recommended species for the bio-detention basins and WSUD car park plantings see **Section 2.4.2** and **Appendix B.**

#### 2.3.3.4 Edge species

Edge species are typically hardy species with a bushy habit recommended to be planted along the perimeter of buffer zones and along the tree line of the remnant vegetation. Fast growing edge species help to seal the edge of the planting from drying out and the effects of the sun and wind whilst slower growing edge species provide a permanent edge in the longer term which assists in weed control.

It is recommended that one row of edge species planted 1.8m apart will be planted along the perimeter of each buffer zone (MZ 6 and 7) and along the remnant vegetation tree line in the northern section of the Site (MZ 1.2 to 1.6). A list of recommended edge species is provided in **Appendix B.**

#### 2.3.3.5 Planting density

Planting densities and layouts are as per recommended guidelines (BSRLG 2005). High density planting of 1.5 m spacing (or approximately 5,100 trees per hectare or 2 $m^2$per tree) is recommended to achieve faster canopy closure and therefore less ongoing weed maintenance, faster achievement of habitat values, better aesthetic values and lower ongoing maintenance costs as opposed to low density plantings. This provides habitat for specialist rainforest dependent species such as the Mitchell's rainforest snail *Thersites mitchellae* and avoid attracting open habitat generalist species.

Depending on practicality, planting layouts should either be ‘random’ or ‘row’. Provisions should be made for ensuring access ways to facilitate the transport of trees, mulch and water as well as considerations for concurrent civil and construction works.

#### 2.3.3.6 Assisted regeneration

Following primary and follow up weed control works, assisted regeneration should be undertaken in Zones 1.1, 1.2, 1.3, 1.6 and 2.2 and within retained buffer zone (Zone 6 and 7) vegetation. Assisted regeneration involves planting Subtropical Rainforest species within existing vegetation where canopy gaps exist. Assisted regeneration aims to improve habitat quality for threatened rainforest species by increasing biodiversity, plant density and reducing canopy gaps which facilitate weed invasion and favour common generalist species, such as noisy miners *Manorina melanocephala*.

A spacing of approximately 2.5 m will be aimed for in assisted regeneration zones, however, spacing and planting densities will ultimately be determined by the amount of weeds removed, amount of unassisted regeneration and the presence canopy gaps.

#### 2.3.3.7 Sourcing plants

All planting stock will be sought from local provenance. The local nursery providing planting stock should be able to provide information on the sources of their seed. When accepting the stock the plant health should be assessed to ensure that the plants look healthy and vigorous and are not showing any signs of stress or disease as this can impact the success rate of the revegetation program

(BSRLG 2005). Plant orders must be given to suppliers with enough time (minimum of 3 to 6 months) to allow them to harvest propagules, propagate and grow on tubestock. A bush regeneration team leader must inspect the planting stock prior to delivery to the Site to sign off on quality. Any plant stock showing signs of disease, poor health or lacking vigour should not be brought on to the Site and alternative plant stock will be sourced.

### 2.3.4 Vegetation maintenance

The vegetation maintenance program will involve:

- Maintenance of planting areas in MZ 1.4 and 1.5 should be carried out over a minimum of four maintenance events per year for a five-year maintenance period following the primary works. Should performance criteria not be met at the completion the five-year period, then the program will be reviewed and extended until performance criteria are met;
- Maintenance of planting areas in MZ 6 and 7, sediment/bio-detention basins and supplementary plantings within established vegetation (MZs 1.1, 1.2, 1.3, 1.6, 2.1, 2.2, 2.3 and 5) should be carried out over a minimum of four maintenance events per year for a three year period, following the primary works. If performance criteria are not met after a three year period then the program will be reviewed and extended until performance criteria are met;
- The first two months of establishment is the critical time for plant survival. Therefore, following planting, provisions should allow for weekly inspections to be conducted for the first two months and any additional maintenance of planting areas i.e. weed control, watering or replacement planting;
- Weed control works should be carried out over a minimum of four maintenance events per year with provisions to allow for additional events during the peak weed growth period over summer and spring (i.e. every month). Weed control maintenance involving inspections conducted at a minimum frequency of every three months during operation of the Project and will be evaluated annually upon submission of an annual weed control report. Inspections are to be conducted to identify new weed infestation areas or follow up weed control requirements for any previously treated weeds.

Vegetation maintenance works should include:

- Inspections;
- Timely and effective weed control (spot spraying) (See **Section 2.3.2**);
- Supplementary planting to replace dead, poorly growing or diseased plants;
- Management of insect damage, if necessary; and
- Watering during dry periods;
- Records of all works undertaken (See **Section 2.3.5**); and
- Reporting and evaluation of performance criteria (See **Section 2.3.5**).

A summary of the vegetation maintenance program is provided in **Table 8**.

### 2.3.5 Monitoring, reporting and performance criteria

Regular monitoring and reporting should be undertaken to evaluate the progress and compliance with the VMP. The monitoring programme should commence following completion of any primary and secondary weed control works.

The contractor will undertake monitoring and reporting in accordance with the frequency and performance criteria as specified in **Table 6** below. If a performance criterion is not met, then a review of methods would be undertaken and follow up weed control measures would be implemented. For each vegetation maintenance event, contractors must complete a record of all works undertaken, including but not limited to:

**General information**

- Date
- Personnel
- Time including time spent on each task
- Location
- Works carried out
- Weather
- Site conditions
- A description of any issues/problems
- Quarterly photo monitoring images relative to the baseline (initial event)

**Weed control**

- Area treated
- Weed control methods used
- Herbicide and other chemicals used, including quantity, dilution rate and other relevant information
- Weed species treated;
- If required, photos and/or maps of weed distribution and density

**Revegetation**

- Percentage survival rates for plantings
- Supplementary planting (number, species and location)
- Any other observations including insect attack/plant disease;

A rapid monitoring methodology has developed to capture key indicators of vegetation management success on the Site, including weed cover, survival rate of all plantings, canopy cover and leaf litter. Photo monitoring will monitor vegetation condition by detecting any changes in growth, vigour, vegetation structure, regeneration and species composition. A typical loss of 2 to 10% is expected in rainforest revegetation sites, therefore 90% survival rate criteria will be used to evaluate planting success rates (BSRLG 2005).

As per the Stage 1 BMP, baseline reports will be submitted prior to Stage 2 works documenting the primary and secondary weed control activities undertaken in MZ 1.4, 1.5, 1.6, 2.1, 6 and 7.

A summary of the vegetation monitoring program is provided in **Table 8**.

**Table 6 Vegetation monitoring, reporting and performance criteria**

| Item | MZ | Frequency | Performance Criteria | Monitoring Methodology | Reporting | Project Phase[1] | Who |
|---|---|---|---|---|---|---|---|
| 16 | MZ 1.4 and 1.5 | Following completion of primary works, 2 monitoring events per year for the 5-year maintenance period. | • Following completion of primary and secondary weed control works, less than 5% weed cover is recorded at every monitoring event.<br>• Following revegetation greater than 90% survival rate of all plants.<br>• At the end of the 5-year maintenance period, greater than 70% canopy cover.<br>• At the end of the 5-year maintenance period, greater than 90% leaf litter cover | • Visual inspection of each MZ to determine percentage weed cover and rate of revegetation/assisted regeneration planting survivorship. GPS locations of any significant weed infestations or high priority weeds.<br>• Establish permanent 20 x 20 m vegetation monitoring plots to monitor:<br>  ○ 3 x random replicate 1m x 1m quadrats in each plot to measure estimated percentage cover and leaf litter; and<br>  ○ Photo monitoring<br>• Photo monitoring: The centre of each 20 m x 20 m plot will be marked by a permanent post and represented a fixed photo-point. From this point a landscape photograph of a labelled site marker board positioned 1.5 m away will be taken while facing each corner post.<br>• These images will monitor vegetation condition by the | • One baseline report following completion of primary works (including primary and secondary weed control).<br>• One half-yearly and one annual vegetation monitoring report following each monitoring event for the 5-year maintenance period.<br>• All reports (baseline, half-yearly and annual) are to include:<br>  ○ Work record for each management event.<br>  ○ Photo monitoring photographs presented relative to the 2019 baseline.<br>  ○ Results of visual inspection data against performance criteria.<br>  ○ Locations of any major weed infestations or high priority weeds mapped.<br>• Annual reports are to compare the results with previous reporting periods and include a review of the vegetation management program. | Stage 2 C & O | Management, Bush Regeneration Contractor |

| Item | MZ | Frequency | Performance Criteria | Monitoring Methodology | Reporting | Project Phase[1] | Who |
|---|---|---|---|---|---|---|---|
| | | | | detection of potential changes in growth, vigour, vegetation structure, regeneration and species composition over time.<br>• Use a field proforma to capture and record photo monitoring, visual inspection (% weed cover and survivorship), estimated % cover and leaf litter cover data. | | | |
| 17 | MZ 1.1, 1.2, 1.3, 1.6, 2.1, 2.2, 2.3, 5, 6 and 7. | Following completion of primary works, 2 monitoring events per year for the 3-year maintenance period. | • Following completion of primary and secondary weed control works, less than 5% weed cover is recorded at every monitoring event.<br>• Following revegetation and/or assisted regeneration, greater than 90% survival rate of all plants. | • Visual inspection of each MZ to determine weed cover and rate of revegetation/assisted regeneration planting survivorship. GPS locations of any significant weed infestations or high priority weeds.<br>• Photo monitoring methods (one location at each zone).<br>• To establish the permanent location, mark the exact photo monitoring location with a permanent star picket and label the location with a number on the safety cap, record the latitude and longitude and compass bearing. | • One baseline report following completion of primary works (including primary and secondary weed control).<br>• One half-yearly and one annual vegetation monitoring report following each monitoring event for the 3-year maintenance period.<br>• All reports (baseline, half-yearly and annual) are to include:<br>○ Work record for each management event.<br>○ Photo monitoring photographs presented relative to the 2019 baseline.<br>○ Results of visual inspection data against performance criteria. | Stage 2 C & O<br>(Monitoring events may be required during the operational phase depending on the timing of commencement of primary works and the length of construction). | Management, Bush Regeneration Contractor |

| Item | MZ | Frequency | Performance Criteria | Monitoring Methodology | Reporting | Project Phase[1] | Who |
|---|---|---|---|---|---|---|---|
| | | | | • Take a photo to capture the exact same frame and angle as has been captured previously.<br>• Take landscape photographs and centre the photo so that the sky and ground are captured in equal proportions.<br>• Use a field proforma to capture and record photo monitoring data.<br>• These images will monitor vegetation condition by the detection of potential changes in growth, vigour, vegetation structure, regeneration and species composition over time. | ○ Locations of any major weed infestations or high priority weeds mapped.<br>• Annual reports are to compare the results with previous reporting periods and include a review of the vegetation management program. | | |

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

## 2.4 Other considerations

### 2.4.1 Bushfire protection

Both an Asset Protection Zone (APZ) has been identified in accordance with RFS 2018. The APZ coincides with MZ 2.1, 2.2, 2.3 and 4 and must be landscaped and maintained in accordance with the relevant guidelines (Appendix 4 of PBP; RFS 2018) as described in the *Bushfire Hazard Assessment Report* (GeoLINK 2019). As shown in **Figure 6**, there will be minimal impact to retained native vegetation as most of this is outside of APZ.

The APZ needs to be landscaped and maintained to prevent the spread of fire towards the building. As per the Schematic LZP (Turf 2019), landscaping will consist of clumps of separated native vegetation and appropriate grasses (couch) and will meet the requirements of Asset Protection Zone Standards (Appendix 4 of PBP; RFS 2018). The separation of an APZ into Inner (IPA) and Outer (OPA) applies to forest vegetation and therefore is required for this site, which was classified as Coastal Swamp Forest, so the 67 m APZ is divided up into a 20m OPA and a 47m IPA (GeoLINK 2019).

Requirements when establishing and maintaining an IPA and OPA are listed in Table 4.2 and Table 4.3 of the *Bushfire Hazard Assessment Report* (GeoLINK 2019).

No retained vegetation is within the IPA. Retained vegetation within the OPA (MZ 2.2) may need to be pruned to meet the requirements outlined in Table 4.3 of the *Bushfire Hazard Assessment Report* (GeoLINK 2019) including;

- Tree canopy cover should be less than 30%;
- Trees should have canopy separation;
- Canopies should be separated by 2-5m;
- Shrubs should not form a continuous canopy;
- Shrubs should form no more than 20% of ground cover;
- Grass should be kept to no more than 100 mm in height; and
- Leaves and other vegetation debris should be mown, slashed or mulched.

With reference to the above guidelines, species selection for revegetation in the APZ should consider less flammable plants from the recommended species list in **Appendix B** that have the following features:

- Do not retain dead material or deposit excessive quantities of ground fuel in a short period;
- High moisture content;
- High levels of salt;
- Low volatile oil content of leaves;
- Smooth barks and ever green species; and
- Dense crown and elevated branches.

Maintenance of the IPA and OPA to the standards given in the *Bushfire Hazard Assessment Report* (GeoLINK 2019) should be undertaken as per the frequency outlined in **Table 8** during construction and operations, at a minimum on an annual basis, in advance of the fire season (generally prior to September). Maintenance within the APZ to reduce the impact of bushfires should include, but is not limited to:

- Removal of any weeds as a first priority;
- Raking or removing fine fuels such as leaves, twigs and bark on a regular basis;
- Moving or slashing grass. Once established, native grasses such as will need to be cut back heavily in summer to prevent flammable fuel loads (below 10 centimetres). Care must be taken to consider

timing as dry cut material may become a fire hazard. A slashing regime should reduce as cooler weather develops;

- Existing vegetation can be managed by pruning trees, shrubs and understorey; and
- Do not store materials such as wood, large quantities of mulch or building materials within the APZ.

Implementing these measures addresses requirements detailed in Section 4.2 of the *Bushfire Hazard Assessment Report* (GeoLINK 2019) to prevent the spread of a fire towards the hospital buildings and prevent flame contact and reduce radiant heat to buildings, minimise the potential for wind driven embers to cause ignition and reduce the effect of smoke on residents and fire-fighters.

### 2.4.2 WSUD specifications

A range of WSUD features will be incorporated into the design of the site in order to minimise the impact of water quality and protect the TEC in the wetland area and provide a range of 'stepping stone' habitat and 'moist corridors' to facilitate the movement of threatened species. These features include:

- Sediment basins (MZ 2.3) have been constructed as part of preliminary works which will capture and treat stormwater on the Site during the construction phase of the project.
- Once the site excavation works and roads have been completed and all surfaces have been stabilised with appropriate ground cover (i.e. landscaping has commenced) (~June 2021), the sediment basins will then be converted into bio-detention basins (MZ 2.3) that will capture and treat stormwater on the Site for the operational life of the project.
- New plantings within rain gardens, swales and carparks in MZ 2.3 and 5 will treat both stormwater quality and contribute to providing a range of 'steppingstone' habitat and 'moist corridors' across the site to facilitate the movement of threatened species.

Water quality outcomes and the functionality of sediment and bio-detention basins for the Project are addressed further in the WQMP in **Section 4** and in the SWMP (RBG 2019).

**Design, establishment and operation**

The planning of bio-detention systems requires specialist planting design and documented procedures to operate the system, the development of which is beyond the scope of this BMP. Moreover, once planted bio-detention systems require extended establishment period (18-24 months). During the establishment period the system will require intense management by wetland specialists that involves both frequent scheduled maintenance and maintenance that is triggered by rainfall events. Notwithstanding the above, consideration of guidelines for the design of bioretention systems (Healthy Waterways 2006, Water by Design 2014, TSC 2016) the following recommendations are made.

**Configuration**

Design of planting configuration should consider the separate functional components of a bio-detention system as described in **Section 4.1.2.2**.

**Plant selection**

Plant selection must consider the different species which are suitable for growing in different zones of the bio-detention basins. A range of specialist species are recommended for water sensitive urban design (WSUD) features. For the bio-detention basins located in MZ 2.3, planting needs to be drought resistant, but also tolerant of occasional inundation, high nutrient intake, ideally native medium and fast-growing aquatic and grass-like plant species associated with sedgeland/rushland and freshwater wetland vegetation are recommended. For rain gardens and other WSUD assets located in MZ 5, medium and fast-growing small tree and tree species have been selected from the Broad-leaved paperbark vegetation types.

For appropriate species to plant behind the hard edge of *Lomandra longifolia* for cane toad exclusion please refer to the species list in **Appendix B**.

**Planting and establishment**

Grow bags should be used to protect from feeding by water birds such as swamp hens which will pull up seedlings. Jute matting and/or mulching of areas on the batter and surrounding the basins will suppress weed growth while plants establish. Consideration should be given to planting at a suitable time of year. For instance, planting in September-October will allow for plant establishment and root growth before the summer storm season whilst also reducing the maintenance water requirements. Maintenance of the basins will require supplementary planting to replace dead, poorly growing or diseased plants.

**Cane toad exclusion**

In accordance with TSC (2016) sediment/bio-detention basins on the site should incorporate measures to discourage breeding of cane toads *Rhinella marina* in accordance with published guidelines (BSC 2013) as described in **Section 3.4**.

**Salvinia exclusion**

Consideration should be given to planting native aquatic species such as nardoo *Marsilea mutica*, duck weed *Lemna spp*. or azolla *Azolla filiculoides* that may outcompete and potentially suppress the growth of salvinia *Salvinia molesta* in the bio-detention and sediment basins.

Aquatic weed infestations are common within the agricultural drains in the wetland area to the north of the site and control of aquatic weeds in (particularly salvinia *Salvinia molesta*) must be undertaken as described in **Section 2.3.2.6**.

### 2.4.3 Land use conflict

The *Land Use Conflict Risk Assessment* report (Tim Fitzroy & Associates 2018) outlines recommendations for vegetated buffers to provide an effective safeguard to spray drift. In consideration of these recommendations, it is advised that where practical the species with larger or rough leaves (e.g. sandpaper fig *Ficus fraseri*) and species with compound leaves (e.g. white cedar *Melia azedarach*) are planted in MZ 6 and 7 on the western side of the Site to assist in capturing spray drift.

### 2.4.4 Mitchell's rainforest snail *Thersites mitchellae* habitat

For bush regeneration works conducted in the retained undisturbed forest (i.e. MZs 1.1-1.6) it is essential that the contractor has demonstrated experience working in MRS habitat. Upon Stage 1 SSD approval, a bush regeneration contractor should be engaged and provide a detailed schedule of prioritised weed management actions for the site in consideration of the strategies outlined below.

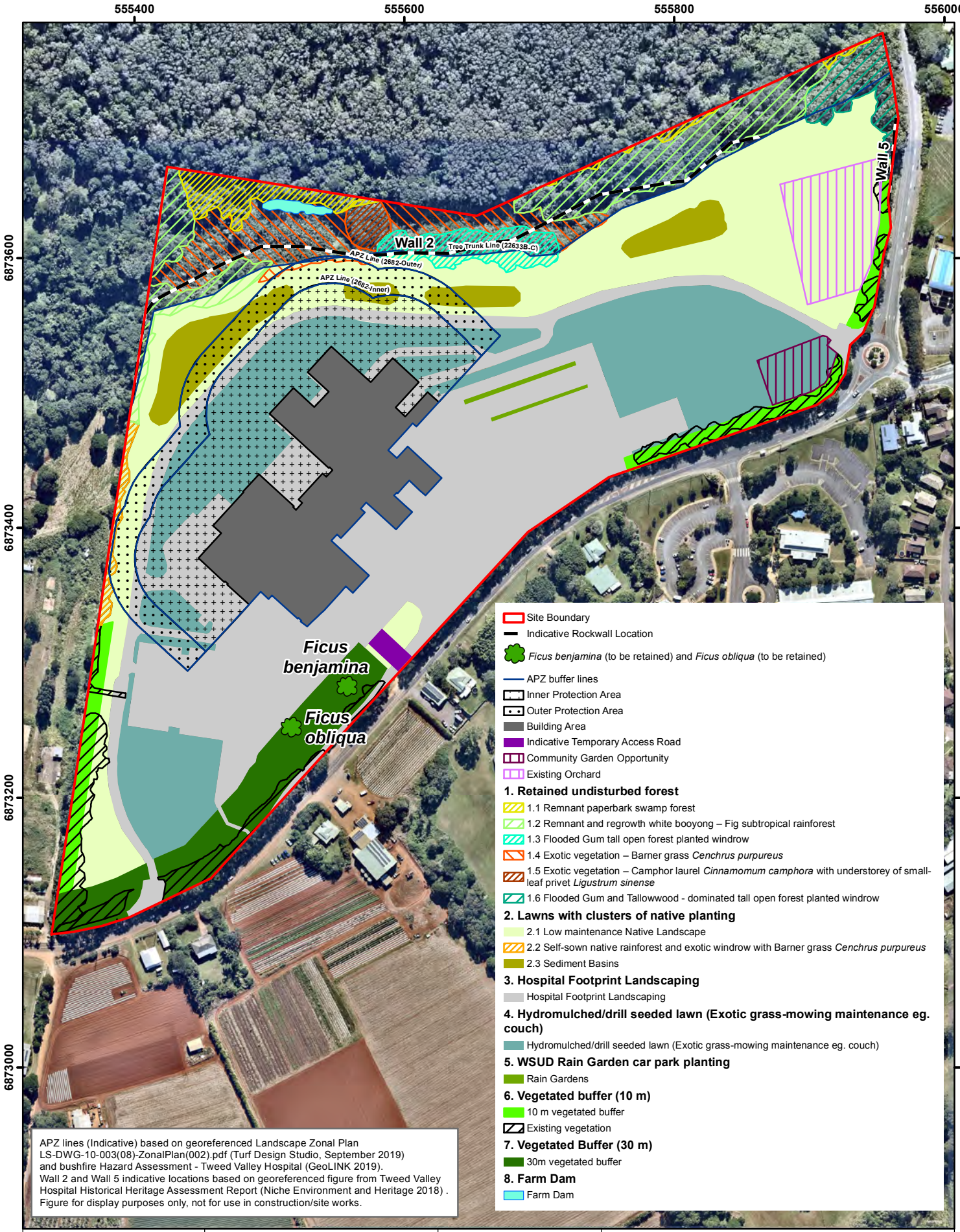
As described in **Table 8** the removal of barner grass *Cenchrus purpureus* in MZ 1.4 and woody weeds in MZ 1.5 should be undertaken in a staged approach together with revegetation of a hard edge in order to prevent desiccation of adjacent rainforest habitat.

Core habitat for MRS is in the paperbark swamp forest of MZ 1.1 and Subtropical Rainforest of MZ 1.2. Weed control within MZs 1.1 and 1.2 will be targeted (spot spraying, drill and fill or cut and paint methods) and staged to minimise any potential direct impact on the MRS. Weed control in MZ 1.1 and 1.2 should be undertaken in a staged approach to retain undisturbed areas for MRS habitat to allow areas under weed management to recover and regenerate with native plant species, thereby developing additional preferable habitat for the MRS.

Weed control activities should be initially undertaken in non-core areas of MZs 1.3 to 1.6 which contain a higher density of weeds. This will enable the MRS to disperse into the rehabilitated areas before disturbing the core MRS habitat (MZ 1.1 and 1.2). The following strategies have been adapted from the *Weed Reduction Strategy Mitchell's Rainforest Snail Habitat* (Bushland Restoration Services 2016) for restoration of MRS

habitat. These strategies were developed in consultation with Dr John Stanisic, an MRS expert, and should be undertaken to control weeds in MRS core habitat MZ 1.1 and 1.2:

- Plan activities and methods to minimise impact on canopy and forest debris (e.g. logs, leaf litter, fallen palm fronds and edges of the remnant vegetation);
- Identify and target invasive weed species that threaten or degrade MRS habitat (e.g. madeira vine *Anredera cordifolia*, barner grass *Cenchrus purpureus*, morning glory *Ipomoea indica and* climbing asparagus fern *Asparagus aethiopicus*);
- Stage the removal of weed species that provide MRS habitat (e.g. Alexander palm *Archontophoenix alexandrae* and umbrella trees *Schefflera actinophylla*). These species should be controlled later as condition of the MRS habitat improves;
- Target areas along edges that do not provide habitat for MRS as a first priority (e.g. dense areas of Lantana *Lantana camara* or barner grass *Cenchrus purpureus*) to encourage fast-growing native rainforest species to colonise and create a new 'closed edge' and expand habitat; and
- Maintain areas under management by controlling weed regrowth and encourage regeneration of native species; and
- Report and evaluate progress as per **Section 2.3.5**.

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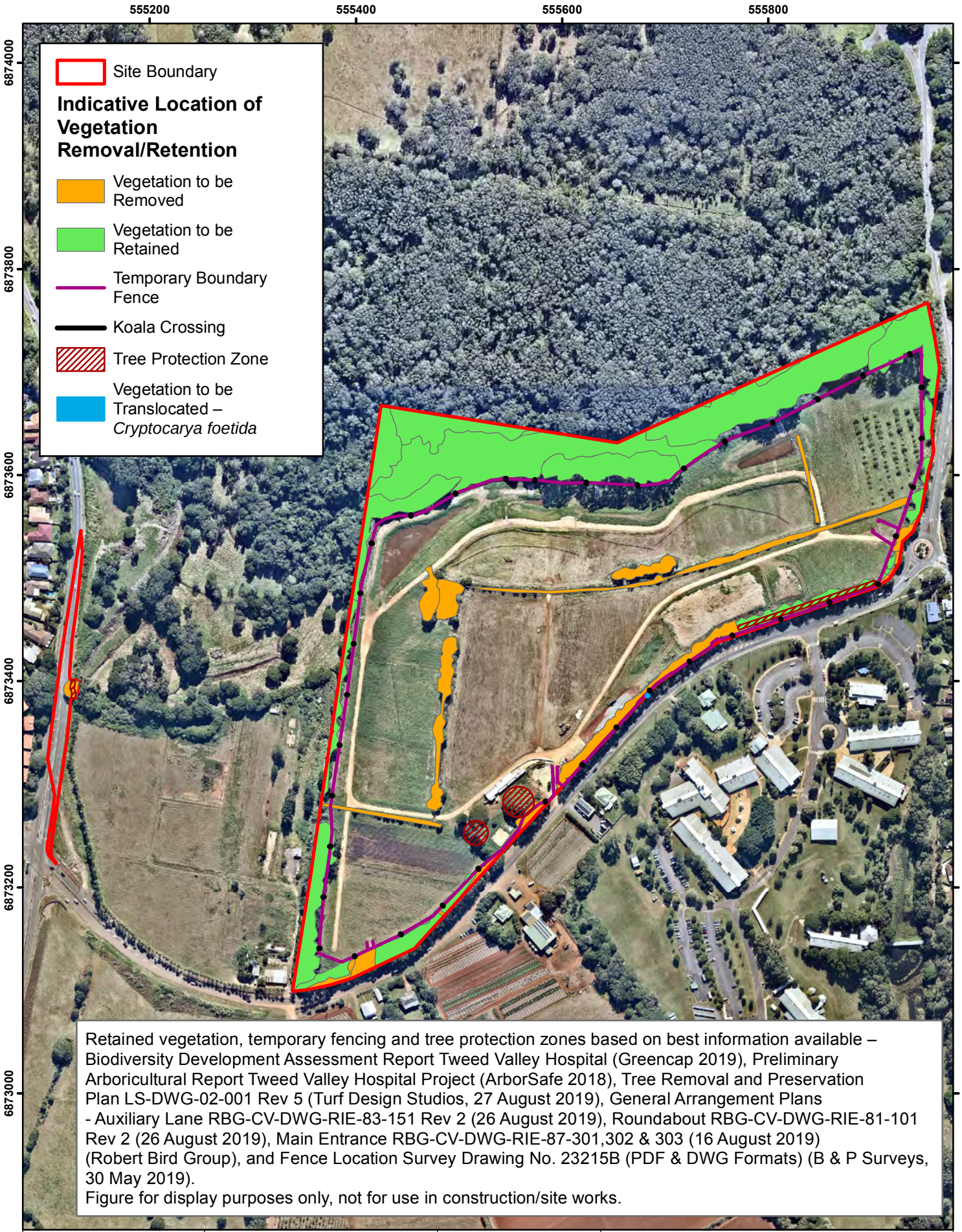
| Client: C107778 | N 0 40 80 m | Scale (@A4): 1:3,632 | **Vegetation Management Zones – Stage 2** |
| Job #: J156455-13 | | | |
| Author: D. Correa | Coordinate System: GDA 1994 MGA Zone 56 | | |
| Checked: C. Maloney | *Imagery 15th July 2019 (7.5 cm) @ Nearmap 2019.* *Vegetation mapping: Greencap (2018). Vegetation management zones based on best information available – Biodiversity Development Assessment Report Tweed Valley Hospital (Greencap 2019), georeferenced Landscape Zonal Plan LS-DWG-10-003(08)-ZonalPlan(002).pdf (Turf Design Studio, September 2019) (Turf Design Studio, August 2019), Preliminary Arboricultural Report Tweed Valley Hospital Project (ArborSafe 2018), and the Civil Engineering Drawings Aerial Overlay (Indicative) (Lendlease Group, May 2019). Figure for display purposes only, not for use in construction/site works.* | Tweed Valley Hospital BMP<br>771 Cudgen Road<br>Cudgen NSW | **Figure 6** |
| Date: 12/09/2019 | | | |
| GREENCAP | | | |



*Doc Path: R:_Projects\C107778_Health Infrastructure\J156455_Tweed Valley Hospital\3. Job Folder\GIS\J156455_13_TVHs2\BMPs2\mxd\J156455_13_BMPs2_F06_Veg_Mgmt_zones_190912.mxd*




Retained vegetation, temporary fencing and tree protection zones based on best information available – Biodiversity Development Assessment Report Tweed Valley Hospital (Greencap 2019), Preliminary Arboricultural Report Tweed Valley Hospital Project (ArborSafe 2018), Tree Removal and Preservation Plan LS-DWG-02-001 Rev 5 (Turf Design Studios, 27 August 2019), General Arrangement Plans - Auxiliary Lane RBG-CV-DWG-RIE-83-151 Rev 2 (26 August 2019), Roundabout RBG-CV-DWG-RIE-81-101 Rev 2 (26 August 2019), Main Entrance RBG-CV-DWG-RIE-87-301,302 & 303 (16 August 2019) (Robert Bird Group), and Fence Location Survey Drawing No. 23215B (PDF & DWG Formats) (B & P Surveys, 30 May 2019).
Figure for display purposes only, not for use in construction/site works.

| | | | |
|---|---|---|---|
| Client: C107778 | N 0 50 100 m | Scale (@A4): 1:4,750 | **Temporary Boundary Fencing and Vegetation Protection Fencing – Stage 2** |
| Job #: J156455-13 | | | |
| Author: D. Correa | Coordinate System: GDA 1994 MGA Zone 56 | | |
| Checked: C. Maloney | | Tweed Valley Hospital BMP<br>771 Cudgen Road<br>Cudgen NSW | **Figure 7** |
| Date: 29/08/2019 | *Imagery 15th July 2019 (7.5 cm) @ Nearmap 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_F07_Fence_190829.mxd*

## 2.5 VMP Overview

The guidance presented in this VMP is intended to facilitate effective vegetation management throughout the life of the project via the application of tailored weed control, regeneration, revegetation, maintenance, monitoring and reporting. The timing of various activities is also aligned with the different phases of the Project. **Table 8** provides a general overview of the key objectives, activities and timing.

## 2.6 Timing

The timing for vegetation management measures as shown for each MZ in **Table 7** and in the Project Phase column of **Table 8** is indicative only and based on the information available at the time of writing this Stage 2 BMP.

Weed control commenced during Stage 1 early works in June 2019. Some measures, such as hydro mulching commenced in the Stage 1 pre-construction phase in late-2018 to mid-2019 prior to approval.

As per the Stage 1 BMP, primary and secondary (conducted 6-8 weeks following the primary treatment) weed control activities were undertaken in the following areas during Stage 1;

- Exotic vegetation adjacent to the farm dam (MZ 1.4, 1.5 and 8);
- Koala habitat (MZ 1.6);
- Hydro-mulched lawn/farm landscape (MZ 4);
- The low maintenance native landscape/ around the site entrances (MZ 2.1);
- The vegetated buffers (MZ 6 and 7); and
- The development footprint (before topsoil stripping).

Stage 2 primary and secondary weed control activities will commence in the remaining areas; MZ's 1.1 to 1.3, 2.1, 2.2 and 2.3.

Expected timing for Stage 2 Project Phases is as follows;

- Construction: June 2020 to late-2022; and
- Operation: Targeting opening in early-2023.

Revegetation will commence during the construction phase of the Stage 2 following primary and secondary weed control activities, as shown in **Table 7.**

**Table 7 Indicative timing for commencement of revegetation activities during Stage 2**

| MZ | Description | Revegetation commences |
|---|---|---|
| 1.1 to 1.3 and 1.6 | Remnant paperbark swamp forest/subtropical rainforest/Flooded Gum forest/ incl. Koala and MRS habitat | Q2 June 2020 – Q4 November 2020 |
| 1.4 and 1.5 | Exotic vegetation | Q2 June 2020 |
| 2.1 and 2.2 | Low maintenance Native Landscape and Remnant Vegetation windrows | Q2 June 2020 – Q2 June 2021 |
| 2.3 | Bio-detention basins | Q2 June 2021<br>Please note: Sediment basins have been hydro mulched with grass seed during Stage 1 and do not require further planting.<br>The sediment basins will be converted into bio-detention basins in Q2 June 2021, once the site excavation works and roads have been completed and all surfaces have been stabilised with appropriate ground cover (i.e. landscaping has commenced). |
| 4 | Hydromulched lawn | NA: Planting not required. Lawn maintenance only. |

| MZ | Description | Revegetation commences |
|---|---|---|
| 5 | WSUD carpark/roadway planting | Q3 2021 – Q4 2021 (once the carparks/roads have been completed) |
| 6 and 7 | Vegetated buffers | Q2 June 2021 |
| 8 | Farm dam | Q2 June 2020 (dam decommissioning works) |

[1] Q1: January to March, Q2: April to June, Q3: July to September and Q4 October to December.

A number of management zones (i.e. MZ 6 and 7) will not be established until revegetation is undertaken during the later stages of Stage 2, once the majority of construction activities and primary and secondary weed control activities have been completed.

## Table 8 Summary of vegetation management activities (weed control, planting, maintenance, monitoring, reporting)

| Item | MZ | Activity[4] | Frequency | Project Phase[1] | Who[2] |
|---|---|---|---|---|---|
| **Primary and secondary weed control** | | | | | |
| 18 | MZ's 1.1 to 1.3, 2.1, 2.2 and 2.3 | Conduct primary weed control.<br>MZ 1.1 and 1.2 activities must consider strategies to protect MRS habitat as per **Section 2.4.4**.<br>For open grassy areas (i.e. MZ 2.1 and 2.3) slashing/ brush cutting (if required, see **Section 2.3.2.4**) and spot spray with an appropriate herbicide (e.g. glyphosate).<br>Secondary weed control to be conducted 6-8 weeks following primary weed control.<br>Follow up hydro mulch application where required. See **Section 2.3.1.3** for hydro mulching in MZ 2.1 and 4.<br>Maintenance of MZ's 2.1, 2.2 and 1.6 must comply with APZ guidelines as per **Section 2.4.1**.<br>*Please note: Primary and Secondary weed control were conducted during Stage 1, as per the Stage 1 BMP in MZ's 1.4, 1.5, sections of 2.1, 4, 6, 7 and 8 and the project footprint.* | Two main events as per the bush regeneration contractor detailed schedule (See **Table 5**). | Stage 2 C | Management, Contractor (Bush Regeneration/ Weed control) |
| **Planting** | | | | | |
| 19 | MZ 1.4 and 1.5 | Following completion of the staged primary and secondary weed control and site preparation activities as per **Section 2.4.4**, **revegetate** as per **Section 0** and **Section 2.4.4** to lowland rainforest on floodplain to increase area of habitat available for threatened species, particularly the MRS. | As per the bush regeneration contractor detailed schedule (See **Table 5**). | Stage 2 C | Management, Contractor (Bush Regeneration/ Weed control) |
| 20 | MZ 1.1, 1.2, 1.3, 1.6, 2.1, 2.2 and 5 | Following completion of primary and secondary weed control and site preparation activities, **assisted regeneration** as per **Section 2.3.3.6** and **Section 2.4.4** to retain and enhance biodiversity values and Koala habitat values (MZ 1.6), create stepping-stone or 'moist corridor' habitat corridors across the site.<br>MZ's 2.1, 2.2 and 1.6 must comply with APZ guidelines as per **Section 2.4.1**. The planting design includes lawn with clusters of native planting (min 20m apart) as per the Schematic LZP by Turf Design (June 2019). | | Stage 2 C | |

| Item | MZ | Activity[4] | Frequency | Project Phase[1] | Who[2] |
|---|---|---|---|---|---|
| 21 | MZ 2.3 | **Revegetate** basins as per **Section 2.4.2** to enhance biodiversity values and create stepping-stone or 'moist corridor' habitat across the site. | As per the bush regeneration contractor detailed schedule (See **Table 5**). | Stage 2 C | |
| 22 | MZ 6 and 7 | Following completion of primary and secondary weed control and site preparation activities, retain existing vegetation (where possible) and **revegetate buffer zones** to Subtropical Rainforest as per **Section 0.**<br>Increase area of habitat available for threatened species.<br>Create habitat corridors across the site. | As per the bush regeneration contractor detailed schedule (See **Table 5**). | Stage 2 C | |
| **Maintenance, monitoring and ongoing weed control [3]** | | | | | |
| 23 | MZ 1.4 and 1.5 | Maintenance of planting areas | Following completion of primary works, minimum of **four maintenance events per yea**r for the **five-year** period.<br>If performance criteria are not met after a five-year period then the program will be reviewed and extended until performance criteria are met. | Stage 2 C & O*<br>*Events may be required during the operational phase depending on the timing and success of primary works.<br>Monitoring, maintenance and weed control events can be conducted in conjunction. | Management, Contractor (Bush Regeneration/ Weed control) |
| 24 | MZ 1.1, 1.2, 1.3, 1.6, 2.1, 2.2, 2.3, 5, 6 and 7. | Maintenance of planting areas | Following completion of primary works, minimum of **four maintenance events per yea**r for the **three-year** period.<br>If performance criteria are not met after a three-year period then the program will be reviewed and extended until performance criteria are met. | | |
| 25 | All MZs | Vegetation maintenance report | For each vegetation maintenance event (**four per yea**r), contractors must complete a record of all works undertaken to be submitted to management and all data should be | | |

| Item | MZ | Activity[4] | Frequency | Project Phase[1] | Who[2] |
|---|---|---|---|---|---|
| | | | compiled into an annual vegetation maintenance report. | | |
| 26 | MZ 1.4 and 1.5 | Monitoring of planting areas | Following completion of primary works, **two monitoring events per year** for the **five-year** period.<br>If performance criteria are not met after a five-year period then the program will be reviewed and extended until performance criteria are met. | | |
| 27 | MZ 1.1, 1.2, 1.3, 1.6, 2.1, 2.2, 2.3, 5, 6 and 7. | Monitoring of planting areas | Following completion of primary works, **two monitoring events per year** for the **three-year** period.<br>If performance criteria are not met after a three-year period then the program will be reviewed and extended until performance criteria are met. | | |
| 28 | All MZs | Vegetation monitoring report | **Two per year** following **each monitoring event** and **one annual vegetation monitoring report**. All data should be compiled into an annual report to assess the effectiveness of the works undertaken in accordance with the performance criteria as specified in **Table 6** and recommendations for program adjustments. | | |
| 29 | All MZs and Project footprint | Weed control activities and inspections as per **Section 2.3.2**, and specifically **Section 2.3.2.6** for *Salvinia molesta* control<br>MZ's 2.1, 2.2 and 1.6 must comply with APZ guidelines as per **Section 2.4.1**. | A minimum of **four events per year with provisions to allow for additional events** during the peak weed growth period over summer | | |

| Item | MZ | Activity[4] | Frequency | Project Phase[1] | Who[2] |
|---|---|---|---|---|---|
| | | | and spring (i.e. every month), **in perpetuity.** | | |
| 30 | All MZs | Weed control reporting | Contractors must complete a record of all works undertaken to be submitted to management per event and all data should be compiled into an annual weed control report. | | |
| **Measures of rehabilitating the existing dam** | | | | | |
| 31 | MZ 8 | The dam will be incrementally infilled without dewatering in a monitored and staged approach to ensure gradual displacement of water so that the impact of the process on native aquatic fauna is mitigated. Advice was sought from a local fauna ecologist with experience dam decommissions (Ben Gunston, 2019, pers. comm. 26 June) on the best practice process to mitigate impacts on native fauna. The best practice method will be employed to decommission the dam and mitigate impacts on native flora and fauna as per **Section 2.3.2.7.** | Several events, prior to civil works which are expected to be undertaken in June 2020, and as per the bush regeneration contractor and fauna rescue contractor detailed schedule. | Stage 2 C | Management, Fauna Rescue Contractor, Construction Contractor, Bush Regeneration Contractor |
| 32 | MZ 1.1 and 1.4 | Following completion of the dam works (expected in June 2020), vegetation restoration, maintenance, weed management activities and monitoring and reporting will be undertaken around the decommissioned dam in accordance with **Sections 0, 2.3.4** and **2.3.5**. | <u>Planting:</u><br>Upon completion of works, and as per the bush regeneration contractor detailed schedule.<br><u>Maintenance:</u><br>Following completion of primary works, minimum of **four maintenance events per yea**r for the **five-year** period.<br><u>Monitoring:</u><br>Following completion of primary works, **two monitoring events per yea**r for the **five-year** period.<br><u>Reporting:</u> | Stage 2 C & O | Management, Bush Regeneration Contractor |

| Item | MZ | Activity[4] | Frequency | Project Phase[1] | Who[2] |
|---|---|---|---|---|---|
| | | | **Two per yea**r following **each monitoring event** and **one annual vegetation monitoring report**. | | |

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

[2] Suitably qualified and experienced bush regeneration contractors must be engaged to undertake vegetation management works within all areas containing native vegetation except for mechanical removal of slash pine *Pinus ellioti.*

[3] Prior to the undertaking of each maintenance event a site inspection is to be completed to determine what, if any, weed control is required.

[4] Vegetation management works within MZ 1.1 to 1.6 should refer to strategies to protect the MRS habitat as per **Section 2.4.4**.

# 3. FAUNA MANAGEMENT PLAN

## 3.1 Fauna management aims and objectives

The objective of this FMP is to conserve and enhance biodiversity values on the Site and avoid and mitigate any potential impacts on threatened species, in particular MRS, which has been identified adjacent to the Site. In order to achieve this objective, several activities will be undertaken at different phases of the Project during Stage 2 as outlined in **Table 8.**

These measures will mitigate the residual impacts of the Project as outlined in the BDAR (Greencap 2019b; Appendix I, J). This FMP refers to the MZ identified in **Figure 6**.

## 3.2 Threatened Species

Threatened species surveys were undertaken on the Site in 2018 to inform the development of a BDAR (Greencap 2019b). Targeted fauna surveys were undertaken using methodology as detailed in the BDAR (Greencap 2019b). There were no threatened fauna species recorded on the Site. However, MRS was found outside and adjacent to the Project Site boundary (**Section 3.2.2**),

The following subsections address potential impacts of the Project on the known population of the endangered MRS directly adjacent to the Site and a small area of preferred habitat for the endangered population of koala *Phascolarctos cinereus* on the Site. Water quality impacts on pH dependent threatened amphibians in the downstream receiving wetland environment are also addressed. Furthermore, highly mobile threatened species that have been recorded in the Tweed LGA, namely; grey-headed flying fox *Pteropus poliocephalus,* eastern osprey *Pandion cristatus* and white-bellied sea eagle *Haliaeetus leucogaster* are described below and potential impacts on these species due to Project related aviation activities are addressed in **Section 3.8.3**.

### 3.2.1 Koala *Phascolarctos cinereus* habitat

A population of the Koala Phascolarctos cinereus between the Tweed and Brunswick Rivers east of the Pacific Highway is listed under the BC Act as an endangered population, consisting of an estimated 144 animals (TSC 2014). A small 0.2 ha area of preferred koala Phascolarctos cinereus habitat is located on Site in MZ 1.6, in the far north-east corner of the Site outside the Project footprint area (**Figure 6**). This vegetation contains preferred food source trees (tallowwood *Eucalyptus microcorys*) and meets the definition of 'Secondary (Class A) Habitat' as defined in the Tweed Coast Comprehensive Koala Plan of Management (CKPoM) and 'Potential Koala Habitat' as defined in State Environmental Planning Policy 44 – Koala habitat protection 44.

Targeted koala *Phascolarctos cinereus* surveys were undertaken in July and December 2018 to inform the development of the BDAR, however no koalas *Phascolarctos cinereus* were recorded (Greencap 2019b). Whilst undertaking the survey, it was also observed that weedy vegetation and growth of vines would be challenging for koalas *Phascolarctos cinereus* to utilise the trees. Whilst no koalas *Phascolarctos cinereus* were recorded on Site during the BDAR surveys, measures will be taken to avoid any disruption to the movement or impacts on habitat connectivity for this species as outlined below in **Section 3.3** or any impacts during the native vegetation clearing activities as outlined below in **Section 3.7**. Primary and secondary weed control measures commenced during Stage 1 in the area of preferred koala *Phascolarctos cinereus* habitat (MZ 1.6) **.** Ongoing weed control works during Stage 2 will be a priority for this area of habitat. A tree protection zone (TPZ) and signage has been installed to protect this area of koala *Phascolarctos cinereus* habitat as outlined in the VMP **Section 2.3.**

### 3.2.2 Mitchell's rainforest snail *Thersites mitchellae*

#### 3.2.2.1 Records

To date, no MRS specimens were found on the Site, however, MRS were detected during surveys outside the Project Site boundary in the northern portion of former Lot 102 DP 870722. **Figure 10** presents the locations of the MRS survey results undertaken as part of the BDAR in 2018 as well as suitable MRS habitat (MZs 1.1 and 1.2) and an area of Subtropical rainforest restoration that will potentially provide further suitable habitat for this species (MZs 1.4 and 1.5). Survey records of MRS are as follows;

- On 19 November 2018, an opportunistic recording of MRS by Dr Damian Licari and David Milledge. One live individual was recorded at the ecotone between the Subtropical Rainforest and Coastal Swamp Forest, and one dead shell was recorded on the perimeter of MZ 1.2 outside the Project Site boundary.
- On 19 and 20 December 2018, targeted diurnal and nocturnal surveys for the snail concentrating on windrow vegetation to be cleared were undertaken by Dr Stephanie Clark (invertebrate identification specialist), Dr David Robertson and Craig Faulkner. Whilst no specimens were recorded in windrow vegetation to be cleared on Site, the target species was detected in paperbark swamp forest in the northern extremity of former Lot 102 DP 870722. One living individual and three dead shells were found.
- On 21 and 22 May 2019, during the pre-construction baseline survey by Dr Stephanie Clark, three living MRS were found on the ground, under logs and crawling at night and three empty shells were also found, all of which were outside the Project Site boundary (Clark 2019c). Some of the empty shells showed signs of predation by birds (such as brush turkey *Alectura lathami*) and by mammals (such as black rat *Rattus rattus*) both of which were observed on the Site (Clark 2019c).

In addition, there are known records for MRS to the east and west of this location (NSW BioNet database searched, 7 December 2018).

The targeted survey undertaken by Dr Clark concluded that the clearing of 0.95 ha of rainforest vegetation from the proposed development area during Stage 1 would not significantly impact Mitchell's rainforest snail habitat as this was not considered suitable habitat for MRS (Clark 2019a).

#### 3.2.2.2 Protection of snail populations and habitat

The MRS is classified as endangered in NSW under the BC Act (OEH 2018) and Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and has an adopted recovery plan (NPWS 2001). Under this Stage 2 BMP, MRS habitat will be managed to protect this threatened species, including the management of vegetation and invasive species which may be harmful to threatened species, in particular weeds and rats which are one of the known threats to the MRS (OEH 2018; NPWS 2001). Ongoing long-term monitoring and reporting should be undertaken to establish an estimated population size at the Site and to monitor any changes in population over time. Changes to MRS populations are to be addressed with adaptive management actions. Mitigation and management measures to protect MRS populations are described below.

**Vegetation Management**

Vegetation in core MRS habitat (MZs 1.1 and 1.2) will be managed to protect and increase the quality of habitat by improving key habitat requirements of well-developed leaf litter and intact canopy (NPWS 2001). Weed control commenced in Stage 1 and assisted regeneration with rainforest plants will be undertaken in Stage 2 as outlined in the VMP (**Section 2**).

Under the BMP, the Vegetation Management Plan (VMP) incorporates revegetation of MZs 1.4 and 1.5 (total area of approx. 0.95 ha) which are currently dominated by weed species barner grass *Cenchrus purpureus*

and camphor laurel *Cinnamomum camphora*. Once established, revegetation of MZs 1.4 and 1.5 will represent an overall net increase in MRS Subtropical rainforest habitat on the Site. Revegetation should consist of high density planting with a diverse range of rainforest species to achieve a closed canopy rainforest with a thick leaf litter cover which is addressed in **Section 2.4.4**.

As described in the VMP **Section 2.4.4,** weed control activities within the retained undisturbed forest should be undertaken in a staged approach to minimise the disturbance on MRS habitat and preferably by a bush regeneration contractor who has demonstrated experience working in MRS habitat.

Bushfire risk will be managed in accordance with the adopted guidelines (RFS 2006) and Asset Protection Zone (APZ) regulations (RFS 2007). Furthermore, during construction of the Project, if smoking is to be permitted on site, designated smoking areas will be established, and suitable receptacles will be provided for cigarette butts.

**Pest management**

Predation by introduced black rat *Rattus rattus* is a potential impact on the MRS (OEH 2018; NPWS 2001). Several black rats were detected on the Site during BAM surveys and during the baseline MRS survey (Greencap 2019a; Clark 2019c). This has consequently been identified as a potential threat to the MRS on the Site. Therefore, it is recommended that a black rat *Rattus rattus* control program be implemented during construction of the Project. In order to avoid impact on non-target native species, control measures are to be undertaken around the ancillary facilities and not within native animal habitat (i.e. MZs 1.1 to 7). A specialist pest control contractor should be engaged to develop a black rat *Rattus rattus* control program for the Site.

**Water quality**

Stormwater run-off containing poisons and other chemicals has the potential to adversely directly impact the MRS, as well as indirectly through changes in vegetation structure from change in water quality and flow regimes (Clarke 2019b). The quality of stormwater entering the downstream wetland MRS habitat (MZs 1.1 and 1.2) will be managed and monitored in accordance to measures outlined in the WQMP in **Section 4** of this Stage 2 BMP.

**Monitoring program**

A specialist invertebrate consultant, Dr Stephanie Clark, has been engaged to develop a scientific survey and management plan for the MRS at the Site. A pre-construction survey was undertaken in May 2019 to collect baseline data on population size, with further surveys to resume later in 2019 during warmer weather when snails are more active. The survey was undertaken at night within the MRS habitat within the Site boundary (MZs 1.1 and 1.2). An ongoing repeatable monitoring program will ensure long term consistency of data to determine the population size.

In accordance with the adopted recovery plan (NPWS 2001), it is recommended that ongoing, long term monitoring be conducted every second year for the life of the Project (construction and operations) to identify any changes in the status of the species. Management objectives, actions, monitoring and compliance for the MRS are provided in the management plan for the MRS (Clark 2019b).

**Reporting**

As part of the baseline monitoring program, a specialist invertebrate consultant has submitted a pre-construction baseline survey of MRS report (Clark 2019c) outlining; date of survey, personnel, weather, areas surveyed, survey methodology, results, photos, observations, threats and impacts on the MRS, an evaluation of the monitoring program and any recommendations.

During Stage 2, following the monitoring program conducted every two years, a specialist invertebrate consultant will submit a report including but not limited to; date, personnel, weather, areas surveyed, survey

methodology and results of population size, trends in population size, observations, photos, impacts and threats on the MRS, an evaluation of the monitoring program and any recommendations.

During construction, the Safety & Environmental Manager at Lendlease will be responsible for managing the MRS monitoring and reporting program. Lendlease will rely upon input from the specialist invertebrate consultant and the bush regeneration subcontractor.

Post construction, the Manager Capital Assets and Resources (or similar role) at LHD will be responsible for managing the MRS monitoring and reporting program, with input from external specialist subcontractors.

### 3.2.3 Aquatic fauna

During the development of the BDAR, two pH dependent amphibians were identified by the BAM Calculator as candidate threatened species – 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 rapidly settle sediment-laden stormwater runoff during construction may have an impact upon pH dependent amphibian species following discharge to the downstream receiving wetland environment. To avoid any potential changes in pH and impacts on these threatened 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.

As part of a Water Quality Monitoring Program as outlined in the WQMP in **Section 4**, physico-chemical parameters including pH will be monitored in water discharged from sediment basins and in the downstream wetland environment.

The impact of erosion and sedimentation on terrestrial and aquatic flora and fauna during Stage 2 works will be managed in accordance with an ESCP prepared for the Site to effectively manage erosion and subsequent sediment mobilisations (RBG 2019). 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 Certified Practitioner in Erosion and Sediment Control (CPESC) during the planning phase of the ESCP development. ESC design should be in accordance with the guidelines in the NSW Managing Urban Stormwater “Blue Book” (Landcom 2004).

For management of aquatic fauna during the decommissioning of the existing dam please see **Section 2.3.2.7**.

### 3.2.4 Flying Fox Camps

Initial desktop assessment determined that there were two flying fox camps located within a 1 km radius of the Site (Greencap, 2018), however, there are no flying fox camps located on the Site. Potential impacts (injury/mortality) from aviation activities on flying foxes during operations of the Project are addressed in **Section 3.8.3**.

### 3.2.5 Coastal Raptor Nests

Coastal raptors such as the eastern osprey *Pandion cristatus* and white-bellied sea eagle *Haliaeetus leucogaster* have been recorded in the Tweed LGA. No coastal raptor nests were recorded on the Site, however, two known osprey nests have been recorded within the 1500m assessment area (TSC, 2018). The potential impacts of helicopter collision from aviation activities on coastal raptors during operations are addressed in **Section 3.8.3** and indirect impacts on coastal raptors that potentially utilise the paperbark swamp forest (MZ 1.1) are addressed in **Section 3.9**.

## 3.3 Habitat Connectivity

### 3.3.1 Fencing

The primary impact on movement of threatened species relates to boundary fencing of the site, noting that species would be able to move around the Project site unless impeded by a boundary fence. In respect of the current fencing on the site, the only existing permanent fencing in proximity to the site is the wildlife fencing along the Turnock St roadside. The Project will not impact this existing fencing.

Temporary boundary fencing has been installed during the pre-construction works. Tree Protection Zones (TPZ) have been installed around native vegetation and specific trees to be retained adjacent to the construction footprint (See VMP **Table 5**, **Section 2.3.1** and **Figure 7**). This temporary fencing will be removed at the conclusion of the construction phase of the development. Temporary boundary fencing has been fitted with a 'post and bridge' system at least every 50 m in accordance with published guidelines (KRS 2009) to facilitate movement of koala *Phascolarctos cinereus* and other arboreal marsupials. As per the Stage 1 SSD application, there is no intent for a permanent boundary fence to be installed for the operation phase of the Project, thereby allowing movement of threatened species.

As per SEARs supporting advice received from DPIE on the 12 July 2019; '*the design and implementation of wildlife-friendly fencing that avoids impeding fauna movement on and through the Site and protects species such as koalas for collisions with vehicles along Cudgen Road and Turnock Street'* is currently being assessed in consultation with the DPIE and is planned to continue until final lodgement of the EIS (also see **Section 1.9**).

### 3.3.2 Habitat corridors

Habitat connectivity will be maintained across the Site by vegetation management measures as outlined in the VMP (**Section 2.3**), primarily by the installation of TPZ's to protect retained native vegetation during the construction works.

Importantly, to facilitate the movement of fauna, vegetated buffer zones (MZs 6 and 7) will be substantial (10 m and 30 m wide) and representative of forest types being connected by these zones. Vegetated buffer zones will connect to the retained Subtropical Rainforest vegetation in the northern portion of the site and will run north to south in line with the mapped regional fauna corridor (**Figure 9**). This will provide important stepping-stone and refuge habitat for threatened species and will represent an improvement in connectivity from the existing use of the Site. Revegetation will be undertaken during Stage 2 works and is addressed in **Section 2.3.3.**

Furthermore, stormwater management will incorporate WSUD principles and the make use of landscaped areas for filtering runoff, swale drains and vegetated sediment basins. New plantings in MZ 2.3 as part of Stage 2 works will treat both stormwater quality and contribute to providing a range of native habitat or 'moist corridors' across the site.

Where possible, landscaping will include habitat features such as rocks that have been salvaged from other areas of the Site (cleared windrows) that will create habitat for ground dwelling species (Turf, 2018).

## 3.4 Pest animal management

No major pest species have been identified on the Site, except for the black rat *Rattus rattus* which poses a potential impact on MRS populations. A black rat *Rattus rattus* control program will be implemented during Stage 2 of the Project as discussed in **Section 3.2.2.2**.

The introduction of pest species or disease onto the Site will be mitigated by installing an environmental protection area (or TPZ) to protect retained vegetation on the Site during construction. Furthermore, weed control and high density Subtropical Rainforest revegetation across the Site will also provide habitat for

specialist rainforest dependent species such as the Mitchell's rainforest snail *Thersites mitchellae* and avoid attracting open habitat generalist species or exotic species.

**Cane toad exclusion**

In accordance with TSC (2016) sediment basins on the site should incorporate measures to discourage breeding of cane toads *Rhinella marina* in accordance with published guidelines (BSC 2013).

- Cane toad *Rhinella marina* exclusion fencing will be installed around sediment basins consisting of:
    - Shade cloth or similar material;
    - 900 mm wide cloth provides enough height (at least 700 mm) and depth into the ground (at least 100 mm);
    - Posts should be spaced approximately 1.6 m apart;
    - Dig a trench at least 100 mm deep and drive posts into the trench;
    - Secure the cloth tightly between posts with the base of the cloth in the ground;
    - Backfill the trench to cover the base of the fencing material; and
    - Once the barrier has been erected, check regularly to make sure no toads are trapped inside the fence.

Timing for installation of the cane toad *Rhinella marina* exclusion fencing will follow the conclusion of civil works directly around/involving the sediment basins.

Following the conclusion of civil works directly around/involving the sediment/bio-detention basins, the basin batter and rip rap/overflow areas 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 can be removed (BSC 2013).

## 3.5 Native fauna management

Documentation of all native fauna injuries and deaths will be recorded in incident registers to monitor species mortality, including fauna mortality resulting from vehicle strikes or entanglement. Should an increase in the frequency of Project related fauna mortality/injury incidents occur, it will trigger investigation and appropriate adaptive management actions will be implemented to mitigate the impacts.

To minimise interactions with fauna, it is recommended that Site Management enforce the following policies on the Site:

- Catching or feeding of native or feral animals on Site is prohibited.
- Site personnel will be prohibited from harming or intentionally killing any wildlife.
- Throughout operation of the Project pets will be permitted on the Site, managed under operational policies.
- Discarding food wastes on the Site is strictly prohibited.

The following fauna management practices will be implemented on the Site:

- Excavations will exclude fauna entry or allow for fauna egress. Where it is not practical to provide fauna egress, daily checks will be undertaken before work commences.
- All excavations left open overnight will be inspected each morning.
- Uninjured trapped fauna will be released to a predetermined species-relevant nearby area of suitable habitat away from the Site by a suitably qualified and wildlife handler.
- Dead native animals that are found on the Site will be recorded in a fauna incident register, reported, collected and disposed of appropriately so as not to attract predators or scavengers.

- Injured native animals will be collected and taken to nearby veterinary facilities for treatment, as required.
- Personnel will record fauna sightings/encounters during construction activities using a fauna register.

Site inductions will include the following specific components for flora and fauna management:

- Commentary regarding the flora, fauna and ecological values within and in the vicinity of the Site.
- Project commitments specific to how flora and fauna are protected during construction or operation works.
- Procedures in the event that fauna are encountered within the Site.
- Requirement that all clearing/earthworks/construction activities are to be confined within the Site boundary.

### 3.6 Waste management

Construction activities on the Site during Stage 2 works will be managed in accordance with the approved CEMP CWMSP (LLB 2019).

The following measures should be included to prevent fauna being attracted to Site:

- The 'eliminate, reduce, re-use, recycle' disposal waste management principles will be applied.
- Limit the amount of rubbish and waste onsite through good housekeeping practices.
- Food waste will be disposed of at a designated facility.
- Putrescible wastes will be stored in secure bins with lids or transported offsite daily for disposal.

### 3.7 Fauna management procedure during vegetation clearing and rock removal

To minimise impacts and ensure the safety of any native ground dwelling and arboreal fauna occupying trees, vegetation and around rocks proposed for removal, a suitably qualified and experienced fauna rescue person shall be present to supervise the clearing activities. A Fauna Management Procedure for vegetation and rock clearing activities on the Site is outlined below in sequential order:

1. A suitably qualified and experienced ecological consultant will be engaged to undertake fauna rescue for native vegetation clearing and rock removal activities. Relevant qualifications/licenses include:
    a. 'Animal Research Authority' as approved by the Animal Care and Ethics Committee (Department of Primary Industries).
    b. A biodiversity conservation licence granted under Part 2 of the BC Act that allows handlers to legally catch and release reptiles (usually snakes) from commercial and residential homes and backyards.
2. A pre-clearing inspection will be done of all areas to be cleared, including around rocks within windrow vegetation being cleared. All trees within 30 metres of those trees to be cleared are to be inspected for the presence of native fauna. The pre-clearing inspection will assess for presence of any native fauna, tree hollows, bird nests etc.
3. A pre-clearing inspection report will be submitted to TSA Management containing pre-clearing inspection results and any recommendations such as elevated work platform requirements for working at heights.
4. During vegetation and rock clearing works a daily survey will be undertaken before works commence to assess if any fauna has moved into the area overnight or within 30 metres of those trees to be cleared (including construction of bird nests etc.).

5. Fauna spotters / rescue personnel at 1 person per operational machine will be present at all times during clearing works. The fauna rescue personnel must be responsible for identifying fauna present on the site and will remain on site during any clearing works to ensure that any tree occupied by fauna is not accidentally cleared or interfered.
6. If any fauna is found during clearing, where possible, uninjured native fauna detected will be caught by the fauna rescue personnel and released at a predetermined location of appropriate habitat that is nearby, but outside of the Project footprint.
7. Any injured native fauna detected shall be rescued and transferred to a local veterinarian for treatment and/or WIRES for rehabilitation.
8. The Fauna rescue consultant will submit a post-clearing report outlining at a minimum any observations, mortality, injuries, captures and translocations.

If koalas *Phascolarctos cinereus* are found on the Site during vegetation clearing works and/or earthworks;

- All construction clearing/earthwork activities must be temporarily suspended within a range of 30 metres from any tree which is occupied by a koala.
- Works are to be avoided in any area between the koala and the nearest areas of habitat to allow the animal to move to adjacent undisturbed areas.
- Works must not resume until the koala has moved from the tree of its own volition.

## 3.8 Traffic management

### 3.8.1 On site

The following traffic management measures will reduce the risk of impact on wildlife during the construction and/or operations phase of the Project:

- A Preliminary Construction Traffic Management Plan (CTMP) has been produced as part of an approved CEMP and its prescriptions will be implemented during the construction phase of the Project (LLB 2019).
- Construction traffic must maintain low vehicle speeds to 20km/hr on internal roads and access ways (LLB 2019) and operators shall take care and be aware of any wildlife that may be in the area to minimise the risk of fauna injury or mortality. Should wildlife enter the construction footprint, a suitably qualified fauna handler should be notified and actions taken in accordance with the FMP and CEMP (LLB 2019).
- During the 24-hour operation of the hospital, traffic must maintain low vehicle speeds to 20km/hr on internal roads and access ways.
- Documentation of all native fauna injuries and deaths will be recorded in incident registers to monitor species mortality and any direct impacts will trigger investigation and adaptive management actions where possible.
- Any injured native fauna detected shall be rescued and transferred to a local veterinarian for treatment and/or WIRES for rehabilitation.
- Traffic will be mainly restricted to the southern portion of the Site where the project footprint is at least 67 m from the remnant native vegetation. This provides a natural buffer zone.

### 3.8.2 Off site

At peak of operations in 2033 the Project is estimated to generate an incremental increase in the order of 5,232 to 5,894 trips per day along Cudgen Road and Turnock Street at the peak of operations in 2033 (Bitzios, 2019). Weekday peak visitor numbers have been estimated at 408 visitors per day in year 2026/27 and 448 visitors per day in year 2031/32 (Bitzios, 2019).

There is an existing wildlife fence along Turnock Street owned and managed by TSC that is located adjacent to MZs 1.1, 1.2 and 1.6 **(Figure 1**). The wildlife fence is located adjacent to the koala habitat on the Site (MZ 1.6).

In general, the wildlife fence is in good condition and affords good protection for small to medium size ground dwelling mammals. However, overgrown vegetation on both sides of the fence allows arboreal mammals such as koala *Phascolarctos cinereus* to cross the fence and the road. Consequently, this provides connectivity between areas of habitat for arboreal mammals, it also places these species at risk of vehicle strike. Weed control measures that commenced in MZ 1.6 in Stage 1 as outlined in **Section 2.3.1** will improve the function of this fence as a barrier and will provide better protection for risk of vehicle strike to fauna trying to cross Turnock Street.

During Stage 1, the Applicant design plans were submitted to the relevant road authority and obtain necessary permits and approvals to implement measures during Stage 2 on the Turnock Street and/or Cudgen Road to reduce the risk of impact on wildlife. All roads and traffic facilities must be designed to meet the requirements standards/road specifications of Council and/or RMS.

During Stage 2, the road environment adjoining the site will be changed from rural to urban. The road environment will be upgraded to enable Site access as well as install and/or upgrade features associated with urban roads such as street lighting, kerb and channel guttering, signage, lane delineation and line-marking. Along with the increased pedestrian activity and traffic associated with the Project these measures are expected to reduce the existing traffic speeds along Turnock Street and Cudgen Road.

Furthermore, advisory signage should be installed to establish a wildlife crossing to the north-east of the Site where the Turnock Street roadway passes through the remnant vegetation (MZ 1.6) between the two Turnock Street roundabouts. This will mitigate impacts on wildlife (movement and collisions with vehicles) due to the increase in traffic numbers along Cudgen Road and Turnock Street, particularly on the endangered population of Koalas. An example of suitable koala crossing advisory signage is provided in **Appendix C**.

### 3.8.3 Aviation

The proposed development includes a Helicopter Landing Site (HLS) on the top of the main building (Level 7), which will result in low level air traffic in the vicinity of the Site. There is a small risk that threatened bird and bat species may fly over the Site in remnant vegetation that is located at the level of the floodplain at the time of aircraft operation.

Flying fox strike with helicopters is classed by Civil Aviation Safety Authority (CASA) as 'birdstrike' and negligible birdstrikes occur with helicopters. In 2015, a total of 32 birdstrikes with helicopters were reported in Australia (Australian Transport Safety Bureau, 2017). Reported birdstrikes were significantly lower for most helicopter weight categories when compared with most aeroplane groups which may be may partly due to helicopters flying at lower speeds and being easier for birds and pilots to see and avoid (Australian Transport Safety Bureau, 2017).

The highest proportion of helicopter birdstrikes recorded is whilst on the ground (standing) and the lower proportion of birdstrikes during landing and take-off, possibly due to the louder and varying noise caused by helicopter rotor speed and pitch changes during these flight phases (Australian Transport Safety Bureau, 2017). The HLS will be situated on the top of the multiple level hospital facility that is constructed on a ridge above the level of the floodplain. As such this location is considered to be above the flight path altitude of any birds or bats and will therefore not interrupt any local migration or cause death through aircraft strike.

Based on the available data from the northern NSW/SE QLD hospital transfers from NSW Ambulance, it is estimated that aircraft movements at peak operation of the Project would amount to approximately two movements per week, with a typical expected average of six per month. The helicopter movement and 'noise' event associated with arrival and departure is a total estimated time of 6 minutes for each event (i.e. three minutes inbound and three minutes outbound) (Steve Graham, AviPro, 2019, pers. comm. 15

February). The nature of aircraft operation for the site is such that the majority of aviation movements are outbound (i.e. not inbound transport of trauma patients). Consequently, most outbound patient transfers would take place during the day when clinicians are available to make transport decisions. This would therefore minimise if not avoid aircraft movements in the peak periods of flying fox activity in the hours preceding dusk and dawn. As a consequence the probability of aircraft strike on flying foxes is considered very low.

Obtainable data for birdstrikes comes from helicopter operations in the vicinity of aerodromes. The Australian Transport Safety Bureau record the risks for birdstrikes and the Civil Aviation Safety Authority regulate the requirements for that recording. Because HLS are not regulated like aerodromes, the only data comes from helicopter operations in the vicinity of aerodromes. Therefore, the data does not give as clear a picture for birdstrikes in the vicinity of hospitals and threshold criteria which will trigger adaptive management actions for aircraft strike on flying foxes/birds cannot be easily defined. However, this aerodrome birdstrike data does provide information on the characterisation of the rate of strikes and the times of day they occur and will be used to recommend peak birdstrike times to avoid helicopter operations where practical in the Aviation Operations Manual.

The following mitigation measures will be implemented to reduce the likelihood of fauna injuries and deaths from aviation operations:

- Aviation operations for the development will be conducted in accordance with an approved Aviation Operations Manual. This manual will identify areas of wildlife hazards including bird and flying fox activity such as the Elrond Drive and Kingscliff Library flying fox camps that are located within 1km of the Site (Ecosure, 2018, Greencap, 2018). The location of known flying fox camps will be included as either an 'avoid area' or a 'fly neighbourly' area. Recommendations will also be made to avoid aviation activity when possible during peak periods of flying fox activity (hours preceding dusk and dawn) and at peak birdstrike times as reported in the Australian aviation wildlife strike statistics report (Australian Transport Safety Bureau, 2017). These details will also be incorporated into the Enroute Supplement Australia (ERSA) published by Airservices Australia. The ERSA is a publication which contains information vital for planning a flight and for in flight operations for the aircraft pilot.
- The siting of the HLS and primary considerations in HLS approach and departure path selection included avoidance of ecologically and environmentally sensitive areas and areas sensitive to noise and vibration. The SSD general requirements of preferred flight path directions are detailed in the *Aviation State Significant Development Report: Tweed Valley Hospital SSD-9575* (AviPro 2019). The planned flight approach and departure paths to the HLS align almost north-south, minimising any impact on the environmentally sensitive areas (Flying fox camp) shown in **Figure 8.**
- Documentation of all native fauna injuries and deaths will be recorded in incident registers to monitor species mortality, including fauna mortality resulting from aircraft movement. Should any of the following occur, it will trigger investigation and adaptive management actions may be implemented such as auditory repellents, visual deterrents and physical barriers where birds, bats and other animals are an issue:
    - when aircraft experiences an increase in frequency of wildlife strikes;
    - when an aircraft experiences substantial damage following a wildlife strike; and
    - when wildlife are observed on or close to the HLS in size or in numbers that are capable of causing the events described above.


**Figure 8 Flight path illustration at TVH HLS (AviPro 2019)**

### 3.9 Managing indirect impacts on fauna

Sensitive environmental receptors relevant to dust, vibration and light spill impacts include vegetation communities and wildlife adjacent to the Project's construction activities. The impact of dust, air quality, vibration and light spill on surrounding flora and fauna will be managed in accordance with management plans including guideline criteria and any prescriptions will be implemented as part of an approved CEMP and sub-plans, including the CAQMDMSP and the CNVMSP.

Where avoidance of light spill, airborne noise, vibration and dust generation is not practicable, key mitigation measures to address residual impacts from light, noise, vibration or dust generated as a result of construction activities will be implemented, as outlined below.

#### 3.9.1 Light spill impacts displacing or disrupting terrestrial fauna

Light sensitive species are presumed unlikely to be present at the Site and impacts of light spill is likely to be negligible. Construction and operational activities will be restricted to the Project footprint in the southern portion of the Site where the project footprint is at least 67 m from the remnant native vegetation. This provides a natural buffer zone to dissipate light spill impacts.

All construction works and associated activities would be delivered in compliance with AS4282 Control of the obtrusive effects of outdoor lighting. As per the CEMP (LLB 2019), the lighting designer will have the appropriate competence in the fields of illuminating engineering and environmental design.

The lighting design will include measures to avoid impacts on ecologically and environmentally sensitive areas. As per the *External Lighting Strategy Report* (LCI 2019), obtrusive lighting will be minimised during the construction and operations of the Project by incorporating the following external lighting design approaches:

- External lighting will be designed with due consideration of lighting spillage to adjacent properties and sensitive receivers.
- External lighting will comply with AS 4282 – Control of the obtrusive effects of outdoor lighting.

- Due to the helicopter activity associated with the hospital, luminaires will generally be low-cutoff aeroscreen style to minimise uplight.
- Use of warm white (3000K) LED luminaires to provide lighting with a longer wavelength. Fluorescent lighting, and lights with significant ultraviolet emissions will not be used Mounting heights and luminaires shall be selected to minimise spillage and provide good control over the lighting distribution;
- Quality luminaires will be selected with good glare control;
- Luminaires will be set-back from the property boundary to reduce light spill where possible;
- Luminaires shall feature narrow beams and sharp cut-off angles; and
- Luminaires shall have low vertical aiming angles.
- Lighting shall be positioned in consideration with the local environment and ensure upward waste light ratios do not exceed the standard requirements.
- The local government will be consulted to determine any restrictions on the frequency of use and hours of operation of the external lighting.
- All construction works must be undertaken between the hours of 7.00am and 6.00pm Monday to Friday, between the hours of 8.00am and 1.00pm Saturday. No work will be undertaken on Sunday or Public Holidays.
- Consideration will be given to applicable safeguards and management measures before works commence including daily timing of construction activities such as avoiding night works and directing lights away from remnant vegetation.
- Lighting in and adjacent to the native vegetation areas, should incorporate low impact lighting design considerations where possible, such as:
    - Avoid installing lighting in or around native vegetation areas unless necessary. If lights cannot be avoided, use lower impact globes or lights with protective shields.
    - Install shields on streetlights, to direct illumination downwards, reducing the spill-over into adjacent habitat.
    - Use timers, sensors or motion detectors to switch lights on and off at appropriate times, reducing the length of time native vegetation is exposed to unnatural light levels.
    - Choose light globes that will have the least impact on wildlife.
    - Install lights as low to the ground as possible, reducing the spill-over of light into adjacent areas.

The site is a hospital, operating 24 hours with no curfew lighting period, external lighting will generally operate between dusk and dawn and be controlled by time-clock/light level sensors with a manual override located in central location. Lighting control will be combined into the main building management systems (LCI 2019).

Revegetation commencing around June 2020 will increase tree and shrub cover in bushland and corridors will reduce light penetration and improve the habitat value of these areas over time.

Lighting to the helicopter pad shall be provided in accordance with the External Lighting Strategy Report (LCI 2019) and Civil Aviation Safety Authority requirements.

### 3.9.2 Airborne noise and vibration impacts displacing or disrupting terrestrial fauna

Noise and vibration during construction and operation including construction works and traffic has the potential to disrupt threatened species or reduce the viability of adjacent habitat. After mitigation measures described below are implemented, it was assessed that there is a very low risk of noise and vibration impacts.

Noise and vibration levels during construction will be managed in accordance with the approved CEMP CNVMP (LLB 2019) and by implementing the control measures listed in the Noise and Vibration Impact Assessment (JHA 2019). Noise during construction will be mitigated by applying appropriate safeguards and management measures before works commence including daily timing of construction activities and restricting works to approved construction hours and identifying acceptable periods when specific 'noisy works' can occur. Whenever possible, equipment will be selected to minimise noise generation, e.g., electric cranes which are quieter and more efficient than traditional diesel cranes or retrofitted with noise silencing devices and the Site Induction will include information about noise and vibration minimisation, management and monitoring (LLB 2019).

Furthermore, construction will be restricted to the southern portion of the Site where the project footprint is at least 67 m from the remnant native vegetation. This provides a natural buffer zone to dissipate noise and vibration impacts.

As a requirement of the SEARs, noise and vibration must be managed in accordance with the following relevant policies and guidelines:

- NSW Noise Policy for Industry 2017 (EPA)
- Interim Construction Noise Guideline (DECC 2009)
- Assessing Vibration: A Technical Guideline 2006
- Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008)
- Australian Standard 2363:1999 Acoustics – Measurement of noise from helicopter operations.

The Noise and Vibration Impact Assessment (JHA 2019) identified noise and vibration sensitive receivers that will potentially be impacted by the operation of the Project, established relevant noise level criteria, carried out noise assessments, determined whether the relevant criteria can be achieved and provided recommendations. Based on the results of the preliminary assessment, the noise associated with the normal construction works is expected to meet the noise limits for standard hours & out-of-hours works in accordance with the Interim Construction Noise Guideline (DECC 2009). Furthermore, the results of the external mechanical plant noise emission assessment indicated that the noise level criteria will be met during operations and traffic generated as a result of the proposed hospital development is not expected to have an adverse noise impact on the surrounding roads (JHA 2019).

Noise and vibration monitors were established during Stage 1 in three different locations on site, covering the areas that are most susceptible to be affected. The sensors will be maintained throughout the duration of construction works. The sensors will trigger a warning (sent to the nominated recipient) when the maximum allowed levels are exceeded (LLB 2019).

Additional assessments may be conducted in response to changes in the work environment, the timing of which will be determined in consultation between the site management, Site Safety Committee and the Principal (LLB 2019).

Potential noise impacts on noise sensitive receivers for helicopter operations are addressed within the *Airservices Australia Principles and Procedures for minimizing the impact of aircraft noise fly Neighbourly Guide* (JHA 2019).

### 3.9.3 Dust impacting vegetation which is fauna habitat

There are potential dust impacts during construction and operation including inadvertent dust deposition on native vegetation, and the potential disruption to threatened species or reduced viability of adjacent habitat. After the mitigation measures described below are implemented, it was assessed that there is a very low risk of dust impacts. Dust levels during construction will be delivered in accordance with an approved CEMP sub pan Construction Air Quality Management and Dust Management Sub-plan (CAQMADM) (LLB 2019).

Site specific controls have been identified in this Sub-plan to prevent or minimise the impacts of construction related air emissions on the environment and community. Air quality monitoring will be undertaken where required, as per project approval, and the effectiveness of management controls periodically reviewed (LLB 2019). Where avoidance of dust-generation is not practicable, mitigation measures to address impacts from dust generated as a result of construction activities will include but are not limited to:

- Dust suppression techniques will be applied where necessary to protect vegetation health. This may include spraying from water trucks, irrigation, or stabilisation and revegetation of cleared areas that are no longer needed as soon as practicable during construction.
- Temporary stockpiles that are not required for imminent use will be stabilised.
- For unpaved roads, the periodic application of water will be used for dust suppression, dependent up on weather conditions and traffic volumes. Additional measures for high-volume traffic areas, such as impermanent gravel cover may also be required. For paved roads, the removal of accrued material from roadways will occur when possible.
- Maximum speed limits (to 20km/hr on internal roads and access ways) will be implemented to limit dust generated on site.
- On-site roads required for the operations phase will be sealed during the construction phase.
- Clear distinction between trafficable and non-trafficable areas with speed limits implemented.
- Multiple handling of soil or rock materials will be minimised.
- Loads in all trucks transporting soil, aggregate or other dust-generating materials to and from the on-site development area will be covered.
- Planning of construction activities will consider dust management requirements where practicable.
- Avoid excavation during high wind and extreme wet weather conditions.
- Periodic inspection of surrounding roads to ensure no construction contamination and initiation of road sweeping if required.
- Dust management and suppression will be undertaken during and following vegetation clearing and earthwork activities.
- No blasting will be performed as part of the proposed construction works program.
- The Site Induction will include information about the risks and potential impacts of dust and emissions on the environment and community.

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## Table 9 Fauna Mitigation Measures

| Item | Management Zone | Activity Description | Project Phase[1] | Responsibility | Outcome | Performance/ Trigger Criteria |
|---|---|---|---|---|---|---|
| Mitchell's rainforest snail *Thersites mitchellae* | | | | | | |
| 33 | 1.1 and 1.2 and 1.4 and 1.5 once vegetation is established and meets performance criteria for weed cover, canopy cover and leaf litter. | Long term monitoring of MRS population size at the Site. Ongoing monitoring will be conducted every second year to identify any changes in the status of the species. | Stage 2 C & O (every two years following the baseline survey) | During construction: Safety & Environmental Manager, Lendlease<br>Post construction: Manager Capital Assets and Resources (or similar role), LHD and Specialist consultant/s | Long term data on MRS population size | Survey completed every two years |
| 34 | 1.1 and 1.2 and 1.4 and 1.5 once vegetation is established | Following the monitoring program conducted every two years, a specialist invertebrate consultant will submit a report including but not limited to; date, personnel, weather, areas surveyed, survey methodology and results of population size, trends in population size, observations, photos, impacts on the MRS, an evaluation of the monitoring program and any recommendations. | Stage 2 C & O (every two years following the baseline survey) | | Long term reporting on MRS population size | Report submitted every two years<br>Trends in MRS population size or Project impacts which could result in a significant decreasing trend in population size.<br>Population trends will indicate: no change = acceptable, increase = evidence of successful vegetation management, decrease = mitigation / adaptive actions |
| 35 | 1.1 and 1.2 and 1.3 and 1.4 once vegetation is established | Specialist invertebrate consultant survey/report results indicate a stable or increasing trend in MRS population size | Stage 2 C & O (every two years following the baseline survey) | | Conservation of the MRS population | If stable or increasing performance criteria in **Table 6** is met, review of the monitoring program to be undertaken |
| 36 | 1.1 and 1.2 and 1.3 and 1.4 once vegetation is established | Specialist invertebrate consultant survey/report results indicate a significant decreasing trend in MRS population size or identify potential impacts from Project activities which could results in a significant decreasing trend in population size, in consultation with specialists Project management will undertake an investigation into | Stage 2 C & O (every two years following the baseline survey) | | Conservation of the MRS population | If stable or increasing performance criteria in **Table 6** is not met, an investigation will be triggered and adaptive management measures will be implemented |

| Item | Management Zone | Activity Description | Project Phase[1] | Responsibility | Outcome | Performance/ Trigger Criteria |
|---|---|---|---|---|---|---|
| | | addressing the decreasing population and adaptive measures will be implemented to mitigate any impacts. | | | | |
| 37 | 1.4 and 1.5 | Staged removal of weeds in MZ 1.4 and 1.5 to avoid desiccation of adjacent MRS habitat as per **Section 2.4.4**. | Stage 2 C & O | Management & Bush regeneration contractor | Avoid desiccation of adjacent MRS habitat | Staged removal of weeds in MZ 1.4 and 1.5 is adhered to |
| 38 | 1.1, 1.2, 1.3,1.4 and 1.5 | Vegetation Management to protect MRS populations including weed control as per **Section 2.4.4** and creation of diverse, dense Subtropical Rainforest with a closed canopy suitable with key habitat components: well developed leaf litter, intact canopy. | Stage 2 C & O | Management & Bush regeneration contractor | Conserve and enhance MRS habitat | Maximum 5% weed cover following weed control activities<br>Vegetation condition Monitoring performance criteria as per **Section 2.3.5** |
| Bushfire Prevention | | | | | | |
| 39 | All areas | A Bushfire Hazard Assessment Report (GeoLINK 2019) has been prepared that addresses the requirements for Special Fire Protection Purpose development as detailed in Planning for Bush Fire Protection (RFS 2006; RFS 2018). | Stage 2 C & O | Management and Specialist consultant | Prevention of bush fires | A bushfire control plan will be developed and be adhered to |
| 40 | All areas | If smoking is permitted on the Site, designated smoking areas will be established and suitable receptacles will be provided for cigarette butts. | All times | Management and all contractors | Prevention of bush fires | Designated smoking areas and receptacles will be established and adhered to by all Site personnel |
| Vertebrate Pest Management | | | | | | |
| 41 | All areas | In the event pest species increase in population, spread in area or a new pest species is introduced to Site, corrective actions will be implemented during construction and operations phases to rectify any potential or actual environmental harm. | Stage 2 C & O | Environmental manager/adviso r and contractors | Conservatio n of native species | Corrective actions implemented to rectify any potential or actual environmental harm |
| 42 | Main building/ within Project footprint | To protect MRS populations, a target-specific Black rat *Rattus rattus* control program will be implemented. In order to avoid impact on non-target native species, | Stage 2 C & O | Management and contractors | Conservatio n of the | Target-specific pest control inspections and Black rat |

| Item | Management Zone | Activity Description | Project Phase[1] | Responsibility | Outcome | Performance/ Trigger Criteria |
|---|---|---|---|---|---|---|
| | | control measures are to be undertaken around the ancillary facilities and not within native animal habitat (i.e. MZs 1.1 to 7). | | | MRS population | *Rattus rattus* control program implemented |
| Aquatic Fauna Protection | | | | | | |
| 43 | Sediment basins | To avoid any potential changes in pH and impacts on threatened aquatic species (i.e. Wallum froglet and Olongburra frog) 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 (i.e. Turbiclear). | Stage 2 C | Management and contractors | Threatened aquatic species conservation | No change to pH in receiving environment waters<br>pH meets water quality criteria outlined in the WQMP, **Section 4.4.4** |
| 44 | Sediment basins and receiving environment | Physico-chemical parameters including pH will be monitored in water discharged from sediment basins or bio-detention basins and in the downstream wetland environment to protect aquatic wetland fauna. | Stage 2 C & O | Management and contractors | Threatened aquatic species conservation | No change to pH in receiving environment waters<br>pH meets water quality criteria outlined in the WQMP, **Section 4.4.4** |
| 45 | All areas | The impact of erosion and sedimentation on terrestrial and aquatic flora and fauna during construction will be managed in accordance with an erosion and sediment control plan (ESCP).<br>An erosion assessment will be conducted on these areas by a CPESC during the planning phase of the ESCP development. | Stage 2 C | Management and all contractors | Mitigating impacts of erosion and sedimentation on terrestrial and aquatic flora and fauna during construction | Performance criteria as per the approved ESCP |
| Fauna Movement and Habitat Protection/Generation | | | | | | |
| 46 | All areas | Temporary boundary fencing has been installed with a 'post and bridge' system at least every 50 m. Tree Protection Zones (TPZ) will be installed around all native vegetation to be retained adjacent to the construction | Stage 2 C | Management and contractors | Habitat connectivity / facilitating movement | Temporary fencing installed with features allowing movement of threatened species |

| Item | Management Zone | Activity Description | Project Phase[1] | Responsibility | Outcome | Performance/ Trigger Criteria |
|---|---|---|---|---|---|---|
| | | footprint. This fencing will be removed at the conclusion of the construction phase of the development. | | | of threatened species | |
| 47 | Vegetated buffer MZs 6 and 7 | Habitat connectivity will be maintained across the Site by vegetation management measures as outlined in the VMP (**Section 2.3**). Importantly, to facilitate the movement of fauna, vegetated buffer zones will connect to the retained Subtropical Rainforest vegetation in the northern portion of the site, and will run north to south, in line with the mapped regional fauna corridor. | Stage 2 C & O | Management and vegetation clearing contractors | Habitat connectivity / facilitating movement of threatened species | Maximum 5% weed cover following weed control activities<br>Clearing of vegetation is only conducted within the surveyed clearing area |
| 48 | All landscaped areas | Where possible, landscaping will include habitat features such as rocks that have been salvaged from other areas of the Site (cleared windrows) that will create habitat for ground dwelling species. | Stage 2 C | Management, Landscape designers and bush regeneration contractors | Conserve and enhance habitat quality | Habitat features such as salvaged rocks included in Landscaping |
| Weed and Pest Management | | | | | | |
| 49 | All areas with trees and native vegetation | The introduction of pest species or disease onto native vegetation areas on the Site will be mitigated by installing an environmental protection area (or TPZ) to protect retained vegetation on the Site during construction. | Stage 2 C | Management, bush regeneration contractors and all Site personnel | Prevent introduction of pest species or disease | Environmental protection area exclusion zone adhered to |
| 50 | 1.1 and 1.2 | The introduction of pest species or disease onto the Site will be mitigated by restricting public access in areas of conservation value (in particular MZs 1.1 and 1.2) throughout operation of the Project. | Stage 2 C & O | Management | Prevent introduction of pest species or disease | Maximum 5% weed cover following weed control activities<br>Environmental protection area access restrictions adhered to |
| Fauna-related Interactions and Incidents | | | | | | |
| 51 | All areas | Documentation of all native fauna injuries and deaths will be recorded in incident registers to monitor species | Stage 2 C & O | Environmental manager/adviso | All native fauna | Statistically significant increases in frequency or |

| Item | Management Zone | Activity Description | Project Phase[1] | Responsibility | Outcome | Performance/ Trigger Criteria |
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| | | mortality, including fauna mortality resulting from vehicle strikes and entanglement. | | r and all Site personnel | injuries and deaths will be recorded in incident registers | multiple fauna mortality/injury incidents will trigger investigation |
| 52 | All areas | Should increases or multiple fauna mortality/injury incidents occur, it will trigger investigation and where practical adaptive management actions implemented. | Stage 2 C & O | Environmental manager/adviso r | Reducing impacts on native fauna | Statistically significant increases in frequency or multiple fauna mortality/injury incidents will trigger investigation |
| 53 | All areas | To minimise interactions with fauna, Site Management will enforce the following policies on the Site:<br>• Catching or feeding of native or feral animals on Site is prohibited.<br>• Site personnel will be prohibited from harming or intentionally killing any wildlife<br>• No pets are permitted in areas of environmental conservation on the Site<br>• Discarding food wastes on the Site is strictly prohibited. | Stage 2 C & O | Management, all Site personnel and general public | Nil impacts on native fauna | Adherence to policies |
| 54 | Project footprint | Excavations will exclude fauna entry or allow for fauna egress. Where it is not practical to provide fauna egress, daily checks will be undertaken before work commences. | Stage 2 C | Management and construction/ earthworks contractors | Nil impacts on native fauna | Excavation exclusion/egress measures undertaken, recorded and checked by Site supervisor<br>Adherence to fauna management policies |
| 55 | Project footprint | All excavations left open overnight will be inspected each morning. | Stage 2 C | Management and construction/ earthworks contractors | Nil impacts on native fauna | Daily checks undertaken, recorded and checked by Site supervisor<br>Adherence to fauna management policies |

| Item | Management Zone | Activity Description | Project Phase[1] | Responsibility | Outcome | Performance/ Trigger Criteria |
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| 56 | All areas | Uninjured trapped fauna will be released to a predetermined nearby area of suitable habitat away from the Site by a suitably qualified and wildlife handler. | Stage 2 C | Management, all Site personnel and suitably qualified and wildlife handler | Nil impacts on native fauna | Adherence to fauna management policies |
| 57 | All areas | Injured native animals will be collected and taken to nearby veterinary facilities for treatment, as required. | Stage 2 C & O | Management, all Site personnel and suitably qualified and wildlife handler | Nil impacts on native fauna | Adherence to fauna management policies |
| 58 | All areas | Personnel will record fauna sightings/encounters during construction activities using a fauna register. | Stage 2 C & O | Management, all Site personnel and suitably qualified and wildlife handler | Nil impacts on native fauna | Adherence to fauna management policies |
| 59 | All areas | Dead native animals that are found on the Site will be recorded in a fauna incident register, reported, collected and disposed of appropriately so as not to attract predators or scavengers. | Stage 2 C & O | Management, all Site personnel and suitably qualified and wildlife handler | Nil impacts on native fauna | Adherence to fauna management policies |
| 60 | All areas | Site inductions will include but are not limited to the following specific components for flora and fauna management:<br>• The flora, fauna and ecological values within and in the vicinity of the Site, and the Project commitments how flora and fauna are protected during construction or operation works | Stage 2 C | Environmental manager/advisor, all Site personnel | Site personnel aware of specific components for flora and fauna management | Adherence to fauna management policies |

| Item | Management Zone | Activity Description | Project Phase[1] | Responsibility | Outcome | Performance/ Trigger Criteria |
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| | | • the procedures in the event that fauna are encountered within the Site<br>• the requirement that all clearing/earthworks/construction activities are to be confined within the Site boundary | | | | |
| 61 | All areas | The following measures will be included to prevent fauna being attracted to Site:<br>• The "eliminate, reduce, re-use, recycle" disposal waste management principles will be applied<br>• Limit the amount of rubbish and waste onsite through good housekeeping practices<br>• Food waste will be disposed of at a designated facility<br>• Putrescible wastes will be stored in secure bins with lids or transported offsite daily for disposal | Stage 2 C & O | Management, all Site personnel | Site personnel aware of waste management policies | Adherence to waste management policies |
| 62 | Project footprint | A suitably qualified and experienced fauna rescue person shall be present to supervise the clearing activities and the Fauna Management Procedure for Clearing native vegetation and rocks will be adhered to. | Stage 2 C – clearing | Management and suitably qualified wildlife rescuer | Protection of native fauna | Adherence to Fauna Management Procedure for Construction- Clearing (**Section 3.7**) |
| 63 | Project footprint within a range of 30 metres from any tree which is occupied by a koala | If koalas *Phascolarctos cinereus* are found on the Site during vegetation clearing works and/or earthworks:<br>• All construction clearing/ earthwork activities must be temporarily suspended within a range of 30 metres from any tree which is occupied by a koala.<br>• Works are to be avoided in any area between the koala and the nearest areas of habitat to allow the animal to move to adjacent undisturbed areas. | Stage 2 C –if required | Management and suitably qualified wildlife rescuer | Protection of native fauna | Adherence to Fauna Management Procedure for Construction- Clearing (**Section 3.7**) |

| Item | Management Zone | Activity Description | Project Phase[1] | Responsibility | Outcome | Performance/ Trigger Criteria |
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| | | • Works must not resume until the koala has moved from the tree of its own volition. | | | | |
| 64 | 1.6 and 1.1 | Weed control measures outlined in **Section 2.3.1** will improve the function of the wildlife fence along Turnock Street and provide better protection for risk of vehicle strike to fauna trying to cross Turnock Street. | Stage 2 C & O | Management and bush regeneration contractors | Protection of native fauna | Maximum 5% weed cover following weed control activities |
| 65 | All trafficked areas | A CTPMSP and supporting documentation will be produced as part of an approved CEMP and their prescriptions will be implemented. | Stage 2 C | Management and all Site personnel | Site personnel aware of traffic management policies | Adherence to traffic management policies |
| 66 | Project footprint | Traffic will be restricted to the southern portion of the Site where the project footprint is approximately 67 m from the intact remnant native vegetation. | Stage 2 C | Management and all Site personnel | Site personnel aware of traffic management policies | Adherence to traffic management policies |
| 67 | All trafficked areas | Construction traffic must maintain low vehicle speeds (up to 20km/hour) and operators shall take care and be aware of any wildlife that may be in the area. Should wildlife enter the construction footprint, a suitably qualified fauna handler should be notified and actions taken in accordance with the CEMP. | Stage 2 C | Management and all Site personnel | Site personnel aware of traffic management policies | Adherence to traffic management policies |
| 68 | All trafficked areas | Appropriate speed limits for both earthmoving equipment and light vehicles will be implemented, signposted and enforced on all roads throughout the Site to minimise the risk of fauna injury or mortality. | Stage 2 C | Management and all Site personnel | Site personnel aware of traffic management policies | Adherence to traffic management policies |

| Item | Management Zone | Activity Description | Project Phase[1] | Responsibility | Outcome | Performance/ Trigger Criteria |
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| 69 | Cudgen Road/Turnock Street access road | 'Koala crossing' advisory signage should be installed to establish a wildlife crossing to the north-east of the Site where the Turnock Street roadway passes through the remnant vegetation (MZ 1.6) between the two Turnock Street roundabouts. | Stage 2 C | Management | Protection of native fauna | Establish a wildlife crossing<br>Off Site traffic calming measures implemented along the access road |
| 70 | Project footprint/ Helicopter Landing Site (HLS) | Aviation operations for the development will be conducted in accordance with an approved Aviation Operations Manual. This manual will identify areas of wildlife hazards including bird and flying fox activity. The location of known flying fox camps will be included as either an 'avoid area' or a 'fly neighbourly' area. Recommendations will also be made to where possible avoid aviation activity during peak periods of flying fox activity (hours preceding dusk and dawn) and at peak birdstrike times. | Stage 2 O<br>Upon HLS commissioning | Management, Avipro and aviation crew | Protection of native fauna | When an aircraft experiences multiple wildlife strikes<br>When an aircraft experiences substantial damage following a wildlife strike<br>When wildlife are observed on or close to the HLS in size or in numbers that are capable of causing the events described above |
| 71 | All areas | Should any performance criteria occur, it will trigger investigation and adaptive management actions may be implemented such as auditory repellents, visual deterrents and physical barriers where birds, bats and other animals are an issue. | Stage 2 O | Management, Avipro and aviation crew | Protection of native fauna | Investigation and adaptive management actions upon performance criteria trigger |
| 72 | Project footprint | Light will be restricted to the Project footprint in the southern portion of the Site where the project footprint is at least 67 m from the remnant native vegetation. This provides a natural buffer zone to dissipate light spill impacts. | Stage 2 C & O | Management and all Site personnel | No disruption or dissipation of native fauna | Statistically significant increases in frequency or multiple fauna mortality/injury incidents will trigger investigation |
| 73 | Project footprint and all surrounding native vegetation | The impact of dust, air quality, vibration and light spill on surrounding flora and fauna will be managed in accordance with impact assessments, management plans and any prescriptions will be implemented as part of an approved CEMP as detailed in **Sections 3.9.1, 3.9.2** and **3.9.3.** | Stage 2 C & O | Management and construction contractor | No disruption or dissipation of native fauna | Statistically significant increases in frequency or multiple fauna mortality/injury incidents will trigger investigation |

| Item | Management Zone | Activity Description | Project Phase[1] | Responsibility | Outcome | Performance/ Trigger Criteria |
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| 74 | Project footprint and all surrounding native vegetation | Timing of construction activities to avoid night works, work within the approved construction hours as per **Section 3.9.1**.and direct lights away from remnant vegetation. | Stage 2 C | Management and construction contractor | No disruption or dissipation of native fauna | Statistically significant increases in frequency or multiple fauna mortality/injury incidents will trigger investigation |
| 75 | Project footprint and all surrounding native vegetation | Limit high-impact noise to daylight hours and work within the approved construction hours as per **Section 3.9.1**. | Stage 2 C | Management and construction contractor | No disruption or dissipation of native fauna | Statistically significant increases in frequency or multiple fauna mortality/injury incidents will trigger investigation |
| 76 | Project footprint and all surrounding habitat | Noise levels during operations would be delivered in accordance with an approved CNVMP that details safeguards and management measures in accordance with the relevant guidelines.<br>Noise and vibration monitors established in Stage 1 will be maintained throughout the duration of Stage 2 construction works. The sensors will trigger a warning (sent to the nominated recipient) when the maximum allowed levels are exceeded (LLB 2019). | Stage 2 C | Management and construction contractor | No disruption or dissipation of native fauna | Statistically significant increases in frequency or multiple fauna mortality/injury incidents will trigger investigation<br>Noise and vibration maximum allowed levels as per the CNVMP (LLB 2019). |
| 77 | Project footprint and all surrounding native vegetation | Air quality monitoring will be undertaken where required, as per project approval, and the effectiveness of management controls periodically reviewed. | Stage 2 C | Management and construction contractor | Avoid or minimise impact in native fauna habitat | Dust suppression managed in accordance with air quality management plans specifying guideline criteria and any prescriptions will be implemented |
| 78 | Project footprint | Dust suppression techniques will be applied where necessary to protect vegetation health. This may include spraying from water trucks, irrigation, or stabilisation and revegetation of cleared areas that are no longer needed as soon as practicable during construction. | Stage 2 C | Management and construction contractor | Avoid or minimise impact in native fauna habitat | Dust suppression managed in accordance with air quality management plans specifying guideline criteria and any |

| Item | Management Zone | Activity Description | Project Phase[1] | Responsibility | Outcome | Performance/ Trigger Criteria |
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| | | | | | | prescriptions will be implemented<br>Vegetation Management Criteria in **Section 2.4.4**. |
| 79 | Project footprint | For unpaved roads, the periodic application of water will be used for dust suppression, dependent up on weather conditions and traffic volumes. Additional measures for high-volume traffic areas, such as impermanent gravel cover, may also be required. For paved roads, the removal of accrued material from roadways will occur when possible. | Stage 2 C | Management and construction contractor | Avoid or minimise impact in native fauna habitat | Dust suppression managed in accordance with air quality management plans specifying guideline criteria and any prescriptions will be implemented<br>Vegetation Management Criteria in **Section 2.4.4**. |
| 80 | Project footprint | Maximum speed limits will be implemented during construction works to 20km/hr to limit dust generated on site. | Stage 2 C | Management and construction contractor | No native fauna vehicle strikes | Statistically significant increases in frequency or multiple fauna mortality/injury incidents will trigger investigation |
| 81 | Project footprint | On-site roads required for the operations phase will be sealed during the construction phase. | Stage 2 C | Management and construction contractor | Avoid or minimise impact in native fauna habitat | Dust suppression managed in accordance with air quality management plans specifying guideline criteria and any prescriptions will be implemented<br>Vegetation Management Criteria in **Section 2.4.4**. |
| 82 | Project footprint | Multiple handling of soil or rock materials will be minimised. | Stage 2 C | Management and construction contractor | Avoid or minimise impact in native fauna habitat | Dust suppression managed in accordance with air quality management plans specifying guideline criteria and any prescriptions will be implemented |

| Item | Management Zone | Activity Description | Project Phase[1] | Responsibility | Outcome | Performance/ Trigger Criteria |
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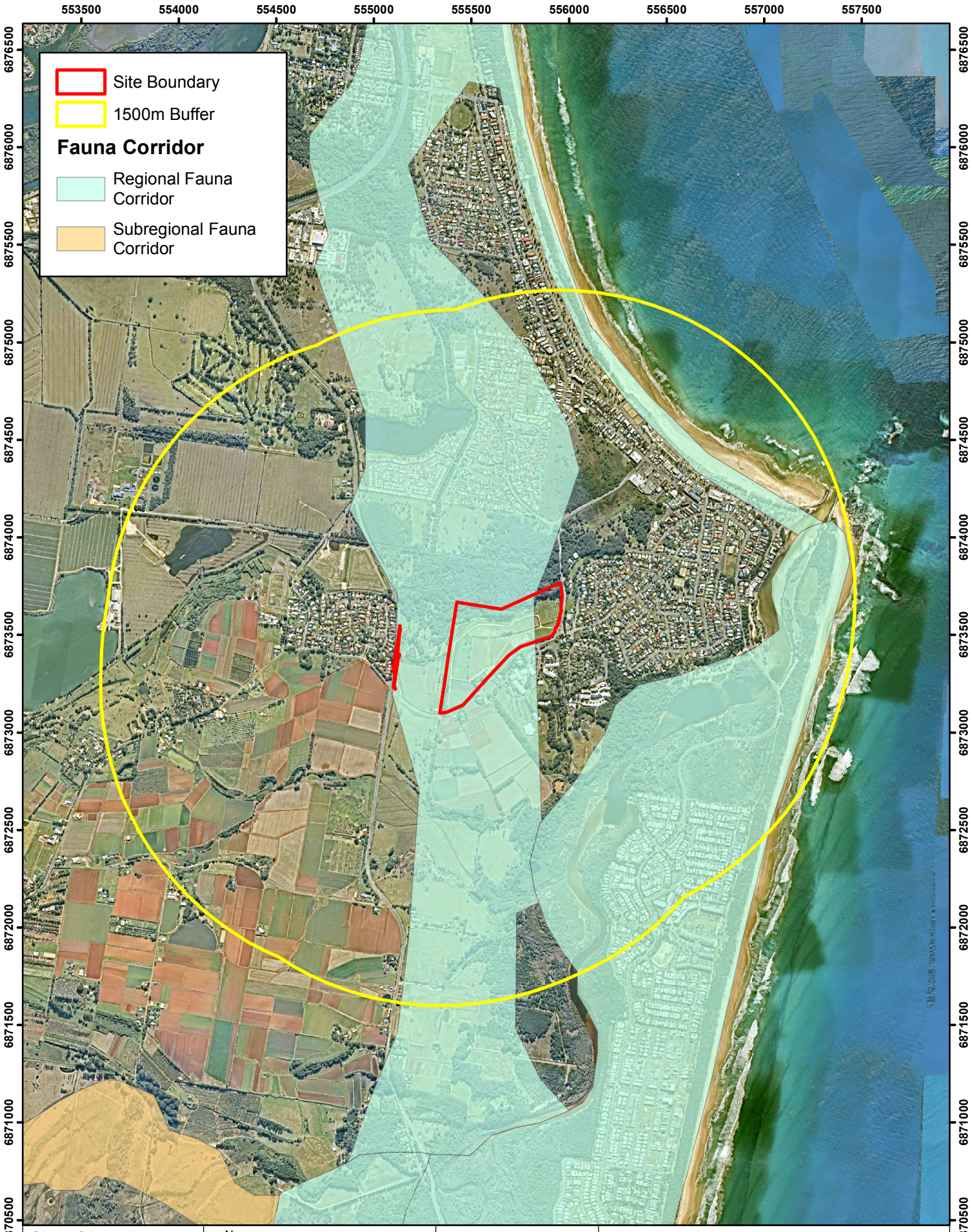
| 83 | Project footprint | Loads in all trucks transporting soil, aggregate or other dust-generating materials to and from the Project construction area will be wetted down to reduce dust. | Stage 2 C | Management and construction contractor | Avoid or minimise impact in native fauna habitat | Dust suppression managed in accordance with air quality management plans specifying guideline criteria and any prescriptions will be implemented |
| 84 | Project footprint | Planning of construction activities will consider dust management requirements where practicable. | Stage 2 C | Management and construction contractor | Avoid or minimise impact in native fauna habitat | Dust suppression managed in accordance with air quality management plans specifying guideline criteria and any prescriptions will be implemented |
| 85 | Project footprint | Dust suppression will be undertaken during and following vegetation clearing and earthwork activities. | Stage 2 C | Management and construction clearing contractor | Avoid or minimise impact in native fauna habitat | Dust suppression managed in accordance with air quality management plans specifying guideline criteria and any prescriptions will be implemented |
| 86 | All area | Should monitoring results indicate performance criteria non-compliance or potential impacts from Project activities which could results in an increasing in frequency of non-compliance events, management will undertake an investigation into addressing the issue and adaptive measures will be implemented to mitigate any impacts. | At all times | Management and consultants | Protecting fauna | Non-compliance to performance criteria in **Table 6** will trigger investigation and adaptive management measures will be implemented |

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

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| Client: C107778 | N 0 350 700 m | Scale (@A4): 1:25,000 | **Habitat Corridors – 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<br>771 Cudgen Road<br>Cudgen NSW | **Figure 9** |
| Date: 1/08/2019 | *Fauna corridors for NE NSW © Office of Environment and Heritage (OEH) 2010.* | | |
| GREENCAP | | | |



*Doc Path: R:_Projects\C107778_Health Infrastructure\J156455_Tweed Valley Hospital\3. Job Folder\GIS\J156455_13_TVHs2\BMPs2\mxd\J156455_13_BMPs2_F09_connectivity_location_190801.mxd*