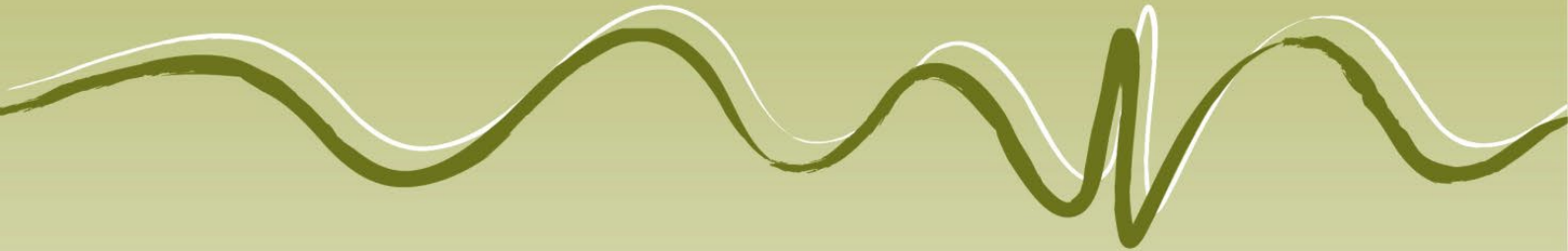


Vegetation Management Plan

Lot 46 DP751395 Miles Street Yamba



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Prepared for: Garrard Building Pty Ltd
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Appendix F Expert Advice on Rotala Impacts and Management



1. Site Description

1.1 Introduction and Background

GeoLINK has prepared this Vegetation Management Plan (VMP) on behalf of Garrard Building Pty Ltd with regard to the future subdivision and development of Lot 46 DP751395 Miles Street, Yamba in the Clarence Valley Local Government Area (LGA). The northern part of Lot 46 has consent from Clarence Valley Council (CVC) for filling works under DA2018/0553 as modified by MOD2019/0019 (granted 30 April 2019). Since that approval, a further application has been lodged for the filling of an additional 20,000m³ of land at the site, under DA2019/0492 (refer to plan at **Appendix A**). The DA2019/0492 application was approved 12 June 2020, with condition 7 stating:

A Controlled Activity Approval is to be obtained and provided to Council prior to any works commencing on-site under this approval.

The requirement for the preparation of a Controlled Activity Approval (CAA) under the *Water Management Act 2000* (WM Act) was provided to CVC by the Natural Resources Access Regulator (NRAR) in their General Terms of Approval (GTA), as advised by letter (11/05/2020). GTA condition GT005 specifically notes that the application for a controlled activity approval must include the following plan(s):

1. *Revised riparian plan detailing a Vegetated Riparian Zone for the full width of the required riparian corridors and offset areas.*
2. *Detailed civil and drainage construction plans.*
3. *Erosion and sediment control plans.*
4. *Vegetation Management Plan.*

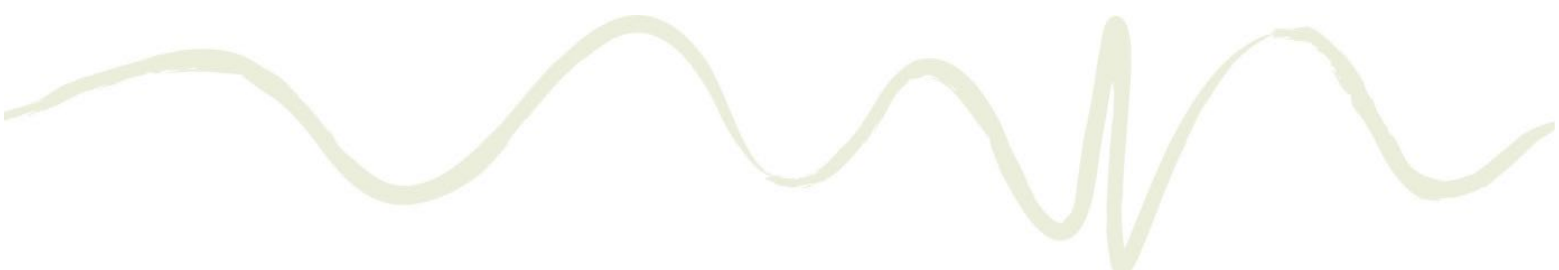
This VMP fulfills the requirements of items 1 and 4 of GT005 and has been prepared in accordance with guidelines prepared by NSW Office of Water (2012a). The GTA are attached at **Appendix B**.

1.2 Expert Review and Input

On request from CVC, the Biodiversity and Conservation Division (BCD) of the Biodiversity, Conservation and Science Directorate in the Environment and Heritage Group of the Department of Planning and Environment have provided advice/ comments on the Biodiversity Development Assessment Report (BDAR) and two VMPs prepared separately for retained land on Lot 46 and Lot 47. In relation to this VMP (for Lot 46) they have provided the following comment:

4. *The Vegetation Management Plan (VMP) for Lot 46 should be revised to include management of all known and potential *Rotala* habitat.*
5. *The VMPs for both Lots 46 and 47 are prepared by an expert in wetland botany and ecology to ensure the most appropriate methods for management of the *Rotala* habitat are incorporated into the VMPs.*

Point 4 above has been incorporated into this VMP by extending management zone 2 to capture all of the retained area in the south west corner of the site.



In order to address point 5 the proponent engaged Dr Andrew Benwell (ecologist/ botanist) who has experience in providing advice/ managing numerous threatened flora species including *Rotala*. Dr Benwell's report is included as **Appendix F** with recommended management actions for *Rotala* incorporated into this VMP.

1.3 Site Description

The site consists of Lot 46 DP751395 Miles Street Yamba and occurs within an area of agricultural land west of Yamba township (refer to **Illustration 1.1**). The site (~ 21 ha) comprises land which has been historically cleared and modified (refer to **Illustration 1.2**). The site is currently grazed by cattle and has been under this management regime for many years. The majority of the site comprises improved pasture, with several scattered patches of native vegetation occurring. The northern portion of the site comprises consolidated fill as permitted under DA2018/0553; all vegetation has been removed within this area. No infrastructure occurs.

A narrow, forked drainage line occurs in the west of the site and appears to receive surface flows funnelled down the eastern side of Carrs Drive (refer to **Illustration 1.2**). One branch of the drainage line flows into a small wetland within an isolated patch of swamp sclerophyll forest before draining surface flow into adjacent land to the south (second order stream). A minor watercourse (first order stream) branches off the east and terminates within the site.

Whilst estuarine systems occur in the immediate locality, no estuarine waters enter the site.

1.4 The Proposal

The proposal is for the further filling of the site (20,000m³), consistent with that completed under DA2018/0553. In the longer term, subdivision for residential development is proposed at the site. GeoLINK completed a *Biodiversity Development Assessment Report* (BDAR) to support a Statement of Environmental Effects (SEE) for the subdivision application, which was lodged with CVC under SUB 2019/0492.

Since lodgement of the DA, the subdivision concept has been revised and an amended application is in progress. The amended application will significantly differ from the previous concept by retaining the second order stream and associated vegetation in the south-west corner of the site. The minor branch watercourse (first order stream) will be filled and regrowth vegetation removed.

A draft concept plan is provided at **Appendix C**.

1.5 Biodiversity Values

The following biodiversity values were identified at the site as part of the BDAR prepared by GeoLINK (2019) to support SUB 2019/0492.

1.5.1 Vegetation

Three native vegetation communities occur at the site (refer to **Table 1.1**) in varying states of disturbance. The balance of the site either comprises fill (north), or pasture (south). Native vegetation at the site is depicted at **Illustration 1.3**. Areas of woody native vegetation are generally in good condition with low levels of woody weeds (minor Winter Senna, Lantana, Camphor Laurel) and few

introduced vines or herbs. Lippia (*Phyla nodiflora*) occurs in some parts of paperbark swamp forest (PCT 1064) and sedgeland areas (PCT 780). The introduced herb Cuphea (*Cuphea carthagenensis*) is common within parts of PCT 780.

Sedgeland areas (PCT 780) are highly disturbed from grazing stock and previous landuse (slashing) and host pasture grasses and the introduced herb Cuphea (*Cuphea carthagenensis*) at low densities. Sedgeland areas show high resilience and would be expected to regenerate with ease once cattle are removed from the site. High levels of resilience have been noted within similar areas of sedgeland within adjacent Lot 47.

Table 1.1 Native Vegetation Communities

Plant Community Type	Comments	Area (ha)
<p>PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion</p> <p>Dominated by Broad-leaved Paperbark (<i>Melaleuca quinquenervia</i>) with occasional Swamp Oak (<i>Casuarina glauca</i>). Midstorey sparse. Groundcover of patchy Bare Twigrush (<i>Baume juncea</i>). An open wetland area is dominated by Spike-rush (<i>Eleocharis acuta</i>) and Water Spinach (<i>Enydra woollsi</i>).</p>	Good condition – some cattle disturbance.	0.975
<p>PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion (derived)</p> <p>Dominated by Swamp Oak, with infrequent Broad-leaved Paperbark. Midstorey absent. Groundcover of Couch (<i>Cynodon dactylon</i>) and bare Twigrush. Central drain contains a low incidence of mixed aquatic species: <i>Baumea articulata</i>, <i>Eleocharis acuta</i>, <i>Ludwigia peploides</i> <i>Philydrum lanuginosum</i>, <i>Cycnogeton procerum</i>, <i>Schoneplectiella mucronata</i>.</p>	Narrow linear regrowth along drainage line. High edge to core ratio, low species diversity.	0.292
<p>PCT 780: Coastal floodplain sedgelands, rushlands, and forblands of the North Coast (derived)</p> <p>Disturbed ephemeral wetland (slashed, grazed). Trees and shrubs absent. Typical species: <i>Baumea articulata</i>, <i>Eleocharis acuta</i>, <i>Persicaria strigosa</i>, <i>Philydrum lanuginosum</i>, <i>Ludwigia peploides</i>, <i>Bacopa monnieri</i>. Cuphea* (<i>Cuphea carthagenensis</i>) is a common weed species.</p>	Small disjunct disturbed patches associated with drainage areas. Scattered regeneration of Swamp Oak < 1m height.	0.564
*Introduced species		

Table 1.1 Native Vegetation Communities

Plant Community Type	Comments	Area (ha)
<p>PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion</p> <p>Dominated by Broad-leaved Paperbark (<i>Melaleuca quinquenervia</i>) with occasional Swamp Oak (<i>Casuarina glauca</i>). Midstorey sparse. Groundcover of patchy Bare Twigrush (<i>Baume juncea</i>). An open wetland area is dominated by Spike-rush (<i>Eleocharis acuta</i>) and Water Spinach (<i>Enydra woollsi</i>).</p>	Good condition – some cattle disturbance.	0.975
<p>PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion (derived)</p> <p>Dominated by Swamp Oak, with infrequent Broad-leaved Paperbark. Midstorey absent. Groundcover of Couch (<i>Cynodon dactylon</i>) and bare Twigrush. Central drain contains a low incidence of mixed aquatic species: <i>Baumea articulata</i>, <i>Eleocharis acuta</i>, <i>Ludwigia peploides</i> <i>Philydrum lanuginosum</i>, <i>Cycnogeton procerum</i>, <i>Schoneplectiella mucronata</i>.</p>	Narrow linear regrowth along drainage line. High edge to core ratio, low species diversity.	0.292

Plant Community Type	Comments	Area (ha)
<p>PCT 780: Coastal floodplain sedgelands, rushlands, and forblands of the North Coast (derived)</p> <p>Disturbed ephemeral wetland (slashed, grazed). Trees and shrubs absent. Typical species: <i>Baumea articulata</i>, <i>Eleocharis acuta</i>, <i>Persicaria strigosa</i>, <i>Philydrum lanuginosum</i>, <i>Ludwigia peploides</i>, <i>Bacopa monnieri</i>. <i>Cuphea</i>* (<i>Cuphea carthagenensis</i>) is a common weed species.</p>	Small disjunct disturbed patches associated with drainage areas. Scattered regeneration of Swamp Oak < 1m height.	0.564
*Introduced species	Total	1.831

1.5.2 Threatened Flora

The following two threatened flora species have been identified on the site (Lots 46 and 47):

Rotala (Rotala tripartita)

A single individual of *Rotala tripartita* was recorded in the west of the site in association with disturbed sedgeland in November 2018. A subsequent target survey for the species was undertaken in February 2021 which recorded additional plants in the southwest corner of the site. *Rotala* was recorded extensively in Lot 47 where wetland communities are extensive and moist boggy areas with surface water and a high table water were present. Numerous seedlings were observed growing within tractor wheel ruts at some locations, while other plants also occurred in association with the margins of Broad-leaved Paperbark swamp forest. The concentrated population within the north-east of Lot 47 is extensive and significant in a local context.

Records of *Rotala* occurring on the site and a species polygon drawn in accordance with the Biodiversity Assessment Method (BAM) requirements are shown in **Illustration 1.4**.

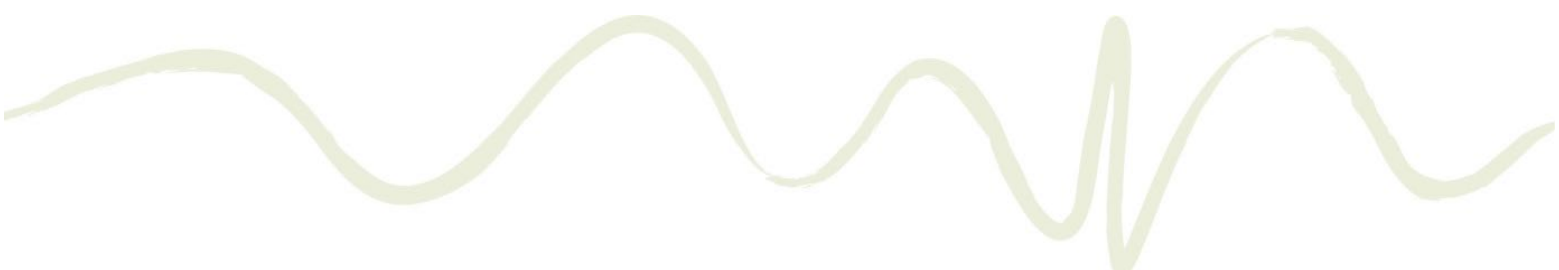
Spider Orchid (Dendrobium tetragonaum var. melaleucaphilum)

Initial surveys on Lot 47 identified a population of Spider Orchids growing on Prickly-leaved Tea Trees (*Melaleuca stypheloides*) within Paperbark forest associated with PCT 1064. Despite extensive survey effort, no Spider Orchids were detected on Lot 46. Records of Spider Orchid occurring on the site and a species polygon drawn in accordance with the Biodiversity Assessment Method (BAM) requirements are shown in **Illustration 1.4**.

1.5.3 Threatened Ecological Communities

Native vegetation at the site is floristically characteristic of four threatened ecological communities (TECs) associated with alluvial floodplains listed in the BC Act:

- Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion (floristically analogous with PCT 837).
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South-East Corner Bioregions (floristically analogous with PCT 1064).
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South-East Corner Bioregions (floristically analogous with PCT 1235).
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-East Corner Bioregions (floristically analogous with PCT 780).



While Swamp Oak forest is also listed in the EPBC Act (as the TEC *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland*) it is subject to condition thresholds, where a minimum patch size of 0.5 ha applies. The small patch of Swamp Oak at the site is <0.5 ha and hence does not meet condition thresholds as per the EPBC Act listed community.

1.5.4 Threatened Fauna

No threatened fauna were recorded as part of the BDAR. While Eastern Osprey have historically nested at the site, the tree which hosted the old nest has been removed as part of approved clearing under DA2018/0553. Due to the disturbed nature of the site and the paucity of habitat, the site does not provide suitable habitat for any resident threatened fauna.



0 1 Km



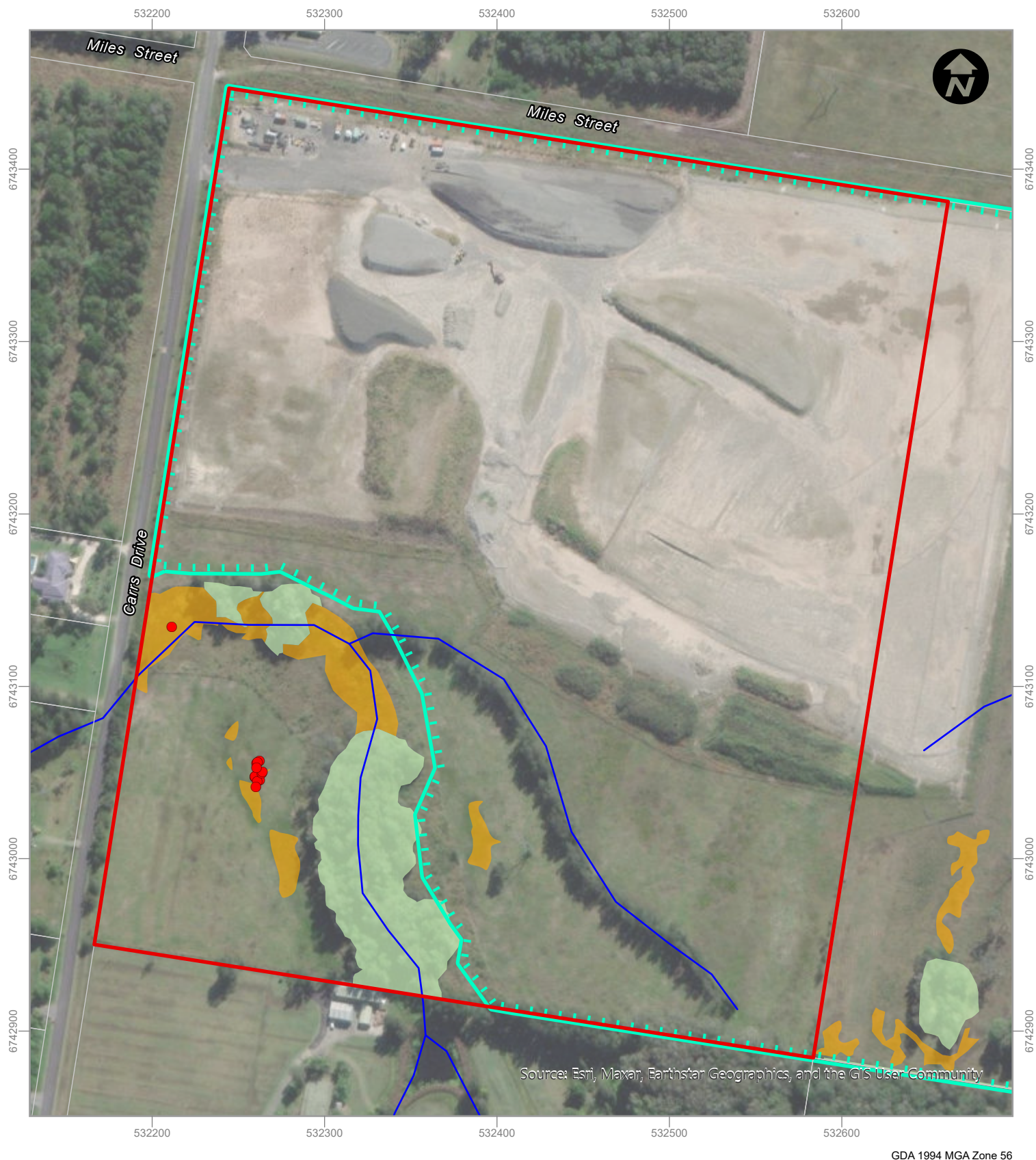
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

GDA 1994 MGA Zone 56

LEGEND

- The site
- Cadastre
- Watercourse

0 60 Metres

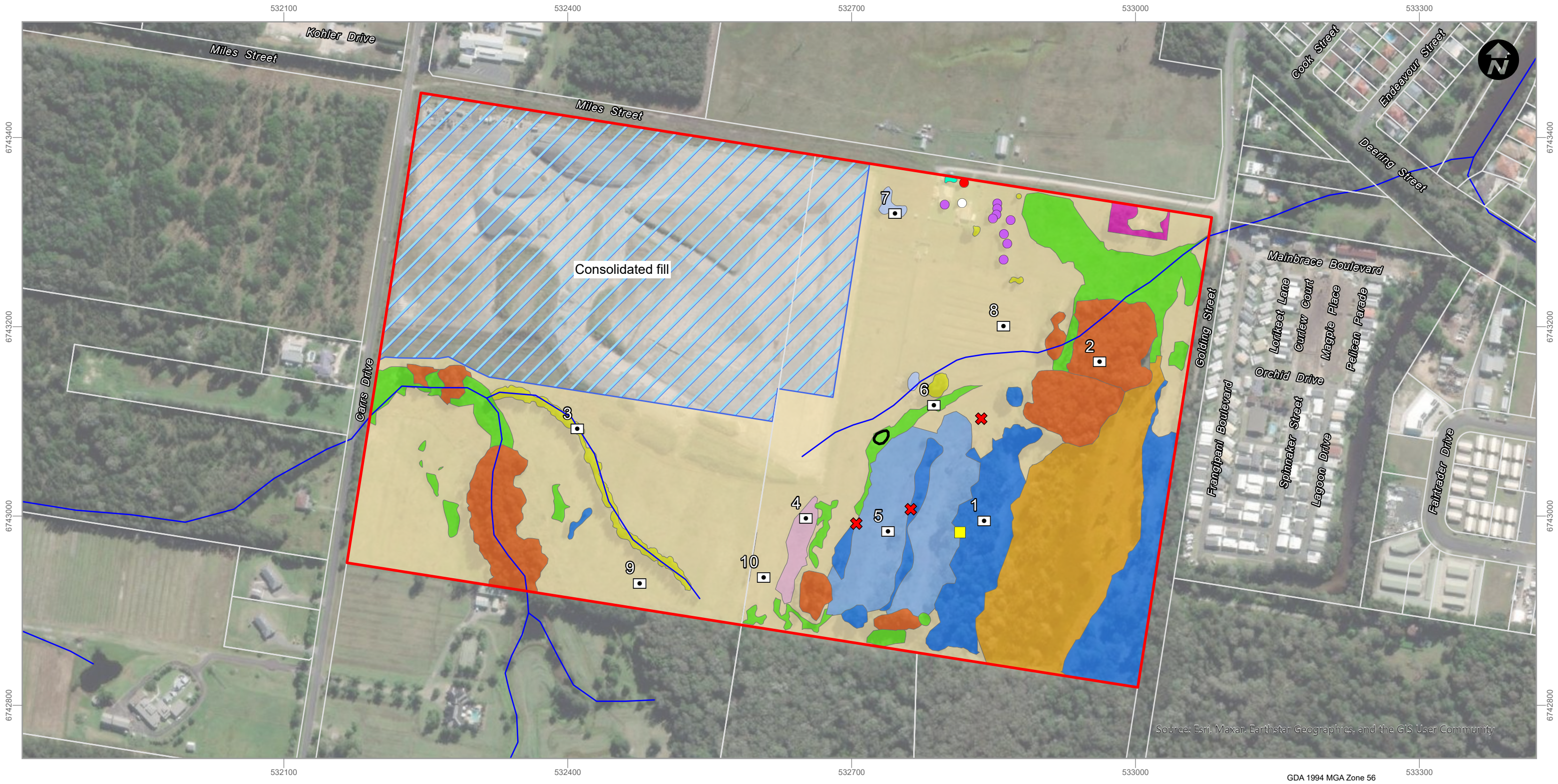


LEGEND

- | | | |
|---|--|---|
| The site | Spider Orchid species polygon | ● <i>Rotala tripartita</i> |
| Cadastre | <i>Rotala tripartita</i> species polygon | |
| Development area | — Watercourse | |

0 60 Metres

Threatened Flora - Illustration 1.4



LEGEND

- The site
- Cadastre
- Consolidated fill - all vegetation removed
- Dam
- Watercourse

- Non-native vegetation (landscaping)
- PCT 837: Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion (Zone 1)
- PCT 837: Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion (Zone 2)
- PCT 837: Forest Red Gum – Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion (Zone 3)
- PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Zone 1)
- PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Zone 2)
- PCT 1064: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Zone 3)
- PCT 1227 Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Zone 1)
- PCT 1227 Swamp Box swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Zone 2)
- PCT 1235: Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
- PCT 780: Coastal floodplain sedgelands, rushlands, and forblands of the North Coast

- Non-native Tree (Mango)
- Planted Native Vegetation (Flame Tree)
- Planted Native Vegetation (Plum Pine)
- Raptor nest
- ✕ Stag (no hollows)
- Vegetation plot





2. Statutory Matters

This VMP is required under consent conditions relating to DA2019/0492. The SEE for the DA has addressed relevant environmental legislation including:

- *Environmental Planning and Assessment Act 1979* (EP&A Act).
- *Biodiversity Conservation Act 2016* (BC Act).
- State Environmental Planning Policy (SEPP) 44 – Koala Habitat Protection¹.
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The works prescribed in this VMP fulfil the requirements of a controlled activity approval, as directed by the GTA and in accordance with guidelines issued by NSW Office of Water (2012a, 2012b).

¹ Since repealed and replaced by SEPP (Koala Habitat Protection) 2019.



3. Aims, Objectives and Performance Criteria

3.1 Aims and Objectives

The aim of this VMP is to prescribe a range of vegetation restoration measures to comply with CAA requirements and hence:

- Protect and manage retained vegetation and threatened flora habitat.
- Control weeds within areas of retained vegetation and threatened species habitat.
- Enhance and expand riparian zones by infill planting.
- Ensure environmental conditions are maintained to not impact the threatened flora species (*Rotala tripartita*) that has been recorded within the area subject to the VMP.

3.2 Performance Criteria

The following performance criteria are proposed to address the above aims/ objectives:

1. Weeds are continually reduced and suppressed at the site.
2. Healthy populations of the threatened species, *Rotala* are maintained on the site.
3. To determine whether restoration measures have been successful and result in desired outcomes (as above), performance criteria have been nominated. The *Guidelines for vegetation management plans on waterfront land* (NSW Office of Water 2012a) state that a minimum 80% survival rate for all plantings should be achieved, with a maximum 5% weed cover; these criteria have been adopted for this plan.

A monitoring program would be implemented to measure the above performance criteria and the success of these in achieving the aims of this VMP.



4. Project Work Plan, Schedule and Budget

4.1 Introduction

As noted, this VMP seeks to protect and restore the second order stream. No works are proposed for the minor branch that comprises the first order stream as this will be removed as part of a future development application to Council. The removal of the first order stream has been supported by NRAR (Gina Potter; email of 22/06/2018) and Clarence Valley Council as part of the future development of the site.

NSW Office of Water guidelines (2012b) require a Vegetated Riparian Zone (VRZ) of 20 metres for second order streams on either side of the watercourse. As per the averaging rule (NSW Office of Water 2012b), rather than provide a VRZ of an equal 20 metres on either side of the watercourse, the VRZ will be averaged to account for approved filling within 10 m of the watercourse in the north only. In this section a 10m VRZ will apply on the northern side of the watercourse and a 30 m VRZ on the southern side, to achieve a total VRZ width of 40 metres (refer **Appendix D**). For the balance of the VRZ, a standard width of 20 metres either side applies. A rationale for the VRZ is provided in the notes on the VRZ plan at **Appendix D**.

The proposed VRZ is based on survey of the top of bank of either side of the watercourse in accordance with NSW Office of Water guidelines (2012b).

Parts of the proposed VRZ (refer **Appendix D**) are already established with native vegetation (typically Broad-leaved Paperbark *Melaleuca quinquenervia* or Swamp Oak *Casuarina glauca*). Outside of these areas, where pasture already occurs, additional plantings of woody vegetation will be completed. Existing areas of sedgeland (refer Vegetation Plan at **Illustration 1.3**) will be retained and assisted regeneration and establishment will be achieved by cattle exclusion and weed management. The outer boundary of the entire VRZ will be protected from grazing stock by installation of stock fencing so the VRZ cannot be browsed, trampled or degraded.

In relation to *Rotala* habitat at the site, expert advice on management of the species has been provided by Dr Andrew Benwell (refer to **Appendix F**). Proposed management includes suitable habitat being managed by a combination of tractor slashing and periodic low intensity burning.

4.2 Management Zones

4.2.1 Introduction

Three Management Zones have been nominated for restoration actions (refer to **Table 4.1** and **Illustration 4.1**). Management Zones have largely been determined based on species composition (PCTs) and land condition.

Prescriptions for all weed control and planting requirements (including planting schedules) are provided at Appendix E. These prescriptions shall inform all vegetation restoration and weed control works at the site.

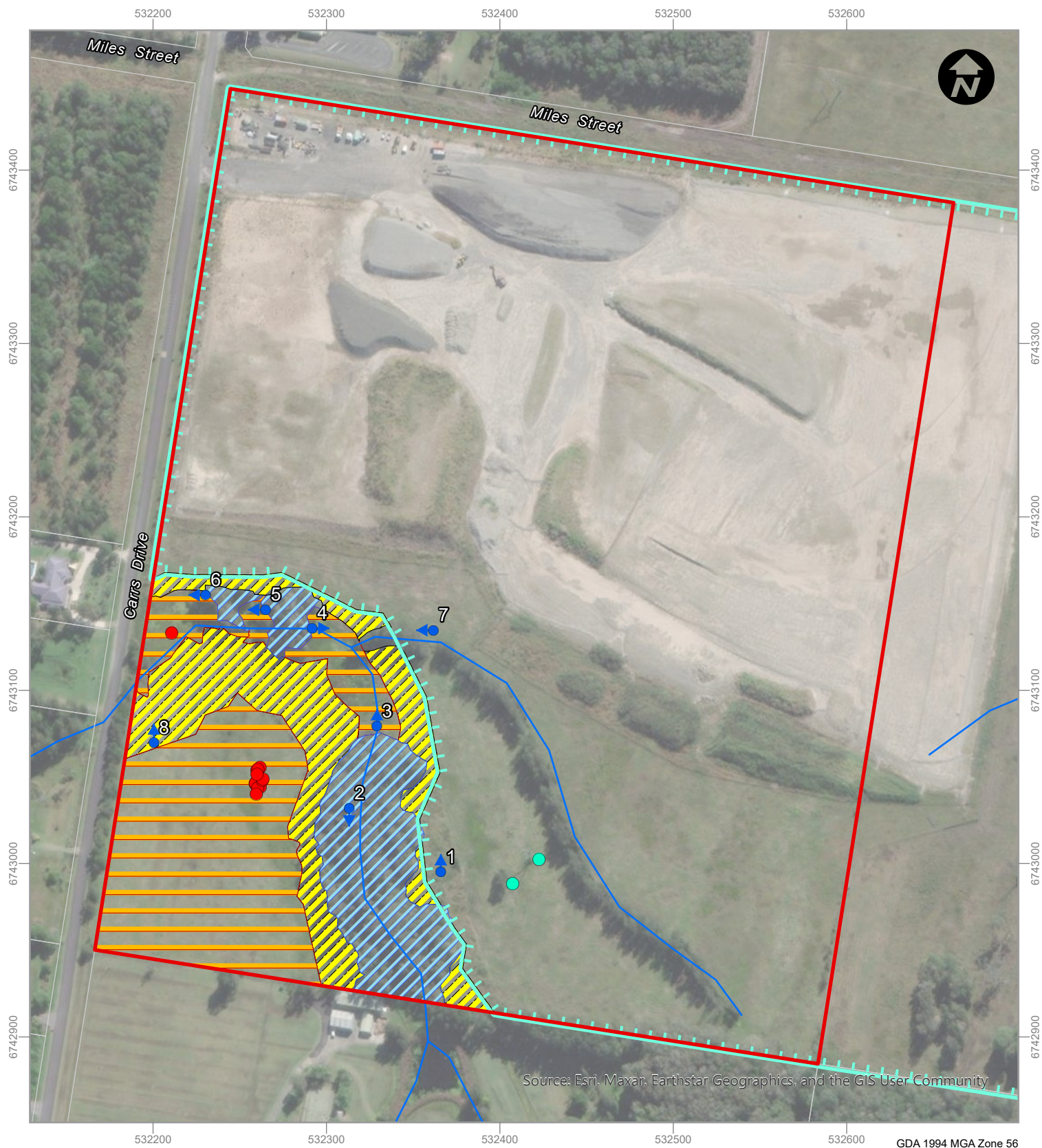
Table 4.1 VMP Management Zones

Zone	Management Zone	Management Zone Description
1	Paperbark and Swamp Oak zone (PCT1064 and PCT1235)	Existing patches of paperbark and swamp oak swamp forest where weed control will be completed.
2	Sedgeland (PCT780) and cleared pasture land	Existing degraded sedgeland and pasture land would be managed by a combination of tractor slashing and periodic low intensity burning to promote suitable conditions for this species.
3	Planting zone	Grazing land with little native vegetation to be planted as VRZ.

The following sections discuss the actions required to complete vegetation restoration within each Management Zone from site preparation and weed control to planting and aftercare (where relevant).

As noted in the VMP prescriptions (refer to **Appendix E**), prior to weed control or planting works, a registered surveyor must identify and clearly peg/ mark the VRZ boundaries consistent with those depicted at **Appendix D**. No planting should commence until cattle are excluded from the site by either fencing or appropriate land management measures (eg. all cattle are restricted to adjacent Lot 47 only).

Photographs have been taken within each Management Zone (refer to **Illustration 4.1** for photo points and **Plate 4.1** to **Plate 4.8**).



LEGEND

- | | | |
|---|---|--|
| The site | Vegetation management zone 1 | — Watercourse |
| Cadastre | Vegetation management zone 2 | ● Rotala tripartita (recorded 30/10/2018) |
| Development area | Vegetation management zone 3 | ● Forest Red Gum |
| | | ● Photo point |
| | | → Photo direction |

0 60 Metres

Vegetation Management Zones - Illustration 4.1



Plate 4.1 Photo point 1 looking north to pasture and Swamp Oak flanking the first order stream



Plate 4.2 Photo point 2 looking south to wetland basin within swamp paperbark forest (PCT 1064)



Plate 4.3 Photo point 3 looking north to regenerating sedgeland (PCT 780) within vegetation gap



Plate 4.4 *Photo point 4 looking east across regenerating sedgeland (PCT 780) to Swamp Oak (PCT 1235) on first order stream*



Plate 4.5 *Photo point 5 looking west across regenerating sedgeland (PCT 780) to patch of swamp paperbark forest (PCT 1064)*



Plate 4.6 *Photo point 6 looking west across regenerating sedgeland (PCT 780) to Carrs Drive*



Plate 4.7 Photo point 7
looking west across edge of
PCT 1235 on north side of
watercourse; this area will be
planted out over a width of 10
metres



Plate 4.8 Photo point 8
looking north across pasture
to regenerating sedgeland
(PCT 780); areas of pasture will
be planted out over a width of
30 metres in this location

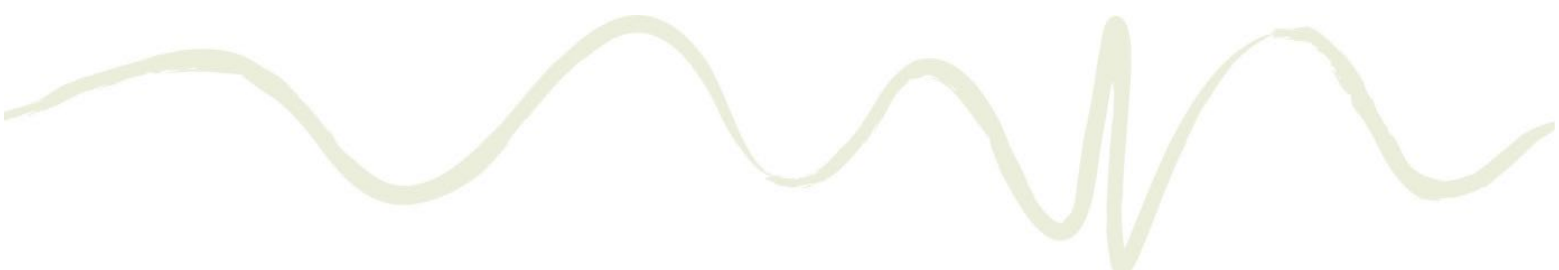
4.2.2 Management Zone 1

Management Zone 1 includes existing swamp sclerophyll forest dominated by Broad-leaved Paperbark and or Swamp Oak. Works within Management Zone 1 are limited to minor weed control (Camphor Laurel, Winter Senna). Infill planting of gaps between patches (from previous historical clearing) is not proposed as these are already well vegetated by macrophytes and will regenerate naturally.

Prescribed actions within Management Zone 1 are summarised at **Table 4.2**.

Table 4.2 Prescribed Actions - Management Zone 1

Action	Requirement	Timing	Responsibility
Weed control	Weed removal (Camphor Laurel, Winter Senna, Lippia, Cuphea); refer to prescriptions at Appendix E.	At any time following approval of the VMP	Appointed bush regenerator



Action	Requirement	Timing	Responsibility
Follow up weed control	Follow up weed control for three years following initial works.	Three years from plant establishment (refer to Maintenance Schedule at Section 4.4).	Appointed bush regenerator

4.2.3 Management Zone 2

Management Zone 2 includes all areas of sedgeland (PCT 780) and pastureland to be retained within Lot 46 with the exception of pasture land proposed for replanting which is designated as Management Zone 3. Management Zone 2 includes all retained areas of habitat for the threatened species, *Rotala* on Lot 46. The key management aim for Zone 2 is to ensure that a healthy population of *Rotala* is maintained on the site. Recommended management measures for *Rotala* are included in the expert report provided by Dr Andrew Benwell (refer to **Appendix F**). Recommended management measures for the species include:

- Low intensity fire with *Rotala* habitat to be burnt every 2-4 years in winter or early spring; and
- Tractor slashing of all *Rotala* habitat to be undertaken twice a year in autumn and spring. Summer slashing should be avoided to minimise disturbance to *Rotala* plants as they mature and produce seed. After a winter/ early spring burn, slashing would not be carried out before *Rotala* seedlings have set seed. Inspection of plants before slashing will be required in these instances.

A summary of all prescribed management actions for Management Zone 2 is provided below in **Table 4.3**.

Table 4.3 Prescribed Actions - Management Zone 2

Action	Requirement	Timing	Responsibility
Removal of cattle	Cattle grazing is to cease on the site.	Upon approval of DA/ VMP	Landowner
Slashing	*Tractor slashing would be undertaken of the entire management zone.	Twice annually in autumn and spring	Landowner
Low intensity fire	#Low intensity burns would be undertaken in all parts of the management zone	Every 2-4 years in winter or early spring	Landowner
Initial weed control	Foliar herbicide treatment of all weeds; refer to prescriptions at Appendix B.	Upon approval of DA/ VMP	Landowner
Ongoing weed control	Foliar herbicide treatment of all weeds; refer to prescriptions at Appendix B.	Twice annually (December, March)	Landowner

* Summer slashing should be avoided to minimise disturbance to *Rotala* plants as they mature and produce seed.
 # After a winter-early spring burn, slashing would not be carried out before *Rotala* seedlings have set seed. Check by inspecting plants before slashing.

4.2.4 Management Zone 3

Management Zone 3 comprises disturbed pasture adjacent to established native vegetation. Infrequent regeneration of Swamp Oak (and to a lesser extent Broad-leaved Paperbark) is present in some areas. While it is anticipated that over time, woody native regeneration will increase and

establish, these areas will be planted to accelerate the re-establishment of native vegetation in these disturbed areas. Management Zone 3 includes an additional area east of the southern patch of swamp forest (PCT 1064) to consolidate irregularities along the edge and provide additional buffering (refer red hatched area depicted at **Appendix D**).

Prescribed actions within Management Zone 3 are summarised at **Table 4.4**.

Table 4.4 Prescribed Actions - Management Zone 3

Action	Requirement	Timing	Responsibility
Weed control	Weed control (Groundsel, Lippia, Cuphea, pasture grasses) refer to prescriptions at Appendix E.	At any time following approval of the VMP	Appointed bush regenerator
Planting	Planting outer areas of the VRZ.	Following appropriate preparation.	Appointed bush regenerator
Follow up weed control/maintenance	Follow up weed control for three years following initial works. This is unlikely to require much effort following primary works and annual follow up is sufficient.	Three years from plant establishment (refer to Maintenance Schedule at Section 4.4).	Appointed bush regenerator

4.3 Work Plan Summary

Based on the actions prescribed in **Section 4.2**, a summary of all works within all Management Zones is provided at **Table 4.5**. Note that the ability to complete works may be impeded by various factors including delays in approvals, survey, fencing and inclement weather. As such, the timing of prioritised works in **Table 4.5** is a guide only.

Table 4.5 Summary of Works Schedule

Mgmt Zone	Retain Vegetation	Fencing	Slashing	Low intensity fire	Weeding	Planting
1	✓	✓			✓	
2	✓	✓	✓	✓	✓	
3		✓			✓	✓

4.4 Works Schedule

The works prescribed in this VMP may only commence following approval of this plan by NRAR/ Council.

Weed control and site preparation for supplementary plantings shall be implemented within 12 months following written approval of this VMP.

4.5 Maintenance Schedule

Maintenance of the plantings and environmental weed control is required for a period of three years following installation and/ or commencement. Maintenance requirements of plantings in Management Zone 3 will include:

- Watering (initial planting aftercare only)
- Weed control

- Re-mulching
- Plant replacement (if required).

Table 4.6 provides a summary of maintenance requirements for plantings within Management Zone 3.

Table 4.6 Summary of Maintenance Requirements – Management Zone 3

Requirement	Timing	Actions
Watering	Three weeks following initial establishment – watering for 3 consecutive days following planting, then once weekly for 3 weeks.	Watering: Total of 6 watering events
Mulching	At end of year 1	Mulching: 1 event only
Weed control	Year 1: at 3, 6, 9 and 12 months (quarterly) Year 2: at 16, 20 and 24 months (every 3 months) Year 3: at 28, 32 and 36 months (every 3 months)	Weed control: Total of 10 weed control events
Plant replacement	Assessed and completed at each weed control event.	Plant replacement (if required)

4.6 Budget

A cost estimate for the proposed works as has been prepared (refer to **Table 4.7**) based on the maintenance requirements in **Section 4.5** and the cost of plants as per the planting schedule at **Appendix E**. All costs will be borne by the proponent.

Labour for weed control, plant installation and maintenance tasks has been assumed at \$60/ hr (ex GST). Monitoring and reporting has been assumed at \$120/ hr (ex GST). Fencing costs are not included.

Note: the costs in Table 4.7 are an estimate only, however, may be used as a basis for determining the security bond for the works (if required). Costs for weed control are based on broad assumptions - control of Lippia and Cuphea can be difficult in the long term and several treatments may be required. A quote from a professional and experienced bush regenerator following assessment of the site is the best means of gauging potential weed control and maintenance costs.

Total costs for the works (excluding the omissions noted below) are estimated at approximately \$28,092 (ex GST).

Notes:

- Costings are inclusive of weed control, site preparation, the supply and installation of plants, mulch, tree guards and maintenance and monitoring over a three year period.
- Costings do not include fencing.
- Costings do not include the services of a registered surveyor.
- Costings do not account for the replacement of dead trees, as this is an unknown quantity.
- Costings do not account for tractor slashing/ periodic low intensity burns required for Rotala habitat in management zone 2.

Table 4.7 Estimated Costs for Vegetation Establishment, Maintenance and Monitoring

Treatment	Unit Cost	Total Cost	Notes
PRIMARY WEED CONTROL			
Weed control (woody weed control, foliar spray)	\$960/ day (2 persons)	\$960	Preliminary weed control (2 persons, est. 1 day)
Follow up weed control (foliar spray)	\$960/ day (2 persons)	\$960	One days follow up from preliminary works
PLANTING PREPARATION			
Mgmt. Zone 3 (initial)	\$960/ day (2 persons)	\$960	Foliar spray of introduced grasses and herbs (2 persons, est. 1 day)
PLANTING			
Trees x 1111 units	\$12 per plant (installed, mulched, fertilised and with tree guard)	\$13,332	Supplied & installed – 1111 trees
MAINTENANCE (PLANTINGS AND EXISTING VEGETATION)			
Watering (initial)	\$240 per event	\$1,440	Initial watering post planting over 4 weeks (1 person for 4 hrs) – 6 events)
Weed control	\$360 per treatment	\$3,600	3 years maintenance – total of 10 weed control events (est. 6 hrs/1 person per treatment)
Mulch replacement (one year after planting)	\$10/bale	\$1,860	186 bales required
Mulch replacement (labour)	\$1920/ day (2 persons)	\$1920	One event (4 people, 1 day)
MONITORING			
Monitoring and reporting	\$1,200/ event	\$4,800	3 years monitoring – total of 3 monitoring events and reports <u>plus</u> post planting assessment & brief email report
TOTAL		\$29,832 (ex GST)	



5. Monitoring and Reporting

5.1 Monitoring

5.1.1 General monitoring

Formal monitoring shall be undertaken in all three management zones and would require:

- Installation (and survey by GPS) of permanent photo points as shown in **Illustration 4.1**.
- Preparation of a brief summary report following completion of the plantings, including:
 - Notes on site preparation (including herbicide use).
 - The success of the planting (including photographs).
 - Details of any aftercare which have been completed.
- Inspection of plantings at 12 month intervals (ie. a total of three monitoring events), with tasks including:
 - Inspection of plants.
 - Assessment of weed cover.
 - Photographs from permanent photo points.
 - Assessment of mulch cover.
- Preparation of a brief annual report for a three year period with notes on:
 - Weed control requirements during the maintenance period.
 - Details of any plant loss and replacement.
 - Recommendations for any other additional works (eg. further weed control or supplementary planting).

It is preferable that all plantings are completed at the same time, both for efficiencies during the planting process, and so aftercare and monitoring are completed at the same intervals. Informal annual monitoring shall be completed for Management Zone 3 with regard to assessing sedgeland regeneration, and weed issues, a description and photographs (where relevant).

5.1.2 Threatened Flora Monitoring

Monitoring of the threatened species, *Rotala* would be undertaken annually for five years as described below.

5.1.2.1 *Rotala*

Monitoring for *Rotala* is to be undertaken in summer annually as this is the recorded flowering season for this species on the site. Two 100 m transects are to be established and monitored with the following recorded:

- Date.
- Photo of transect from start and end point.
- Presence/ absence of *Rotala* within twenty 5 m portions of the transect.
- General description of the health of any *Rotala* present.
- If present the general extent of *Rotala* is to be mapped by undertaking random meanders of habitat and taking GPS points to define the extents of its occurrence.



5.2 Reporting/ Analysis

Annual monitoring reports are to be completed and supplied to Council and shall include the following information:

- A timetable of works/ monitoring completed in that year for both management zones.
- Results of the monitoring completed with regard to performance criteria.
- Comments on any problems at the site and how these have been managed.
- Photographs from fixed photo points showing the progress of the plantings.
- A log of herbicide use during all maintenance operations.
- Any other relevant information or recommendations for future maintenance.

Where performance criteria have not been met, corrective actions must be provided. In the event that *Rotala* is not detected at the site after two years, the ecologist must reassess management measures for the species in collaboration with Council and any relevant stakeholders including Dr Andrew Benwell. Agreed changes to management of these species must be implemented by the proponent as agreed.



References

Ecos (2023). Additional information on ecology, impact and management of a population of the endangered plant species *Rotala tripartite* (*Rotala*) on a proposed residential subdivision at 52-54 Miles Street, Yamba. Report prepared for GeoLINK.

GeoLINK (2019). *Biodiversity Development Assessment Report Lot 46 DP751395 Miles Street Yamba*. Report prepared for Garrard Building Pty Ltd.

NSW Office of Water (2012a). *Guidelines for vegetation management plans on waterfront land*. NSW Office of Water through the Department of Trade and Investment, Regional Infrastructure and Services.

NSW Office of Water (2012b). *Guidelines for riparian corridors on waterfront land*. NSW Office of Water through the Department of Trade and Investment, Regional Infrastructure and Services.



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Appendix A

Approved Filling Plan

CLARENCE VALLEY
COUNCIL
APPROVAL

This is the plan
referred to in Council's
Notice of
Determination of
DA2019/0492

Date: 12/06/2020



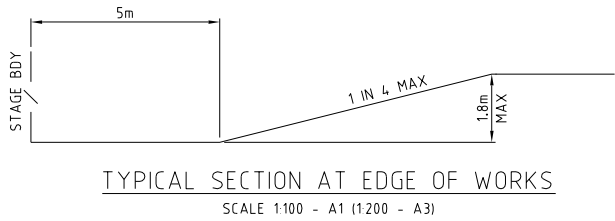
SPREAD LIME OVER THE EXPOSED
AREA AT A NOMINAL RATE OF 2KG/m²
LIGHTLY ROLL STOCKPILE AREA TO
REDUCE WATER INFILTRATION.

EARTHWORKS

1. TOPSOIL STRIPPING
TOPSOIL SHALL BE STRIPPED ACROSS THE ENTIRE LIMIT OF THE EARTHWORKS CUT AND FILL AREAS AND SHALL BE STOCKPILED IN A LOCATION APPROVED BY THE SUPERINTENDENT. THE EXISTING STRATA IS TO BE TREATED IN ACCORDANCE WITH THE SPECIFICATION PRIOR TO PLACING ANY FILL.
 2. EARTHWORKS LEVELS
EARTHWORKS LEVELS SHOWN ON DRAWINGS ARE TO STRUCTURAL FILL LEVEL.
 3. COMPACTION STANDARD
SITE FILLING SHALL BE COMPACTED TO THE STANDARDS OUTLINED IN THE LOCAL AUTHORITY'S SPECIFICATIONS AT A MINIMUM. ALL WORK SHALL BE IN ACCORDANCE WITH AS 3798, LEVEL 1 INSPECTION AND TESTING AND NRDC.
 4. TESTING AND CERTIFICATION
ALL COMPACTION TESTING SHALL BE CARRIED OUT BY AN APPROVED N.A.T.A. TESTING AUTHORITY. ALL SITE FILLING SHALL BE TESTED AT LEVEL 1 REQUIREMENTS. THE CONTRACTOR IS TO PROVIDE ALL REQUIRED EARTHWORKS CERTIFICATIONS IN ACCORDANCE WITH THE APPROVAL CONDITIONS.
 5. TOPSOIL REPLACEMENT
ALL FOOTPATHS, BATTERS AND ALLOTMENT CUT & FILL AREAS SHALL BE TOPSOILED WITH TOPSOIL FROM ONSITE STOCKPILES, AND AMELIORATE SOIL AS NECESSARY TO ENSURE GRASS STRIKE.
 6. GRASSING
ALL CUT/FILL AREAS, DISTURBED AREAS AND TRENCHED AREAS SHALL BE GRASSED TO THE SATISFACTION OF THE SUPERINTENDENT AND LOCAL AUTHORITY.
 7. ROCK
THE CONTRACTOR IS TO INCLUDE ROCK EXCAVATION AS PART OF THEIR EARTHWORKS RATE.
 8. EARTHWORKS ZONE
THE FOLLOWING ACTIVITIES ARE PROHIBITED OUTSIDE THE EARTHWORKS ZONE - STORAGE AND MIXING OF MATERIALS, VEHICLE PARKING, LIQUID DISPOSAL, MACHINERY REPAIRS/REFUELLING, PLACEMENT OF SITE OFFICES OR SHEDS, COMBUSTION OF ANY MATERIAL, STOCKPILING OF SOIL, RUBBLE OR DEBRIS, ANY FILLING OR EXCAVATION INCLUDING TRENCHES, TOPSOIL, SKIMMING AND/OR SURFACE EXCAVATION UNLESS OTHERWISE APPROVED BY THE RELEVANT AUTHORITY.
1. CONSTRUCTION - STOCKPILING
THE CONTRACTOR SHALL NOT CREATE STOCKPILES OF SURPLUS MATERIALS UNLESS DIRECTED BY THE SUPERINTENDENT. ALL MATERIALS ARISING FROM THE WORKS SHALL BE COMPACTED TO FUTURE FILL AREAS AS NOMINATED.
 2. TOPSOIL SCREENING
TOPSOIL SHALL BE SCREENED BY THE CONTRACTOR WHEN DIRECTED BY THE SUPERINTENDENT. ALL UNSUITABLE MATERIAL SCREENED FROM THE TOPSOIL WILL BE TAKEN TO AN OFFSITE TIP BY THE CONTRACTOR AT THE CONTRACTORS EXPENSE.
 3. RECORDS
RECORD DETAILS OF ALL EARTHWORKS, INCLUDING TEMPORARY STOCKPILE LOCATIONS, APPROXIMATE VOLUMES, TREATMENT UNDERTAKEN, IF ANY, AND MONITORING RESULTS. THE FOLLOWING MONITORING REGIME IS RECOMMENDED:
 - REGULAR VISUAL MONITORING DURING EXCAVATION TO NOTE THE PRESENCE OF ANY DARK GREY SANDS OR DARK GREY CLAYS THAT REPRESENT POTENTIAL ASS.
 - ACTION - THERE ENCOUNTERED EXCAVATION WORKS SHOULD TEMPORARILY CEASE AND AN ASSESSMENT OF THE EXCAVATION BE MADE BY A GEOTECHNICAL ENGINEER.
- IF ANY ACIDIC TOPSOIL IS TO BE TAKEN OFF SITE AND REQUIRE NEUTRALISATION TO PH 7 AT A LIMING RATE OF 6KG CaCO₃/TON DRY WEIGHT AND ASSESSMENT IN ACCORDANCE WITH NSW EPA REQUIREMENTS.

- LEGEND
- EXISTING PROPERTY LINE
 - - - 1.0 EXISTING CONTOURS MAJOR
 - - - 1.5 EXISTING CONTOURS MINOR
 - - - SURVEYED TOP OF BANK LINE
 - - - STAGE BOUNDARY
 - STAGE 02 (FILLED TO 1.8m MAX)
 - STAGE 03

NOTE:
CONTRACTOR TO MAKE ALL NECESSARY
ALLOWANCES FOR EXISTING SERVICES
DURING ALL WORKS.



PROJECT NAME

YAMBA
GARDENS

EARTHWORKS
SKETCH

CLIENT

KAHUNA NO. 1
PTY LTD



0 10 20 30 40 50m
Scale 1:1000 - A1 (1:2000 - A3)

ISSUES	DATE	
TENDER		
COUNCIL		
CONSTRUCTION		

B	03-04-20	DETAILS REVISED
A	01-10-19	PRELIMINARY ISSUE
PRE DATE		AMENDMENT

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ASSOCIATED CONSULTANTS

DRAWING TITLE

BULK EARTHWORKS
STAGING AND FILLING
SKETCH

MORTONS
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Urban & Regional Planning
Civil Engineering
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Gold Coast Office
Suite 9, 19 Short St
Southport QLD 4215

DESIGNED PP	DRAWN CB
APPROVED <i>[Signature]</i>	RPED 4706 DATE 03-04-20

DRAWING NUMBER	AMEND.
33801-EWMP-SK001	B



Appendix B

GTA (NRAR)



Contact: Jeremy Morice
Phone: 02 4275 9320
Email: jeremy.morice@nrar.nsw.gov.au

Our ref: IDAS1120700
Your ref: DA2019/0492

11/05/2020

General Manager
Clarence Valley Council
Locked Bag 23
GRAFTON NSW 2460

Attention: James Hamilton

Dear Sir

Re: Integrated Development Referral – General Terms of Approval
Dev Ref: DA2019/0492
Description: Earthworks (filling of land) - additional 20,000 cubic metres of fill within 40 metres to a natural watercourse
Location: 52-54 MILES STREET YAMBA 2464

I refer to your recent letter regarding an integrated Development Application (DA) proposed for the above location. Attached, please find Natural Resources Access Regulator's General Terms of Approval (GTA) for part of the proposed development requiring a Controlled Activity approval under the *Water Management Act 2000* (WM Act), as detailed in the subject DA.

Please note Council's statutory obligations under section 4.46 of the *Environmental Planning and Assessment Act 1979* (EPA Act) which requires consent, granted by a consent authority, to be consistent with the general terms of any approval proposed to be granted by the approval body.

If the proposed development is approved by Council, NRAR requests these GTA be included (in their entirety) in Council's development consent. Please also note NRAR requests notification:

- if any plans or documents are amended and these amendments significantly change the proposed development or result in additional works or activities (i) in the bed of any river, lake or estuary; (ii) on the banks of any river lake or estuary, (iii) on land within 40 metres of the highest bank of a river lake or estuary; or (iv) any excavation which interferes with an aquifer.

NRAR will ascertain from the notification if the amended plans require review of or variation/s to the GTA. This requirement applies even if the amendment is part of Council's proposed consent conditions and do not appear in the original documentation.

- if Council receives an application under s4.46 of the EPA Act to modify the development consent and the modifications change the proposed work or activities described in the original DA.
- of any legal challenge to the consent.

As the proposed work or activity cannot commence before the applicant applies for and obtains an approval, NRAR recommends the following condition be included in the development consent:

The attached GTA issued by NRAR do not constitute an approval under the *Water Management Act 2000*. The development consent holder must apply to NRAR for a Controlled Activity approval **after consent** has been issued by Council **and before** the commencement of any work or activity.

A completed application form must be submitted to NRAR together with any required plans, documents, application fee and proof of Council's development consent. Finalisation of an approval can take up to eight (8) weeks from the date the application and all required supporting documentation is received.

Application forms are available from the NRAR website at:

<https://www.industry.nsw.gov.au/water/licensing-trade/approvals/controlled-activities>

NRAR requests that Council provide a copy of this letter to the development consent holder.

NRAR also requests a copy of the determination for this development application be provided by Council as required under section 4.47(6) the EPA Act.

Yours Sincerely



For

Alison Collaros

Manager Licensing & Approvals

Water Regulatory Operations

Natural Resources Access Regulator

Reference Number:	IDAS1120700
Issue date of GTA:	11/05/2019
Type of Approval:	Controlled Activity
Location of work/activity:	52-54 MILES STREET YAMBA 2464
Waterfront Land:	Tributaries of Oyster Channel
DA Number:	DA2019/0492
LGA:	Clarence Valley Council

The GTA issued by NRAR do not constitute an approval under the *Water Management Act 2000*. The development consent holder must apply to NRAR for the relevant approval **after** development consent has been issued by Council **and before** the commencement of any work or activity.

Condition Number	Details
GT0009	Before commencing any proposed controlled activity on waterfront land, an application must be submitted to Natural Resources Access Regulator, and obtained, for a controlled activity approval under the Water Management Act 2000.
GT0002	<p>A. This General Terms of Approval (GTA) only applies to the proposed controlled activity described in the plans and associated documents found in Schedule 1, relating to Development Application DA2019/0492 provided by Council to Natural Resources Access Regulator.</p> <p>B. Any amendments or modifications to the proposed controlled activity may render the GTA invalid. If the proposed controlled activity is amended or modified, Natural Resources Access Regulator, Parramatta Office, must be notified in writing to determine if any variations to the GTA will be required.</p>
GT0005	<p>A. The application for a controlled activity approval must include the following plan(s):</p> <ol style="list-style-type: none"> 1. Revised riparian plan detailing a Vegetated Riparian Zone for the full width of the required riparian corridors and offset areas. 2. Detailed civil and drainage construction plans; 3. Erosion and sediment control plans; 4. Vegetation Management Plan <p>B. The plan(s) must be prepared in accordance with Natural Resources Access Regulator's guidelines located on the website https://www.industry.nsw.gov.au/water/licensingtrade/approvals/controlled-activities.</p>
GT0004-00003	<p>A. A security deposit must be provided, if required by Natural Resources Access Regulator. B. The deposit must be:</p> <ol style="list-style-type: none"> i. a bank guarantee, cash deposit or equivalent, and ii. equal to the amount required by Natural Resources Access Regulator for that controlled activity approval.



Appendix C

Revised Concept



Appendix D

Proposed VRZs



Appendix E

VMP Prescriptions

Lot 46 DP751395 - PRESCRIPTIONS FOR VEGETATION RESTORATION

NOTE: These prescriptions are to apply to all vegetation restoration works at Lot 46 DP751395. Significant variation to any of these methodologies or planting schedule requires agreement from Clarence Valley Council/NRAR.

Site Identification

Prior to weed control or planting works, a registered surveyor must identify and clearly peg/mark out the extent of the VRZ.

Removal of Cattle

Cattle are to be removed from the site upon approval of the DA/ VMP.

Weed Control and Site Preparation

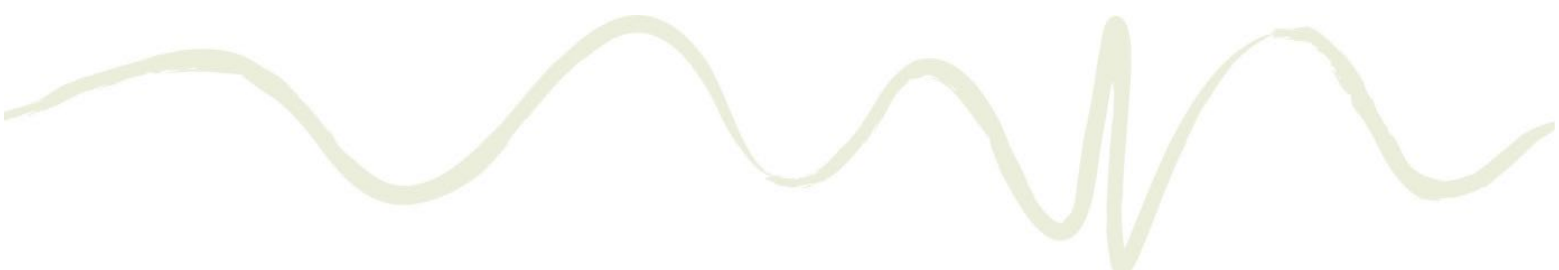
The following weed control actions are prescribed:

- Poisoning established woody weeds (Camphor Laurel, Winter Senna, Lantana, Groundsel) in-situ.
- Remove exotic vines (Coastal Morning Glory) using standard bush regeneration techniques (eg. the 'cut, scrape and paint' technique).
- Use of foliar spray to control areas of pasture grasses and aquatic herbs (Lippia, Cuphea). Weed control and preparation in grassland areas must be sensitive to regenerating woody native species (eg, Swamp Oak, Broad-leaved Paperbark, Willow Primrose, Eclipta).

Weed control works apply, (but may not be limited to) to introduced species recorded at the site within **Table E.1**. Following initial works, ongoing weed control will be required over a three year period to control pasture grasses and exotic herbs (eg. Cuphea, Lippia) in the ground layer.

TABLE E.1 ENVIRONMENTAL WEEDS RECORDED AT THE SITE

Scientific name	Common name	Biosecurity Act 2015
<i>Ageratum houstonianum</i>	Billygoat Weed	
<i>Asclepias curassavica</i>	Red-head Cotton Bush	
<i>Axonopus fissifolius</i>	Carpet Grass	
<i>Baccharis halimifolia</i>	Groundsel Bush	Regional Recommended Measure Land managers should mitigate the risk of spread/establishment of the plant from their land.
<i>Bidens pilosa</i>	Farmer's Friends	
<i>Cenchrus clandestinum</i>	Kikuyu	
<i>Chloris gayana</i>	Rhodes Grass	
<i>Cinnamomum camphora</i>	Camphor Laurel	
<i>Cuphea carthagenensis</i>	Cuphea	
<i>Ipomoea cairica</i>	Coast Morning Glory	
<i>Lantana camara</i>	Lantana	Prohibition on dealings Must not be imported into the State or sold
<i>Ochna serrulata</i>	Ochna	
<i>Paspalum mandiocanum</i>	Paspalum	
<i>Paspalum urvillei</i>	Vasey Grass	
<i>Passiflora suberosa</i>	Corky Passionfruit	
<i>Passiflora subpeltata</i>	White Passionflower	



Scientific name	Common name	Biosecurity Act 2015
<i>Phyla nodiflora</i>	Lippia	
<i>Polygala paniculata</i>	Milkwort	
<i>Psidium cattleianum</i>	Cherry Guava	
<i>Senecio madagascariensis</i>	Fireweed	Prohibition on dealings Must not be imported into the State or sold
<i>Senna pendula</i> var. <i>glabrata</i>	Winter Senna	
<i>Setaria sphacelata</i>	Pigeon Grass	

Weed control notes:

- Weed control must be completed by professional, experienced contractors only.
- Contractors must be advised on the need to complete works sensitively to avoid damaging any native vegetation and threatened flora habitat (eg. *Rotala* habitat).
- Due to wetland environments frog habitat, foliar spraying should use 'frog friendly' forms of Glyphosate and be completed outside of any flood events where water levels may be higher than usual.
- Foliar spraying should not occur if rain is predicted in the coming 48 hours and should be completed in dry, still conditions.
- A minimum of two weeks (three weeks in winter) should be allowed for dieback of pasture grasses prior to planting being completed.

Planting

Following weed control works, planting may commence within Management Zone 3 as below:

- All trees and shrubs shall be spaced at a minimum distance of 3 metres (this allows opportunities for regeneration to infill gaps).
- No groundcovers are proposed for planting, as native regeneration will occur naturally over time.

A total area of 1 ha has been calculated for Management Zone 3.

Planting methodology for all Management Zone 3 is as follows:

- The size of the planting hole should be at least twice the size of the plant root-ball.
- The planting hole should be heavily watered immediately prior to planting and filled with enough soil to ensure root-soil contact.
- Slow release fertiliser should be applied in accordance with the manufacturer's instructions.
- A slight depression or raised lip should be made around the plant to assist in trapping and infiltration of water.
- All plants should be heavily mulched with straw following installation.

To prevent browsing by macropods and assist in establishment, tree guards shall be installed around all planted trees and shrubs.

Watering is required for initial establishment and during early stages of the maintenance period (or as required) to maintain healthy plant growth. A schedule for watering is provided in **Table 4.6**. Water requirements provided are indicative and should be assessed on a day to day basis. A deep, drenching watering regime is preferred over frequent light watering, to encourage a deep root system. Soaked water crystals provide a good alternative if planting occurs during particularly hot conditions.

Planting Schedule

A planting schedule for Management Zone 3 is provided at **Table E.2** and provides planting frequencies based on typical assemblages within prescribed vegetation types, based on a total area of 1 ha. All plants prescribed are common locally occurring species and should be readily available from local nursery suppliers. All plants specified shall be planted as standard tubestock.

Planting notes:

- All plants must be sourced from a reputable nursery specialising in native plants. Where possible, native plants and seed sources of local provenance should be used.
- If some species are unavailable, numbers of other species should be adjusted as required, or an appropriate replacement species should be utilized.
- All plants must be healthy, sun-hardened, and free of pests and diseases.
- All plants must be well-watered in at the time of planting; follow up watering must be completed for three consecutive days following plant installation, and then as prescribed in the watering schedule at **Table 4.6**.

TABLE E.2 Management Zone 3 Planting Schedule (1 ha)

Scientific Name	Common Name	Frequency	No. Plants
<i>Callistemon salignus</i>	Willow Bottlebrush	5%	56
<i>Casuarina glauca</i>	Swamp Oak	25%	278
<i>Eucalyptus tereticornis</i> *	Forest Red Gum	2%	22
<i>Glochidion sumatranum</i>	Umbrella Cheese Tree	3%	33
<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	60%	666
<i>Melaleuca styphelioides</i>	Prickly Paperbark	5%	56
TOTAL		100%	1111

*plant around margins of southern patch of PCT1064 only

Slashing

Tractor slashing is to be undertaken twice annually (Autumn and Spring) within management zone 1 in perpetuity. The following considerations should be taken into account in relation to slashing:

- Only slashing of vegetation zone 1 as shown in **Illustration 4.1** is to be undertaken.
- Slashing should be delayed where ground conditions are too wet and would lead to bogging.
- After a winter-early spring burn, slashing would not be carried out before *Rotala* seedlings have set seed. Check by inspecting plants before slashing.

Low intensity fire

A low intensity burn of management zone 1 would be undertaken every 2-4 years in winter or early spring.



Appendix F

Expert Advice on Rotala Impacts and Management

Additional information on ecology, impact and management of a population of the endangered plant species *Rotala tripartita* ('Rotala') on a proposed residential subdivision at 52-54 Miles Street, Yamba. Application No: SUB2023/0001

Prepared for:

Geolink

Level 1, 64 Ballina St

Lennox Head, NSW 2478

Prepared by:

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3 Short St, New Brighton 2483

4/7/2023

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1 Introduction

Ecos Environmental (Dr Andrew Benwell) has been engaged by Geolink to assess the impact of a proposed residential subdivision located at 52-54 Miles Street Yamba, NSW 2464, comprising Lot 46 DP 751395 and Lot 47 DP 751395 (the 'Subject Site') on the endangered plant species *Rotala tripartita* ('Rotala'), including whether there is likely to be a decline in the species, and to make recommendations on how to manage its habitat within the Subject Site.

Clarence Valley Council (CVC), the determining authority for the proposed sub-division, has requested this additional information on Rotala in relation to a letter from the Department of Planning and Environment – Biodiversity and Conservation Division dated 3 March 2023 recommending that several points of the Biodiversity Development Assessment Report (BDAR) and Vegetation Management Plan be revised.

Ecos Environmental has been engaged by Geolink to address Point 3 of BCD's letter:

3. A suitably qualified expert in wetland biology and ecology assesses the likely impacts from filling the proposed development areas on the adjoining wetland areas to help council determine whether the proposal is likely to have a serious and irreversible impact (SAIL) on Rotala tripartita.

The report should address but not be limited to:

- a. The change in landscape morphology.*
- b. Hydrological impacts such as quality and quantity of stormwater inflow, altered water flow and altered wetting and drying regimes of the wetland.*
- c. Consideration of whether the impacts are likely to result in the decline of the Rotala population on the subject land.*

All Rotala records from the Subject Site are on slightly lower terrain including a designated floodway and are excluded from the development area (Figure 1). The letter from BCD is concerned with possible indirect impacts *from filling the proposed development areas on the adjoining wetland areas* may cause a serious and irreversible impact (SAIL) to the Rotala population.

Following this introduction, Section 2 presents brief background information on the development proposal and site. Section 3 contains an ecological profile of *Rotala tripartita* including its habitat requirements and life history. Section 4 describes the Rotala population. Section 5 examines the impact of development on the hydrology of Rotala habitat. Section 6 recommends management measures to maintain suitable habitat for Rotala and Section 7 presents the assessment conclusion.

The author (Dr Andrew Benwell) has professional experience in wetland plant ecology of the NSW North Coast including botanical survey, plant community mapping, threatened species recovery plans, specialist research, monitoring and translocation. Threatened wetland species he has worked on for the public and private sectors include *Eleocharis tetraquetra*, *Arthraxon hispidus*, *Maundia triglochinoides*, *Phaius australis*, *Persicaria elatior*, *Centranthera cochinchinensis*, *Cyperus aquatilis* and *Rotala tripartita*. A CV can be supplied on request.

2 Background

2.1 Development proposal

Application No: SUB2023/0001. The development proposal is for a 284 lot subdivision consisting of 277 low density residential lots, 1 medium density residential development lot, 1 commercial development lot, 1 low density development lot, 3 drainage reserve lots and 1 open space reserve lot (BDAR Geolink 2022). The total area of the property consisting of Lots 46 and 47 is approximately 42ha. About one third is excluded from development and includes a designated floodway and swampy drainage lines supporting freshwater wetland and paperbark in the north east and south west of the Subject Site where *Rotala* has been recorded (Figure 1). The northern side of the site adjoining Carr Dv and Miles St has already been filled with 3 m of material under a previous approval (see Figure 1 'consolidated fill').

2.2 Natural Environment

2.2.1 Landform

The proposal is located on the estuarine floodplain of the Clarence River and the topography is flat to very gently sloping with slightly lower terrain across the southern part of the property that acts as a floodway directing runoff during heavy rain southeast and south towards Lake Wooloweyah, a large lake connected to the Clarence River. Difference in elevation from the highest to lowest point of the site is approximately 1-2 m. The site is 3 km from the sea and underlain by Pleistocene marine sand and Recent estuarine clay and silt alluvium from the Clarence River deposited during floods.

2.2.2 Vegetation

Most of the site is cleared and has a long history of agricultural land use consisting mainly of cattle grazing, and sugar cane cultivation in the past is also reported. Remnants of *Melaleuca quinquenervia*-*M. stypheloides* swamp sclerophyll forest, disturbed *Lophostemon suaveolens* floodplain forest and freshwater wetland occur in the east, south and southwest of the site (see Figure 1).

Rotala is associated with the mapped plant communities *PCT 780: Coastal floodplain sedgelands, rushlands, and forblands of the North Coast*, and *PCT 1064 Paperbark swamp forest* (Figure 1), both excluded from the development footprint. Cattle appear to have grazed the whole property, including areas where *Rotala* has been recorded, for several decades and are still present.

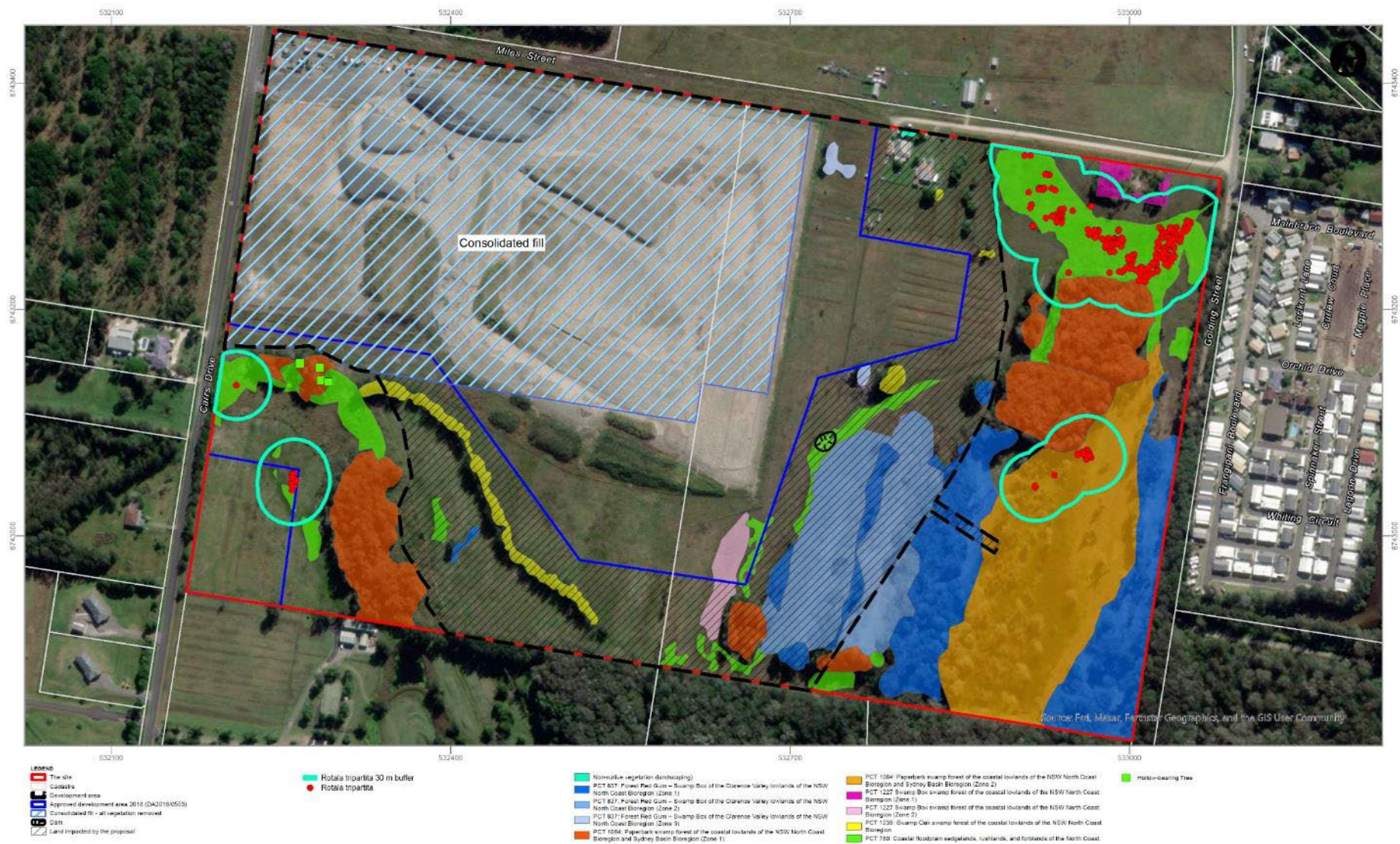


Figure 1: The Subject Site, showing boundaries of the site (red line), development area (dashed black line), approved development area 2018 (blue line) and area impacted by this proposal (lighter hatching). Rotala records are red dots. See legend. Source: BDAR

0 60 Metres

GeoLINK
Biodiversity Development Assessment Report - Lots 46 & 47 DP751395 Miles Street Yamba
3041-1101

Biodiversity Impacts - Illustration 5.1

Information shown is for illustrative purposes only
Drawn by: AB Reviewed by: DGH
Source of base data: ESRI World Imagery
Date: 22/05/2023
Revision: C

2.2.3 Present drainage

The slightly lower relief along the eastern and southern sides of the Subject Site acts as a floodway directing runoff from the site and surrounding urban land from Golding Street south towards the Lake Wooloweyah basin. This is a designated floodway and excluded from development. The southwestern corner of the site is also slightly more low lying and receives runoff from Carr Drive, which is also directed southwards via a swampy drainage line and excluded from development (BDAR, Geolink 2022).

3 Ecological Profile of *Rotala tripartita*

3.1 Conservation Status

Endangered (NSW BC Act)

3.2 Description of species

Herbaceous, upright annual to 40 cm high, or decumbent perennial 10 -20 cm high with short stolons 10-40 cm long often present, producing short leafy shoots and flowers. Leaves glabrous, opposite, often decussate, sessile, ovate to lanceolate, 2-20 mm long and 1-5 mm wide, lower surface often paler than upper surface. Flowers sessile, solitary in axils of very small leafy bracts, dense along stems. Hypanthium c. 1 mm long. Sepals 3 or rarely 4, appendages longer than sepals. Petals 3 or rarely 4, elliptic, ± colourless to red. Stamens 3 or rarely 4, inserted near base of hypanthium. Style c. 0.5 mm long. Capsule globose, c. 1.5 mm long, 3-valved,

3.3 Distribution

NSW

Rare in NSW, known from fewer than 10 locations in a triangle between Casino, Grafton and Yamba, including Shannon Dam, Pillar Valley, Rappville, Pacific Highway Devils Pulpit, Mongongarie and Dilkoon (BDAR). Also in Qld and NT.

Local

The nearest known populations to Yamba are 20 km north at the intersection of Jacky Bulbin Flat Rd and the Pacific Highway (also referred to as Devils Pulpit, which is the adjacent range where the species does not occur), and Pillar Valley 30 km southwest, indicating the species' very sparse distribution.

3.4 Habitat and soil

Rotala tripartita appears to prefer marsh habitat where soil moisture persists for several months without extended periods of flooding and soil waterlogging. On coastal floodplains with a high water table and slight undulations and depressions, such as the Subject Site, marsh and swamp habitat are differentiated by subtle topographic-hydrological gradients. Marsh occurs on the margins of and slightly upslope of swamp habitat, and downslope of elevated, freely draining topsoil. Marsh, swamp and freely draining soils have different,

intergrading soil profiles and plant communities. Swamp soils are generally peaty due to accumulation of organic matter under saturated, anaerobic conditions, and can form on alluvium or sand. A marsh soil is usually an organic loam with a lower organic matter and higher clay or sand content. Marsh habitat is flood prone, but surface water drains away rapidly and in the dry season it can dry out and carry fire.

3.5 Plant community

Rotala occurs in *PCT 780: Coastal floodplain sedgeland, rushlands, and forblands of the North Coast*, and to a lesser extent *PCT 1064 Paperbark swamp forest* on the Subject Site (Figure 1). Both of these plant communities have a modified species composition and structure as a result of clearing and grazing, and a high percentage exotic species in the ground layer.

Appendix 1 records the present species composition and structure of PCT 780 in two 20 m x 50 m plots in the northeast of Lot 47 and south west of Lot 46 where *Rotala* was recorded in June 2023.

3.6 Species life history

Bionet describes *Rotala* as an annual or short-lived perennial. The plants recorded on Lot 47 in November 2018 appeared to be annual as they died out in summer, 3-4 months after being recorded (BDAR, Geolink 2022). This is consistent with the species listing information which states: “There appear to be extreme fluctuations in abundance of the species, with plants observed to germinate prolifically and establish in large numbers after substantial rainfall. Individuals disappear above-ground during dry periods and may only persist during these times in the seed-bank.”

By contrast, the author found that *Rotala* plants monitored on the W2B project at Jacky Bulbin Rd and the Pacific Highway were perennial, as they persisted in situ for 2 years in a cleared paddock, then for another 5 years after being translocated (Ecos Environmental 2021). More than half the translocated plants died, but some survived for five years. Many flowers were produced but no seedling recruitment was observed in five years. Plants spread 10-30 cm by prostrate stolons that took root at nodes. They died back during the year in dry or cold conditions and appeared to persist by means of leafless stolons (see Plate 8). Additional watering was carried out that may have prolonged their life span.

The *Rotala* plants recorded on Lots 46 and 47 in June 2023 by Ecos Environmental and Geolink (approx. 10) appeared to be older plants rather than recent seedlings (see Plates 1 and 2). They could have germinated in hoof depressions or tractor ruts in 2022 and gone undetected until June 2023, which would make them about 12 months old.

Photographs of *Rotala* at Mongogarrie (south of Casino) supplied by David Havilah show dense, advanced *Rotala* seedlings that appear to have germinated after fire, as indicated by lack of dead grass and other litter, blackened litter on the ground, and new grass and sedge shoots (see Plates 6 and 7). David Havilah confirmed there was evidence of a recent fire at the Monogogarrie location. Fire appears to remove the seed dormancy normally preventing

germination of most *Rotala* seed from the soil seedbank, thereby allowing mass seed germination to occur after rain.

The 'extreme' fluctuations in *Rotala* abundance referred to in the Bionet species profile is simply a natural expression of the life cycle of a short-lived disturbance specialist. Mass germination of seedlings after fire is typical of this class of plants. Occasional individuals may also germinate and establish in bare ground created by cattle hooves, tractor wheel ruts and other haphazard disturbances that remove plant cover from the soil surface (like fire), exposing seed to dormancy breaking light and warmth (and other cues). Flooding can also create 'gaps' in ground cover that trigger seed germination but has to be prolonged to kill ground layer plants, not just defoliate them (this is less likely in marsh habitat). Individuals can apparently persist as perennials but generally they are uncommon or rare.

4 *Rotala* population on the Subject Site

4.1 Population fluctuation

The biodiversity assessment surveys carried out by Geolink provide a record of the abundance and location of *Rotala* on the Subject Site over a five-year period, from 2018 to 2023 (Table 1). *Rotala* was first recorded in the southeast section of the Subject Site on Lot 47 in November 2018 (see Figure 1) then from summer 2019 was not recorded again on Lot 47 until the site inspection for this report in June 2023. The first record of *Rotala* on Lot 46 was in January 2021, then again in 2023.

The BDAR notes that: "*Rotala* can be a difficult species to survey for as it is an annual or short-lived perennial responsive to rainfall and seasonal conditions. During inappropriate conditions the species lies dormant in the seed bank and is not detectable. The Threatened Biodiversity Data Collection (TBDC) prescribes a survey period for *Rotala* as between December and March and notes: "Survey within about 6 months of soaking rainfall. Species will be absent above ground if the habitat remains dry for over 6 months. Short-lived perennial, easily overlooked in the field in the dense habitat that it occurs." The best time to survey for *Rotala* is in summer, but the species can be recorded throughout the year as shown by records from spring and autumn on Bionet and those from June 2023.

Geolink carried out frequent biodiversity assessment surveys that included flora or were specifically for *Rotala* (and timed for summer) from 2018 to 2021 (Table 1), so it can be assumed that the *Rotala* population data accurately record the *Rotala* population on the Subject Site.

Table 1: Biodiversity field surveys conducted by Geolink on Lots 46 and 47 between 2018 and 2023 (Source: BDAR; Table 4.2)

Date	Site Assessed	Task
26/06/2018	Lots 46 and 47	Initial assessment and stratification, VI plots, incidental fauna survey
16/07/2018	Lots 46 and 47	VI plots, incidental fauna survey
17/07/2018	Lots 46 and 47	Paddock tree survey for DA2018/0553, incidental fauna survey, GPS PCT 780 boundaries
30/10/2018	Lots 46 and 47	Targeted flora surveys, stick nest survey, bird census x 2, incidental fauna survey
31/10/2018	Lots 46 and 47	bird census x 2, incidental fauna survey. First recording of <i>Rotala</i> .
8/11/2018	Lots 46 and 47	Target flora surveys (<i>Rotala</i> , <i>Maundia</i>), incidental fauna survey
28/01/2018	Lots 46 and 47	Coastal Petaltail survey # 1, <i>Rotala</i> inspection, incidental fauna survey
8/02/2018	Lots 46 and 47	Coastal Petaltail survey # 2, <i>Rotala</i> inspection, incidental fauna survey
28/03/2019	Lot 46 only	Target flora surveys (SSSR, Swamp Foxglove, Tall Knotweed), incidental fauna survey, <i>Rotala</i> inspection
5/8/2020	Lot 46 only	Vegetation assessment for BAR, <i>Rotala</i> inspection (both lots), incidental fauna survey
30/9/2020	Lot 46 only	Vegetation assessment for VMP, <i>Rotala</i> inspection (both lots), incidental fauna survey
20/10/2020	Lots 46 and 47	<i>Rotala</i> inspection (both lots), incidental fauna survey
01/12/2020	Lots 46 and 47	<i>Rotala</i> inspection (both lots), incidental fauna survey
28/01/2021	Lots 46 and 47	<i>Rotala</i> inspection (both lots), incidental fauna survey
28/02/2021	Lots 46 and 47	<i>Rotala</i> inspection (both lots), incidental fauna survey
20/04/2021	Lots 46 and 47	Vegetation assessment and mapping, additional VI plots, SAT plot, wetland flora survey, incidental fauna survey
10/6/2023	Lots 46 and 47	<i>Rotala</i> inspection (both lots), Ecos Environmental and Geolink

Changes in the *Rotala* population on the Subject Site between 2018 and 2022 are described in the BDAR as follows: “*Rotala (Rotala tripartita)* was first recorded on the Subject Site on Lot 47 in November 2018, when an estimated population of 650 plants were present. Further targeted surveys on numerous occasions failed to detect the species since this time, until a small population was detected in association with several melonhole depressions in the south-west of Lot 46 on 28/01/2021. An estimated 45 plants were recorded, the majority of which are up to 20 cm in height; only one plant was in fruit. Plants were typically

within dense *Setaria*. Despite the good conditions and regular summer rain, no *Rotala* was recorded within Lot 47 on this same occasion where a robust population was previously recorded in 2018.

“The established population at Lot 47 (recorded November 2018) was used as a population indicator and was inspected on the following occasions: 29/01/2019, 8/02/2019, 28/03/2019, 5/8/2020, 30/9/2020, 20/10/2020, 01/12/2020, 28/01/2021. No plants were ever recorded during these times, and it was assumed that suitable prior rainfall had not occurred to create favourable conditions for the species. *Rotala* was recorded on Lot 46 outside of the development footprint on 28/01/2021 but was absent within the more substantial known habitat at Lot 47; the reasons for this are not known. Further incidental assessment on 20/04/2021 involved a random meander through the NE corner of Lot 47 (previous *Rotala* records) and small isolated patches of PCT 780 as part of habitat mapping.

“*Rotala* was recorded extensively in Lot 47 where wetland communities are extensive and moist boggy areas with surface water and a high table water were present. Numerous seedlings were observed growing within tractor wheel ruts at some locations, while other plants also occurred in association with the margins of Broad-leaved Paperbark swamp forest. As noted, following a hot and dry summer, all *Rotala* at the site had died, but had flowered and seeded prior to this time, suggesting that future plants are likely to germinate during suitable conditions. The site has been subject to ongoing slashing and grazing for many years (several decades).”

4.2 Germination trigger

Environmental processes that may trigger the germination of *Rotala* seed on the Subject Site include rainfall pattern, tractor slashing, grazing and fire. These processes or factors trigger seed germination by altering habitat and removing the dormancy mechanism normally preventing germination of *Rotala* seed in habitat unsuitable for seedling establishment.

The BDAR suggests that flooding rain was the environmental factor producing the large *Rotala* population recorded on Lot 47 in November 2018, but also notes that no plants appeared at the same location after flooding rain in 2021, even though some appeared on Lot 46. The BOM rainfall record in 2018 shows a spike of high rainfall in Aug-Sept/2018 (about 250 mm), followed by four major flood events in 2020-2022 (see Figure 2). *Rotala* was only recorded on Lot 47 after the spring 2018 rainfall event, not in the other years, for reasons that are not clear.

The photograph of *Rotala* on the Subject Site in 2018 supplied by Geolink (Plate 5) appears to show evidence of fire, similar to the photos from Mongogarrie (Plates 6 and 7), which suggests plants recorded in 2018 on the Subject Site could have germinated after an earlier low intensity fire. *Rotala* plants in Plate 5 appear to be seedlings a few months old and may have germinated after heavy rain in Aug-Sept 2018 (Figure 2). This rainfall event was preceded by a drier than average period of about three months (conditions suitable for a pasture burn) and then another, more intense dry period extending into summer (Figure 2) when the population is reported to have died out. However, there is no mention of evidence of fire in the BDAR and David Havilah considered it unlikely (pers. comm.).

Generally, it appears that rainfall pattern, tractor slashing, grazing and fire can act as triggers to stimulate germination of *Rotala* seed. CVC will probably be responsible for site management of the floodway and areas outside the residential footprint and is unlikely to continue cattle grazing. That leaves tractor slashing and fire as strategies available for managing the site to maintain suitable habitat conditions for the *Rotala* population. Generally, the aim would be to maintain a fairly open ground layer with gaps to enable germination and seedling establishment, as described in Section 6 below.

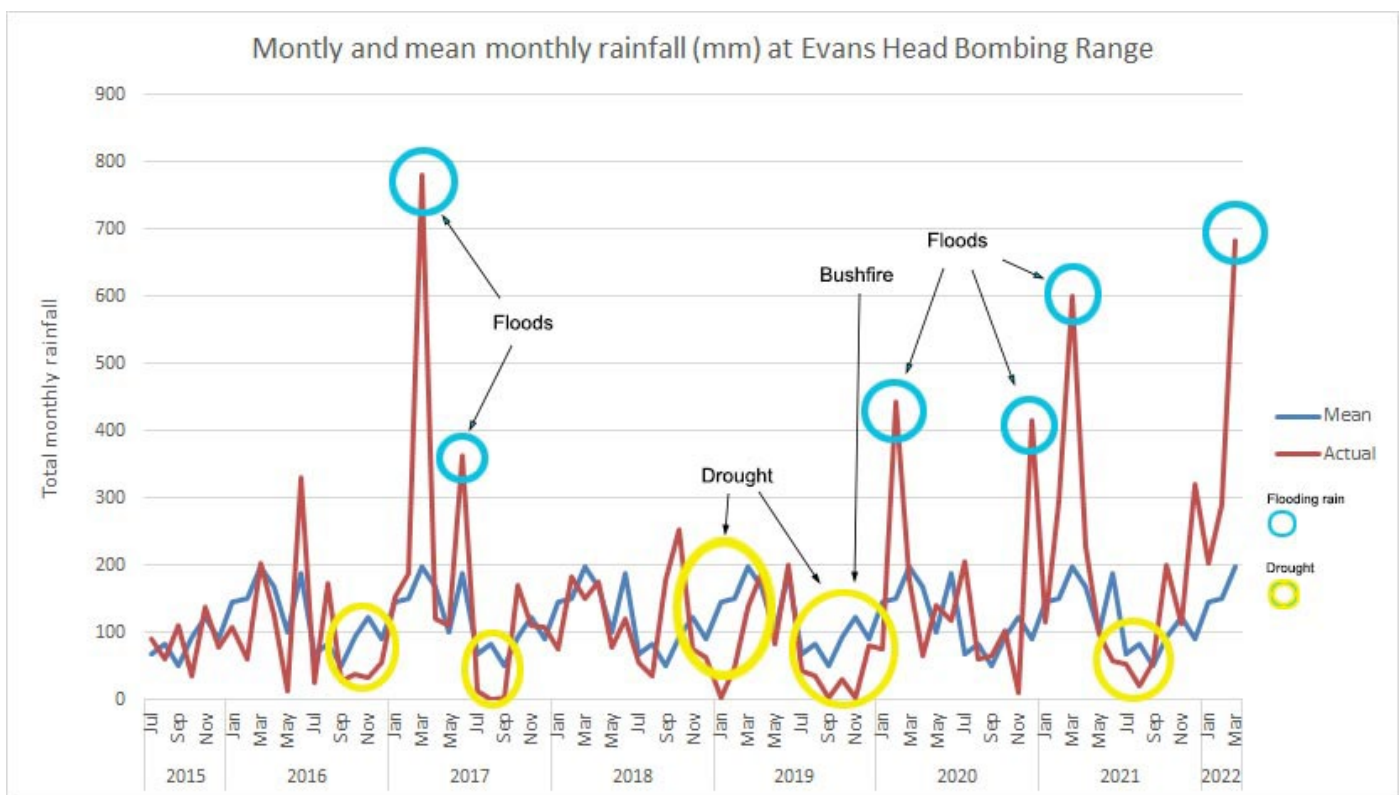


Figure 2: Monthly and mean monthly rainfall for Evans Head Bombing Range approximately 30 km north of Yamba, 2015 to 2022. The weather pattern was characterised by high rainfall variability with frequent droughts (defined as three or more months of below average rainfall) and floods (the bushfire shown in 2019 did not affect the Subject Site). Source: Ecos Environmental (2022).

5 Development impact on the hydrology of Rotala habitat

5.1 Introduction

Being a species of marshy habitat and adjoining an expanding urban area, the residential development has the potential to alter the hydrological regime of Rotala habitat, including depth and duration of flooding, and soil wetting and drying regime. This could cause change in germination conditions or survival of germinated seedlings, and possible decline (or increase) in Rotala abundance. In assessing the hydrological impact of the development on Rotala below, the reports prepared by expert hydrologists are relied on to indicate possible changes in the hydrological regime in Rotala habitat on the Subject Site.

The following issues relating to site hydrology that may impact on the Rotala population are examined below:

- Duration and height of flooding from stormwater run-off.
- Stormwater quality management (sedimentation and eutrophication).
- Groundwater Impacts.

5.2 Duration and height of flooding from stormwater run-off

The BDAR reporting on hydrology modelling by Biome Pty Ltd describes the impact of the proposal on duration and height of flooding from stormwater run-off as follows: “Regarding the timing of flows within the floodway, depending on the event, critical storms (i.e. with the highest flows) have a duration between 3-6 hours, meaning the storm peak flow will generally be reached after about 3 hours from the onset of the storm. Based on 1D modelling, the floodway flows generally subside after around 10 hours from the onset of the storm.

“The stormwater basin will provide detention of flows, thereby ensuring that the peak flows leaving the site in the post-development situation do not exceed the peak flows in the pre-development situation, for a range of storm events.

“A simulation of pre and post construction flood inundation was undertaken by Biome Consulting for the Q2 and Q100 events at two sites:

Site 1 – fork of branched waterway in the south-west corner of the site subject to VMP.

Site 2 – first order waterway in northern part of floodway representing threatened flora habitat subject to VMP.

For site 1, the model indicated that flood peak levels for Q2 and Q100 events being the same but with slightly increased water heights after the peak for a period of time. Such a minor change would be unlikely to affect ecological values associated with the waterway in the south west of the site.

For site 2, the model indicated very similar flood peaks and duration for the Q2 and Q100 events suggesting that the frequency and duration of flows entering the receiving environment will be similar to the pre-development situation.

Drainage of the floodway appears to occur north to south with the proposed stormwater outlet from the site positioned south of threatened flora habitat (see Figure 1, narrow projection on Lot 47 near Rotala habitat) further attenuating the risk of impacts to threatened flora habitat from changes in hydrology.

Conclusion

From the modelling studies carried out, there is unlikely to be a significant change in duration and height of flooding of off-site areas including habitat for threatened flora species within floodway as a result of stormwater run-off from the residential area.

5.3 Stormwater Management

Low lying areas are susceptible to changes in species composition caused by sedimentation and eutrophication originating in run-off from construction sites, roads, residential areas and other sites of soil disturbance associate with changes in land use (DPE 2022). Eutrophication of soil poses a significant risk to the long-term survival wetland threatened plant species such as Rotala and should be reduced as much as possible.

Management of stormwater run-off described in Geolink (2022) and Biome (2023) includes use of various structures including stormwater detention basins/bio-ponds/bio-retention ponds. Stormwater management will include two detention basins with the eastern basin discharging via a grass swale into the floodway and the western basin discharging into the second order stream. The stormwater outlet for the eastern basin consists of both pipe (1x450mm RCP) and weir flow. As the invert of the basin and subsequent downstream invert of the pipe outlet is quite low (0.8m AHD), construction of a shallow swale is required to outlet this pipe within the floodway (see Figure 1, narrow projection on Lot 47 near Rotala habitat). The swale will be approximately 60 m from the piped outlet and have a 2.5 m base. The swale has been designed as grassed/vegetated and will convey approximately 0.5m³/s.

Water quality management described in Biome Consulting (2023) states on p. 2:

“The results of modelling including a comparison between the pre-developed, developed (untreated), and developed (treated) scenarios are summarised in the table below (i.e. Table 1). Treatment measures have been sized to achieve the water quality targets specified within Table H2 of the DCP and will ensure that surface water pollutant loads are reduced by at least 85%, 60% and 45% for TSS, TN and TP respectively of the developed flow.

Table 1 Pre-Development vs Developed (Untreated) vs Developed (Treated) Nutrient & Sediment Loads

Catchment ID	Pollutant	Pre-Development (kg/yr)	Developed (Untreated) (kg/yr)	Developed (Treated H2 requirements) (kg/yr)
Overall Site (TOTAL)	TSS	11,041	34,510	3,619
	TP	13	66	21.6
	TN	107	435	236

“In comparison to the pre-development scenario, whilst increases in nutrient loads (TN and TP) are expected as a result of urbanisation of the site, sediment loads are generally expected to largely decrease due to the inclusion of stormwater treatment measures within the development. To achieve a reduction in nutrient loads that would meet with pre-developed conditions an 80% reduction in TP and 75% reduction in TN would be required from the untreated developed flow.”

The report notes on p. 3 “bioretention performance as a ratio of bioretention treatment area exhibits a non-linear relationship comparable to a logarithmic regression. This relationship implies that treatment performance increases rapidly with treatment area size then reaches a point of ‘diminishing performance’ where incremental increases in basin size result in only marginal increases in bioretention performance.”

Regarding the size of bio-retention ponds, the report states: “ the most optimal treatment area is 1-2% of the total contributing catchment area. It is noted that whilst the information provided above represents catchments modelled within Queensland climates, it is deduced that a similar relationship would be prevalent for catchments within the site locality.

“The bioretention treatment measures for the proposed development have been sized to achieve the required load based reductions specified in Table H2 of the DCP. The resultant filter treatment areas equate to approximately 1.1% of the developed contributing catchment. It is therefore considered that the optimal treatment basin size has been provided for each catchment.

Furthermore, increasing the size of the basins would likely not offer a material change in of treatment efficiency but would result in large assets delivered to Council and therefore increase maintenance costs.

Attachment A of Biome Consulting (2023):

The current version of the Clarence Valley Council DCP as sourced from the link below specified the current water quality targets within TABLE H2.

https://www.clarence.nsw.gov.au/files/assets/public/building-and-development/files/development-control-plans/residential-dcp_29_july_2022.pdf

TABLE H2 Default Water Quality Targets

WATER QUALITY PARAMETER	DEFAULT TARGET
Gross Pollutants	90% of average annual load retained
Total Phosphorus (TP)	60% of average annual load retained
Total Nitrogen (TN)	45% of average annual load retained
Total Suspended Solids (TSS)	85% of average annual load retained

Appendix 2 at the end of this report includes diagrams showing the current design of two bio-retention basins and how they will linked with housing. This design is repeated across the site.

Summary comment

It appears from water quality performance measure for the Subject Site, intended to be consistent with those of CVC (see Table H2 above), after treatment of run-off in the system of bio-retention structures, 40% of Total Phosphorus (TP) and 60% Total Nitrogen (TN) will still remain in treated run-off from the construction site and later from the residential area, which will be discharged onto the floodway containing *Rotala* habitat and drain southwards.

Table 1 from the Biome report (see above) indicates that measured in kg/yr, P will increase from 13 kg/yr 'pre-development' to 21.6 kg/yr 'developed with treatment in the bio-ponds'; N will increase from 107 kg/yr pre-development to 236 kg/yr developed and after treatment in the bio-ponds. This is roughly a doubling of pre-development N and P concentration in run-off to the floodway.

If spread over the whole low lying area supporting wetland vegetation, including PCTs 780 and 1064 (i.e. ~10 ha), these increases in nutrient input (kg/yr) would probably have a relatively mild stimulating effect on plant growth. Any stimulating effect would probably attenuate rapidly with increasing distance from the discharge point so its position in relation to *Rotala* plants is important, which appears to have been considered. Concentrations of N and P in the present soil are already likely to be elevated as a result of the long history of cattle grazing, compared to a soil still in its natural state, unmodified by agriculture.

Vegetation and soil monitoring plots recorded during and after construction would be required to accurately determine the indirect effects of changes in land use (i.e. grazing and no grazing) and stormwater run-off (pre- and post-construction; before and after treatment) on plants communities and the *Rotala* population.

5.4 Groundwater Impacts

Regional Geotechnical Solutions Pty Ltd (RGS) carried out a geotechnical assessment of the residential subdivision that involves placement of between 1.5 and 3m of fill across the site. The impact of fill on groundwater conditions was assessed with regard to:

- The potential for consolidation settlement due to the placement of between 1.5 and 3m of controlled fill;
- An estimate of potential consolidation settlement, and the approximate lateral extents to which the settlement is predicted to occur; and
- Potential influence of the fill surcharge on existing groundwater levels.

The RGS report made the following findings: "The development includes the placement of up to about 3m of fill over the existing marine sand and silt deposits. The fill is expected to be placed progressively over many months with small height increases (i.e. fill lifts) applied over large areas, rather than the full surcharge being applied over a short period.

Groundwater was measured during the site investigation at depths of between 0.2 and 0.9m.

The marine soils below the groundwater level that underlie the site comprise two components – the soil particles themselves and water. Consolidation settlement occurs due to the reduction in volume of the saturated soil because of the increase in total stress and the drainage of excess pore water pressure. On this basis, at sites that experience large consolidation settlements there is the potential that the groundwater level surrounding the applied load/surcharge to be influenced and can rise. Groundwater levels would be expected to fluctuate at the site by up to about 1m due to tidal influences and in response to rainfall and particularly extended rainfall events.

Conclusion:

On this basis and due to the limited predicted consolidation settlement, the influence of the fill surcharge on the groundwater levels on surrounding sites is expected to be negligible.

5.5 Summary of hydrological impacts on Rotala habitat

The hydrological reports conclude that there will be no significant change in the height and duration of flooding in areas surrounding the residential development as a result of filling the residential footprint (as fill area is small in relation to the area of the surrounding Clarence floodplain), or to ground water levels from the weight of three metres of fill, which models show respond primarily to rainfall and tidal fluctuation.

The main hydrological risk to Rotala habitat from the development is change in water quality of storm water run-off, particularly elevated levels of major plant nutrients N and P remaining in stormwater after treatment in a network of bio-retention basins to be constructed in the residential area. Eutrophied run-off has the potential to produce changes in the structure and species composition of the wetland plant community PCT 780 which provides habitat for Rotala. Potential changes include (i) increased soil concentrations of major plant nutrients, (ii) increased biomass and density of herbaceous ground layer plants, and (iii) changes in species composition including increase in exotic species.

The bio-retention technology to be applied to the residential development (Biome Pty Ltd 2023) appears to be state of the art and able to substantially reduce N and P concentration in run-off discharged to the floodway and Rotala habitat. Although substantially reduced, the data provided suggests that levels of N and P in stormwater run-off after treatment are likely to be twice those of run-off on the undeveloped site. However, in terms of (i) kg/yr of nutrient discharged to floodway, (ii) attenuation effects with increasing distance from the discharge point and (iii) previous cattle grazing, likely impact on Rotala habitat will probably be at the lower end of the scale (qualitatively speaking), but this is by no means certain, and may still have an adverse affect on the Rotala population on the Subject Site.

6 Maintenance of Rotala habitat

The maintain habitat conditions most likely to perpetuate a population of *Rotala* on the Subject Site, it is recommended that *Rotala* habitat areas be managed with a combination of tractor slashing and periodic, low intensity burning. 'Rotala habitat' is assumed to comprise all or most of the low-lying parts of the site excluded from development.

6.1 Tractor slashing

Tractor slashing has been carried out in recent years to suppress sapling regrowth on the designated floodway, and also appears to have helped maintain suitable habitat conditions for *Rotala* by reducing vegetation height and density, and forming micro-disturbance sites where *Rotala* seed can germinate. Observations showed that some *Rotala* seed germination occurs in tractor wheel ruts although generally only very sporadically and in low numbers.

Without slashing, the floodway and other open areas would rapidly regenerate to forest and displace the *Rotala* population. Small *Melaleuca* saplings were observed on the floodway during fieldwork in 2023.

Timing

Tractor slashing twice a year is recommended in Autumn and Spring. Summer slashing should be avoided to minimise disturbance to *Rotala* plants as they mature and produce seed.

After a winter-early spring burn, slashing would not be carried out before *Rotala* seedlings have set seed. Check by inspecting plants before slashing.

If slashing only is used to manage *Rotala* habitat, a small population may persist in tractor wheel ruts, or as dormant seed in the soil seedbank, but species seedbanks decay and need to be renewed to prevent the species dying out. To maintain a healthy population of *Rotala* on the site, occasional burns are recommended, with aim of stimulating large scale seed germination.

6.2 Low intensity fire

Observations of the population ecology of *Rotala* on the Subject Site and other locations indicate that *Rotala* can appear in large numbers for a short period after fire disturbance, then die-off and persist as dormant seed, until the next disturbance. This is the natural life cycle of the species which is adapted to utilise open conditions in the earliest stages of plant community regrowth after fire.

To maintain a healthy population, the site should be burnt every 2 to 4 years in winter or early spring when conditions are favourable. The site should be burnt when fuel (i.e. ground layer vegetation and litter), weather and soil moisture conditions are suitable for a complete burn of ground layer, herbaceous plants. Advice can be sought from NPWS rangers who carry out ecological burns in local National Parks. Fire breaks around the perimeter of the Subject Site are already planned as part of the Vegetation Management Plan.

A Bushfire Risk Management Plan (BushfireSafe Aust 2021) has been prepared for the proposal. The Plan notes the following:

- A perimeter road has been designed along the entire length of the floodway (eastern side of development).
- The development has been designed with a 21 metre wide perimeter road along the bushfire hazard interface.
- A minimum 25 metre Asset Protection Zone (APZ) along the forest vegetation adjacent to the southwestern margins of the site and a minimum 9 metre APZ from the remnant and riparian vegetation areas is prescribed.

6.3 Monitoring

As already emphasised, a monitoring strategy with clear objectives, methods and scheduling is essential to determine how treated stormwater run-off and site management measures (slashing and burns) affect the *Rotala* population and wetland habitat.

7 Conclusion

Assuming (i) the accuracy of hydrological models used in reports to assess hydrological impacts, reviewed above; and (ii) application of habitat management measures as described in Section 5, the likelihood of the residential development having a Serious and Irreversible Impact (SAII) on the *Rotala* population, resulting in a significant decline in the population, is considered to be low.

There is unlikely to be any major change in depth and duration flooding due to run-off from the filled residential area but data presented in reports indicate that stormwater discharged to low lying wetland habitat containing the *Rotala* records, will have about twice the concentration of N and P as pre-development run-off. However, as the quantity of nutrient in terms of kg/yr added to the low lying area is relatively small, the risk of eutrophication of habitat is also considered to be low.

Implementation of the habitat management regime described in Section 5 would increase the likelihood of the species persisting on the site. There is no certainty of outcome as the extent of the dormant *Rotala* seedbank on the Subject Site, which is crucial to the continued presence of *Rotala*, is largely unknown and simply assumed to be present based on where the species has previously been recorded.

A monitoring strategy is essential to determine how stormwater treatment and habitat management measures affect the *Rotala* population and wetland plant communities.

References

Biome (2023). Additional information request response – stormwater. Development Application Sub2023/0001, 52-54 Miles St, Yamba 2464/

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Geolink (2022). Biodiversity Development Assessment Report. Lot 46 & 47 DP751395 Miles Street Yamba: Proposed Subdivision.

RGS (2022). Geotechnical Assessment Yamba Gardens Residential Estate 52-54 Miles St, Yamba, Report by Kahuna No. 1 Pty Ltd, Regional Geotechnical Solutions

Photographs



Plate 1: About 10 *Rotala* were recorded on Lot 47 in June 2023 in the same location plants were recorded in 2018. This plant has turned red and is starting to die back due to cold conditions.



Plate 2: A *Rotala* recorded on Lot 46 in June 2023 at the same location plants were recorded in 2021. This plant is turning brown and dying back due to cold conditions.



Plate 3: Wetland community PCT720 on Lot 47 in June 2023 dominated by the exotic herb *Cuphea carthagenicus*.



Plate 4: Wetland community PCT 720 on Lot 46 in June 2023, browning off due to cold temperatures.



Plate 5: *Rotala* seedlings on Lot 47 in November 2018. Photo supplied by D. Havilah.



Plate 6: Dense *Rotala* seedlings germinated after fire on a property at Mongogarrie, south of Casino. Photo supplied by D. Havilah.



Plate 7: *Rotala* seedlings germinated after fire on a property at Mongogarrie, south of Casino. Photo supplied by D. Havilah.



Plates 8-10: *Rotala* plants translocated from near the intersection of Jacky Bulbin Rd and the Pacific Highway to a recipient site 1 km south, for the Woolgoolga to Ballina project. Some plants survived for five years after being transplanted. **Plate 8** (top) – reddish stolons (prostrate, perennating stems) with small shoots. **Plates 9-10.** - clump of *Rotala* 3-5 cm high spreading by stolons and close up. Sept 2020

Appendix 1: Present species composition and structure of PCT 780 in two 20 m x 50 m plots in the northeast of Lot 47 and south west of Lot 46, at the locations where *Rotala* was recorded in June 2023.

Lot 47	0532986 6743264 (UTM, GDA)	20/6/2023
Plot = 20 m x 50 m	Miles St/Golding St	
Species	Crown-cover	Native/Exotic
<i>Cuphea carthagenicus</i>	4	e
<i>Schoenus brevifolius</i>	3	n
<i>Cyperus polystachyos</i>	3	n
<i>Axonopus affine</i>	3	e
<i>Paspalum dilatatum</i>	3	e
<i>Polygala multiflora</i>	2	e
<i>Centella asiatica</i>	2	n
<i>Alternanthera denticulate</i>	2	n
<i>Cynodon dactylon</i>	2	n
<i>Philydrum lanuginosum</i>	2	n
<i>Aster subulatus</i>	2	e
<i>Juncus cognatus</i>	2	e
<i>Baumea articulata</i>	2	n
<i>Enydra fluctuans</i>	2	n
<i>Bacopa monneiri</i>	2	n
<i>Hypocheirus radicata</i>	2	e
<i>Melaleuca stypheloides</i>	1	n
<i>Asclepias currasavica</i>	1	e
<i>Cyperus rotundus</i>	1	e
<i>Christella</i> sp.	1	n
<i>Melaleuca quinquenervia</i>	1	n
<i>Andropogon virginicus</i>	1	e
<i>Rotala tripartita</i>	1	n

Lot 46	0532217 6743126 (UTM, GDA)	20/6/2023
Plot = 20 m x 50 m	Carr Drive	
Species	Crown-cover	Native/Exotic
<i>Eleocharis acuta</i>	5	n
<i>Cuphea carthagenics</i>	4	e
<i>Baumea articulata</i>	3	n
<i>Paspalum dilatatum</i>	3	e
<i>Philydrum lanuginosum</i>	2	n
<i>Baumea rubiginosa</i>	2	n
<i>Juncus ursitatus</i>	2	n
<i>Axonopus affine</i>	2	e
<i>Cyperus polystachyos</i>	2	n
<i>Schoenus brevifolius</i>	2	n
<i>Persicaria strigosa</i>	2	n

Polygala multiflora	2	e
Ranunculatus inundatus	1	n
Christella sp.	1	n
Asclepias currasavica	1	e
Casuarina glauca	1	n
Cyperus rotundus	1	e
Senecio madagascarensis	1	e
Alternanthera denticulate	1	n
Rotala tripartita	1	n

Appendix 2: Location of two bio-retention basins and how they will be linked with housing. This design is repeated across the site. Below is the design the bioretention media which is a soil/particulate medium (source: Biome Pty Ltd 2023)

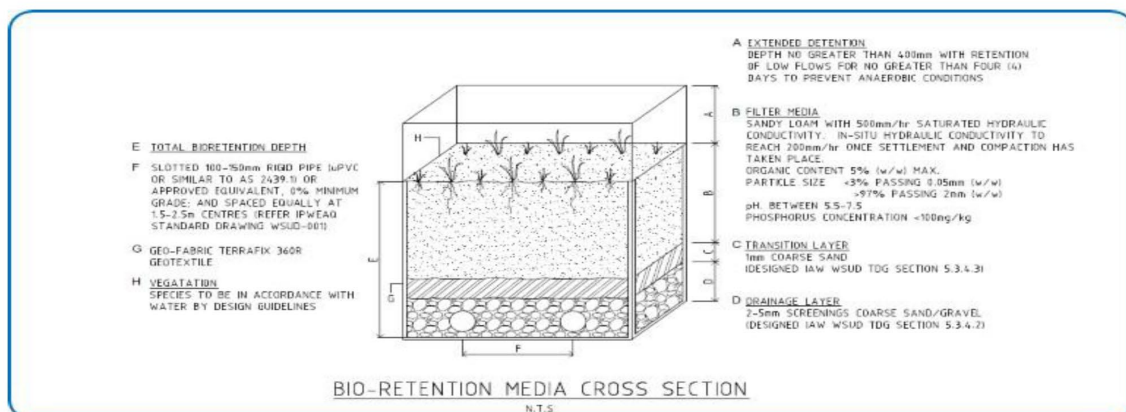
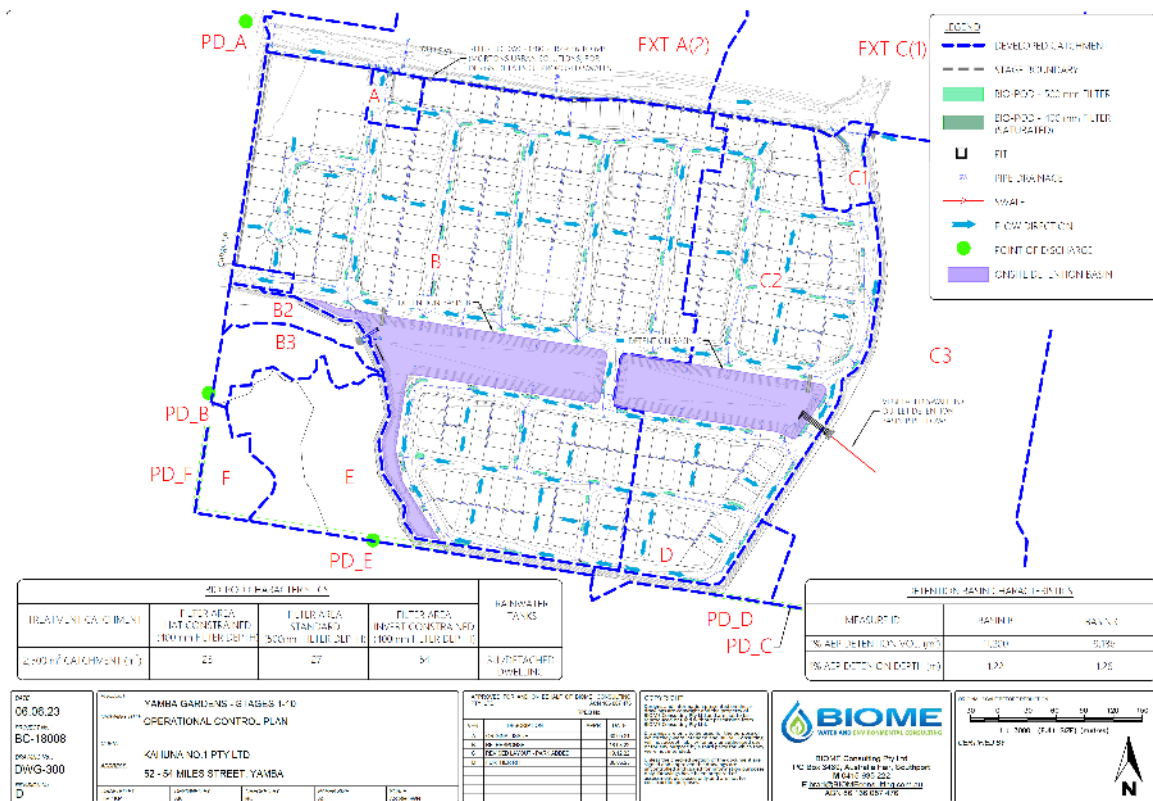


Figure 7.1 Bioretention specifications (Typical)