Biodiversity Assessment of proposed Vegetation Management
Terrace Holiday Park: Southern Precinct

By Ecological Consultants Australia Pty Ltd TA
Kingfisher Urban ecology and Wetlands

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About this document

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Statement of Authorship

This study and report was undertaken by Ecological Consultants Australia for the Client. The authors of the report are Geraldene Dalby-Ball whose qualifications are BSc. majoring in Ecology and Botany with over 20 years' experience in this field.

Limitations Statement

Information presented in this report is based on an objective study undertaken in response to the brief provided by the client. Any opinions expressed in this report are the professional, objective opinions of the authors and are not intended to advocate any particular proposal or pre-determined position.

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Author:	Geraldene Dalby-Ball BSc Hons I Ecology
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Distribution:	**Greg Asher** Executive Manager – Operations PO Box 212, Carrington, NSW 2294 t: 02 4914 5507 | m: 0400 364 455 e: Greg.Asher@reflectionsholiday.com.au

Signed: Geraldene Dalby-Ball – Director of Ecological Consultants Australia

1 Summary of Findings and Recommendations

Objective
This report provides an ecological impact assessment of proposed tree management works in the Southern Precinct of The Terrace Holiday Park.

Findings

Vegetation Management Works include actions to implement tree protection mechanisms including load cells to spread weight, a reduction in site density, designated site dimensions and sizes, a refining of site usage, specific tree protection measures and the allocation of specific areas to regeneration and assisted regeneration these are detailed in ArborSafe (March 2018).

Vegetation works include planting canopy, mid and ground level species from the EEC and convert turf areas to areas of native plants from the EEC community including under planting the existing trees with species from the CCPF.

- Tree Management recommendations from the report ArborSafe (March 2018) are detailed in Appendix F and include the removal of deadwood/stubs (minor work) and the removal of selected branches from 29 trees (25, 29, 30, 38, 50, 51, 53, 62, 65, 68, 76, 82, 98, 100, 109, 116, 121, 122, 127, 131, 136, 142, 153, 174, 196, 200, 201, 207, 231, 260).
- Three trees (232, 234, 238) are proposed for removal (of the 115 CP in this part of the site). While most of the trees have a life expectance over 10 years these three have under 5 years and a high safety risk form an arboriculture perspective.
- Mulching with a native forest blend or wood chip mulch that conforms to *AS4454–2012 Composts, Soil Conditioning and Mulches* is recommended to be installed in as much of each Structural Root Zone (SRZ) and regeneration area as possible
- Simpson Reserve (Formally South Terrace Reserve) is a narrow Reserve situated between the estuary edge and the main entrance road into Brunswick Heads. It's located immediately south of Terrace Holiday Park and is not part of the commercial camping area. This area retains well-developed stands of Coastal Cypress amongst extensive areas of mowed grass. This area is within the lease area and bush regeneration will occur in remnant CP EEC as well as conversion of turf to CP EEC areas.
- The Southern Precinct of The Terrace Holiday Park contains and surrounds contain Coastal Pine Endangered Ecological Community (CP EEC). CP EEC.
- Coastal Pine EEC is the vegetation community growing in the southern precinct – albeit largely restricted to canopy trees.
- The CP EEC was found to occur in an area covering approximately 7ha in the immediate vicinity of the Park with the southern precinct making up 0.75ha of that area. The 7ha includes ~ 1ha of residential land and highly fragmented EEC, foreshore reserve area (over

3ha) with high potential for the restoration of existing PC EEC and incremental re-creation of PC EEC.

- Additional areas of PC EEC occur on the western side of the Pacific Hwy (~2ha). Currently these are the most impacted by weeds. No works are proposed in these areas now, as part of this plan, however they are potential areas for rehabilitation.

Recommendations

- Recommendations to minimise impacts of trees in the Southern Precinct in the report by ArborSafe (March 2018) are recommended for implementation.
- On-site and off-site planting along with restoration and re-creation of CP EEC in the reserve are effective long-term solutions to maximising the condition and survival of this EEC.
- The Southern precinct can be a case study and example for best practice holiday park use within a treed area. It can also be an education area for the PC EEC community and have a program of restoration registered with Saving Our Species program – as they currently have no sites of stewardship or works within this EEC.
- Weed invasion is a listed Key Threatening Process and without active management the land is likely to revert to weed based.
- The Southern Precinct is less than 15% of the local CP EEC and the retention of this area operational within the park can generate funds to care for and consolidate those areas in the care, control and management of the Holiday Park, public open space and reserves. The park can also become a leader in the area of education pertaining to the EEC and provide experience for people to stay and removed weeds (as is done successfully in other areas – see examples in this report).

In summary it is recommended that the Arboricultural Report (ArborSafe March 2018) be fully implemented. Resourcing is recommended to go to both on-site and off-site restoration of CP EEC areas as suggested in this report. With the land owner's approval (Crown Lands) of a detailed 5 year, costed action plan, for works off-site that will see the regeneration of CP EEC in public areas will be completed.
This can also be submitted to Council for review and feedback. A *minimum* of 200m^2 would be re-created each year of the plan and then maintained on-going with the scope to rehabilitate at least 2 ha (of the 3ha of Crown Land) that is within the CCM of the Holiday Park. Additional lands can be rehabilitated with matching grant funding for ecological works in the EEC.

After an in principle agreement with landowners regarding the resourcing of works for CP EEC the existing VMP (2011) would be updated to specifically designate on and off-site works over a 5 year and on-going period. The detail for work would be completed within 6 weeks of land owners consent.

On-site restoration and tree protection works within the current park boundaries would start without delay.

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We acknowledge the traditional owners of the land and Elders past, present and future. We acknowledge the First People of the area the Minjangbal and Durrungbil tribes of Brunswick Valley.

2 Introduction

Ecological Consultants Australia was engaged by Reflections Holiday Parks, to provide an ecological impact assessment of recommendations proposed in the Arboricultural Report (ArborSafe March 2018) and to provide recommendations for the vegetation management of the Southern Precinct of the Terrace Holiday Park, Brunswick Heads, NSW.

This ecological assessment and recommendations are provided here.

A site inspection (March/April 2018) was made of the vegetation, focusing on the Coastal Cypress Pine Forest EEC both within the holiday Park and the immediate surrounds. The site inspection informs much of this EVMP. The following literature was also reviewed.

Reports reviewed during this work include:

- Terrace Holiday Park: Southern Precinct Arboricultural Impact Assessment (ArborSafe March 2018)
- Results of Property Inspection and Site Assessment of Crown Land Crown Reserve known as The terrace Holiday Park Brunswick Heads by Dr. Robert Kooyman for Byron Shire Council (October 2017).
- Vegetation Management Plan for Terrace Reserve Holiday Park Prepared for the North Coast Accommodation Trust by Idyll Spaces Environmental Consultants (January 2011)

Other Literature

- Coastal Cypress Pine Forest in the NSW North Coast Bioregion - endangered ecological community listing NSW Scientific Committee - final determination

  http://www.environment.nsw.gov.au/determinations/coastalcypresspinefd.htm
- Coastal Cypress Pine Forest in the New South Wales North Coast Bioregion - profile

  http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20081
- Coastal Cypress Pine Forest in the New South Wales North Coast Bioregion – Recovery Actions under the Saving Our Species Program
  http://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=20081
- Byron Shire Council Web-site under environment and Bushcare
- North Coast Regional Strategic Weed Management Plan 2017-2022 Local Land Services North Coast
- Draft PLAN OF MANAGEMENT for the TERRACE RESERVE HOLIDAY PARK, TERRACE PARK and BANNER PARK at BRUNSWICK HEADS Prepared by Integrated Site Design Pty Ltd (August 2010)
- Brunswick Heads Foreshore Reserves Strategic Plan prepared by the Department of Lands in 2008

2.1 Site Location and Study Area

The Terrace Holiday Park is the key site location shown in Figure 1a (yellow approximate outline). The study area included the site and land adjoining. The study area covered ~ 42ha see Figure 1b


1:2,257
0
30
60m
NSW

Figure 1a. The Terrace Holiday Park. Source: Six Maps 2018.

Figure 1b. Study Area. Source: Six Maps 2018. Yellow Highlight shows surveyed area ~ 40ha.

2.1 Vegetation Overview.

A detailed description of the vegetation on-site has been provided in the report by Kooyman (2017) and is not repeated here except to say the same diversity of species was identified on site during this survey.

In agreement with that report the vegetation in the southern precinct and adjoining land is Coastal Cypress Pine Forest in the New South Wales North Coast Bioregion Conservation status in NSW: Endangered Ecological Community.

Figure 2 shown the known distribution of this community – as per www.environment.nsw.gov.au Coastal Cyprus EEC (last update Oct 2017).

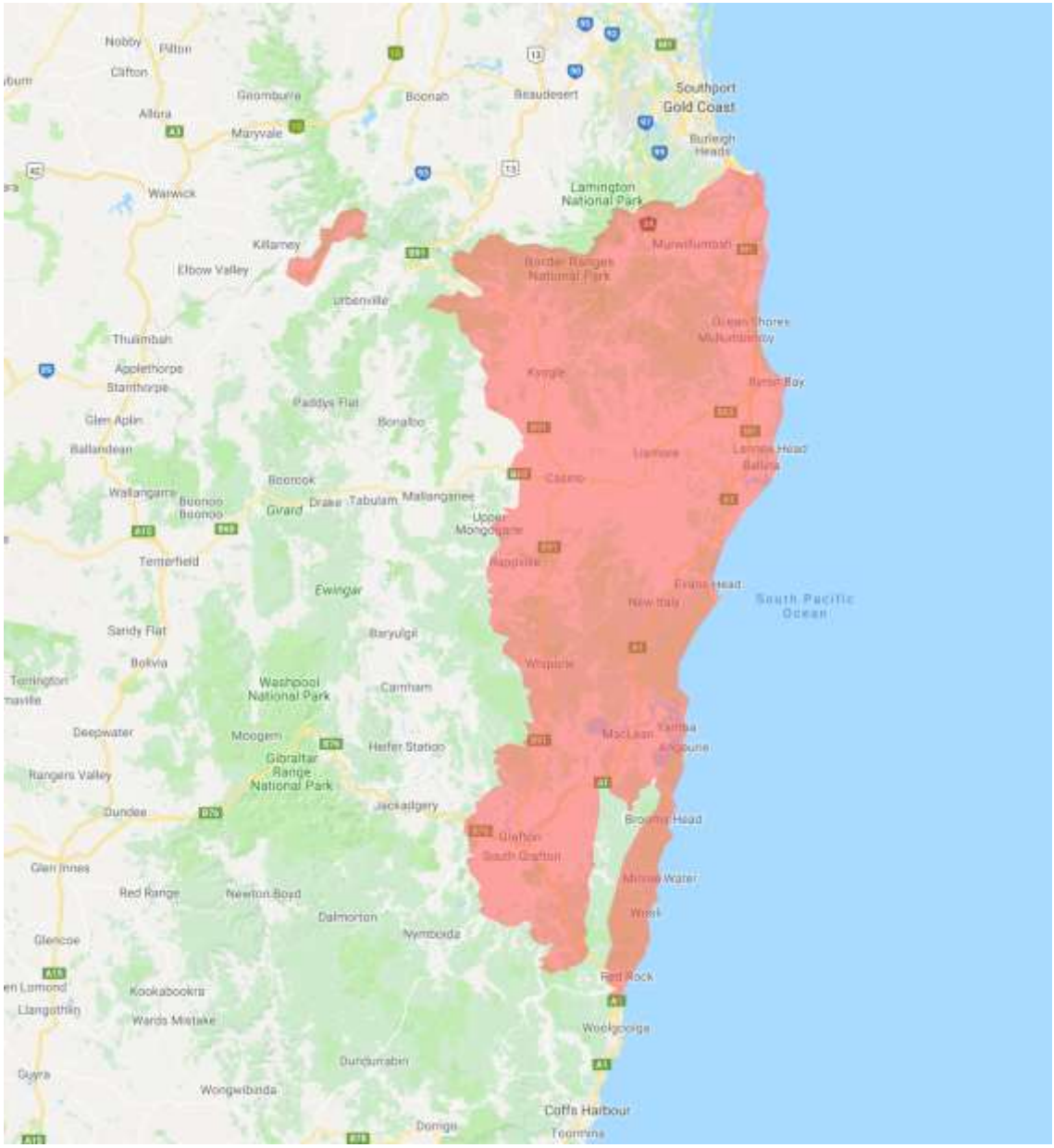

Figure 2. The Terrace Holiday Park. Source: www.environment.nsw.gov.au Coastal Cyprus EEC 2018.

3 Current Distribution and Condition

3.1 Distribution of Coastal Cyprus in the Location

To ascertain the potential impacts of the on-going use of the Southern precinct on the EEC and to determine opportunities for sustaining this EEC Community in the region an assessment was made of the local community of this EEC.

Figure 3 shows the local distribution of this community. Mapping was conducted by Geraldene Dalby-Ball of Ecological Consultants Australia in March/April 2018. The area of Coastal Cyprus is ~10ha with 1ha of this being in highly urbanised residential area and limited to isolated street and garden trees.

A further 0.85ha is isolated trees within the Terrace Holiday Park (see Figure 4). Mapping was conducted by walking the edge of the vegetation and creating a polygon. The EEC was deemed present where the canopy was dominated by Coastal Cyprus and other key canopy species form the EEC as per the final determination (Appendix I).

Its noted that the vegetation along the western edge of the road side was dense with weeds and the inner boundary (reserve side) of the EEC was determine through spot checks obtained by walking into the forested area every 20m to a depth of around 20m or where ever needed to see where the Coastal Pines stopped. It is noted that the Coastal Pine intergrades here with other EECS.

Figure 3. Location of Coastal Cyprus EEC. Source: ECA mapping March/April 2018.

Figure 4. Location of Coastal Cyprus Trees within cleared land at The terrace Holiday Park. Source: ECA mapping March/April 2018. ~0.85ha noting much is cleared land with remnant canopy.

Approximately 4ha is within public open space (foreshore or road reserve) as shown on Figure 5. It is noted that the area is larger than that shown in Figure 5. Figure 5 shows the key areas of Coastal Cyprus EEC in this location.

Figure 5a. Location of Coastal Cyprus Trees within the foreshore reserve and along the road reserve. Source: ECA mapping March/April 2018. ~4ha. The extent of the community in these reserves is greater than this map (with an additional ~6ha of marginal ECC)

Figure 5b. Location of Coastal Cyprus within the CCM of Reflections Holiday Park. Source: ECA mapping March/April 2018. ~3ha.

3.2 Current Condition

3.2.1 Southern Precinct - The Terrace Holiday Park

Current Condition is well documented and mapped in the ArborSafe Arborcultural Assessment – with respect to Trees. Site inspections by the ecologist focused on assessing mid and understory species from the community and identifying opportunities for enhancing these.

Findings

See Arboricultural Report for current condition of the trees. Findings and recommendations of that report were reviewed (and checked on-site) and concurred with – from an ecological perspective. It was noted that while natural regeneration of Coastal Pine seedlings were uncommon (3 found) the Pines were being successfully planted and there is wide scope for additional planting as discussed in recommendations section.

From an ecological perspective the EEC is represented by canopy trees almost exclusively. Under and mid-story species are largely absent however there is scope to convert areas of turf, especially at the interface with the riparian vegetation, back to the lower and mid-level of the EEC. The is discussed more in the recommendations section. Plates shows Coastal Pine growing in turf within the Parks boundaries.

Plate 1 Callitris and undersotry turf leading to the camping area of the Southern Precinct Easter Day 2018

Plates 2 and 3 show the southern end of the Park adjoining the riparian zone where naturally occurring mid and understory species are growing.

Plate 2 Callitris and understory along the foreshore area of The Terrace Southern Precinct Easter Day 2018 NB: this area is not open for recreation use.

Plate 3 Callitris and understory along the foreshore area of The Terrace Southern Precinct at the far southern end NB: this area is not open for recreation use.

3.2.2 Current Condition – urban residential

Immediately adjoining the Holiday Park is an area of residential dwellings and street. Coastal Pines are growing within the road reserve and the gardens of the residential dwellings See Plate 4 as an example. Gardens observed are planted mostly with exotic species.

Plate 5 shows the road reserve adjoining the park. This area has a high potential for revegetation with Coastal Pine EEC. See recommendations section. Approximate area 1100m^2.

Plate 4 Residential area road reserve with Coastal Pine EEC (canopy species)

Plate 5 Road Reserve alongside Park with high potential for revegetation with Coastal Pine EEC

3.2.1 Current Condition – foreshore lands

Coastal Pine EEC is growing along the reserve between the Pacific Hwy and Simpsons Creek. This area is ~ 3.5ha. Approximately 20% of the area is sloping foreshore lands where the EEC adjoins intertidal areas with Mangroves.

The remaining land is flat and mown with remnant Coastal Pines in clusters and isolated. Native ground and mid vegetation are restricted to unmown areas under clumps of trees and make up less than 10% of this open flat area.

Bushcare is occurring in this area and the clumps of vegetation have low weed density.

This area has a very potential for further rehabilitation and revegetation with the Coastal Pine EEC. See Plates 6 to 8 for current condition and opportunities.

Plate 6 Coastal Pine on foreshore – high potential to convert mown areas to this EEC

Plate 7 Coastal Pine on foreshore – weed management would see native species return to the ground and mid layers of this EEC

Plate 8 southern end of this foreshore area (at Bowling Club) Coastal Pines in turf and parking. Opportunities for consolidating parling and rehabilitating the EEC in this area

3.2.2 Current Condition West of the Pacific Hwy and Brunswick Heads Nature Reserve

West of the Pacific Hwy there are dense stands of vegetation and that closest to the road is Coastal Pine EEC.

The EEC is within the road reserve – mown area with isolated trees and within the reserve area and private land area (forested). Approximately 2.5ha in growing in this area.

Weed impact in this area is high and it appears there is no active bushland management in this zone.

High potential for increased sustainability of the community with weed management implemented. See Plates 9-11.
Here the Coastal Pine EEC intergrade with another EEC – See Plate 12.

Plate 9 Road Reserve along Pacific Hwy with Coastal Pine – isolated trees in turf and weedy edge with remnant canopy.

Plate 10 Coastal Pine within dense Asparagus Fern (weed)

Plate 11 Coastal Pine EEC along Pacific Hwy – weed dominated edge

Plate 12 Good Condition Forest Wetland Vegetation adjacent to the Coastal Pine EEC along Pacific Hwy.

4 Proposed Works

Vegetation Management Works include actions to implement tree protection mechanisms including load cells to spread weight, a reduction in site density, designated site dimensions and sizes, a refining of site usage, specific tree protection measures and the allocation of specific areas to regeneration and assisted regeneration these are detailed in ArborSafe (March 2018).

Defining protection areas around trees reduction in the number of sites and set-backs from trees with use limited.

Installation of load cells Ground protection measures are to be put in place to minimise impacts to the tree roots see the ArborSafe (March 2018) report for recommended locations. Locations were proposed were examined as part of this assessment and biodiversity values will be retained as the cells are porous and allow water infiltration.

Areas proposed for camping within the CCPF do not require any form of ground protection if vehicle parking is excluded from the TPZ and camping from the SRZ.

The installation of permanent screw anchors should be instigated at obvious key locations around the sites. These anchor points will negate the need for hammering in new pegs, each causing potential root damage every time there is an occupancy changeover

Mulching The pros and cons of adding mulch around the SRZ of the individual trees situated in the Southern Precinct has been reviewed and it is recommended that Structural Root Zone (SRZ) and rehabilitation areas (turf to CP EEC) be mulched with a native forest blend or wood chip mulch that conforms to AS4454–2012. Mulching will NOT occur in areas of possible natural regeneration of the EEC. Mulch generated from works onsite can be used if allowed to compost in a pile for between 3 and 6 months. Application of fresh, 'green' mulch around trees is to be avoided as this can induce a nitrogen drawdown, which can result in the mulch drawing nitrogen from the soil resulting in plants with nutrient deficiencies.

The outcome of mulching will be monitored annually to determine the level of benefit to the trees and modify as appropriate. Detailed mulch specifications have been given in Appendix D of the Arboriculture Report.

Tree Management Pruning recommendations from the report ArborSafe (March 2018) are detailed in Appendix F of that report and include the removal of deadwood/stubs (minor work) and the removal of selected branches from 30 trees (25, 29, 30, 38, 50, 51, 53, 62, 65, 68, 76, 82, 98, 100, 109, 116, 121, 122, 127, 131, 136, 142, 153, 174, 196, 200, 201, 207, 231, 260).

Tree Removal three Callitris trees (232, 234 and 238) are proposed for removal (of the 115 CP). While most of the trees have a life expectance over 10 years these three have under five years and a high safety risk from an arboriculture perspective. Trees were carefully observed for signs of key fauna habitat, hollows etc. Care will be taken when removing these trees so that mammals are protected during works. Trees can be utilised on-site to created buffers to stop the access to vegetation rehabilitation areas including under existing trees.

Planting and Rehabilitation of CP EEC Vegetation works include planting canopy, mid and ground level species from the EEC and convert turf areas to areas of native plants from the EEC community including under planting the existing trees with species from the CCPF.

Simpson Reserve (formally South Terrace Reserve) is a narrow Reserve situated between the estuary edge and the main entrance road into Brunswick Heads. It's located immediately south of Terrace Holiday Park and is not part of the commercial camping area. This area retains well-developed stands of Coastal Cypress amongst extensive areas of mowed grass. This area is within the lease area and bush regeneration will occur in remnant CP EEC as well as conversion of turf to CP EEC areas. All weeding should be undertaken by hand. Any chemical use must not impact the regeneration of CCPF. Works will be done by experienced bush regenerators.

Removal of Exotic Vegetation All exotic trees and shrubs not aligning with the CCPF will be systematically removed from the southern precinct over time and replaced with CCPF associated species. This includes the removal of the *Murraya paniculate* hedges and various shrubs.

Signage and Engagement The significance and vulnerability of CCPF would be unknown by the majority of site visitors. Informative and educational signage is likely to increase the respect and understanding of the importance of CCPF by site users. Example wording may include (source: Arboriculture Report ArborSafe 2018);
The Cypress Pine trees within Terrace Reserve form part of an endangered ecological community named 'Coastal Cypress Pine Forest in the NSW North Coast Bioregion' (CCPF). The forest is in a vulnerable condition and in order to preserve the viability of the forest, please park in designated locations only, refrain from discharging waste water in the area and do not damage the trees in any way'

Infilling of low areas with clean sand A course grade sand (an inorganic mulch) has been recommended for areas where depressions in the natural soil grade have been created by vehicle or storm wear or where structural roots have been exposed. The sand will allow free drainage to the underlying soil profile, so no perched water tables are created, while providing support and protection. The infilling is expect to have a positive outcome with increased protection to sub-soils.

5 Test of Significance (5-part test)

Test of Significance for determining whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats - *Callitris columellaris* (Coastal Cypress Pines)

Test of Significance (5-part test for the Endangered Ecological Community (EEC) of Coastal Callitris Pine Forest (CCPF), namely the *Callitris columellaris* (Coastal Cypress Pines). The CCPF was designated as an EEC in 2008. This 5-part test investigates the possible impacts of proposed vegetation works being: defining and mulching protection areas around trees, installation of load cells, tree management pruning, tree removal, planting and rehabilitation of CP EEC, removal of exotic vegetation, educational signage and infilling of low areas with clean sand - all measures detailed in the Recommendations in the Arboriculture Report (Arbor Safe 2018).

(1) *The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:*

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

CCPF is not a threatened species

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

The activity has 3 components and each is listed here with an assessment of its likelihood to have an adverse effect on the **extent** of the community.

The activity proposed is:

Tree protection works being the increased protection for tree roots via the installation of permeable, weight spreading surfaces at camp sites (installation of load cells), designated maximum camping footprints at each site, set places for tent peg tie-off (details are provided in the Arboricultural Impact Assessment March 2018).

This component of works will assist in tree retention relative to the existing use. The expert Aboricultural advice has recommended these actions and concludes that the trees will continue to grow well in this area. Materials recommended for load spreading have been reviewed along with specific camp locations. There is not an adverse effect on the extent of the community by undertaking the recommended tree protection works.

The reduction in sites increases the potential to replant and regenerate areas of CCPF on the site so overall the *extent of the community is to be increased.*

Tree management works comprising of removing dead wood and removal of three trees is proposed for safety reasons. Currently the number of semi-mature and mature trees within the Southern Precinct of the Terrace Holiday Park is 115 trees. This number includes 105 *Callitris columellaris* (Coastal Cypress Pines) which are the dominant tree within the CCPF. The majority of the 115 existing trees located within the Southern Precinct were assessed as being in good health (79), with the remainder being fair (39) or poor (3), during the most recent 2018 ArborSite assessment.

The 3 trees in poor condition are proposed for removal. While this reduces the number of trees (from 115) is does not reduce the extent of the EEC. Replanting will occur at a ratio of minimum 10:1 with on-going monitoring.

Re-vegetation Works are confined to areas that are currently tuft and transforming these into areas with at least the plants species of this EEC. The species for planting are those in the EEC and listed as native and currently growing on-site (R. Kooyman Oct 2017). On-site investigations back up the findings of this report with regard to species present. Re-vegetation works are in the VMP and will require a minimum expansion of the EEC area of 300m^2 per annum (for at least 5 years) resulting in progressive increases in extent.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

The composition of the EEC currently in the existing use area is a modified section of the EEC and is comprised of turf and exotic plant understory and Callitris Pine canopy. The proposed activities (as in (i)) will see the modification of turf within the CCPF on-site converted to native under and mid story species at a rate of 200m^2 each year on-site and likely larger areas as they becomes available. Will be written for this land and specific VMP will detail areas to be revegetated.

The other areas of the CCPF outside the southern precinct can be replanted (areas existing as turf) and bush regenerated (in areas of bushland).

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The current total number of existing semi-mature and mature trees within the Southern Precinct of the Terrace Holiday Park is 115 trees. This number includes 105 *Callitris columellaris* (Coastal Cypress Pines) which are the dominant tree within the CCPF. The majority of the 115 existing trees located within the Southern Precinct were assessed as being in good health (79), with the remainder being fair (39) or poor (3), during the most recent 2017 ArborSite assessment.
Three trees, all listed as poor, are proposed for removal.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

Areas with CCPF are already fragmented with the distribution being both patchy and restricted (see also this description in the final determination). The CCFP EEC was found to be growing in an area covering approximately 7ha in the immediate vicinity of the Holiday Park with the southern precinct making up 0.75ha of that area. The 7ha includes ~ 1ha of residential land and highly fragmented EEC, foreshore reserve area (over 3ha) with high potential for the restoration of existing PCCF EEC and incremental re-creation of PCCF EEC.

Additional areas of CCPF EEC occur on the western side of the Pacific Hwy (~2ha). Currently these are the most impacted by weeds. No works are proposed in these areas now, as part of this plan, however they are potential areas for rehabilitation.

The proposed activity will not further fragment the EEC and on-ground rehabilitation works will increase the area of ground and mid story vegetation under existing Callitris and link patches with understory both on and off site.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

The three trees that are in poor condition will have no negative impact on the EEC. Cut wood can also be included in the local revegetation projects such that the wood stays onsite and can act as informal edging protecting areas that have been rehabilitated or planted (recreated).
There will be no increase in fragmentation or isolation.

A minimum of 30 trees of the same species will be planted on-site and maintained until they reach maturity and beyond.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

not a declared area

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The proposed activity includes tree removal which is part of the key threatening process of 'clearing'. The proposal also has activities that go towards mitigating the loss of the 3 trees including replanting locally collected and propagated seed form these trees and associated ground and mid-story.

At least 2000m^2 is to be actively rehabilitated each year and an additional 200m^2 re-created annually and maintained on-going. Re-creation of EEC in existing areas of turf is finite however maintenance is not. Once all relevant areas are converted to EEC then these areas are to have on-going maintenance.

6 Recommendations

The following recommendations have been made with the aim of maximising the long-term survival of the Coastal Pine EEC and increase both its area of coverage and resilience.

Effective management of ecosystems occurs at a landscape scale. It is noted that there are currently no projects or key management sites listed for this community with Office of Environment and Heritage – Saving Our Species. So what is planned here is recommended to be listed with them as an official site. See the page below calling for input for management sites and voluntary agreements from landowners.

Recommendations have been made to minimse impact on-site, maximise awareness and education on-site and improve and restore adjoining off-site locations.

Extract from OEH website under Saving Our Species
Key management sites for ecological communities are being identified by the Office of Environment and Heritage and other program partners, where feasible, cost-effective and beneficial to the ecological community. Currently, no management sites have been identified for this ecological community.

Are you or is someone you know doing conservation work for this ecological community or in this area?
Contact us to tell us about the work. Your input will help OEH evaluate the status of threatened ecological communities and provide a broader picture of conservation work across NSW.
http://www.environment.nsw.gov.au/SavingOurSpecies/survey.htm

Action toolbox

Action Description	Scale
The extent and condition of this ecological community will be improved or maintained primarily via positive management consistent with Catchment Action Plans, water management plans, and by regulating clearing. Where it occurs on private lands, this ecological community will also benefit from voluntary agreements with landholders to manage the land for conservation purposes.	Site

How will this ecological community be managed?

Key management sites for ecological communities are being identified by the Office of Environment and Heritage and other program partners, where feasible, cost-effective and beneficial to the ecological community. Currently, no management sites have been identified for this ecological community.

Management sites

Click on column headers to sort

Site name	Site type	Status	Local government area (LGA)
Currently no priority sites identified			

Are you or is someone you know doing conservation work for this ecological community or in this area?

Contact us to tell us about the work. **Your input** will help OEH evaluate the status of threatened ecological communities and provide a broader picture of conservation work across NSW.

6.1.1 Recommendation for Recovery

Threats listed for this EEC on Office of Environmental, and Heritage (OEH) profile for this community are listed below and each has been addressed in the recommendations in relation to on and off-site works:

- Occurrence in small, isolated stands enhances risks from environmental stochasticity, disruption to pollination and dispersal of fruits or seeds, and likely reductions in the genetic diversity.
- Edge encroachment associated with maintenance of service easements and fence construction.
- Trampling and rubbish dumping where the community is close to towns and recreational sites.
- Invasion of weeds, which may form a dense understorey or ground layer, displacing native understorey species and inhibiting recruitment of canopy species. Principal weed species include *Asparagus aethiopicus, Bryophyllum delagoense, Chloris gayana, Lantana camara, Ochna serrulata* and *Schefflera actinophylla.* Other weed species recorded in the community include *Panicum maximum, Rhaphiolepis indica, Solanum nigrum and S. seaforthianum*.
- Inappropriate fire regimes. The dominant species, *Callitris columellaris*, may be killed by crown fires or heavy scorching of the lower trunk. High frequency fires are likely to be deleterious while occasional fires may be needed to create gaps for regeneration.

Recovery Strategies - on Office of Environmental, and Heritage (OEH) profile for this community
A targeted strategy for managing this species has been developed under the Saving Our Species program – none yet developed.

Activities to assist this species - on Office of Environmental, and Heritage (OEH) profile for this community

- Avoid edge encroachment and trampling, using defined walking tracks and fencing where appropriate.
- Undertake weed management in remnants.
- Generally avoid fire in this community but arrange ecological burning where assessed by OEH as necessary for regeneration.
- Expand and connect isolated remnants by planting and/or bush regeneration.

6.2 On-site works to minimise damage and maximise awareness and education – Southern Precinct

6.2.1 Maximising Tree health and longevity

- Implement all the recommendations of the ArborSafe Arborial Cultural Assessment March 2017.
- Seed collect and propagate Coastal Pine.
- Plant Pines in appropriate locations – near existing pines to allow for long-term replacement of canopy. Recommend planting 50 per year over 5 years and then 20 per year in perpetuity with the assumption that 25% will make it to maturity.

6.2.2 Maximising health of existing Coastal Pine Community (CP EEC) (mid and understory) and associated coastal processes

- Convert area of turf to typical CP EEC through actively planting.
- Planting to be a minimum of 6 different species with no 1 species being more than 20% of the planting. Plant species to be form the list in Appendix I.
- Recommended species are included below. All must be locally native stock – that is collected from only as far as it main pollinator would reasonably travel.
- 800 - 1000m^2 2is available for converting from turf to native species.

Canopy – the following order of abundance

- *Callitris columellaris* (Coastal Cypress Pine),
- *Eucalyptus tereticornis* (Forest Red Gum)
- *Eucalyptus robusta* (Swamp Mahogany),
- *Lophostemon confertus* (Brush Box),

Mid story - the following order of abundance

- *Banksia integrifolia* subsp*. Integrifolia* and *Banksia serrata*
- *Acacia ulicifolia* (Prickly Moses),
- *Leucopogon ericoides* (Pink Beard-heath),
- *Leucopogon leptospermoides* (spiky)
- *Monotoca elliptica* (Tree broom-heath)

Grasses

- *Aristida vagans* (Three-awn Speargrass),
- *Eragrostis brownii* (Brown's Lovegrass),
- *Imperata cylindrica* var. *major* (Blady Grass) and
- *Paspalidium distans*

Ground edges'

- *Lomandra longifolia (NB must be local stock and not more than 25% of planting in any one area)*
- *Dianella caerulea (NB must be local stock)*
- *Oxylobium robustum*
- *Leucopogon ericoides* and *L. leptospermoides* (spiky)

Examples images for plants that could create a green screen and biodiversity area along the existing turf road reserve.

Examples of native spiky shrubs, that are part of the Coastal Pines EEC.
Spiky species can be planted as buffer to area of more sensitive vegetation.

Leucopogon ericoides

Leucopogon leptospermoides

Acacia ulicifolia

Monotoca elliptica

Plate 13 a- d Spiky shrubs that can be planted as buffer to sensitive areas and around the base of Coastal Pines.

6.3 Off-site works to maximise Coastal Pine EEC sustainability

Off-site works are recommended for all the areas listed in this report. The following section summarises recommendations for each area. All are additional to the recommendations on-site and not relied upon to achieve a neutral biodiversity outcome.

6.3.1 Road Edge Conversion to Fully Structured Coastal Pine EEC

The area of road verge that is potential PC EEC re-creation is shown in Figure Benefits of converting this from turf to fully structured vegetation of Coastal Pine EEC includes:

- Coastal Pine EEC recreated 600-800m^2 in area (remove exotic grass and conversion to EEC ground, mid and canopy. NB this leave a 2m wide strip that would be just ground covers to facilitate sight lines and walking off-road.
- Visual amenity for the residents whose properties look into/over the Holiday Park Southern precinct area.
- This side of the road is currently no parking so there would be no loss of car-parking spaces.

The cost of establishment and maintenance can be covered by The Terrace Holiday Park and works conducted under an MOU with the land owner. Qualified experienced bushregenerators or equivalent can do the on-ground works or others under the direction of an ecologist.

End result would be a minimum of 6 plants per m^2 including one canopy trees for every 10m^2.

Figure 6 area of road reserve recommended for re-creating as CP EEC. Source Six Maps April 2018.

Plate 14 vegetation buffer with Coastal Pine EEC species and Coastal Pine seedlings on the Holiday Park side of the log-fence on road reserve.

6.3.1 Foreshore Reserve Regeneration of Coastal Pine EEC

Recommended to provide resourcing for at least 4000m^2 of CP EEC within this area and work with and support bushregeneration in areas that already have ground and mid story.

In conjunction with Council and community identify areas within the mown locations that could be converted to native PC EEC species resulting in larger patches, smaller edge effects and greater resilience. This could be done on an annual basis with 200m^2 being added per year and then maintained.

The Holiday Park could assist in facilitating accommodation for the express purpose of bringing back this ECC. This would follow the success of other similar projects such as Asparagus Fern Out Weekends https://www.yha.com.au/about/news/pittwater-yha-offers-free-beds-for-green-hearts/ and more at: https://www.youtube.com/watch?v=A0SwmNS1kMM hosted in accommodations in Pittwater in NSW and Recreating of Swift Parrot Habitats in the Central West. Programs can also sponsor the local community with provision of tools, training and promotion.

Such projects could supplement the works already occurring there through the Bushcare group. The proposal would be finalised in conjunction with the Bushcare group and Council's environmental team.

Table 2. Summary of Mitigation Activities associated with each year of operation of the VMP.

Mitigation Measure	Timing			Frequency	Zone				Responsibility
	Pre-works	During Operations	On-going		On-site	Road reserve	Foreshore	Other – as needed	
Biodiversity Management									
Fencing of protected vegetation to keep out activities that could damage it.	✓			Prior to commencement of works and continually maintained.	✓	✓	✓		Construction contractors.
Replanting Activities									
Collection of native seeds if planting is to be from locally native species.		✓		Once, at least 6 months prior to planting.	✓	✓	✓		Bush regeneration contractors.
Seed propagation see above.		✓		Once for initial planting and then as required for replacement plantings.					Bush regeneration contractors.
Triggering of soil seedbank to encourage natural regeneration in areas of medium to high resilience.		✓		Once, followed up by continual monitoring and weed control. Could	✓	✓	✓		Bush regeneration contractors.

Mitigation Measure	Timing			Frequency	Zone				Responsibility
	Pre-works	During Operations	On-going		On-site	Road reserve	Foreshore	Other – as needed	
				use flood simulation.					
Direct seeding and planting.			✓	Once for initial planting and then as required for replacement plantings.			✓	✓	Bush regeneration contractors.
Confirmation of the successful supply and installation of local provenance native seed.			✓				✓	✓	Bush regeneration contractors.
Installation of a 75mm layer of mulch to planted areas and/or in cleared areas to suppress weeds.			✓		✓	✓	✓	✓	Bush regeneration contractors.
Sediment and Erosion Control – if required eg along foreshore works									
Implementation of sediment, soil or water management plans as part of the broader Construction	✓	✓	✓	Applied continually and daily.	✓	✓	✓	✓	Construction contractors.

Mitigation Measure	Timing			Frequency	Zone				Responsibility
	Pre-works	During Operations	On-going		On-site	Road reserve	Foreshore	Other – as needed	
Environmental Management Plan.									
Bush Regeneration									
Primary weeding.		✓	✓	Every second month.	✓	✓	✓		Bush regeneration contractors.
Secondary Weeding.		✓	✓	Quarterly.	✓	✓	✓		Bush regeneration contractors.
Weed inspections.		✓	✓	6 monthly	✓	✓	✓		Ecologist.
Maintenance Activities									
Pest and disease monitoring.			✓	As required.	✓	✓	✓		Bush regeneration contractors.
Maintenance weeding.			✓	Quarterly.	✓	✓	✓		Bush regeneration contractors.
Maintenance watering.			✓	Initially after planting					Bush regeneration contractors/owner.
Replacement plantings.			✓	Approximately 6 months following initial planting			✓	✓	Bush regeneration contractors /site manager.
Maintenance inspections.			✓	Quarterly.	✓	✓	✓		Bush regeneration contractors.

Mitigation Measure	Timing			Frequency	Zone				Responsibility
	Pre-works	During Operations	On-going		On-site	Road reserve	Foreshore	Other – as needed	
Reporting		✓	✓	Yearly throughout the implementation of this plan then as needed.	✓	✓	✓		Ecologist.
Confirmation of completion of key performance indicators.			✓	Once all performance criteria have been met. Criteria to be determined.	✓	✓	✓		Ecologist/Bushregenerators/Owner.

Example targets – to be determined prior to plan finalization.
Reduction in weed density to 50% or less in all management zones within one year.
Reduction in weed density to 25% or less in all management zones within five years.
No high-risk (as per Biosecurity Act) aquatic weeds.
Evidence of gradual expansion of native plant cover.

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7 Mitigation and Rehabilitation

Activities to be implemented

Table 3. Checklist.

Management Measure	Details
Soil and Water Management	• Plans relating to the management of soil, sedimentation, erosion and water are being detailed for the riparian edge. • Stormwater management is to prevent accidental spread of exotic species to the riparian zone and vegetated buffer area.
Access Controls	• Parking, access/egress routes, stockpiles and materials storage areas must be identified and mapped outside the protected vegetation areas.
Biodiversity Protection	• Exclusion zone fencing must be erected to protect the native flora habitat within the site.
Weed Control	• Weeds must be managed. Weed propagules must be disposed of such that they can not spread elsewhere.

7.1.1 Primary Weed Removal

Low impact bushland regeneration methods will be utilised to meet weed control performance criteria in all areas of remnant native vegetation, to prevent unnecessary impacts to native vegetation and disturbance to soil. Low impact bush regeneration methods include the manual removal of herbaceous weeds and their propagules by hand and with hand tools. All bush regeneration activities requiring the use of chemicals must be performed in accordance with the NSW *Pesticides Act 1999.* Herbicides must not be applied whilst exotic plants are setting seeds. The weed removal program aims to be broad in approach and sustained in application to provide the best possible conditions for natural regeneration and to control weeds within the site. Weed removal will be performed until the site exhibits 50% or less cover within two years in all management zones and 25% or less weed cover within five years.

7.1.1.1 Key Threatening Processes

Weed removal additionally aims to impede key threatening processes (KTP), to fulfil the requirements of the Biodiversity Conservation Act (2016), the EPBC Act and DPI vegetation management plan guidelines.

Table 4. Key Threatening Processes.

Key Threatening Process	Act	Details
Invasion and establishment of exotic vines and scramblers	BCA	The site contains a diversity of exotic vines. Bush regeneration will aim to reduce impacts of exotic vines and scramblers upon native vegetation.
Invasion of native plant communities by exotic perennial grasses	BCA	The site contains a diversity of exotic perennial grasses encroaching upon native vegetation. Bush regeneration will aim to reduce impacts of exotic grasses upon native vegetation.
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants	EPBC	*Lingustrum* sp. is an example of plants which were once garden plants that have become noxious weeds. These species were observed to be abundant within the site and significant management focus will be placed upon controlling them.

Although soil borne pathogens have not been identified as a KTP, accidental spread of pathogens can occur during pre-construction, construction and post-construction phase. To prevent the introduction of pathogens, Bushland Hygiene Protocols outlined in Appendix B must be followed. The hydrological conditions of the site may promote the spread of Phytophthora (a group of fungus-like diseases affecting plants) due to its moist soil and proximity to water. It is recommended that Bushland Hygiene Protocols be followed closely.

7.1.1.2 Weeds

The following weeds have been observed within the site and must be controlled. Noting that the new *Biosecurity Act 2015* provides location specific requirements. The old descriptions of the Noxious Weed Act have also been included in Table 5 as they provide a good description of what's needed. See Table 5 below.

Table 5. Weeds present onsite.

Scientific Name	Common Name	Legal Requirements (old as per Noxious Weed act – not repealed description as Guidance only)
Asparagus asparagoides	Bridal Creeper	The plant must not be sold, propagated or knowingly distributed. Whole of NSW
Asparagus aethiopicus	Ground Asparagus	The plant must not be sold, propagated or knowingly distributed. Whole of NSW
Bryophyllum sp.	Mother of Millions	The plant must be continuously suppressed and destroyed.
Chrysanthemoides monilifera ssp. monilifera	Boneseed	The plant must be eradicated from the land and that land must be kept free of the plant. Whole of NSW

Scientific Name	Common Name	Legal Requirements (old as per Noxious Weed act – not repealed description as Guidance only)
Ligustrum lucidum	Broad-leaf Privet	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread
Ligustrum sinense	Small-leaf Privet	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread

7.1.1.3 Weed Removal Methods

As part of this VMP, weed removal methods have been provided tailored specifically to the site. Along with traditional bush regeneration techniques, flame (thermal) weeding has been recommended in controlling non-seeding annuals and grasses. Thermal weeding may stimulate natural regeneration and germinate of native species as well as achieving ecological burns. See Table 6 below.

Table 6. Weed Removal Methods.

Weed type	Primary control treatment	Follow-up control	Maintenance weeding post-planting (revegetation)	Disposal
Woody weeds (e.g. shrubs and trees)	Cut/scrape and paint with herbicide for small shrubs[1]. Large trees greater than four metres high and diameter > 10 cm drill and inject with registered herbicide[2].	Retain dead trunks in or on ground has habitat. Continue to Cut/scrape and paint remaining weeds. Monitored monthly and controlled as required (and within a minimum of three months) and up until the date of final plantings.	Cut/scrape and paint germinating weeds. Monitored and carried out regularly for a period of five years from the date of final planting.	Raft and pile non-reproductive parts on site (for later pile burns or left as habitat) and bag flower heads, berries and seeds.
Climbing weeds (e.g. vines and scramblers)	Hand pull/ Dig juvenile growths and bag. Bag seeds, pods and flowers then skirt vines out of the canopy and Scrape and paint for	Scrape and paint and bag reproductive parts. Monitored monthly and controlled as required (and within a minimum	Scrape and paint and bag reproductive parts. Monitored and carried out regularly for a period of five years from the date of final planting.	Bag and remove from site.

Weed type	Primary control treatment	Follow-up control	Maintenance weeding post-planting (revegetation)	Disposal
	established growths. Scrape from the base up the stem covering 1 m length. Large infestations foliar spray using registered herbicides.	of three months) and up until the date of final plantings.		
Herbaceous weeds	Hand removal or is essential Treatment using a combination of non-selective and selective herbicides where damage to adjoining native vegetation can be avoided.	Spray or hand pull seedlings. Monitored monthly and controlled as required (and within a minimum of three months) and up until the date of final plantings.	Spray or hand pull seedlings. Monitored and carried out regularly for a period of five years from the date of final planting.	Bag and remove from site.
Exotic grasses and broadleaf annuals around native grasses	Hand-weed around natives. Low volume spot spraying of broadleaf selective and non-selective herbicides if required also consider flame (thermal) weed in areas of large infestation of grasses and annuals NB NOT IN Coastal Pine EEC.	Continue hand weed prep and spot spraying for re-established growths. Hand pull and bag weeds in amongst natives. Monitored monthly and controlled as required and up until the date of final plantings.	Hand weed isolated patches. Monitored and carried out regularly for a period of five years from the date of final planting and on-going as required.	Bag and remove from site.
Weeds and seedlings in close proximity to protected	Hand weed prep around natives and hand weed or for extensive areas spot spray.	Spray prep around natives and Spot spray. Where possible hand weed. Monitored monthly and controlled as	Monitored and carried out regularly for a period of five years from the date of final planting.	Bag and remove from site.

Weed type	Primary control treatment	Follow-up control	Maintenance weeding post-planting (revegetation)	Disposal
native vegetation		required (and within a minimum of three months) and up until the date of final plantings.		
Bulbous and succulent weeds	Hand pull/dig, bagging all plant parts and removing from site[3].	Foliar spray and/or Cut and Paint.	Monitored and carried out regularly for a period of five years from the date of final planting.	Bag and remove from site.
Aquatic weeds	Hand dig/pull juvenile plants. Contact your local weed officer if you require a permit to spray near water.	Hand pull.	Monitored and carried out regularly for a period of five years from the date of final planting.	Bag and remove from site.

Note: [1]Some weeds will have different treatment requirements i.e. *Ochna serrulata* requires scrape and paint on one side with stem width less than 2 cm thick, scrape and paint both sides from root to 2/3 up the stem >2 cm thick. *Ligustrum s*pp. and Lantana are treated with cut and paint.
[2] After drill and inject treatment, the plant usually will drop its leaves within six weeks and dies within a few months. Monitor the plant and if it resprouts, the process will need to be repeated. Drill around the base of the tree and on exposed lignotubers less than 20mm apart and as deep as possible.
[3] If hand pulling/dig, ensure all reproductive parts of the plant e.g. corms, tubers and rhizomes are removed.
See Appendix I for more details on Bush Regeneration Techniques.

7.1.1 Soil Stabilisation

The banks of the creek running through the site were not observed to be extensively eroded, with vegetation currently providing sufficient soil stabilisation. Soil stabilisation may be required throughout the project in the riparian zone where bank erosion may be a risk. The installation of soil stabilisation apparatus may be performed at the discretion of the Engineering personnel, the Environmental Officer and bush regeneration contractors. Thick jute mesh will be applied to areas requiring soil stabilisation with the added benefit of suppressing weed growth. Soil stabilisation may be required after primary weed removal works.

7.1.2 Woody Debris and Mulching

All trees, native vegetation, and plant litter to be removed for safety purposes, falling within construction footprints may be used as mulch throughout all management zones. These activities

must be performed at the discretion of the bush regeneration contractors in consultation with the project ecologist.
Mulch stockpiles must be kept under 1m in height, must be monitored for the presence of weeds and turned frequently to avoid spoilage. If the site does not contain enough mulch in situ, a native composition mulch may be imported to the site.

7.1.3 Seed Collection

Plants to be used during planting activities within the site must be propagated from native seed collected from within the site and other appropriate areas within 10km of the site at the discretion of the bush regeneration contractors. Seed collection must be undertaken in accordance with Florabank Guidelines by an appropriately experienced bush regeneration contractor with appropriate licences and permits under the *National Parks and Wildlife Act 1974* to collect seed from protected flora.

7.1.4 Plant Propagation

Plants may be propagated by a local nursery or the bush regeneration contractors if they have the appropriate facilities. In either case, plants must be propagated by an organisation that is a member of a recognised industry association. 10-20% of planting stock may be expected to fail and subsequently, seeds must be stored to allow for propagation of replacement stock to allow for an 80% survival rate of each species

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7.1.5 Secondary Weed Removal

Secondary weed removal will occur quarterly, considering the life cycles of targeted weed species, with greater effort required in the warmer months when weed growth will be greater. Secondary weed removal will follow the protocols outlined for primary weed removal, with more of a focus on controlling new weed growth in their early stages to prevent future release of propagules. Secondary weed removal aims to maintain optimal conditions for the regeneration and growth of native plants by reducing the competitive pressures. Exotic plants typically outcompete native species for soil nutrients and water and can shade out native plants, resulting in fatalities and decreased vigour.

7.1.6 Plant Establishment

Planting must be undertaken by an appropriately experienced bush regeneration contractor or person with equivalent skills. Native vegetation plantings within management Zone 2 must be performed post-construction once performance criteria are on their way to being met to ensure that plantings do not get outcompeted by exotic flora. Plant Replacement is required to achieve the final 5m of vegetated edge in the area that is now turf. Nothing that vegetation many be ground covers. The extensive bushland along other sections of creek more than amply make up for the reduction in this outer 5m of the 10m wide zone.

7.1.7 Maintenance Inspections

Management inspections will take place to gauge how all management zones are responding to rehabilitation works, and whether they are meeting performance criteria. Maintenance inspections will be performed by comparing the objectives of the project to the maintenance information recorded by the bush regeneration contractors. Maintenance inspections must be performed quarterly during the construction phase, reduced to bi-annually during the post-construction phase if performance criteria are being consistently met.
Quarterly or bi-annual maintenance inspections (for 1 year) must include the following items:

- **Weeds:** Weeds must be assessed in terms of total weed cover per management zones with average densities of each species provided and updates to treatment recommendations.
- **Pests and disease:** Regenerating areas within all management zones must be monitored for herbivory by exotic and native fauna and the presence of any other disease or infection. The species being impacted must be recorded in addition to the type of pest or disease, proportion of total individuals being impacted and treatment recommendations.
- **Mulch:** Mulched areas should be maintained to a depth of 75mm. Alterations to mulching requirements may be made at the discretion of the bush regeneration contractors.
- **Sedimentation and Erosion:** Regenerating areas within all management zones must be monitored for erosion and sedimentation, particularly within the riparian zone with actions made if necessary.

7.1.8 Checklist

Activities to be implemented in the Post-Construction Phase are outlined in Table 8 below.

Table 8. Checklist.

Management Measure	Details
10. Soil and Water Management	• Soil, sedimentation, erosion and water management strategies implemented in earlier phases are to be retained where appropriate to continue to protect native vegetation zones from additional minor works and impacts arising from site operation.
11. Access Controls	• Parking, access/egress routes, stockpiles and materials storage areas must be identified and mapped outside of biodiversity protection exclusion zones.
12. Biodiversity Protection	• Exclusion zone fencing must be maintained and kept in adequate, functional condition until site operation commences.
13. Sensitive vegetation and silt fencing	• Property sensitive vegetation and silt fencing are to be monitored and maintained.
14. Bush regeneration	• Maintenance weeding is to commence throughout the site to facilitate rehabilitation of native vegetation in accordance with the frequencies defined in Table 2 and 9. • The soil seedbank is to be triggered to encourage natural regeneration in areas of medium to high resilience or where appropriate at the discretion of the bush regeneration contractors.
15. Planting	• Planting is to commence once performance criteria are on track to being met and there is little risk of plantings being outcompeted by exotics.
16. Reporting	• Reporting is to occur at OC stage.

Table 9. Annual Maintenance Schedule.

Maintenance Task	Frequency	Responsibility
1. Secondary Weed Control	Quarterly, performed with respect to weed life cycles.	Bush Regeneration Contractor
2. Weed Inspections	At OC stage.	Ecologist
3. Erosion and Sediment controls	Annually, or after extremely heavy rain.	Bush Regeneration Contractor

8 Monitoring and Reporting

8.1 Performance Criteria

The following performance criteria must be met to affirm the successful implementation of the VMP:

- For any replanting activities, plant stock must be certified to have been collected from local provenance sources.
- Weed density to be less than 20% across the total area of each management zone.
- Aquatic weeds to be removed and no seeding problem aquatic weeds to occur on-site.
- The native plant diversity in the area to be revegetated to be as per locally native ground and mid-story species.
- Bush regeneration activities must facilitate the natural regeneration and gradual extension of native plant cover throughout each management zone containing native vegetation.
- Appropriate management of erosion and sedimentation within construction areas such that native biodiversity is not being negatively impacted.
- Monitoring is to occur to ensure the plan outcomes are being met.
- Independent monitoring of works is to be conducted by a qualified ecologist with proven experience in ecological restoration of EECs.
- Report on work outcomes, relevant to the plan, is to be produced 3, 6 and 12 months at the start and annually from year 2 onwards.
- Report and recommendations to be supplied to Reflections Holidays Parks management and to Byron Council.
- Reports are to include any non-compliances with actions (and timeframe) to be taken to remain compliant.
- The plan is to detail the monitoring requirement for: flora and Fauna, water quality and water cycle management.

8.2 Reporting

Monitoring must be performed by a suitably experienced ecologist/ or bush regenerator on an annual basis. Reporting to be performed in association with maintenance inspections to form the primary source of information for monitoring and review reports. Monitoring recommended annually. A primary goal of monitoring and reporting will be to provide recommendations to improve compliance with performance criteria to be incorporated into forthcoming management strategies.

8.2.1 Photo monitoring

Photo monitoring (PMP) must occur throughout all management zones to provide evidence of compliance (or non-compliance) with the supplied performance criteria. Six PMP are required.

9 Roles and Responsibilities

Due to the highly technical nature of restoration works, on-ground works and reporting must be performed by contractors and/or consultants external to the proponent and construction contractors. The broader management and implementation of the VMP must be performed by an appropriately experienced and qualified ecologist reporting the project managers of the works. On-ground restoration works must be performed by an appropriately experienced and qualified Bush Regeneration contractor with sufficient capacity to undertake the works (see Table 11 below).

Table 11. Roles and Responsibilities.

Role	Responsibility
Project Manager	• Integration of VMP conditions relating to operational activities with the broad goal of ensuring that native biodiversity is protected and enhanced throughout the various phases of the project and during the post-maintenance period.
Construction Contractor	• Compliance with the conditions described in the VMP.
Arborist	• Monitor tree health and success of measures such as mulching and load cells and set tie up areas for tents. Recommend actions and seem them implemented.
Bush Regeneration Contractor	• Performance of the on-ground works described in the VMP. • Confirmation of supply and installation of local provenance native seed. • Maintenance inspections in collaboration with the project Ecologist. • Achieving performance criteria outlined in the VMP. • Management of pests and disease, potentially in collaboration with pest management contractors if required. • Providing technical advice and recommendations to improve compliance with performance criteria to be incorporated into forthcoming management strategies.
Ecologist	• Managing the implementation of the broad aspects of the VMP. • Maintenance inspections in collaboration with the bush regeneration contractors. • Production of reports following monitoring inspections. • Providing technical advice and recommendations to improve compliance with performance criteria to be incorporated into forthcoming management strategies. • Confirmation of completion of the maintenance period of the project once all performance criteria have been met.

10 References

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North Coast Regional Strategic Weed Management Plan 2017-2022 Local Land Services North Coast
https://northcoast.lls.nsw.gov.au/biosecurity/weed-control/north-coast-regional-strategic-weed-management-plan

See also
Bowman, D. M. J. S. and P.K. Latz. 1993. Ecology of Callitris glaucophylla (Cupressaceae) on the MacDonnell Ranges, Central Australia. Australian Journal of Botany 41(2):217.

11 Appendices

Appendix I– Key Weed Removal Methods NB: herbicide use is a last resort and not deemed necessary in this community

Physical removal

Technique	Method	Equipment
Hand Removal 	Seedlings and smaller weed species where appropriate will be pulled out by hand, without risk of injury to workers. The size that this can occur varies throughout the treatment area. Generally, it ranges from post seed to approximately 300mm in height. Rolling and raking is suitable for larger infestations of Wandering Jew. The weed can be raked, and stems and plants parts rolled. The clump of weed material can then be bagged and removed from site.	Tools: Gloves, Rakes, Knife and Weed Bags
Crowning 	Plants that possess rhizomes or bulbs might not respond to various removal techniques and may need to be treated with crowning. A knife, mattock or trowel is to be driven into the soil surrounding the bulb or rhizome at an angle of approximately 45 degrees with surrounding soil, so as to cut any roots that may be running off. This is occurred in 360 degrees around the bulb/rhizome. The rhizome or bulb is to be bagged and removed from the site and disposed of at an appropriate waste recycling facility Soil disturbance is to be kept to a minimum when using this technique.	Tools: Knife, mattock, trowel, impervious gloves, and all other required P.P.E.

Technique	Method	Equipment
Cut and Paint Stems 	Weed species deemed unsuitable for hand removal shall be cut. Those that have persistent of vigorous growth will be cut and painted with appropriate Herbicide or equivalent. Juvenile and smaller weed species will be cut with secateurs at base of plant, and herbicide applied via applicator bottle. Stem to be cut horizontally as close to the ground as possible, using secateurs, loppers or a pruning saw. Horizontal cuts to be made on top of stem to prevent the herbicide running off the stump. Apply herbicide to the cut stem immediately, within 10-20 seconds, before the plant cells close and the translocation of the herbicide is limited. Herbicide is not to reach sediment or surrounding non-targeting	Tools: loppers, secateurs, pruning saw, herbicide applicator/sprayer, impervious gloves, Roundup® Biactive Herbicide and all
Scrape and Painting 	More resilient weed species, where other techniques are less reliable are to be scraped with a knife or chisel and painted with an appropriate Herbicide. Works to be carried out by a contractor with a current herbicide license. Weed species will be scraped with a knife or chisel up the length of the trunk, and herbicide applied via applicator bottle. Scrape the trunk from as close to the ground as possible to approximately ¾ of the plants height. Where trunk diameters exceed approximately 5 cm a second scrape shall be made on the other side of the trunk. Apply undiluted herbicide to the cut trunk immediately, within 10-20 seconds, before the plant cells close and the translocation of the herbicide is limited. All care must be taken by the contractor not to spill herbicide onto sediment or surrounding non-targeting plants. Follow up treatment may be required. If plants resprout, scrape and paint the shoots using the same method after sufficient regrowth has occurred.	Tools: knife, chisel, protective clothing, safety glasses herbicide applicator/sprayer, impervious gloves, Roundup® Biactive Herbicide, and all other required P.P.E.

Technique	Method	Equipment
Cut with a Chainsaw and Paint 	Larger size weed species, too large for cutting with hand tools, shall be cut with a chainsaw and painted with Herbicide. Works to be carried out by a contractor with a current chainsaw and herbicide license. Larger weed species will be cut with a chainsaw at base of plant, and herbicide applied via applicator bottle. Cut the stem horizontally as close to the ground as possible, using the chainsaw. Remove upper branches to reduce bulk of plant. If cutting at the base is impractical, cut higher to get rid of the bulk of the weed, then cut again at the base and apply herbicide. Make cuts horizontal to prevent the herbicide running off the stump. Apply undiluted herbicide to the cut trunk immediately, within 10-20 seconds, before the plant cells close and the translocation of the herbicide is limited. Ensure there is no runoff of poison. All care must be taken by the contractor not to spill herbicide into water, onto sediment, or surrounding non-targeting plants. Follow up treatment will be required. If plants resprout, cut and paint the shoots using the same method.	Tools: chainsaw, ear muffs, protective clothing, safety glasses herbicide applicator/sprayer, impervious gloves, Roundup® Biactive Herbicide, and all other required P.P.E.

Appendix II Expertise of authors

Geraldene Dalby-Ball
DIRECTOR

With over 20 years wetland and urban ecology experience, a great passion for what she does, and extensive technical and on-ground knowledge in restoration projects make Geraldene a valuable contribution to any project.

Geraldene has over 8 years local government experience as manager of environment and education for Pittwater Council. Geraldene presented papers on the topic at the NSW Coastal Conference. Geraldene is a Technical Advisor Sydney Olympic Park Wetland Education and Training (WET) panel.

Geraldene has up to date knowledge of environmental policies and frequently provides input to such works. Geraldene was a key contributor to the recent set of Guidelines commissioned by South East Queensland Healthy Waterways Water Sensitive Urban Design Guidelines. Geraldene's role included significant contributions and review of the Guideline for Maintaining WSUD Assets and the Guideline for Rectifying WSUD Assets.

Geraldene is a frequent contributor to many community and professional workshops on ecological matters particularly relating to environmental management. She is an excellent Project Manager.

Geraldene is a joint author on the popular book Burnum Burnum's Wildthings published by Sainty and Associates. Author of the Saltmarsh Restoration Chapter Estuary Plants of East Coast Australia published by Sainty and Associates (2013).

Geraldene's early work included 5 years with Wetland Expert Geoff Sainty of Sainty and Associates. Geraldene is an expert in creating and enhancing urban biodiversity habitat and linking People with Place.

SPECIALISATIONS

- Urban Ecology – and habitat rehabilitation and re-creation.
- Urban waterway management – assessing, designing and supervising rehabilitation works
- Saltmarsh and Wetland re-creation and restoration – assessment, design and monitoring
- Engaging others in the area of environmental care and connection
- Technical Advisor – environmental design, guidelines and policies
- Sound knowledge and practical application of experimental design and statistics
- Project management and supervision
- Grant writing and grant assessment
- Budget estimates and tender selection
- Expert witness in the Land and Environment Court

CAREER SUMMARY

- **Director and Ecologist**, Ecological Consultants Australia. 2014-*present*
- **Director and Ecologist**, Dragonfly Environmental. 1998-*present*
- **Manager** Natural Resources and Education, Pittwater Council 2002-2010
- **Wetland Ecologist** Sainty and Associates 1995-2002

QUALIFICATIONS AND MEMBERSHIPS

- **Bachelor of Science with 1st Class Honors**, Sydney University
- WorkCover WHS General Induction of Construction Industry NSW White Card.
- Senior First Aid Certificate.
- **Practicing member and vice president** Ecological Consultants Association of NSW

Laura has great passion about the natural environment, sustainable development and biodiversity conservation. Laura is in her last semester of her double degree of Environmental Engineering and Science at the University of New South Wales.

Laura has valuable on-ground experience working with conservation organisations in different parts of the world, as well as contributing to environmental educational projects. Laura has participated in educational talks focused on ecological and sustainability matters and currently volunteers for organisations around the globe to help raise awareness, promote sustainable living and natural protection.

Laura has attended fundamental courses and workshops such as Sustainability in Construction; Environmental Frameworks, Law and Economics; Applied Geotechnics and Engineering Geology; and Contaminant Transport. Laura participated as one of the leading members of the Environmental Committee at her University in Colombia organising various campaigns promoting environmental awareness.

Laura has also prepared two theses, one on Orica's Botany Industrial Park Groundwater Clean-up Plan based on remediation technologies for contaminated land and groundwater; and the other one on Environmental Impacts in Port Stockton Development: Air, Water and Noise Pollution, based on the proposal of creating a new port as an extension to Port of Newcastle.

Laura Conde-Barona ENVIRONMENTAL ENGINEER INTERN

SPECIALISATIONS

- Creative and sustainable solutions in environmental engineering, particularly in waterways and wetlands, sustainable design and development.
- Engineering and environmental project management focusing on creating environmental and social outcomes.
- Engaging others in environmental protection and sustainability.

CAREER SUMMARY

- **Environmental Consulting Internship,** Ecological Consultants Australia, 2018 present
- **Marine Turtle Internship Program,** Conflict Island's Conservation Initiative, 2017

QUALIFICATIONS AND MEMBERSHIPS

- **Bachelor of Environmental Engineering and Marine Science**, University of New South Wales (Expected June 2018)
- **Study Abroad Program in Science,** University of New South Wales (2015)
- **Initiated Bachelor's Degree in Environmental Engineering and Biology,** Universidad de los Andes, Bogotá, Colombia (Transferred to UNSW in 2016)
- **Practicing member** Australian Herpetological Society
- Emergency First Response Certificate (2016)
- PADI Rescue Diver (2016)

12 Appendix III – final determination Coastal Cypress Pine endangered ecological community

Coastal Cypress Pine Forest in the NSW North Coast Bioregion - endangered ecological community listing NSW Scientific Committee - final determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Coastal Cypress Pine Forest in the NSW North Coast Bioregion as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act. Listing of endangered ecological communities is provided for by Part 2 of the Act.
The Scientific Committee has found that

1. Coastal Cypress Pine Forest in the NSW North Coast Bioregion is the name given to the ecological community dominated by Coastal Cypress Pine, *Callitris columellaris*, found typically on coastal sand plains, north from the Angourie area on the far north coast of NSW. The community is characterised by the species listed in paragraph 2, and typically has a closed to open canopy of *C. columellaris*, which may be mixed with eucalypts, wattles, banksias and/or rainforest trees, and an open to sparse understorey of shrubs, sedges and herbs. Structural forms of the community include woodland, open forest and closed forest, although the tree stratum may be very sparse, absent, or comprised only of dead trees in stands affected by partial clearing, tree senescence or fire.

2. Coastal Cypress Pine Forest is characterised by the following assemblage of species:

Abildgaardia vaginata	*Cyperus stradbrokensis*
Acacia aulacocarpa	*Dianella caerulea*
Acacia disparrima subsp. *disparrima*	*Eragrostis brownii*
Acacia ulicifolia	*Eucalyptus pilularis*
Acianthus caudatus	*Eucalyptus resinifera* subsp. *hemilampra*
Acianthus exsertus	*Eucalyptus signata*
Acronychia imperforata	*Euroschinus falcata*
Acrotriche aggregata	*Halfordia kendack*
Allocasuarina littoralis	*Hoya australis* subsp. *australis*
Alyxia ruscifolia	*Imperata cylindrica* var. *major*
Araucaria cunninghamii	*Leptospermum polygalifolium*
Aristida spp.	*Leucopogon ericoides*
Astroloma humifusum	*Leucopogon leptospermoides*
Austromyrtus dulcis	*Leucopogon margarodes*
Baloskion tetraphyllum subsp. *meiostachyum*	*Lomandra longifolia*
Banksia integrifolia subsp. *integrifolia*	*Monotoca elliptica*
Banksia serrata	*Notelaea longifolia*
Bulboschoenus barbata	*Oxylobium robustum*
Callitris columellaris	*Paspalidium distans*

Chiloglottis sp.	*Persoonia stradbrokensis*
Commelina cyanea	*Platycerium bifurcatum*
Corymbia intermedia	*Pomax umbellata*
Cyclophyllum longipetalum	*Pteridium esculentum*
Cymbopogon refractus var. *refractus*	*Pterostylis nutans*
	Pterostylis pedunculata
	Zieria smithi

3. The total species list of the community is considerably larger than that given above, with many species present in only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought condition and by its disturbance (including fire) history. The number of species, and the above ground relative abundance of species will change with time since fire, and may also change in response to changes in fire regime (including changes in fire frequency). At any one time, above ground individuals of some species may be absent, but the species may be represented below ground in the soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. The list of species given above is of vascular plant species; the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented.

4. Coastal Cypress Pine Forest is dominated by a dense to open canopy of *Callitris columellaris* (Coastal Cypress Pine), sometimes with *Coyrmbia intermedia* (Pink Bloodwood), *Eucalyptus pilularis*(Blackbutt), *E. signata* (Scribbly Gum), *Acacia disparrima* subsp. *disparrima* (Salwood), *Allocasuarina littoralis* (Black She-oak), *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia) or *B. serrata*(Old Man Banksia). The typically sparse layer of shrubs may include, *Acacia ulicifolia* (Prickly Moses), *Leucopogon ericoides*(Pink Beard-heath), *L. leptospermoides*, *Monotoca elliptica* (Tree broom-heath) and juveniles of any of the canopy species. The typically sparse groundcover comprises scattered grasses, including *Aristida vagans* (Three-awn Speargrass), *Eragrostis brownii* (Brown's Lovegrass), *Imperata cylindrica* var. *major* (Blady Grass) and *Paspalidium distans*, graminoids such as *Baloskiontetraphyllum* subsp. *meiostachyum* (Plume Rush) and *Lomandra longifolia* (Spiny-headed Mat-rush) and forbs including *Dianella caerulea* (Blue Flax Lily) and *Pomax umbellata* or it may also contain a rich orchid flora (Moye *in litt*. 2008). The community may have a distinctive litter layer with patches of compressed *Callitris*branchlets, which have a characteristic chemical composition that is high in terpenes, such as limonene and pinene (Ogunwande *et al*. 2005). Undisturbed stands of the community may have a woodland or forest structure, with *C. columellaris* dominating the canopy, although larger trees, such as eucalypts may be emergent. Stands of the community that have been partially cleared in the past may be reduced to scattered trees and a few characteristic ground cover species, possibly with other native species represented in a soil seed bank. Fires may also influence the structure of the community, as the dominant tree species, *C. columellaris*, is generally killed when burnt. Post-fire regeneration of the community may therefore have the structure of shrubland or heathland for many years.

5. A number of threatened flora species have been recorded in Coastal Cypress Pine Forest or associated ecotones. These include *Acronychia littoralis* (Scented Acronychia), *Archidendron hendersonii* (White Lace Flower), *Geodorum densiflorum* (Pink Nodding Orchid, Shepherds Crook Orchid) and *Drynaria rigidula*(Basket fern).

6. Coastal Cypress Pine Forest typically occurs on the inland side of the coastal sandplain on low rises that represent eroded Pleistocene backbarrier dunes (Morand 1996). A few examples of the community are located on coastal bedrock hills mantled with wind-blown sand or more rarely without a sandy mantle (e.g. Landmark 1999). The community has also been recorded from Holocene sand dunes (Griffith 1999). The sandy soils are generally deep, freely draining podsols, loam or clay soils associated with basalt or, less commonly, fine-grained sedimentary rocks and similar substrates. Currently known occurrences of the community are generally within 35km of the coast and below 100m elevation. Mean annual rainfall varies from approximately 1000 mm up to 1800 mm across the distribution of the community.

7. Coastal Cypress Pine Forest is apparently restricted to the NSW North Coast bioregion. The dominant species, *C. columellaris*, extends into south-east Queensland as far north as Hervey Bay. Biantoff and Elsol (1989) record *C. columellaris* in forest on the Sunshine Coast in south-east Queensland, although it is uncertain whether this represents the same community or other communities in which *C. columellaris* is sub-dominant. However, any occurrence of the community in south-east Queensland is likely to be highly restricted. In NSW, Coastal Cypress Pine Forest is currently known from the local government areas of Tweed, Byron, Ballina, Richmond Valley and Clarence Valley, but may occur elsewhere within the bioregion.

8. Coastal Cypress Pine Forest includes 'Coast Cypress Pine' (Forest Ecosystem 22) of NPWS (1999) and DEC (2004), '*Callitris columellaris* tall open to closed forest' (F4) of Pressey and Griffith (1992), the 'Cypress Pine' unit of Landmark (1999), 'Cypress Pine Open Forest to Woodland' (313) of Kingston *et al*. (2004), Coast Cypress Pine on Dunes and Ridges' (Community 33) of Sherringham *et al*. (unpubl. data) and Coastal Cypress Pine assemblages described by Benwell (1995, 1998). Coastal Cypress Pine Forest belongs to the Coastal Dune Dry Sclerophyll Forests vegetation class of Keith (2004).

9. Based on detailed field inspections, the total distribution of Coastal Cypress Pine Forest covers approximately 150 ha (A. Benwell, unpubl. data), and is certainly less than 200 ha. Coastal Cypress Pine Forest is currently known from 15-20 localities, most of which are patches no larger than 10 ha. Stands of the community have been mapped in Bundjalung, Yuraygir and Broadwater National Parks (Griffith

1983, 1984, 1985) and Billinudgel Nature Reserve (Benwell 1998), accounting for about half of the total known occurrence. The remaining stands occur primarily on private land or road easements. All known occurrences of the community are within a total extent of occurrence of 2500 –3000 km^2. These estimates indicate that the community has a highly restricted distribution.

10. Since European settlement, and relative to the longevity of its dominant trees, which live for more than a hundred years, Coastal Cypress Pine Forest has undergone a large reduction in geographic distribution. This reduction has occurred as a result of vegetation clearing for sand mining, agriculture and coastal development. Estimates based on field observations of old remnant trees in cleared land around the remaining stands of the Coastal Cypress Pine Forest suggest that the area occupied by the community may have declined by more than 77% (A. Benwell, unpubl. data). The actual reduction in geographic distribution is likely to be larger than this estimate suggests because stands which may have been totally destroyed could not be included in the calculation. Small-scale clearing continues to threaten the community, primarily as a result of coastal development and associated upgrading of roads. For example, within the past two decades, fragmentation of the community has increased as a result of clearing for tea tree plantations, caravan parks, road construction and associated quarrying (DECC *in litt.,* A. Benwell, pers. comm. August 2006), indicating a continuing decline in the geographic distribution of the community. The remaining area of the community is severely fragmented. The integrity and survival of small, isolated stands of the community is impaired by the small population size of its component species, enhanced risks from environmental stochasticity, disruption to pollination and dispersal of fruits or seeds, and likely reductions in the genetic diversity of isolated populations (Young *et al*. 1996, Young and Clarke 2000). 'Clearing of native vegetation' is listed as a Key Threatening Process under the *Threatened Species Conservation Act* 1995.

11. Other threats to Coastal Cypress Pine Forest include habitat degradation and weed invasion. Maintenance of service easements and fence construction encroaches on the edges of some stands, while trampling and rubbish dumping occurs where the community is close to towns and recreational sites. Such disturbances accelerate the invasion of weeds, which may form a dense understorey or ground layer, displacing native understorey species and inhibiting recruitment of canopy species. Principal weed species include *Asparagus aethiopicus*, *Bryophyllum delagoense*, *Chloris gayana, Lantana camara, Ochna serrulata* and *Schefflera actinophylla*. Other weed species recorded in the community include *Panicum maximum, Rhaphiolepis indica, Solanum nigrum*and *S. seaforthianum*. The invasion and establishment of exotic species in Coastal Cypress Pine Forest, results in a large reduction in the ecological function of the community. 'Invasion of native plant communities by exotic perennial grasses' and 'Invasion, establishment and spread of *Lantana* (*Lantana camara* L. *sens. lat*)' are listed as Key Threatening Processes under the *Threatened Species Conservation Act* 1995.

12. Inappropriate fire regimes also pose a threat to Coastal Cypress Pine Forest. Undisturbed stands of the community typically have a sparse understorey and apparently do not accumulate large quantities of uncompacted litter. These attributes do not favour propagation of fires under common weather

conditions. However, the dominant species, *C. columellaris*, may be killed by crown fires or heavy scorching of the lower trunk. Such effects have been observed in localised patches (A. Benwell, pers. comm.), as incursion of fire may be facilitated by more flammable vegetation that surrounds the small patches of the community. A recent crown fire in Bundjalung National Park killed existing seedlings, saplings and mature trees of *C.columellaris* and apparently resulted in little post-fire recruitment (S. J. Griffith, pers. comm.). Regeneration of the species appears to rely on seed that is released regularly from non-persistent cones, mainly in the summer months. Seedling recruitment is mainly seen in gaps created by small-scale disturbance (A. Benwell, pers. comm.). Given these characteristics and observations, high-frequency fires are likely to be detrimental to the persistence of the community, although infrequent fires may be necessary to create the gaps apparently required for seedling recruitment to replace senescent trees. Frequent fires are also likely to accelerate the invasion of weeds, since these species are efficient colonisers of open space where there are sources of propagules nearby. Weed invasion is likely to alter the fuel characteristics, making the community more flammable. Increasing human population pressures, such as those occurring on the NSW north coast, typically result in an increase in fire ignitions in bushland that is accessible to urban areas. 'High frequency fire resulting in disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is listed as a Key Threatening Process under the *Threatened Species Conservation Act* 1995.

The ecological community has undergone, is observed, estimated, inferred or reasonably suspected to have undergone, or is likely to undergo within a time span appropriate to the life cycle and habitat characteristics of its component species:

(b) a large reduction in ecological function, as indicated by any of the following:

(d) change in community structure

(g) invasion and establishment of exotic species

(h) degradation of habitat

(i) fragmentation of habitat