Vegetation Management Plan

for proposed

200 lot residential subdivision

Pacific Bay West Development

West Korora Road, Bruxner Park Road and Pacific Highway,

Korora

prepared by

BushFireSafe

(aust) pty ltd

February 2009

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1.0 INTRODUCTION

The Korora Development Control Plan requires the preparation of a Vegetation Management Plan for approval by Coffs Harbour City Council before granting a Subdivision Certificate. This requirement ensures that future development of the particular site is consistent with policies, guidelines and community expectations. The Coffs Harbour City Vegetation Strategy (Coffs Harbour City Council, nd) provides a guiding document for the conversation and rehabilitation of a local area. The following Vegetation Management Plan is both consistent with the Coffs Harbour City Vegetation Strategy and associated policies and guidelines and conforms to the requirements of Government agencies responsible for the administration of the legislative instruments governing future development of urban space.

1.1 Background

Bushfiresafe (Aust) was engaged by Thackral Pty Ltd to complete a Vegetation Management Plan for a proposed residential development on approximately 29ha of land identified by the following title details:

Lot 1 DP 592173	Lot 3 DP 820652
Lot 2 DP 226560	Lot 4 DP 820652
Lot 23 DP 716144	Lot 5 DP 820652

The aims of the Vegetation Management Plan are to;

- ensure that future development is consistent with relevant legislation, policies and guidelines;
- address community concerns regarding the maintenance of biodiversity of the Coffs Harbour region;
- rehabilitate and protect the vegetation along Jordan's Creek, a creek that forms part of the southern boundary to the subject land;
- provide a habitat link between natural vegetation to the east of the subject site along Jordan's Creek with connection to a regionally-significant fauna corridor along Bruxner Park Road to the north and;
- conserve areas previously identified as warranting Zone 7(a) Environmental Protection 'Habitat and Catchment' and 7(b) Environmental Protection 'Scenic Buffer' under the Coffs Harbour Local Environment Plan (LEP).

1.2 Location of proposed Development.

The area subject to the proposed development is located on the western side of the Pacific Highway in West Korora, approximately 4.5km north of Coffs Harbour Central Business District, within the Coffs Harbour Local Government Area, north coast of NSW. The subject land has multiple zonings under the Coffs Harbour LEP. The majority of the site is zoned 1(a) Rural Agricultural and is mostly cleared to grassland. Vegetated areas including the riparian

margin of Jordan's Creek are zoned 7(a) Environmental Protection 'Habitat and Catchment'. A strip of land bordering the Pacific Highway along the eastern margin is zoned 7(b) Environmental Protection 'Scenic Buffer'.

The current 1(a) Rural Agricultural zoning of the site does not permit the development concepts presented in this development application. However, the Coffs Harbour City Council has formally resolved to commence the preparation of an amendment to the Coffs Harbour LEP 2000 for the North Coffs area. The subject land will be included in this area and it is anticipated that the site will be rezoned to permit low to medium density residential development.

1.3 Geology and Soils

The geological unit underlining the subject land has been mapped as being the Coramba Beds of the Coffs Harbour Association, a faulted block of metasedimentary units of Early Palaeozoic age (Pogson and Hitchins, 1973). The steep terrain over most the subject land precludes soil development. These skeletal soils often exhibit outcroppings of the underlying highly fractured metashale and greywacke rocks. These rocks weather to provide the yellow and red earth soils typical of the region.

Towards the lower foot slopes and terraces associated with the riparian zone of Jordan's Creek soil development have achieved the greatest thickness, typically consisting the deep humic layer overlying alluvial silt and clay sediments. For most of the reaches observed, Jordan's Creek possessed an armoured bed of metasedimentary rocks that have been transported from outcrops located higher in the landscape. The only location where any pool (temporary or permanent) has developed along this watercourse is immediately upstream of the temporary causeway previously constructed in the western area that currently provides access to an adjoining property. The elevation of this causeway above the permanent level of Jordan's Creek, has resulted in the extensive accumulation of alluvial sediments upstream and has enhanced the establishment of a freshwater lagoon identified on the subject land.

1.4 Objectives

The objectives of the Vegetation Management Plan are to undertake vegetation restoration and thereby assist in conserving and enhancing the local biodiversity. Restoration work will focus of the establishment of a Core Riparian Zone (CRZ) adjacent to Jordan's Creek for the entire length of Jordan's Creek on the subject land as required by Department of Water and Energy guidelines (DWE, 2008). The existing riparian zone varies between 5 and 20m in width and contains a number of weed species including mature Camphor Laurel trees, Lantana thickets and other non-native shrubs. The Core Riparian Zone will be extended to

20m in width and comprise native species common to the site., an additional 10m wide Vegetated Buffer will compliment the CRZ providing a 30m environmental buffer to the residential development. An area south of Jordan's Creek in the eastern portion of the subject land is currently cleared to mainly grassland and has been identified any having potential flooding risks during extreme events (PTW Planning, 2006). It is proposed to undertake any required compensatory planting within this area, extending the riparian vegetation to the property boundary.

A secondary objective is to provide a 30m environmental buffer zone surrounding the freshwater lagoon associated with Jordan's Creek. This lagoon has been identified as providing habitat for the Giant Barred Frog (Bushfiresafe (Aust), 2009). The buffer zone to be so established should ameliorate any potential effects of:

- pollutants associated with the agricultural pursuits of adjacent, upstream properties from endangering this habitat;
- sediment input from upslope areas should these be potentially developed; and
- water levels fluctuating rapidly within the freshwater lagoon and so maintaining a suitable habitat for the Giant Barred Frog.

The subsidiary objective of the Vegetation Management Plan is to enhance the aspects of the Primary and Secondary koala habitats identified as occurring over the subject land. The Comprehensive Koala Plan of Management (Lunney *et al*., 1999) outlines the requirements for the preservation of koala habitat. In particular, this CKPoM seeks to maintain the connectivity of possible koala habitats ensuring uninterrupted movement of koala populations within the local government area. This will be achieved through planting of koala-preferred species providing a vegetated linkage with existing areas of koala habitat and can be enhanced through the encouragement of future residents to incorporate koala feeding trees into their property landscaping goals.

1.5 Legislative Framework

The Coffs Harbour City Council requires the preparation of a Vegetation Management Plan under the Korora Development Control Plan. The information provided should include:

- Designation of vegetation regeneration areas and planting
- Methods to maintain and protect native vegetation
- Information on the control and management of weed species
- Any works recommended for sediment and erosion control
- Strategies recommended for the protection the Jordan's Creek from degradation.

1.6 Site Inspection and Authorship

Field inspection was carried out on the 19th February, 2008. This included traversing all vegetation communities as well as important geomorphologic features. Detailed recording of slope and aspect was made. Particular focus was applied to the creek bed and adjacent banks of Jordan's Creek, the portion of open grassland to the extreme southeast of the site as well as the position of a remanent Tall Open Forest in the north western area. The information gathered was incorporated with previously undertaken surveys and on-site meetings to form the basis for the maps and diagrams attached to this report. The report was written by Stephen Cotter, B.A. (New England), B. Applied Sc. (Hons), M. Sc (Southern Cross).

2.0 FLORA ASSESSMENT

The flora assessment of the subject land undertaken by Bushfiresafe (Aust) identified the following vegetation communities.

Table 1 Vegetation communities described for the subject land

	Description	Coffs Harbour LEP
Community 1	Wet Sclerophyll Tall Open Forest	Zone 7(a)
Community 2	Riparian Lowland rainforest / Wet sclerophyll Tall Closed Forest	Zone 7(a)
Community 3	Coastal Freshwater Lagoon	Zone 7(a)
Community 4	Grassland / Open Woodland	Zone 1(a)

Source: Bushfiresafe (Aust.) 2008

These communities are illustrated on the map presented as Attachment 1. A list of species identified during the flora assessment has been tabled in Appendix 1.

2.1 Community 1: Wet Sclerophyll Tall Open Forest

This community occurs on the higher south-facing slopes of the subject land in two locations, the largest comprises all of the land detailed as Lot 4 DP 820652. A second area exists in the north-western corner of the subject land. The steep slopes upon which this Community has developed, has dictated a zonation in the species present with the lower slopes dominated by mature trees of Flooded Gum, Tallowwood, Blackbutt, Brushbox, a midstorey of Turpentine, Bangalow Palm, Red Bean, Creek Sandpaper Fig and tree ferns with an understorey of native vines, Bracken Fern and Lantana (Figure 1).

On the higher slopes, the dominant storey comprises Tallowwood, Grey Gum, Northern Grey Ironbark and Forest She-Oak indicative of less moisture availability within the shallower soils present near the ridgeline. The midstory is dominated by Brushbox, Winter Senna and Tamarind and understorey of Bracken Fern, Lomandra, Tobacco Bush and Lantana.

An isolated population of mature, multiple-stemmed Rusty Plum trees (*Amorphospermum whitei*) occurs along the western edge of a small south flowing tributary of Jordan's Creek (see Attachment 1). This plant is listed as Vulnerable in the NSW Flora Atlas (NPWS, 2002). This population's mature age, habit and location towards the western margin of Community 1 is possibly the result of a previous bushfire (Bushfiresafe (Aust), 2009).

A number of the tree species identified within this Community are listed as being of significant value to Koala populations (Lunney *et al*., 1999). Both areas of vegetation relating to Community 1 are listed under SEPP 44 as Primary Koala Habitat.

Figure 1. Wet Sclerophyll Tall Open Forest (main area of vegetation) and managed grassland in the foreground (Photograph, S. Cotter).

2.2 Community 2: Riparian Lowland Rainforest / Wet sclerophyll Tall Closed Forest

Along the margins of Jordan's Creek is an example of the Coastal Lowland Rainforest on Floodplain endangered ecological community. Brushbox and emergent Hoop Pine trees dominate with isolated mature Flooded Gum indicating that the riparian community may be undergoing rainforest regeneration. Species present include Camphor Laurel, Red Bean, Turpentine, Red Ash, Doughwood, Tamarind and Creek Sandpaper Fig. Whilst no species recorded are listed in the NSW Flora Atlas (Bushfiresafe (Aust), 2009) a number of species are recorded as being within 50km of their southernmost recorded locations.

This community has developed upon the lower terraces and toe-slopes adjacent to Jordan's Creek (Figure 2). The greatest lateral extend of the riparian vegetation occurs downstream of a culvert crossing and in a region characterised by the inflow of numerous tributary streams. The streams, and associated sediment input have lead to the development of a wide (*c*. 20m) near-horizontal alluvial terrace. Further downstream, and in the absence of the steep hill slope along the northern edge of Jordan's Creek, this community is confined to the immediate margins (*c*. <5m) of the creek line. Past land-use practises in the eastern region of the subject land (grazing, sporting fields, *etc*.) have removed much of this vegetation community in this downstream region. There is anecdotal evidence that a vegetation along a section of the northern bank of Jordan's Creek in the vicinity of the sporting fields has be regenerated, possibly 15 years ago as evidenced by the Wattle and Lomandra planting in this area.

Figure 2 Left: Bangalow palms within the Riparian rainforest vegetation and Right: Jordan's Creek (Photographs, S. Cotter).

Flooded Gum (*E. grandis*) is a preferred tree species for koala populations. The abundance of mature, emergent Flooded Gum trees both within, and along the margins of this Lowland Rainforest / Tall Closed Forest Community (Figure 3) has initiated the listing of this riparian community as a Secondary Koala Habitat (Lunney *et al*., 1999).

Figure 3. View from West Korora Road towards the development site illustrating emergent Flooded Gum (*E. Grandis*) within the riparian rainforest vegetation along Jordan's Creek (Photograph, S. Cotter).

2.3 Community 3: Coastal freshwater lagoon

The margins of the freshwater lagoon comprise Swamp Oak, Saw Sedge, Typha, Lomandra, Ferns, Lantana and exotic grass species. This lagoon has developed in response to the construction of an elevated culvert to provide a wet-weather crossing of Jordan's Creek. Downstream of the culvert there is a c. 5m drop to the creek bed (creating a waterfall scenario preventing fish migration). Upstream, the present water surface of the lagoon is <1m below the culvert surface with the level controlled by the provision of 2 storm water pipes. The lagoon therefore can be regarded as an example of an artificially-constructed wetland (Figure 4). The mix of native and exotic species occurring along the margins of this lagoon, represent a range of colonising plants that have exploited this niche environment. Hence, the ecological significance of this lagoon is not on the plants species present, but rather as a habitat for a population of the endangered Giant Barred Frog recorded from this environment (Bushfiresafe (Aust), 2009).

Figure 4. Freshwater Lagoon exists upstream of the culvert crossing in the western portion of the subject property (Photograph, S. Cotter).

2.4 Community 4 Grassy woodland

This community comprises the majority of the subject land and is the result of past agricultural practises. It is dominated by exotic grass species and invasive herbs and has little conservation value, its primary roll at present being to maintain a cover for the skeletal soils and hence preventing excessive sediment erosion from the steep slopes present (Figure 5).

Figure 5. Managed grassland covers the majority of the site, including all areas to be developed. Banana plantations surround the property to the south (Photograph, S. Cotter).

2.5 Areas for Development

The vegetation of the subject land is dominated by the grassy woodland (Community 4). This area will be the subject to the proposal residential development. A section of the north bank of Jordan's Creek near the sporting field will need to be removed during excavation of a flood bypass channel. This flood bypass channel is required to prevent any additional flooding from occurring on adjoining properties as a result of the development proceeding. Jordan's Creek forms the southern boundary to the property in this area and a narrow constriction in the channel results in overbank flows during extreme rainfall events. It is proposed to excavate an additional channel to reduce these flooding issues. It is a recommendation that the integrity of Jordan's Creek be retained where ever possible; the existing creek bank will remain intact for a distance of up to between 0.5m and 2.0m above a low flow level of the creek. The remaining areas of natural vegetation are **NOT** affected by the proposed development.

This Vegetation Management Plan will outline the proposed revegetation of this flood bypass channel; the replanting within the Core Riparian Zone that will commence from the top bank of the excavated bypass channel; the replanting of a Vegetated Buffer to compliment the CRZ and provide a 30m environmental buffer between Jordan's Creek and the residential development; rehabilitation of the existing vegetation along Jordan's Creek that are not affected by the flood bypass and extension to provide a 30m wide environmental buffer; and compensatory planting within a designated area in the east of the subject property and south of Jordan's Creek. In addition, this Plan will outline the steps to hence the vegetation communities through weed management, sediment and erosion control, ongoing maintenance and community participation.

3.0 PLANTING STRATEGY

To achieve the objectives of this proposed Vegetation Management Plan, it is envisaged that a replanting strategy be implemented such that the natural processes of plant succession can occur. The concept of vegetation succession whereby the vegetation present shifts from being dominated by pioneering species towards a stable climax community is sought as an induction of successful regeneration. Vegetation succession is however, a slow process and for riparian communities can take several centuries to fully establish. By manipulating the sequence of planting, it is hoped that the framework to allow the process of vegetation succession to develop, can be in place within a short time frame for this proposed development. Planting is to be undertaken within defined buffer zones between the proposed residential development and the natural features of the subject land.

For the Flood bypass channel it is necessary to consider a two stage planting strategy. The primary planting will rapidly achieve a covering of vegetation over the affected area to reduce potential erosion; this would comprise annual (non-native) grasses. Once the coverage is achieved a secondary planting of natives that will grow through and replace the grasses and reach the desired community structure. For other locations along Jordan's Creek where a rainforest community structure is the desired outcome, an initial planting of colonising native species to provide a closed canopy is preferred with a subsequent planting of rainforest species occurring after sufficient protection is available (2-3 years). Additional replacement plantings may be required where success has not been obtained or where the species selected are not suited to those conditions.

3.0.1 Buffer zones

Vegetated buffer zones may achieve several key environmental outcomes if undertaken with due consideration of the environmental parameters within a locale. Primarily, buffer zones can exist as a barrier to sediment and nutrient transport entering an aquatic environment. Secondly, they can limit the spread of exotic plants into a more pristine community. The connection of discrete vegetated communities through the establishment of buffer zones can assist in the migration of fauna along features such as creeks and ridges. Lastly, a buffer zone can achieve improved bush fire safety for adjacent developments when established within the guidelines proposed by the Rural Fire Service (RFS, 2006). The buffer zones for this Vegetation Management Plan are proposed to incorporate all of these attributes to achieve a desired environmental outcome.

The replanting strategy will focus on the extension of the riparian community in the eastern region of the subject area. This planting is to incorporate a 30m environmental buffer zone commencing from the top of the stream bank of Jordan's Creek as required given the 7(a) Environmental Protection 'Habitat and Communities' zoning that applies to this creek, and the Department of Water and Energy guidelines for Riparian Corridors (DWE, 2008). Jordan's Creek is a third order semi-permanent stream and will require a 20m Core Riparian Zone and 10m Vegetated Buffer. Discussions with staff from the Department of Fisheries, have confirmed that a 30m is a satisfactory buffer for Jordan's Creek. On the northern bank of Jordan's Creek, both a perimeter road and pedestrian boardwalk associated with the residential development are to be included within the 30m buffer. Furthermore, after discussions with staff from the Department of Fisheries and the Environmental Officer Coffs Harbour City Council, the establishment of a 30m buffer zone surrounding the freshwater lagoon is proposed. A further 10m planting strategy of appropriate species along the western margin of the subject area is proposed as both a connection of two areas of Primary Koala

Habitat within Community 1, and as a buffer zone from a banana plantation on the adjacent property.

It is envisaged that the proposed residential development will not remove any native vegetation for the construction of the residential dwellings, access roads, driveways, associated infrastructure and Asset Protection Zones for bushfire protection. However, should the removal of trees from the northern property boundary or within Community 4: Grassland vegetation become necessary, only a limited number of trees will be removed. Any trees present within these areas are highly isolated and of low conservation value and hence would be given a Low (Level 4) Ecological Status value according to the Coffs Harbour Vegetation Strategy (Coffs Harbour City Council, n.d.). Any requirement for compensatory planting on a 2:1 basis will be greatly exceeded by the proposed strategy for the regeneration of the riparian community and associated buffer zones.

The excavation of the northern bank of Jordan's Creek from upstream of the sporting field to near the associated equipment building and facilities will involve the removal of High Ecological Status value vegetation (Secondary Koala Habitat) and will require compensatory planting on a 10:1 basis. This planting is proposed to be undertaken in the eastern portion of the subject property, south of Jordan's Creek in an area that has been identified any having potential flooding risks during extreme events (PTW Planning, 2006) and hence will not be developed, extending the riparian vegetation to the property boundaries.

3.1 Flood Bypass

A section of Jordan's Creek in the vicinity of the existing playing fields represents the southern boundary of the subject property. A Director General of Planning requirement (DGR) for approval was that enhanced flooding of adjoining lands should not occur as a result of the development proceeding. Modelling of flooding for the: existing; 100year event; and possible effects of climate change of flooding levels indicate that flooding may occur on adjoining lands as a result of a constriction in the channel of Jordan's Creek slightly to the north (upstream) of the sporting fields. A proposal to provide a flood bypass along a section of Jordan's Creek will alleviate this constriction and eliminate any flooding issues for adjoining properties.

3.1.1 Channel excavation

It is proposed to create a flood bypass along a section of Jordan's Creek upstream of the playing fields and rejoining Jordan's Creek downstream of the existing associated buildings. This bypass will involve: the removal of approximately 130m in length and varying widths of between 5 and 10m of riparian vegetation along the north bank of Jordan's Creek

(approximately 2400m^2 of vegetation); excavation of the existing channel bank to a depth of 0.50 above the existing channel invert (above low flow level) for a width of 6m to create a near horizontal terrace; and the gradual sloping of the terraced area to the existing land surface over an additional distance ranging from 11 to 14 metres. This work is illustrated diagrammatically in Attachment 2. A total 125 trees will be removed during excavation of this channel. To maintain the integrity of Jordan's Creek, it is proposed that for two locations where: mature Camphor Laurel trees occur; the stream bank is near vertical and being undercut; the opposite bank being depositional (accumulating gravel and cobble-sized sediment) and gently sloping; and a pool (*c*. 20m in length and 0.50m in depth) has developed; the existing channel bank is retained and the excavation for a bypass commences after approximately 2m creating an in-stream island during high flows (Attachment 2). The in-stream island, the bypass channel proper and the CRZ and VB will be vegetated as outlined below.

3.1.2 Site pre-treatment

Successful revegetation of the channel bypass requires:

- availability of acceptable soil material
- correct site preparation
- selection of the most suitable establishment technique
- selection of appropriate species, fertilisers, etc
- application of sufficient water for germination
- adequate maintenance programme

Each of these requirements is addressed in this Vegetation Management Plan.

During excavation of the bypass channel, all topsoil should be stockpiled for re-use to assist in revegetation. An Erosion and Sediment Control Plan must be developed to eliminate sediment entering Jordan's Creek and should comply with the guidelines outlined in the Blue Book (Landcom, 2004). This should include both floating sediment barriers and silt curtains within Jordan's Creek downstream of the proposed construction activity. The reserved topsoil should also be managed to prevent erosion. Jordan's Creek has generally eroded to bedrock with cobble-size clasts forming the channel bed; hence after excavation little soil will remain to assist in germination; the retained topsoil may need to be supplemented with other supplies to provide adequate material for germination.

Modelling of the 100-year flood events would indicate that stream velocities exceed 2m/sec in several locations along the channel during high flows. The erosion potential of such velocities must be addressed in the site pre-treatment. For the sections where low velocities are expected, a biodegradable erosion control blanket such as Jute Matting (600gsm grade)

is recommended to overlie topsoil spread from the reserved stockpile. This matting is specifically designed to protect the soil surface, reducing runoff; controlling weed growth and enhancing growth of tubestock. It will have a life expectancy of 12-24 months after which the vegetation should be established. The heavier grade is recommended as this will remain in place during occasional high water flows.

For the sections of the bypass channel where stream velocities are expected to exceed 2m/sec it is recommended that the surface be covered with a non-biodegradable turf reinforcing mat such as Landloc TRM 1060 or equivalents. This mat can be filled with the reserved topsoil and is recommended for situations that may experience stream velocities of up to 4.3m/sec for 50 hours duration.

3.1.3 Planting – in stream islands

The created in-stream islands will need to be vegetated. These islands are the result of the occurrence of mature Camphor Laurel trees along the existing stream bank. The Camphor Laurel trees with be systematically removed (See Section 4, below) from the property and appropriate species planted to stabilise the banks. Suggested species that already occur along the unaffected sections of Jordan's Creek include: Creek Sandpaper Fig, Pear-fruited Tamarind and Black Wattle with Lily Pilly and Pittosporum planted on the slope towards the bypass channel as illustrated in Attachment 3. Planting should use tubestock with on-going monitoring to remove any germinating Camphor Laurel. It would be expected that once the Camphor Laurel is removed, native species will germinate from the available soil seed bank. No soil pre-treatment is advised since the site already contains significant topsoil and any disturbance may lead to erosion with sediment entering Jordan's Creek.

3.1.4 Planting – bypass channel

The bypass channel will be covered by two discontinuous erosion control blankets relating to areas of differing stream velocities during peak stream flows. Where the Jute matting (or equivalent) is present, direct planting of tubestock into the underlying topsoil is recommended. However, where the Turf Reinforcing Mats are required, a primary planting of grass seeded into the soil-filled network of the reinforced mat will be necessary to quickly obtain a complete coverage of vegetation and reduce erosion potential (C-factor or ground cover and management factor of less than 0.05 after 10 days). A secondary planting with desired species both from seed or tube stock can occur subsequently and replace the non-native grasses.

Planting within the bypass channel is proposed using 3 zones: Zone A of width 1m immediately adjacent to the existing stream bank; Zone B of width 6m along the near

horizontal terrace; and Zone C of varying widths (11-14 metres) as a gradual slope or terraced area that returns to the existing floodplain land surface (Attachment 4).

Planting within Zone A is necessary to stabilise the existing channel bank and should comprise: Creek Sandpaper Fig, Water Gum, Lilly Pilly, Lomandra and Cordyline species and is diagrammatically illustrated in cross section as Attachment 3.

Planting within Zone B should consider that this area will be subject to periodic inundation, but also that a dense stand of mature trees will create further flooding issues by restricting the flow velocities. A low lying area downstream of the proposed channel works is dominated by Paperbark (*Melaleuca quinquenervia*) and this species is recommended for this Zone. Other species recommended for this Zone include: Tuckeroo, Three-leaved Laurel, Red Olive Plum, Lilly Pilly and Lomandra as illustrated in Attachment 3.

Planting within Zone C should stabilise the bank and/or terraced areas whilst providing suitable protection for rainforest taxa that will be planted within the adjoining Core Riparian Zone. It is therefore important to include emergent and colonising species such as: Brushbox, Tallowwood, Rose Maple, Black Wattle and Water Gum with an understorey of Pear-fruited Tamarind, Native Tamarind, Pittosporum and Lilly Pilly (Attachment 3). Plant spacings should reflect the need to maintain stream velocities during peak flows.

3.2 Compensatory Planting Zone

The easternmost region of the subject land has been identified as being subjected to periodic inundation during extreme rainfall events. Furthermore, inspection of this area indicated the presence of a number of terraces associated with Jordan's Creek despite the area being subjected to previous agricultural pursuits (Figure 6). The opportunity to utilise this area as the primary focal point for regeneration offers two benefits. Firstly, the re-establishment of the riparian community should be simplified by the presence of an underlining geomorphologic regime suited to such vegetation communities. Secondly, the requirements of any compensatory planting due to the removal of High Ecological Status vegetation during excavation of the flood bypass channel and/or earthworks associated with the residential development can be met by utilising an area of little developmental value but potentially high environmental return.

The extension of the riparian community in this region can further enhance this secondary koala habitat and provide greater opportunities for fauna migration via a connective corridor with neighbouring koala habitats to the east of the Pacific Highway using the existing Pacific Highway underpass as recommended in the Flora and Fauna Assessment (Bushfiresafe

(Aust), 2009). An area of approximately 1Ha is available for compensatory planting between the property's eastern and southern boundaries, the southern residential precinct and Jordan's Creek that will equate to the planting up to 1500 individual plants.

Figure 6. Photograph of the southern margin of Jordan's Creek that is proposed to the revegetated with riparian rainforest plants utilising the small-scale terraces and toe slopes (Photograph, S. Cotter).

3.2.1 Site pre-treatment

The area immediately adjacent from Jordan's Creek should receive minimal disturbance to maintain both: the slope characteristics; and soil structure present. Heavy slashing of the present grassland vegetation over the area under consideration is required. The removal of all vegetation for approximately 1m^2 surrounding the site where species are to be planted and cultivation of this area to a depth of a least 40cm is recommended. Planting establishment would be further enhanced by the incorporation of the slow-release fertiliser into the cultivated soil. Importantly, a local plant ecologist or bush regenerator should be engaged to supervise the planting and advise on the appropriate spacing.

3.2.2 Species for planting

The primary focus of the compensatory planting is to replace the high Ecological Status vegetation that will be removed from along Jordan's Creek during the excavation of the flood bypass. The vegetation to be removed comprises mainly mature Camphor Laurel trees above a regenerating rainforest understorey. The compensatory planting scheme should therefore focus on providing a regenerating rainforest community whilst enhancing the opportunities for koala movement throughout the area. Recommended species include: Brushbox, Flooded Gum, Tallowwood, Turpentine, Hoop Pine, Rose Myrtle, Black Wattle, Pear-fruited Tamarind, Rose Maple, Three-veined Laurel, and Native Tamarind. Advice regarding appropriate tree spacing should be sought from an experienced bush regenerist. Subsequent planting of appropriate species may be undertaken after 3 years to progress the

vegetation community structure towards a regenerated lowland rainforest after due consultation with a plant ecology / regenerator.

3.3 Riparian Vegetation

The Core Riparian Zone along Jordan's Creek for the sections not affected by the excavation of the flood bypass will be rehabilitated to achieve a 20m in width regenerating rainforest zone (Core Riparian Zone). An additional 10m wide Vegetated Buffer will then be planted that will compliment the CRZ, providing a 30m environmental buffer to the residential development.

3.3.1 Site pre-treatment

The area adjacent for Jordan's Creek should receive minimal disturbance to maintain: the slope characteristics; soil structure present; and to prevent erosion and hence sediment entering Jordan's Creek. The removal of all vegetation for approximately 1m^2 surrounding the site where species are to be planted and cultivation of this area to a depth of a least 40cm is recommended. Planting establishment would be further enhanced by the incorporation of the slow-release fertiliser into the cultivated soil. Importantly, a local plant ecologist or bush regenerator should be engaged to supervise the planting and advise on the appropriate spacing.

3.3.2 Species for planting

An outline of the proposed planting scheme is presented in Attachment 1 with a schematic cross-section of Jordan's Creek and associated terraces in Attachment 5. On the lowermost terrace, immediately adjacent to the creek line (Zone A, Attachment 1), initial plantings of emergent and pioneering species such as Hoop Pine, Brushbox, Corkwood, Scentless Rosewood, Red Bean, Creek Sandpaper Fig, Native Tamarind and Turpentine will provide a canopy under which a second storey of local species can be established. This second planting should be commenced approximately three years after establishment of the pioneering species listed above and include species consistent with that previously identified on the subject land (Red Olive Plum, Lilly Pilly, Mock Olive, Blueberry Ash, Narrow-leaved Orangebark, Bangalow and Cabbage Palms).

On the slope and upper terrace to a distance of 20m from the creek line (Zone B, Attachment 1), initial plantings should comprise tree species including Flooded Gum, Tallowwood, Grey Gum, Hoop Pine, Brushbox, Creek Sandpaper Fig and Forest Oak with an understorey of Wattle, Rose Myrtle, Narrow-leaved Orangebark and Lilly Pilly. Subsequent planting of appropriate species may be undertaken after 3 years to progress the vegetation community

structure towards a regenerated lowland rainforest after due consultation with a plant ecology / regenerator.

The outer 10m of the environmental buffer (Zone C, Attachment 1) will also function as the required set back for bushfire protection. This area should be managed as an Asset Protection Zone as recommended in the Planning for Bushfire Protection manual (RFS, 2006). This zone will include landscaping, pedestrian paths and boardwalks and any perimeter roads and provide a buffer between the revegetated areas and the proposed dwellings. The suggested species listed can be modified after consultation with a landscape designer but should be restricted to native plants known to occur within the Coffs Harbour region.

3.3.3 Bushfire protection of adjoining property

No plantings are to be considered for any area on the northern side of Jordan's Creek between the proposed pedestrian crossing and the area designated 7(b) Habitat Protection 'Scenic Buffer' so as not to compound any potential bushfire risk to the adjoining caravan site (RFS, 2006). Furthermore, it is envisaged that plantings within the 30m Buffer zone that are also within 40m of the caravan park are to be complimentary with a grassy woodland structure, defined by Keith (2004) as having tree spacings such that the projected foliage cover at mature growth would remain less than 30% and a dominantly grassy understorey (Zone C, Attachment 5). Planting of grouped Tallowwood and Flooded Gum trees within this area will achieve the benefit of enhancing the Koala Habitat and if positioned appropriately, will not increase the fire risk to the adjoining property.

3.4 Buffer Zone to Freshwater Lagoon

A 30m buffer zone is proposed for the freshwater lagoon located on the subject land. This lagoon is an example of a constructed wetland within the channel of Jordan's Creek. Any proposed plantings surrounding this wetland should consider both the need to maintain the current water level (and hence habitat for the Giant Barred Frog); and the need to limit sediment input into the system. These two requirements will dictate the level of manipulation that should be contemplated. Additionally, given the proximity of this buffer zone with a Tall Open Forest (Community 1 described above) that has been identified as a possible Primary Koala Habitat, planting along the outer margin of the buffer zone that are complementary with enhancing the koala habitat should be considered.

3.4.1 Site pre-treatment

Paramount for this location is the need to limit sediment inputs from the steep (>18°) slopes adjacent to the creek line. It is proposed that a shallow swale and bund be constructed at

approximately 25m from the margin of the freshwater lagoon. Furthermore, all areas should be heavily slashed, with equipment preferably following the contours of the slope during slashing.

3.4.2 Species for planting

An outline of the proposed planting scheme is presented in Attachment 1 with a schematic cross-section of the freshwater lagoon and associated slopes in Attachment 6. The shallow swale at the margins of the buffer zone should be planted with a close-spaced herbaceous groundcover such as Lomandra, with wattle and Forest Oak planted on top of the bund located immediately down slope (Zone C, Attachment 6). A 20m zone (Zone B, Attachment 6) should comprise an initial planting of koala habitat trees (Tallowwood, Blackbutt, Flooded Gum, Grey Gum, Hoop Pine, Swamp Mahogany and Forest Oak) with an understorey of Wattle species, Narrow-leaved Orangebark, Lilly Pilly, Veiny Wilkea, Croton, Cordyline and Mock Olive. There is the possibility of establishing Rusty Plum plants as an understorey species in this community from seeds gathered from the small population identified in the adjacent Tall Open Forest. The 5m inner zone (Zone A, Attachment 6) should comprise Wattle, Swamp Oak, Lomandra, Typha, sedges and native grasses. A bush regenerator should advise on the appropriate plant spacings. However, as a bushfire protection measure, tree spacings in zones B and C should be a minimum of 10m apart and sited randomly within the zone rather than in any equidistant regular formation.

3.4.3 Erosion control

The proposed buffer zone terminates immediately adjacent to the perimeter road for the Western Precinct. It is therefore necessary to adopt a number of specific erosion and sediment control measures to ensure that Freshwater lagoon remains as a suitable habitat for the Giant Barred Frog. It is recommended that a sediment fence (ecofencing-type) be positioned along the perimeter of the Buffer Zone and when used in tandem with vegetated mounds constructed within the outermost Zone C of the Buffer Zone will act to slow runoff velocity and limit sediment input to the Lagoon.

3.5 Buffer zone to Banana Plantation

A banana plantation exists along the western margin of the subject land (Figure 7 Left). The NSW Department of Primary Industries regards a 10m buffer between plantations and residential developments to be inadequate and should be widened to a minimum of 50m setback (NSW DPI, 2006). In complying with this request, and having due regard for both the continued operation of a banana plantation on the adjacent agricultural land and the possibly of future residential development of Lot 1 (Thoms Hill and Paddock), a 10m wide zone for planting is proposed along the western edge of the subject land. This zone is to comprise

mainly koala feeding trees to connect an isolated remnant of Community 1 Tall Open Forest (Primary Koala Habitat) with the riparian vegetation currently existing along Jordan's Creek (Secondary Koala Habitat). Figure 7 (Right) illustrates that a small creek line has developed on the slope draining from a Tall Open Forest towards Jordan's Creek. It is envisaged to exploit the western margin of this tributary to Jordan's Creek as the boundary of tree plantings. The connection of this remanent Tall Open Forest (Community 1) with Jordan's Creek would enhance the objectives for the revegetation of Habitat Links as outlined in the Korora Development Control Plan (DCP) (Coffs Harbour City Council, 2006).

Figure 7 Left: Banana plantation along the western margin of the property. Right: View looking upslope from Jordan's Creek on Lot 1 (Thoms Paddock and Hill) showing the small creek line draining the uppermost Tall Open forest. This creek has developed on the steep southerly-facing slope. Revegetation is proposed from the western margin of this creek line to the subject property boundary within the marked polygon (Photographs, S. Cotter).

3.5.1 Site pre-treatment

Paramount for this location is the need to limit sediment erosion from the steep (>18°) slopes adjacent to the creek line. All areas should be heavily slashed, with equipment preferably following the contours of the slope during slashing.

3.5.2 Species for planting

An outline of the proposed planting scheme is presented in Attachment 6. Initial planting of koala habitat trees should comprise Tallowwood, Blackbutt, Grey Gum, Northern Grey Ironbark and Forest Oak with an understorey of Wattle species. Approaching Jordan's Creek on the lower slope, Grey Gum and Northern Grey Ironbark should be replaced by Flooded Gum and Brushbox. Tree spacings should be a minimum of 10m so as not to impinge upon the specifications of an Asset Protection Zone for the adjacent property. Furthermore, since koalas due not follow a straight line, clumping or grouping of trees should be the preferred spacing option rather than linear arrays of equidistant tree plantings (Lunney *et al*., 1999). The established community would be expected to achieve a grassy woodland community structure.

3.5.3 Limitations in DCP to address environmental conditions

The Korora Rural Residential Master Plan contained in the Korora Development Control Plan (Coffs Harbour City Council, 2006) outlines a proposed construction of an access road from West Korora Road, in the vicinity of the freshwater lagoon, to service rural subdivisions including the western portion of this Pacific Bay West development and also properties to the west. Any major redevelopment of the present, temporary culvert to a level stipulated by NSW Fisheries for a linkage road (Fairfull and Witheridge, 2003) will greatly impinge upon the viability of the freshwater lagoon to persist. The resultant loss of this aquatic habitat will affect an endangered population of Giant Barred Frogs. A more environmentally appropriate access road for any future developments to the west could be the extension of Bruxner Park Road.

However, the upgrade of the present crossing to a level suitable for limited service of any future proposed dwellings on Lot 1 (Thoms Paddock) of the subject land is feasible. The upgrade could consider the need to accommodate greater flow volumes, whilst improving the structural integrity of the crossing **AND** maintaining the present freshwater lagoon habitat. Furthermore, should such a situation be proposed in the future, the buffer zone along the western margin of the subject land adjacent to the banana plantation becomes a more beneficial option within the Vegetation Management Plan by providing a vegetated corridor from Jordan's Creek, along a western bank of a small tributary, and connecting a remanent Tall Open Forest (Primary Koala Habitat) with a Habitat Link proposed in the Korora Development Control Plan (Coffs Harbour City Council, 2006).

3.6 Vegetation planting of developed Allotments

One aspect of the Vegetation Management Plan is the proposal to encourage residents to incorporate a planting strategy of specific koala feeding trees within their landscaping. It is the feature of this development that no native vegetation is to be removed during construction. All trees within the open Grassland / Open Woodland Community (highly disturbed, exotic species) are to be retained. However, to supplement the buffer zones described above, all residents will be encouraged to:

a) retain any mature trees present on their allotment and position their proposed dwelling such that those trees lie outside their Asset Protection Zone, or if tree is singular, within the Outer Protection Area; and

b) Plant additional recognised koala feeding trees from the following list. These trees can be so planted at the Resident's discretion with due encouragement to

provide additional understorey plantings of appropriate species following guidelines provided by Lunney *et al*. (1999).

Table 2 List of Koala feeding species recommended for planting in the Korora region

Scientific name	Common name	Scientific name	Common name
Eucalyptus microcorys	Tallowwood	*Eucalyptus robusta*	Swamp Mahogany
Eucalyptus propinqua	Grey Gum	*Eucalyptus grandis*	Flooded Gum
Eucalyptus pilularis	Blackbutt	*Eucalyptus tereticornis*	Forest Red Gum
Melaleuca quinquenervia	Paperbark	*Allocasuarina torulosa*	Forest Oak

3.7 Post-planting maintenance

Regular heavy mulching surrounding the plantings is recommended to prevent invasive weeds. Pea straw or sugar cane mulch is preferred to enhance the build up of organic matter within the soil profile. Care should be taken to ensure that the mulch does not rest upon the stems of the plants so as to prevent stem-rot diseases. The continuance of slashing in the areas surrounding the plants will be necessary to maintain a weed-free environment for at least 5 years. Irrigation of the seedlings will be required during the first summer season to ensure establishment and again if extreme dry conditions prevail. This is particularly essential with the riparian community given these plants greater need for moisture. This water can be obtained from the reclamation ponds constructed nearby.

For the Freshwater Lagoon Buffer Zone and the Banana Plantation Buffer Zone, the parameters for post-planting maintenance are dictated by the need to prevent any detrimental effects to the freshwater lagoon through increased sediment input. Whilst regular mulching around the plants will limit moisture losses and prevent any competition by invasive weeds, continued slashing of these areas with equipment preferably following the contours of the slope during operation, should only be necessary for an additional 5 years to prevent weed establishment.

3.8 Source of planting materials

Plants should be propagated from locally-collected seeds, either germinated from the soil seed bank obtained from the subject land, or obtained from nearby communities. The ground maintenance staff of the Pacific Bay Resort has the facilities and competency to germinate species that may be difficult to obtain commercially. Plant numbers and diversity may be augmented from commercial tube stock obtained from local nurseries. Where ever possible, plants that can be conclusively attributed to germinating within the local environment should be sought in preference to non-local species.

4.0 MONITORING AND WEED MANAGEMENT

The control of herbaceous regrowth during the first 5 years is essential to achieve a low mortality planting success. Any application of herbicide should consider the residual effects upon the aquatic fauna identified on site. If herbicide treatment is undertaken within the weed management program, both pre- and post-planting applications are recommended, with subsequent annual applications prior to the summer high rainfall period. The following methods are recommended for these noxious weeds identified within the vegetation.

4.1 Control of Camphor Laurel

Camphor Laurel (*Cinnamomum camphora*) comprises the majority of the riparian vegetation along Nana Creek. A comprehensive eradication programme for Camphor Laurel has been initiated for the North Coast region as part of the Northern Rivers Invasive Weeds Action Strategy (NSW NCWAC, 2007). To assist landholders a Camphor Laurel eradiation Kit has been developed (NSW NCWAC, n.d). The following methods for control of Camphor Laurel should be applied to infestations present on the subject property.

Herbicide application – many herbicides are registered for Camphor Laurel control, each being specific to the particular method: Stem Injection - TORDON®; Basal Bark – GARLON 600®; Foliar Spray - GRAZLON® EXTRA; and Cut Stump - GARLON 600® (Dow AgroSciences, n.d.). The stem injection method has received considerable success and is the preferred method for control of established trees for this property. This involves drilling a 1-2cm deep hole into the trunk of the Camphor Laurel trees at waist height and injecting 20ml of the herbicide (1:10 dilution) into this hole, preferably within 20 seconds. Holes are drilled at approximately the same height around the tree with centers 10-13cm apart. All trunks of each plant must be treated and hence this method is time consuming and expensive and requires annual follow up. Evidence for failure should be assessed during any follow up and techniques modified accordingly. Caution must be applied regarding the selection of herbicide type; GRAZLON® and TORDON® based herbicides are residual chemicals and can prevent germination of native species within the area, or can enter the watercourses affecting non-targeted plants downstream.

The application of herbicide using the basal bark technique can be effective for saplings and regrowth areas (plants less than 10cm in diameter). Incisions into the bark are made near ground level and herbicide applied rapidly to preclude any disruption in translocation of the chemical through the plant. Foliar spraying of seedlings can be adopted, particularly during follow up control but caution needs to be applied to prevent chemical drift towards non-targeted plants from occurring.

Mechanical – physical removal of the Camphor Laurel plants using chainsaws, tractors, etc is not advised for this property. Removal of this plant may result is significant soil erosion due to the wide shallow root system present and likely disruption to the soil environment from the equipment used. Potential soil erosion is more likely where the plant occurs on the steep slopes of the property. Additionally, colonising weed establishment is prevented by not creating a sudden reduction in the tree canopy, compared to that that would occur during the manual removal of the Camphor Laurel trees.

Revegetation – revegetation of the effected areas will limit re-establishment of Camphor Laurel from occurring. The list of native species occurring along the watercourses of the property is provided in Appendix 1. This list provides a selection of suitable plants for planting. In addition, it is recommended that Ficus species with aggressive aerial roots such as Moreton Bay Fig (*Ficus macrophylla*), Strangler (Watkins) Fig (*Ficus watkinsiana*) or Small-leaved Fig (*Ficus obliqua*) should be planted directly upon the treated Camphor Laurel tree where ever anchorage is possible (preferably in a low fork in the tree). In time, the fig tree will entirely replace the Camphor without major distribution to the vegetation canopy. Other species such as Creek Sandpaper Fig (*Ficus coronata*), whilst present within the riparian community, are not suitable as they require planting within soil.

4.2 Control of *Lantana camara*

Lantana camara is a *Weed of National Significance*. It is regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts. Lantana forms dense, impenetrable thickets that take over native bush land and pastures on the east coast of Australia. It competes for resources with, and reduces the productivity of, pastures and forestry plantations. It adds fuel to fires, and is toxic to stock. Lantana can spread in extent by adopting either of two characteristics:

a) The layering of stems where roots are sent into the soil allowing vegetative reproduction and hence the Lantana can quickly form very dense stands; and

b) Birds and animals consume the fruit and pass the seed, potentially spreading the viable seeds large distances. The germination rate for fresh seed is low but improves after being digested (Weeds CRC, 2003).

For the control of Lantana, a number of methods should be adopted in tandem with long-term follow up strategies. Both herbicide application (cut stem) and mechanical removal methods are suitable to deal with the present Lantana infestation with follow up management to prevent reinfestation. Best results are achieved by working from light infestation towards heavier infestations.

Herbicide application – many herbicides are registered for Lantana control. Techniques can include cut stem, foliar spray and basal bark injection. For each method all of the stems / plant must be treated as quickly as possible after the incision into the plant has been made to be effective. This method is time consuming and expensive. Caution must be applied regarding the selection of herbicide type; GRAZLON® and TORDON® based herbicides are residual chemicals and can prevent germination of native species within the area, or can enter the watercourses effecting non-targeted plants downstream.

Mechanical – involves the physical removal of all of the Lantana plant. This method is suitable for limited infestations and requires extensive follow up management to be effective. Caution needs to be applied regarding the potential for soil erosion.

Fire – fire can be an effective and inexpensive where large dense stands occur and risks to people and property can be managed. Follow up management is required. Potential soil erosion issues will dictate suitable areas for control of Lantana using this method. Extensive Lantana infestation is not apparent for this property and hence the application of fire in controlling this noxious is not advised.

Revegetation – revegetation using native plants should be adopted once the initial Lantana infestation is managed. This will prevent weed establishment and limit soil erosion. Heavy mulching around the native plants will enhance establishment and limit competition.

Follow up management – may include all of the above methods of control and should be undertaken annually over a 5 year timeframe. To be effective, follow up management should be performed as part of the holistic approach to property management that seeks to prevent weed establishment occurring during the development of the residential precincts.

4.3 *Ageratina adenophora, Solanum mauritianum*

Minor occurrences of these noxious weeds and other similar herbaceous plants are present along Jordan's Creek and throughout the western portion of the property. The following method of control of these weeds is recommended.

Herbicide application – many herbicides are registered for control of Crofton weed and Tobacco Bush. Foliar spraying is the preferred application method using herbicides registered for control such as Techniques can into cut stem and basal bark injection; foliar spray is not recommended in NSW. For each method all of the stems must be treated as quickly as possible after the GRAZON® EXTRA. Caution must be applied regarding the selection of herbicide type; GRAZON® and TORDON® based herbicides are residual

chemicals and can prevent germination of native species within the area, or can enter the watercourses effecting non-targeted plants downstream.

Mechanical – involves the physical removal of all of the Crofton Weed and Tobacco Bush. This method is suitable for the limited infestations and requires regular follow up management to be effective. Caution needs to be applied regarding the potential for soil erosion.

Revegetation – revegetation of the effected areas will limit re-establishment of the weeds from occurring. The list of native species occurring along the watercourses of the property is provided as Appendix 1. This list provides a selection of suitable plants for planting. The use of heavy mulching surrounding the native plants will assist in suppressing any weed competition.

4.4 Follow-up Actions

On-going monitoring and any future rehabilitation works on the riparian regeneration can be best achieved by the involvement of, and financial commitment to, a local community-based Land-Care Group.

5.0 Soil and Erosion Controls

The relatively steep slopes present on the subject site require careful consideration of sediment and erosion issues during the construction phase of the development. A detailed sediment and erosion control plan will be prepared by appropriately qualified consultants and is presented in a separate report. It is recommended that silt traps be constructed along all buffer zones prior to any construction activity to limit sediment and nutrient inputs into the Freshwater lagoon and Jordan's Creek. Any pre-treatment of the buffer zones by slashing of the existing non-native vegetation should be undertaken along contour lines. The resultant vegetation debris will maintain a cover to the ground and prevent splash erosion, and will restrict flow velocities of surface run-off thereby reducing the erosive potential.

6.0 Works Restoration Schedule

The Works Restoration Schedule proposed below incorporates three aspects of the Vegetation Management Plan. Detailed times are listed for those activities that deal with the establishment of the buffer zones surrounding the native vegetation of geomorphic features. The second section allocates the most appropriate times to commence supplementary planting by individual allotment residents. The schedule is based on a five-year timeframe as required by the Korora DCP. The on-going management of the buffer zones will be the responsibility of the Developer during this five-year period, after which the areas will be

transferred to the Coffs Harbour City Council for inclusion within their parks and reserves programme. However, the future success of this regeneration program requires the participation; and on-going support by a local community-based organisation such as Landcare or Greening Australia and efforts should be made to establish such a relationship.

			Year 1				Year 2				Year 3				Year 4				Year 5	
	W	S	S	A	W	S	S	A	W	S	S	A	W	S	S	A	W	S	S	A
Native Vegetation																				
Site Preparation																				
Seed Germination																				
Initial Planting																				
Stage 2 Planting																				
Irrigation																				
Weed Management																				
Herbicide Application																				
Allotments																				
Planting																				
Community																				
Land-care assistance																				

6.1 Budget

All work will be undertaken by the Pacific Bay Resort ground staff. Costs will be borne by the Corporate Body.

7.0 COMPLIANCE

All restoration works will be undertaken by a suitably qualified and experienced bush regenerator of professional qualifications and/or knowledge and experience extending beyond 5 years in current bush regeneration, restoration and relocation techniques. Current membership to the Australian Association of Bush Regenerators (AABR) is desirable.

Coffs Harbour City Council will be notified of the compliance with objectives and budget commitment within the Vegetation Management plan for each stage of the project as detailed in the Works restoration Schedule.

All initial works held within the approved Vegetation Management Plan (other that prescribed maintenance) is completed on each of the registered lots prior to release of the linen plan.

The registered proprietor of the subject land will enter into positive covenants with the Coffs Harbour City Council to maintain the prescribed works in accordance with the approved Vegetation Management Plan. The registration to title / lot of effective covenants in pursuant

to Section 88E of The Conveyancing Act 1919 will occur in conjunction with the registration of the Plan of subdivision.

8.0 CONCLUSIONS

The Vegetation Management Plan outlined above describes the procedures for ther revegetation of areas along Jordan's Creek; surrounding the freshwater lagoon; along the western boundary of the property and throughout a flood-prone area to the southeast of the property.

It is recommended that a 30m buffer either side of Jordan's Creek for its entire length on the subject property is created. This buffer will comprise a 20m wide Core Riparian Zone and an outer 10m Vegetated Buffer and will exceed the vegetation presently existing along the creek. A section of the northern creek bank in the vicinity of the Playing Fields will be excavated to address potential flooding issues. Approximately 2400m^2 of vegetation will be removed for this Flood Bypass. This vegetation includes trees planted following the development of the playing fields, approximately 15 years ago, and does not include any known threatened species. The area will be revegetated using native species present along other sections of Jordan's Creek and after completion, there will be:

- No net loss of riparian vegetation;
- No loss of connectivity along Jordan's Creek; and
- No barriers to fauna movement within this vegetation community.

A 30m buffer zone is proposed to surround the freshwater lagoon located in the western portion of the subject land. The threatened species, Giant Barred Frog, was recorded within this lagoon. The proposed buffer zone will be vegetated in zones to provide erosion control and will enhance the opportunities for the continued existence of this species on the property. A 10m buffer zone is proposed along the western boundary. This buffer will be vegetated using known koala-preferred tree species, arranged in clumps to replicate natural occurrence; and will provide a connection between an isolated area of Primary Koala Habitat in the north-western portion of the property with the Secondary Koala Habitat along Jordan's Creek.

A strategy for the management of existing non-native plant species is proposed in the Vegetation Management Plan. This will include the removal of Camphor Laurel over a period of 5 years, management of Lantana along Jordan's Creek and the management of herbaceous weeds within the grassland areas. The applications of herbicide through either stem injection or painted onto any cut stem for smaller trees is the recommended technique for both Camphor Laurel and Lantana, with subsequent replanting with native species in the

affected areas. The planting of strangler figs onto the lower forks of the Camphor Laurel after death will allow the figs to envelope the Camphor laurel trees over time, providing minimal disturbance to the soil. However, if removal of the Camphor Laurel is required, retaining the stump and root system will provide suitable erosion control measures. The physical removal of the Lantana from an infestation along Jordan's Creek is not recommended, but rather, allowing the growth of native species to colonise the area once the Lantana has been treated. The works proposed, materials and on-going maintenance will be provided by the ground staff of the Pacific Bay Resort with possible assistance from local community organisations such as Landcare.

9.0 GLOSSARY

APZ	Asset Protection Zone
EP&A Act	Environmental Planning and Assessment Act (1979).
CKPoM	Comprehensive Koala Plan of Management
CRZ	Core Riparian Zone
DECC	Department of Environment and Climate Change
DWE	Department of Water and Energy
DGR	Director General of Planning Requirements
GIS	Geographic Information System
GPS	Geographical Positioning System
IPA	Inner Protection Area
KPoM	Koala Plan of Management
LEP	Local Environmental Plan
LGA	Local Government Area
NPWS	National Parks and Wildlife Service
OPA	Outer Protection Area
RFS	Rural Fire Service of New South Wales
SEPP	State Environmental Planning Policy
TSC Act	Threatened Species Conservation Act (1995)
TSCA Act	Threatened Species Conservation Amendment Act (2002)
VB	Vegetated Buffer
WIRES	Wildlife Information and Rescue Service

10.0 REFERENCES

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APPENDIX 1. Native plant species recorded during the Flora Survey.

Tree species

Family	Binomial Name	Common Name
Anacardiaceae	*Euroschinus falcata var, falcata*	Chinaman's Cedar
Araliaceae	*Polyscias elegans*	Celerywood
Araucariaceae	*Araucaria cunninghamii*	Hoop Pine
Arecaceae	*Archontophoenix cunninghamiana*	Bangalow Palm
	Livistona australis	Cabbage Palm
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak
	Casuarina glauca	Swamp Oak
Celastraceae	*Cassine australis*	Red Olive Berry
Cunoniaceae	*Caldcluvia paniculosa*	Corkwood
	Schizomeria ovata	Crabapple
Elaeocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash
Epacridaceae	*Trochocarpa laurina*	Waddy Wood
Escalloniaceae	*Cuttsia viburnea*	Native Elderberry
Euphorbiaceae	*Baloghia inophylla*	Scrub Bloodwood
	Cleistanthus cunninghamii	Omega
	Glochidion ferdinandi	Cheese Tree
Fabaceae (Mimosoideae)	*Acacia fimbriata*	Fringed Wattle
	Acacia floribunda	Sally Wattle
	Acacia irrorata	Green Wattle
	Acacia melanoxylon	Black Wattle
Flacourtiaceae	*Scolopia braunii*	Flintwood
Lauraceae	*Cryptocarya glaucescens*	Jackwood
	Cryptocarya microneura	Murrogun
	Cryptocarya obovata	Pepperberry
	Cryptocarya rigida	Rose Maple
	Cryptocarya triplinervis	Three-veined Laurel
	Endiandra muelleri	Mueller's Walnut
	Endiandra sieberi	Hard Corkwood
	Neolitsea dealbata	Hairy-leaved Bolly Gum
Meliaceae	*Dysoxylum muelleri*	Red Bean
	Synoum glandulosum	Scentless Rosewood
Moraceae	*Ficus coronata*	Creek Sandpaper Fig
	Ficus obliqua	Small-leaved Fig
	Ficus rubiginosa	Port Jackson Fig
Myrsinaceae	*Rapanea howittiana*	Muttonwood
Myrtaceae	*Acmena smithii*	Lily Pilly
	Angophora costata	Smooth-barked Apple
	Backhousia myrtifolia	Grey Myrtle
	Corymbia intermedia	Pink Bloodwood
	Eucalyptus grandis	Flooded Gum
	Eucalyptus microcorys	Tallowwood
	Eucalyptus pilularis	Blackbutt
	Eucalyptus propinqua	Grey Gum
	Eucalyptus resinifera	Red Mahogany
	Eucalyptus siderophloia	Northern Grey Ironbark
	Lophostemon confertus	Brush Box
	Rhodamnia rubescens	Scrub Turpentine
	Rhodomyrtus psidioides	Native Guava
	Syncarpia glomulifera	Turpentine
	Syzygium luehmannii	Riberry
	Syzygium oleosum	Blue Lily Pilly
	Tristaniopsis laurina	Water Gum
Oleaceae	*Notelaea longifolia*	Mock Olive
	Olea paniculata	Native Olive
Pittosporaceae	*Hymenosporum flavum*	Native Frangipanni
	Pittosporum undulatum	Pittosporum
Rhamnaceae	*Alphitonia excelsa*	Red Ash

Family	Binomial Name	Common Name
Rubiaceae	*Hodgkinsonia ovatiflora*	Hodgkinsonia
Rutaceae	*Acronychia oblongifolia*	White Lilly Pilly
Sapindaceae	*Alectryon subcinereus*	Bird's Eye
	Castanospora alphandii	Brown Tamarind
	Cupaniopsis anacardioides	Tuckeroo
	Diploglottis australis	Native Tamarind
	Guioa semiglauca	Guioa
	Jagera pseudorhus f, pseudorhus	Foambark
	Mischocarpus pyriformis ssp. pyriformis	Pear-fruited Tamarind
Sapotaceae	*Amorphospermum whitei*	Rusty Plum
Sterculiaceae	*Brachychiton acerifolius*	Flame Tree
	Commersonia bartramia	Brown Kurrajong
Verbenaceae	*Clerodendrum floribundum*	Smooth Clerodendrum
	Gmelina leichhardtii	White Beech

Shrub species

Family	Binomial Name	Common Name
Apocynaceae	*Tabernaemontana pandacaqui*	Banana Bush
Araliaceae	*Astrotricha longifolia*	Star Hairs
	Polyscias sambucifolia	Elderberry
Asteliaceae	*Cordyline petiolaris*	Broad-leaved Cordyline
	Cordyline stricta	Cordyline
Asteraceae	*Ozothamnus diosmifolius*	Native Daisy
Celastraceae	*Maytenus silvestris*	Narrow-leaved Orange Bark
Cyathaceae	*Cyathea cooperi*	Straw Treefern
	Cyathea leichhardtiana	Prickly Treefern
Euphorbiaceae	*Croton verreauxii*	Croton
	Omalanthus populifolius	Bleeding Heart
Eupomatiaceae	*Eupomatia bennettii*	Small Bolwarra
	Eupomatia laurina	Bolwarra
Fabaceae (Mimosoideae)	*Acacia longifolia*	Coast Wattle
Malvaceae	*Abutilon oxycarpum*	Flannel Weed
Monimiaceae	*Wilkiea huegeliana*	Veiny Wilkea
Myrtaceae	*Archirhodomyrtus beckleri*	Rose Myrtle
Pittosporaceae	*Pittosporum revolutum*	Hairy Pittosporum
Sambucaceae	*Sambucus gaudichaudiana*	White Elderberry
Sapindaceae	*Alectryon coriaceus*	Beach Bird's Eye
Zamiaceae	*Lepidozamia peroffskyana*	Burrawang Palm

Herb species

Family	Binomial Name	Common Name
Family name	Binomial name	Common name
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower
Adiantaceae	*Adiantum formosum*	Giant Maidenhair
	Adiantum hispidulum	Rough Maidenhair
Araceae	*Alocasia brisbanensis*	Cunjevoi
Aspleniaceae	*Asplenium australasicum*	Bird's Nest Fern
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern
	Doodia aspera	Prickly Rasp Fern
	Doodia caudata	Small Rasp Fern
Commelinaceae	*Commelina cyanea*	Scurvy Weed
Convulvulaceae	*Dichondra repens*	Kidney Weed
Cyperaceae	*Carex polyantha*	Carex Sedge
	Cyperus filipes	A Sedge

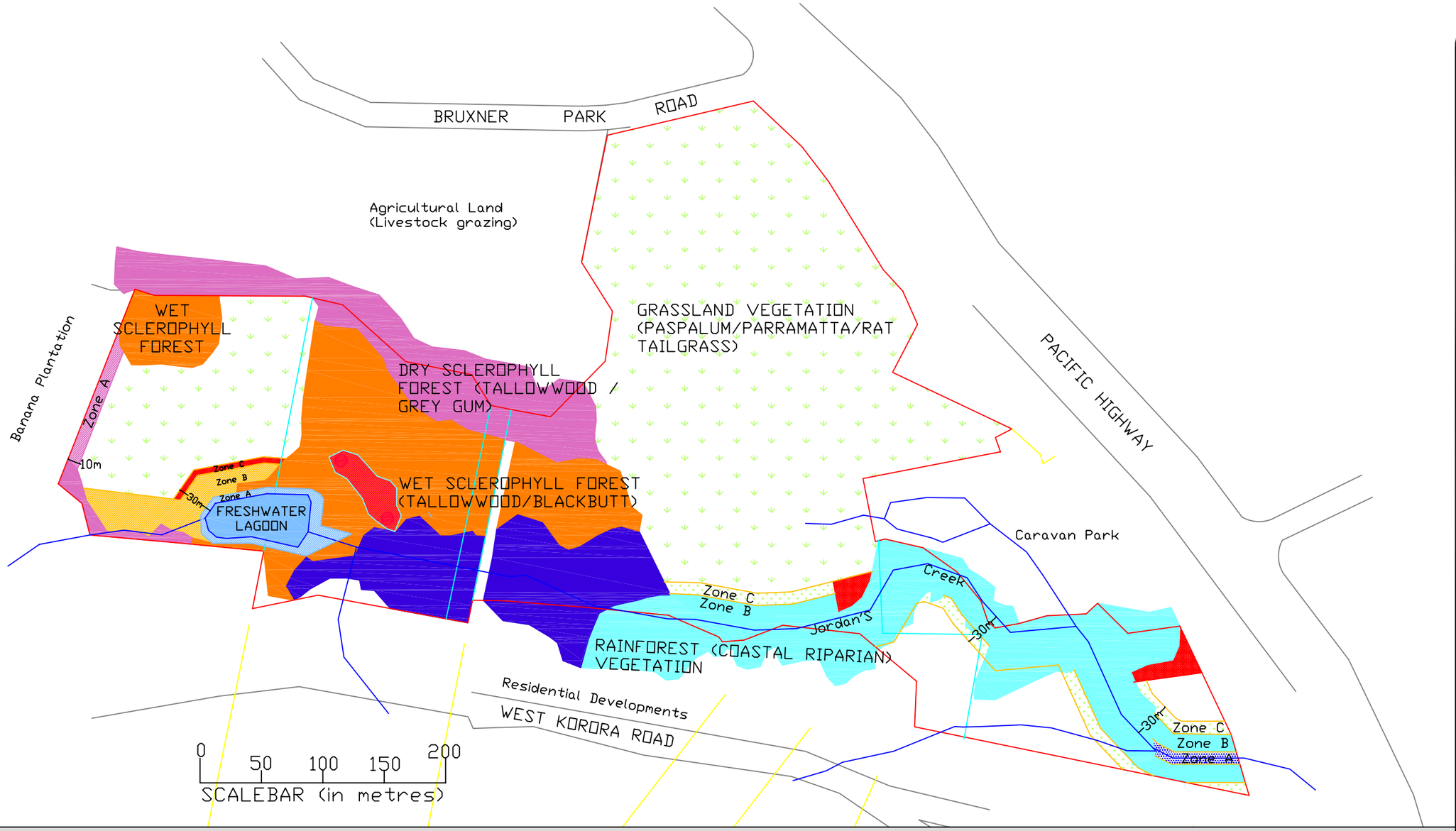
Family	Binomial Name	Common Name
	Gahnia sieberiana	A Saw Sedge
Davalliaceae	*Nephrolepis cordifolia*	Fishbone Fern
Dennstaedtiaceae	*Dennstaedtia davallioides*	Lacy Ground Fern
	Pteridium esculentum	Bracken Fern
Dicksoniaceae	*Calochlaena dubia*	Common Ground Fern
Euphorbiaceae	*Phyllanthus gasstroemii*	A Phyllanthus
	Phyllanthus virgatus	A Phyllanthus
Lomandraceae	*Lomandra hystrix*	A Lomandra
	Lomandra longifolia	A Lomandra
	Lomandra multiflora ssp. *multiflora*	A Lomandra
Phormiaceae	*Dianella caerulea*	Dianella
Poaceae	*Entolasia stricta*	Wiry Panic
	Microlaena stipoides	Microlaena
	Oplismenus aemulus	Basket Grass
	Themeda australis	Kangaroo Grass
Polypodiaceae	*Pyrrosia confluens*	Horseshoe Felt Fern
Thelypteridaceae	*Christella dentata*	Binung
Typhaceae	*Typha* sp	Bulrush
Uvuvlariaceae	*Tripladenia cunninghamii*	Kreysegia Lily
Violaceae	*Viola hederacea form d*	Native Violet
Zingiberaceae	*Alpinia caerulea*	Native Ginger

Vine species

Family	Binomial Name	Common Name
Amaranthaceae	*Deeringia arborescens*	Deeringia
Apocynaceae	*Melodinus australis*	Southern Melodinus
	Parsonsia induplicata	Thin-leaved Silkpod
	Parsonsia straminea	Ivy Silkpod
Arecaceae	*Calamus muelleri*	Lawyer Vine
Asclepidiaceae	*Marsdenia rostrata*	Common Milk Vine
Bignonaceae	*Pandorea pandorana*	Wonga Vine
Dilleniaceae	*Hibbertia scandens*	Twining Guinea Flower
Dioscoraceae	*Dioscorea transversa*	Native Yam
Flagelliariaceae	*Flagellaria indica*	Whip Vine
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry
	Geitonoplesium cymosum	Scrambling Lilly
Menispermaceae	*Legnephora moorei*	Round-leaf Vine
	Stephania japonica var. *discolor*	Snake Vine
Monimiaceae	*Palmeria scandens*	Anchor Vine
Moraceae	*Malaisia scandens*	Burny Vine
Myrsinaceae	*Embelia australiana*	Embelia
Pittosporaceae	*Billardiera scandens*	Common Apple-berry
Ripogonaceae	*Ripogonum album*	White Supplejack
	Ripogonum elseyanum	Hairy Supplejack
	Ripogonum fawcettianum	Small Supplejack
Rosaceae	*Rubus moorei*	Molucca Bramble
	Rubus nebulosus	Thorny Bramble
	Rubus rosifolius	Rose-leaf Bramble
Rubiaceae	*Morinda jasminoides*	Morinda
Smilacaceae	*Smilax australis*	Austral Sarsaparilla
	Smilax glyciphylla	Sweet Sarsaparilla
Vitaceae	*Cissus antarctica*	Water Vine
	Cissus hypoglauca	Five-leaf Water Vine

Parasitic plant species

Family	Binomial Name	Common Name
Loranthaceae	*Dendrophthoe vitellina*	A Mistletoe



LEGEND

- SUBJECT PROPERTY BOUNDARY
- EXISTING PROPERTY BOUNDARIES
- ADJOINING PROPERTY BOUNDARIES
- EXISITNG ACCESS ROADS
- JORDANS CREEK
- COASTAL FRESHWATER LAGOON
- Zone A surrounding Freshwater lagoon Lomandra / Saw sedge
- WET SCLEROPHYLL VEGETATION (TALLOWWOOD/BLACKBUTT)
- Zone B TALLOWWOOD / BLACKBUTT / SHE-OAK
- RUSTY PLUM (*Amorphospermum whitei*)
- Zone C Erosion Control measures
- Zone A Creek bank and adjacent areas
- RAINFOREST (COASTAL RIPARIAN) VEGETATION (TALLOWWOOD/FLOODED GUM / BRUSHBOX / TUCKEROO / CREEK SANDPAPER FIG)
- Zone B Lower slopes and terraces
- GRASSLAND VEGETATION (PASPALUM/PARRAMATTA/RAT TAILGRASS)
- Zone C Landscaped areas / pedestrian paths / Perimeter roads
- Planting exclusion area - Limit bushfire risk to Caravan Park
- FLOODED GUM TALL OPEN FOREST
- DRY SCLEROPHYLL VEGETATION (TALLOWWOOD/GREY GUM)
- Zone A Tallowwood / Grey Gum

N

General Notes

This drawing was prepared by Bushfiresafe (Aust) P/L to demonstrate the identified vegetation communities present within the development property and should not be used for any other purpose.

ATTACHMENT 1

VEGETATION COMMUNITIES / PLANTING ZONES

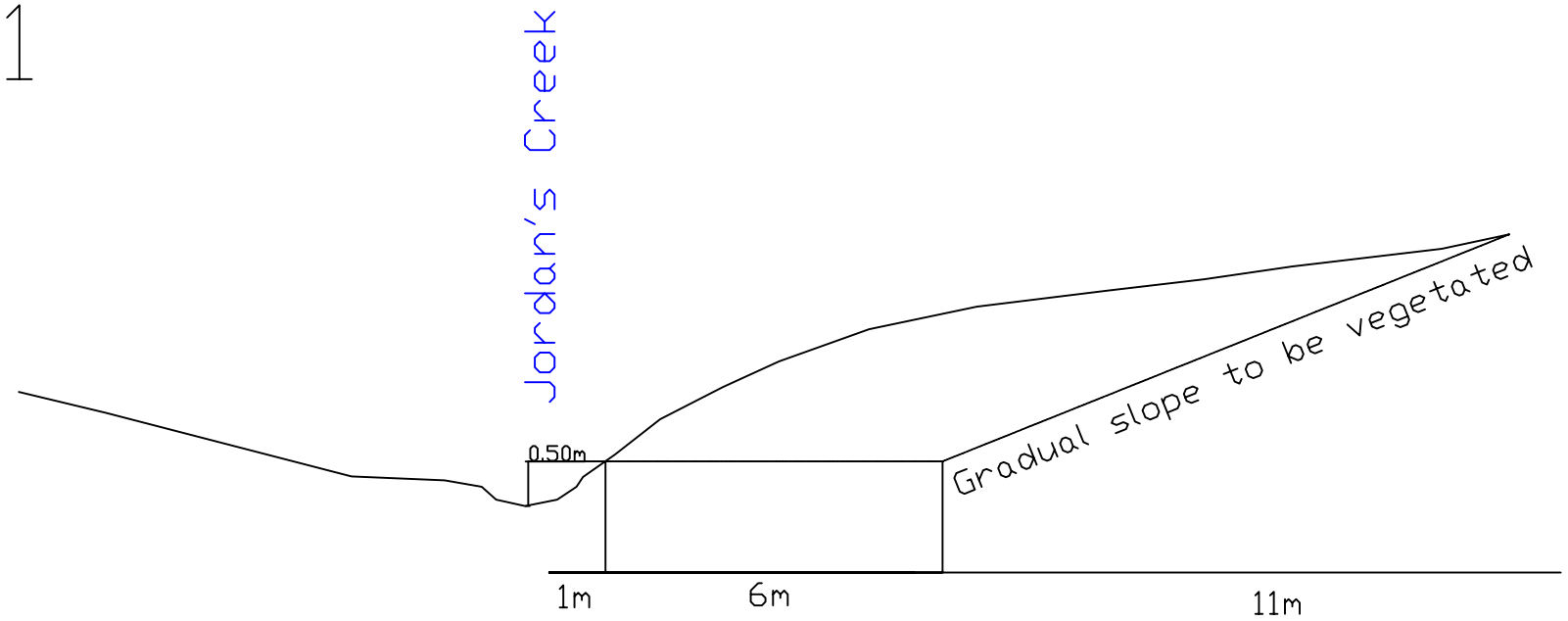
Bushfiresafe (Aust) P/L
20 McLachlan St
Maclean NSw 2463
02) 66451088

CLIENT:
Thakral Holdings P/L
George Street
Sydney

Project
Vegetation Management Plan
Pacific Bay West Residential Development

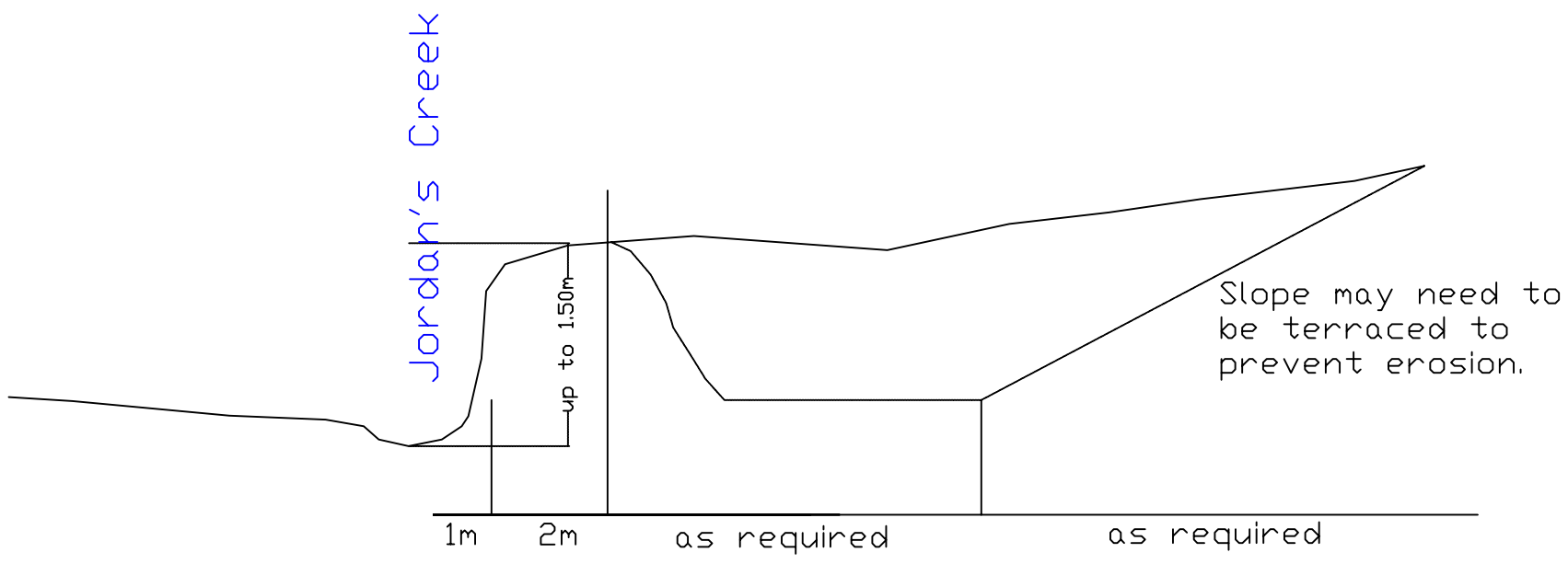
Date: June 2008
Scale:
Ref# 7016

1



Cross sextion where existing channel banks gentle slope towards Jordan's Creek. Retain exiating channel bank up to 0.50m above channel invert, excavate a near horizontal bench of width 6m at this height return to existing floodplain level by gradual slope.

2



Cross section of excavation where existing channel bank is near vertical and greater than 1 metre. Retain existing bank, creating an island with extra material removed from distal part of bank as required to maintain cross sectional area and flood flows.

General Notes

This drawing was prepared by Bushfiresafe (Aust) P/L to demonstrate a sectional view of the riparian revegetation area and should not be used for any other purpose.

ATTACHMENT 1

Schematic cross section of Jordan's Creek excavation channel

Bushfiresafe (Aust) P/L
20 Maclachlan St
Maclean NSW 2463
(02) 6645 1099

CLIENT:
Thakral Holdings P/L
George Street
Sydney

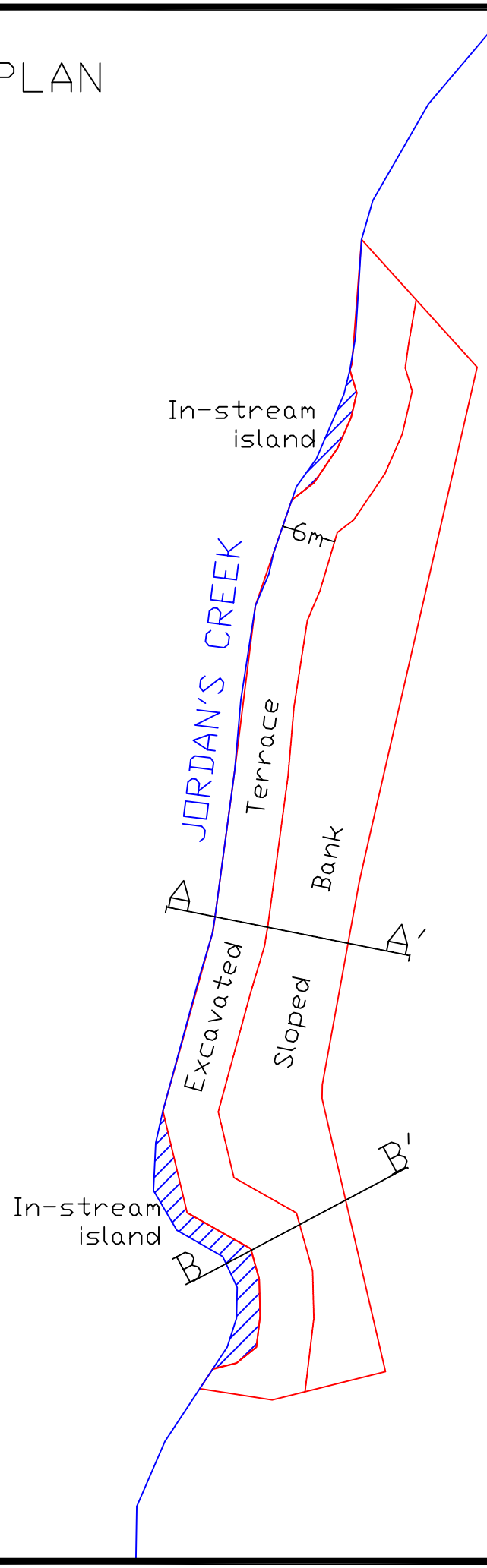
Project
Vegetation Management Plan
Pacific Bay West Residential Development

Date: February, 2009

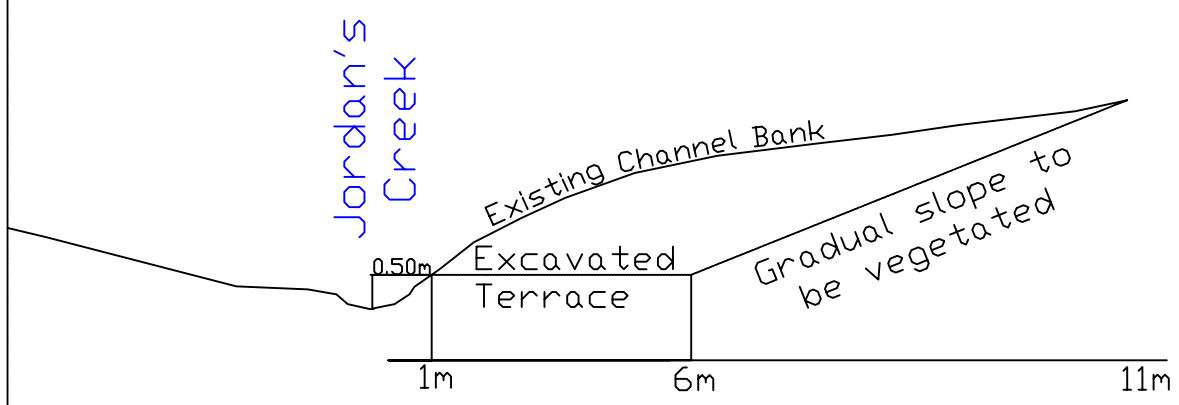
Ref# 8053

Scale:

PLAN

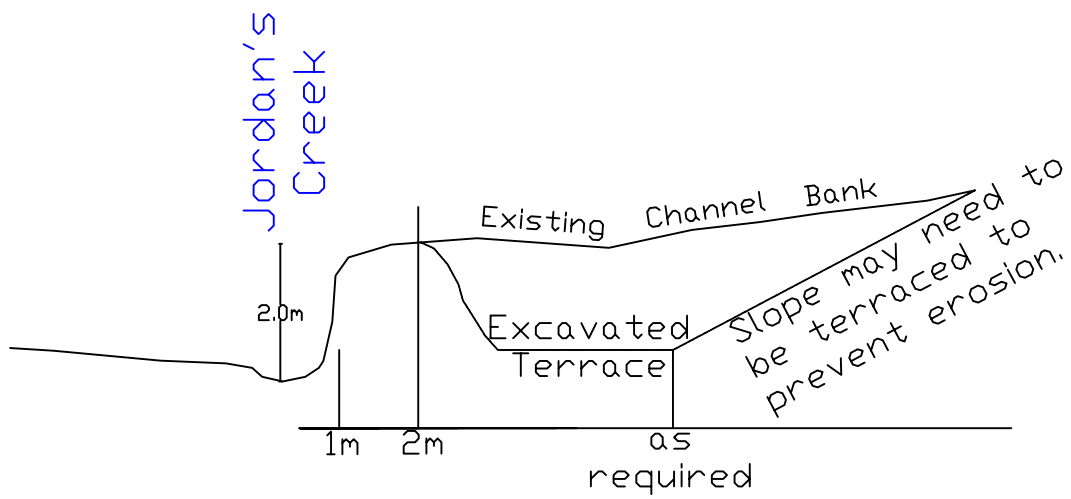


Section A-A'



Cross sextion where existing channel banks gentle slope towards Jordan's Creek. Retain exiating channel bank up to 0.50m above channel invert, excavate a near horizontal bench of width 6m at this height return to existing floodplain level by gradual slope.

Section B-B'



Cross section of excavation where existing channel bank is near vertical and greater than 1 metre. Retain existing bank, creating an island with extra material removed from distal part of bank as required to maintain cross sectional area and flood flows.

General Notes

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ATTACHMENT 2

Plan of Bypass Channel and Schematic cross section of Jordan's Creek

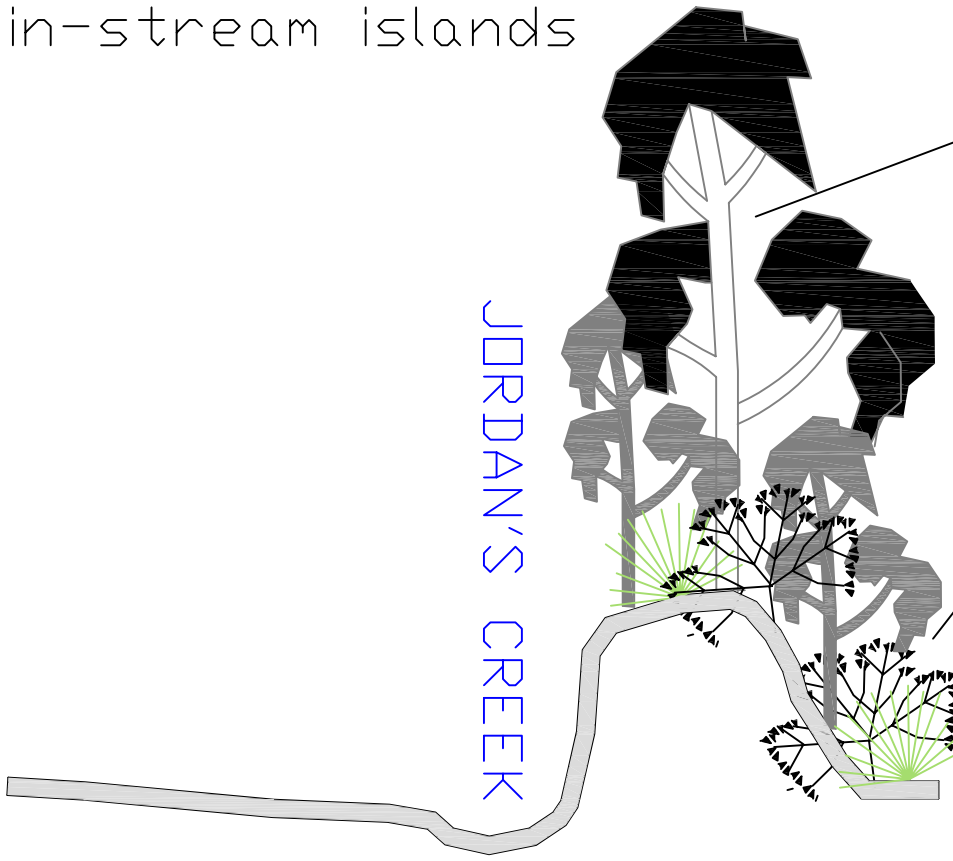
Bushfiresafe (Aust) P/L
20 Maclachlan St
Maclean NSW 2463
(02) 6645 1099

CLIENT:
Thakral Holdings P/L
George Street
Sydney

Project
Vegetation Management Plan
Pacific Bay West Residential Development

Date: February, 2009
Ref# 8053
Scale: Not to scale

Schematic Planting Scheme for in-stream islands



OVER STOREY PLANTING
(stabilise island)

Creek Sandpaper Fig
Pear-Fruited Tamarind
Black Wattle

UNDERSTOREY PLANTING
(stabilse slopes)

Lomandra
Lilly Pilly
Pittosporum

Terrace and slope planting similar to that shown below

Schematic Planting Scheme for channel excavations

Zone A
(Stabilise bank)

Creek Sandpaper Fig
Water Gum
Lilly Pilly
Lomandra
Cordyline

Zone B
(Terrace)

Paperbark
Tuckeroo
Swamp Mahogany
Red olive Plum
Lomandra

Zone C (Slope)

Brushbox
Tallowwood
Black Wattle
Water Gum
Pear-FruitedTamarind
Native Tamarind
Pittosporum
Lilly Pilly
Lomandra

ATTACHMENT 3
Cross-Sections showing planting scheme in Bypass Channel

BushfireSafe Services
20 McLachlan Street
Maclean NSW 2463
PH: 02) 6645 1099

www.bushfiresafe.com.au

Vegetation Managemernt Plan
Pacific Bay West Residential Development

CLIENT:
Thakral Holdings
George Street, Sydney

NOTES:
This drawing was prepared by Bushfiresafe (Aust) P/L to illustrate the proposed revegetation of the Flood Bypass Channel and should not be used for any other purpose.

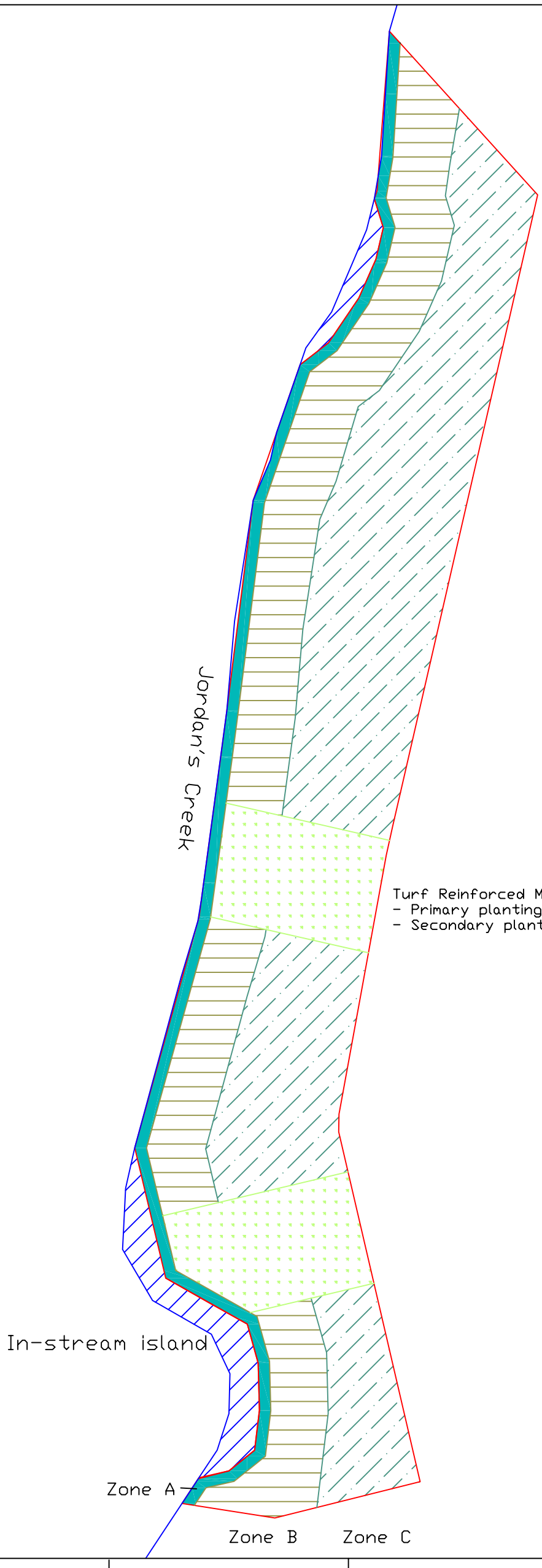
SIZE

DATE: February 2009

REF# 8053

SCALE: Not to scale

SHEET



Turf Reinforced Matting
- Primary planting of seeded grass
- Secondary planting of native species after as least 6 months

Legend

- Zone A 1m in width
- Zone B 6m in width
- Zone C 11-14m in width
- High Stream Velocity Turf Reinforced Matting

ATTACHMENT 4
Revegetation Planting Zones in Bypass Channel

BushfireSafe Services
20 McLachlan Street
Maclean NSW 2463
PH: 02) 6645 1099

www.bushfiresafe.com.au

Vegetation Managemernt Plan
Pacific Bay West Residential Development

CLIENT:
Thakral Holdings
George Street, Sydney

NOTES:
This drawing was prepared by Bushfiresafe (Aust) P/L to illustrate the proposed revegetation of the Flood Bypass Channel and should not be used for any other purpose.

SIZE	DATE: February 2009	REF# 8053
SCALE: Not to scale	SHEET	

ZONE A Bank
variable width 2-6m

ZONE B Lower slope
variable width 14-18m

ZONE C Upper slope (Buffer)
width 10m

Complies with requirements for an Asset Protection Zone for dwelling within the Southern Precinct

TREES

Hoop Pine
Brushbox
Corkwood
Red Bean
Turpentine
Scentless Rosewood
Creek Sandpaper Fig
Native Tamarind

SHRUBS

Red Olive Plum
Lilly Pilly
Mock Olive
Blueberry Ash
Narrow-leaved Orangebark

PALMS

Bangalow Palm
Cabbage Palm

TREES

Flooded Gum
Tallowwood
Grey Gum
Creek Sandpaper Fig
Hoop Pine
Brushbox
Native Tamarind
Forest Oak

SHRUBS

Coastal Wattle
Rose Myrtle
Lilly Pilly
Narrow-leaved Orangebark

SHRUBS

Coastal Wattle
Hairy Pittosporum
Narrow-leaved Orangebark
Native Ginger
Lomandra

This Zone will include landscaping, paths, boardwalks and perimeter roads

General Notes

This drawing was prepared by Bushfiresafe (Aust) P/L to demonstrate a sectional view of the riparian revegetation area and should not be used for any other purpose.

ATTACHMENT 5

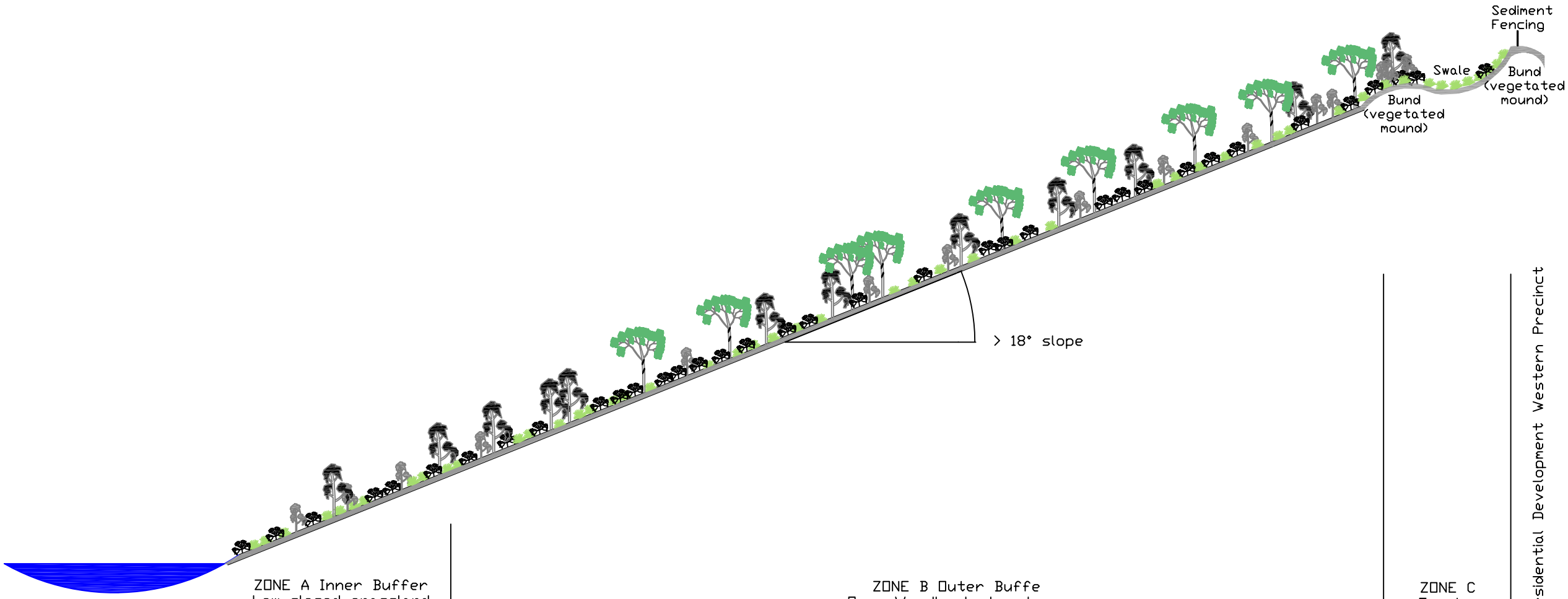
Revegetation of Environmental Buffer to Jordan's Creek

Bushfiresafe
(Aust) P/L
20 Maclachlan St
Maclean NSW 2463
(02) 6645 1099

CLIENT:
Thakral Holdings P/L
George Street
Sydney

Project
Vegetation Management Plan
Pacific Bay West Residential Development

Date: Feb 2009
Ref# 8053
Scale:



SHRUBS

Coastal Wattle
Swamp Oak

GROUNDCOVER

Lomandra
Sedges
Native Grasses

TREES

Tallowwood
Blackbutt
Flooded Gum
Grey Gum
Hoop Pine
Swamp Mahogany
Forest Oak

GROUNDCOVER

Lomandra
Sedges
Native Grasses

SHRUBS

Coastal Wattle
Lilly Pilly
Narrow-leaved Orangebark
Mock Olive
Rusty Plum
Veiny Wilkea
Croton
Cordyline

SHRUBS

Coastal Wattle
Forest Oak

GROUNDCOVER

Lomandra
Sedges
Native Grasses

General Notes

This drawing was prepared by Bushfiresafe (Aust) P/L to demonstrate a sectional view of the riparian revegetation area and should not be used for any other purpose.

ATTACHMENT 6

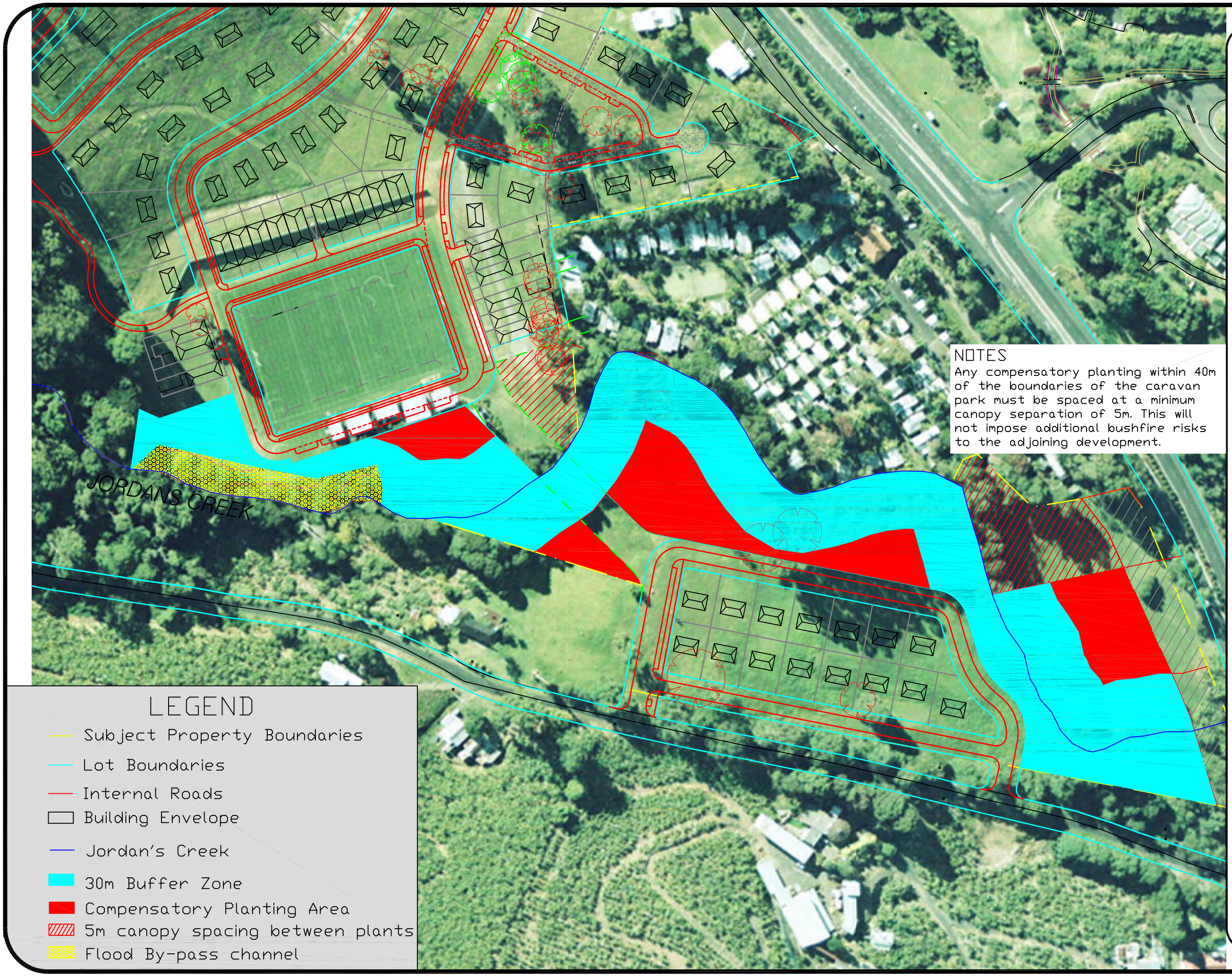
Revegetation of Environmental Buffer to Freshwater Lagoon

Bushfiresafe
(Aust) P/L
20 Maclachlan St
Maclean NSW 2463
(02) 6645 1099

CLIENT:
Thakral Holdings P/L
George Street
Sydney

Project
Vegetation Management Plan
Pacific Bay West Residential Development

Date: Feb, 2009
Scale:
Ref# 8053



NOTES
Any compensatory planting within 40m of the boundaries of the caravan park must be spaced at a minimum canopy separation of 5m. This will not impose additional bushfire risks to the adjoining development.

LEGEND
- Subject Property Boundaries
- Lot Boundaries
- Internal Roads
- Building Envelope
- Jordan's Creek
- 30m Buffer Zone
- Compensatory Planting Area
- 5m canopy spacing between plants
- Flood By-pass channel

General Notes

This drawing was prepared by Bushfiresafe (Aust) P/L to demonstrate the identified vegetation communities present within and adjacent to the development property and should not be used for any other purpose.

Vegetation line has not been surveyed and has been assumed for demonstration purposes

ATTACHMENT 7

COMPENSATORY PLANTING AREAS

Bushfiresafe (Aust)
20 Maclachlan St
Maclean NSW 2463
(02) 6645 1099

CLIENT:
Thakral Holdings Limited
Level 12
301 George Street
Sydney, 2000

Project
Pacific Bay Resort
Western Lands
Development,
Coffs Harbour

Date: MAR 2010	Ref# 8053
Scale:	