Westleigh Natural Area - Assessment of Future Use

Hornsby Shire Council

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Template 2.8.1

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Abbreviations

Abbreviation	Description
BAM	Biodiversity Assessment Method
BBAM	BioBanking Assessment Method
BC Act	Biodiversity Conservation Act
BP	Bushland Protection Areas
CEEC	Critically Endangered Ecological Community
BOAMS	Biodiversity Offsets and Agreement Management System
BOPC	Biodiversity Offsets Payment Calculator
BOS	Biodiversity Offsets Scheme
BS Act	Biosecurity Act
BSA	Biodiversity Stewardship Agreement
DA	Development Application
DCP	Development Control Plan
DPIE	NSW Department of Planning Industry and Environment
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EP&A Act	*NSW Environment Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESD	Ecologically Sustainable Development
FM Act	*Fisheries Management Act 1995*
LGA	Local Government Area
MBT	Mountain Bike Trails
NPWS	National Parks and Wildlife Services
LEP	Local Environmental Plan
LGA	Local Government Area
OEH	NSW Office of Environment and Heritage
PFAS	Per- and Poly-Fluoroalkyl Substances
PoM	Plan of Management
RAP	Remediation Action Plan
RE	Revegetation Areas
REF	Review of Environmental Factors
SAII	Serious and Irreversible Impacts
SoS	Saving Our Species
TEC	Threatened Ecological Community
VMP	Vegetation Management Plan

Abbreviation	Description
WM Act	*Water Management Act 2000*
WoNS	Weeds of National Significance

1. Background

Hornsby Shire Council (HSC) has commissioned a review of current ecological, cultural, planning, social and recreation information for 62 Quarter Sessions Road, Westleigh and has requested recommendations on the future use of the natural area, particularly of the existing unauthorised mountain bike trail network. The study area is known as Westleigh Park and is described as Lot 101 DP 1217395 shown in Figure 1.

Westleigh Park was acquired by HSC from Sydney Water in 2016 and is currently zoned R2 Low Density Residential and E3 Environmental Management. It is comprised of community and Crown land and a specific Plan of Management is in preparation for the site. The 34-hectare site is comprised of areas of cleared land and 23 hectares of bushland, which is the focus of the review.

Historic land uses have included a night soil depot, a borrow pit for rock excavation for the Sydney Water Reservoir, and a storage area for treated timber and construction spoil. Current uses include Rural Fire Service training, unauthorised mountain biking tracks and walking trails. These uses have resulted in land contamination by asbestos, PFAS, and other materials requiring the Remedial Action Plan for the site to be implemented prior to redevelopment as a park, as well as consideration of what level of usage is appropriate or requires remediation within the bushland. The proposed future uses of the open space area include multiple sportsgrounds and tracks, amenities, playground areas, walking and cycling tracks, car parks and road access. In the natural area, proposed uses include bushwalking, accessible access tracks, education, conservation and mountain bike trails.

1.1 Project scope

The purpose of the review is to provide guidance to HSC on the future use of the natural area to inform the draft Plan of Management for the park. The natural area has a high conservation value as well as unauthorised mountain bike trails which may potentially become formalised.

This review has included:

1. the current reports provided by HSC including ecological, cultural, planning, social and recreation information for the site; and
2. recommendations about the future use of the natural area with consideration of the mountain bike trail network.

The list of current reports provided for review and consideration include:

- Vegetation mapping (including methodology)
- Mountain bike trail network mapping
- Mountain bike trail network condition assessment
- Mountain bike trail network REF
- Concept plans for development
- Draft Plan of Management
- Remedial action plan for asbestos
- Treatment options report for contaminated areas

The recommendations for the preferred uses within the natural areas have considered and assessed a range of uses including:

- bushwalking
- accessible access tracks
- education
- conservation
- mountain bike trails

The brief advised that the 'mountain bike trail' use may include a no trail option, an existing trail option, a new trail option, or a mix of options.

1.2 Inception meeting and site visit

At the inception meeting, HSC identified some focus areas.

Following the inception meeting, a site familiarisation inspection of the site and MTB trails was undertaken on 4 September 2019 by Accredited BAM Assessor Diane Campbell, Project Ecologist Stacey Wilson and Hornsby Shire Council Acting Manager Natural Resources Strategy Mark Hood. The site visit included inspection of vegetation communities and threatened flora species, habitat values, mountain bike track issues, visible landfill / contamination issues relating to the natural area; and considered future walking track entry points.

Figure 1 Location map

2. Review of Current Reports

The following is a review of the *existing project studies* named in the project brief, outlined in the background of this proposal.

As requested by HSC, a more focussed review was undertaken of:

- Vegetation mapping, Hornsby Shire Council, 2016
- Ecological advice on remediation options in bushland, Kingfisher, 2019
- Mountain bike trail network condition assessment by Trailscapes, 2018,
- Mountain bike trail network mapping options 2 and 2B.

Other documents reviewed included:

- Mountain bike trail network REF
- Concept plans for development
- Draft Plan of Management

The Remedial action plan for asbestos and remediation options reports were reviewed as part of the Ecological advice on remediation options in bushland.

2.1 Vegetation Mapping

The Vegetation mapping of the former Sydney Water site 62 Quarter Sessions Road, Westleigh, prepared by Hornsby Shire Council's Natural Resources Branch (Mark Hood, Alex Fraser, Ross Rapmund) October 2016 was reviewed.

Overall, the report documents a well carried-out and robust survey that identifies a very high diversity of species present (244) in the bushland part of the Westleigh site including five vegetation communities, two threatened ecological communities, 4 species of threatened flora, 11 species of native orchids and 50 species of birds observed on the site. The report notes the conservation significance of the flora and fauna and discusses the loss of structural and species diversity from too frequent fire in the southern area. The report identifies encroachments of private gardens and weeds in the eastern side of the site. It highlights the major impacts on vegetation from 9 km of mountain bike trails throughout the forest impacting on threatened species, EEC's, and the adjoining Biobanking sites. It documents low level of weed in the bushland with weeds occurring in drainage lines and disturbed sites, noting the presence of threatened species on trail edges and weed spread by trail users and through garden encroachments. The report discusses future management and makes recommendations.

Table 1 indicates issues and recommendations relating to the report. The major issue is the timing of its preparation, being undertaken just prior to the major change of legislation and biodiversity assessment methodology with the introduction of the *NSW Biodiversity Conservation Act 2016*. This does not affect the veracity of the findings but outlines technical updates that would be required if the report is to be used to support a future development application (DA) or if a future Review of Environmental Factors (REF) was to voluntarily opt-in to use the Biodiversity Assessment Method (BAM).

Also, the analysis of Duffys Forest Endangered Ecological Community (EEC) has undergone internal review by OEH around that time, with decommissioning of PCT 1085, and subsequent allocation of Duffys Forest to PCT 1786 and Coastal Shale-Sandstone Forest to PCT 1845, the latter not being part of an EEC. This issue needs to be addressed and updated within the report.

Overall it is recommended that the report be updated in view of the above comments. Subject to this, the report is suitable for the purpose of public land site assessment, planning and management of the natural area and mountain bike trails.

Table 1 Review of Vegetation Mapping Report

Page No.	Heading	Paragraph/ Dot Point	Issue	Recommendation
5 & 6	Methodology - Vegetation community classification	1,2, 4	Utilised reports including Tozer et al (2010) Vegetation in south-east NSW, Smith, P. & Smith, J. (2008a), Native vegetation communities of Hornsby Shire, and Smith, P. & Smith, J. (2000) Survey of the Duffy's Forest Vegetation Community. Has not referenced Office of Environment and Heritage (OEH) Native Vegetation of the Sydney Metropolitan Area V3 (2016), VIS vegetation classification or NSW Scientific Committee Final Determinations.	Include consideration of OEH 2016, VIS classification and NSW Scientific Committee Final Determinations within the report.
7	Methodology - Vegetation Mapping	2	14 quadrats were placed through the site based on canopy species present and composition changes. The report does not identify whether vegetation has been zoned 'as an area of native vegetation on the subject land that is the same PCT and has a similar broad condition state', and whether the minimum number of plots and transects required per zone area have been undertaken on the site	The report needs to identify the vegetation zones on the site based on the PCTs and broad condition states. Identify in the report whether the minimum number of plot/ transects have been located within each vegetation zone.
7	Methodology - Vegetation Mapping	1,3	The report is based on Biobanking Assessment Method (BBAM) current at the time of writing the report, not the subsequent and now current Biodiversity Assessment Method (BAM). The BBAM plot data can be reused as plot data collected is the same; transect and other data will be different if BAM is required for a future DA.	Data collection has been robust and is suitable for the planning of the site. If the report is to be used in a DA or the BAM is to be applied optionally in an REF, the report should be updated by a BAM accredited assessor collecting BAM plot and transect data.
10	Methodology - Data analysis	1	The report analysed vegetation communities, especially for Duffys Forest, using positive diagnostic species within a 20 m x 20 m quadrat as per Tozer 2010 and Duffys Forest Index (Smith and Smith 2000) to determine Duffys Forest EEC. Given the changes to the Duffys PCT this data needs to be reanalysed for the site.	Report should reassess data for the quadrats identified as Duffys Forest in the report, using positive diagnostic species and descriptions in OEH 2016 and the Scientific Committee's Final Determination to review plot data and determine PCT.
11 & 12	Mapping Results –	2, 1	The report identifies 244 flora species including 4 threatened species. Three species not previously recorded or rare in the	At the time of writing, Sydney Turpentine-Ironbark Forest (STIF) was listed as Critically Endangered in Australia and an EEC in NSW. The

Page No.	Heading	Paragraph/ Dot Point	Issue	Recommendation
	Vegetation Communities and Threatened Species		Hornsby Shire and 11 species of orchids. It identifies 5 vegetation communities, 2 of which are Threatened Ecological Communities. There is a typo in the text stating 'three threatened flora species were observed' but four are listed. An additional threatened species *Lasiopetulum joyceae* (a vulnerable species under the BC and EPBC Acts) was located in the 2020 BioNet search.	report should be updated to reflect that STIF is now listed as Critically Endangered in both Australia and NSW. Correct the typo and update threatened flora list.
12	Mapping Results – Site Value Assessment	1	Duffys Forest is identified as PCT 1085. This PCT has been decommissioned with PCT 1786 being allocated to Duffys Forest and PCT 1845 to Coastal Shale Sandstone Forest.	The report needs to re-evaluate site value assessment score against the new PCT benchmark.
15	Discussion – Vegetation Communities	1-4	The report discusses STIF and Duffys Forest, however has not referred to OEH 2016 report and VIS vegetation classification that describes Duffys Forest and Coastal Shale-Sandstone Forest with the latter a previously described variant of Duffys, now recognised as not being part of Duffys Forest EEC. The wet area of the site with a boardwalk is not considered in the discussion as to whether it is consistent with Coastal Upland Swamp EEC.	The report needs to re-evaluate plot data relating to Duffys Forest EEC. ELA's initial analysis of data from several of the quadrats are that the site is likely to contain PCT1845 Coastal Shale Transition Forest. The report should discuss if Coastal Upland Swamp is present on the site and should evaluate the ecological value/ constraints of the area of swamp vegetation.
18	Discussion – Clearing/ Encroachment	2	The report discusses the impact of 9 km of mountain bike trails on threatened flora, EECs, Biobanking sites. It addresses impact of dust on plant viability, severe gully erosion and impact on exposed tree roots. The report does not address the impacts of fill or dumped contaminants.	The report needs to consider adding the following to the impacts of mountain bike trails: i) clearing of vegetation, ii) fragmentation of habitat, and iii) increased human disturbance on the ecology. It needs to discuss the fill on the edges of the remnant and dumped contaminants.

2.2 Ecological advice on remediation options in bushland

The Westleigh Park Sporting Complex Concept Design Eco Advice by Kingfisher Urban Ecology and Wetlands January 2019 was reviewed. This was done so with reference to the Coffey Remediations Options Report 2018 and the Arcadis Remedial Action Plan 2017.

The report focuses on the interface areas of STIF vegetation, several significant individual trees, weedy edges to the interface and exotic grasslands in the central cleared area. It recommends treatments within Bushland Protection (BP) and Revegetation Areas (RE). ELA has identified issues within the report and makes recommendations on the suitable treatments within Table 2.

The main issues are that the report needs to better reference and incorporate the findings and recommendations of the Remedial Action Plan and Remediations Options Report for the site. It needs to better define and map BP and RE areas – they appear to be over-mapped with large areas mapped as contaminated that may actually contain scattered fly-tip sites. It needs to adopt a minimum impact approach to BP areas by minimising introduction of additional fill material or soil during site remediation.

Other recommendations relating to ongoing edge management, significant trees, threatened species and endangered ecological communities are generally appropriate, except they require some updating. The report is suitable for use in site assessment, planning and management, subject to updating the report to reflect to the recommendations in this report.

Table 2 Review of Interface Ecology Report

Page No.	Heading	Paragraph/ Dot Point	Issue	Recommendation
5	2. Introduction and Background	2	The report states that fill has been 'pushed in the forested area up to 15 m into the canopy trees'. The report has not documented how this measurement was derived and has not provided a map to show the location of the fill.	Report needs to better document the location of fill. It should provide a map such as the Coffey 2018 Report drawing 3527.PC.01 Issue F, if this is the basis of the statement. It should identify the need to refine the fill boundary on the site.
5	2. Vegetation Management	2	The report states that vegetation communities on the site include STIF listed as Endangered Ecological Community under the BC Act. Since writing this has been up listed as a Critically Endangered Ecological Community (CEEC), although it correctly attributes its status on page 20. It states that Duffys Forest EEC under the BC Act is present.	Update the STIF listing as a CEEC. Following Council's review of the vegetation report as to the potential for Duffys Forest EEC to occur on the site or not, update this and all relevant sections of this report with respect to whether this community is present.
10	3.1 Fill Management	Dot point 2	The report states that an option is 'leaving the fill in-situ in forest areas and formalising the edge of the open space / forest interface. Formalised edging could be with retaining walls and/or could include a gentle batter into the bushland area with the area planted densely on the edge closest to the open space.' It does not give any criteria as to when to apply the two different techniques, with the latter being problematic if there are native canopy trees or bushland or threatened species present, or where there is a steep and stable batter or retaining wall adjoining bushland with good resilience. It does not give treatments for fill on mountain bike trails. It appears to have derived these options from Coffey Remediations Options Report 2018 but has not referenced this in the text. It has not referenced the Arcadis Remedial Action Plan 2017 for the site.	The report needs to include treatment of fill / Asbestos Containing Materials (ACM) for different settings. Where there is low resilience and no trees present (i.e. weed dominated edges and no native canopy in RE), the site should be treated sequentially as described in 3.1.3 comments below. For areas where there is good resilience and/ or native trees or bushland or threatened species present (BP), the site should be treated sequentially as outlined in 3.1.2 comments below. For mountain bike trail areas, the site should be treated sequentially: • hand-picked then raked to a depth of 100 mm. For all areas include RAP requirements: • material collected should be recorded by GPS and weight of material removed, • a final visual inspection of the area that should not detect surface asbestos containing materials (ACM) and comply with the Validation procedure outlined in the Validation Plan within the Remediation Action Plan, • classify waste for offsite disposal & waste tracking for encapsulation, • compile a report of the works conducted including all locations, weights and disposal measure undertaken,

Page No.	Heading	Paragraph/ Dot Point	Issue	Recommendation
				• remove location from the ACM register, and • prepare an Environmental Management Plan (EMP) to outline all ongoing management and maintenance requirements to ensure adequate cover is maintained to provide sufficient protection (EMP covers RE area, bike trails and BP areas). The report needs to reference the Coffey Remediation Report 2018 and the Arcadis Remediation Action Plan 2017 as sources of the treatment recommendations.
10	3.1 Fill Management	2	The study area is grouped into Bushland Protection (BP) and Revegetation Areas (RE), however no map has been included to show the location of BP and RE on the site. These terms are not linked to the Coffey report, which appears to be their source. Note that another term 'EP' is introduced in 3.1.1.2 and 3.5. The location of fill on the Coffey map drawing 3527.PC.01 Issue F appears to be too far eastward in the southern part of the site.	Include a map to show locations of BP and RE on the site. Define what is BP and RE and reference Coffey, demonstrating how this report differs from Coffey definitions. Make terms consistent – it appears 'EP' should be changed to 'BP' in sections 3.1.2 and 3.5, or this is a typo. This report should recommend the need to refine the eastern treatment boundary where it abuts STIF.
10	3.1.1 Bushland Protection	3	Mulching around trees to a depth of 100 mm in areas of high ecological value and around trees.	The report should state that the WA DoH (2009) guidelines recommend that in bushland parks or nature reserves and where areas are to be minimally disturbed that fill be removed through dragging it away from trees. Replace with advice as outlined in above recommendations relating to 3.1 Fill Management.
	3.1.1.2 Treatment – Access Management	3	Report suggests management of access to defined tracks being very obvious through use of armoured stone or boardwalk surfaces. This may not always be practical.	Report should offer alternative treatments to make defined tracks and closed tracks visible to users.
	3.1.1.1 Treatment – Sandstone Mulching	Dot points 3 and 4	BP areas are not mapped in this report; hence it is difficult to assess the appropriateness of the technique. Generally, sandstone mulching of 200-300 mm is not appropriate in resilient BP areas and additional fill should not be applied near trees. No sequential advice has been provided for treatment	In BP areas the following should be added to this section as additional advice to be treated sequentially: • hand-picked then raked to a depth of 100 mm, • drag fill from around trees • weeds removed through cut and paint and/or spray techniques,

Page No.	Heading	Paragraph/ Dot Point	Issue	Recommendation
			of BP areas. The general advice provided is acceptable but omits sequential treatment.	• inspection by asbestos assessor • only apply 100mm crushed sandstone (VENM or ENM) as a last resort where necessary in areas of broadscale contamination that cannot be successfully addressed using the above measures, and • where there are adjoining steep fill walls, heavy duty jute mat secured where required, or stacked rock retaining walls constructed by hand, followed by planting of indigenous provenance species selected from strata and compatible with adjoining vegetation community.
	3.1.3 Option A		Standard techniques are generally acceptable with some additional techniques to be included. Need to minimise weed propagules and to minimise introduction of additional fill material to the site.	Include additional techniques: • drag fill from around trees • weeds removed through cut and paint and/or spray techniques, • where land is steep heavy-duty jute mat is laid and secured, • site and/ or edges capped with crushed sandstone (as Virgin Excavated Natural Material (VENM) or ENM) to a depth of 100 mm and shaped to maximum 1:4 batter
20 & 21	3.4 Threatened Species and EECs – Management Considerations	4	Missing date reference to the plants *Tetratheca glandulosa*, and *Darwinia biflora* recorded by Hornsby Council. Typo in *Darwinia biflora* on both pages.	Add date of report and correct typos.
25	3.5 Test of significance	Figure 3.5	Report identifies an area of PCT 1237 (Blue Gum High Forest CEEC) within the area but has not mentioned its occurrence in any other part of the report relating to threatened ecological communities.	The occurrence of Blue Gum High Forest should be verified and included within all relevant sections of the report or removed if not found to be present.
Various	Various	Various	Typo – Coffey is spelled as Coffee.	Correct typos.

2.3 Mountain bike trail network condition assessment

The Westleigh Park Trails Assessment by TrailScapes Pty Ltd October 2018 was reviewed. GIS data recorded by Trailscapes was provided to ELA by Council as part of the review.

The report identified that the trail network is not sustainable, with 350 sites being non-compliant with IMBA classifications, dangerous or are contributing to environmental impacts, but has not mapped the sites that are non-compliant with IMBA Trail Core Elements.

The report states that the trail is generally compliant with IMBA Trail Classifications however it has a general absence of trail signage and markers, with fewer non-compliances and has provided a map in Appendix 2, although this map label is misleading.

It states that the network does not comply with IMBA trail core elements to incorporate a balance of the five sustainable trail principles most notably a low number of grade reversals, adequate outslope and conflicts with the half rule. The report identifies that the imbalance of these core elements is contributing to the current and emerging issues. It identifies that the flatter nature of much of the terrain and the trail building construction techniques as inadequate to address issues of erodible soils, coupled with the ridable trail length being maximised within the site. Many trails are depressed and cupped, with no outslope for water shedding leading to water erosion.

The report identifies consistent trail issues created by the construction techniques. The numerous flat corners with low bermed turns have been formed through using excavated mineral earth to build up a berm, often with fallen logs or standing trees for support. These result in low points that pool water, and riders seek to avoid puddles thereby spreading trail widths. They also result in tree decline from soil piled around the base of trunks.

The report correctly identifies that the main impacts have already occurred through the clearing of vegetation for unauthorised trails. It states that if the network was left unmanaged the usage would allow further unplanned trail construction and trail creep, trail deterioration and erosion, resulting in increasing environmental damage. It does not however, map the significant number of erosion points or issues along the whole of the trail network. It does not identify the very dense and close nature of the trails that traverse the southern section as an issue, or the loss of vegetation within the mapped threatened ecological communities (TECs) and impact on threatened flora and wildlife habitat.

The report provides solutions to the issues raised. Some of the main solutions addressed include erosion and water management in the southern part of the site with flatter terrain and non-compliance with the half-rule, with grade reversals recommended. Hundreds of metres of Fibre Reinforced Plastic (FRP) and hundreds of metres of stone are recommended to address current and future erosion, as well as to mitigate damage to tree roots that have been exposed. Other issues addressed include contaminated material in the jumps, weeds, and future issues of increased stormwater, nutrients, vegetation trampling and use of E-bikes.

The report states that user numbers will significantly increase following formalisation and promotion of the network. It makes recommendations for trail upgrades and trail closures as well as shared use trails and signage. It provides costed management and recommended treatment options for trail specific issues and recommends a signage plan for trail signs and markers. It recommends fencing of the site

and some trail closures, rehabilitation of closed trails and that the final network trailhead should link to the site entry points.

The report considers the recreational value of the trail network using a quantitative trail significance hierarchy (Over the Edge - Destination Development) and identifies that its significance is Community/ Local and that a minimum of 5 km of trail is recommended. The report has not evaluated how this Community/ Local trail relates to the Old Mans Valley (OMV) Trail except to identify that usage is half of the OMV trail and that there is an informal link through a Biobank site of high conservation value bushland.

It recommends Proposal 1B or Proposal 2, stating that although 1B offers a greater variety and volume of trail compared with Proposal 2 however 2 does ultimately minimise the quantity of trail in STIF and Duffy's Forest ecological communities while maintaining a functional and sustainable trail network and still offers a good quality user experience.

The report documents a matrix to provide a quantitative score and qualitative assessment that is used to compare the seven HSC trail proposals. The scores compare the current trail condition, post-treatment and remediation costs. The qualitative assessment of criteria has been populated by Council and Trailscapes have provided a response. In the detailed proposal evaluation section, the conservation value needs to be updated for STIF that is now listed as a Critically Endangered Ecological Community under the *NSW Biodiversity Conservation Act 2016*. This recognises that the STIF community is facing an extremely high risk of extinction in the wild.

The report has a general summary of all 7 Council provided proposals as well as the additional TrailScapes proposal 1B and concludes that Proposals 1, 1B, 2 non-asbestos and 2 are the only options with any considered merit as potential trail networks.

Table 3 identifies issues and recommendations.

Table 3 Review of Trailscapes Report

Page No.	Heading	Paragraph/ Dot Point	Issue	Recommendation
7	Trail Assessment - General commentary	1, 3, 5	Report gives qualified support that network is in reasonably good condition for unplanned trails, then contradicts itself stating that it is not sustainable due mainly to water issues and has 350 sites that are non-compliant with IMBA classifications, are not sustainable, are dangerous, or are contributing to environmental impacts	The opening section should reflect that condition is unsustainable as outlined in the following paragraph.
7	Compliance with IMBA Australia Trail Classifications	2	States the trail network is generally compliant with the IMBA trail classifications and general safety requirements except there is no signage and marker system and refers to Appendix 2 for details, however it does not provide a summary of non-compliances.	The report should provide a summary of IMBA trail classification non-compliances i.e. seven trail sections/ features that do not comply with the IMBA grading, six low hanging branches, four failing structures/ safety issues, three poorly shaped features and absence of signage.
8	Compliance with IMBA Trail Core Elements		Report states the trail network does not incorporate a balance of the five sustainable trail principles i.e. a low number of grade reversals, adequate outslope and conflicts with the half rule. It outlines that this has been a result of maximising of the length of trail construction and inappropriate trail building techniques in the flatter terrain contributing to trail cupping/ water erosion and impact on trees. It refers to 'current and emerging issues identified in the opening statement on IMBA Trail Core Elements' but has not addressed or mapped the 300+ sites that are non-compliant with IMBA core elements and are contributing to environmental impacts.	This section should provide a summary and a map of the number, type and location of over 300 non-compliances with IMBA trail core elements and environmental issues.
9	Environmental Impact of the Network	1	It refers to the REF which identifies potential environmental concerns and mitigation measures. The REF is being reviewed as part of this report as it currently does not address a number of issues. When the REF is updated, this section should reflect any additional issues covered.	Additional environmental issues related to the trail network identified in an updated REF should be included in the report, for example the need for specific flora and fauna impact assessment, impacts of contaminant remediation, impacts of trail construction, impacts of pathogens and additional pressure on the Biodiversity Stewardship site.
11	Managing erosion	1	Addresses water management on the trails in the flatter terrain in the southern end of the park but does not describe erosion issues in the north where there is steeper terrain. The report does not map erosion points across the trail network.	The report needs to describe erosion issues in the north where there is steeper terrain. It needs to map erosion points across the whole trail network.

Page No.	Heading	Paragraph/ Dot Point	Issue	Recommendation
11	Impact on Vegetation and Habitat		The trail report has not identified the impact of dense multiple trails in the south, or the resultant loss of vegetation within the mapped TECs, or impact on threatened flora and wildlife habitat.	The report should identify the very dense and close nature of many southern trails as an issue for TECs, threatened flora and wildlife habitat, and include potential solutions and mitigation measures.
11	Trail armouring with Fibre Reinforced Plastic (FRP)	1	The report recommends hundreds of metres of FRP. It does not consider the fire-prone nature of the site and loss of the structure and potential pollution associated with bushfire impacting on FRP.	The report should recognise the fire-prone nature of the site and consider alternative treatments such as steel mesh grating.
12	Stormwater and Nutrients	1,1	Increased stormwater discharge is identified as likely to impact on trail surfaces, requiring robust trail treatments, and nutrients from fertilizers are likely to increase weed issues.	The report should include that a suitable solution to stormwater and nutrient discharge would be the use of a biofiltration system and water re-use on the playing fields.
14	Shared-use Trails and Signs	2	The report states that Easy and Intermediate trails are suitable for shared-use (walking and cycling) because of adequate sight lines along the trails. This may become unsustainable if the trail usage increases and conflicts should be monitored. It does not recommend a direction of travel.	The report should recommend that conflicts between cyclists and walkers should be monitored. Direction of travel should be identified for the trails.
15	Final network design and linkages	1	Report does not recommend trailhead locations or comment on the existing trailhead signage in the southern part of the site.	Report would be enhanced if trailhead locations were recommended and comment was made on the trailhead signage
19 (also p. 3)	The Westleigh Trail Resource		The report has not evaluated how this Community/ Local trail contributes to the trail network within the Local Government Area except to identify that usage at Westleigh is half of that of existing Old Mans Valley (OMV) Trail and that there is an informal link through a Biobank site of high conservation value bushland. It has not addressed impacts of authorising a Westleigh trail on the Biobank site and unauthorised trail use and construction within that site.	The report needs to identify how this trail is required within the Community/ Local context. It needs to discuss impacts of increased usage of authorising the Westleigh trails on the adjoining Biobank site.

Page No.	Heading	Paragraph/ Dot Point	Issue	Recommendation
26, 30, 34, 38, 42, 46, 50, 54	Proposals 1, 1B, 2 (non asbestos), 2, 3, 4, 5, 6	Conservation value	STIF that is now listed as a Critically Endangered Ecological Community under the *NSW Biodiversity Conservation Act 2016*.	Update the report sections.
60	Appendix 2		Map indicates 'IMBA non-compliant sections' – this is misleading as the map includes only trail classification and safety issues and does not include areas of track erosion and other issues that do not comply with IMBA core elements. It also does not include the lack of signage or markers. There is no map of the 300+ IMBA trail core elements non-compliances.	Alter the name of the current map to 'IMBA trail classification non-compliance map'. Map should be added of 'IMBA trail core elements non-compliances'.

2.4 Mountain bike trail network mapping options 2 and 2B

ELA has assessed the mapped trail options for Proposal 2 and Proposal 2B (also called 2 non-asbestos) against data derived from the Trailscapes and vegetation mapping reports. ELA has examined proximity to threatened species, length of impact on threatened ecological communities, track erosion and other management issues. A general comparison was made of which is the preferred trail option.

2.4.1 Proximity to Threatened Species

Both Proposal 2 and 2B have trails located adjacent to the occurrences of threatened flora as shown in Figures 2 and 3. Other locations of threatened flora are more distant from the trail network. Both proposals have the same impact layout in proximity to threatened flora. If either trail is selected, management of threatened flora will need to be addressed in upgrades, maintenance and operations.

2.4.2 Impact on Vegetation Communities

The MTB trails in Proposal 2B traverse a smaller area of native vegetation communities than Proposal 2. The area of impact on native vegetation of Proposal 2B is 3,517 m^2 compared with Proposal 2 which is 3,632 m^2. The impacts on Sydney Turpentine Ironbark Forest is also smaller in area for Proposal 2B, comprising of 731.3 m^2, compared to Proposal 2 which impacts 929.6 m^2. This is shown in Figures 4 and 5 and Tables 4 and 5.

Table 4 Proposal 2 Impacts on Vegetation Communities

Vegetation Community	Area of Impacted Vegetation (m^2) by Trail Type							Grand Total
	Black	New Black	Green	New Green	Light blue	New Light Blue	Blue	
Bloodwood Scribbly Gum Woodland	429.5	66.7	221.4		257.6	0.9	709.9	1,686
Duffy's Forest	1.3		263.1	16.8	139.9	9.3	246.6	676.9
Peppermint Angophora Forest	240.1	2.4					96.9	339.4
Scribbly Gum Open Woodland						0.4		0.4
Sydney Turpentine Ironbark Forest	241.6		271.4		387.5		29	**929.6**
Total	**912.5**	**69**	**755.9**	**16.8**	**785**	**10.6**	**1,082.5**	**3,632.3**

Table 5 Proposal 2B Impacts on Vegetation Communities

Vegetation Community	Area of Impacted Vegetation (m^2) by Trail Type							Grand Total
	Black	New Black	Green	New Green	Light blue	New Light Blue	Blue	
Bloodwood Scribbly Gum Woodland	475.6	66.7	221.4		257.6	0.9	709.9	1,732.1
Duffy's Forest	12.8		288.1	16.8	139.9	9.3	246.6	713.4
Peppermint Angophora Forest	240.1	2.4					96.9	339.4
Scribbly Gum Open Woodland						0.4		0.4
Sydney Turpentine Ironbark Forest	148.8		165.9		387.5		29	**731.3**
Total	**877.3**	**69**	**675.4**	**16.8**	**785**	**10.6**	**1,082.4**	**3,516.6**

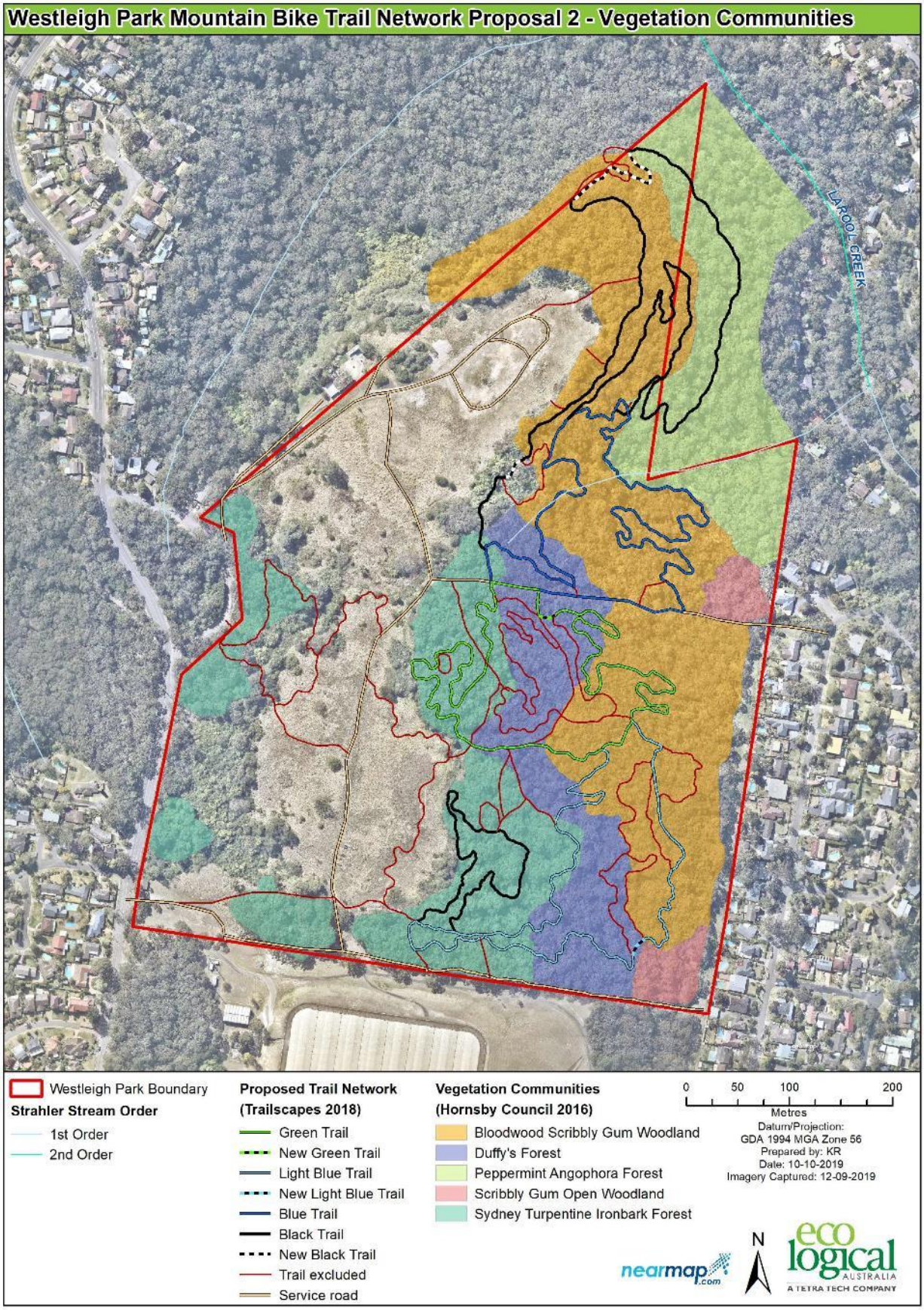


Figure 4 Impact of Proposal 2 on vegetation communities

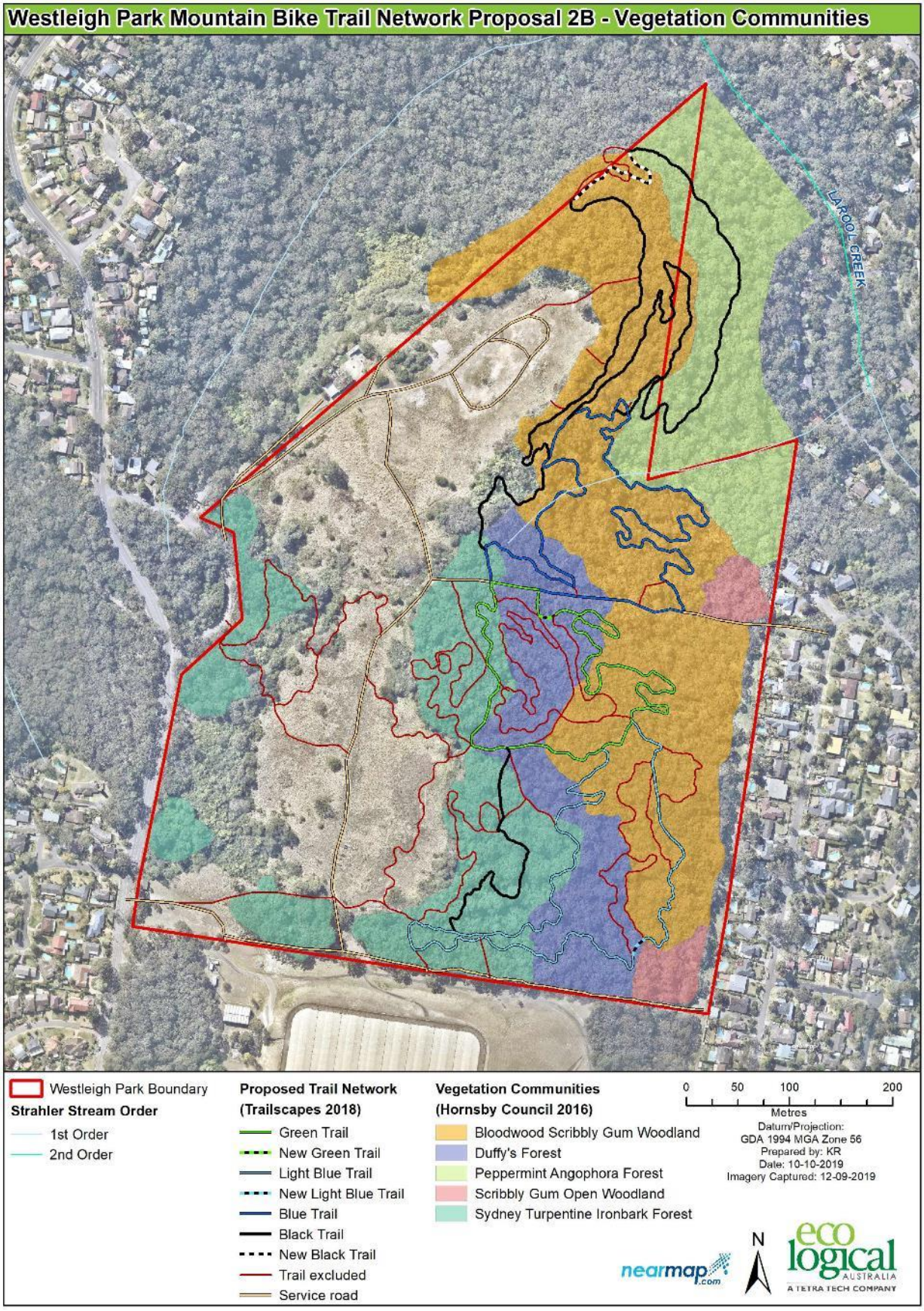


Figure 5 Impact of Proposal 2B on vegetation communities

2.4.3 Erosion and Trees

The proximity of the trails to erosion caused by water resulting in trail cupping and impact of the trails on trees were examined. The number of erosion and tree damage points were documented within 5 m, 10 m and 20 m of Proposals 2 and 2B. Trail Segments that had erosion and tree damaged were mapped for Proposal 2 and Proposal 2B. Proposal 2B showed 80 trail segments within 5 m of the trail with erosion related to water and tree damage than Proposal 2 which had 108 trail segments affected, shown in Figures 6 and 7, Table 6 and Table 7. This indicates that 2B would include fewer erosion and tree damage impact points.

Table 6 Proposal 2 Erosion impacts - water and tree damage

Total Erosion Points	No. Points within 5 m	No. Points within 10 m	No. Points within 20 m
Black	21	33	65
New Black	0	0	1
Blue	11	25	66
Green	40	60	87
New Green	0	0	2
Light Blue	35	69	97
New Light Blue	1	2	9
Total	**108**	**189**	**327**

Table 7 Proposal 2B Erosion impacts – water and tree damage

Total Erosion Points	No. Points within 5 m	No. Points within 10 m	No. Points within 20 m
Black	15	18	72
New Black	0	0	0
Blue	11	24	66
Green	23	45	74
New Green	0	0	2
Light Blue	30	68	102
New Light Blue	1	2	9
Total	**80**	**157**	**325**

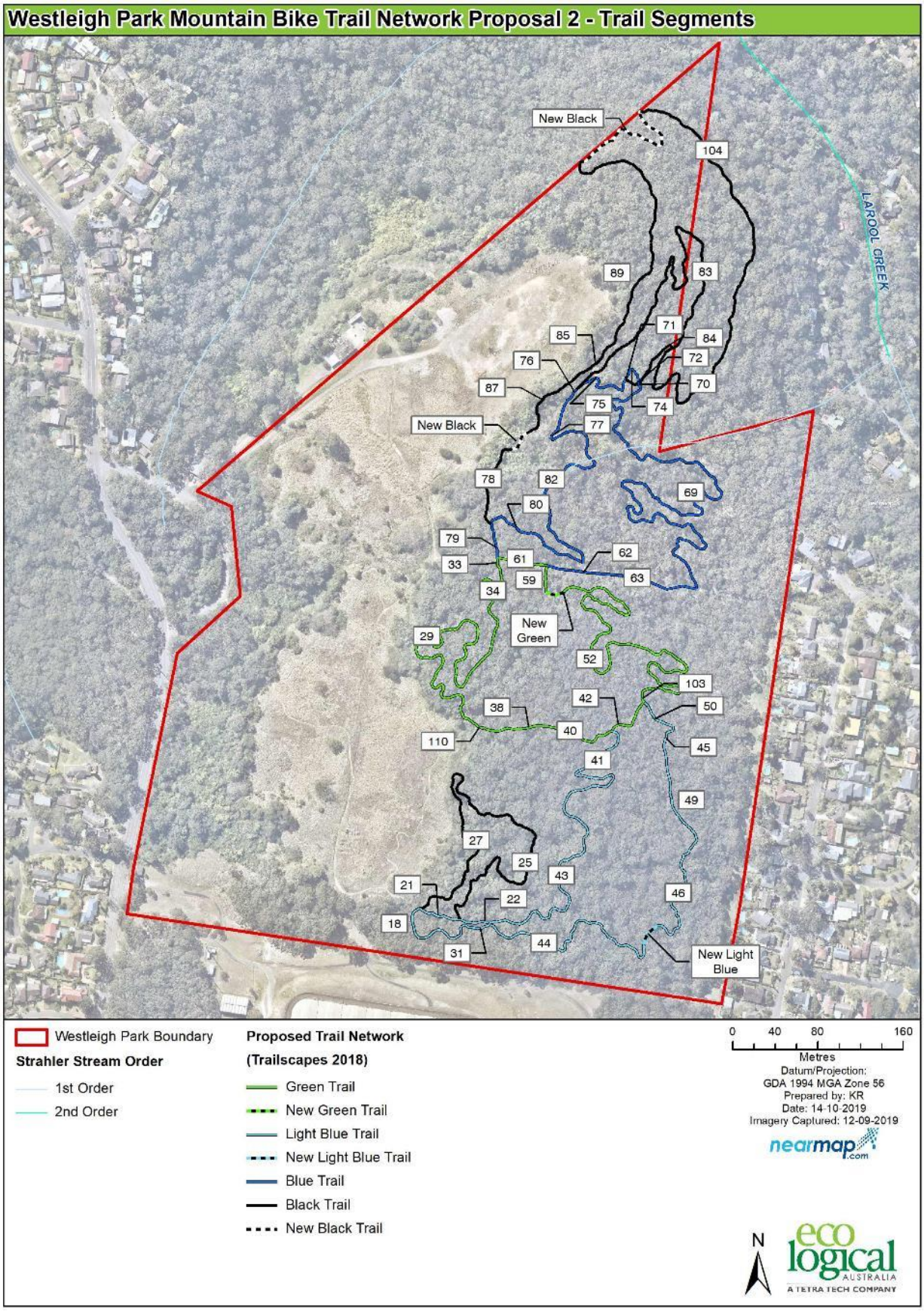


Figure 6 Trail segments with water erosion and tree damage in Proposal 2

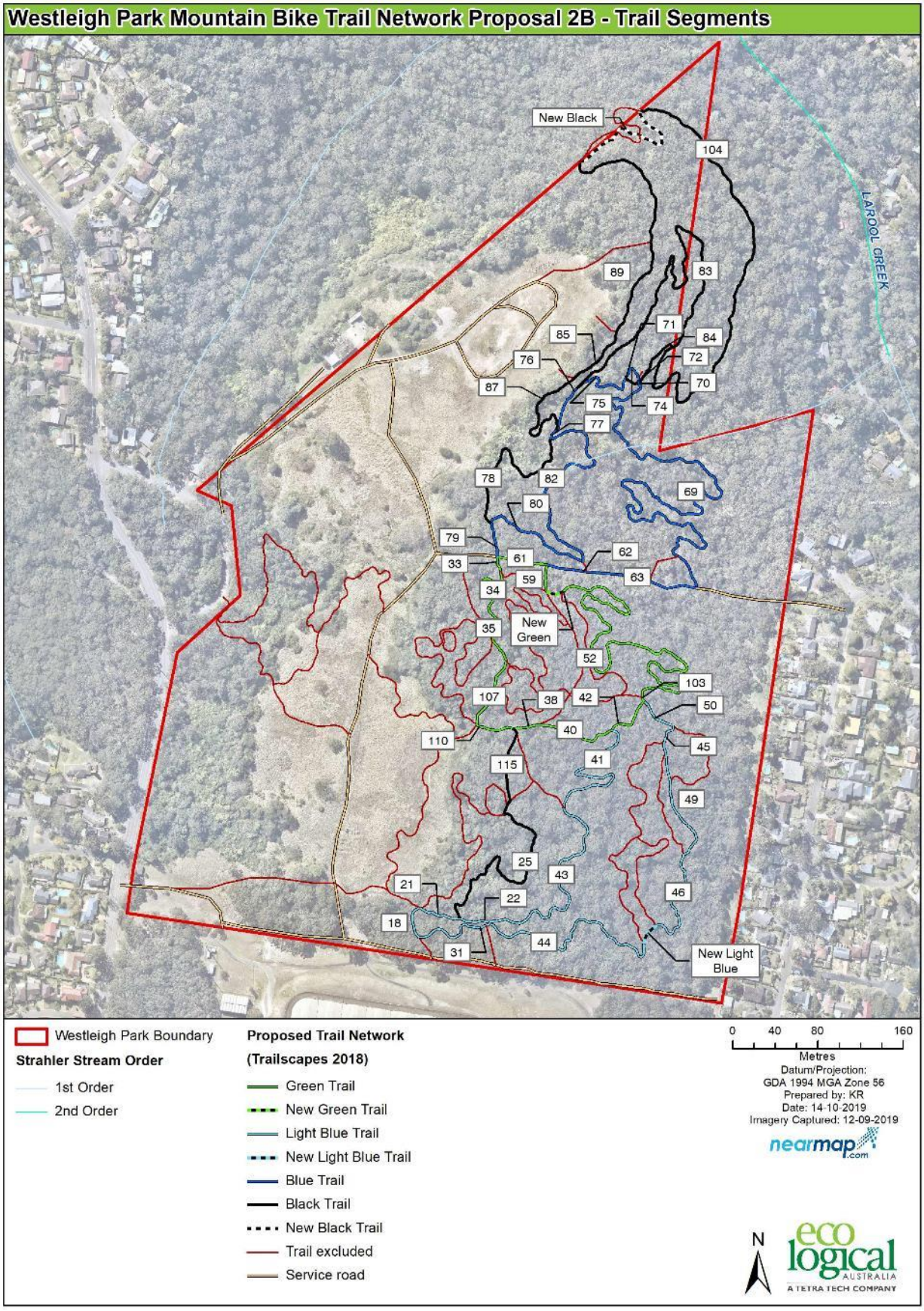


Figure 7 Trail segments with water erosion and tree damage in Proposal 2B

2.4.4 Trail Proximity to Contaminated Sites

Proposal 2B is preferred as there are 22 sites contaminated by asbestos in located within 5m and 54 within 10 m of the Proposal 2 Trail, and in comparison, there are 12 sites contaminated by asbestos in located within 5m and 20 within 10 m of the Proposal 2B Trail, shown in Tables 8 and 9 and Figures 8 and 9.

Table 8 Asbestos located within proximity to Proposal 2

Trail Colour/ Grade	Trail Segment ID	Within 5 m of trail	Within 10 m of trail	Within 20 m of tral
Black	25			3
	27	13	29	34
Blue	80		1	
Green	29	1	2	3
	38			1
	110			
Light blue	18	4	11	
	21	4	11	16
	22			1
	31			3
Total Number	**10**	**22**	**54**	**61**

Table 9 Asbestos located within proximity to Proposal 2B

Trail Colour/ Grade	Trail Segment ID	Within 5 m of trail	Within 10 m of trail	Within 20 m of trail
Black	25	4	7	8
	87	1	1	1
	85			1
	83		1	2
	104		1	2
	76	1	1	1
Green	34	1	2	2
	35	2	2	2
	110	1	2	2
Light blue	50	1	1	1
	43	1	1	1
	18			3
	31		1	1
Total Number	**13**	**12**	**20**	**27**

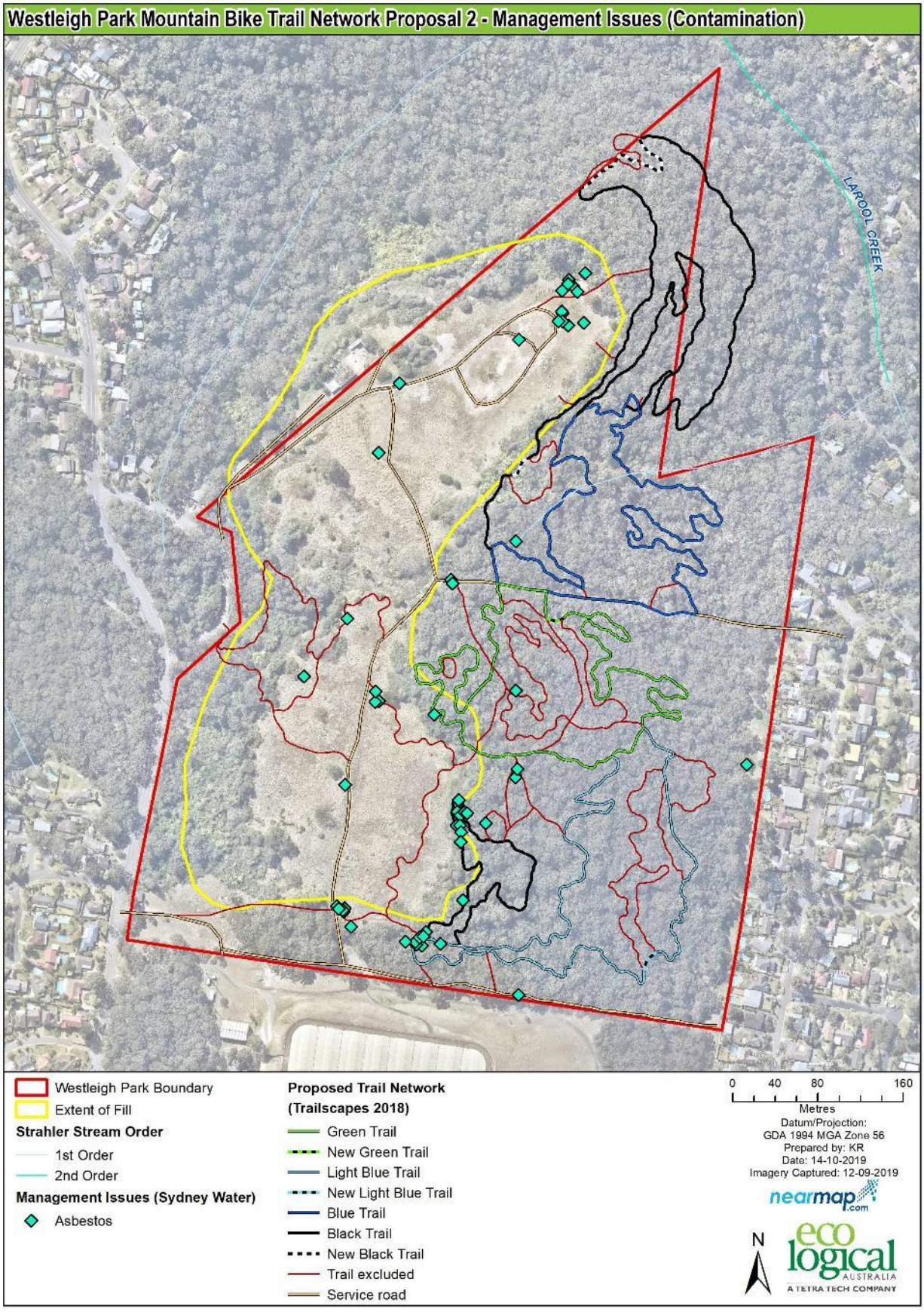


Figure 8 Proximity of Proposal 2 to contaminated sites

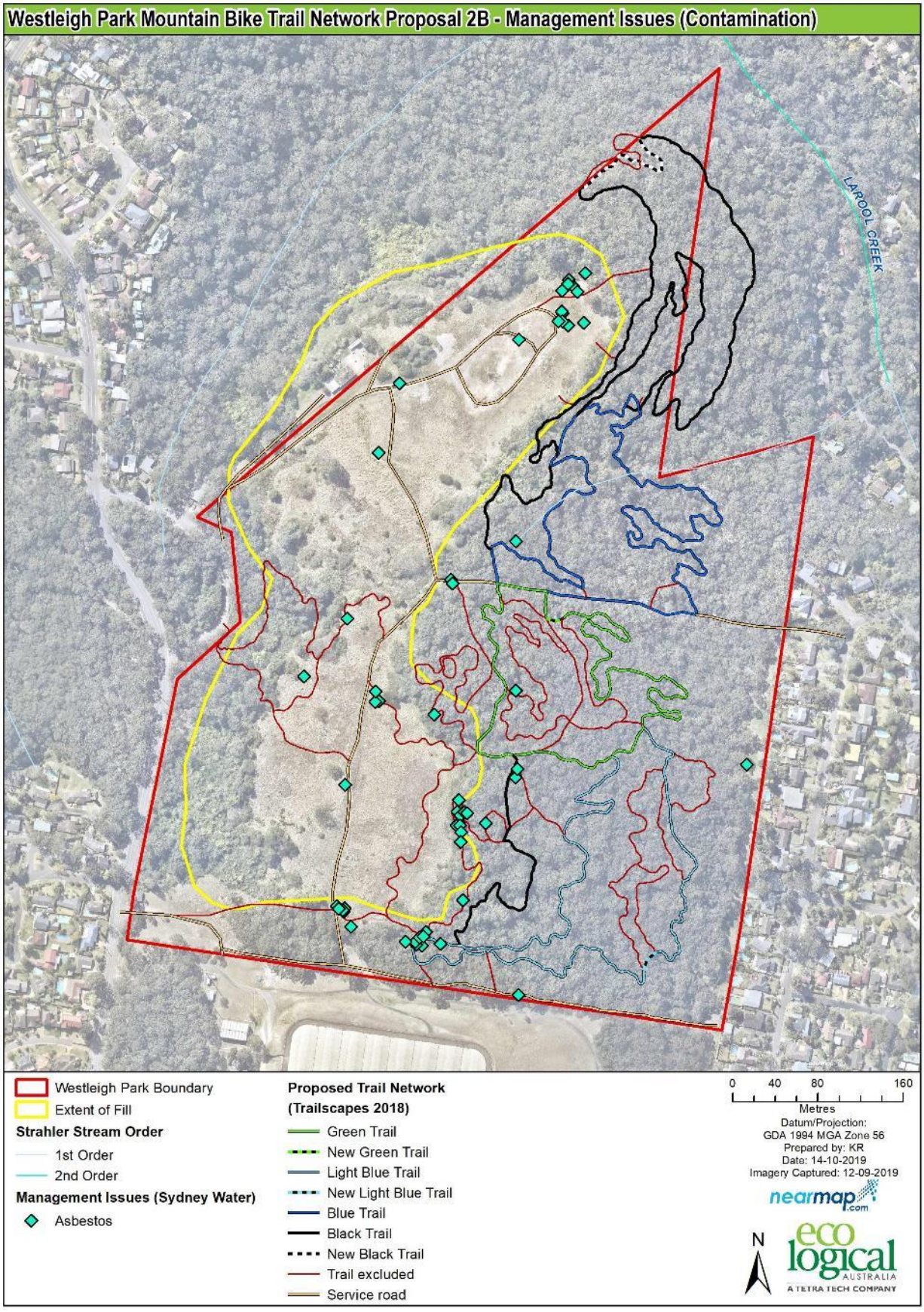


Figure 9 Proximity of Proposal 2B to contaminated sites

2.4.5 Overall Proximity of Trails to a Range of Management Issues

Proposal 2 and Proposal 2B were reviewed for their proximity to a range of management issues. These included potential habitat impacts, tree impacts/ hazards to riders, erosion, impacts on tree roots, water erosion, water erosion and riders going off-track, blocked watercourse, water collection, hazard (hole), open impact area (rest area), rubbish/ sediment collection, structure/ design failures or concerns.

Overall Proposal 2B has fewer impacts either on the trail or in close proximity and is therefore the preferred option.

These are shown in Table 10 and Figures 10 and 11.

Table 10 – Proposal 2 and Proposal 2B compared to a range of management issues

Management Issue	Proposal 2	Proposal 2B
Erosion	6	7
Erosion (Exposed tree roots)	9	8
Erosion (Water)	93	65
Riders going off-track	2	1
Asbestos	22	12
Threatened Flora records (client)	5	5
Threatened Flora records (BioNet)	1	1
Number of watercourses cut*	2	2

*one of these watercourses the trails cut through it at least 3 times

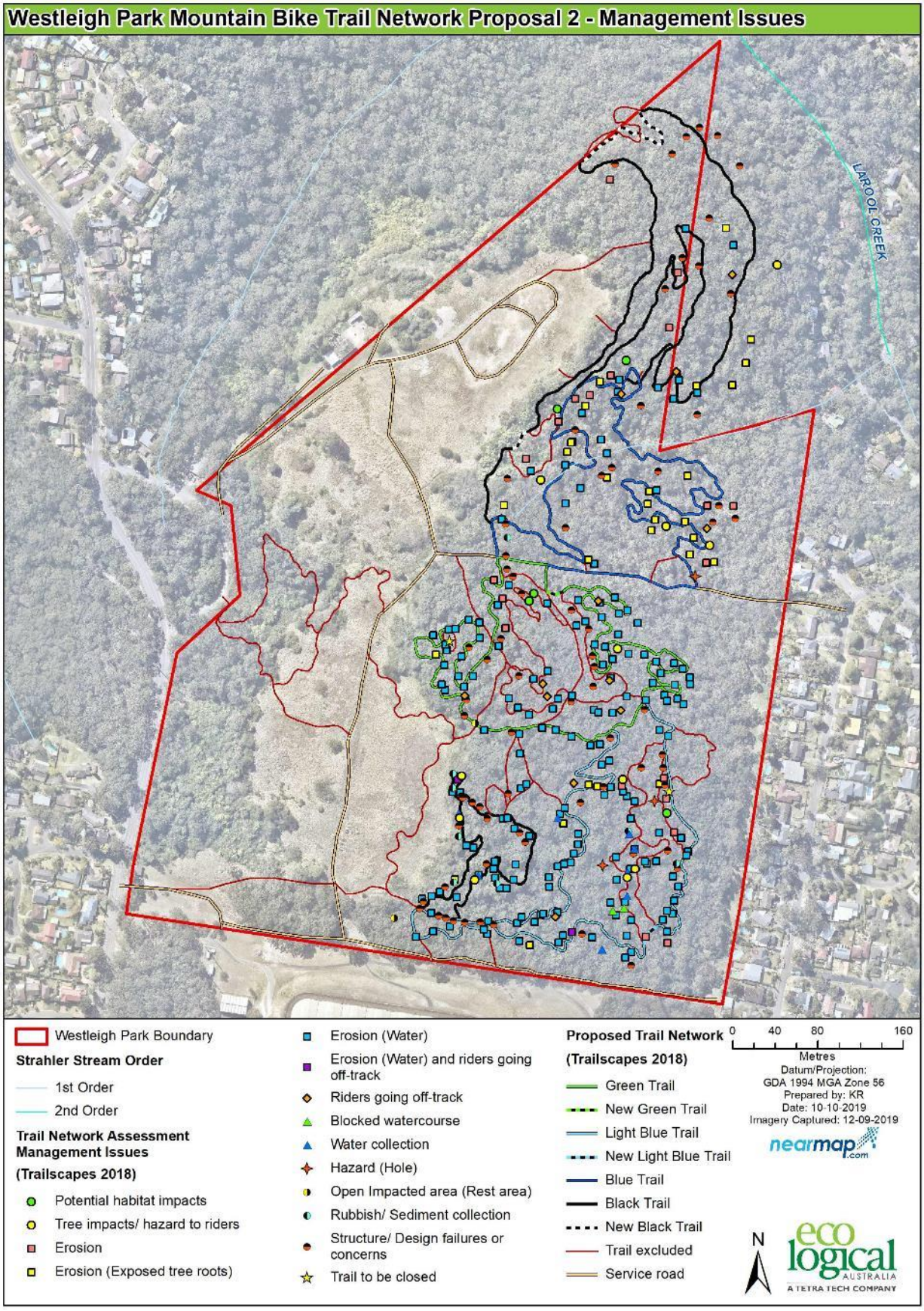


Figure 10 Proximity of Proposal 2 to a range of management issues

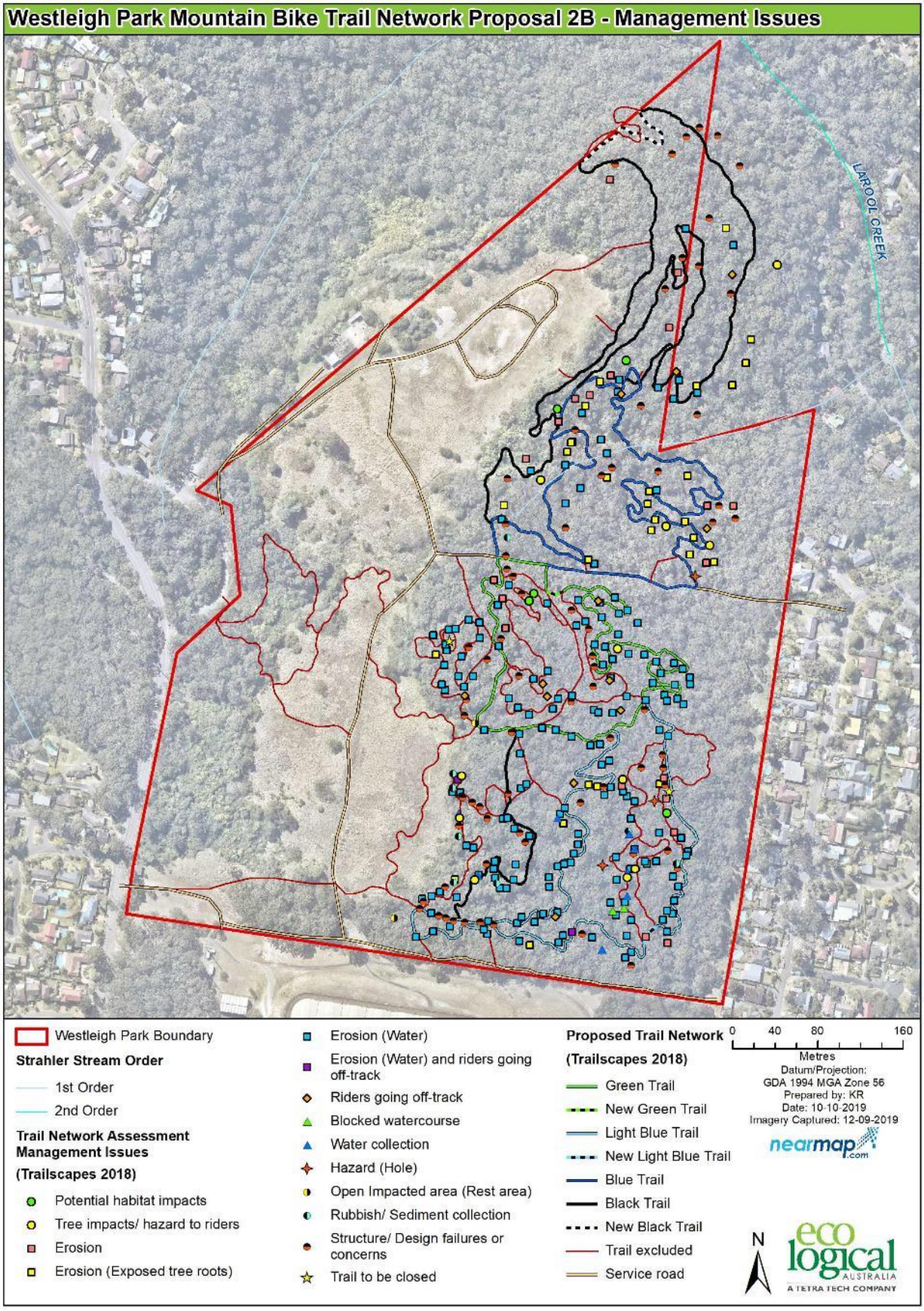


Figure 11 Proximity of Proposal 2B to a range of management issues

2.5 Mountain bike trail network REF

The REF for Westleigh Natural Areas by Hornsby Shire Council 21 December 2017 was reviewed.

Overall, the REF lacks detail on how the use of trails within the Westleigh Nature Area is currently and will continue to affect the biodiversity on site. The REF states that it is a retrospective assessment of previously constructed, unapproved trails and therefore inadequately assesses actual impacts to the environment within the site. All comments are general and do not provide enough information to make an informed decision as to the impact from MBTs. The REF should be updated to focus on the preferred option for MBTs or those trails most likely to be implemented and specifically assess the impacts from the trail(s).

Relating to Biodiversity, the REF has generally identified that threatened species are likely to be present within the site, however the level of detail pertaining to where on the site these species might be present, could be stronger. A table or figure showing which BioNet records have been recorded near the site would strengthen this, or a likelihood of occurrence matrix detailing habitat requirements for these threatened species. The table should identify habitat features (e.g. sandstone benching, hollow-bearing trees, winter flowering Eucalypts) that are present/not present on site and compare this to the habitat requirements for each threatened flora or fauna species that is likely to occur within the site; and finally the table should then deduce from this information, if the species is in fact likely to occur on/utilise the site. A comparative matrix such as this would offer a greater level of confidence as to which species are most likely to occur on/utilise the site and therefore would help determine which species are most likely to be impacted by the preferred MBT.

A review of recent threatened species records within a 5 km radius of the site (BioNet, PMST) has shown the potential for four additional flora species which are not included in the REF. These are:

- *Galium australe,*
- *Lasiopetalum joyceae,*
- *Rhodamnia rubescens* and;
- *Syzgium paniculatum.*

The REF should consider these species in the report. ELA also undertook a review of threatened fauna and the REF has considered these species.

The REF notes that targeted surveys for threatened flora and fauna species have not been conducted for the site, and that fauna listed on site have been recorded from incidental observations only. Targeted searches of both flora and fauna likely to be present within the site could be undertaken to update the REF.

The REF states that it is a retrospective assessment of previously constructed, unapproved trails only and has therefore not included Tests of Significance in accordance with s7.3 of the *Biodiversity Conservation Act 2016* (BC Act). Tests of Significance need to be undertaken for the impact to threatened species and endangered ecological communities to determine if the preferred option(s) for the MBTs is likely to have a significant impact to threatened flora and fauna listed under the BC Act. Similarly, Significant Impact Criteria also need to be applied to TEC's and threatened species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Track construction is briefly covered in the REF. The REF should refer to construction guidelines such as Trail Solutions IMBA's Guide to Building Sweet Singletrack to provide more detail into the technical aspects of 'best-practice' trail design, development and construction.

The report correctly identifies that the main impacts have already occurred through the clearing of vegetation for trails. It states that the 'do nothing approach' would allow further unplanned trail construction and trail creep, trail deterioration and erosion, and likely worsening of identified environmental concerns. However, there is known pressure from the local mountain bike community to link the Westleigh MBT to the Hornsby MBT. This creates additional pressure for a link to be created through the Biobank site. The REF needs to address the issue of public pressure and how this may encroach on the Westleigh area and adjacent biobank sites.

There have been multiple assessments of contamination for the Westleigh site. The REF needs to incorporate findings from the Coffey Remediations Options Report 2018 and the Arcadis Remedial Action Plan 2017 as amended by the Kingfisher Ecological advice on remediation options in bushland, subject to issues raised in this review.

The REF does not adequately address pathogen management. Hygiene protocols and mitigation measures for *Phytophthora cinnamomi* (Phytophthora*)* and *Austropuccinia psidii* (Myrtle Rust - formerly *Puccinia psidii*, initially identified as *Uredo rangelii*) need to be updated and addressed in the REF as *P. cinnamomi* and *A. psidii* are known to occur within the adjacent Biodiversity Stewardship site.

Table 11 includes recommendations relating to the report.

Table 11: Review of the Westleigh Natural Areas REF

Page No.	Heading	Paragraph/ Dot Point	Issue	Recommendation
1	Section 2 - Planning Issues	1	Consideration of relevant State Plans and policies. SEPP 44 is not included for assessment	Include State Environmental Planning Policy No 44—Koala Habitat Protection
3	Introduction	10th dot point in last paragraph.	The introduction lists some examples of environmental law to be considered and mentions the 'Biodiversity Act 2016'. This should be updated to the Act's full title '*Biodiversity Conservation Act 2016*'	Change the dot point to *Biodiversity Conservation Act 2016*
3	National/State/Regional/Local Conservation significance	2.2	Scientific names of species should be italicised including *Darwinia bilfora, Melaleuca deanei, Tetratheca glandulosa.* Epacris purpurascens ssp. Purpurascens should be written as *Epacris purpurascens* var. *purpurascens.*	Update throughout the entire report.
3	National/State/Regional/Local Conservation significance	2.2	Department of Environment, Climate Change and Water (DECCW)	Update DECCW to Department of Planning, Industry and Environment (DoPIE) effective as of 1 July 2019.
3.8	Threatened Species Considerations		Refers to *Threatened Species Conservation Act 1995*. The Threatened Species Conservation Act has now been replaced by the *Biodiversity Conservation Act 2016.* The REF does not include additional flora species including *Galium australe, Lasiopetalum joyceae, Rhodamnia rubescens* and *Syzgium paniculatum* that have been found to occur within 5 km of the site in a recent search. The REF does not include a likelihood of occurrence for threatened species. The REF does not include a test of significance (5 part-test) for the impact of the trails on each threatened entity.	Update to *Biodiversity Conservation Act 2016.* Include consideration of threatened flora: *Galium australe, Lasiopetalum joyceae, Rhodamnia rubescens* and *Syzgium paniculatum.* Include a likelihood of occurrence for threatened species. Include a test of significance (5 part-test) for each threatened species, population or ecological community likely to occur.
5	What is the vegetation present?	2.3.3	The report states that vegetation communities on the site include STIF listed as Endangered Ecological Community under the BC Act. Since writing this has been up listed as a Critically Endangered Ecological Community (CEEC)	Update the STIF listing as a CEEC.

Page No.	Heading	Paragraph/ Dot Point	Issue	Recommendation
5	What is the vegetation present?	2.3.3	The analysis of Duffy's Forest Endangered Ecological Community (EEC) has undergone internal review by OEH, with decommissioning of PCT 1085, and subsequent allocation of Duffy's Forest to PCT 1786 and Coastal Shale-Sandstone Forest to PCT 1845, the latter not being part of an EEC.	Update.
9	Areas sensitive because of physical / biological factors	2.3.9	*Phytophthora cinnamomi* should be italicised throughout the report	Update
10	Contamination	2.3.10	The REF has not included remedial actions from the contamination reports prepared for the site.	The REF needs to include remedial actions be reflect reviewed information in Section 2.2 of this report
11	Aboriginal heritage	2.5.1	The REF has undertaken a desktop assessment of Aboriginal heritage with an AHIMS search and not included a site survey.	The REF should have an Aboriginal heritage due diligence site survey undertaken as the initial step in addressing this issue.
57	Appendix C	Figure 3	Vegetation communities do not match a PCT	The report needs to identify the vegetation zones on the site based on the PCTs and broad condition states and the threatened species should be noted on in the figure.
7	Alternative Proposals	4 and 4.1	Appendix D is referred to in the REF but not included.	Include Appendix D within the REF rather than as a separate document for clarity and ease of access to this information.

2.6 Concept masterplans for development

The Concept masterplans for development for the location of accessible trail, walking trails and other proposed future tracks within the site were reviewed in relation to preferred option two.

The shared recreational/ maintenance path trail occurs on the perimeter of the cleared land and utilises retaining walls with sections shown in six locations. The retaining walls in Section 1-1 and Section 2-2 are located within BP areas. The downhill parts of Sections 4-4 and 6-6 are in BP areas.

Sections 5-5, 6-6 and 7-7 are located adjacent to Sydney Turpentine Ironbark Forest. Section 1-1 indicates a cut for capping layer but does not specify what the capping layer consists of. This needs to be of crushed sandstone VENM or ENM in areas of BP and RE and adjoining bushland, maximum 100mm depth where required as last resort in broadscale contamination areas. The specifications for remediation need to reflect the recommendations of the Interface Area Ecology Report and comments made in Section 2.2 of this report.

Section 4-4 appears to be approximately 3.2 m in height and would be visually intrusive, being in a BP area. An alternative lower visual solution needs to be developed for this part of the site. This should include refined mapping of ground surface and fill, consideration of minimum impact techniques and interface treatment options such as a stepped sandstone wall with locally indigenous native plantings.

The access points to the adjoining Mountain Bike Track will need to be reviewed when the preferred MTB trail layout is finalised.

There is no provision for any bushwalking trail locations within the bushland area.

No comment has been made relating to the concrete pedestrian / cycle shared path because it is located within the cleared land. However, in general the Concept masterplan is suitable, subject to addressing the issues raised.

2.7 Draft Plan of Management

The Draft Plan of Management (POM) was reviewed. Particular attention was paid to the natural area for adequacy of consideration of issues relating to core objectives for natural areas under the *Local Government Act and Regulations 1993*.

The draft Plan of Management is missing a number of elements throughout that are indicated in red text. It is assumed that these will be completed by Council when the draft is updated.

Section 2.2 outlines core objectives for sportsgrounds, natural area and bushland, and general community use. Westleigh Park requires the development of additional objectives to provide a low impact passive mountain bike trail network that is sustainably managed in consideration of the needs of the current and future community, user groups and locality characteristics at an appropriate level that will minimise any impacts; to close and rehabilitate unauthorised trails; and to design, restore and maintain all authorised trails to industry standard; to provide inclusive facilities and equity of access; and to promote community involvement in management of bushland and trail network.

Section 3 references the Crown Lands Regulation 2008 but needs to be updated to reference the current *Crown Land Management Act 2016* and the *Crown Land Management Regulation 2018* that relate to the small area of Crown land at Warrigal Drive. The plan also needs to obtain and consider Native Title Manager advice in relation to the Crown Land.

The Site History in Section 4 does not indicate the date or approximate time that mountain bike trails started to be constructed on the site.

Following review of the Vegetation Community mapping as to the presence of Duffys Forest Endangered Ecological Community, Section 4.4 and Figure 4.8 need to be updated.

Section 4.6 needs to include accessible access tracks, education and conservation as additional uses for the park.

Section 5.2 Performance targets for 'Natural area bushland' needs to amend point 5 that states 'Manage MTB trail system in accordance with 2018 Westleigh Parks Trail Assessment' by adding the additional clause 'as amended and in accordance with Council's preferred trail option.' It needs to include additional performance targets to:

- Remediate contaminated sites and rehabilitate closed mountain bike trails
- Undertake bushland restoration in areas degraded by weeds and other disturbances
- Construct a bushwalking trail.

Section 4.4, Figure 4.9 and Section 6.2 refer to the Dog Pound Creek Biobanking Agreement and Biobanking Area. This needs to be updated to reflect that this is now a Biodiversity Stewardship Agreement and Biodiversity Stewardship Area under the *Biodiversity Conservation Act 2016.*

Section 4.5 and 5.4.2.11 need to be amended to reflect that the current mountain bike trail network is not sustainable due to the 350 non-compliances with IMBA trail classifications, signage, core elements and environmental impacts. Hence the statement that the mountain bike trail network is in "reasonably good condition" is not accurate.

Section 5.3 that states 'The MTB trail network to the west can also provide bush walk standard amenity accessed from Westleigh Park'. This needs to be amended as these uses are likely to be incompatible if the MTB is formalised which is likely to result in increased usage, as experienced at the Hornsby MTB Trail. The section needs to state that a bushwalking trail will need to be developed separately to the MTB trail and that closed MTB trails will need to be rehabilitated.

Section 5.3.5 needs to include, under vegetation management, that an ongoing program of bushland restoration will need to occur.

Section 5.4.16 6. States that three entry points to the MTB are proposed along the eastern edge of the park accessed from the shared path or perimeter road. The plan should reflect that this will need to be developed following Council's selection of a preferred trail option.

Section 5.4.4 indicates that Duffys Forest is also listed as an Endangered Ecological Community under the TSC Act. This should be removed.

Section 7.2.4 Leasing and Licensing in Natural Areas needs to include a section that allows for hire of the MTB track for club events, if this activity is intended by Council. It needs to include under 'Granting of Estates' the authorisation for Council to enter into a Biodiversity Stewardship Agreement if this is being considered by Council.

The Action Plan needs to develop management statements, actions, management team responsibilities, timeframes and performance measures for MTB closure and remediation, restoration and upgrading; and maintenance and operations. This should be based on practices put in place for the Hornsby MTB.

3. Additional Analysis

More detailed analysis has been undertaken for several issues raised by Council:

1. Discussion of the merits of a potential Biodiversity Stewardship site with reference to current market trades of BBAM credits of STIF as shown in the Spot Price Index versus potential credit generation under the BAM and with reference to the Biodiversity Offsets Payment Calculator (BOPC)
2. The local versus regional values/ characteristics of the current trail network comparing Westleigh to Old Mans Valley and other MTB trails including trail density
3. Comparison of the relative merits of retention of the Northern Trails to the Southern Trails
4. Long term impacts of development of the cleared areas as sportsgrounds on the natural area.

3.1 Biodiversity Stewardship Site

The Westleigh site adjoins the Dog Pound Creek (BioBanking) Biodiversity Stewardship Agreement (BSA) Site. ELA was asked to examine the inclusion of the site within the BSA as an option. The retention or creation of mountain bike trails within a BSA is inconsistent with the purposes of a BSA site. The discussion below relates to the option if there were no mountain bike tracks within the Turpentine-Ironbark Forest vegetation community.

As part of biodiversity reforms, the State Government has established the Biodiversity Assessment Method (BAM) which replaces other methodologies such as the BioBanking Assessment Methodology (BBAM). The BAM is based on these previous methodologies and determines the number and type of credits required at a development site, and the number and type of credits created at a Biodiversity Stewardship site (previously called 'BioBank' sites).

Like BioBanking, the new Biodiversity Offset Scheme is a market-based system where landowners enter into a Biodiversity Stewardship Agreement to ensure no net loss of biodiversity values by undertaking management actions such as fencing, feral animal control and weed control. The agreement is registered on title and requires current and future landowners to manage the land in accordance with the agreement.

The sale of the credits provides the resources for the conservation management of the land in perpetuity (there is no obligation to manage the land if no credits are sold), and subject to market demand, additional returns can also be obtained.

The credit sale price includes two components:

- Credit Price Part A - the funds required for in perpetuity management, held in the Biodiversity Trust Fund and paid back to the landowner each year to undertake conservation management.
- Credit Price Part B - the funds returned to the landholder such as site establishment costs and risk or profit margins – this component is subject to prevailing taxation issues including capital tax provisions.

The equations and data used to calculate the biodiversity credits generated from a biodiversity stewardship site under BAM are quite different to the BBAM; with diverse numbers and types of credits

being generated. Under the old scheme, biobank sites would approximately generate 9 ecosystem credits per hectare; however, under the new scheme, the number of BAM credits generated may be between 2-6 per hectare. The arrangements for the eligibility for biobank sites under the TSC Act remain the same under the BC Act; however, the management expectations are more onerous, thus more funds need to be deposited in the Trust Fund and as a result (in theory), the credit price should be higher, as other costs have not changed.

3.1.1 Current Market – Spot Price Index

The Spot Price Index is for Biodiversity Credits created based on the BBAM. This provides information on the biodiversity credit market data in the BioBanking Public Register, including the spot market price for biodiversity credits, the number of transactions registered, the volume of credits transferred, the total market value and the number of active Stewardship Agreements in NSW.

The main marketable credit type on the site is Sydney Turpentine Ironbark Forest (HN604 and ME041). The current maximum spot price per credit for HN604 is $10,000, for ME041 is $17,500 and the average of the two is $10,833, as shown in Figure 12, Figure 13 and Figure 14. However, the weighted average price per credit for HN604 is $7,457.64, for ME041 is $16,701.52 and average of the two is $11,586.75, as shown in Figure 15, Figure 16 and Figure 17. This is useful to gain an appreciation of the current market sales.

3.1.2 Biodiversity Offsets Payments Calculator Pricing

The Biodiversity Offsets Payments Calculator (BOPC) is a public tool that estimates the amount that can be paid per credit to the Biodiversity Conservation Trust (BCT) for a person or entity to discharge their commitment to purchase and retire biodiversity credits. This is an alternate method to finding credits to purchase from a seller.

The purpose of the Biodiversity Offsets Payment Calculator (BOPC) is to provide a charge that predicts the costs that the BCT will incur in securing each type of biodiversity credit as an offset. The BOPC is used to formally generate a charge and facilitate payment into the Biodiversity Conservation Fund and is kept within the Biodiversity Offsets and Agreement Management System (BOAMS) where it is linked to the assessment data for a development proposal assessed using the Biodiversity Assessment Method (BAM). The prices are regularly updated and this last occurred in November 2019, with its earlier iteration being based on BBAM and now it is more aligned to BAM.

A public tool is also separately available for anyone to test the cost associated with paying into the Biodiversity Conservation Fund (BCF). We have accessed the public tool to test how the BOPC works and to obtain an estimate for a credit obligation. It is important to note that this tool cannot be relied upon to determine the final payment obligation – this must be done through the BOPC within the BOAMS.

The public BOPC was examined on 14 January 2020. The BOPC prices to discharge credit commitments prices indicated for PCT 1281 - Turpentine-Grey Ironbark Open Forest on Shale in the Sydney Basin is $7,687.88 per credit, as shown in Figure 18.

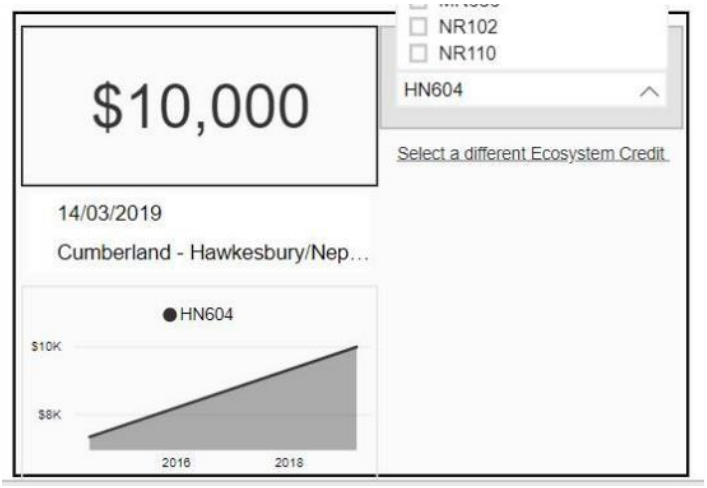


Figure 12 Spot Price Index value of HN 604 Sydney Turpentine Ironbark Forest

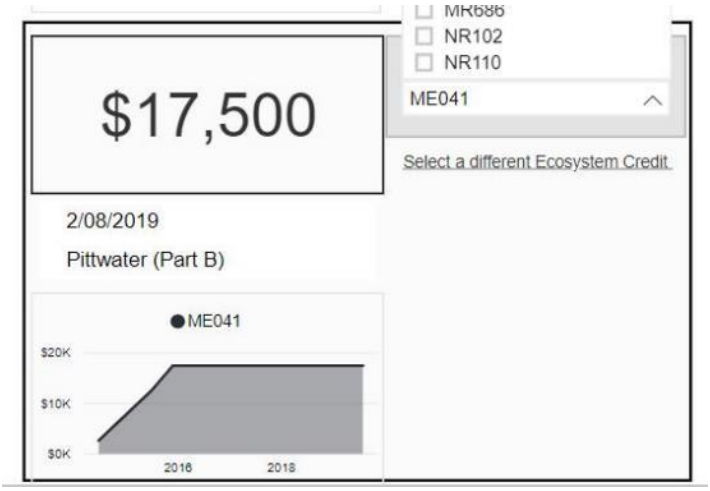


Figure 13 Spot Price Index value for ME041 Sydney Turpentine Ironbark Forest

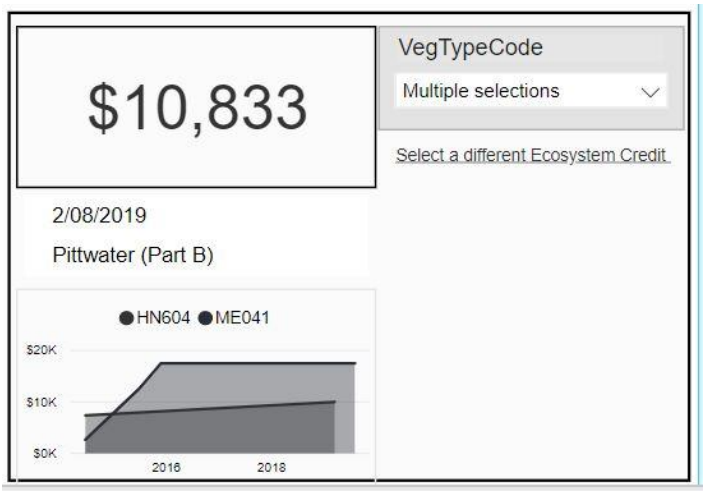


Figure 14 Spot Price Index value for HN604 and ME041 Sydney Turpentine ironbark Forest

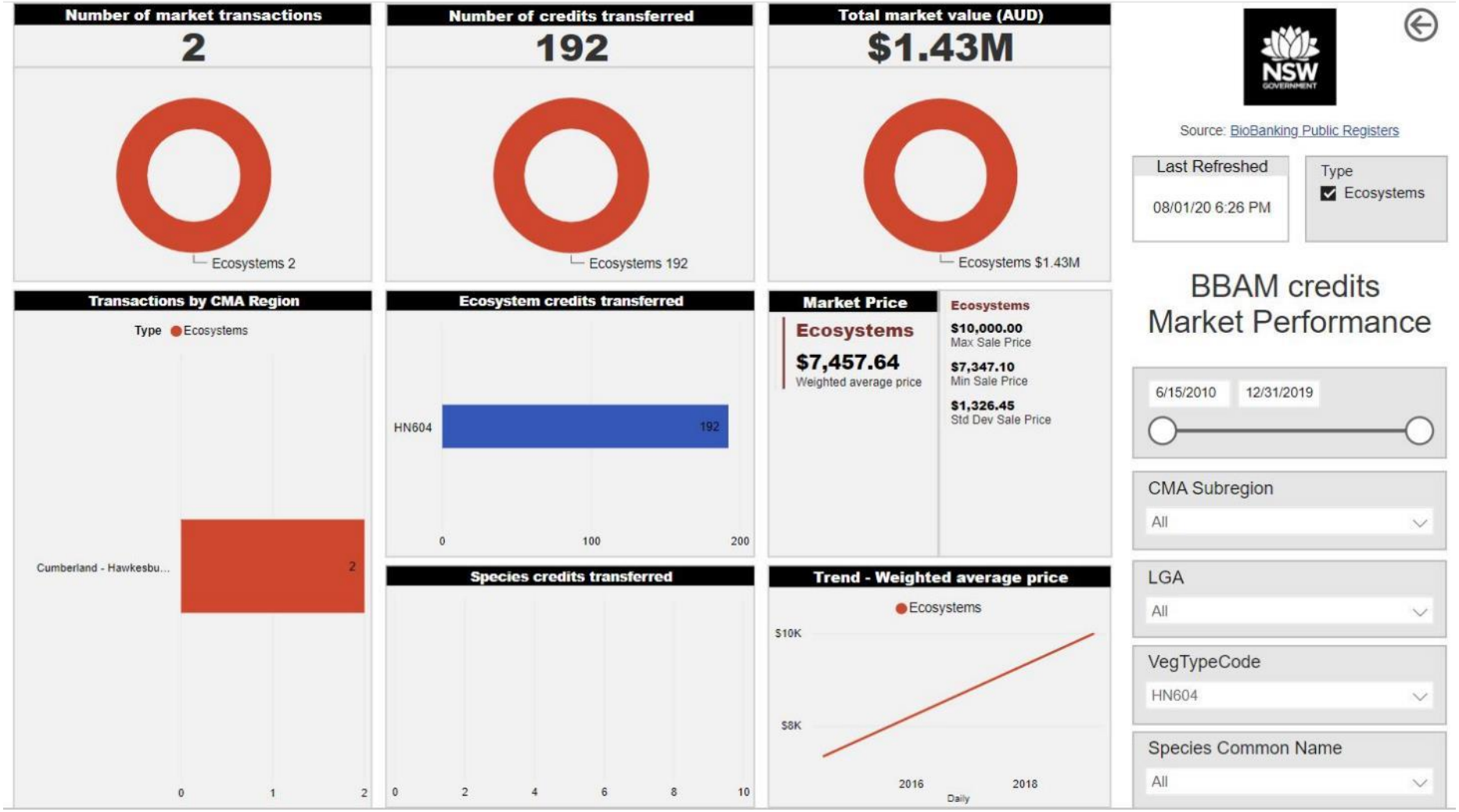


Figure 15 BBAM market performance for HN 604 Sydney Turpentine Ironbark Forest

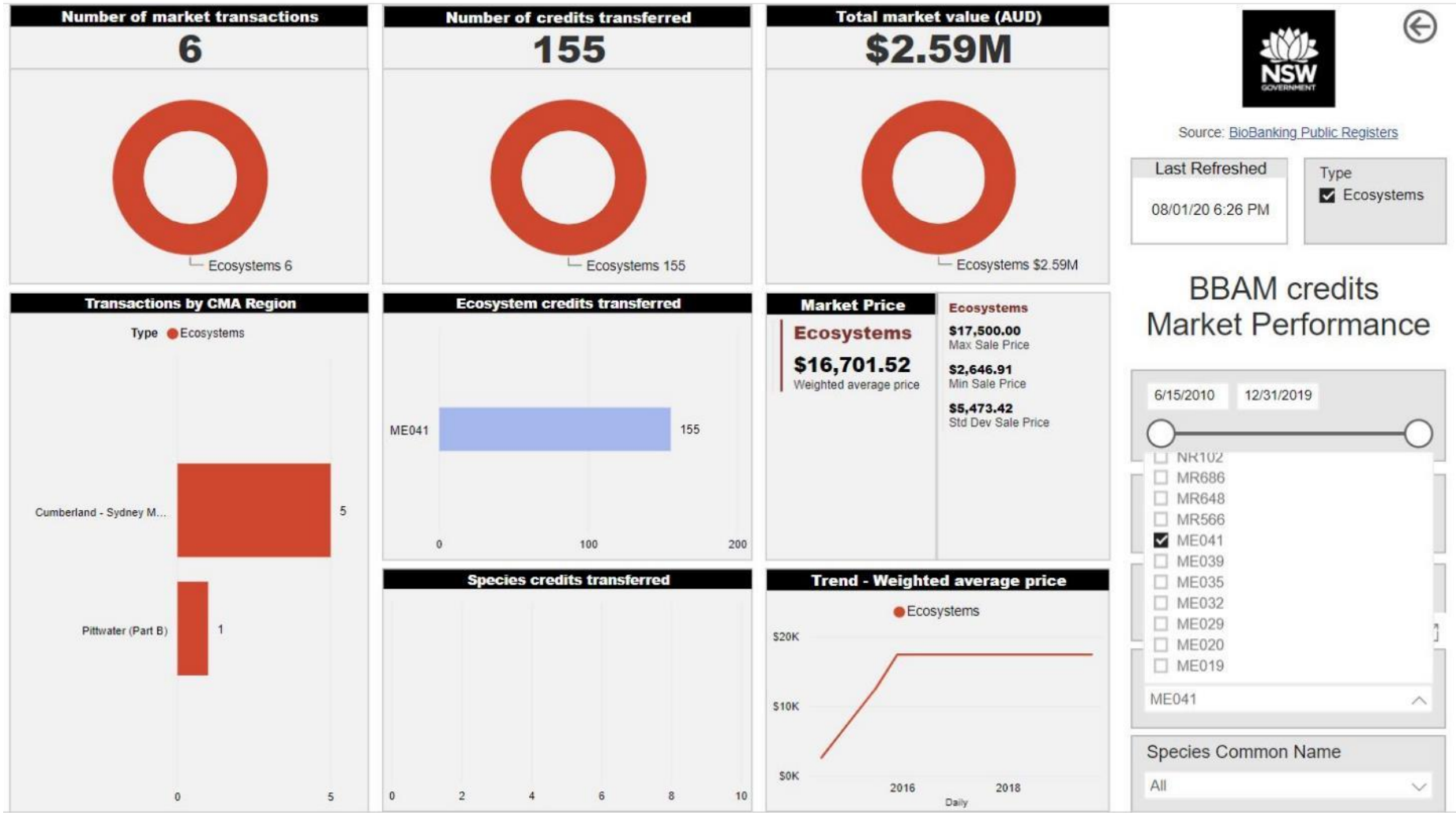


Figure 16 BBAM market performance for ME041 Sydney Turpentine Ironbark Forest

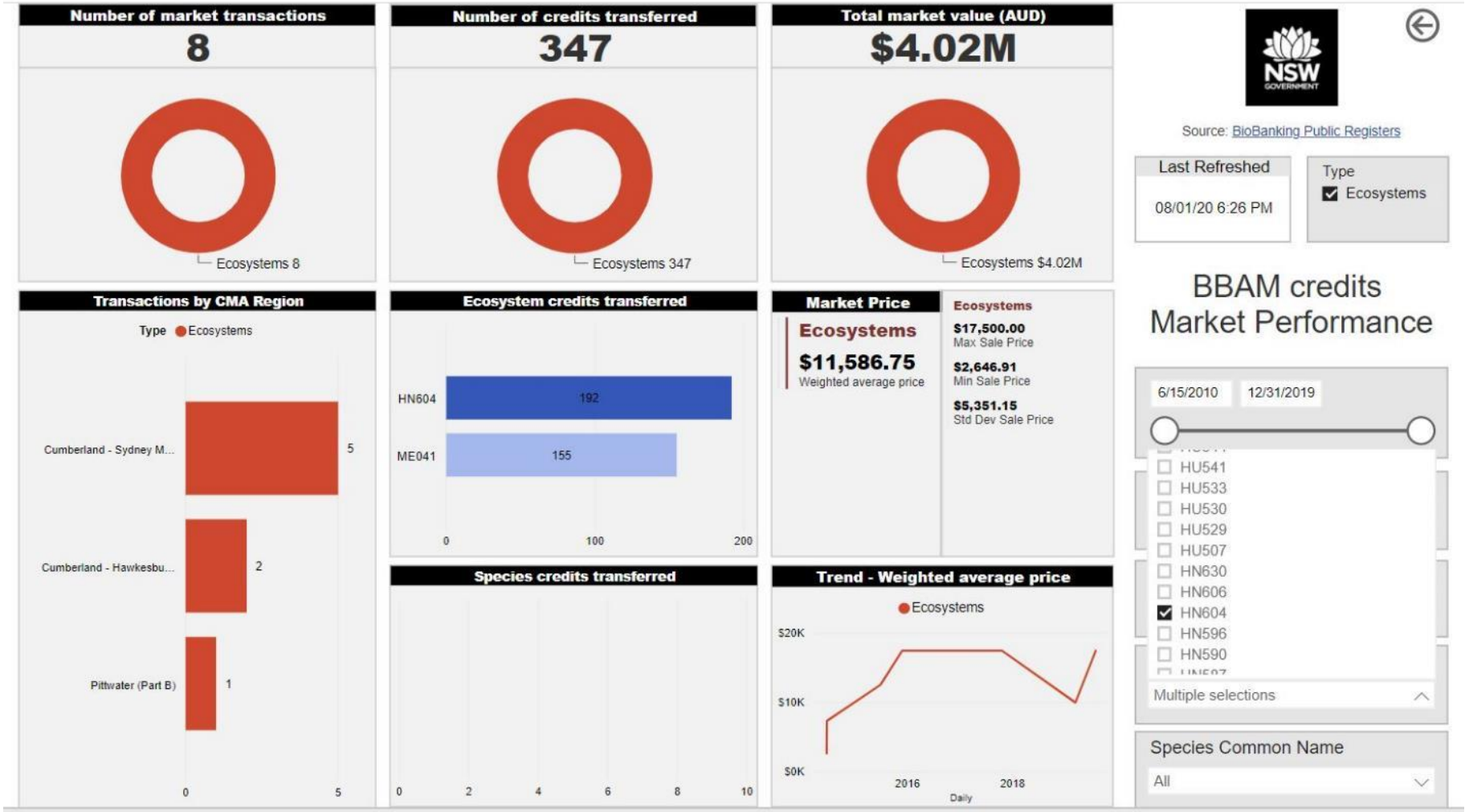
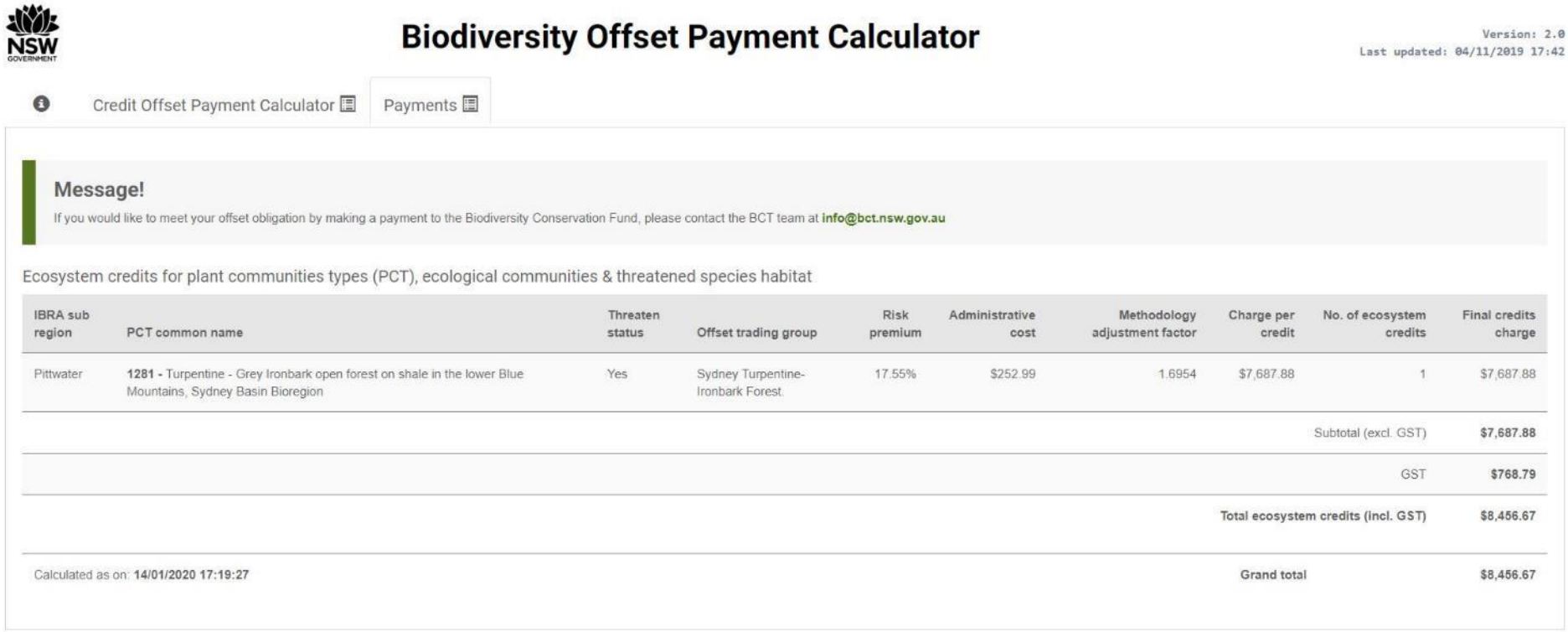


Figure 17 BBAM market performance for HN604 and ME041 for Sydney Turpentine Ironbark Forest



Biodiversity Offset Payment Calculator

Version: 2.0
Last updated: 04/11/2019 17:42

Credit Offset Payment Calculator | Payments

Message!

If you would like to meet your offset obligation by making a payment to the Biodiversity Conservation Fund, please contact the BCT team at info@bct.nsw.gov.au

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

IBRA sub region	PCT common name	Threaten status	Offset trading group	Risk premium	Administrative cost	Methodology adjustment factor	Charge per credit	No. of ecosystem credits	Final credits charge
Pittwater	**1281 -** Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion	Yes	Sydney Turpentine-Ironbark Forest	17.55%	$252.99	1.6954	$7,687.88	1	$7,687.88
								Subtotal (excl. GST)	**$7,687.88**
								GST	**$768.79**
							Total ecosystem credits (incl. GST)		**$8,456.67**
Calculated as on: **14/01/2020 17:19:27**							**Grand total**		**$8,456.67**

Figure 18 BOPC price for Sydney Turpentine Ironbark Forest using the public tool

3.1.3 Comparison of Different Pricing Levels

The difference in credit pricing in Spot prices and pricing in the BOPC, indicate that sales through trades on private trading arrangements reached a higher price ($11,586.75 weighted average price) for BBAM generated credits, than the BOPC price ($7,686.88) which is based on sales of BAM generated credits.

As stated in Section 3.1, the lower number of credits generated under the BAM scheme creates the expectation of a higher credit price in order to implement the management works required under the Total Fund Deposit. This leads to the expectation that the BAM prices under the BOPC would therefore be higher for the fewer credits to generate the same income to fund the works. Hence the lower BOPC price is unexpected because it would logically need to be higher.

A key issue is that the BOPC is setting the price, meaning that if credits generated for a Stewardship Site are higher than the BOPC then the credit owner will not be able to sell credits to a developer.

Another issue is that the BCT is a significant purchaser in the market for credits. The BCT calls for tenders for credits and purchases the lowest price (reverse auction). This drives down prices.

We are confident that there is a market for Turpentine Ironbark Forest credits (PCT 1281). The above prices don't account for the cost of management actions for the Westleigh site, or the number of credits that could be generated at this site. Therefore, these prices are indicative estimates only. Further information could be derived through conducting a Biodiversity Stewardship Feasibility Assessment that would include collection of BAM plot data and a draft TFD estimate.

3.2 Local Versus Regional Characteristics of Trail Network

Council has requested additional analysis of the local versus regional values / characteristics of the current trail network comparing Westleigh to Old Mans Valley and other MTB trails; including analysis of trail density.

The Westleigh Trail was reviewed in relation to State and Regional planning and other government documents relating to off-road cycling in Table 12. The Westleigh trails are included in the more recent relevant local planning and other government documents.

Table 12 State, regional and local government documents

State and Regional resources, policies and plans	Westleigh Park Trails	Comment
North District Plan https://www.greater.sydney/north-district-plan/future-of-north-district	Not included	Aims to provide improved and safe cycleways.
NSW Cycleway Finder https://www.rms.nsw.gov.au/maps/cycleway_finder	Not included	The Cycleway Finder Map is under review and is in the process of being updated. Map may not be current.
NSW Bike Plan 2010	Not included	Priority given to completing missing links in the Metro Sydney Bike Network of off-road regional routes, to connect all Metropolitan Strategy centres.

State and Regional resources, policies and plans	Westleigh Park Trails	Comment
Hornsby Integrated Planning Statement 2019 - Walking and Cycling Strategy	Text states 'With the assistance of State Government funding, Council will be working to explore opportunities to expand the trail and provide links to new recreational facilities at Westleigh'	Westleigh Park is mapped as major urban parkland to provide priority infrastructure for sportsgrounds. Some of the Westleigh trails are included in the walking and cycling map, but not the in legend which maps key movement corridors. The Walking and Cycling Strategy is yet to be completed.
Hornsby Bike Plan 2017/2018 Review	Trails documented on maps and in text	Off-road trails are not included in the map legend.
Hornsby Unstructured Recreation Strategy 2008	Westleigh documented	Report states 'Some jumps and trails' and 'Narrow access not suitable'.
Hornsby Cycling Map 2008	Not included	
Hornsby Bike Plan 1998	Not included	
Hornsby Integrated Transport and Land Use Strategy 2004	Not included	Off-road addressed but Westleigh is not included

The TrailScape report evaluated Old Mans Valley as providing Community / Local trail characteristics and significance. ELA has compared this to the regional trail characteristics and significance, which confirms TrailScapes findings that the site does not generally contribute to regional values, rather provides local and community scale of trail.

Table 13 Trail characteristics and significance

Attribute	Actual metric	Comments	Significance rating	Regional Metric
Trailheads accessible by bike from local communities?	300 m	Trail network is part of and well used by the local community.	Community	30 km maximum from population centre of regional significance
Total distance of marked trails	9 km	A minimum of 5km of quality MTB trail is recommended.	Community/Local	30 km minimum
Distance from other network for same or similar user group	8 km	8km to Old Mans Valley	Community/Local	50 km minimum
Trailhead distance from a main/highway road	2.5 km		Community/Local	10 km
Trailhead distance from a surfaced road	300 m		Community/Local	5 km
Trailhead visitor services and infrastructure	basic	Trail information, parking etc will be formalised as part of the sporting fields development.	Community/Local	Orientation, Interpretation and trail information,

Attribute	Actual metric	Comments	Significance rating	Regional Metric
				Parking, Toilets, Possibly refreshments, Bike hire

ELA was requested to review the trail density at Westleigh in relation to other mountain bike trails. This is shown in Table 14 and indicates that both Westleigh and Hornsby have a high density of trails compared to other trails examined.

Table 14 MTB trail density and other characteristics

Trail	Managed/ official	Multiple Use	Riding Protocols	Distance	Trail Type	Trail Density
Manly Dam	Y	Y	Y	11 km		Low
Bantry Bay Gahnia and Serrata Trails Garigal NP	Y	N	IMBA rules	6.5 km	Single Track	Low
Glenrock SCA	Y	Y walking	Code of conduct	14 km		Moderate
OMV	Y	N	IMBA rules	6.4 km	Cross country single track	High
Ourimbah SF	Y	N		14 km singletrack 45 km firetrail	Downhill, single trail, fire trail	Low – dense in small area
Westleigh	N	Y – local walkers	Partial IMBA	9.37 km	Cross country single track	High

The Westleigh trail, also known as H_20, has a high level of local support from the community and funding support through the local MP, the Hon. Matt Keane, Minister for Energy and Environment. Hornsby Councillors have also indicated support for the Westleigh trails, stating that support is conditional on any link not impacting on environmentally sensitive bushland, such as the blue gum high forest (in the adjoining Dog Pound Creek Biobank/ Biodiversity Stewardship Agreement (BSA) site) (Cllr Nathan Tilbury, The Bush Telegraph, January 2020).

The Trailscapes Report states that there is an informal link through a BSA site of high conservation value bushland. Should Council authorise the Westleigh trail, it would need to consider the impacts on the BSA site which also currently has a number of unauthorised trails constructed by local community.

Council would need to be aware that mountain bike trails are incompatible with the purpose of the BSA. The Dog Pound Creek BSA excludes the Sydney Water easement, however the width of the easement is very narrow and may be insufficient for a trail corridor, although it may be suitable for a walk-up and walk-down connection.

The TrailScapes Report also that states that the current usage is half of the OMV trail, with the Westleigh MTB Track Facebook page stating that 56,885 laps have been ridden since 2009 with Strava sporting activity tracking app (https://www.facebook.com/groups/890967521023089/). This assertion of track usage has not been confirmed as no data has been provided.

Whilst the TrailScapes Report considers that "Provision of local MTB trail offers a passive trail compared to an active trail at Hornsby / OMV, and thereby complements the current official trails"; this is dependent on the trail layout that Council decides to proceed with, because the flatter terrain at the southern part of Westleigh which differs from Hornsby / OMV, occurs in the location of the Sydney Turpentine Ironbark Forest. It is possible however, that a trail network that minimises environmental impacts and incorporates dedicated trails for mountain bikes, walking and accessible trail on the interface, as opposed to the current predominant mountain bike trails, could provide for a complementary range of uses within the Westleigh Park natural area whilst avoiding conflicts between users.

3.3 Relative Merits of Northern Trails Versus Southern Trails

ELA has assessed the mapped trail options for the Northern Trails versus the Southern Trails against data derived from the Trailscapes and vegetation mapping reports. ELA has examined proximity to threatened species, length of impact on threatened ecological communities, track erosion and other management issues. A general comparison was made of the two to consider a preferred trail option.

3.3.1 Proximity to Threatened Species

Both the Northern and Southern Trails are located near to occurrences of threatened flora as shown in Figure 19. There is one record of a threatened flora species in proximity to the Northern Trails and 22 records of two threatened flora species near the Southern Trails. If the Southern Trails are selected, management of threatened flora will need to be addressed in upgrades, maintenance and operations.

3.3.2 Impact on Vegetation Communities

The current MTB trails in the Northern Area traverse a smaller area of native vegetation communities than Southern Area. The area of impact on native vegetation of the Northern Area is 2,006 m^2 compared with the Southern Area which is 3,298 m^2. The impacts on Sydney Turpentine Ironbark Forest is also smaller in extent for the Northern Area, comprising of 39 m^2, compared to the Southern Area which impacts on 1,512 m^2. This is shown in Figure 20, Table 15 and Table 16.

Table 15 Northern Trails Impacts on Vegetation Communities

Vegetation Community	Area of Impacted Vegetation (m^2) by Trail Type		
	Black	Blue	Total
Bloodwood Scribbly Gum Woodland	568	769	**1,337**
Duffy's Forest	1	288	**289**
Peppermint Angophora Forest	230	110	**340**
Sydney Turpentine Ironbark Forest	9	30	**39**
Total	**808**	**1,197**	**2,006**

Table 16 Southern Trails Impacts on Vegetation Communities

Vegetation Community	Area of Impacted Vegetation (m^2) by Trail Type				
	Black	Green	Light blue	Blue	Total
Bloodwood Scribbly Gum Woodland	0	365	145	367	**877**
Duffy's Forest	0	574	285	49	**909**
Peppermint Angophora Forest	0	0	0	0	**0**
Sydney Turpentine Ironbark Forest	235	736	455	86	**1,512**
Total	**235**	**1,675**	**885**	**502**	**3,298**

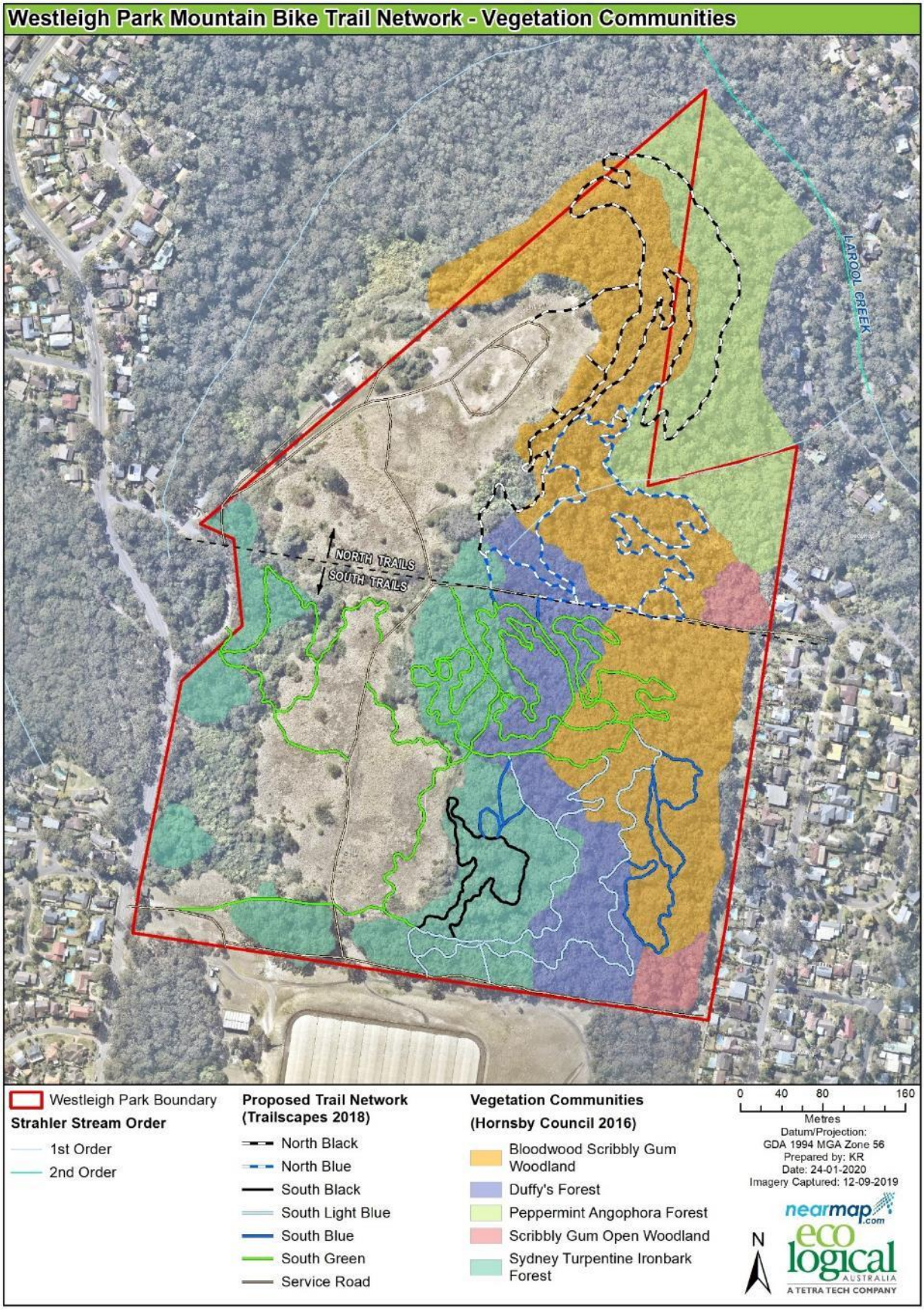


Figure 20 Northern and southern trails and vegetation communities

3.3.3 Management Issues

The proximity of the trails to a range of management issues resulting in trail impacts were examined. The issues included erosion, impacts of erosion on tree roots, water erosion, impacts on potential habitat, riders going off-track, structure / design failure or concerns and impacts of tree hazards to riders. The damage points were documented within 5 m, 10 m and 20 m of the Northern Trails and the Southern Trails. Northern Trails had fewer management issues than the Southern Trails with 37 points mapped within 5 m of the Northern Trails and points mapped within 5 m of the Southern Trails, shown in Figure 21, Table 17 and Table 18.

Table 17 Northern trails current impacts/ management issues

Trail Colour/ Location	Management Issue	Number of points within:		
		5m	10m	20m
North Black	Erosion	2	6	23
	Erosion (Exposed tree roots)	1	3	13
	Erosion (Water)	7	14	27
	Potential Habitat	0	1	6
	Riders going off-track	1	2	5
	Structure/ Design failures or concerns	4	11	27
	Tree impacts/ hazard to riders	0	1	2
	Total	**15**	**38**	**103**
North Blue	Erosion	2	8	21
	Erosion (Exposed tree roots)	7	21	51
	Erosion (Water)	5	16	47
	Hazard (Hole)	1	3	5
	Potential Habitat	1	3	7
	Riders going off-track	2	5	12
	Rubbish/ Sediment collection	0	0	2
	Structure/ Design failures or concerns	2	7	24
	Tree impacts/ hazard to riders	2	5	8
	Total	**22**	**68**	**177**
Grand Total		**37**	**106**	**280**

Table 18 Southern Trails - current impacts/ management issues

Trail Colour/ Location	Management Issue	Number of points within:		
		5m	10m	20m
South Black	Erosion (Exposed tree roots)	0	1	3
	Erosion (Water)	14	35	63
	Erosion (Water) and riders going off-track	1	2	3
	Rubbish/ Sediment collection	3	8	14
	Structure/ Design failures or concerns	12	28	53
	Tree impacts/ hazard to riders	3	7	11
	Water collection	2	4	7
	Total	**35**	**85**	**154**
South Blue	Blocked watercourse	0	0	1
	Erosion	4	12	26
	Erosion (Exposed tree roots)	1	2	5
	Erosion (Water)	16	42	97
	Hazard (Hole)	1	2	4
	Potential Habitat	1	3	7
	Rubbish/ Sediment collection	1	2	7
	Structure/ Design failures or concerns	10	28	56
	Trail to be closed	1	4	7
	Tree impacts/ hazard to riders	1	3	5
	Water collection	0	5	10
	Total	**36**	**103**	**225**
South Green	Erosion	2	8	18
	Erosion (Exposed tree roots)	1	3	5
	Erosion (Water)	65	165	329
	Open Impacted area (Rest area)	4	7	11
	Potential Habitat	2	5	11
	Riders going off-track	3	10	25
	Rubbish/ Sediment collection	0	0	1
	Structure/ Design failures or concerns	19	55	124
	Trail to be closed	1	3	5
	Tree impacts/ hazard to riders	1	2	3
	Total	**98**	**258**	**532**
South Light Blue	Blocked watercourse	1	2	5
	Erosion	1	4	9
	Erosion (Exposed tree roots)	2	6	13

Trail Colour/ Location	Management Issue	Number of points within:		
		5m	10m	20m
	Erosion (Water)	39	107	214
	Erosion (Water) and riders going off-track	1	2	3
	Hazard (Hole)	0	2	4
	Open Impacted area (Rest area)	0	0	1
	Riders going off-track	0	2	4
	Rubbish/ Sediment collection	0	2	4
	Structure/ Design failures or concerns	17	41	79
	Tree impacts/ hazard to riders	1	5	9
	Water collection	1	10	22
	Total	**63**	**183**	**367**
Grand Total		**232**	**629**	**1,278**

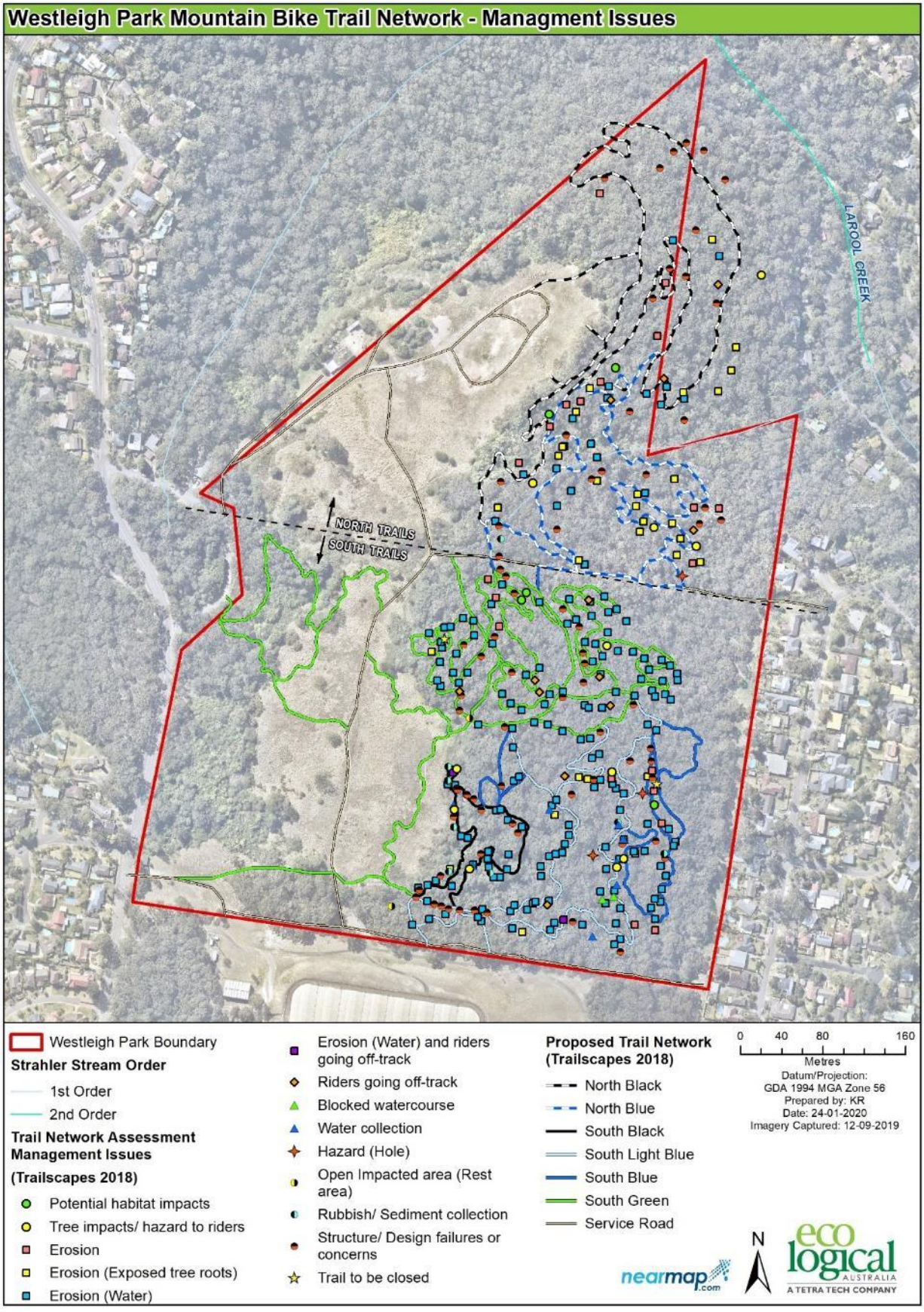


Figure 21 Management issues in the Northern Trails and Southern Trails

3.3.4 Trail Proximity to Contaminated Sites

The Northern Trails have fewer sites contaminated by asbestos, with 1 point in located within 5 m, 12 within 10 m and 16 within 20 m of the Northern Trail. In comparison, there are 46 points contaminated by asbestos located within 5 m, 127 within 10 m and 186 within 20 m of the Southern Trails, shown in Table 19 and Figure 22.

Table 19 Asbestos located in proximity to Northern and Southern Trails

Trail Colour/ Location	Number of points within:		
	5m	10m	20m
North Black	1	11	14
North Blue	0	1	2
Total	**1**	**12**	**16**
South Black	14	35	49
South Blue	2	5	7
South Green	20	55	83
South Light Blue	10	32	47
Total	**46**	**127**	**186**

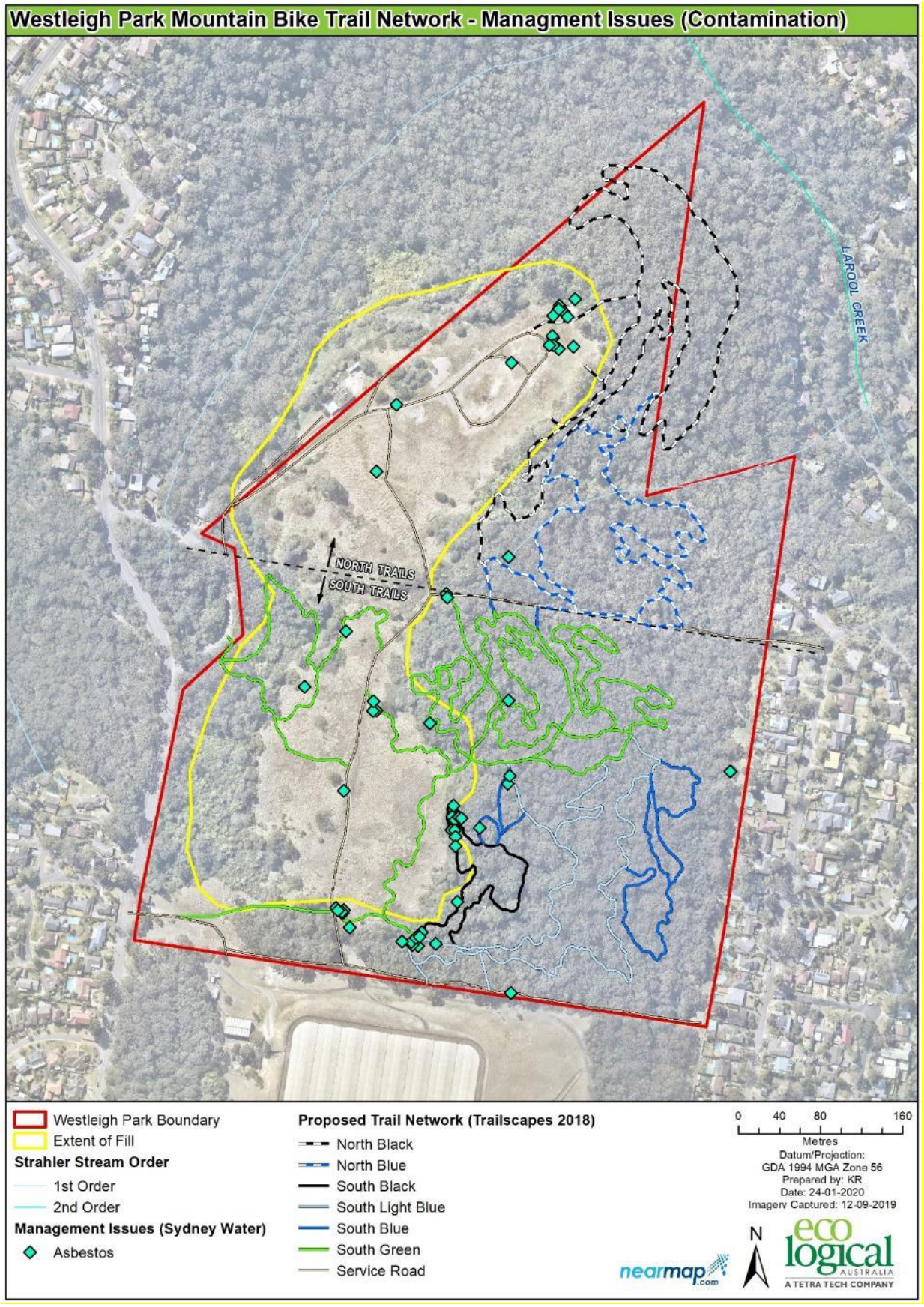


Figure 22 Proximity of Northern and Southern Trails to contaminated sites

3.3.5 Discussion of Relative Merits of Northern Versus Southern Trails

3.3.5.1 Length of trails

The Northern Trails are shorter in length providing 3.2 km than the Southern Trails providing 6.2 km as shown in Table 20.

Table 20 Trail lengths for Northern versus Southern Trails

Tail Type	Length (m)
North Black	1792
North Blue	1375
Total	**3,167**
South Black	488
South Blue	822
South Green	3618
South Light Blue	1268
Total	**6,196**
Service Road	2,212

3.3.5.2 Impacts of Current Trails

The current Northern Trails have fewer environmental and management impacts than the Southern Trails as indicated in sections 3.3.1-3.3.4. The preferred lesser impact of the Northern Trails would also result in a reduced cost to address the management issues and upgrade the trails to meet IMBA construction and signage standards. Should the Northern Trails be authorised by Council there is still a cost to Council to restore the Southern Trails to bushland, together with the costs of ongoing compliance to enforce such a decision. The fact that all these trails are currently constructed means that many of the impacts have already occurred; although formalising some or all trails would lead to an increased usage and is likely to result in increased disturbance.

In considering the relative merits of the Northern versus Southern Trails, the impacts need to be considered against the length of trails being provided in the Northern Area being far shorter than the Southern Area. In addition, given the history of the site being constructed and self-managed by the local mountain biking community over time, should the Southern trails be fully closed this may be difficult for the community to accept, leading to their lack of support for such a decision and potential non-compliance.

3.4 Long Term Impacts of Development of Cleared Areas on Natural Area

The major long-term impacts of development of the cleared areas, such as sportsgrounds on the natural area have been considered. The Statement of Environmental Effects or Review of Environmental Factors will consider the full range of impacts on the Westleigh Park Natural Area in more detail. Some of the key issues will include:

- Impacts of lighting on fauna
- Management of water and nutrients required for sports turf
- Site drainage and runoff
- Potential disturbance of clay cap exposing contaminants
- Treatment of weeds, tree hazards, pests and diseases with harmful pesticides
- Altered fire regime
- Increase in disturbance and visitor numbers.

3.4.1 Impacts of Lighting on Fauna

An edge effect impact on biodiversity includes the effect of artificial lighting on nocturnal fauna, such as micro-bats which have been recorded as occurring within the LGA. Biosphere (2007) noted that a single back yard spotlight can dislocate fauna for 50 metres either side of the light source. This can effectively reduce the area of habitat for some native fauna. The large bright lights at the sporting fields can impact adjacent bushland due to the height and intensity of the light, e.g. the lights surrounding Westleigh Park.

The sportsgrounds at Westleigh Park will need to be designed to have wildlife friendly lighting. This is generally filtered yellow-green and amber LEDs with wavelength in the spectrum of around 590 nm and incorporating light shield protection controlling light spill.

3.4.2 Management of water and nutrients required for sports turf

Sportsfields can be a source of excess nutrients entering bushland resulting in conditions favouring weed growth. Over time this can develop into weed plumes that displace habitat for native flora and fauna.

Increased water use can lead to the transport of nutrients into receiving ephemeral creeks and waterways, especially during high flows, which can result in excessive weed growth and algal blooms, as well as erosion.

Sportsgrounds at Westleigh Park need to operate under a regime to reduce, retain and remove nutrients to ensure they do not enter the adjoining natural area. Turf selection needs to include species with lower nutrient and water requirements. Retention of 'rough' grass areas on sportsground edges will assist in uptake of excess nutrients. Fertilizer application needs to use the minimum quantity and be timed to avoid rain where possible. Drainage of the sportsgrounds need to be designed to deliver the pre-development quantity of water to the adjoining natural areas and minimise the concentration of flows.

3.4.3 Site drainage and runoff

Alteration of site drainage and runoff can result in an altered hydrological regime such which may increase or decrease water amounts to native vegetation communities including wetlands within the

natural area and adjoining bushland. Longer term impacts can include erosion and creation of conditions suitable for:

- weed invasion and pathogens,
- replacement of native vegetation communities with assemblages of weeds, as well as
- tree canopy dieback.

Stormwater runoff can also carry nutrients and other materials including litter, leaves, finer silts, sediment, heavy metals and gross pollutants.

The construction of sportsgrounds at Westleigh Park should include erosion and sediment controls on the site. Controls should also include the use of gross pollutant traps and sediment basins, as well as the use of biofilters and constructed wetlands to mitigate gross pollutants, finer sediments and pollutants, nutrients and metals. These biofilters systems can be installed as raingardens in smaller parts of the site and constructed wetlands in larger areas of open space (Biofilters and wetlands for stormwater treatment and harvesting, CRC for Water Sensitive Cities, 2014).

Such systems need to be maintained in accordance with Council's Catchment Remediation Rate (CRR) program. Water harvesting and recycling need to be considered for the sportsgrounds.

3.4.4 Potential Disturbance of Clay cap to Expose Contaminants

There is potential for the disturbance of the future clay cap to expose contaminants when conducting deep soil renovation, or during trenching to install new lighting or sub-surface drains.

The final Remedial Action Plan and subsequent Validation Report need to include a plan of the clay capped areas to be documented within Council's Asset Management System so that future activities do not breach the clay cap and release contaminants. If required, signage can be installed on the site.

3.4.5 Treatment of Weeds, Tree Hazards, Pests and Diseases

Minimising the long-term impacts of pests, hazards and diseases on the natural area and native flora and fauna will rely on integrated management practices.

The aim is to minimise the long-term impact of weed control on adjoining bushland and non-target species, hence weed control on the sportsgrounds should utilise herbicides that comply with the *Pesticides Act 1999* and codes of practice. Weed control should use minimum toxicity sprays applied when desirable turf grasses are dormant. Staff utilising herbicides should be suitably qualified and / or trained. Vigorous dense turf should be encouraged to minimise weed infestation and turf pests and diseases. Low toxicity line marking products should be used on the sportsgrounds.

The Greater Sydney Regional Strategic Weed Management Plan 2017-2022 provides a framework to prioritise weed management actions and controls for weeds that newly emerge through time on the interface of the sportsground.

Should trees and major limbs die or exhibit dieback, all hollows should be retained unless they pose a risk to risk to life or property. Hollows from dangerous trees should be relocated nearby.

Pesticide use on insects, other invertebrates, or vertebrate pests, should be kept to a minimum and avoid impacts on native fauna and non-target species. If available biocontrols or biological insecticides should be considered where appropriate.

Phytophthora cinnamomi (Phytophthora) is a root-rot fungus that is a soil-borne pathogen known from the bushland adjoining Westleigh Park as well as various parts of Sydney and Australia. It spreads through the movement of spores through water, the transmission from infected plant roots, or by machinery or animals. Phytophthora infects numerous native plant species with some being killed, damaged or showing no symptoms. Westleigh sportsground management should prevent the spread of Phytophthora from current known locations to non–infected areas. Washing down of all construction vehicles should occur for vehicles entering/exiting the sportsground. Wash baths should be constructed and maintained for bikes and walkers entering the bushland. If Phytophthora is located at Westleigh Park, it should be monitored through checking for presence of dieback and soil sampling where required, and additional containment strategies should be introduced.

Austropuccinia psidii (Myrtle rust) threatens trees and shrubs in the Myrtaceae family including Australian natives such as *Rhodamnia rubescens* (Scrub Turpentine), *Callistemon* spp. (bottle brush), *Melaleuca* spp. (tea tree) and eucalypts, causing deformed leaves, heavy defoliation of branches, reduced fertility, dieback, stunted growth, and plant death. Myrtle rust is known from the adjoining bushland, and throughout Sydney and Australia. Its spores can be spread easily via contaminated clothing, hair, skin and personal items, infected plant material, equipment, as well as by insect/animal movement and wind dispersal. It is extremely difficult to control and impossible to eradicate from natural settings. A fungicide spray program can effectively reduce the levels of myrtle rust infection in contained areas such as plant nurseries and home gardens. As this is not feasible for natural bushland settings, long-term management of Westleigh Sportsgrounds should minimise the risk of its introduction or spread on items such as clothing, equipment, vehicles, machinery or plant material.

3.4.6 Altered fire regime

Long term management of Westleigh Park should utilise the new sportsgrounds as Asset Protection Zones and use the access road as a perimeter road. Any constructed wetlands or water storage facility introduced as part of the sportsground should have a water outlet so that any water can be utilised for firefighting if required.

The native vegetation communities in the adjoining bushland should not be used as Asset Protection Zones. With respect to the current fire regime in the natural area of Westleigh Park, this includes a high regularity of burning within the Turpentine - Ironbark Forest that exceeds its preferred non-fire interval. The native vegetation communities should be burnt at their preferred fire interval and in accordance with the Hornsby Ku-ring-gai Bush Fire Risk Management Plan 2016-2021. The fire sensitivity of threatened flora and fauna should be considered and impacts minimised when planning each hazard reduction (HR) through Reviews of Evironmental Factors, bush fire environmental impact assessment code assessments and HR certificates.

The historical use of PFAS should be discontinued on the site. Only low toxicity fire retardants should be utilised for fire incident control when required; they should not be applied to the site as part of training exercises.

3.4.7 Increase in Disturbance and Visitor Numbers

Increased visitor numbers will occur with construction of sportsgrounds and thereby increase disturbance. The increased access to Westleigh Park may include the increased potential for dumping of rubbish, lawn clippings, exotic plants and garden plant escape; removal of bush rock, logs and dead trees from the adjacent bushland; as well as an increased impact of pets and feral animals on native fauna.

Westleigh Park should be managed long-term to introduce and maintain effective community education, bushland weed and pest control, monitoring and compliance programs to minimise the impacts on the adjoining native flora and fauna and vegetation communities.

4. Recommendations for Future Use of the Natural Area

Overall recommendations on the future use of the natural area include:

- The development of a bushwalking track in a location that does not coincide with the mountain bike trail and any crossing points are well marked from all directions of travel
- Accessible access along the interface of the natural area and cleared land generally in accordance with Concept Masterplan Option 2
- The restoration and upgrading of Proposal 2B to provide a mountain bike trail network
- The use of the natural area for environmental education and conservation

These recommendations are considered in more detail in Table 12.

The recommended mountain bike trail network will reduce the current impacts on the trail and impacts on biodiversity by closure of many of the existing trails that traverse the Sydney Turpentine Ironbark Forest. Development of an alternative trail to those that have already been constructed is not recommended due to the level of clearing and other environmental impacts already present on the site. Proposal 2B will minimise impacts on biodiversity as outlined in Section 2.4.5 of this report.

Table 21 Value to the Local and Regional Community and Trail Recommendations

Proposal 2B	Value to Local Community and Recommendations	Value to the Region and Recommendations
Recreational - MTB	• There is existing use and expectation that Council will utilise some of the unauthorised trails • Trailscapes have identified the MTB is of community/local rating as local recreation resource with Proposal 2B providing trail length of 5.32 km • Flatter terrain with predominantly Easy and Intermediate trails appeals to current users. • The trail should be promoted as a more 'passive' type trail network. • The Advanced trails offer reasonable opportunities for riders to progress their skills and confidence riding a bike.	The trail will provide a complementary passive style compared to the technical nature of the Old Mans Valley. Members of the mountain bike community expressed in relation to Hornsby Quarry that they are seeking to develop broad, regional connections and connections to the Westleigh site recently acquired by Council and other areas to the west of Hornsby (Elton 2017). However, Council has previously resolved that no link would be made from Westleigh to Hornsby via Dog Pound Creek as is it is too environmentally sensitive. A trail link through the adjacent Dog Pound Creek Biodiversity Stewardship Site is not compatible with of the BSS agreement. Other options should be investigated; this would also need to avoid Heritage Steps and other walking trails.
Recreation – MTB construction	Trail upgrade and construction could be undertaken with a combination of professional trail builders and a team of dedicated volunteers to undertake hand-built works. Where possible most of the trail should be restored, upgraded and constructed with a minimum of machinery. A professional trail builder should undertake the closure of trails and build major features to ensure safety and a quality, well-constructed and	IMBA design documentation should be used for trail construction consistent with Hornsby OMV Trail as shown in Appendix C.

Proposal 2B	Value to Local Community and Recommendations	Value to the Region and Recommendations
	sustainable trail. A small number of volunteers could work closely with the professional company to assist in both guiding trail design and to learn techniques for the trail maintenance.	
Recreational - Bushwalking	The MTB trail and walking trail should be separate trails. A bushwalking trail could link to existing trails within the adjacent walking and fire trails in Dog Pound and Larool Creeks, and for a link to Marjorie Headon Lookout to be assessed.	There is potential for a bushwalking trail to link to a greater network of trails including the Hornsby Heritage Steps and the Blue Gum Walk, and the regionally significant Great North Walk.
Recreational – accessible trail	The shared recreational/ maintenance path trail on the perimeter of the cleared area will be accessible to all users including those with mobility issues, subject to the environmental controls listed in Section 2.6 including minimum impact construction techniques and stepped sandstone wall in specific locations.	NA
Ecological – TECs and threatened species	The trail network passes through significant patches of STIF a critically ecological community under the NSW BC Act 2016 and Commonwealth. EPBC Act. It also traverses populations of *Darwinia biflora* and *Melaleuca deanei* (EPBC Act, BC Act), *Tetratheca glandulosa* (BC Act) and habitat that supports the Square-tailed Kite (BC Act). Proposal 2B will reduce the heavily traversed trails within the STIF community and habitat for threatened flora and fauna. The trail should be closed at night due to impacts on wildlife and rider safety.	Restoration of closed trails and the upgrade of Proposal 2B trail will reduce impacts to TECs and habitats for threatened flora and fauna. This will reduce currently uncontrolled impacts of MTB and benefit their conservation and management. This will contribute to the conservation of these entities within the LGA, Sydney region, NSW and Australia. Conservation of 5.5 ha of STIF contributes significantly to the area being managed within Council's conservation reserves, being the second largest area of STIF conserved (following Carrs Bush) and contributes to the network being more comprehensive, adequate and representative (CAR).
Ecological – erosion, tree, water, asbestos	Although the proposal passes along trails that exhibit numerous trail issues, the shorter trail length when compared to proposal 2 will have fewer issues. Restoration and upgrade of the trail to meet IMBA core elements and trail classification guidelines will minimise the current and emerging impacts to the trail network. A wet weather closure and opening protocol should be introduced to ensure the trail is in rideable condition.	Reduced impacts of MTB on the site's ecology through trail closure, reduced disturbance and footprint, reduction of burning, asbestos removal and control of trail proliferation, erosion, tree root damage and drainage will enhance the ecological values of the state and federally listed communities and species.
Ecological - pathogens	Trail facilities such as pathogen control tyre scrubber/wash down bays should be designed so they are readily used and are maintained regularly.	Such facilities are important to minimise spread of pathogens across other MTB trails.
Ecological - BSA	There is potential to consider inclusion of the STIF community within adjoining or new BSA sites. Given the potential high cost of restoration for the site, versus the good credit prices achieved historically for STIF, this is worthy of consideration. A feasibility investigation is warranted.	

Proposal 2B	Value to Local Community and Recommendations	Value to the Region and Recommendations
Recreation/ Ecology – Monitoring and Audit	A monitoring program should be developed and implemented for the MTB to assess the environmental impacts of the trail on the ecology and the effectiveness of ongoing management on the trail. A baseline survey should be conducted immediately prior to the opening of any section of trail. This should include: • Photo monitoring points • Video records of the trail • GPS location of features • Weed locations. Ongoing monitoring should repeat the above and include: • Trail usage statistics from counters • Monitoring after extreme events such as wildfire, hazard reductions, major rain events; • Any significant observable changes: major tree damage, boulder movement, removal/deposition of sediment; and • Work sessions, including reason for and influence of work. During the first year of operation there should be monthly site audits to respond to initial operational and maintenance requirements. During subsequent operations audits should be undertaken every three months.	For consistency the monitoring program needs to be based on that used at Hornsby/ Old Mans Valley.
Social - Equity	A bushwalking trail separate to the MTB trail would provide for users of the Westleigh Park bushland other than mountain bike riders and provide equity of access.	NA
Social – visual impact	Visual impacts of proposed retaining walls need to be reduced, including use of stepped sandstone walls and native plantings along parts of the shared accessible trail.	NA
Social – Multiple Use	The provision of a mountain bike trail network, walking trail and interface accessible trail will provide for complementary range of uses within the Westleigh Park natural area whilst avoiding conflicts between users.	Provision of short walks throughout the Hornsby LGA is part of Council's walking track masterplan for the region. Provision of local MTB trail offers a passive trail compared to an active trail at Hornsby/ OMV, and thereby complements the current official trails.
Social – Community Engagement	There should be ongoing engagement with the community including mountain bike riders and the bushwalking community to explain why some trails are being, closed, upgraded and opened. A Trailcare group should be formed together with members of the local mountain bike community. A	Once walking trails are developed, include within Council's Free Guided Bushwalks Program. Trailcare should use Council's existing guidelines shown in Appendix D.

Proposal 2B	Value to Local Community and Recommendations	Value to the Region and Recommendations
	Bushcare group should be formed should there be local community members seeking to join.	
Social Signage -	Walking trail signage should include interpretive signs on STIF and potential threatened species, plus warning signs for trail crossings. MTB signage should include and trailhead sign indicating the trail network, directional markers, numbered and named trail sections.	Walking trail directional signs should be complementary to signage across the region. MTB signage should be compatible with the Hornsby OMV MTB.

5. Analysis of Council Comment and New Option 2B Trail

Council staff comment has been made on the report Chapters 1-4, and Council has provided a new Option 2B Trail shown in Figure 23. ELA has analysed the environmental impacts of the trail in this section. Comparison has been made with original Proposed Trail 2B.

5.1 New Option 2B Trail

5.1.1 Impacts of New Option2B Trail on Watercourses and Trail Length

Trail Segment 82 (Blue) cuts through the same 1st Order Stream at least three points. Trail Segment 69 (Blue) cuts through the same 1st Order Stream as segment 82 at one point.

Table 22 Impacts of New Option 2B Trail on watercourses and trail lengths

Proposed Trail Grade	Length of Tracks (m)
Black	1020
Black New	236
Blue	1140
Blue New	427
Green	1200
Green New	620
Light Blue	683
Light Blue New	96
Shared Use	101
Walking Track	651
Walking Track New	454
Total	**6628**

5.1.2 Proximity of New Option 2B Trail to Threatened Species

New Option 2B Trail is within 5 m of *Darwinia biflora* and no other mapped threatened species as shown in Table 23 and Figure 24 which is preferred over original Proposed 2B that has trails located adjacent to the occurrences of threatened flora as shown in Figures 3. Management of threatened flora will still need to be addressed in detailed siting and design of upgrades, as well as maintenance and operations.

Table 23 Proximity of threatened species to New Option 2B Trail

Proposed Grade	Threatened Sp	Number of points within 5m	Number of individuals within 5m
Blue	Darwinia biflora	2	5

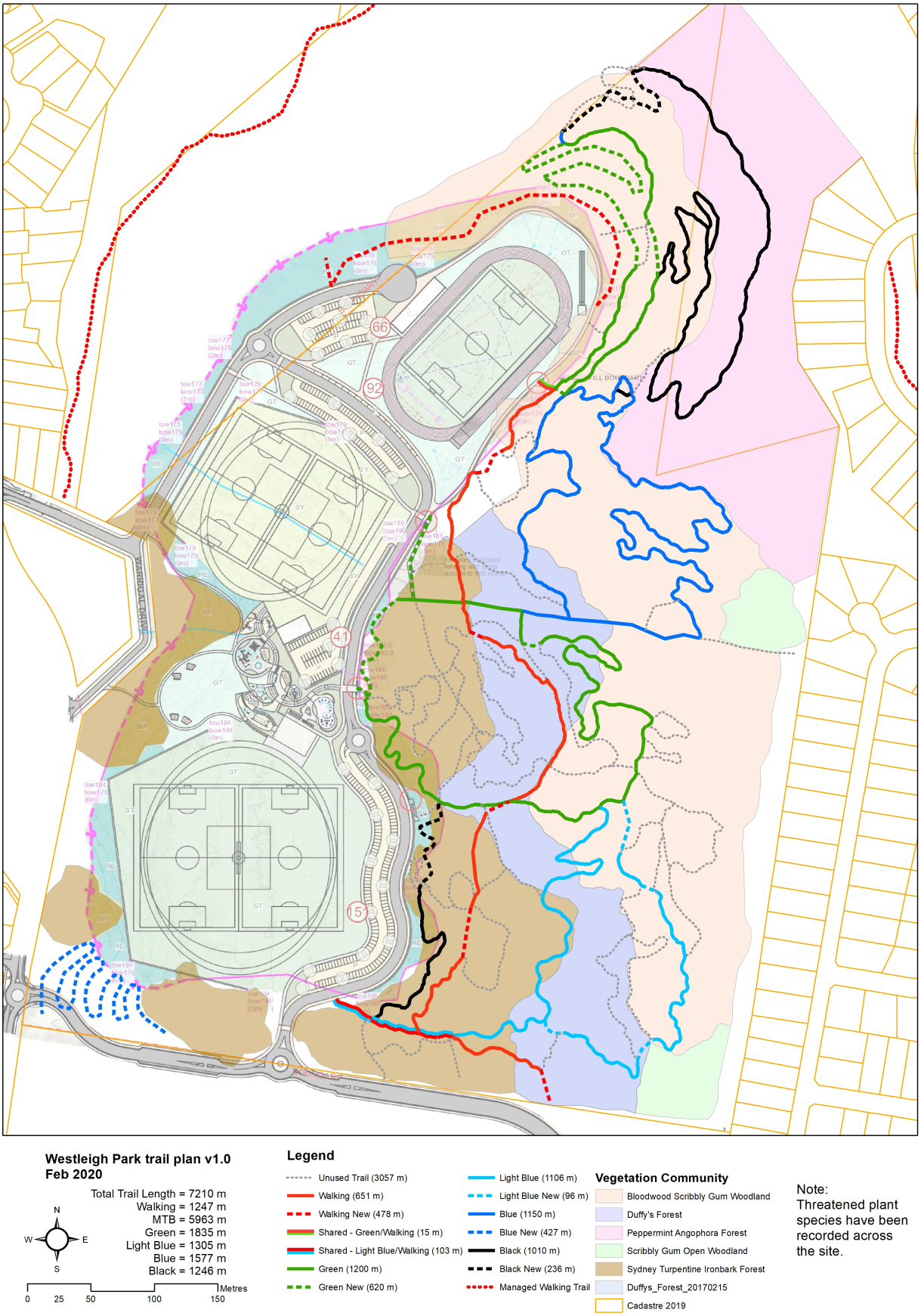


Figure 23 New Option 2B Trail

5.1.3 Proximity of New Option 2B Trail on Management Issues

The proximity of the trails to a range of management issues resulting in trail impacts were examined. The issues included erosion, impacts of erosion on tree roots, water erosion, impacts on potential habitat, riders going off-track, structure / design failure or concerns and impacts of tree hazards to riders. The damage points were documented within 5 m, 10 m and 20 m of the New Option 2B Trail had fewer management issues than the original Proposed 2B Trails, shown in Figure 24, Figure 21, Table 24 and Table 18. The New Option 2B has minimal proximity to management issues when compared with the original Proposed 2B, but has greater issues further away from the trails, indicating the importance of restoration of the existing trails.

Table 24 Proximity of New Option 2B Trail to management issues

		Distance from Trail Segment (m)			
Proposed Grade	**Management Issue**	**0**	**5**	**10**	**20**
Black trails	Erosion	0	5	15	95
	Erosion (Exposed tree roots)	0	5	25	105
	Erosion (Water)	1	46	206	626
	Riders going off-track	0	5	15	75
	Structure/ Design failures or concerns	1	41	171	651
	Erosion (Water) and riders going off-track	0	0	0	20
	Rubbish/ Sediment collection	0	5	25	85
	Tree impacts/ hazard to riders	0	5	25	65
	Water collection	0	5	15	55
	Potential Habitat	0	0	0	20
	Total	**2**	**117**	**497**	**1797**
Black new trails	Structure/ Design failures or concerns	1	6	26	246
	Erosion (Water)	0	5	35	95
	Erosion (Water) and riders going off-track	0	0	10	30
	Open Impacted area (Rest area)	0	5	15	35
	Rubbish/ Sediment collection	0	0	0	40
	Tree impacts/ hazard to riders	0	5	15	55
	Water collection	0	0	0	20
	Total	**1**	**21**	**101**	**521**
Blue trails	Erosion	0	10	70	310
	Erosion (Exposed tree roots)	0	30	140	680
	Erosion (Water)	0	20	110	630
	Riders going off-track	0	10	40	140
	Structure/ Design failures or concerns	0	5	35	275
	Erosion (Water) and riders going off-track	0	0	20	60
	Rubbish/ Sediment collection	0	0	0	0
	Tree impacts/ hazard to riders	0	10	40	100
	Water collection	0	0	0	0

		Distance from Trail Segment (m)			
	Potential Habitat	0	5	25	105
	Total	**0**	**90**	**480**	**2300**
Green trails	Erosion	0	0	10	170
	Erosion (Exposed tree roots)	0	5	25	85
	Erosion (Water)	0	125	525	2145
	Riders going off-track	0	10	40	100
	Structure/ Design failures or concerns	0	50	200	660
	Erosion (Water) and riders going off-track	0	0	0	0
	Rubbish/ Sediment collection	0	0	0	20
	Tree impacts/ hazard to riders	0	5	15	35
	Water collection	0	0	0	0
	Potential Habitat	0	0	0	80
	Total	**0**	**195**	**815**	**3295**
Green new trails	Erosion	0	5	15	95
	Erosion (Exposed tree roots)	0	0	0	20
	Erosion (Water)	0	0	0	10
	Riders going off-track				
	Structure/ Design failures or concerns	0	0	10	70
	Erosion (Water) and riders going off-track				
	Rubbish/ Sediment collection				
	Tree impacts/ hazard to riders				
	Water collection				
	Potential Habitat	0	0	0	40
	Total	**0**	**5**	**25**	**235**
Light blue trails	Erosion	0	5	55	215
	Erosion (Exposed tree roots)	0	10	40	160
	Erosion (Water)	0	102	462	1502
	Riders going off-track	0	0	20	365
	Structure/ Design failures or concerns	0	15	65	20
	Erosion (Water) and riders going off-track	0	0	0	20
	Rubbish/ Sediment collection	0	5	15	55
	Tree impacts/ hazard to riders	0	0	20	60
	Water collection	0	0	10	70
	Potential Habitat	0	5	15	35
	Blocked watercourse	0	0	0	20
	Hazard (Hole)	0	5	15	35
	Trail to be closed	0	0	0	20
	Total	**0**	**147**	**7171**	**2577**
Light blue new trails	Erosion	0	102	462	1502
	Erosion (Exposed tree roots)	0	0	0	20
	Erosion (Water)	0	20	80	55
	Riders going off-track	0	5	15	75

		Distance from Trail Segment (m)			
	Structure/ Design failures or concerns	0	5	75	295
	Erosion (Water) and riders going off-track	0	0	0	20
	Rubbish/ Sediment collection				
	Tree impacts/ hazard to riders	0	0	0	20
	Water collection				
	Potential Habitat	0	0	0	20
	Hazard (Hole)	0	0	0	20
	Trail to be closed	0	0	0	20
	Blocked watercourse	0	0	0	0
	Total	**0**	**132**	**632**	**2047**
Shared Use	Erosion (Water)	0	2	57	272
	Open Impacted area (Rest area)	0	0	0	20
	Structure/ Design failures or concerns	0	32	122	342
	Total	**0**	**34**	**179**	**634**

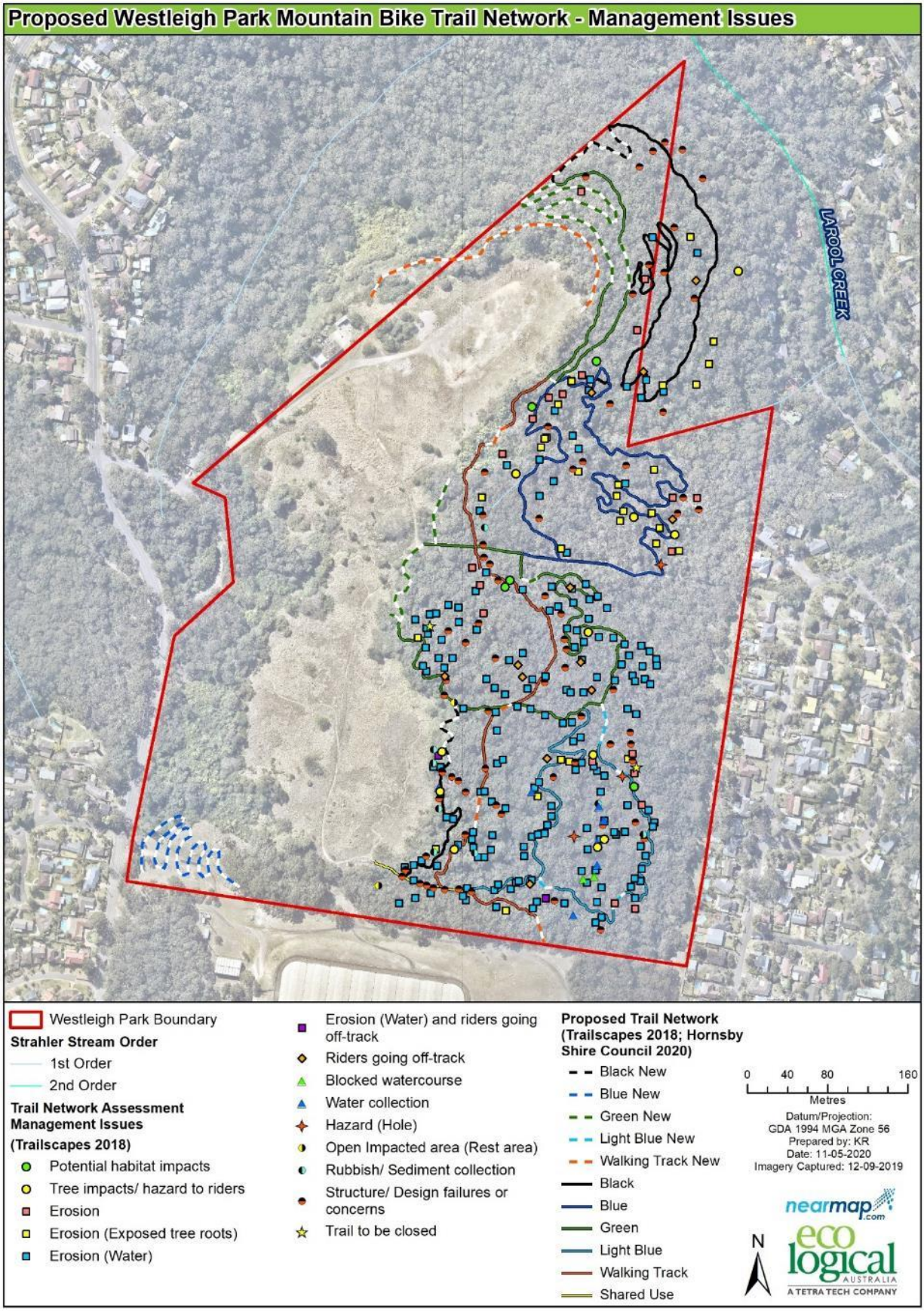


Figure 24 Proximity of New Option 2B Trail to management issues

5.1.4 Impacts of New Option 2B Trail on Vegetation Communities

The New Option 2B trail traverses a smaller area of native vegetation communities than the original Proposed 2B. The area of impact on native vegetation of New Option 2B is 3,205 m^2 compared to the original Proposed 2B which is 3,517 m^2. The impacts on Sydney Turpentine Ironbark Forest is also smaller in area for New Option 2B which is 551.98 m^2 compared to the original Proposed 2B comprising of 731.3 m^2; likewise, the impacts of New Option 2B on mapped Duffys Forest is 602.78 m^2, being smaller than the impact of the original proposed 2B which is 713.4 m^2. This is shown in Figure 5, Figure 25, Table 5 and Table 25.

Table 25 Impact of New Option 2B Trial on vegetation communities

Vegetation Community	Area of Impacted Vegetation (m^2) by Trail Type									Grand Total
	Black	New Black	Blue	New Blue	Green	New Green	Light blue	New Light Blue	Shared	
Bloodwood Scribbly Gum Woodland	198.09	66.6	709.6	0	360.02	209.62	154.02	28.17	0	1726.12
Duffy's Forest	0	0	205.72	0	260.9	8.29	109.09	18.78	0	602.78
Peppermint Angophora Forest	228.15	2.35	92.97	0	0	0	0	0	0	323.47
Scribbly Gum Open Woodland	0	0	0	0	0	0	0	0.44	0	0.44
Sydney Turpentine Ironbark Forest	76.85	37.53	0	0	183.86	29.74	78.03	0	145.97	551.98
Total	**503.909**	**106.6**	**100.83**	**0**	**404.5**	**248.65**	**279.94**	**38.11**	**145.97**	**3,204.79**

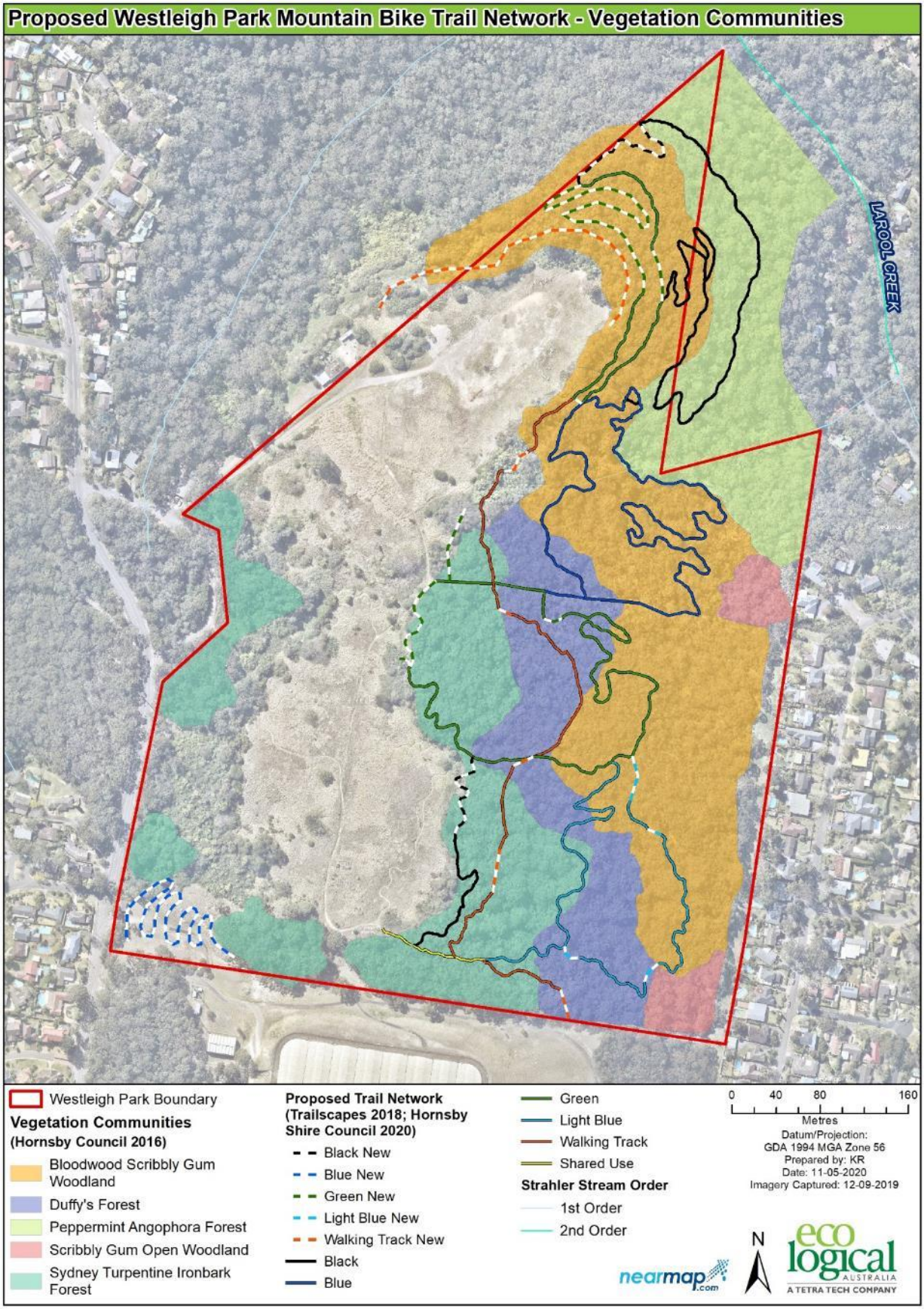


Figure 25 Impact of New Option 2B Trail on vegetation communities

5.1.5 Impacts of New Option 2B Trail to Contaminated Sites

New Option 2B Trail has no asbestos contaminated sites adjacent to the trail, compared with original Proposed 2B which has 13 sites adjacent to the trail. However New Trail Option 2B more contaminated sites at 5 m (125), 10 m (505) and 20 m (1605) than does the original Proposed 2B, shown in Table 26, ,Table 9, Figure 26 and Figure 9, indicating that remediation will be a significant issue for the site.

Table 26 Contaminated sites in proximity to New Option 2B Trail

Proposed Grade	Distance from Trail (m)			
	0	5	10	20
Black	0	40	140	500
Black New	0	30	120	340
Green	0	25	75	215
Green New	0	10	40	120
Shared Use	0	20	130	430
Total	**0**	**125**	**605**	**1605**

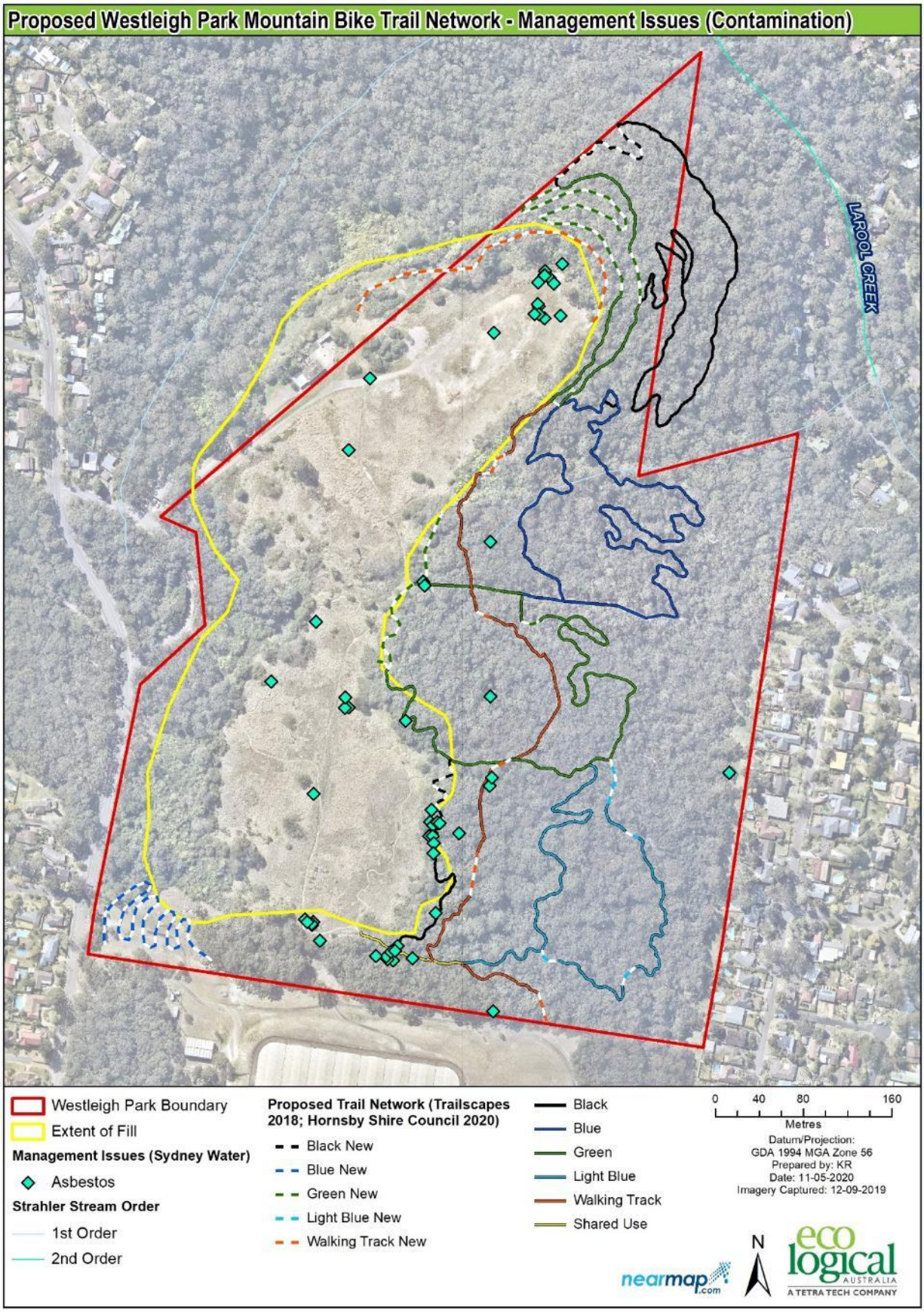


Figure 26 Proximity of New Option 2B Trail to asbestos

5.2 Analysis of Council Comment

Table 27 Analysis of Council staff comment

Issue	Staff Comment	Action
Non-compliances with IMBA classifications	350 non-compliant IMBA classifications require more detail and mapping.	ELA has mapped IMBA non-compliances in this report Each non-compliance should be addressed through trail upgrade and/ or closure and rehabilitation
REF impact assessment for flora and fauna	REF should include additional flora and fauna impact assessments and detailed • map trail 'edge effects' with a buffer of 50m • map buffer around all threatened species • map high risk pathways for pests and diseases from external sites e.g. from known phytophthora sites within Hornsby Park and Dog Pound Creek.	REF/ DA should include 5-part tests and survey to meet legislative requirements. Trail edge effect has been considered for 20 m either side of trail for all management issues including threatened species in this report All entry points to the trail network are considered high risk pathways.
Phytophthora cinnamomi	*Phytophthora cinnamomi* management to include detailed mitigation methods and rigorous data	REF/ DA should include *Phytophthora cinnamomi* management to include best practice mitigation methods, i.e. Managing Phytophthora Dieback in Bushland (Blue Mountains Botanic Gardens) https://www.bluemountainsbotanicgarden.com.au/science/plants/pests-diseases/phytophthora-dieback/managing-phytophthora-dieback-in-bushland, Management of Phytophthora cinnamomi for Biodiversity Conservation in Australia (Murdoch University, 2006http://www.environment.gov.au/biodiversity/invasive-species/publications/management-phytophthora-cinnamomi-biodiversity-conservation)
Long Term Impact of Development of Cleared Areas on Natural Area	Issues raised in Chapter 3 of this report • Impacts of lighting on fauna • Management of water and nutrients required for sports turf • Site drainage and runoff • Potential disturbance of clay cap exposing contaminants	REF/ DA should consider the long-term issues raised in Chapter 3 of this report

Issue	Staff Comment	Action
	• Treatment of weeds, tree hazards, pests and diseases with harmful pesticides • Altered fire regime • Increase in disturbance and visitor numbers.	
Treatment of Weeds, Tree Hazards, Pest and Diseases	Trees a comparison is required between the potential different uses of the natural area and the degree of vegetation management /lopping /removal that would be required to ensure public safety and the likelihood, rate and amount of tree dieback as per Chapter 4 of this report. Recommendations for Future Use of the Natural Area and OMV benchmark. Discussion of *Phytophthora cinnamomi* as per 2.5 Mountain bike trail network REF.	Detailed on-ground trail needs to be designed to minimise vegetation dieback, pruning and removal. Similar standard of vegetation / tree hazard management would apply on trail for bikes as with walking trail. DA should assess impacts of trails on TPZs within trails. Expected greater user numbers on mountain bike trail than walking trail would likely lead to an increased risk of *Phytophthora cinnamomi* associated with MTB. Further assessed in REF/ DA.
Altered Fire Regime	Agrees native vegetation should not be used as Asset Protection Zones. New facilities need to incorporate standards for bush fire protection within building or facility design. Any asset protection zones for Sydney Water Infrastructure to the south of the site should be contained within Sydney Water Lands. There is an existing fuel reduced zone on the eastern edge (protecting overhead electricity primarily but also reducing impact to residences) which is maintained according to the Hornsby Kuring-gai Bushfire Risk Management Plan – Asset ID 192. Consideration to be given to materials used for any trail construction and how some material types could limit opportunities for establishing fire regimes to protect and conserve ecological integrity of bushland in perpetuity	Recommend including in REF/ DAs Recommend including in REF/ DAs Recommend including in REF/ DAs Recommend including in REF/ DAs Recommend including in REF/ DAs
Recommendations for Future Use of the Natural Area	Table 21 Value to the Local and Regional Community and Trail Recommendations 'IMBA design documentation should be used for trail construction consistent with Hornsby OMV Trails as shown in Appendix C'. (should it be Appendix A?)	Appendix C of this report includes the IMBA design documentation from OMV trails.
Recommendations for Future Use of the Natural Area	Hornsby OMV Trail construction should be a benchmark for any future MBT proposals within the Hornsby Shire, to examine what social, economic and environmental aspects have worked and what have not. Data needs to be	Data collation and review of OMV of issues would be beneficial, however are outside the scope of this report.

Issue	Staff Comment	Action
	collated to determine if the current trail standards, experiences, management issues and environmental outcomes of the OMV trail hold up against the scrutiny of reports prepared for Westleigh. It they do not, what needs to be improved? Are these improvements achievable at OMV before we venture to formalise or create any new trail? Examples of issues to examine from a management perspective: • A cost benefit analysis (including construction and ongoing operations/maintenance) • Accidents – explore causes, rate and severity - ambulance and hospital data • Trail closure and opening management – wet weather, trail maintenance • Survey of users to establish bike rider demographic and percentage of the public using the track • Trail hygiene management • The impact on other user groups (botanists, education, bushwalkers, the elderly and very young) Aspects to examine through adaptive management including an audit of the OMV REF to identify: • Fauna and flora changes • Tree decline and tree loss • Shrub and ground cover decline • Habitat (shelter, foraging, breeding) decline in quality and availability • Erosion, sedimentation and increases in trail width • Water management	Many issues raised in relation to OMV are operational in nature, (accidents, trail closure, trail hygiene) and ELA recommends that Hornsby Shire Council practices ongoing monitoring, adaptive management, risk management in relation to trail management issues. Audit of OMV REF would be beneficial however it is outside the scope of this report.
Recommendations for Future Use of the Natural Area	Agrees with the recommendations. Would like to see the recommendations, including dual usage design, spatially referenced so there is a visual representation of the actual amount of activity which could possibly put pressure on the site ecology.	New Option 2B Trail includes maps and assessment of impacts in Section 5.1 of this report

Issue	Staff Comment	Action
Recommendations for Future Use of the Natural Area	How do any of the recommendations relate to Council's LSPS?	Hornsby Integrated Planning Statement 2019 - Walking and Cycling states 'With the assistance of State Government funding, Council will be working to explore opportunities to expand the trail and provide links to new recreational facilities at Westleigh'. Westleigh Park is mapped as major urban parkland to provide priority infrastructure for sportsgrounds. Some of the Westleigh trails are included in the walking and cycling map, but not as key movement corridors. The Walking and Cycling Strategy is yet to be completed and should adopt the recommendations made in Chapter 4 of this report including location of MTB trail linkages, IMBA trail construction standards, opportunity for bushwalking trail linked to other trails, minimising environmental impacts and consistent signage etc.
Recommendations for Future Use of the Natural Area	Bushwalking. The site is close to transport, an easy grade and is adjacent to a variety of other recreational uses. This type of walking experience has been specifically identified as a needs gap within the Hornsby Active Living Strategy.	New trail Option 2B has included bushwalking trail.
Immediate recommended actions to protect all vegetation, threatened species and/or CEECs	The existing trail network has been constructed without environment assessment and without collaboration with landowners. No education program has been provided to mountain bike community regarding the impact of their activities on ecological values (and human health through asbestos movement) The length, width and construction activity of trails has noticeably increased since acquisition of the land by Council. As a result, soil erosion, soil and seed translocation and vegetation damage has also noticeably increased. These key issues threaten the integrity of the native vegetation to a point that some areas are currently at risk of approaching an ecological threshold. The current condition is not acceptable as a baseline for future management decisions. The baseline should be zero trail disturbance. However, current conditions need to be documented to form the basis of monitoring and evidence to inform ongoing management decisions. Whilst 2.2 Ecological advice on remediation options in bushland and Table 2 Review of Interface Ecology Report deals with recommendations for vegetation management on the site, that is under the assumption that	Agree trails have been constructed without environmental assessment and consultation with landowners, (albeit trail bikes and cycle use mentioned in Sydney Water Property Environmental Management Plan 2010 as a question as to which activities are acceptable) and without education of MTB community about ecological and health impacts (asbestos). Note that trails have increased in size and length and environmental impacts since Council acquisition, however, have not assessed any data on this aspect. Agree that some areas have significant threats to ecology with erosion, soil and seed translocation and vegetation damage. Agree that current condition is not a baseline for future management decisions. However, the purpose of the updated REF/ DAs will address the trails in situ and whether they should remain open, require upgrade, or be closed and rehabilitated. Part of this process is to assess current condition. Recommend that immediate action be taken to address active erosion through hand installation of low impact silt and sediment controls,

Issue	Staff Comment	Action
	current land use has been formalised and the land is under active management. Recommendations for immediate actions to preserve and protect the existing native vegetation are required with consideration to what is currently occurring and the delicate nature any action will have on the status quo.	protective fences around threatened flora and trail closures where significant damage is occurring.
MB Trail design suggestions:	• Western interface combine pump park, bike riding, walking with landform reshaping and mass revegetation in collaboration with landscape plans, site access and movement to establish a bushland experience whilst providing an edge and protecting the core. • The group does not support the placement of access roads close to the existing vegetation and supports moving such access into Sydney Water land to limit impact on STIF. • Trail design to recognise dual usage with the least impact • Trail design to be away from threatened species with minimal, if any, presence in the southern section. Eastern boundary of site to be maintained as mown grassland consistent with the provision of a fuel reduced area (Asset Protection Zone) for bushfire mitigation purposes and infrastructure access. This area could be used for the dual purpose of MTB and walking trails. Refer to 3.4.6 Altered fire regime comments. • Resources could be put towards more constructed tracks, jumps etc within the currently cleared areas (particularly western) to offset loss within bushland areas.	New trail Option 2B has included additional mountain bike trail opportunities in the south west corner. Additional opportunities for mountain bike trails on the western side is recommended for consideration in the updated Masterplan to offset the loss of trails from the natural area. The location of access roads on Sydney Water land would be subject to its agreement. New Trail Option 2B has located the trail away from most threatened species locations. New Trail Option 2B includes eastern boundary as APZ.

Appendix A Initial review of vegetation quadrat data

Quadrat 1								
Soil: Glenorie (Wianamatta shale)					Diagnostic species			
	14/6/16	Tozer et al 2010		**Syd Metro 2016**		Smith & Smith 2000		
Common name	Scientific name	STIF	Sydney Shale-Ironstone Cap Forest (Duffys)	**Coastal Shale-Sandstone Forest**	**Duffys**	Duffys	SSRW	SSGF
Flax-leaved Wattle	*Acacia linifolia*		Y	+				
Sydney Golden Wattle	*Acacia longifolia*			-				
Myrtle Wattle	*Acacia myrtifolia*		Y	+	+			
Black She-oak	*Allocasuarina littoralis*		Y	+	+			
Smooth-barked Apple	*Angophora costata*	Y	Y	+	+			
Oat Grass	*Anisopogon avenaceus*	Y	Y	-	+			
Three-awn Grass	*Aristida vagans*	Y		+	-	+		-
Hairpin Banksia	*Banksia spinulosa*		Y	+	+			
Apple Berry	*Billardiera scandens*	Y	Y	+	+			
Spiny Bossiaea	*Bossiaea obcordata*		Y	+	+	+	-	
Devil's Twine	*Cassytha glabella*		Y	-	-			
Red Bloodwood	*Corymbia gummifera*		Y	+	+			
Blue Flax-lily	*Dianella caerulea var. producta*	Y	Y	+				
Plume Grass	*Dichelachne sp.*	?	?	-				
Hedgehog Grass	*Echinopogon caespitosus*	Y		+				
Wiry Panic	*Entolasia stricta*	Y	Y	+	+			
White Stringybark	*Eucalyptus globoidea*	Y	Y	+		+		
Blackbutt	*Eucalyptus pilularis*	Y	Y	+				

			Quadrat 1						
Red Mahogany	*Eucalyptus resinifera*	Y	Y	+					
Love Creeper	*Glycine clandestina*	Y		+				-	
Love Creeper	*Glycine tabacina*	Y							
Bushy Needlebush	*Hakea sericea*		Y	+	+	+			
Rough Guinea Flower	*Hibbertia aspera*	Y	Y	+	+				-
Blady Grass	*Imperata cylindrica*	Y	Y	+	-				
Running Postman	*Kennedia rubicunda*	Y		-					
	Lepidosperma laterale		Y	+	+				
Bearded Heath	*Leucopogon juniperinus*	Y		+					
	Lomandra cylindrica			-	-				
	Lomandra gracillis		Y	-	-				
Mat Rush	*Lomandra longifolia*	Y		+					
Crinkle Bush	*Lomatia silaifolia*		Y	+	+				
	Micrantheum ericoides		Y	+	+				
Weeping Grass	*Microlaeana stipoides*	Y		+					
	Opercularia diphylla			-					
Two-coloured Panic	*Panicum simile*	Y		+					
Golden Geebung	*Persoonia laurina*		Y	+	+	+	-		
Smooth Geebung	*Persoonia levis*		Y	+	+				
Pine-leaved Geebung	*Persoonia pinifolia*		Y	-	+				
Sweet Pittosporum	*Pittosporum undulatum*	Y		+	-				

			Quadrat 1					
Handsome Flat-pea	*Platylobium formosum*		Y	+			-	
Elderberry Panax	*Polyscias sambucifolia*	Y		+			-	
White Root	*Pratia purpurescens*	Y		+			-	
Bracken Fern	*Pteridium esculentum*		Y	+	+			
Turpentine	*Syncarpia glomulifera*	Y		+		+	-	
Kangaroo Grass	*Themeda australis*	Y	Y	+	-	+		-
Forest Grass Tree	*Xanthorrhoea media*		Y	-	+			
	47 species	24/23	29/26	**35/20**	**19/29**	67.5	32.5	42.5
				Requires 20 or more +ve diagnostic species, where total number of native species is 39 or more	**Requires 29 or more +ve diagnostic species, where total number of native species is 42 or more**			
Weeds								
Large-leaf Privet	Ligustrum lucidum							
Asparagus fern	Asparagus aethiopicus							
Small-leaf Privet	Ligustrum sinense							
Pampas Grass	Cortaderia sp.							
Mickey Mouse plant	Ochna serrulata							
	Senna pendula							

		Quadrat 2						
Soil: Glenorie (Wianamatta shale)/Disturbed					Diagnostic species			
	23/6/16	Tozer et al 2010		**Sydney Metro 2016**		Smith & Smith 2000		
Common name	Scientific name	STIF	Sydney Shale-Ironstone Cap Forest (Duffys)	**Coastal Shale-Sandstone Forest**	**Duffys**	Duffys	SSRW	SSGF
Poaceae 1								
Fringed wattle	*Acacia fimbriata*							
Flax-leaved Wattle	*Acacia linifolia*		Y	+				
Myrtle Wattle	*Acacia myrtifolia*		Y	+	+			
Black She-oak	*Allocasuarina littoralis*		Y	+	+			
Smooth-barked Apple	*Angophora costata*	Y	Y	+	+			
Oat Grass	*Anisopogon avenaceus*	Y	Y	-	+			
Three-awn Grass	*Aristida vagans*	Y		+	-	+		-
Tall Speargrass	*Austrostipa pubescens*		Y	+	+			
Hairpin Banksia	*Banksia spinulosa*		Y	+	+			
Apple Berry	*Billardiera scandens*	Y	Y	+	+			
Spiny Bossiaea	*Bossiaea obcordata*		Y	+	+	+	-	
	Brachycome angustifolia							
Blue Trumpet	*Brunoniella pumilio*	Y	Y	+	+	+		-
Devil's Twine	*Cassytha glabella*		Y	-	-			
	Coronidium scorpiodes							
Red Bloodwood	*Corymbia gummifera*		Y	+	+			
Large Tongue Orchid	*Cryptostylis subulata*		Y					

		Quadrat 2							
Mosquito Orchid	*Cyrtostylis reniformis*								
Blue Flax-lily	*Dianella caerulea var. producta*	Y	Y	+					
Mauve Flax Lily	*Dianella revoluta*		Y	+	-	+			
	Dichelachne rara								
	Drosera sp.								
Blueberry Ash	*Elaeocarpus reticulatus*			+					
Wiry Panic	*Entolasia stricta*	Y	Y	+	+				
NSW Coral Heath	*Epacris pulchella*		Y	+	+				
White Stringybark	*Eucalyptus globoidea*	Y	Y	+		+			
Blackbutt	*Eucalyptus pilularis*	Y	Y	+					
Red Mahogany	*Eucalyptus resinifera*	Y	Y	+					
Northern Cranesbill	*Geranium homeanum*								
Love Creeper	*Glycine clandestina*	Y		+			-		
Love Creeper	*Glycine tabacina*	Y							
Poverty Raspwort	*Gonocarpus tetragynus*			-					
Variable-leaved Goodenia	*Goodenia heterophylla*			+	+	+	-	-	
White Spider Flower	*Grevillea linearifolia*		Y	-	+				
Bushy Needlebush	*Hakea sericea*		Y	+	+	+			
Twining Purple-pea	*Hardenbergia violacea*			-					
Rough Guinea Flower	*Hibbertia aspera*	Y	Y	+	+			-	
Blue Mountains Guinea Flower	*Hibbertia bracteata*		Y	-	+				
	Hydrocotyle peduncularis	Y							

		Quadrat 2						
	Hypericum japonicum							
Blady Grass	*Imperata cylindrica*	Y	Y	+				
	Lepidosperma gunnii							
	Lepidosperma laterale		Y	+	+			
Bearded Heath	*Leucopogon juniperinus*	Y		+				
Lacy Wedge Fern	*Lindsaea microphylla*	Y	Y	+	+			
	Lomandra cylindrica			-	-			
Mat Rush	*Lomandra longifolia*			+				
	Lomandra micrantha							
	Lomandra multiflora		Y	+	-	+		-
Fish bones	*Lomandra obliqua*		Y	+	+			
Crinkle Bush	*Lomatia silaifolia*		Y	+	+			
Ball Honeymyrtle	*Melaleuca nodosa*							
	Micrantheum ericoides		Y	+	+			
Weeping Grass	*Microlaena stipoides*	Y		+				
Bridal Daisy Bush	*Olearia microphylla*			+				
	Opercularia diphylla			-				
	Opercularia varia		Y			+		
	Oxalis perrenans							
Two-coloured Panic	*Panicum simile*	Y		+				
Day Lily	*Patersonia glabrata*		Y	+	+			
Golden Geebung	*Persoonia laurina*		Y	+	+	+	-	
Smooth Geebung	*Persoonia levis*		Y	+	+			

		Quadrat 2						
Sweet Pittosporum	*Pittosporum undulatum*	Y		+	-			
Handsome Flat-pea	*Platylobium formosum*		Y	+			-	
Elderberry Panax	*Polyscias sambucifolia*	Y		+			-	
	Pomaderris discolor							
White Root	*Pratia purpurascens*	Y		+			-	
	Prostanthera howelliae							
Pastel Flower	*Pseuderanthemum variabile*	Y		-				
Bracken fern	*Pteridium esculentum*		Y	+	+			
	Pultenaea palacea							
	Pultenaea retusa							
	Pultenaea scabra							
	Pultenaea villosa	Y		-				
Wallaby grass	*Rhytidosperma racemosum*							
	Senecio diaschides							
Sweet Tea	*Smilax glyciphylla*		Y	+	-			
Turpentine	*Syncarpia glomulifera*	Y		+	-	+	-	
Kangaroo Grass	*Themeda australis*	Y	Y	+	-	+		-
	Veronica plebeia	Y						
	Xanthorrhoea minor							
Rock Xanthosia	*Xanthosia tridentata*		Y	+	+			
	83 species	27/23	40/26	**47/20**	**27/29**	80	30	35
				Requires 20 or more +ve	**Requires 29 or**			

Quadrat 2			
		diagnostic species, where total number of native species is 39 or more	more +ve diagnostic species, where total number of native species is 42 or more
Weeds			
	Lilium formosum		
Asparagus fern	*Asparagus aethiopicus*		
Small-leaf Privet	*Ligustrum sinense*		
Camphor laurel	*Cinnamomum camphora*		
Fire Weed	*Senecio madagascariensis*		
Farmers Friend	*Bidens pilosa*		
Cat's Ear	*Hypochaeris radicata*		
Lantana	*Lantana camara*		
Montpellier broom	*Genista monspessulana*		
	Briza maxima		
Crofton Weed	*Ageratina adenophora*		

	Quadrat 5							
Soil: Glenorie (Wianamatta shale)					Diagnostic species			
	Tozer et al 2010	Tozer et al 2010		**Sydney Metro 2016**		Smith & Smith 2000		
Common name	STIF	STIF	Sydney Shale-Ironstone Cap Forest (Duffys)	**Coastal Shale-Sandstone Forest**	**Duffys**	Duffys	SSRW	SSGF
Flax-leaved wattle	*Acacia linifolia*		Y	+				
Sydney Golden Wattle	*Acacia longifolia*			-				
Myrtle Wattle	*Acacia myrtifolia*		Y	+	+			
Parramatta Green wattle	*Acacia parramattensis*	Y						
Black She-oak	*Allocasuarina littoralis*		Y	+	+			
Smooth-barked Apple	*Angophora costata*	Y	Y	+	+			
Three-awn Grass	*Aristida vagans*	Y		+	-	+		-
	Austrostipa pubescens		Y	+	+			
Hairpin banksia	*Banksia spinulosa*		Y	+	+			
Apple Berry	*Billardiera scandens*	Y	Y	+	+			
Spiny Bossiaea	*Bossiaea obcordata*		Y	+	+	+	-	
Coffee Bush	*Breynia oblongifolia*	Y						
Mulga Fern	*Cheilanthes sieberi*	Y						
Red Bloodwood	*Corymbia gummifera*		Y	+	+			

		Quadrat 5								
	Cyathochaeta diandra		Y	+	+					
Blue Flax Lily	*Dianella caerulea var. producta*	Y	Y	+						
	Dianella prunina				-					
Hedgehog Grass	*Echinopogon ceaspitosus*	Y		+						
Wiry Panic	*Entolasia stricta*	Y	Y	+	+					
NSW Coral Heath	*Epacris pulchella*		Y	+	+					
Brown's Lovegrass	*Eragrostis brownii*			-						
White Stringybark	*Eucalyptus globoidea*	Y	Y	+			+			
Narrow-leaved Scribbly Gum	*Eucalyptus racemosa*									
Red Mahogany	*Eucalyptus resinifera*	Y	Y	+						
Love Creeper	*Glycine clandestina*	Y		+				-		
Grey Spider Flower	*Grevillea buxifolia*		Y		+					
Bushy Needlebush	*Hakea sericea*		Y	+	+		+			
Rough Guinea Flower	*Hibbertia aspera*	Y	Y	+	+				-	
Blady Grass	*Imperata cylindrica*	Y	Y	+	+					
Tick bush	*Kunzea ambigua*	Y		-						
Mountain Devil	*Lambertia formosa*		Y	-	+					

		Quadrat 5						
	Lasiopetalum parviflorum				+			
	Lepidosperma gunnii							
	Lepidosperma laterale		Y	+	+			
Paperbark Tea-tree	*Leptospermum trinervium*				+			
Bearded Heath	*Leucopogon juniperinus*	Y		+				
Screw Fern	*Lindsaea linearis*		Y	-	+			
Lacy Wedge fern	*Lindsaea microphylla*	Y	Y	+	+			
	Lomandra brevis		Y		+			
	Lomandra cylindrica			-	-			
	Lomandra filiformis ssp. coriacea			-	-			
	Lomandra gracillis		Y	-	-			
	Lomandra multiflora		Y	+	-	+	-	
Fishbones	*Lomandra obliqua*		Y	+	+			
Crinkle Bush	*Lomatia silaifolia*		Y	+	+			
	Micrantheum ericoides		Y	+	+			
Weeping Grass	*Microlaena stipoides*	Y		+				
Bridal Daisy Bush	*Olearia microphylla*			+				
	Opercularia diphylla			-				
	Oxalis perrenans							

		Quadrat 5						
Everlasting Daisy	*Ozothamnus diosmifolius*	Y		+				
Golden Geebung	*Persoonia laurina*		Y	+	+	+	-	
Smooth Geebung	*Persoonia levis*		Y	+	+			
Conesticks	*Petrophile pulchella*		Y	-	+			-
Thyme spurge	*Phyllanthus hirtellus*		Y	+	+			
Sweet Pittosporum	*Pittosporum undulatum*	Y		+	-			
Elderberry Panax	*Polyscias sambucifolia*	Y		+			-	
	Pomax umbellata			-				
White Root	*Pratia purpurascens*	Y		+			-	
Bracken Fern	*Pteridium esculentum*		Y	+	+			
Tall Greenhood	*Pterostylis longifolia*							
Sweet Tea	*Smilax glyciphylla*		Y	+	-			
	Thelymitra sp.							
Kangaroo Grass	*Themeda australis*	Y	Y	+	-	+		-
	Xanthorrhoea media		Y	-	+			
	65 species	23/23	37/26	**40/20**	**31/29**	67.5	37.5	37.5
				Requires 20 or more +ve diagnostic species, where total number of native species is 39 or more	**Requires 29 or more +ve diagnostic species, where total number of native species is 42 or more**			
Weeds								

	Quadrat 5
Asparagus fern	*Asparagus aethiopicus*
Small-leaf Privet	*Ligustrum sinense*
Mickey Mouse plant	*Ochna serrulata*
Lantana	*Lantana camara*

Quadrat 6										
Soil: Lucas Heights (Mittagong)/Disturbed – shale/sandstone					Diagnostic species					
	11/7/16	Tozer et al 2010				**Sydney Metro 2016**		Smith & Smith 2000		
Common name	Scientific name	STIF	Sydney Shale-Ironstone Cap Forest (Duffys)	Coastal sandstone ridgetop (Bloodwood-Scribbly)	Coastal Sandstone Plateau Heath (Scribbly gum open woodland)	**Coastal Shale-Sandstone Forest**	**Duffys**	Duffys	SSRW	SSGF
Flax-leaved Wattle	*Acacia linifolia*		Y	Y		+				
Myrtle Wattle	*Acacia myrtifolia*		Y	Y	Y	+	+			
Parramatta Green wattle	*Acacia parramattensis*	Y								
Sweet scented Wattle	*Acacia suaveolens*			Y	Y	-				
Prickly Moses	*Acacia ulicifolia*			Y		-	-			
Lesser Flannel Flower	*Actinotus minor*			Y	Y		-			
Black She-oak	*Allocasuarina litttoralis*		Y			+	+			
Smooth-barked Apple	*Angophora costata*	Y	Y	Y		+	+			
Oat Grass	*Anisopogon avenaceus*	Y	Y	Y	Y	-	+			
Three-awn Grass	*Aristida vagans*	Y				+	-	+		-
Silver Banksia	*Banksia marginata*		Y		Y	-	+			-
	Banksia oblongifolia		Y		Y	-	-			

			Quadrat 6							
Hairpin Banksia	*Banksia spinulosa*		Y			+	+			
Apple Berry	*Billardiera scandens*	Y	Y			+	+			
Spiny Bossiaea	*Bossiaea obcordata*		Y	Y		+	+	+	-	
Devil's Twine	*Cassytha pubescens*		Y	Y		+	+			
Matchheads	*Comesperma ericinum*		Y	Y	Y	+	+			
Red Bloodwood	*Corymbia gummifera*		Y	Y	Y	+	+			
Hooded Orchid	*Cryptostylis erecta*									
Large Tongue Orchid	*Cryptostylis subulata*		Y		Y					
	Cyathochaeta diandra		Y	Y	Y	+	+			
Blue Flax Lily	*Dianella caerulea var. producta*	Y	Y			+				
Heathy Parrot-pea	*Dillwynia retorta*		Y	Y	Y	-	+			
Hedgehog Grass	*Echinopogon caespitosus*	Y				+				
NSW Coral Heath	*Epacris pulchella*		Y	Y	Y	+	+			
White Stringybark	*Eucalyptus globoidea*	Y	Y			+		+		

			Quadrat 6						
Broad-leaved Scribbly Gum	*Eucalyptus haemastoma*		Y	Y	Y	-	+		-
Narrow-leaved Scribbly Gum	*Eucalyptus racemosa*			Y	Y				
Poverty Raspowort	*Gonocarpus tetragynus*					-			
Red Spider Flower	*Grevillea speciosa*			Y	Y				
	Hakea laevipes								
Bushy Needlebush	*Hakea sericea*		Y	Y		+	+	+	
Rough Guinea Flower	*Hibbertia aspera*	Y	Y	Y		+	+		-
	Hovea linearis			Y		-	+		-
Blady Grass	*Imperata cylindrica*	Y	Y			+			
Mountain Devil	*Lambertia formosa*		Y	Y	Y	-	+		
	Lepdisoperma laterale		Y			+	+		
Paperbark Tea-tree	*Leptospermum trinervium*						+		
Bearded Heath	*Leucopogon juniperinus*	Y				+			
Screw Fern	*Lindsaea linearis*		Y	Y	Y	-	+		
	Lomandra filiformis ssp. Coriacea					-	-		

		Quadrat 6									
	Lomandra glauca			Y	Y	-	+				
Fishbones	*Lomandra obliqua*		Y	Y	Y	+	+				
Crinkle bush	*Lomatia silaifolia*		Y	Y	Y	+	+				
	Micrantheum ericoides		Y	Y	Y	+	+				
Weeping Grass	*Microlaena stipoides*	Y				+	-				
	Opercularia diphylla					-					
Everlasting Daisy	*Ozothamnus diosmifolius*	Y				+					
Two-coloured Panic	*Panicum simile*	Y				+					
Rough Geebung	*Persoonia levis*		Y	Y	Y	+	+				
Flax-leaved Geebung	*Persoonia linearis*	Y				-					
Thyme Spurge	*Phylanthus hirtellus*		Y	Y		+	+				
Rice Flower	*Pimelea linifolia*		Y	Y	Y	-	+				
Sweet Pittosporum	*Pittosporum undulatum*	Y				-	-				
Heathy Platysace	*Platysace ericoides*			Y	Y						
Elderberry panax	*Polyscias sambucifolia*	Y								-	
White Root	*Pratia purpurascens*	Y				+				-	

			Quadrat 6							
	Pultenaea tuberculata		Y	Y	Y	-	+			
Kangaroo Grass	*Themeda australis*	Y	Y			+	-	+		-
Broad-leaf Grass Tree	*Xanthorrhoea arborea*								-	+
Forest Grass Tree	*Xanthorrhoea media*		Y	Y	Y	-	+			
Rock Xanthosia	*Xanthosia tridentata*		Y		Y	+	+			
	62 species	19/23	36/26	32/31	27/26	**32/20**	**32/29**	62.5	40	37.5
						Requires 20 or more +ve diagnostic species, where total number of native species is 39 or more	**Requires 29 or more +ve diagnostic species, where total number of native species is 42 or more**			
Weeds										
Small-leaf Privet	*Ligustrum sinense*									
Cats Ear	*Hypochaeris radicata*									

Quadrat 11								
Soil: Hawkesbury Sandstone – minor shale lenses		Diagnostic species						
	16/8/16	Tozer et al 2010						
Common name	Scientific name	Coastal Rock Plate Heath (Rock Platform Heath)	Coastal Upland Swamp (Sandstone Swamp)	Sydney Hinterland Transition Woodland (Grey-Scribbly Woodland)	Coastal sandstone ridgetop (Bloodwood-Scribbly)	Coastal Sandstone Plateau Heath (Scribbly gum open woodland)	Sandstone Riparian Scrub (Peppermint-Angophora)	Coastal Sandstone Gully Forest (Peppermint-Angophora)
Flax-leaved Wattle	*Acacia linifolia*			Y	Y			Y
Sydney Golden wattle	*Acacia longifolia*			Y				
Maidenhair Fern	*Adiantum aethiopicum*							
Black She-oak	*Allocasuarina littoralis*			Y				
Hairpin banksia	*Banksia spinulosa*			Y	Y			Y
	Blechnum ambiguum							
Crimson Bottlebrush	*Callistemon citrinus*		Y				Y	
Narrow-leaved Bottlebrush	*Callistemon linearis*			Y				
Devil's Twine	*Cassytha pubescens*			Y	Y			Y
	Centella asiatica							
	Cyperaceae sp.							
	Cyperus sp.							
Blue Flax-lily	*Dianella caerulea*			Y				Y
Kidney Weed	*Dichondra repens*							
Hedgehog Grass	*Echinopogon caespitosus*			Y				
Hedgehog Grass	*Echinopogon ovatus*							

Quadrat 11										
Blueberry Ash	*Elaeocarpus reitculatus*									
Wiry Panic	*Entolasia marginata*									
Wiry Panic	*Entolasia stricta*				Y	Y	Y	Y	Y	
NSW Coral Heath	*Epacris pulchella*				Y		Y		Y	
Narrow-leaved Scribbly Gum	*Eucalyptus racemosa*					Y	Y			
Red Mahogany	*Eucalyptus resinifera*				Y					
	Gahnia erythrocarpa					Y			Y	
	Gahnia sieberana			Y					Y	
Northern Cranesbill	*Geranium homeanum*									
Cheese Tree	*Glochidion ferdinandi*									
	Hakea gibbosa					Y	Y		Y	
Bushy Needlebush	*Hakea sericea*				Y	Y			Y	
	Hibbertia aspera				Y	Y				
	Hydrocotyle tripartita									
Blady Grass	*Imperata cylindrica*				Y					
	Juncus continuus									
Common Rush	*Juncus usitatus*									
Tick Bush	*Kunzea ambigua*	Y			Y					
Paperbark Tea-tree	*Leptospermum polygalifolium*					Y	Y	Y	Y	
	Lepyrodia muelleri									
Bearded Heath	*Leucopogon juniperinus*									
	Lomandra cylindrica				Y	Y	Y			

Quadrat 11								
Mat Rush	*Lomandra longifolia*						Y	Y
Crinkle Bush	*Lomatia silaifolia*			Y	Y	Y		Y
	Micrantheum ericoides			Y	Y	Y		Y
Weeping Grass	*Microlaena stipoides*							
Basket Grass	*Oplismenus aemulus*							
Everlasting Daisy	*Ozothamnus diosmifolius*			Y				
Narrow-leaved Geebung	*Persoonia linearis*			Y				
Pine-leaf Geebung	*Persoonia pinifolia*			Y	Y	Y	Y	Y
Rough fruited Pittosporum	*Pittosporum revolutum*							
Sweet Pittosporum	*Pittosporum undulatum*							
Elderberry Panax	*Polyscias sambucifolia*							
White Root	*Pratia purpurascens*			Y				
Bracken Fern	*Pteridium esculentum*							Y
Sweet Tea	*Smilax glyciphylla*						Y	Y
Snake Vine	*Stephania japonica*							
	53 species	1/10	2/14	22/31	14/31	9/26	5/8	17/23
	*Threatened species listed under the TSC Act							

Weeds								
Large-leaf Privet	*Ligustrum lucidum*							
Small-leaf Privet	*Ligustrum sinense*							
	Aristea ecklonii							

Quadrat 11	
Farmers Friend	*Bidens pilosa*
Crofton Weed	*Ageratina adenophora*
	Setaria pumilo
	Oxalis sp.
Whisky Grass	*Andropogon virginicus*
Japanese honeysuckle	*Lonicera japonica*
Asparagus fern	*Asparagus aethiopicus*
Lantana	*Lantana camara*
Seaside Daisy	*Erigeron karvinskianus*
Parramatta Grass	*Sporobolus africanus*
Cats ear	*Hypochaeris radicata*
Pampas Grass	*Cortaderia selloana*
Blackberry	*Rubus fruticosus*
	Ehrharta erecta
Fleabane	*Conyza bonariensis*
Clover	*Trifolium sp.*

Soil: Hawkesbury Sandstone – minor shale lenses		Diagnostic species						
	5/9/16	Tozer et al 2010				Smith & Smith (2000)		
Common name	Scientific name	STIF	Sydney Shale-Ironstone Cap Forest (Duffys)	Coastal Sandstone Gully Forest (Peppermint-Angophora)	Coastal sandstone ridgetop (Bloodwood-Scribbly)	Duffys	SSRW	SSGF
Hickory Wattle	*Acacia implexa*	Y						
Flax-leaved Wattle	*Acacia linifolia*		Y	y	Y			
Black She-oak	*Allocasuarina littoralis*		Y					
Smooth-barked Apple	*Angophora costata*	y	Y	y	Y			
Hairpin Banksia	*Banksia spinulosa*		Y	y	Y			
Apple Berry	*Billardiera scandens*	Y	Y					
Spiny Bossiaea	*Bossiaea obcordata*		Y		Y	+	-	
False Bracken Fern	*Calochlaena dubia*							
Mulga Fern	*Cheilanthes seiberi*	Y						
Red Bloodwood	*Corymbia gummifera*		Y	y	Y			
Hooded Orchid	*Cryptostylis erecta*			Y				
Blue Flax-lily	*Dianella caerulea var. producta*	y	Y	Y				
Hop Bush	*Dodonaea triquetra*	Y	Y	Y				
Hedgehog Grass	*Echinopogon caespitosus*	Y						
Blueberry Ash	*Elaeocarpus reticulatus*							
Wiry Panic	*Entolasia marginata*	Y						
Wiry panic	*Entolasia stricta*	y	Y	y	Y			
Browns Love Grass	*Eragrostis brownii*							
Red mahogany	*Eucalyptus resinifera*	Y	Y					

Soil: Hawkesbury Sandstone – minor shale lenses		Diagnostic species				
Wombat Berry	*Eustrephus latifolius*	Y				
Love Creeper	*Glycine tabacina*	Y				
White Spider Flower	*Grevillea linearifolia*		Y			
Twining Purple-pea	*Hardenbergia violacea*					
Blady Grass	*Imperata cylindrica*	Y	Y			
	Juncus continuus					
Common Rush	*Juncus usitatus*					
Lemon-scented Tea-tree	*Leptospermum polygalifolium*		Y	y	Y	
Bearded Coral Heath	*Leucopogon juniperinus*	Y				
	Lomandra filiformis ssp. Filiformis	y			Y	
	Lomandra glauca				Y	
	Lomandra gracillis		Y		Y	
Mat Rush	*Lomandra longifolia*	Y		Y		
	Lomandra multiflora		Y			
Crinkle Bush	*Lomatia silaifolia*		Y	y	Y	
Weeping Grass	*Microlaena stipoides*	Y				
Everlasting Daisy	*Ozothamnus diosmifolium*	Y				
Smooth Geebung	*Persoonia levis*		Y	y	Y	
Sweet Pittosporum	*Pittosporum undulatum*	Y				
Native Parsnip	*Platysace lanceoloata*					
	Poa affinis	Y				
Elderberry Panax	*Polyscias sambucifolia*	Y				-
White Root	*Pratia purpurascens*	Y				-

Soil: Hawkesbury Sandstone – minor shale lenses		Diagnostic species						
Bracken Fern	*Pteridium esculentum*		Y	Y				
Turpentine	*Syncarpia glomulifera*	Y				+	-	
	Veronica pleibeia	Y						
	45 species	24/23	19/26	13/23	12/31	55	40	0
Weeds								
Asparagus fern	*Asparagus aethiopicus*							
Whisky Grass	*Andropogon virginicus*							
Small-leaf Privet	*Ligsutrum sinense*							
Large-leaf Privet	*Ligustrum lucidum*							
	Senna pendula							
Crofton Weed	*Ageratina adenophora*							
Vetch	*Vicia sp.*							
Montpellier Broom	*Genista monspessulana*							
Japanese weedy fern								
Cocos Palm								
	Oxalis sp.							

Quadrat 15								
Soil: Hawkesbury Sandstone – minor shale lenses		Diagnostic species						
	11/4/19	Tozer et al 2010				Smith & Smith (2000)		
Common name	Scientific name	STIF	Sydney Shale-Ironstone Cap Forest (Duffys)	Coastal Sandstone Gully Forest (Peppermint-Angophora)	Coastal sandstone ridgetop (Bloodwood-Scribbly)	Duffys	SSRW	SSGF
Flax-leaved Wattle	*Acacia linifolia*		Y	Y	Y			
Sweet-scented Wattle	*Acacia suaveolens*			Y	Y			
Black She-oak	*Allocasuarina littoralis*		Y					
Smooth-barked Apple	*Angophora costata*	Y	Y	Y	Y			
Old Man Banksia	*Banksia serrata*		Y	Y	Y			
Hairpin Banksia	*Banksia spinulosa*		Y	Y	Y			
Apple Berry	*Billardiera scandens*	Y	Y					
Spiny bossiaea	*Bossiaea obcordata*		Y		Y	+	-	
Old Man's Beard	*Clematis aristata*					+		
Red Bloodwood	*Corymbia gummifera*		Y	Y	Y			
Hooded orchid	*Cryptostylis erecta*			Y				
Mosquito orchid	*Cyrtostylis reniformis*							
Blue Flax-lily	*Dianella caerulea var. caerula*	Y	Y	Y				
Blue Flax-lily	*Dianella caerulea var. producta*							
	Dianella prunina				Y			
	Dipodium sp.						-	
Blueberry Ash	*Elaeocarpus reticulatus*							
Wiry Panic	*Entolasia stricta*	Y	Y	Y	Y			

	Quadrat 15						
Coral Heath	*Epacris pulchella*		Y	Y	Y		
Sydney Peppermint	*Eucalyptus piperita*		Y	Y	Y		
Narrow-leaved Scribbly Gum	*Eucalyptus racemosa*				Y		
Bushy needlebush	*Hakea sericea*		Y	Y	Y	+	
Trailing Guinea flower	*Hibbertia empetrifolia*		Y				
	Hovea linearis				Y		-
Blady Grass	*Imperata cylindrica*	Y	Y				
Mountain Devil	*Lambertia formosa*		Y	Y	Y		
	Lepidosperma gunnii						
Lemon-scented Tea-tree	*Leptospermum polygalifolium*		Y	Y	Y		
Paperbark Tea-tree	*Leptospermum trinervium*			Y	Y		
	Lepyrodia scariosa			Y	Y		
Screw fern	*Lindsaea linearis*		Y	Y	Y		
Lacy Wedge Fern	*Lindsaea microphylla*	Y	Y	Y			
	Lomandra filiformis ssp. filiformis	Y			Y		
	Lomandra gracilis		Y		Y		
Mat Rush	*Lomandra longifolia*	Y		Y			
Fish bones	*Lomandra obliqua*		Y	Y	Y		
Crinkle bush	*Lomatia silifolia*		Y	Y	Y		
	Micrantheum ericoides		Y	Y	Y		
Weeping grass	*Microlaena stipioides*	Y					
	Opercularia diphylla						

	Quadrat 15							
Basket Grass	*Oplismenus aemulus*	Y						
Narrow-leaved Geebung	*Persoonia linearis*	Y						
Thyme spurge	*Phyllanthus hirtellus*		Y		Y			
	Phyllota phylicoides			Y	Y			-
Sweet Pittosporum	*Pittosporum undulatum*	Y						
Carrot tops	*Platyscace linearifolia*		Y	Y	Y			
Bracken Fern	*Pteridium esculentum*		Y	Y				
Native sarsaparilla	*Smilax glyciphylla*		Y	Y				
Wiry Rice grass	*Tetrarrhena juncea*		Y					
Forest Grass Tree	*Xanthorrhoea media*		Y	Y	Y			
Rock xanthosia	*Xanthosia tridentata*		Y	Y	Y			
	51 species	12/23	30/26	28/23	29/31	57.5	45	45
Weeds								
Asparagus fern	*Asparagus aethiopicus*							
Farmers friend	*Bidens pilosa*							
Buffalo grass	*Bouteloua dactyloides*							
Camphor laurel	*Cinnamomum camphora*							
Lantana	*Lantana camara*							
Large-leaf Privet	*Ligustrum lucidum*							
Small-leaf Privet	*Ligustrum sinense*							
Cassia	*Senna pendula*							

Quadrat 15

Quadrat 16								
Soil: Hawkesbury Sandstone – minor shale lenses		Diagnostic species						
	16/4/19	Tozer et al 2010				Smith & Smith (2000)		
Common name	Scientific name	STIF	Sydney Shale-Ironstone Cap Forest (Duffys)	Coastal Sandstone Gully Forest (Peppermint-Angophora)	Coastal sandstone ridgetop (Bloodwood-Scribbly)	Duffys	SSRW	SSGF
Flax-leaved Wattle	*Acacia linifolia*		Y	Y	Y			
Sweet-scented Wattle	*Acacia suaveolens*			Y	Y			
Lesser Flannel flower	*Actinotus minor*			Y	Y			
Black She-oak	*Allocasuarina littoralis*		Y					
Smooth-barked Apple	*Angophora costata*	y	Y	Y	Y			
Three-awned grass	*Aristida vagans*	Y				+		
Oat Grass	*Anisopogon avenaceus*	Y	Y		Y			
	Banksia oblongifolia		Y	Y	Y			
Old Man Banksia	*Banksia serrata*		Y	Y	Y			
Hairpin Banksia	*Banksia spinulosa*		Y	Y	Y			
Apple Berry	*Billardiera scandens*	Y	Y					
Spiny bossiaea	*Bossiaea obcordata*		Y		Y	+	-	
	Caustus flexuosa			Y	Y			
Red Bloodwood	*Corymbia gummifera*		Y	Y	Y			
Hooded orchid	*Cryptostylis erecta*			Y				
Large tongue orchid	*Cryptostylis subulata*		Y					
Mosquito orchid	*Cyrtostylis reniformis*							
Blue Flax-lily	*Dianella caerulea var. producta*	Y	Y	Y				

Quadrat 16						
	Dianella prunina				Y	
Blueberry Ash	*Elaeocarpus reticulatus*					
Wiry Panic	*Entolasia stricta*	Y	Y	Y	Y	
Narrow-leaved Scribbly Gum	*Eucalyptus racemosa*				Y	
Red Mahogany	*Eucalyptus resinifera*	Y	Y			
Grey Spider flower	*Grevillea buxifolia*		Y	Y	Y	
Bushy needlebush	*Hakea sericea*		Y	Y	Y	+
Blue Mountains Guinea flower	*Hibbertia bracteata*		Y	Y	Y	
Bleeding heart	*Homalanthus populifolius*	Y				
Blady Grass	*Imperata cylindrica*	Y	Y			
Mountain Devil	*Lambertia formosa*		Y	Y	Y	
	Lasiopetalum ferrugineum		Y	Y	Y	
	Lepidosperma laterale		Y	Y		
Lemon-scented Tea-tree	*Leptospermum polygalifolium*		Y	Y	Y	
Paperbark Tea-tree	*Leptospermum trinervium*			Y	Y	
	Lepyrodia scariosa			Y	Y	
Lacy Wedge Fern	*Lindsaea microphylla*	Y	Y	Y		
	Lomandra brevis		Y		Y	
	Lomandra cylindrica				Y	
	Lomandra filiformis ssp. coriacea					
	Lomandra filiformis ssp. filiformis	Y			Y	
	Lomandra glauca				Y	

	Quadrat 16							
Mat Rush	*Lomandra longifolia*	Y		Y				
Fish bones	*Lomandra obliqua*		Y	Y	Y			
Crinkle bush	*Lomatia silifolia*		Y	Y	Y			
	Micrantheum ericoides		Y	Y	Y			
Weeping grass	*Microlaena stipioides*	Y						
	Monotoca scoparia			Y	Y			
Smooth Geebung	*Persoonia levis*		Y	Y	Y			-
Narrow-leaved Geebung	*Persoonia linearis*	Y						
Pine-leaf Geebung	*Persoonia pinifolia*		Y	Y	Y			
Thyme spurge	*Phyllanthus hirtellus*		Y		Y			
Sweet Pittosporum	*Pittosporum undulatum*							
Carrot tops	*Platyscace linearifolia*		Y	Y	Y			
	Psilotum nudum							
Bracken Fern	*Pteridium esculentum*		Y	Y				
Native sarsaparilla	*Smilax glyciphylla*		Y	Y				
Wiry Rice grass	*Tetrarrhena juncea*		Y					
Snow wreath	*Woollsia pungens*			Y	Y	-		+
Forest Grass Tree	*Xanthorrhoea media*		Y	Y	Y			
Rock xanthosia	*Xanthosia tridentata*		Y	Y	Y			
	59 species	14/23	35/26	35/23	37/31	55	47.5	50
Weeds								

	Quadrat 16
Buffalo grass	*Bouteloua dactyloides*
Catsear	*Hypochaeris radicata*
Cotoneaster	*Cotoneaster*
Lantana	*Lantana camara*
Small-leaf Privet	*Ligustrum sinense*
Formosa lily	*Lilium formosanum*
Cassia	*Senna pendula*

Quadrat 17								
Soil: Hawkesbury Sandstone – minor shale lenses		Diagnostic species						
	1/5/19	Tozer et al 2010				Smith & Smith (2000)		
Common name	Scientific name	STIF	Sydney Shale-Ironstone Cap Forest (Duffys)	Coastal Sandstone Gully Forest (Peppermint-Angophora)	Coastal sandstone ridgetop (Bloodwood-Scribbly)	Duffys	SSRW	SSGF
	Acacia linifolia		Y	Y	Y			
	Acacia ulicifolia			Y	Y			
	Allocasuarina littoralis	y	Y	Y	Y			
	Angophora costata	Y	Y		Y			
	Aristida vagans		Y	Y	Y			
	Austrostipa sp.		Y	Y	Y			
	Banksia serrata	Y	Y					
	Banksia spinulosa		Y		Y	+	-	
	Billardiera scandens			Y	Y			
	Boronia pinnata		Y	Y	Y			
	Bossiaea obcordata			Y				
	Cassytha pubescens		Y					
	Caustis flexuosa							
	Corymbia gummifera							
	Cyrtostylis reniformis	Y	Y					
	Dianella caerulea var. caerula		Y	Y	Y	+		
	Dianella caerulea var. producta		Y	Y	Y			
	Dianella prunina	Y						

Quadrat 17				
Entolasia stricta		Y	Y	
Epacris pulchella		Y	Y	Y
Eucalyptus resinifera	Y	Y	Y	
Hakea sericea				
Hibbertia aspera	Y			Y
Imperata cylindrica		Y	Y	Y
Lambertia formosa	Y			
Lasiopetalum ferrugineum			Y	Y
Lepidosperma laterale	Y			
Leptospermum trinervium				
Lindsaea linearis		Y	Y	
Lomandra brevis		Y		
Lomandra filiformis ssp. filiformis		Y	Y	Y
Lomandra glauca ssp. glauca				
Lomandra gracilis				
Lomandra longifolia				
Lomandra multiflora				
Lomandra obliqua				
Lomatia silifolia				
Micrantheum ericoides				
Microlaena stipioides				
Patersonia longifolia				
Persoonia linearis				

	Quadrat 17							
	Phyllanthus hirtellus							
	Pittosporum undulatum							
	Platyscace linearifolia							
	Pteridium esculentum							
	Pimelia linifolia							
	Schizaea bifida							
	Syncarpia glomulifera							
	Woollsia pungens							
	Xanthorrhoea media							
	Xanthosia tridentata							
	59 species	14/23	35/26	35/23	37/31	55	47.5	50
Weeds								
	Andropogon viginicus							
	Asparagus aethiopicus							

Quadrat 18							
Soil: Hawkesbury Sandstone – minor shale lenses		Diagnostic species					
	8/5/19	Tozer et al 2010				Smith & Smith (2000)	
Common name	Scientific name	STIF	Sydney Shale-Ironstone Cap Forest (Duffys)	Coastal Sandstone Gully Forest (Peppermint-Angophora)	Coastal sandstone ridgetop (Bloodwood-Scribbly)	Duffys	SSRW SSGF
	Acacia linifolia		Y	Y	Y		
	Actinotus minor	Y	Y		Y		
	Allocasuarina littoralis		Y	Y	Y		
	Angophora costata	Y	Y				
	Austrostipa sp.			Y	Y		
	Banksia oblongfolia		Y	Y	Y		
	Banksia serrata			Y			
	Banksia spinulosa		Y				
	Billardiera scandens						
	Bossiaea obcordata	Y	Y				
	Cassytha pubescens		Y	Y	Y	+	
	Caustis flexuosa		Y	Y	Y		
	Corymbia gummifera		Y	Y	Y		
	Cyrtostylis reniformis	Y			Y		
	Dampiera stricta		Y	Y	Y		
	Dianella caerulea var. caerula	Y					
	Dianella caerulea var. producta			Y	Y		
	Dianella prunina	Y					

Quadrat 18				
Drosera peltata	Y	Y		
Entolasia stricta	Y	Y		Y
Epacris pulchella				
Eucalyptus piperita				
Eucalyptus racemosa				
Eucalyptus resinifera				
Gonocarpus teucrioides				
Grevillea buxifolia				
Hakea sericea				
Hibbertia aspera				
Hovea linearis				
Lambertia formosa				
Leptospermum arachnoides				
Leptospermum polygalifolium				
Leptospermum trinervium				
Lepyrodia scariosa				
Leucopogon microphyllus				
Lindsaea linearis				
Lindsaea microphylla				
Lomandra brevis				
Lomandra glauca ssp. glauca				
Lomandra gracilis				
Lomandra longifolia				

	Quadrat 18							
	Lomandra multiflora							
	Lomandra obliqua							
	Lomatia silifolia							
	Micrantheum ericoides							
	Microlaena stipioides							
	Phyllanthus hirtellus							
	Pittosporum undulatum							
	Pteridium esculentum							
	Smilax glyciphylla							
	Tetrarrhena juncea							
	Woollsia pungens							
	Xanthorrhoea media							
	Xanthosia tridentata							
	59 species	14/23	35/26	35/23	37/31	55	47.5	50
Weeds								
	Ligustrum lucidum							
	Asparagus aethiopicus							

Appendix B Erosion Points Proposals 2 and 2B

Table 28 Erosion Points Proposal 2

Trail Colour/ Grade	Trail Segment ID	Simplified Management Issue Type	No. Points within 5m	No. Points within 10m	No. Points within 20m
Black	25	Erosion (Exposed tree roots)	0	0	1
		Erosion (Water)	6	12	15
	27	Erosion (Exposed tree roots)	0	1	1
		Erosion (Water)	6	9	13
		Erosion (Water) and riders going off-track	1	1	1
	71	Erosion	0	0	1
		Erosion (Water)	0	1	3
	78	Erosion	0	0	1
		Erosion (Exposed tree roots)	0	0	1
		Erosion (Water)	0	0	1
	83	Erosion	1	2	5
		Erosion (Exposed tree roots)	0	2	2
		Erosion (Water)	2	0	3
	84	Erosion	0	0	1
		Erosion (Water)	0	0	2
	85	Erosion	0	0	2
		Erosion (Exposed tree roots)	0	0	1
	87	Erosion	0	0	2

Trail Colour/ Grade	Trail Segment ID	Simplified Management Issue Type	No. Points within 5m	No. Points within 10m	No. Points within 20m
	104	Erosion	0	0	2
		Erosion (Exposed tree roots)	1	1	2
		Erosion (Water)	4	4	5
		Total Erosion Points	**21**	**33**	**65**
New Black	0	Erosion	0	0	1
Blue	62	Erosion (Exposed tree roots)	0	0	1
		Erosion (Water)	0	0	1
	63	Erosion (Exposed tree roots)	0	0	1
		Erosion (Water)	0	1	1
	69	Erosion (Exposed tree roots)	4	7	11
		Erosion	0	1	3
		Erosion (Water)	0	2	5
	70	Erosion (Water)	0	0	1
	72	Erosion (Water)	0	0	2
	74	Erosion (Water)	0	1	3
		Erosion	0	0	1
	75	Erosion (Exposed tree roots)	1	1	2
		Erosion (Water)	2	2	2
		Erosion	0	2	3
	76	Erosion	2	2	3
		Erosion (Exposed tree roots)	0	0	3
		Erosion (Water)	0	0	1

Trail Colour/ Grade	Trail Segment ID	Simplified Management Issue Type	No. Points within 5m	No. Points within 10m	No. Points within 20m
	77	Erosion	0	1	1
		Erosion (Exposed tree roots)	0	0	3
	79	Erosion	0	1	1
	80	Erosion (Water)	1	1	2
		Erosion (Exposed tree roots)	0	1	2
	82	Erosion (Water)	1	1	7
		Erosion (Exposed tree roots)	0	1	5
		Erosion	0	0	1
		Total Erosion Points	**11**	**25**	**66**
Green	29	Erosion (Exposed tree roots)	1	1	1
		Erosion (Water)	14	17	17
		Erosion	0	0	1
	33	Erosion (Water)	0	0	1
		Erosion	0	0	1
	34	Erosion	1	3	3
		Erosion (Water)	0	3	5
	38	Erosion (Water)	0	2	5
	40	Erosion (Water)	4	5	9
	42	Erosion (Water)	1	1	6
	52	Erosion (Water)	17	25	32
	59	Erosion (Water)	0	0	1
	103	Erosion (Water)	1	1	3

Trail Colour/ Grade	Trail Segment ID	Simplified Management Issue Type	No. Points within 5m	No. Points within 10m	No. Points within 20m
	110	Erosion (Water)	1	2	2
		Total Erosion Points	**40**	**60**	**87**
New Green	0	Erosion (Water)	0	0	2
Light Blue	18	Erosion (Water)	1	2	5
	21	Erosion (Water)	1	3	5
	22	Erosion (Water)	1	2	4
	31	Erosion (Water)	4	6	7
	41	Erosion	0	0	1
		Erosion (Exposed tree roots)	2	2	3
		Erosion (Water)	2	7	11
	43	Erosion (Water)	10	17	20
		Erosion (Exposed tree roots)	0	1	1
	44	Erosion (Water)	2	9	14
		Erosion (Water) and riders going off-track	1	1	1
		Erosion (Exposed tree roots)	0	1	1
		Erosion	0	1	1
	45	Erosion (Water)	1	1	2
	46	Erosion (Water)	5	8	10
		Erosion	0	1	2
	49	Erosion	1	2	3
		Erosion (Water)	3	3	5
		Erosion (Exposed tree roots)	0	0	1

Trail Colour/ Grade	Trail Segment ID	Simplified Management Issue Type	No. Points within 5m	No. Points within 10m	No. Points within 20m
	50	Erosion (Water)	1	2	
		Total Erosion Points	**35**	**63**	**97**
New Light Blue	0	Erosion	1	1	2
		Erosion (Water)	0	1	7
		Total Erosion Points	**1**	**8**	**9**

Appendix C Hornsby Mountain Bike Trail Plan: IMBA Trail Network Design Documentation

Appendix A

Hornsby MTB Trail Plan – June 2011

Sustainable Trail Construction Guidelines

The Hornsby MTB Trail Plan refers to a number of sustainable trail construction and techniques repair to implement trail sustainability and trail user safety. The following documentation is intended to provide greater detail on how to implement these trail repair techniques so that Hornsby Shire Council can proceed with the recommendations of the MTB Trail Plan.

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Trail Armouring Techniques – Raised Trail Using Stone and Aggregate

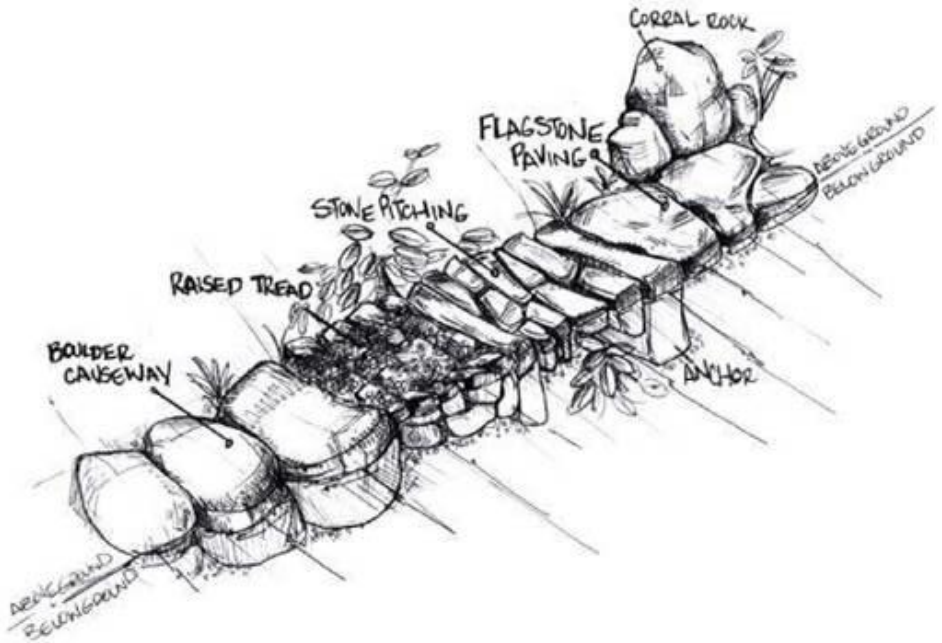
Trail Armouring using stone can be used in various locations to harden the trail surface to make it more resilient to:

- General wear and tear
- High user numbers
- Wet conditions / water logging
- Braking
- Force applied by climbing (riding up steep grades) and
- Water runoff.

In all situations, it is recommended that local (endemic) stone and compactable aggregate is used where possible.

For low lying, boggy areas use the **Boulder Causeway** or **Raised Tread Techniques**. The Raised Trail technique uses larger stone from 10 to 40 kg to create the trail edge and tread. These stones are then locked together using a compactable aggregate. **Anchor Stones** should also be used to "lock" the structure into position. **Corral Rocks** will help to keep riders on the trail.

Stone Pitching is predominantly used for armouring steep trail grades to improve sustainability by reducing erosion. Flag Stones can be used in this situation too, but they should also be **"Anchored"** into position.



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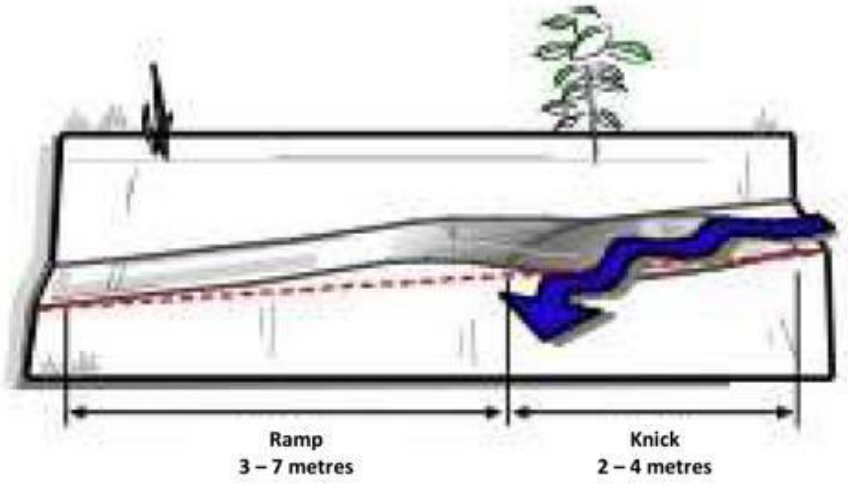
1

Rolling Grade Dips (RGDs)	
A **Rolling Grade Dip** is generally used in place of the traditional "water bar" and hence is used to "force" surface water off the trail tread. This technique is often used to facilitate drainage on existing trails, where the trail tread has become "cupped" or "bermed". Start by excavating the soil in a nominated location to create a "spoon drain" or "knick". This drainage feature should be "out-sloped" more dramatically than the rest of the trail at a gradient of up to 15%. Use the excavated soil to build up the lower end of the Grade Dip, to accentuate the height of the "roller" by 100 to 500mm. This "roller" should be gentle to ride over and blended into the trail and back slope. Furthermore, the bottom of the grade dip should be a least a bike length long to disperse downward force adequately and reduce pressure on the trail surface. In extremely wet areas with soft soils and high trail use, it may be necessary to armour the bottom of the RGD using a Stone Pitching Technique to ensure effective drainage all year round.	

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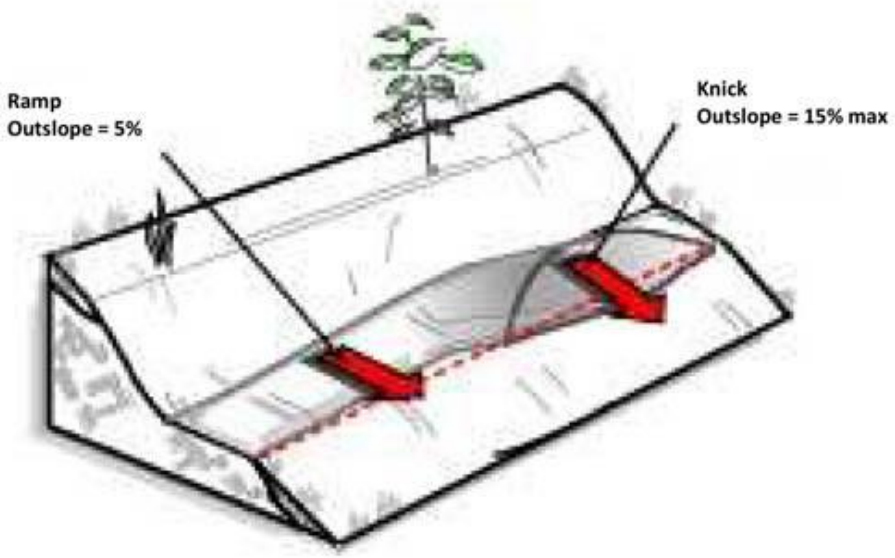
2

Knicks	
Knicks are used to drain puddles on existing trails where the trail tread is "cupped" or "bermed". With this technique, the surface of the trail is "out-sloped" to allow water to drain away easily. Choose a location where water is puddling or in a strategic location to prevent water running along the trail. Simply excavate or rake the soil downhill from the trail to create an exaggerated "outslope" of up to 15% grade. Make sure the lower end of the knick is free of debris and excavated material and blend the knick into the side-slope. This is particularly important in areas with gentle side-slopes as drainage is slower and more likely to become blocked with leaf litter and other materials over time.	

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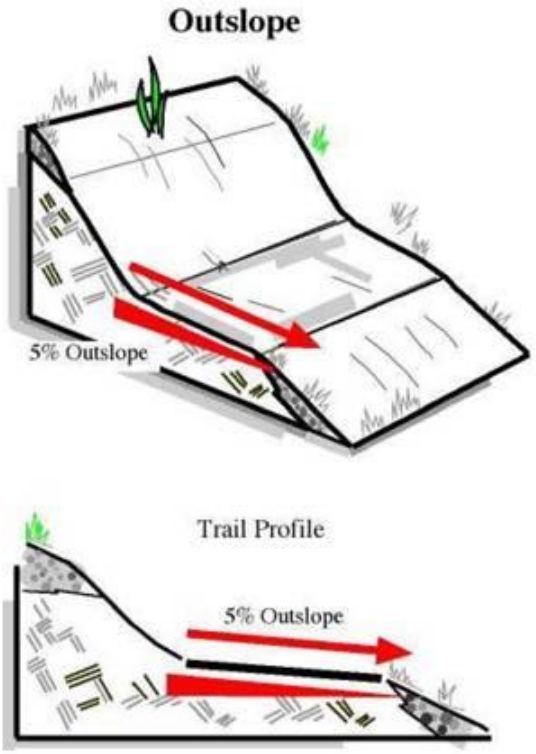
3

Outslope

Outslope simply refers to a gentle "off-camber" trail tread that is used to allow effective drainage of the trail surface in much the same way that "paving" is laid to sheet water away from buildings and direct surface water to an appropriate drainage point.

Outslope of 5% is virtually unnoticeable to the human eye, but will ensure that surface water runs across the trail surface (at perpendicular angles) rather than along the trail. This feature will reduce erosion potential and hence will enhance the longevity of your trail.

High trail user numbers and / or trail use in wet conditions may cause "cupping" of the trail tread whereby the trail surface is compacted or displaced, thus creating more of an in-sloping trail tread. In this instance it will be important to reinstate the outslope using hand tools or machinery to stop water puddling on the trail surface, or running along the trail.



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4

Corner Enhancement - Insloped Turns (Berm) – Flow and Camber	
Insloped Corners are designed and built to allow riders to turn 180 degrees with great ease, fun and flow. To allow this it is important to provide appositive camber (inslope) so that riders can maintain a reasonable pace around the corner. To reduce brake impacts, a small grade reversal or grade dip should be developed at the entry to the corner to wash off speed and provide space for riders to position themselves on the bike and get ready for the corner. A grade reversal at the start and finish of the corner will not only be fun to ride, but will also ensure that the corner sheds water and maintains a firm riding surface all year round. In most instances, IMBA Australia recommends the use of stone (as illustrated) to allow the positive camber to be developed and provide a solid foundation for the bottom of the corner. The use of stone to construct a dry stone wall will make a strong corner that lasts for many years.	

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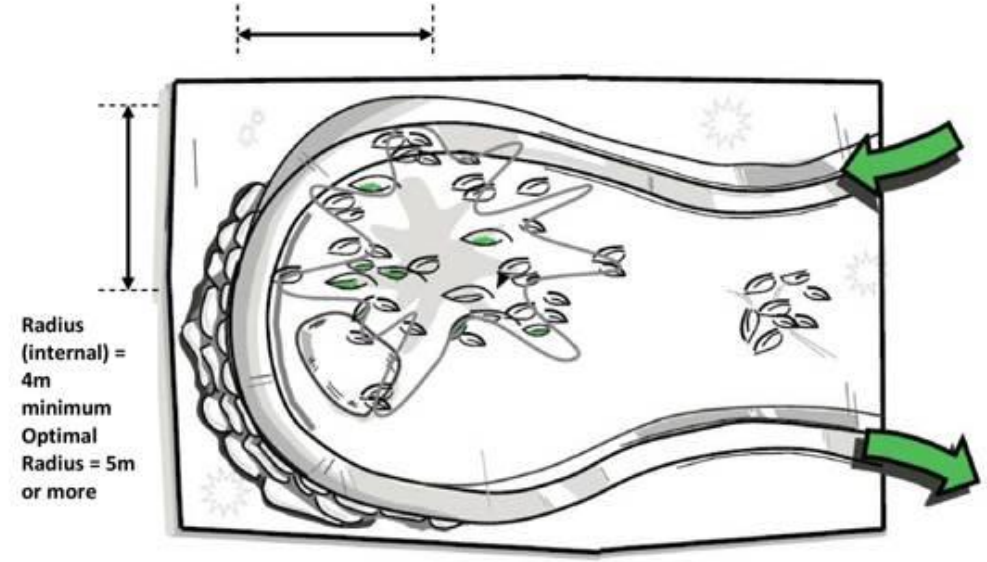
Corner enhancement - Insloped Turn (Berm) – Radius

The **radius** of the **Insloped Turn** is important for the longevity of the corner. A consistent and predictable radius will allow riders to maintain a comfortable pace and ride the corner easily without heavy braking or skidding. Furthermore, an enjoyable corner will reduce the desire to short cut or straight line the trail in open areas.

The best way to measure the radius of the corner is measure the diameter using a tape measure in order to find your centre point. Then "walk" the arch or radius, using pin flags or similar to mark the optimal radius. Once the inside and outside radius of the trail is marked it will be easy to identify why the corner is or is not working properly.

As well as the radius it is important to ensure that the rider is able to lean into the corner properly. That means any trees or rocks that are reducing the space for riders to lean into the corner should be moved or removed. If this is not possible, consider re-positioning the corner in a more appropriate location.



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Chokes and Corrals

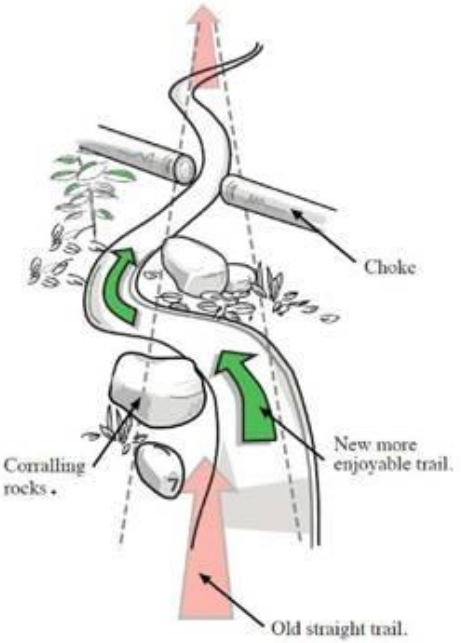
Chokes and Corrals are used to "formalise" or "anchor" the trail flow and dictate the speed of the trail. They can also be used to protect plants on the side of the trails

Use logs and rocks to "anchor" the trail and keep trail users riding on the trail surface provided. Make sure the flow and feel of the trail is appropriate for its intended use. Any inconsistencies in trail flow will cause riders to either move the logs and stones or ride around them.

This technique allows for clear sightlines, will keeping the trail tread narrow.

For **tight and technical** sections of trail a distance of 5m between corrals alternating left and right is recommended.

For **fast and flowing** sections of trail a distance of 10 to 15m between corrals alternating left and right is recommended



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Using Rock to Harden Technical Trail Features (TTFs)

IMBA Australia recommends that log "roll-overs" and TTFs should be anchored and armoured with stone to ensure longevity, safety and sustainability.

The use of small logs to create "ramps" over large logs can lead to risks because they are slippery and can rot which leads to poor riding surfaces and loss of structure integrity. Hence IMBA recommends that rock armouring techniques are use to harden ramps and anchor large logs in place.

In some instances it may be worthwhile completely replacing the log TTF with stone which will reduce need for regular checks to ensure structure integrity and ongoing maintenance. An example of this repair technique is depicted in the photos to the right.

A log TTF before repair

Log TTF replaced with stone with "B-Line" option

The finished product

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8

7.0 Trail Difficulty Rating System - User Guide

	Very easy  White Circle	Easy  Green Circle	Intermediate  Blue Square	Difficult  Single Black Diamond	Extreme  Double Black Diamond
Description	Likely to be a fire road or wide single track with a gentle gradient, smooth surface and free of obstacles. Frequent encounters are likely with other cyclists, walkers, runners and horse riders.	Likely to be a combination of fire road or wide single track with a gentle gradient, smooth surface and relatively free of unavoidable obstacles. Short sections may exceed these criteria. Frequent encounters are likely with walkers, runners, horse riders and other cyclists.	Likely to be a single trail with moderate gradients, variable surface and obstacles.	Likely to be a challenging single trail with steep gradients, variable surface and many obstacles.	Extremely difficult trails will incorporate very steep gradients, highly variable surface and unavoidable, severe obstacles.
Suitable for	Beginner/ novice cyclists. Basic bike skills required. Suitable for most bikes.	Beginner/ novice mountain bikers. Basic mountain bike skills required. Suitable for off-road bikes.	Skilled mountain bikers. Suitable for mountain bikes.	Experienced mountain bikers with good skills. Suitable for better quality mountain bikes.	Highly experienced mountain bikers with excellent skills. Suitable for quality mountain bikes.
Fitness Level	Most people in good health.	Most people in good health.	A good standard of fitness.	Higher level of fitness.	Higher level of fitness.
Trail Width	Two riders can ride side by side.	Shoulder width or greater.	Handlebar width or greater.	Can be less than handlebar width.	Can be less than handlebar width.
Trail Surface and obstacles	Hardened with no challenging features on the trail.	Mostly firm and stable. Trail may have obstacles such as logs, roots and rocks.	Possible sections of rocky or loose tread. Trail will have obstacles such as logs, roots and rocks.	Variable and challenging. Unavoidable obstacles such as logs, roots, rocks drop-offs or constructed obstacles.	Widely variable and unpredictable. Expect large, committing and unavoidable obstacles.
Trail Gradient	Climbs and descents are mostly shallow.	Climbs and descents are mostly shallow., but trail may include some moderately steep sections.	Mostly moderate gradients but may include steep sections.	Contains steeper descents or climbs.	Expect prolonged steep, loose and rocky descents or climbs.

8.0 Trail Difficulty Rating System Land Managers Guide

	Very easy White Circle	Easy Green Circle	Intermediate Blue Square	Difficult Single Black Diamond	Extreme Double Black Diamond
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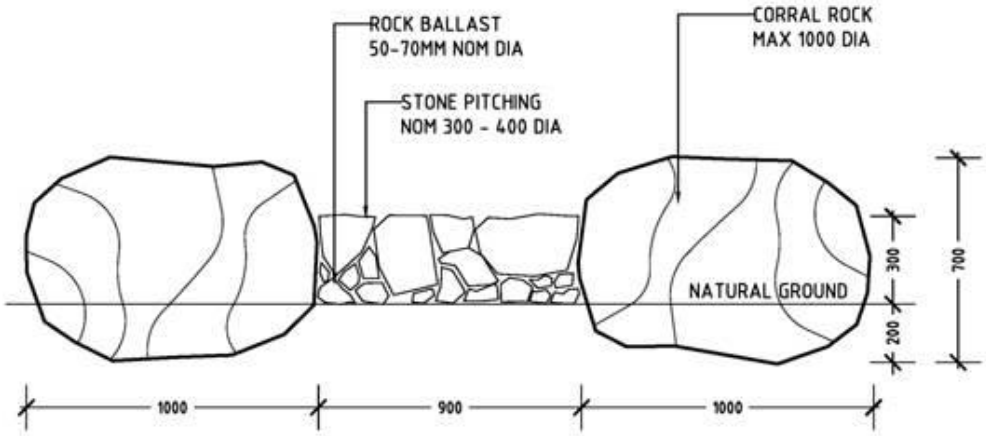
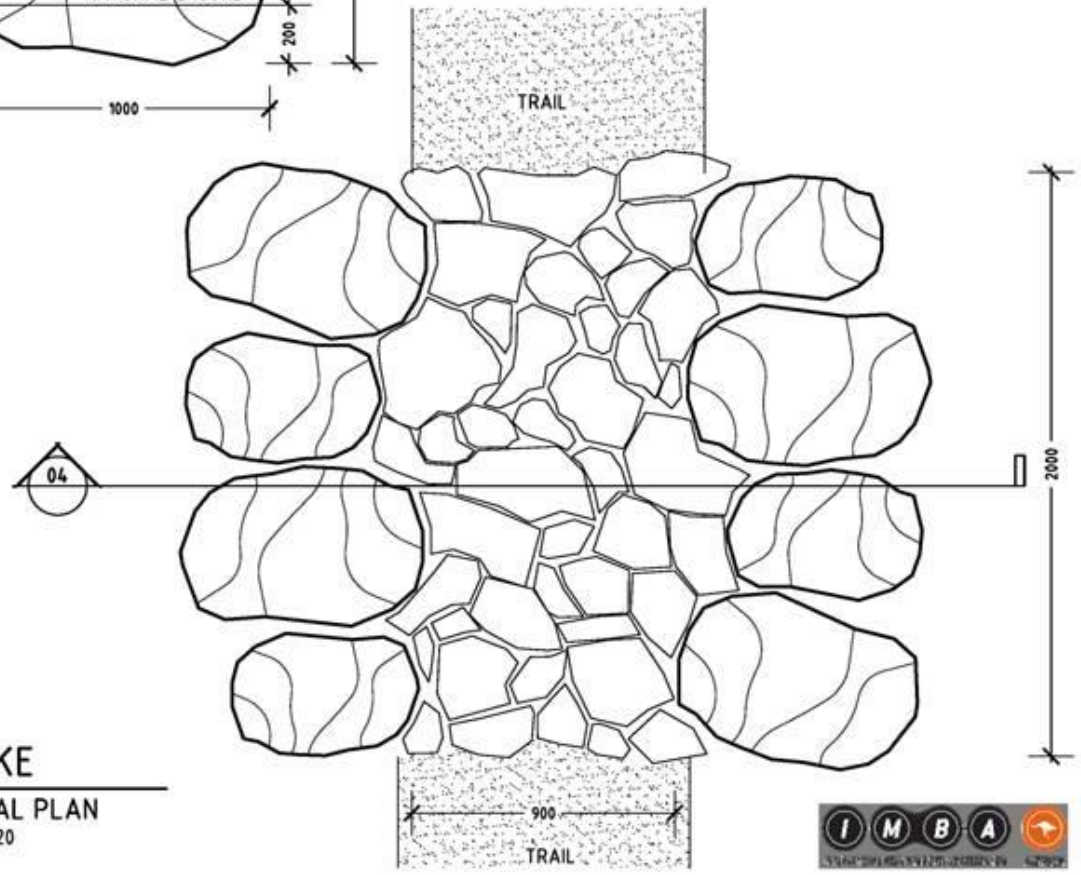
Trail Width	2100mm plus or minus 900mm	900mm plus or minus 300mm for tread or bridges.	600mm plus or minus 300mm for tread or bridges.	300mm plus or minus 150mm for tread and bridges. Structures can vary.	150mm plus or minus 100mm for tread or bridges. Structures can vary.
Trail Surface	Hardened or smooth.	Mostly firm and stable.	Possible sections of rocky or loose tread.	Variable and challenging.	Widely variable and unpredictable.
Average Trail Grade	Climbs and descents are mostly shallow. Less than 5% average.	Climbs and descents are mostly shallow, but may include some moderately steep sections. 7% or less average.	Mostly moderate gradients but may include steep sections. 10% or less average.	Contains steeper descents or climbs. 20% or less average.	Expect prolonged steep, loose and rocky descents or climbs. 20% or greater average
Maximum Trail Grade	Max 10%	Max 15%	Max 20% or greater	Max 20% or greater	Max 40% or greater
Level of Trail Exposure	Firm and level fall zone to either side of trail corridor	Exposure to either side of trail corridor includes downward slopes of up to 10%	Exposure to either side of trail corridor includes downward slopes of up to 20%	Exposure to either side of trail corridor includes steep downward slopes or freefall	Exposure to either side of trail corridor includes steep downward slopes or freefall

Natural Obstacles and Technical Trail Features (TTFs)	No obstacles.	Unavoidable obstacles to 50mm (2") high, such as logs, roots and rocks. Avoidable, rollable obstacles may be present. Unavoidable bridges 900mm wide. Short sections may exceed criteria.	Unavoidable, rollable obstacles to 200mm (8") high, such as logs, roots and rocks. Avoidable obstacles to 600mm may be present. Unavoidable bridges 600mm wide. Width of deck is half the height. Short sections may exceed criteria.	Unavoidable obstacles to 380mm (15") high, such as logs, roots, rocks, drop-offs or constructed obstacles. Avoidable obstacles to 1200mm may be present. Unavoidable bridges 600mm wide. Width of deck is half the height. Short sections may exceed criteria.	Large, committing and unavoidable obstacles to 380mm (15") high. Avoidable obstacles to1200mm may be present. Unavoidable bridges 600mm or narrower. Width of bridges is unpredictable. Short sections may exceed criteria.



4 CHOKE
TYPICAL SECTION
SCALE 1:20



3 CHOKE
TYPICAL PLAN
SCALE 1:20

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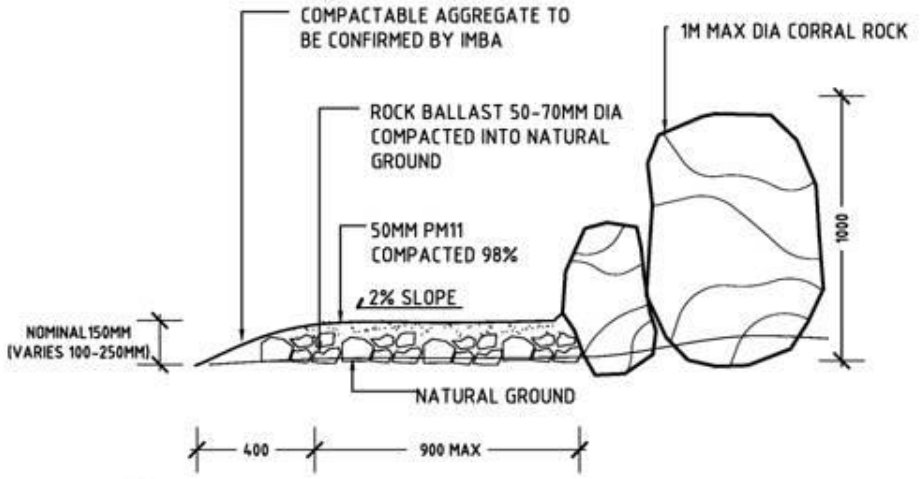
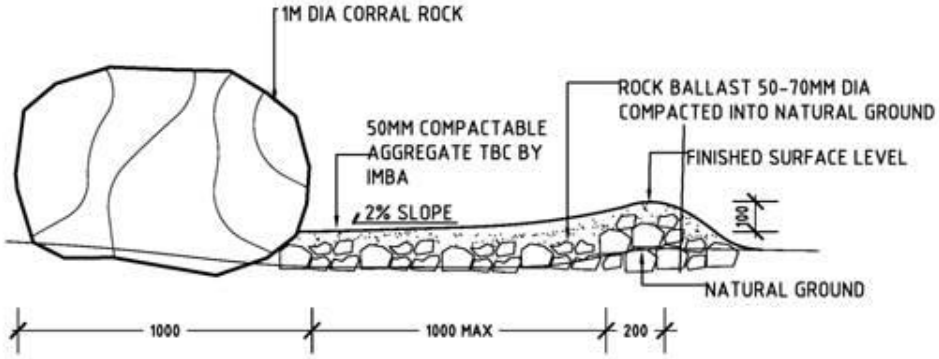


5 CORRAL ROCK
TYPICAL DETAIL
SCALE 1:20



6 CORRAL ROCK WITH BERM
TYPICAL DETAIL
SCALE 1:20

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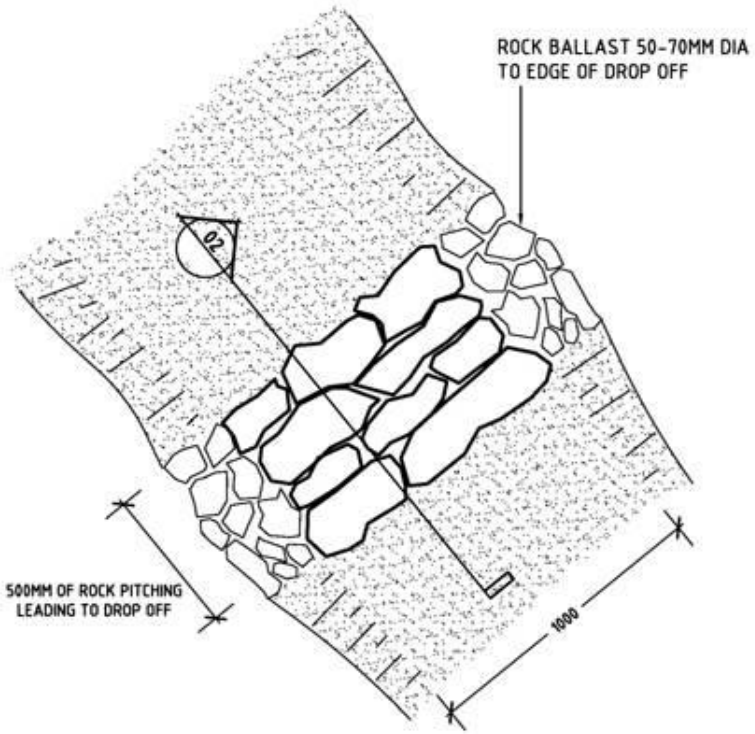
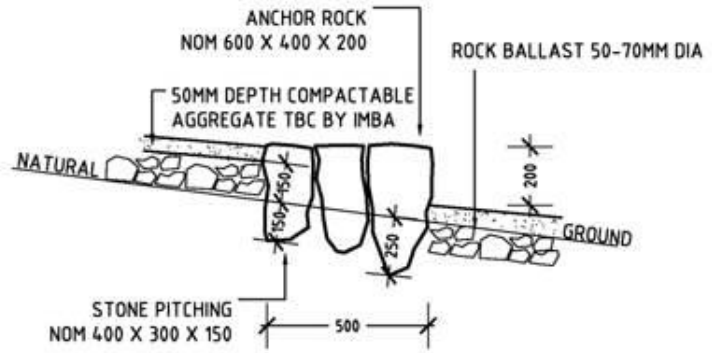


1 DROP OFF
TYPICAL PLAN
SCALE 1:20



2 DROP OFF
TYPICAL SECTION
SCALE 1:20

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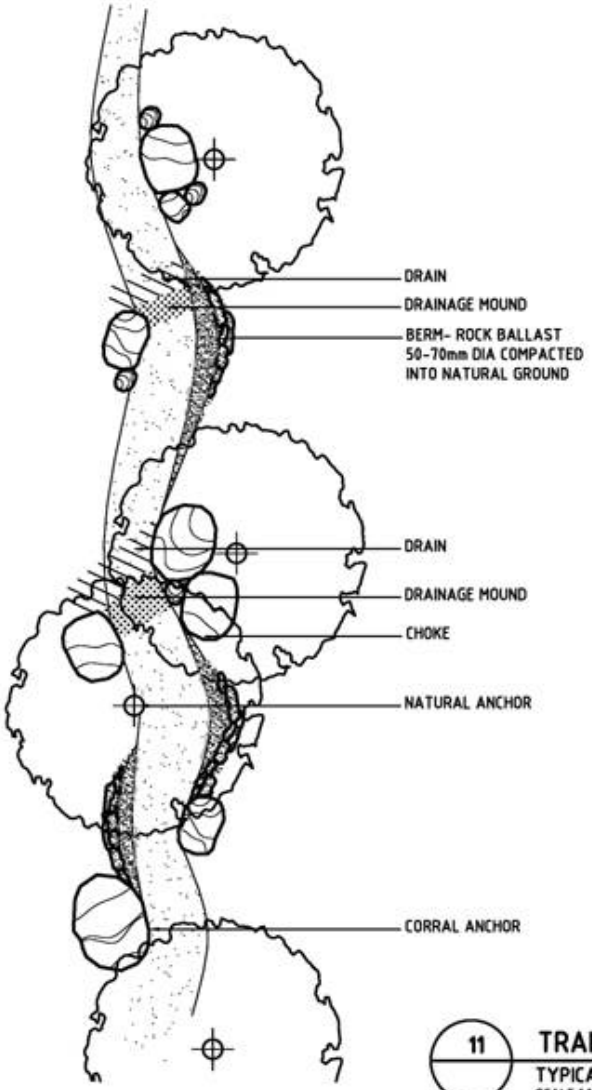

11 TRAIL
TYPICAL PLAN
SCALE 1:100

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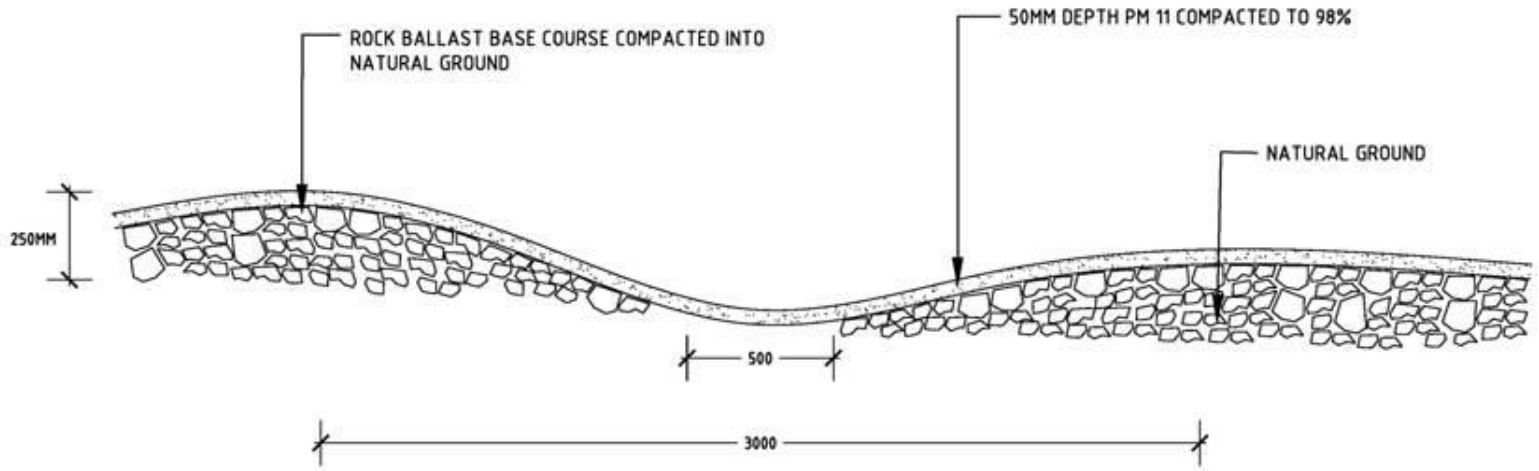
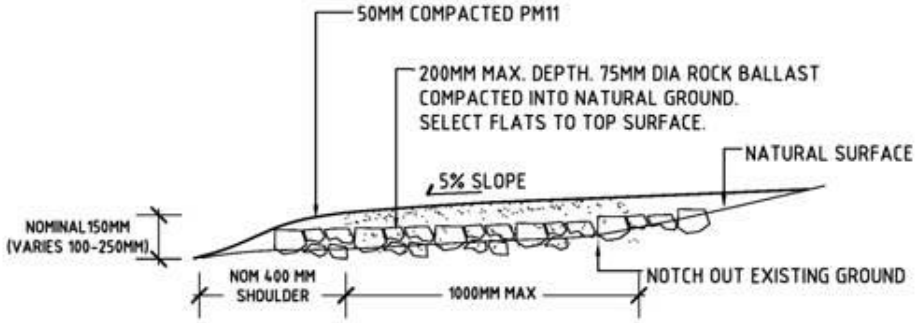


7 TRAIL GRADE REVERSAL: 3m

TYPICAL LONGITUDINAL SECTION

SCALE 1:20



8 TRAIL GRADE REVERSAL

TYPICAL SECTION

SCALE 1:20

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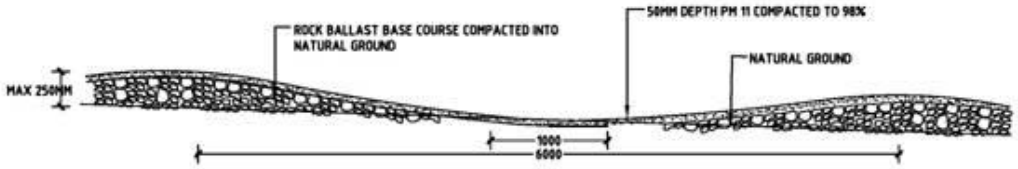
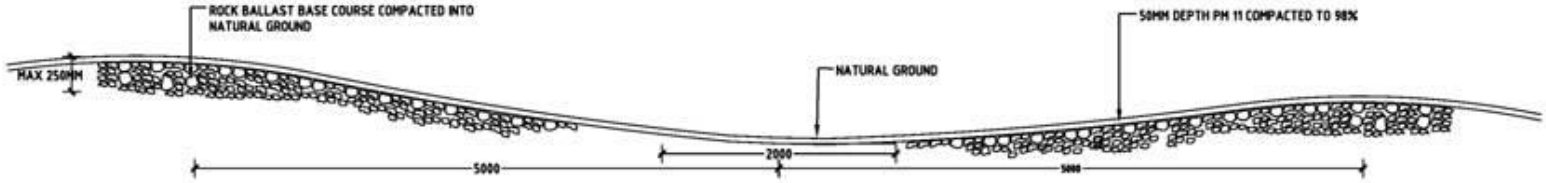


9 **TRAIL GRADE REVERSAL: 6m**
TYPICAL LONGITUDINAL SECTION
SCALE 1:50



10 **TRAIL GRADE REVERSAL: 10m**
TYPICAL LONGITUDINAL SECTION
SCALE 1:50

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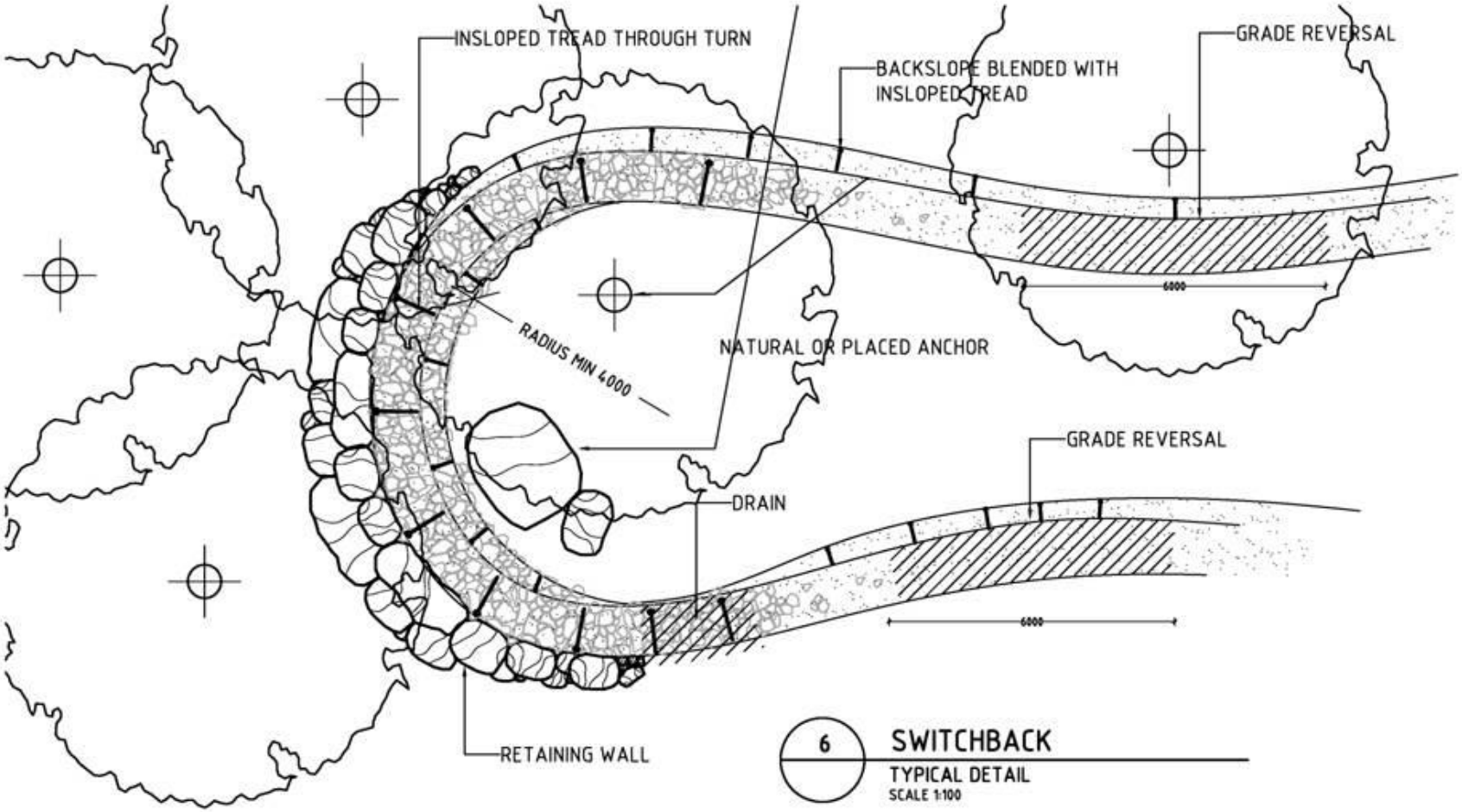

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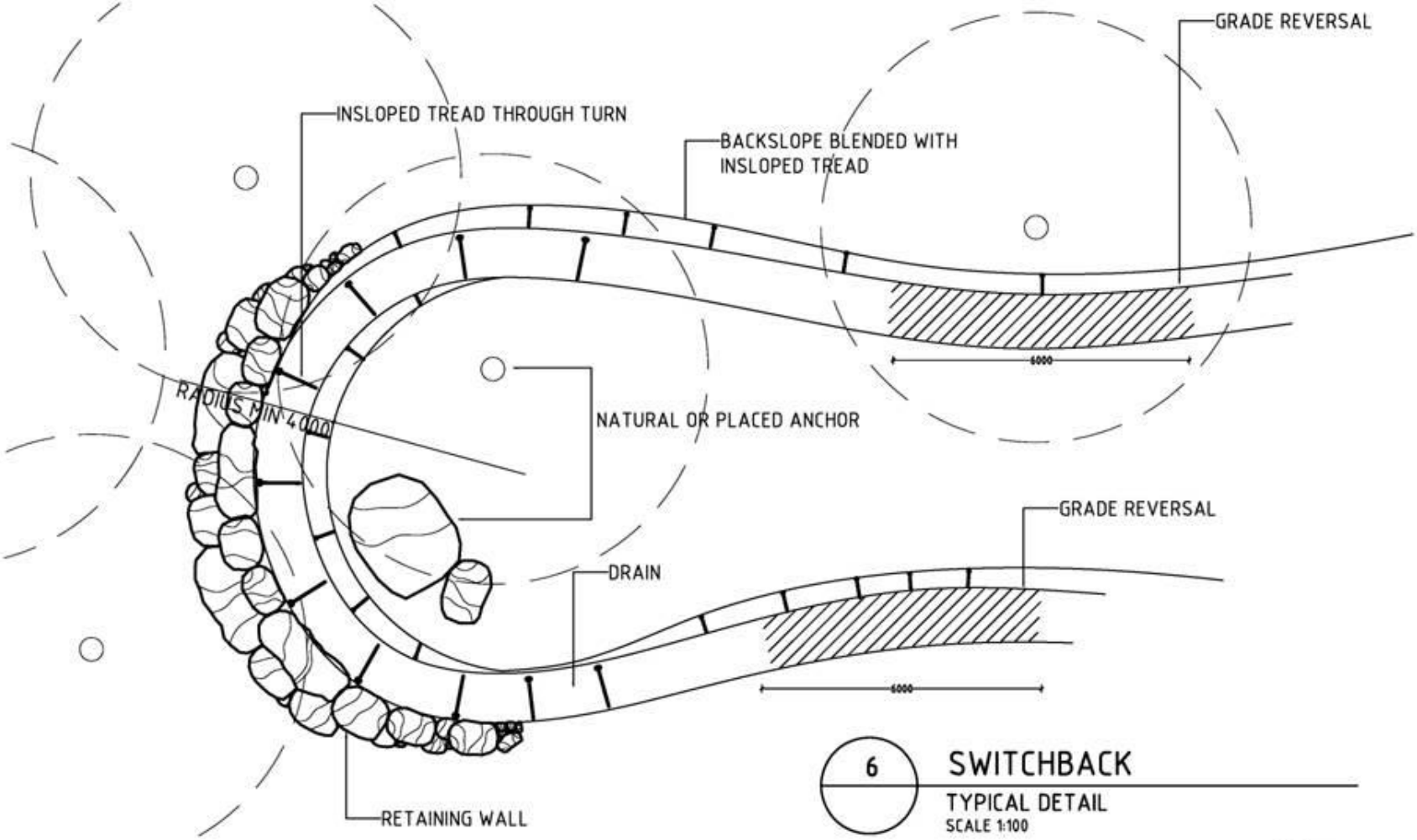

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1. IMBA Australia Trail Difficulty Ratings

1.0 Trail Difficulty Rating System - User Guide

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1.2 Trail Difficulty Rating System Land Managers Guide

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Maximum Trail Grade	Max 10%	Max 15%	Max 20% or greater	Max 20% or greater	Max 40% or greater

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Level of Trail Exposure	Firm and level fall zone to either side of trail corridor	Exposure to either side of trail corridor includes downward slopes of up to 10%	Exposure to either side of trail corridor includes downward slopes of up to 20%	Exposure to either side of trail corridor includes steep downward slopes or freefall	Exposure to either side of trail corridor includes steep downward slopes or freefall
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Appendix D Hornsby Trail Monitoring, Audit and Trailcare Program

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A TETRA TECH COMPANY

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