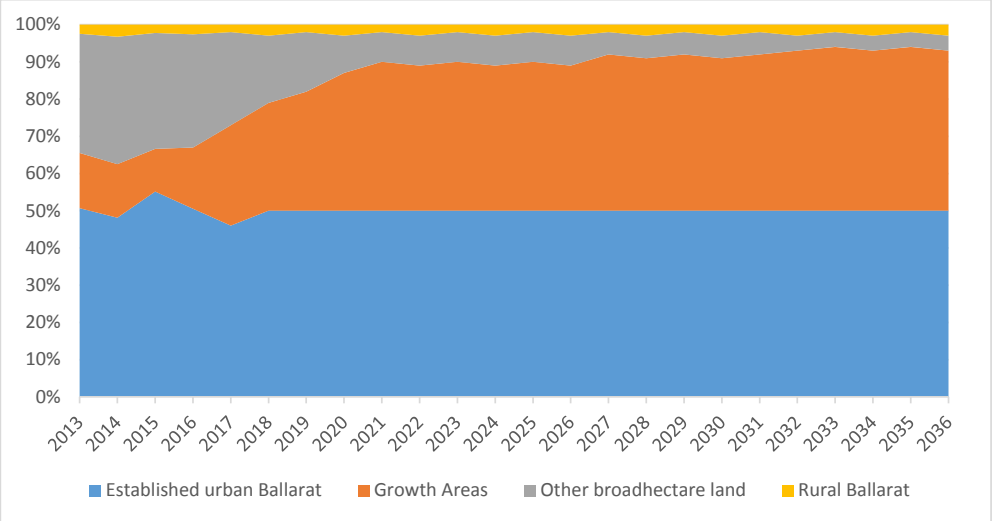
Figure 10: Scenario 2 - share of dwellings by location, Ballarat, 2016 to 2036



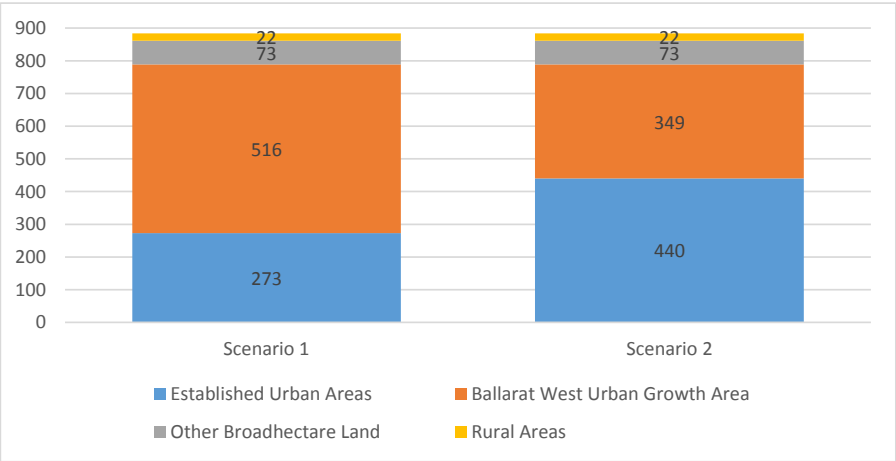
Source: Tim Nott

This scenario satisfies Council's policy target of 50% infill housing. Council has identified a range of initiatives in the Ballarat Strategy to achieve this target (see initiatives 3.1 to 3.3). These include encouraging higher density housing forms in established areas, facilitating development of urban renewal precincts and structure planning for key change areas.

4.4 Scenario Comparison

The following chart provides a comparison of the average annual number of new dwellings in each land type for each scenario.

Figure 11: Comparison of average annual new dwellings by land type for each scenario, Ballarat, 2016 to 2036



Source: Tim Nott

In scenario 1, there is a step change as the urban growth area begins to accommodate the majority of new dwellings in Ballarat, accounting for two thirds of all new dwellings in the latter parts of the study period. Demand in other parts of Ballarat, including infill locations, is correspondingly low. This scenario has the benefit that new services can be concentrated in the Ballarat West Urban Growth Area. However, Ballarat has until now provided a wide variety of outlooks and locations for new dwellings all around the City. It is not certain whether this scenario will cater sufficiently for the aspirations and preferred outlooks of residents.

In scenario 2, the urban growth area accommodates a slightly higher proportion of new dwellings than it has in recent years, with growth area suburbs likely to accommodate 40%-44% of new dwellings after 2021, compared with 37% in the 2010 to 2017 period. This scenario allows for 50% of new dwellings to be built in infill locations, in existing residential, commercial and township zones all around the municipality. This outcome better preserves choice of location. Given that more houses will be in infill locations, and therefore likely to be smaller houses and apartments, it also caters better for the needs of a wider variety of household types.

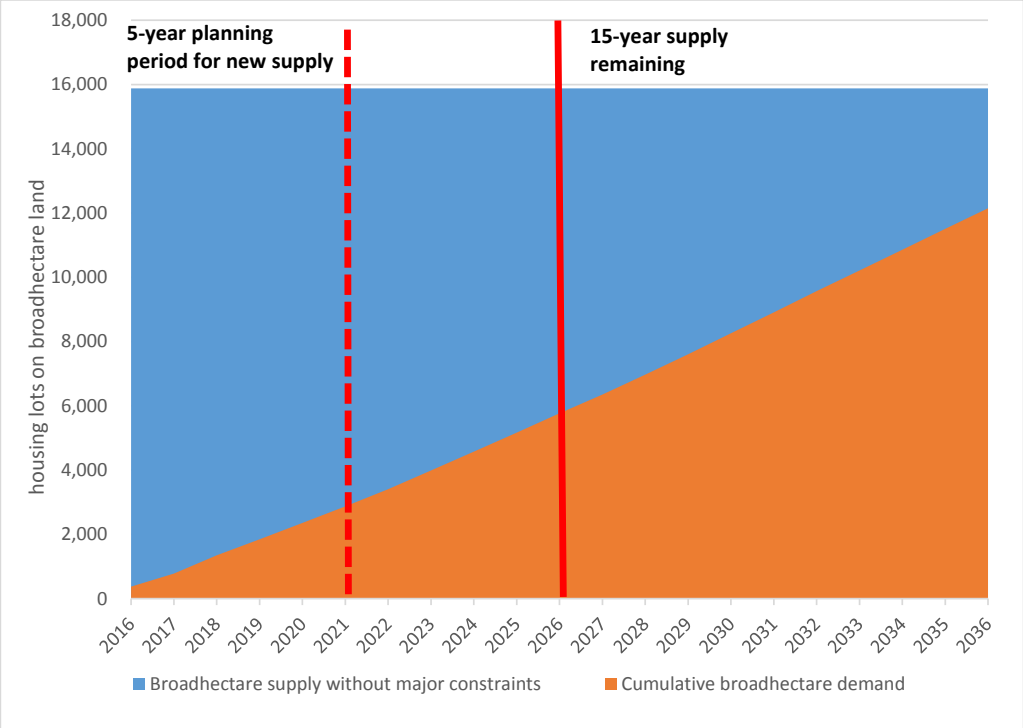
5 TIMING OF NEW GREENFIELD SUPPLY

A key question for this project is how long the supply of land in the Urban Growth Area will last and when a major new greenfield area will be required. In planning for housing, the State Government directs that Councils should "plan to accommodate projected population growth over at least a 15-year period" (Ballarat Planning Scheme, 11.02). Here this is interpreted to mean the provision of 15 years of available broadhectare land supply. The timing of new greenfield supply has been calculated here using the demand scenarios outlined in the previous section. The demand in the scenarios is compared with the supply of broadhectare land without major constraints to development identified by HillPDA in 2013 and adjusted to take account of development between 2013 and 2016.

5.1 Scenario 1: Current Trends

The following chart shows the supply of broadhectare lots (15,878 lots in total) and the cumulative take-up of those lots according to scenario 1 based on current trends as identified by .id for Council.

Figure 12: Scenario 1 - take-up of all broadhectare lots, 2016 to 2036



Source: Tim Nott

Total demand for broadhectare lots over the period 2016 to 2036 in this scenario is 12,148, or 589 per year over the period. Projecting forward, demand for broadhectare lots will equal the existing supply at around 2041. Heeding the policy directive in the Planning Scheme, new supply will be required in 2026 (that is, 15 years before 2041 when the broadhectare demand begins to outstrip

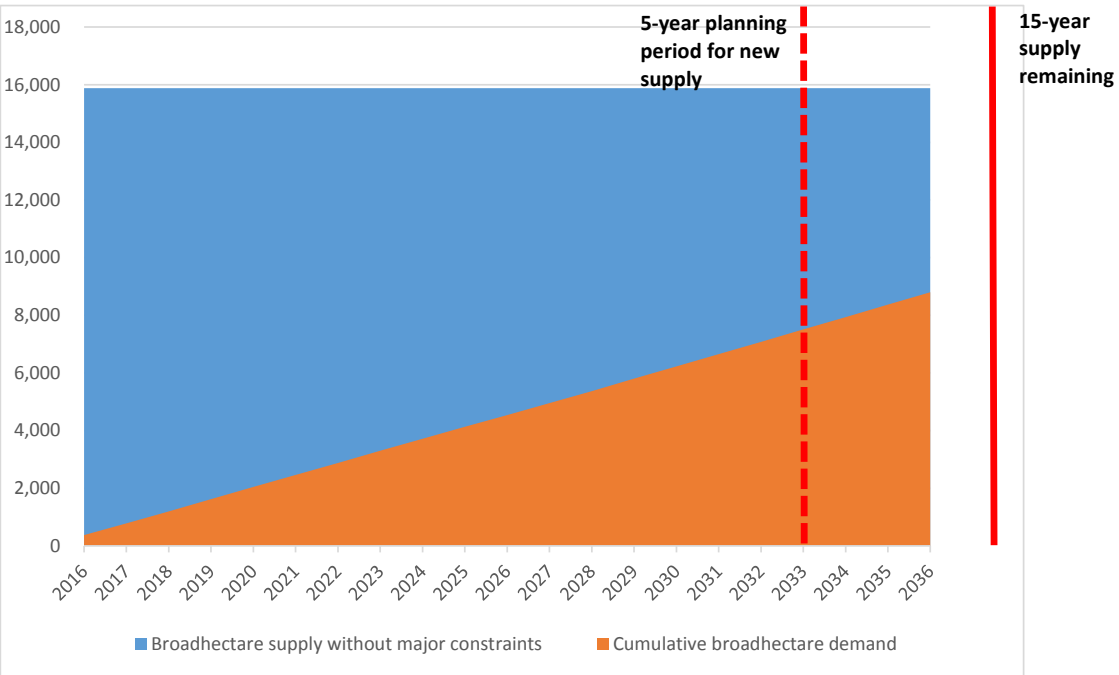
supply). Planning for this new land supply – including framework plans, rezoning, infrastructure plans and precinct structure plans – would take around five years. Planning should therefore commence by 2021.

The reader should recall that the supply here is taken to be lots on broadhectare land without major constraints. It may be that the constraints on at least some of this land may be overcome, releasing up to 3,400 additional broadhectare lots onto the market. This would push back the need for additional broadhectare land by up to five years or so.

5.2 Scenario 2: 50% infill

The following chart shows the supply of broadhectare lots and the cumulative take-up of those lots according to scenario 2 based on achieving Council's policy target of 50% of new dwellings in existing neighbourhoods.

Figure 13: Take-up of unconstrained broadhectare lots, 2013 to 2040



Source: Tim Nott

In this scenario, total demand for broadhectare lots over the period 2016 to 2036 is 8,798, or 421 per year. Projecting forward, total demand will equal supply at around 2053. Heeding the policy directive in the Planning Scheme, new supply will be required in 2038 (that is, 15 years before 2053 when the broadhectare demand begins to outstrip supply). Planning for this new land supply – including framework plans, rezoning, infrastructure plans and precinct structure plans – would take around five years. Planning should therefore commence by 2033. Again, this may be a conservatively short timeframe if identified land with major constraints can be brought onto the market to boost the supply.

5.3 Conclusions on the Timing of New Urban Growth Areas

The two scenarios examined here show a significant difference in the timeframe for the commencement of new urban growth areas in Ballarat. A scenario based on the existing forecasts for dwellings prepared for Council by .id shows that a new urban growth area will be required by 2026 in order to maintain a clear 15-year supply of broadhectare land for the City. However, this scenario suggests that infill development will account for only 31% of new dwellings over the period 2016 to 2036, much lower than Council's policy target in the Ballarat Strategy.

An alternative scenario, in which Council's target of 50% infill is achieved shows that a new urban growth area will not be required until 2038. This scenario still allows the Ballarat West Growth Area to accommodate 349 new dwellings per year on average over the period 2016 to 2036, a more rapid development than hitherto.

There is a 12-year time difference in the need to have a new urban growth area available between the two scenarios. The studies reviewed for this project – see Appendix 2 - suggest that the cost to the community of greenfields development far outweighs the cost of infill development. From this viewpoint, it would be preferable to push back the need for greenfield development in new urban growth areas. The ability to do so will depend in part on Council successfully implementing the measures designed to promote infill development outlined in the Ballarat Strategy.

6 CONSEQUENCES OF A NEW GROWTH AREA

The introduction of a new growth area will have some significant consequences for Council. These include:

- Additional costs for infrastructure provision in the new growth area
- Potentially, additional holding costs of debt associated with the provision of infrastructure in the existing Ballarat West growth area as development in that area slows down
- The likelihood of achieving 50% infill development would recede further

The latter point has been discussed in section five above. This section looks at the additional costs to Council.

6.1 Costs of New Infrastructure

Council will incur additional infrastructure costs as a result of any new growth area in two ways:

1. As a share of items in the development contributions plan (DCP) for the area that benefit the wider community
2. For items that are not covered by the development contributions plan

Items that are not covered by the DCP include unforeseen expenditures or expenditures that cannot be covered by the plan. For example, the funds raised may not be sufficient to deliver the requisite facilities to Council standards, in which case, Council needs to make up any shortfall. These types of costs are difficult to ascertain in advance and are not dealt with here.

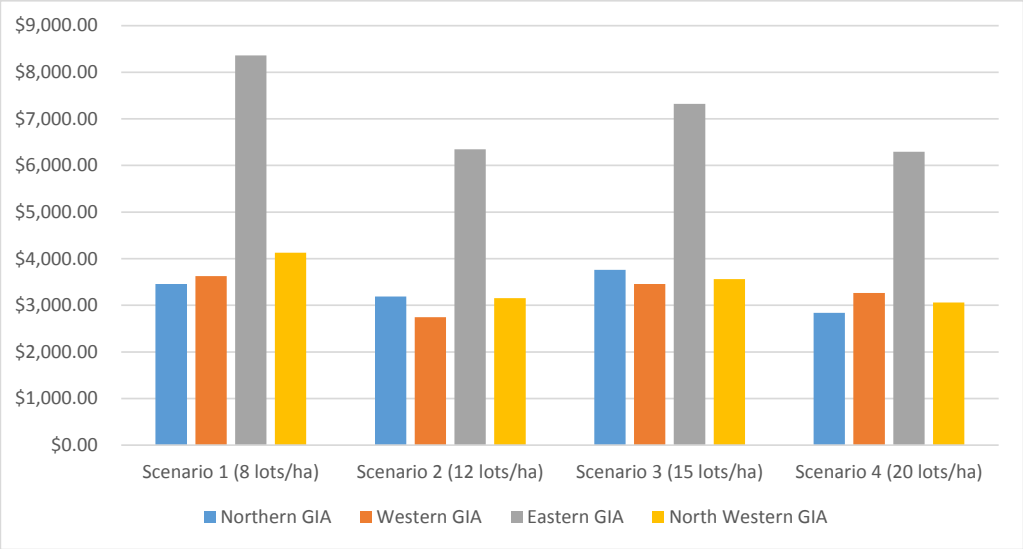
In any DCP, some items will have a benefit that goes well beyond the growth area – regional roads and parks, for example – and an appropriate portion of these is paid for by the Council. In the case of Ballarat West, for example, around 22% of planned infrastructure spending is not funded by contributions from land developers but must be funded by Council (although Council may be able to recoup some of that spending through grants or agreements with State Government agencies such as VicRoads). Judging by other DCPs for growth areas around Victoria, a more typical share of the DCP that would need to be funded by Council is 10%[1].

ARUP has provided infrastructure costs for many of the elements required to develop each of the four growth areas but no costs are available for land or road infrastructure. However, it is impossible to accurately identify the infrastructure costs for which Council would be liable in the absence of a DCP for the chosen growth area. Nevertheless, Council is understandably keen to get some indication of the likely costs. For the purposes of this report a very preliminary indication of infrastructure costs is provided using the information from ARUP and proxies for land and road costs based on other DCPs including that for Ballarat West.

The following chart illustrates that very preliminary indication of infrastructure costs to Council in each of the growth investigation areas. The costs are presented on a per-lot basis in order to provide a fair comparison.

[1] This is the median requirement for 14 DCPs examined in Melbourne's growth areas for example.

Figure 14: Preliminary indication of Council infrastructure cost per lot, greenfield investigation areas ($2015)



Source: Tim Nott
Notes:
Estimates for the cost of infrastructure elements for each scenario have been made as follows:

- Figures for drainage, active open space and community centres in each GIA provided by ARUP for this project
- No figures are available for likely road infrastructure and so, following the example of Ballarat West, a preliminary estimate of 23% of the total costs has been allowed.
- No figures are available for likely land costs and therefore an allowance for land purchase has been made starting at 24%[2] of the total for the area with the cheapest land (the Western GIA) and adjusted to take account of the higher land costs in other GIAs (and land costs have been estimated from Council records)

The share of the total infrastructure cost to be provided by Council is assumed to be 22% in each case in order to provide a comparison with the Ballarat West growth area (although a more typical share would be around 10% - see above). The total cost has been divided by the number of lots to be provided in each case to get the cost per lot to Council.

These figures are intended to indicate the broad scale of potential costs and the differences in cost between the various GIAs. They should not be used for financial planning purposes. In particular, the road infrastructure and land purchase costs are assumed to be a proportion of the total cost here but may differ significantly. The share of costs attributable to Council may also be quite different from the assumptions here. The true costs of GIA infrastructure will only be understood with the preparation of a DCP.

This illustration of potential costs suggests that the differences between the Northern, Western and North Western GIAs are not substantial, with cost per lot between $2,700 and $4,100 across the various scenarios and generally within 20% of each other for each scenario. The Eastern GIA is always the highest cost GIA and this is mainly a result of high land costs.

[2] This is the median figure for 14 DCPs examined in Melbourne's growth areas

For comparison, the total cost per lot to Council in the Ballarat West case is around $2,200 ($2014).

6.2 Impacts on the Ballarat West DCP

The introduction of a new growth area will attract house buyers who would otherwise have bought into Ballarat West. It is reasonable to assume that both the growth areas will be serving the same market and that any new growth area will not draw a large proportion of its customers from people who would otherwise by settling in the established residential areas (since such people would have had the choice to buy into Ballarat West). This will have the effect of slowing down development in Ballarat West as demand is split between the two growth areas. This will likely have some impact on the costs of development for Council.

Through DCPs, Councils are obligated to deliver infrastructure at certain trigger points, such as when the number of dwellings reaches a certain level or when new parts of the development precinct are opened up. At first glance, then, any slow down in the rate of development and development contributions would simply be matched by a slow down in the rate of provision. However, DCP financing is more complex. In the initial stages of development, most development contributions from developers are paid in the form of in-kind works and not cash. Often, when it comes time for Councils to deliver the first elements of infrastructure for which they are responsible, they have collected little or nothing in the form of development finance. Council must therefore borrow money to undertake the development and then pay off the loans as the development contributions flow through in the later stages of precinct development.

If a new growth area is introduced, the expected flow of contributions to service the debt will be reduced and Council's interest costs will increase. Consider the following hypothetical example:

- Council borrows $10 million at the beginning of 2020 to undertake works. The interest-only loan is for ten years, with annual interest of $400,000 (4%). The development contributions to pay the loan are expected to flow from 2026, with sufficient contributions by 2030 to pay off the principal.
- A new growth area is approved and comes on stream in 2026 – as per scenario 1 in sections 4 and 5 of this report. This new growth area accounts for half of all the expected dwellings in Ballarat's growth areas thereafter.
- The expected contributions flowing to Ballarat West that are needed to service the loan fall by half. Instead of taking four years from 2026 to accumulate sufficient funds to pay the principal, it takes eight years. In 2030, the loan must be renegotiated and extended by four years, because Council has not received sufficient contributions to pay it all off. Council can only pay $5 million and must take out another loan for $5 million for four years with an interest cost of $0.8 million.

In this example, the Ballarat ratepayers are liable for an additional interest bill of $0.8 million over four years as a result of the introduction of a new growth area.

There are many factors that could affect the rate of development in Ballarat West but the introduction of a new growth area will certainly have an impact, affecting Council's ability to service loans and deliver infrastructure to the Ballarat West community. In order to minimise any such impact, Council would need to know the timing of any new growth area prior to entering into infrastructure loans.

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APPENDIX 1: HOUSING DEVELOPMENT SCENARIOS

Scenario 1: Total dwellings and share of total dwellings

Year	Total dwellings	Total additional dwelling demand	Share of total dwellings Established urban Ballarat	Ballarat West Growth Area	Other broadhectare land	Total broadhectare land	Rural Ballarat	Total
	dwellings	dwellings	%	%	%	%	%	%
2013	43,065	803	51%	15%	32%	47%	2%	100%
2014	43,865	800	48%	14%	34%	49%	3%	100%
2015	44,853	988	55%	11%	31%	43%	2%	100%
2016	45,652	799	51%	16%	30%	47%	3%	100%
2017	46,432	780	46%	27%	25%	52%	2%	100%
2018	47,326	894	34%	45%	18%	63%	3%	100%
2019	48,207	881	41%	41%	16%	57%	2%	100%
2020	49,098	891	40%	47%	10%	57%	3%	100%
2021	49,981	883	39%	51%	8%	59%	2%	100%
2022	50,851	870	36%	53%	8%	61%	3%	100%
2023	51,746	895	33%	57%	8%	65%	2%	100%
2024	52,624	878	30%	59%	8%	67%	3%	100%
2025	53,498	874	30%	60%	8%	68%	2%	100%
2026	54,359	861	28%	61%	8%	69%	3%	100%
2027	55,217	858	30%	62%	6%	68%	2%	100%
2028	56,097	880	27%	64%	6%	70%	3%	100%
2029	56,999	902	27%	65%	6%	71%	2%	100%
2030	57,910	911	25%	66%	6%	72%	3%	100%
2031	58,793	883	25%	67%	6%	73%	2%	100%
2032	59,706	913	24%	69%	4%	73%	3%	100%
2033	60,610	904	26%	68%	4%	72%	2%	100%
2034	61,501	891	25%	68%	4%	72%	3%	100%
2035	62,409	908	26%	68%	4%	72%	2%	100%
2036	63,323	914	27%	66%	4%	70%	3%	100%

Scenario 1: Demand for dwellings each year

Year	Established urban Ballarat	Ballarat West Growth Area	Demand for dwellings each year Other broadhectare land	Total broadhectare land	Rural Ballarat	Total
	dwellings	dwellings	dwellings	dwellings	dwellings	dwellings
2013	407	119	257	376	20	803
2014	385	115	274	389	26	800
2015	545	113	308	421	22	988
2016	404	131	243	374	21	799
2017	359	211	195	406	16	780
2018	303	403	161	564	27	894
2019	359	363	141	504	18	881
2020	359	416	89	505	27	891
2021	344	451	71	522	18	883
2022	314	460	70	530	26	870
2023	295	511	72	583	18	895
2024	263	518	70	588	26	878
2025	262	525	70	595	17	874
2026	238	528	69	597	26	861
2027	255	534	51	585	17	858
2028	237	564	53	617	26	880
2029	246	584	54	638	18	902
2030	231	598	55	653	27	911
2031	220	592	53	645	18	883
2032	222	627	37	664	27	913
2033	238	612	36	648	18	904
2034	227	602	36	638	27	891
2035	237	617	36	653	18	908
2036	246	604	37	641	27	914

Scenario 2: Total dwellings and share of total dwellings

Year	Total dwellings	Total additional dwelling demand	Share of total dwellings Established urban Ballarat	Ballarat West Growth Area	Other broadhectare land	Total broadhectare land	Rural Ballarat	Total
	dwellings	dwellings	%	%	%	%	%	%
2013	43,065	803	51%	15%	32%	47%	2%	100%
2014	43,865	800	48%	14%	34%	49%	3%	100%
2015	44,853	988	55%	11%	31%	43%	2%	100%
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2024	52,624	878	50%	39%	8%	47%	3%	100%
2025	53,498	874	50%	40%	8%	48%	2%	100%
2026	54,359	861	50%	39%	8%	47%	3%	100%
2027	55,217	858	50%	42%	6%	48%	2%	100%
2028	56,097	880	50%	41%	6%	47%	3%	100%
2029	56,999	902	50%	42%	6%	48%	2%	100%
2030	57,910	911	50%	41%	6%	47%	3%	100%
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2032	59,706	913	50%	43%	4%	47%	3%	100%
2033	60,610	904	50%	44%	4%	48%	2%	100%
2034	61,501	891	50%	43%	4%	47%	3%	100%
2035	62,409	908	50%	44%	4%	48%	2%	100%
2036	63,323	914	50%	43%	4%	47%	3%	100%

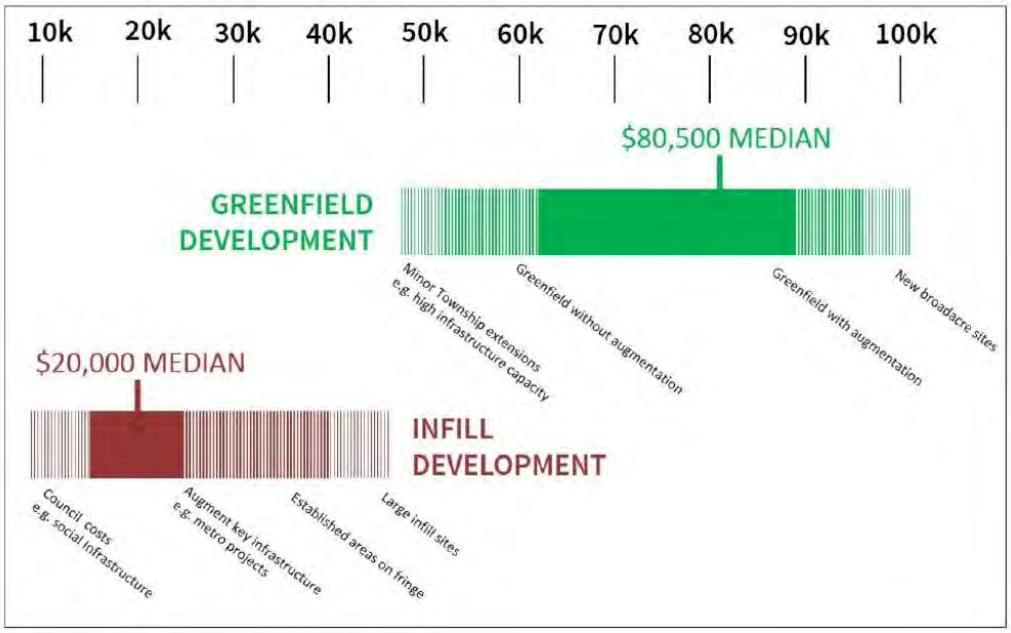
Scenario 2: Demand for dwellings each year

Year	Established urban Ballarat	Ballarat West Growth Area	Demand for dwellings each year Other broadhectare land	Total broadhectare land	Rural Ballarat	Total
	dwellings	dwellings	dwellings	dwellings	dwellings	dwellings
2013	407	119	257	376	20	803
2014	385	115	274	389	26	800
2015	545	113	308	421	22	988
2016	404	131	243	374	21	799
2017	359	211	195	406	16	780
2018	447	259	161	420	27	894
2019	441	282	141	423	18	881
2020	446	330	89	419	27	891
2021	442	353	71	424	18	883
2022	435	339	70	409	26	870
2023	448	358	72	430	18	895
2024	439	342	70	413	26	878
2025	437	350	70	420	17	874
2026	431	336	69	405	26	861
2027	429	360	51	412	17	858
2028	440	361	53	414	26	880
2029	451	379	54	433	18	902
2030	456	374	55	428	27	911
2031	442	371	53	424	18	883
2032	457	393	37	429	27	913
2033	452	398	36	434	18	904
2034	446	383	36	419	27	891
2035	454	400	36	436	18	908
2036	457	393	37	430	27	914

APPENDIX 2: WHY IS MAXIMISING INFILL DEVELOPMENT AN IMPORTANT POLICY GOAL?

The Draft Ballarat Strategy (City of Ballarat, 2015) has emphasised the importance of infill development as a means of promoting the vibrancy of existing neighbourhoods and improving the viability of services including higher frequency public transport. Importantly, the cost of infill development to the community and the Council is likely to be substantially below the cost of greenfield development. This cost differential has been identified in general terms in numerous studies from around Australia. Trubka, Newman and Bilsborough (2010), for example, found that for Perth, housing on the fringe of the urban area was around twice as expensive to develop as housing in the inner city. Infraplan for Adelaide found that the median infrastructure cost per dwelling was around four times more for greenfield development than for infill (albeit with wide variations – see the figure below).

Figure 15: Infrastructure cost per lot (greenfield) or net dwelling (infill), Adelaide



Source: Infraplan, 2013

Work for rural councils in Victoria by SGS (SGS, 2013) provides a model for Councils to calculate the net financial outcome resulting from three forms of housing development – dispersed, greenfield and infill – taking into account development costs and rate revenues. Whilst generally designed for Councils with smaller population growth than envisaged in Ballarat, and although every development situation is more or less different, this model generally indicates that there is a **net cost** to Councils resulting from dispersed and greenfield development and a **net increase** in revenue resulting from infill development. This is very likely to hold true for development in Ballarat. Intuitively, infill development is less costly because it is able to take advantage of spare capacity in

existing social and physical infrastructure, whereas greenfield development requires new capacity from the outset.

Lower costs to Council means that the community benefits either through reduced rates and charges or improved services.

City of Ballarat

Ballarat Greenfields Investigation Areas Review

Part A - Analysis Report

Final Issue | 16 June 2018

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Arup
Arup Pty Ltd ABN 18 000 966 165

Arup
Level 17
1 Nicholson Street
Melbourne VIC 3000
Australia
www.arup.com

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			Prepared by	Checked by	Approved by
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			Prepared by	Checked by	Approved by
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		Name			
		Signature			
				Issue Document Verification with Document	✓

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1 Introduction

1.1 Purpose

The purpose of this *Ballarat Greenfields Investigations Areas Review - Part A – Analysis Report* (the Report) is to provide input to a desktop assessment of three potential greenfield investigation areas (GIAs) to inform a decision on the most appropriate location for the residential expansion of Ballarat beyond 2040. This assessment has been prepared by Arup to complement the overarching Part A assessment report prepared by Hansen Partnership Pty Ltd for the City of Ballarat.

The aspects of each GIA considered in this Report is:

Land capability, encompassing:

- Natural disaster risk
- Protected flora and fauna
- Buffers from sites that require separation from sensitive uses
- Noise impacts
- Contaminated sites
- Sites with past mining activities
- Topography
- Access to existing utility infrastructure
- Geotechnical conditions

Planning assessment, encompassing

- Cultural heritage

Accessibility assessment, encompassing

- Existing and planned future road network
- Public transport network and facilities
- Walking and cycling networks
- Accessibility to employment and services

Deliverability

- New trunk utility infrastructure
- New community infrastructure

Financial and economic assessment

- Development infrastructure costs for trunk infrastructure
- Community infrastructure costs
- Developer costs for local infrastructure

1.2 Greenfield Investigation Areas

The City of Ballarat has identified three GIAs to be considered as part of this assessment:

- Northern GIA
- Western GIA
- Eastern GIA.

Each GIA has been assessed for the same characteristics and this assessment is provided in the remainder of the Report.

1.3 Development Scenarios

To understand the implications of density development scenarios on infrastructure requirements, four scenarios have been considered, with each scenario assuming 75% of the land area within the site is developable, Table 1.

Table 1 Greenfield Investigation Areas - Development scenarios

	Northern GIA (Lots)	**Western GIA (Lots)**	**Eastern GIA (Lots)**
Site Area (ha)	569.58	792.33	615.57
Scenario 1 8 Lots/ha	3,417.45	4,753.96	3,693.44
Scenario 2 (Lots) 12 Lots/ha	5,126.18	7,130.94	5,540.16
Scenario 3 (Lots) 15 Lots/ha	6,407.73	8913.67	6,925.20
Scenario 4 (Lots) 20 Lots/ha	8,543.63	11,884.89	9,233.60

These scenarios only consider the gross land area and other constraints such as those identified in the land capability and planning assessments have not been considered. When factoring in environmental constraints the number of lots per hectare may be reduced and therefore these scenarios are used as a high level mechanism to establish potential servicing issues with different scenarios.

2 Northern GIA

2.1 Land capability assessment

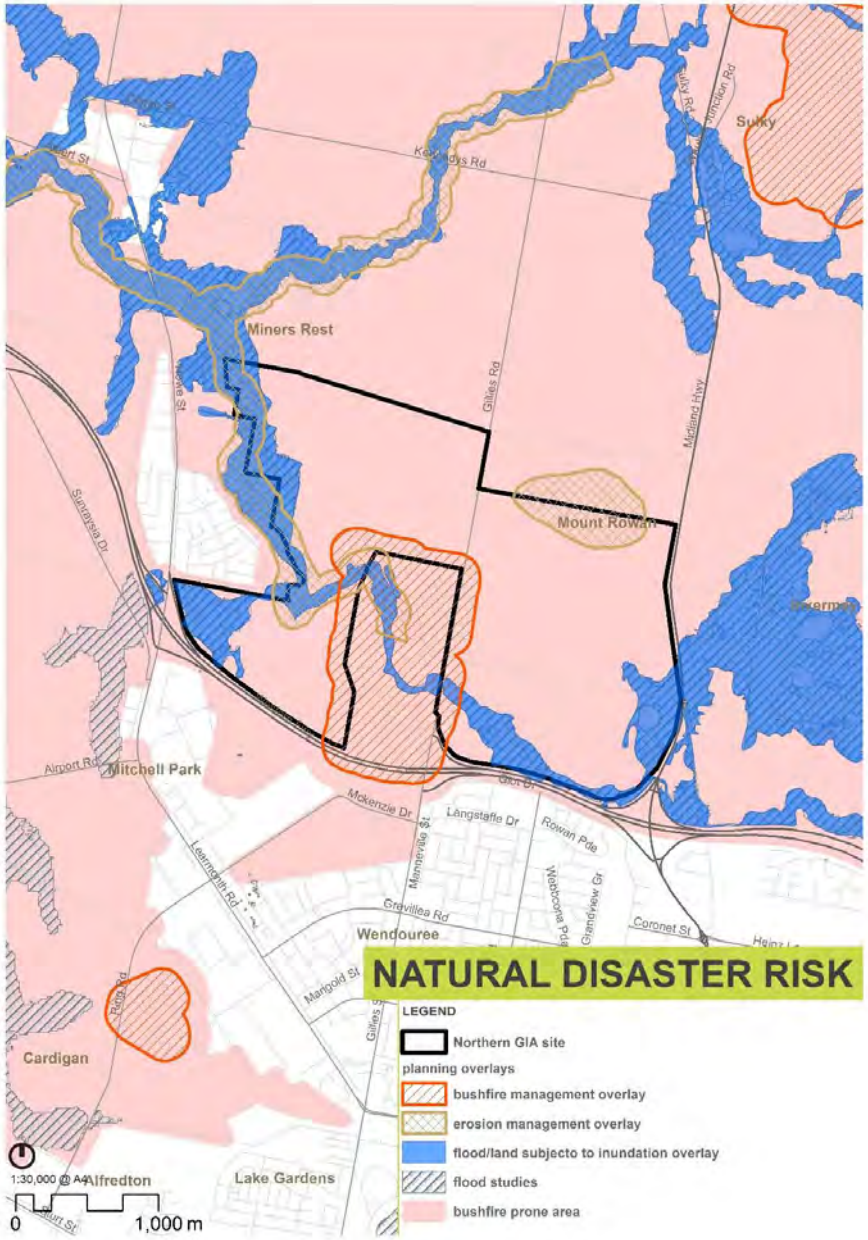

Figure 1 Northern GIA – Natural disaster risk

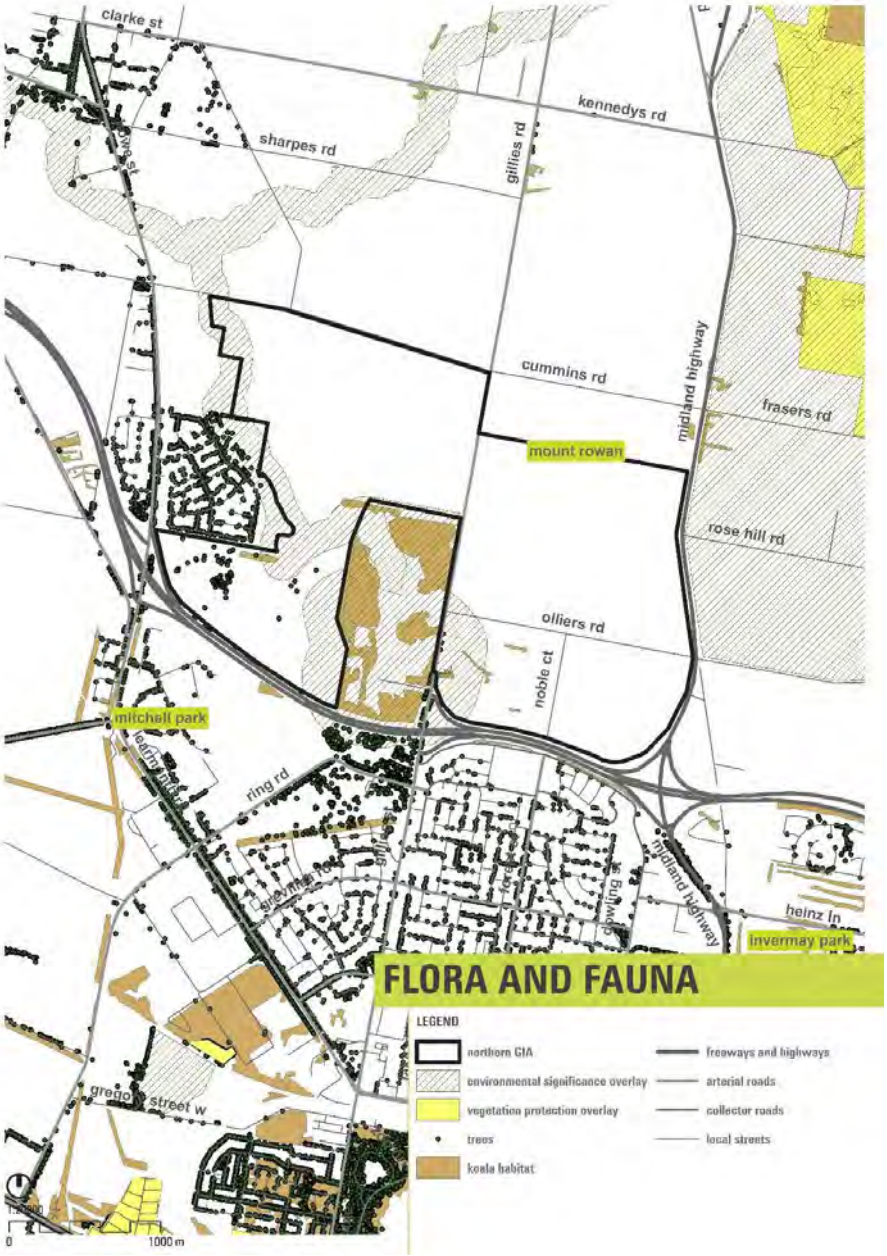

Figure 2 Northern GIA – Flora and fauna

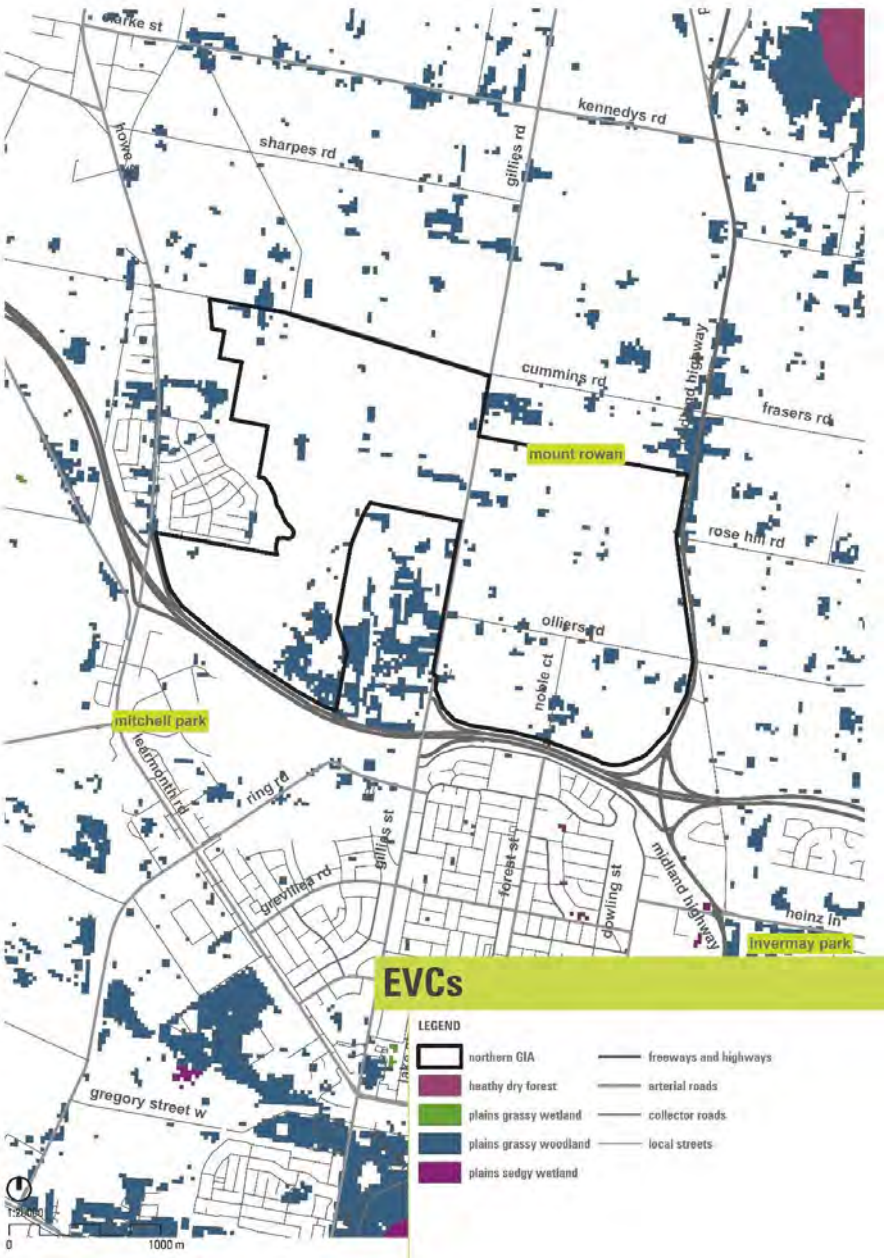

Figure 3 Northern GIA – Ecological Vegetation Classes

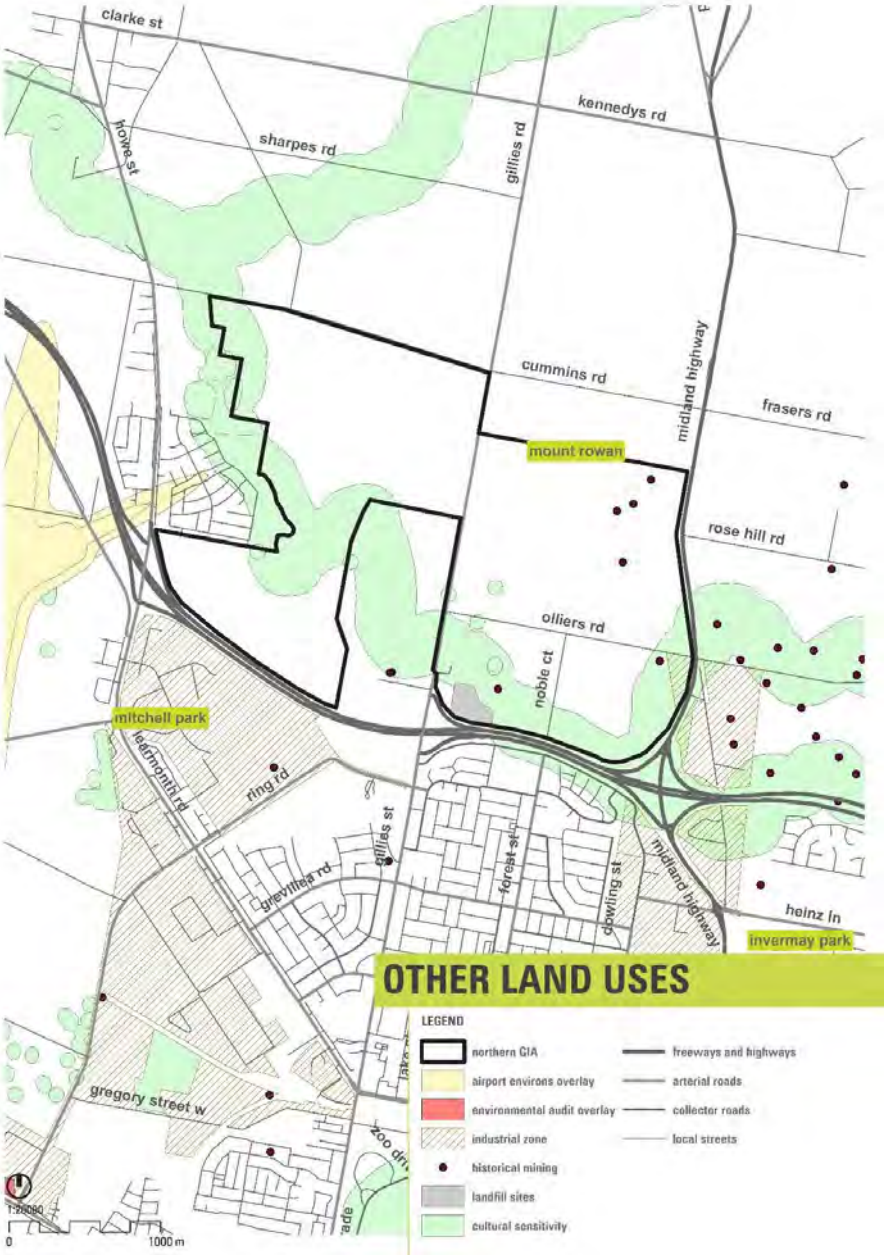

Figure 4 Northern GIA – Other land uses and cultural heritage

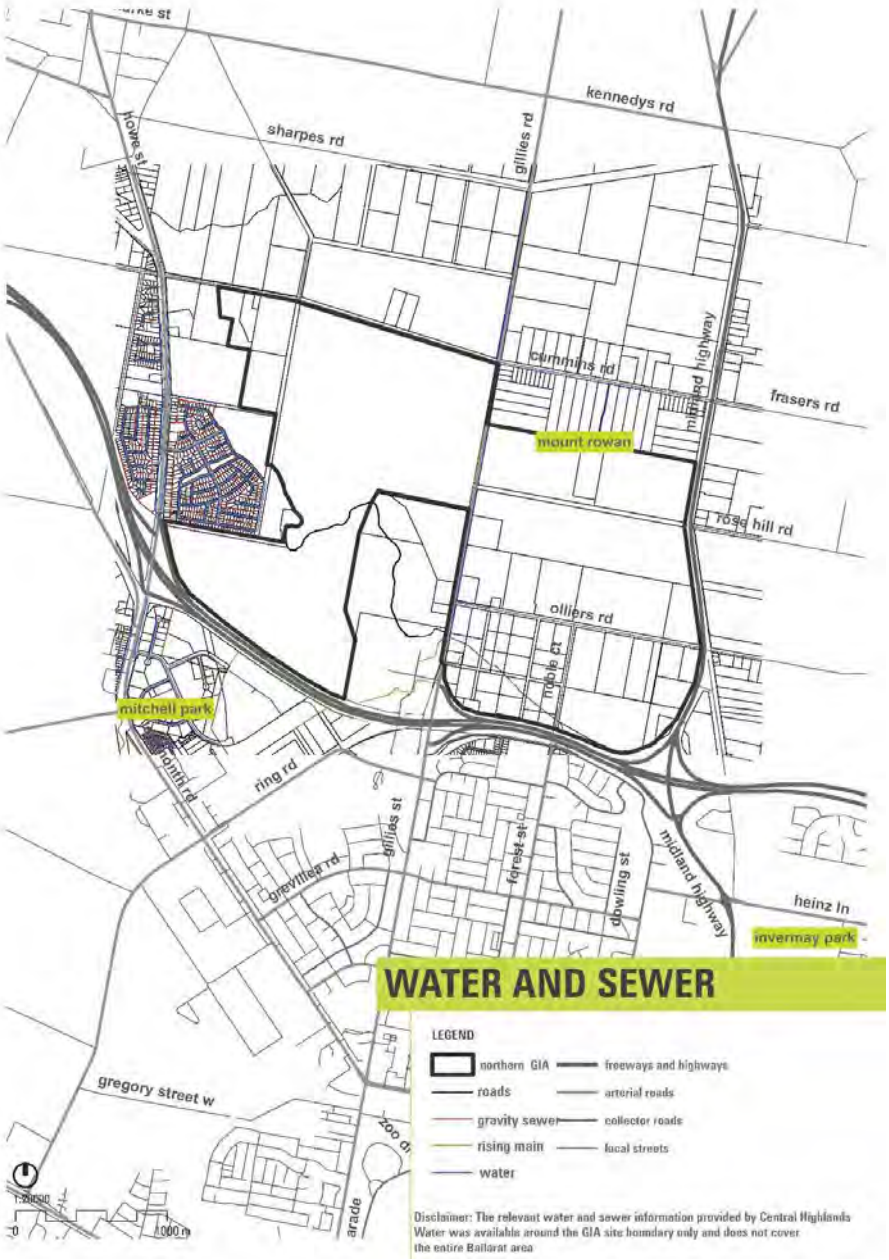

Figure 5 Northern GIA – Water and sewer trunk infrastructure

2.1.1 Natural disaster risk

Bushfire

The Wildfire Management Overlay does not apply to any land within the Northern GIA. However it does apply immediately south of the boundary, to the parcel of land bounded by the Western Freeway and the GIA where the Ballarat North

Water Reclamation Plant is located. There is also a large area covered by this overlay approximately 1.8 kilometres east of the GIA.

The Bushfire Prone Area applies to all the land within the Northern GIA. There have been no recorded fires on the site since 1900. This data was sourced through the Visualising Ballarat mapping tool[1].

Flooding

The Rural Floodway Overlay does not apply to any land within the Northern GIA. The closest location that this overlay applies is approximately 500 metres east of the GIA.

The Land Subject to Inundation Overlay does not apply to any land within or surrounding the Northern GIA.

The Erosion Management Overlay applies to some land within the Northern GIA. The purpose of this overlay is to protect areas prone to erosion by minimising land disturbance. It applies to a 100 metre buffer zone either side of the Burrumbeet Creek. It also applies to Mount Rowan, an elevated area of approximately 16 hectares in the north east corner of the GIA. A permit is required to construct a building, carry out works, remove vegetation or subdivide land in these areas.

Flood studies have been undertaken in preparation for the development of a flood overlay for Ballarat. According to the 100 year ARI flood extent, as mapped in the Ballarat Civil Infrastructure Assessment report, there are areas in the south and west of the Northern GIA that are likely to be impacted by a 100 year flood (SMEC, 2014).

City of Ballarat is currently undertaking a detailed flood investigation in the vicinity of the Burrumbeet Creek, after severe flooding in 2010 and 2011 (City of Ballarat, 2015). This information will be used for the preparation of the flood overlays. The proposed flood overlays indicate that the areas adjacent to the Burrumbeet Creek, as well as the south west corner of the GIA will be impacted by flooding.

2.1.2 Protected flora and fauna

Vegetation Protection Overlay

The Vegetation Protection Overlay does not apply to any land within the Northern GIA.

Environmental Significance Overlay

The Environmental Significance Overlay applies to some land within the Northern GIA. A buffer around the Ballarat North Water Reclamation Plant is subject to Schedule 4, which is intended to prevent development within proximity to wastewater treatment plants that may impact the operation of the plant. Before deciding on an application for development within the boundary of this overlay the responsible authority must consider the impact any proposed development

[1] www.visualisingballarat.org.au

within the vicinity of the Ballarat North Water Reclamation Plant may have on its ongoing operation.

There is also a buffer along the Burrumbeet Creek in the western section of the GIA, which is subject to Schedule 2, relating to streamside and watercourse protection. This overlay is designed to maintain the quality of watercourses and protect habitat. A permit is required to construct a building in this area.

Significant Landscape Overlay

The Significant Landscape Overlay applies to Mount Rowan, which is partially inside the Northern GIA. The purpose of this overlay is to conserve and enhance the character of significant landscapes. The overlay covers an area of approximately 16 hectares in the north east corner of GIA.

Salinity Management Overlay

The Salinity Management Overlay does not apply to any land within or surrounding the Northern GIA.

Ecological Vegetation Classes

There are patchy areas of Plains Grassy Woodland within the Northern GIA. The EVC is classed as Endangered in this area. The vegetation on Mount Rowan has been modified and is dominated by exotic vegetation (CPG Australia, 2009).

Koala Habitat

There are several small patches of land identified in the *Ballarat City Council Comprehensive Koala Plan of Management* within the Northern GIA (Schlagloth & Thomson, 2006). These patches however do not have the preferred koala vegetation, and so have not been identified as likely habitats for koalas.

Environment Protection and Biodiversity Conservation (EPBC) Act Register

According to the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) register, there are several matters of national significance known to occur within a 500 metre buffer of the Northern GIA (Australian Government Department of the Environment, 2014). These are outlined in the table below.

Table 2 EBPC matters in the Northern GIA

Type	Name	Status	Type of presence
Wetlands of International Importance	Western district lakes		Upstream from Ramsar
Listed Threatened Ecological Communities	Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area
Listed Migratory Species – Terrestrial	*Hirundapus caudacutus* White-throated Needletail	Threatened	Species or species habitat known to occur within area

Type	Name	Status	Type of presence
Listed Marine Species – Birds	*Myiagra cyanoleuca* Satin Flycatcher	Threatened	Species or species habitat known to occur within area

There are many additional species that are likely to or may occur in this area. The full list is contained in the EPBC report in Appendix A.

Strategic Biodiversity Score

The Strategic Biodiversity Score measures the importance of native vegetation for Victoria's biodiversity at a landscape scale, relative to other locations across the state. It is measured on a linear scale between 0 and 100, with 100 indicating the most important areas of habitat. The majority of the site has a relatively low value, below 20. The south west corner of the site has a moderate Strategic Biodiversity Score, with values between 20 and 45. The north east of the site also has a moderate value, with a score of up to 32 in the corner. The Strategic Biodiversity Score is used to assess and minimise the impact of vegetation removal and determine offset requirements for the removal of native vegetation.

Ballarat Urban Forest Strategy and Living Corridors

Outlined in the Draft Ballarat Strategy (City of Ballarat, 2015), the Urban Forest Strategy highlights the importance of canopy cover within Ballarat (City of Ballarat, 2015). GIS mapping of trees and the urban forest map in the Ballarat Strategy indicate that there is an assemblage of trees in the south west section of the GIA. There are also some trees located along the eastern border of the wastewater treatment plant.

The Ballarat Strategy also introduces the 'Living Corridors' concept for Ballarat, a network to provide recreational and biological connection of natural areas (City of Ballarat, 2015). The Burrumbeet Creek Corridor runs through the Northern Growth GIA, along the existing Burrumbeet Creek Trail.

This Visualising Ballarat mapping tool does not identify any significant tree cover within or around the Northern GIA.

Waterways

The most significant waterway in the Northern GIA is Burrumbeet Creek. The creek runs east to west through the site, and feeds into Lake Burrumbeet approximately 12 kilometres west of the site. The North Common Wetland Reserve is located in the south west corner of the GIA. The Macarthur Park Wetlands are located adjacent to the west of the GIA

2.1.3 Buffers from sites that require separation from sensitive uses

Ballarat Airport

The Airport Environs Overlay does not apply to any land within the Northern GIA. The Ballarat Airport is located to the east of the GIA, and there is a runway

within 100 metres of the GIA. The Airport Environs Overlay applies to land adjacent to the GIA, directly to the west.

Exposure to aircraft noise is predicted by the Australian Noise Exposure Forecast (ANEF) Index. Based on the Ballarat Aerodrome Noise Modelling Study, the 15 ANEF contour extends into the Northern GIA (Kneebush Planning Pty Ltd, 2010). According to *AS 2021 Acoustics – Aircraft noise intrusion – Building siting and construction*, it is acceptable to construct any type of building, including residential, in areas where noise exposure is less than 20ANEF. The standard notes that effects of noise from aircraft are not confined to areas where the noise exposure exceeds 20 ANEF and may occur at or below 20 ANEF (Standards Australia, 2015).

Ballarat Aerodrome Obstacle Limitation Surfaces (OLS) apply to the land within the Northern GIA. This surface defines the highest Australian Height Datum (AHD) levels to which obstacles may project into the airport airspace. The majority of the GIA is located within the Horizontal Surface RL 480.5 metres contour, with the RL 470 contour extending into the west of the site. These contours are based on the AHD, and are equivalent to a building height of approximately 50 metres (Kneebush Planning Pty Ltd and Airports Plus Pty Ltd, 2013).

Industrial zoned land

There is a small parcel of industrial zoned land in the south east corner of the GIA. There is also industrial zoned land to the south east and south west of the GIA, within 500 metres of the GIA boundary.

Former landfill

There are records of a former landfill located in the southern section of the GIA, near the east boundary of the Ballarat North Water Reclamation Plant (CPG Australia, 2009).

Ballarat North Water Reclamation Plant (WRP)

The Ballarat North Water Reclamation Plant is located adjacent to the proposed Northern GIA. It is also acknowledged that there is an Environmental Significance Overlay surrounding the plant as previously discussed. The recommended separation distance from a wastewater treatment plant should be determined in consultation with the EPA (EPA Victoria, 2013). Based on guidelines in the EPA Publication 1518, *Recommended separation distances for industrial residual air emissions*, the buffer distance would be approximately 920 metres, based on the assumption that the plant is classified as an 'aerobic pondage system' serving an estimated population of 33,600 (GHD, 2014). If implemented a 920m buffer would increase the size of the existing ESO. The GHD Report notes however that it could be argued that the buffer specified in EPA Publication 1518 was intended for a treatment plant that relied only on lagoon treatment, i.e. one that did not have a mechanical/biological pre-treatment plant such as that in the Ballarat North WRP (GHD, 2014) and as such the appropriate buffer would be 320m. The GHD Report is inconclusive and notes that a more appropriate buffer would be an intermediate distance between 920m and 320m.

The above separation distances are taken as default distances from the EPA Publication 1518. The GHD Report has been commissioned by the proponents for the Wyndholm Park Estate, Miners Rest development, which would be impinged by a 920m buffer. Following consideration of the default buffer distances the GHD Report determines a site specific buffer distance based on site meteorological and treatment plant information. From this modelling it identifies a requirement for a significantly reduced buffer distance below 920m, the majority of which is restricted to the existing WRP site and the Western Freeway. The site specific assessment approach is consistent with the considerations identified within EPA Publication 1518, but this also notes that separation distances should be determined in consultation with the EPA. Further the introduction to EPA Publication 1518 notes that site specific assessments must satisfy the EPA.

Central Highlands Water are aware the GHD Report, and in response, in considering the proposed Wyndholm Park Estate, Miners Rest, have noted that they are not opposed to the rezoning, but would seek inclusion of a buffer zone. This infers that Central Highlands Water are unwilling to consider a reduction in the current buffer associated with ESO and may seek to include an increased buffer.

Verbal conversations with Central Highlands Water as part of this project indicate:

- A recognition that the buffer within the existing ESO is based on the WRP odours prior to the plant upgrade;
- They are aware of the recommendations in the GHD Report;
- They are not actively seeking a change to the ESO as while the upgrade may have reduced the buffer requirement (based on an interpretation of EPA Publication 1518, or a site specific assessment), the need for this buffer may return if there is significant population increase and the need to increase the capacity of the existing WRP.
- There is a view that once the buffer is reduced through a change to the ESO and development permitted it will be difficult to have this reinstated.

On the basis of the above it is considered that the ESO remain the primary consideration to guide future development in the Northern GIA until such a time as this changes.

2.1.4 Noise impacts

Aircraft Noise

The Northern GIA is located under the Ballarat Aerodrome runway 05/32 flight tracks and will be impacted by aircraft noise.

The Airport Environs Overlay and the (unendorsed) Ballarat Aerodrome 20 ANEF[2] contour is less than 100 m from western extents of the GIA and does not apply any restrictions.

AS2021[3] recommends that sites near to the 20 ANEF contour are assessed for 'conditional acceptability' and building treatment is to be provided where required to meet internal noise levels.

The maximum event noise levels due to aircraft flyover are predicted to be up to 95 dB(A) at locations within the GIA. On this basis, the acoustic performance of the building constructions in the GIA must be considered to meet the AS2021 requirements.

Road traffic noise

The Northern GIA is affected by road traffic noise from the Western Freeway and Midland Highway.

Based on year 2031 traffic estimates and VicRoads requirements[4], the following noise mitigation measures apply to the GIA:

- A 30 m buffer zone from the Western Freeway at the southern GIA boundary for residential dwellings.
- A noise wall between 2 and 4 m high at the GIA southern boundary with the Western Freeway.
- A noise wall between 2 and 3 m high at the GIA eastern boundary with the Midland Highway.
- Consideration of buffer zones, building restrictions (planning), building treatment or landscaping in cases where noise walls cannot be applied to the southern or eastern boundaries (eg access requirements).

Industrial noise

There are two operational IN1Z industrial zones and a water treatment facility adjacent to the Northern GIA.

Industrial noise affecting the GIA will be assessed under the EPA Noise from Industry in Regional Victoria (NIRV)[5] guidelines that will set specific noise levels based on the EPA State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) (SEPP N1)[6] procedure, including measurement of existing noise levels.

A minimum buffer zone of 150 m from any significant noise sources within the industrial areas is recommended to facilitate compliance with EPA requirements.

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[2] City of Ballarat, *Ballarat Aerodrome Noise Modelling Study*, 2010
[3] AS 2021-2015, *Acoustics: Aircraft noise intrusion, Building siting and construction*, Standards Australia.
[4] VicRoads, *Requirements for Developers – Noise Sensitive Uses*, 2004
[5] EPA, Noise from Industry in Regional Victoria – Publication 1411,
[6] EPA, State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N-1, 1989

Railway noise

Railway noise does not affect the Northern GIA.

2.1.5 Contaminated sites

Environmental Audit Overlay

The Environmental Audit Overlay does not apply to any land within or surrounding the Northern GIA.

It is noted that a former landfill site exists on the south east of the Northern GIA. Although the Environmental Audit Overlay has not been applied by the EPA, there is the potential for this to be applied at some point in the future by the EPA, however the likelihood of this cannot be determined at this stage.

2.1.6 Sites with past mining activities

Historical mining activity

There are six point locations of recorded historical mining activity within the Northern GIA. These sites are in the eastern part of the GIA. Given the intrusive nature of historical mining activities, they could potentially give rise to issues with the geology. The geotechnical conditions are further discussed in Section 2.1.9.

Expired mining licenses and leases

There are no expired mining licenses or leases within the Northern GIA.

2.1.7 Topography

The main features of the site are Mount Rowan in the north east of the site, which has a maximum elevation of 519 metres, and Burrumbeet Creek, which runs from the south east corner of the site though to the west. This generally slopes down with a gentle gradient from Mount Rowan to the Creek. The gradient is steeper at the banks of the creek, and on the sides of Mount Rowan (up to 25%). South of Burrumbeet Creek, there is a general downhill slope from road level to the Creek.

2.1.8 Access to existing utility infrastructure

The current land use in the Northern GIA is predominantly mixed farming and grazing with pockets for rural residential use in the eastern half of the site. Information regarding the existence of major utility services has been obtained by conducting a 'Dial Before You Dig' (DBYD) enquiry and contacting the asset owners directly. The major utility services present in some capacity in the study area include:

- Sewerage;
- Water Supply;
- Electricity (Distribution); and

- Telecommunications.

Formal drainage assets are not present in the GIA and information has not been provided by the gas distribution authorities to confirm the existence of gas mains or reticulation pipes within the study area.

Drainage

Land use planning and drainage management for the Northern GIA are the responsibilities of the City of Ballarat. The Glenelg Hopkins Catchment Management Authority is responsible for the floodplain management of Burrumbeet Creek and this area.

Stormwater across the GIA drains towards Burrumbeet Creek. According to the 100 year ARI flood extent as mapped in the Ballarat Civil Infrastructure Assessment report, there are areas in the south and west of the Northern GIA likely to be impacted by a 100 year flood (SMEC, 2014) and these areas would be preferable to avoid.

Formal stormwater drainage infrastructure does not currently exist within the GIA.

Sewer

Central Highlands Water provides and manages the existing sewerage infrastructure within the Northern GIA. Effluent within the GIA is directed to the Ballarat North Water Reclamation Plant (WRP), which is operated by United Water of behalf of Central Highlands Water (Central Highlands Water, 2014).

The existing Ballarat North WRP is located on Western Highway/Gillies Road junction, along the southern border of the study area. As a consequence of this facility's proximity to the GIA, there are a number of trunk outfall mains that travel within the site and around its perimeter. The largest outfall main, is an 825mm diameter concrete pipe that runs north-east across the site from the southern boundary at Forte Street. This gravity fed systems has no spare capacity at its pump station. The other outfall main located within the study area is a 300mm diameter uPVC pipe, which is centrally located and runs north-south to the Ballarat North WRP. Several other sewer outfall mains enter the wastewater facility from the southern and western boundaries of the GIA.

Central Highlands Water does not own any sewer assets along the northern or eastern boundaries of the site and sewer reticulation within the GIA does not currently exist.

Water

Central Highlands Water provides and manages the existing water supply infrastructure within Ballarat and the outlying areas. The Ballarat water supply is primarily comprised of two headwork systems: the Ballarat System and the Lal Lal System. Potable water to the Northern GIA and the surrounding areas is derived from the Ballarat System and delivered via the Northern Tanks Zone network (Central Highlands Water, 2014)

The only water assets within the Northern GIA are the 150mm diameter pipes that run north-south down Gillies Road and east along Olliers Road. Gillies Road is serviced by a single DICL pipe for most of its length, while the supply of potable water along Olliers Road extends approximately 260m east from the Gillies Road/Olliers Road intersection.

Gas

APA Group Transmission is responsible for the high pressure gas transmission assets and SP AusNet is responsible for the distribution supply assets.

SP AusNet has not provided asset information for this size area but has advised that there is approximately 20% additional capacity to service the existing network but cannot confirm that the current network will be able to service the projected population of Ballarat in 2040 (SMEC, 2014).

Recent supply issues for Miners Rest saw augmentation works undertaken in the area.

Electricity

SP AusNet operates and maintains the Ballarat Terminal Station (BATS) and the electrical transmission lines that feed into the zone substations. The BATS is located in Warrenheip, in the east of Ballarat. Powercor is the electrical network distributor for the Northern GIA and power is supplied from the Ballarat North (BAN) zone substation. BATS-BAN sub-transmission loop supplies the BAN zone substation fed at 66kV and the total combined capacity of the lines is this loop is 167 MVA (Powercor Australia, 2014).

The existing high voltage distribution network in the study area is predominantly limited to the eastern half, along the major access roads within the area, namely; Cummins Road, Gillies Road, Sims Road and Olliers Road. High voltage circulation around this portion of the site is largely achieved with overhead power lines, with overground cabling restricted within easement along Cummins and Sims Road. Powercor has confirmed that some capacity exists to service this GIA.

Telecommunications

Telstra is the main distributor of communication services to residential and commercial customers within the Northern GIA.

Information regarding where the cables identified as part of the Dial Before You Dig (DBYD) enquiry are managed has not been provided by the utility companies.

The National Broadband Network (NBN) has been rolled out in sections of the Northern GIA, such that fixed wireless is accessible in all areas east of Gillies Road as well as that south of Burrumbeet Creek. NBN rollout has not commenced within most of the area located immediately east of Gillies Road and north of Burrumbeet Creek. It is anticipated that by the time urbanisation of this region occurs, NBN rollout will have been completed for all of the study area. Limited information has been provided with regard to the existing network capacity

however it is anticipated that communications providers will upgrade and expand networks in line with regional growth profiles pending developer applications.

2.1.9 Geotechnical conditions

Geotechnical considerations for the Northern GIA are presented below. The geology overlay for the area is shown in Figure 6 below. Further details on geotechnical considerations based on the inferred geology are provided in Appendix B.

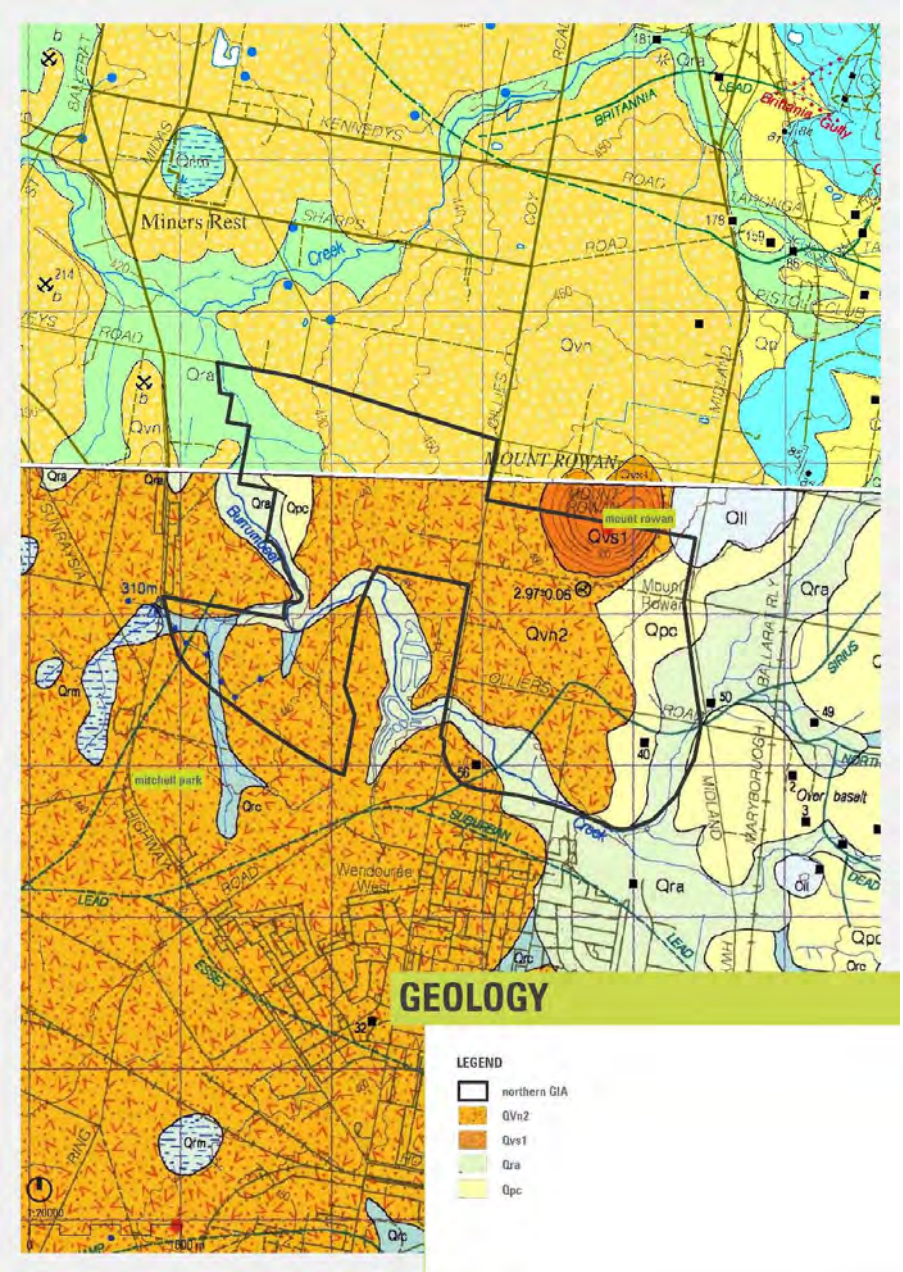

Figure 6 Northern GIA geology based on the 1:50,000 Ballarat Geology Map (Geological Survey of Victoria, June 1996).

The majority of the site consists of newer volcanic material (Qvn2), which typically consist of basaltic clay overlying basalt rock. A volcanic cone (Qvs1, Mt Rowan) is located on the eastern portion of the site. The eastern edges of the site and land around Burrumbeet Creek is alluvium (Qra, water deposited) and colluvium (Qpc, historic landslide) material.

Soil Shrink Swell Potential for Residential Development (AS 2870, 2011)

- Alluvial/colluvial areas will have a Moderate (M) to High (H1) soil reactivity.
- The basaltic clay which covers most of the site typically has a High (H1) to Very High (H2) shrink swell soil reactivity, although in some occurrences it may be Extreme (E) (Peck, Neilson, Olds, & Seddon, 1992).

In recent history (The Age, 2014), large areas of residential development around the north west of Melbourne have had significant issues with building damage and cracking on basaltic clays as a result of inadequate site classification/investigation and foundation construction.

For development in this GIA on basaltic clay, we recommend a strong regime of requirements for geotechnical investigation, site classification and foundation design in accordance with *AS 2870 Residential Slabs and Footings* is implemented.

Excavation and potential to encounter rock

- Shallow excavation for residential developments should be able to be completed with light earthmoving plant in the basaltic clay and alluvial/colluvial deposits.
- Deeper excavations/trenches in the basaltic clay may encounter boulders requiring localised overdig and removal, or basalt rock which may require heavy earthmoving equipment and ripping.
- Deeper excavation in the fluvial deposits may be unstable and/or require dewatering.
- Excavations around the Mount Rowan volcanic cone could encounter hard rock at/close to the ground surface.

Land Instability Potential

Based on topographical contours and geology, the potential for land instability over significant areas in the GIA is generally considered to be very low. Areas of localised instability may occur, particularly adjacent to the existing Creek and waterways. Land instability risk should be able to be managed through good practice for development on sloping sites.

Contours around Mount Rowan are steeper. Based on this material being rock it is inferred that the potential for deep seated instability is low, however there could be a rockfall hazard potential.

General considerations

Other considerations for this GIA include:

- Basaltic clay material can degrade quickly when exposed and wet and it is advised that earthworks should not be undertaken in winter and care should be taken in wet shoulder seasons.

- The basaltic clay may have a low California Bearing Ratio (CBR) requiring improvement of soft zones for pavement construction.

2.1.10 Comparison of the land capability assessment

A multi-criteria analysis has been undertaken to compare the GIAs. The Northern GIA had the second highest rating for the land capability assessment of the options with the results shown in .

2.2 Heritage assessment

2.2.1 Cultural heritage

Heritage Overlay

The Heritage Overlay does not apply to any land within the Northern GIA.

Cultural Sensitivity

There are areas of Aboriginal cultural sensitivity along the Burrumbeet Creek, covered the land in a 200 metre buffer either side of the creek. There are also several circular parcels of land, approximately 100 metres in diameter that are areas of cultural sensitivity. Areas of cultural heritage sensitivity have been designated where Aboriginal cultural places and objects are known or are likely to exist. The presence of these areas indicate the need for a Cultural Heritage Management Plan (CHMP) under the Aboriginal Heritage Act 2006.

Historical Landscape

Mapping Ballarat's Historic Urban Landscape outlines the character of the landscapes within Ballarat (Context Pty Ltd, 2013). The Northern GIA lies across two Indicative Character areas.

The eastern section lies within the Mount Rowan Rural Character area. This area is characterised by a mix of land uses including small scale pasture, potato fields, horse stables and residential. The main community concerns in this area, as identified in the Ballarat Imagine consultation process, are landscape and views, with a key feature of the areas being open views north to the Learmonth hills and mountain ranges beyond.

The western section is in the Wendouree and Miners Rest Urban Character area. This area is characterised by a mix of residential and industrial areas. The main community concerns in this area, as identified in the Ballarat Imagine consultation process, are access to parks and playgrounds.

Heritage Inventory

There are two sites within the Northern GIA that have been identified on the Heritage Inventory, under the Victorian Heritage Act 1995. The Mount Rowan Mullock Heap 1 indicates the presence of a former mining site in the east of the GIA near Creswick Rd. The mullock heap may be extensively disturbed.

The Mount Rowan House remains site is located near the corner of Gillies Rd and Olliers Rd in the centre of the GIA. The site comprises the remains of a house possibly demolished more than 50 years ago, as well as artefacts and exotic trees. These identified archaeological site does not constrain development, however additional planning will be required to assess and excavate the sites.

2.3 Accessibility assessment

2.3.1 Existing and planned future road network

The key features of the existing road network surrounding the site are outlined as follows:

- The site is bounded by the Western Freeway to the south, Midland Highway to the east and is located in close proximity to Ballarat-Maryborough Road (Howe Street). Both the Midland Highway and Howe Street for a full diamond interchange with the Western Freeway. VicRoads are the responsible authority for each of these roads and the associated road hierarchy as shown in Figure 7 Road hierarchy. In terms of other major connections, the site is bisected by Gillies Road (the interchange with the Western Freeway has east facing ramps only) for which Ballarat City Council is the responsible authority north of the Western Freeway and VicRoads as the responsible authority south of the Western Freeway.
- Information contained within the report *Victorian Integrated Transport Model – City of Ballarat, Phase 3A Investigation* (AECOM, 2014) dated July 2014 (Ballarat VITM Report) indicates that the road network which provides access to the site generally operates well within capacity during the AM peak period in 2011. However, the following points are noted:
  - Low to medium levels of congestion on the Midland Highway from the Western Freeway to Howitt Street.
- The assessment of transport forecasts contained within the Ballarat VITM Report indicates that in 2041, the network experiences some levels of congestion along key routes providing access to the site during the AM peak period. shows the 2041 forecast volume/capacity ratio for the Ballarat road network. It is an estimation of traffic volumes when compared to the traffic capacity for a particular section of the road network and provides an indication of where traffic congestion is likely to occur in the future. As the volume / capacity ratio increases towards 1.0 (shown in orange and red), the traffic network is approaching its capacity limit and long delays and unreliable travel times are expected for motorists. Using the base case future land use and network assumptions within the Victoria Integrated Transport Model (VITM), the following points are noted for the year 2041 as shown in :
  - Medium to high levels of congestion on the Midland Highway corridor from the Western Freeway to Howitt Street.
  - Low to medium levels of congestion on the Learmonth Road / Howe Street corridor.

A comparison of the assumptions within VITM indicate that the number of households for the Northern GIA in 2041 are consistent with the Scenario 1 (low development scenario). Additional levels of development associated with the medium and high scenarios would exacerbate those impacts identified for the low development scenario.

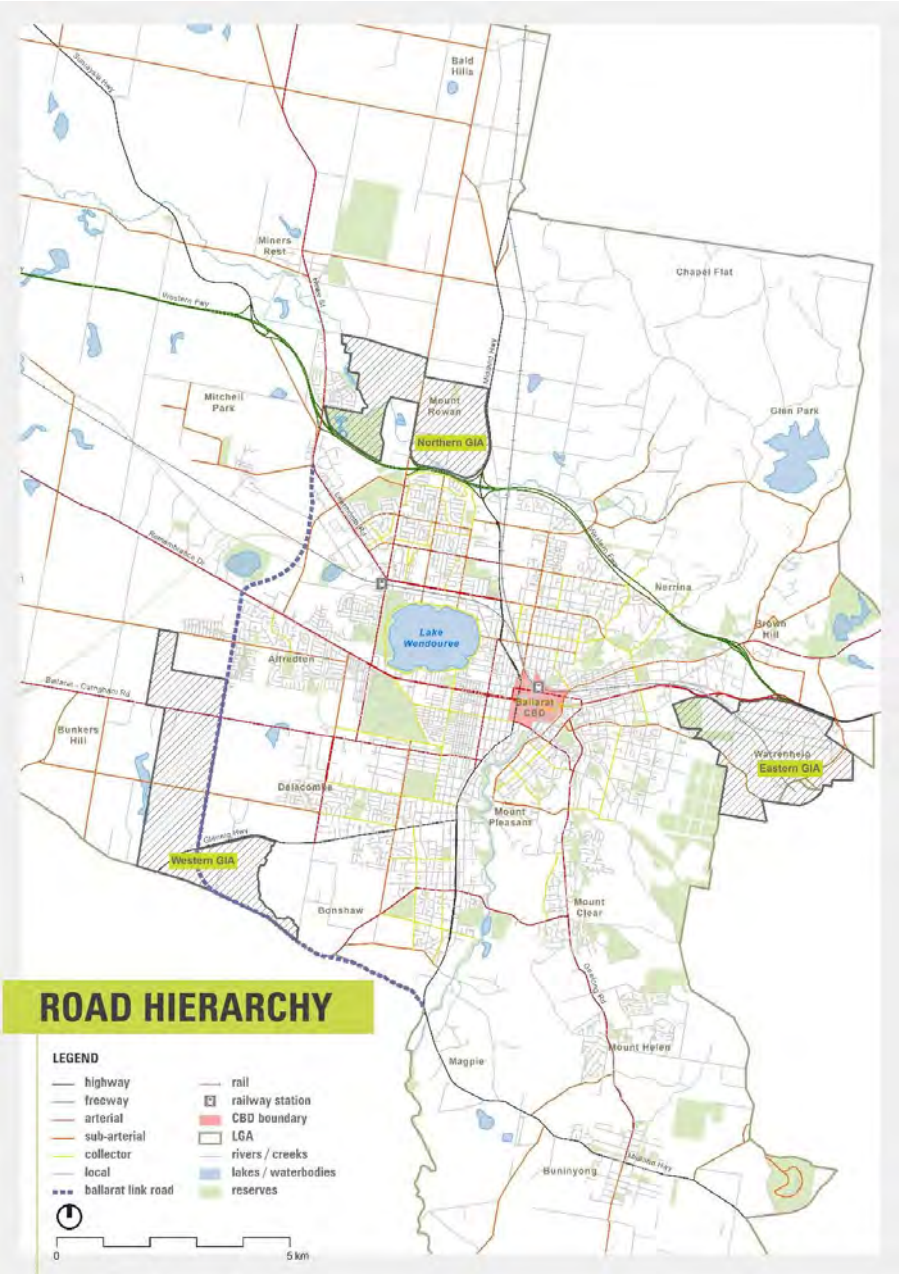

Figure 7 Road hierarchy

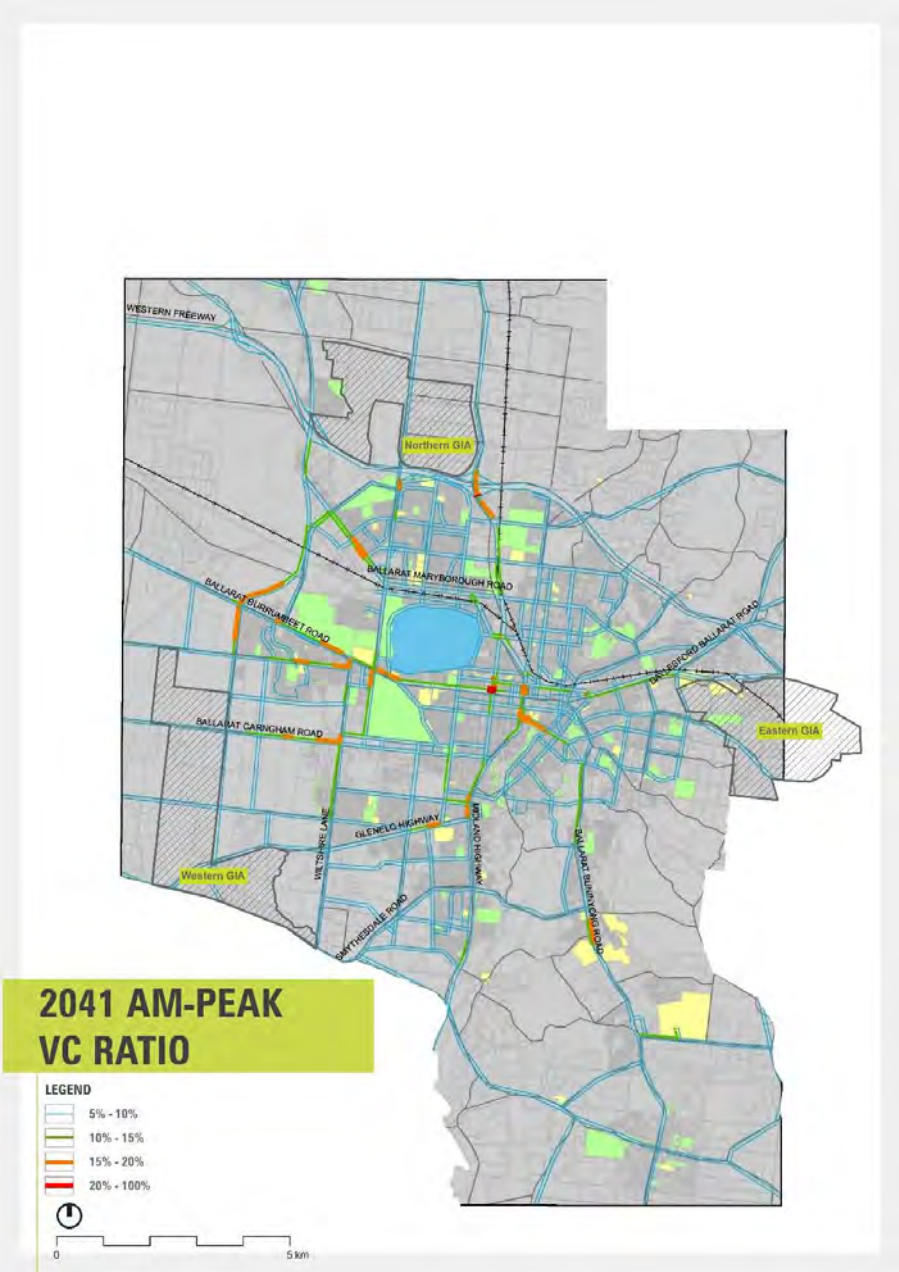

Figure 8 VITM forecast volume to capacity ratio 2041 (AM peak period) (AECOM, 2014)

2.3.2 Public transport network and facilities

The public transport facilities that provide access to the site are summarised in and shown in Table 3 with the key points noted as follows:

- The closest point of the site is located approximately 2.5km from Wendouree Station and approximately 4.8km from Ballarat Station.
- Bus Route 3 operates along the Midland Highway and provides limited catchment that is localised to east of the site.
- Bus Route 17 operates immediately west of the site, though the catchment for these services only extends marginally into the site.
- There is an opportunity for Bus Route 3 and 17 to be extended to service the site though there would be a level of diversion of these services that would be required. There is also the potential to extend Route 2 or Route 6 along Gillies Street to the centre of the site.

Table 3 Bus services summary

Services	Weekday		Weekend Services
	Services	Hours	
Bus Route 3 Ballarat to Creswick	11 to Creswick 11 to Ballarat	6:15am-7:05pm	6 Sat, 3 Sun 6 Sat, 3 Sun
Bus Route 17 Ballarat to Miners Rest	13 to Miners Rest 13 to Ballarat	6:50am-6:32pm	7 Sat, no Sun services 7 Sat, no Sun services

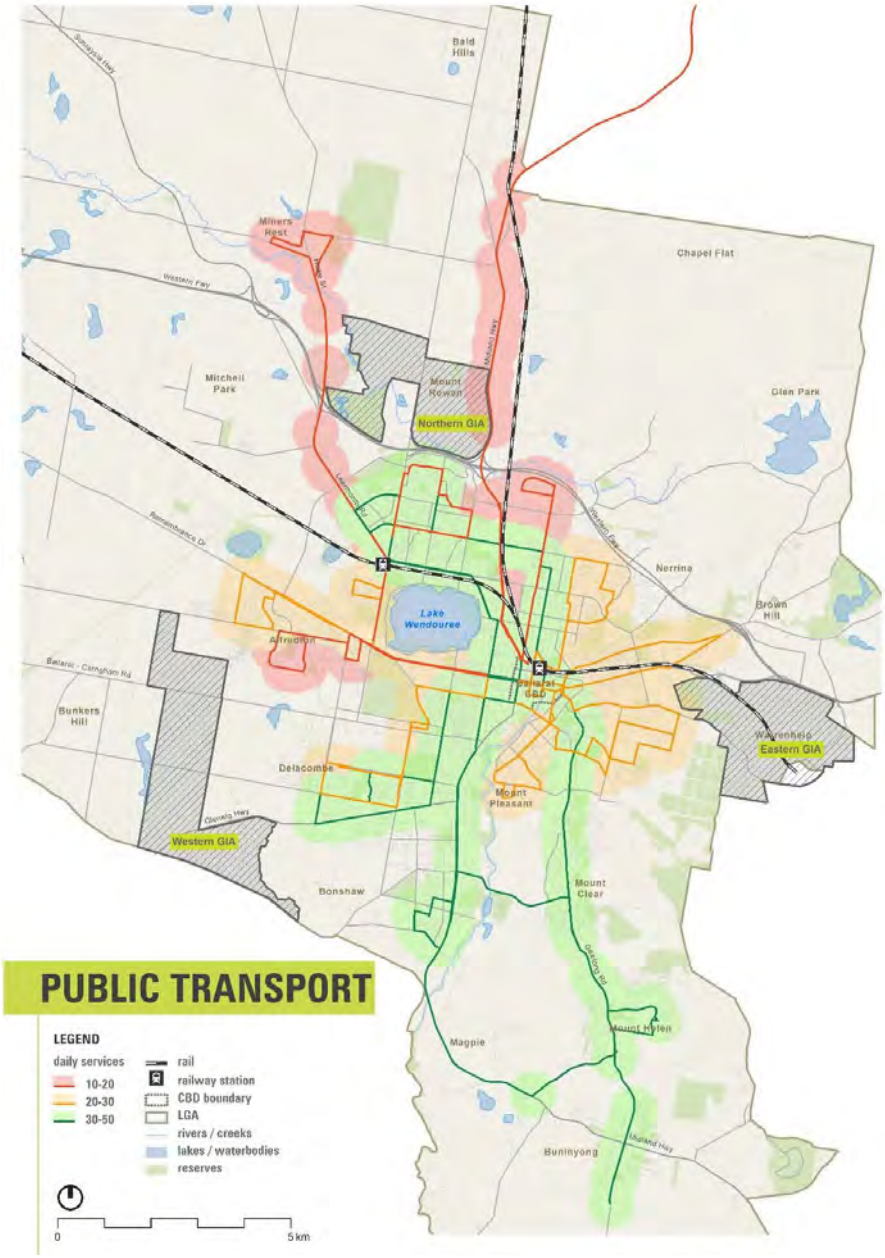

Figure 9 Public transport network and bus frequency

2.3.3 Walking and cycling networks

The key walking and cycling features of the site are noted as follows:

- The Western Freeway presents a significant barrier for walking and on this basis, the majority of walking trips are expected to remain internal to the site.
- The site is generally located at least 4.2km from the Ballarat CBD which means that cycling has only limited viability for these trips with the remainder of trips expected to be internal to the site or to the immediately surrounding suburbs.
- There is an existing route with dedicated bicycle facilities along Gillies Street and although of varying standard and continuity, it provides connection south to the CBD. Cyclists are also permitted to ride along the Western Freeway and while a recognised route by VicRoads, the environment is only considered to be attractive to very confident cyclists.
- The Ballarat Cycling Action Plan 2017 includes a future cycling route with dedicated on-road bicycle facilities along the Midland Highway which would provide connection to the CBD from the east of the site.
- With the inclusion of the existing and planned cycling routes, the cycling catchment remains limited due to barrier represented by the Western Freeway.
- In addition to the planned facilities, there is an opportunity to improve the quality of the Gillies Street link, provide facilities along Howe Street and improve the standard of facilities along the Western Freeway connecting to the Ballarat West Employment Zone.

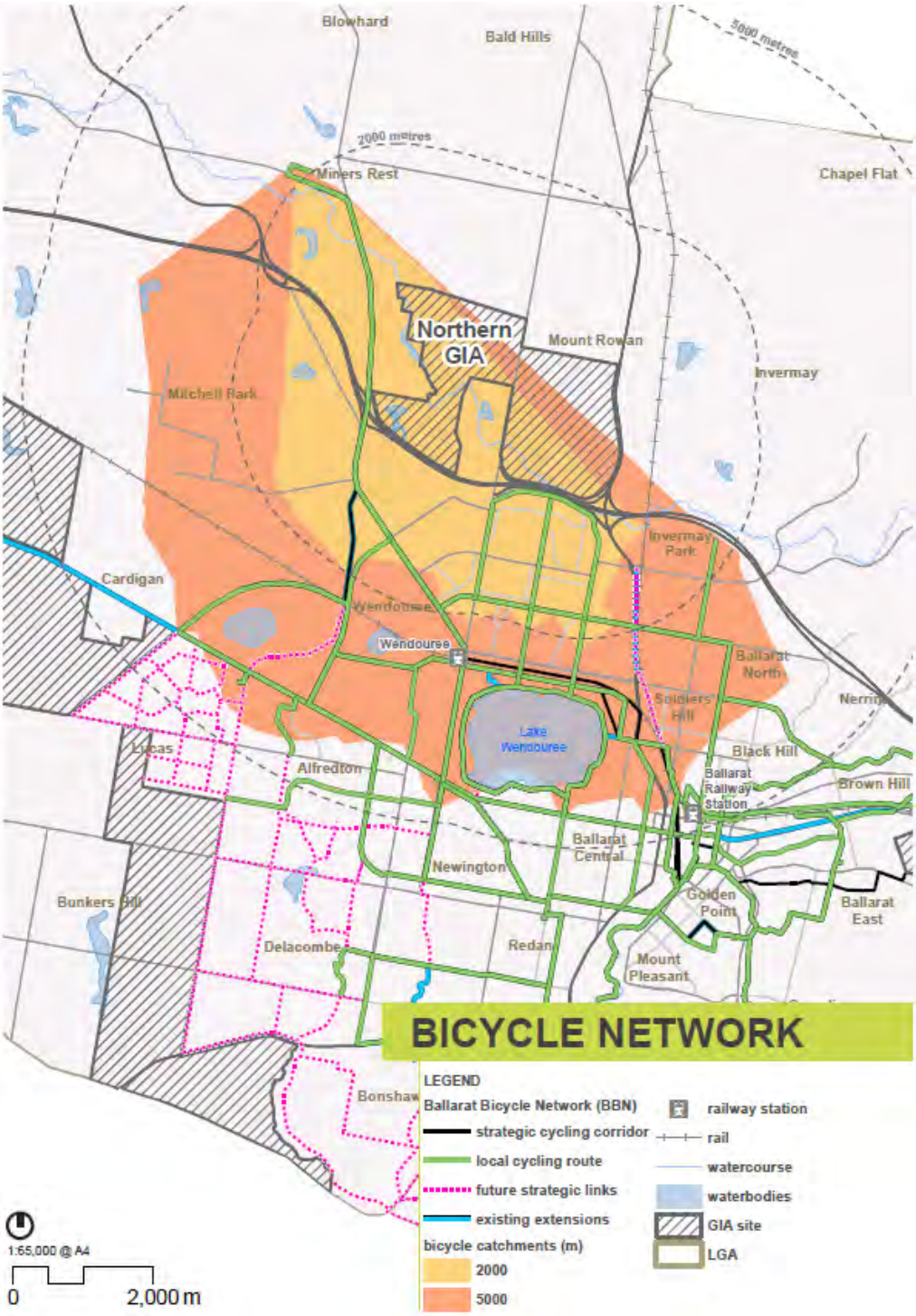

Figure 10 Northern GIA cycling catchment of existing and planned routes

2.3.4 Accessibility to employment and services

The Ballarat VITM Report has been reviewed in relation to the access of each of the sites to employment retail services with the key points noted as follows:

- Based on current planning, the site will have a high level of access to employment and retail services by private vehicle for the foreseeable future. It is expected that between 90% and 100% of employment opportunities and retail services will be able to be accessed within a 20 minute private vehicle trip from now until the year 2041.
- Based on current planning, the site will have negligible access to employment or retail services by public transport for the foreseeable future. It is expected that there will be very limited employment opportunities and retail services that will be able to be accessed by public transport within a 20 minute public transport trip both now and until the year 2041 (the access to employment opportunities is shown in). shows the percentage of employment opportunities that will able to be accessed using public transport within 20 minutes. Higher levels of public transport accessibility (i.e. greater percentage of jobs that can be accessed by public transport within 20 minutes) are shown in green where as low levels of accessibility are shown in red or grey. It is noted that a public transport trip includes walking time, waiting and in-vehicle time.
- The employment distribution forecasts outlined in the Ballarat VITM report suggest that more jobs will be located in the west of Ballarat in the future. On this basis there is an opportunity to provide increased public transport services to connect with these locations of employment (e.g. Ballarat West Employment Zone).

While access by private vehicle is high, there is an opportunity to provide additional transport choice and increased access to employment and retail services through the provision of additional public transport services outlined in Section 2.3.2. It is noted that some of these services may be required for equity and social inclusion.

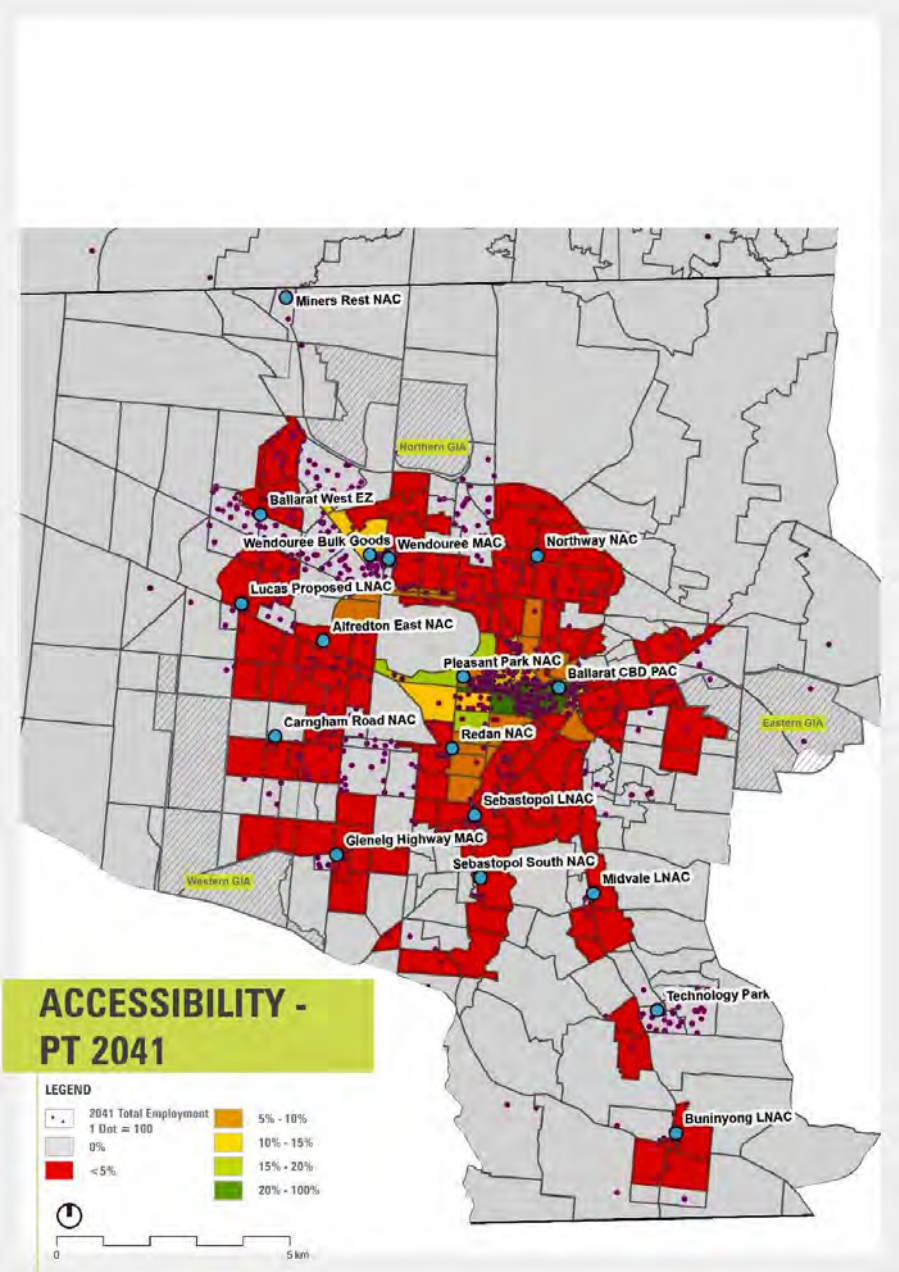

Figure 11 Total accessibility to employment by public transport (2041) (AECOM, 2014)

2.4 Deliverability / Implementation

2.4.1 New trunk utility infrastructure

Drainage

A high level assessment of the trunk drainage infrastructure required for the urbanisation of the Northern GIA has been completed in accordance with the standards stated in the Infrastructure Design Manual (IDM) and by the Corangamite Catchment Management Authority. Accordingly, the following key parameters have been applied to the proposed drainage design:

- The flows are to be maintained at pre-development levels for the peak flow rate in a 100 year ARI event.
- The minor drainage (underground pipes and channels) are sized to convey the 10 year ARI in residential and industrial areas.
- The water discharged into the existing waterways is treated to the Best Practice Environmental Guideline Targets for Stormwater Treatment, such that removal of the following is achieved:
  - 80% of total suspended solids;
  - 45% of total phosphorus;
  - 45% of total nitrogen; and
  - 70% of gross pollutants.

Demand requirements

Catchment areas were identified and runoff and time of concentration coefficients were determined in accordance with the land use of each catchment. The existing land use within the study area was determined based on the GIS information provided by City of Ballarat. As per the IDM, the overland flow for the existing and proposed conditions has been calculated using the Rational Method for Rural Hydrology described in Austroads "Guide to Road Design: Part 5 General and Hydrology Considerations." The design has adopted the runoff coefficients stated in Table 9 of the IDM. For catchment types not identified in the IDM, runoff coefficients defined in AS3600.3 has been adopted.

Table 4 states the minimum detention volume required to ensure that the flow is maintained to pre-development levels for the peak flow rate in a 100 year ARI event.

Table 4 Northern GIA estimated required stormwater detention volumes

Detention volume required (m^3)				
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
Catchment 1	10449	10449	16150	16296
Catchment 2	3205	3205	4972	5023
Catchment 3	8268	8268	12784	12902
Catchment 4	2192	2192	3408	3445
Catchment 5	304	304	485	491
Catchment 6	2653	2653	4139	4178
Catchment 7	5125	5125	7094	4968
Catchment 8	202	202	349	353
Catchment 9	23185	23185	35598	39099

Total	**55583**	**55583**	**84980**	**86755**

New Trunk Infrastructure

The new trunk infrastructure required includes:

- A number of retention basins located throughout the study area. The size and location of individual basins will largely be dependent on the topography and proposed land use of the study area and should be determined in collaboration with civil engineers and town planners.
- Wetlands that will be incorporated into the floor of each retarding basin to improve water quality. The application of this treatment measure ensures that land acquisition cost to meet WSUD requirements can be minimised.
- A network of stormwater drainage pipes that will convey the post-development 10 year ARI event flow to the retention basin.
- Stormwater drainage pipes that will convey the pre-development 100 year ARI event flow from the retention basins to the outfall creeks.

Detailed modelling of the performance of the proposed wetlands has not been conducted as part of this study. Consequently, while the design and cost evaluation assumes that WSUD requirements can be satisfied with the wetlands and green spaces, it is noted that additional tertiary water treatment may be required.

Sewer

A high level sewer network has been designed in accordance with the design principles outlined in the MRWA WSAA Sewage Code, Pressure Sewer Code and Sewerage Pump Station Code, as required by Central Highlands Water. While the design intent has been for a gravity network, the location of the Ballarat North Water Reclamation Plant (WRP) in the centre of the area in conjunction with the south-west grading of the site have meant that two additional pump stations and rising mains will be required. Furthermore, the existing pump station at the Ballarat North WRP may require upgrading.

Demand requirements

The design effluent flow is based on the assumption that residential land use will account for 85% of the overall effluent flow. This value was determined based on engineering industry experience and advice provided within the MRWA WSAA Sewer Code. The values derived were informally provided to Central Highlands Water who advised that they are consistent with the degree of development investigated. Table 5 and Table 6 list the estimated effluent flows for sizing mains and the demand flows for wastewater treatment.

Table 5 Northern GIA estimated effluent flows for sizing of mains

Proposed Sewer Flows (L/s)				
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
Northern GIA	154.20	195.63	224.28	269.10

Table 6 Northern GIA estimated effluent flow for wastewater treatment

	Peak Dry Weather Flow (L/s)	Peak Dry Weather Flow (ML/d)
Scenario 1	39.73	3.41
Scenario 2	59.59	5.11
Scenario 3	74.49	6.38
Scenario 4	99.32	8.51

New trunk infrastructure

The trunk infrastructure required for the development of the Northern GIA has been designed based on the following principles and parameters:

- The mains have been sized assuming PVC pipes.
- The network design should aim to avoid the use of pressure sewers and rising mains.

Table 7 and Table 8 below provides an indication of the size of the trunk mains and pump station required to service each scenario.

Table 7 Northern GIA estimated sewer trunk mains

Meters of trunk mains				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Gravity Mains				
225mm diameter	1000	0	0	0
300mm diameter	0	1000	1000	1000
Rising Mains				
150mm diameter	1300	0	0	0
225mm diameter	0	1300	1300	1300

Table 8 Northern GIA estimated pump station requirements

New pump station required				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Pump station size (kL)	5.6	6.9	8.5	10

The area of the development east of Gillies Road can be served by a gravity fed system. This will require the construction of a new 1km gravity trunk main along Gillies Road to the existing pump station. This pump station has limited capacity and will therefore require upgrades. These upgrades will alter the flow regime to Ballarat North Water Reclamation Plant (WRP). This change will require

construction of a flow control facility or wet weather detention asset, both of which require adequate land and odour offset zones.

The topography of the site indicates that a new pump station and rising main may also be required to direct effluent flow from the lower western side of the site to the main gravity trunk main. This portion of the site should progress in alignment with the development of the Miners Rest area to take advantage of the proposed sewer pump station in this area.

Infrastructure required for wastewater treatment

Central Highlands Water has supported the design conclusion that the effluent generated from the development of the Northern GIA will be directed to the Ballarat North Water Reclamation Plant (WRP).

Ballarat North WRP currently has adequate dry weather capacity but insufficient capacity for wet weather peak flows. The development of the Ballarat West Employment Zone (BWEZ) is earmarked to discharge to this plant and may reduce the spare dry weather capacity as well as add additional strain on wet weather capacity over the next five years.

Upgrade of the Ballarat North WRP would be necessary to facilitate development of the Northern GIA. Beyond the financial implications of such an upgrade, legislative issues around Environmental Protection Authority (EPA) licensing reforms also exist. This could result in the need for an extension to the odour buffer zone, causing implications on properties around the treatment plant.

Water

A high level proposed potable water network has been calculated in accordance with MRWA WSAA Water Code, as per the requirements stated by Central Highlands Water. As further reference, the design has also considered the requirements that Central Highlands Water has stipulated in the Ballarat West Precinct Structure Plan (PSP) 2012 for water demand and network design. It would be anticipated that the additional requirements stated within the PSP will also apply to all other future development within Ballarat.

Demand requirements

The water demand has been determined for the residential properties only, and does not consider the water required for the function of the commercial or landscaped precincts. This decision was made on account of the absence of information regarding the type of commercial and landscape areas proposed for each scenario and their demand requirements.

In accordance with the MRWA WSAA Water Code, the peak daily and hourly demands have been determined.

The peak hourly flow rates for residential density types (high, medium, low) have been provided by Central Highlands Water and are in accordance with those stated by MRWA (MRAW, 2011). Arup has extrapolated these values to ascertain values for the allotment types used in the scenarios.

The peak daily demand has been determined on the assumption that potable water demand reduction measures will not be implemented in the development areas. This approach was applied to ensure that water demand requirements can be achieved when the residential water systems are unable to function as designed, such as during drought and when the residential systems are not maintained. This design measure was proposed and supported verbally by Central Highlands Water.

Table 9 provides a summary of the estimated water demand for each land development scenario. Central Highlands Water has been provided with the estimated demands and have advised that the derived demands are consistent with the degree of development investigated.

Table 9 Northern GIA estimated water demand

Proposed water demand for residential development areas		
	Water Demand (m^3/s)	Water Demand (ML/day)
Scenario 1	0.72	1.81
Scenario 2	0.82	2.71
Scenario 3	0.90	3.39
Scenario 4	1.03	4.52

New trunk infrastructure

Water supply to the Northern GIA will originate from the Northern Tanks Zone network, which currently comprises of 2 x 2.3 ML Ballarat North tanks, fed via the Ballarat North pump station (Central Highlands Water, 2014). Central Highlands Water have advised that a new pressure zone would need to be developed to service this area. This would involve new tanks boosters and mains as well as the upgrade of the existing Mount Rowan tank and pump station. These assets will require new land area for the authority.

It is expected that connection will be made to the 450mm diameter DICL trunk main along the Western Highway to increase the supply of water to the study area. Trunk water mains do not currently exist within the site and as such, extensive new trunk infrastructure is required along all major roadways. It is expected that approximately 1.0km of new water main pipework within the GIA will be required to enable supply for each of the growth scenarios.

Central Highlands Water have advised that supplying the Northern GIA will likely compromise the level of service provided to the nearby Miners Rest area. This would drive the need for further upgrades to surrounding assets. These upgrades could provide costly and complex due to existing mains passing through highly built up areas and dense bushland reserves.

To reduce demand, Central Highlands Water has indicated a desire to mandate household scale rainwater harvesting and notes the ability of the Ballarat North

WRP to provide Class A recycled water. The capacity of this service and support infrastructure needed requires further investigation.

Infrastructure required for water treatment

Central Highlands Water has advised that the Ballarat System is capable of sourcing adequate raw water supply for the next 30 to 50 years and that the two treatment plants in the area have sufficient capacity for the next 20 years.

Gas

Demand requirements

The gas demand for each of the development scenarios has been determined based on the current gas usage per person in Ballarat. In the absence of information pertaining the proposed industrial and commercial development for each scenario, the gas demand calculated consider only the residential demand. The proposed gas demand is shown in Table 10.

Table 10 Northern GIA estimated gas demand

Proposed gas demand for residential development areas	
	Gas Demand (GJ/year)
Scenario 1	10474
Scenario 2	15711
Scenario 3	19639
Scenario 4	26185

New trunk infrastructure

AusNet Services have advised that the location of the Northern GIA would mean that supply would have to travel across Ballarat resulting in significant pressure reductions. This suggests that significant upgrades and new trunk infrastructure would be required to provide reliable supply to this area.

Long term infrastructure requirements

AusNet Services has advised that two new field regulators are currently being installed to enhance network pressures to ensure capacity for the immediate future. These upgrades do not consider future growth in this area.

Electricity

New trunk infrastructure

Powercor has confirmed that there is limited supply available to the North GIA, however 22kV feeder augmentation works would be required to support significant growth in demand. Such augmentation works are included in Powercor's 10 year forward plan.

It is noted that Powercor's longer term plan is to establish a substation in Ballarat West. This substation is proposed to cater for growth in the industrial demand in the area but could also have advantages for the North GIA.

It is likely that the following infrastructure works would be required to support the GIA:

- New transmission lines to supply the existing Ballarat Terminal Station (BATS);
- New sub-transmission lines to fed the Ballarat North (BAN) or Ballart West (BAW) zone substation;
- New 22kV feeders from either the BAN or BAW zone substations to the GIA
- New electricity distribution network within the GIA.

It would be anticipated that at least one new 22kV feeder would be required to support the supply of electricity for Scenario 1 and up to 4 new 22kV feeders for Scenario 4. Similarly, given the proposed sub-transmission lines to the BAW zone substation, additional sub-transmission lines may only be necessary for Scenarios 3 and 4.

Telecommunications

Telstra has advised that trunk infrastructure in growth areas will be dictated by developer applications. These protocols are spelt out by both Telstra and NBN Co and are at a cost to the developer.

2.4.2 New community infrastructure

The new community infrastructure required to provide for the future residents of the Northern GIA was determined based on benchmark recommendations for the provision of facilities. The requirements were determined under four population projection scenarios. Existing facilities in adjacent areas have been documented, as this may reduce the requirement for new community infrastructure.

Table 11 Community infrastructure required for the Northern GIA

Category	Indicator	Benchmark	Access distance	Reference	Number required under scenario				Provider	Existing facilities	Distance from GIA
					1	2	3	4			
1 Recreation and Cultural Infrastructure											
1.1 Sport and recreation	Provision of recreation areas - active open space	One Level 1 active open space reserve (8 ha per active open space reserve) per 6,000 people	1000 metres for 95% of dwellings	ASRR 2008 GAA 2013	1.4	2.1	2.6	3.4	Local council		
1.4 Community centres	Provision of community centres	Level 1 Provision ratios up to 10,000 people		GAA 2009	0.8	1.2	1.5	2.1	Local council	Community Hall	1000 metres
2 Educational Infrastructure											
2.1 Kindergartens	Provision of kindergartens	Provision ratios up to 10,000 people	600 metres	GAA 2009 Barton et al 2010	0.8	1.2	1.5	2.1	Private		
2.2 Long day care and occasional care	Provision of long day care and occasional care facilities	Provision ratios up to 10,000 people	600 metres	GAA 2009 Barton et al 2010	0.8	1.2	1.5	2.1	Private		
2.3 Primary schools	Provision of government primary schools	1 government primary school per 8,000 to 10,000 people	800 metres	ASRR 2008 Barton et al 2010	0.8	1.2	1.5	2.1	State government	Forest Street Primary School (includes Forest Street Deaf Facility)	580 metres

Category	Indicator	Benchmark	Access distance	Reference	Number required under scenario				Provider	Existing facilities	Distance from GIA
					1	2	3	4			
										Yuille Park P-8 Community College	600 metres
	Provision of non-government primary schools	Provision ratios between 10,000 and 30,000 people	800 metres	GAA 2009 Barton et al 2010	0.4	0.6	0.8	1.0	Private	Our Lady Help of Christians	1000 metres
3 Healthcare Infrastructure											
3.1 GP clinics	Provision of GP clinics	0.34 general practices per 1000 people (Victorian average)		Dept of Health 2011	2.8	4.2	5.2	7.0	Private		
3.3 Dental practices	Provision of dentist sites	0.20 dental services per 1000 people (Victorian average)		Dept of Health 2011	1.6	2.5	3.1	4.1	Private		
3.4 Aged care	Provision of aged care facilities	Provision ratios between 10,000 and 30,000 people		GAA 2009	0.4	0.6	0.8	1.0	Private		
	Provision of aged care places	88 beds per 1000 people aged 70+		ANAO 2015	73	110	137	183	Private		
3.5 Community health centres	Provision of community health centres	Provision ratios between 10,000 and 30,000 people		GAA 2009	0.4	0.6	0.8	1.0	State government		
3.6 Hospitals	Hospital beds	3.9 hospital beds per 1000 people (Australian average)		AIHW 2014	32	48	60	80	State government		

The demand for community infrastructure is driven by the population and the provision of existing facilities and services. It has been noted that the healthcare infrastructure may be provided by the public sector. The potential costs associated with the delivery of such community infrastructure is discussed in Table 13.

2.5 Financial and economic assessment

2.5.1 Development infrastructure costs for trunk infrastructure

Drainage

The engineering estimated costs associated with the drainage trunk infrastructure are stated below. For information regarding the design and cost assumptions please refer to Appendix C.

Table 12 Northern GIA estimated drainage trunk infrastructure cost

Item	Scenario 1	Scenario 2	Scenario 3	Scenario 4
New pipes and pits	$3,454,106.28	$4,669,964.23	$5,280,907.24	$5,391,182.22
Retention Basins / Wetlands	$8,059,581.33	$10,896,583.20	$12,322,116.90	$12,579,425.19
Council Fees	$402,979.07	$544,829.16	$616,105.85	$628,971.26
CAPEX (2015 prices)	**$11,916,666.68**	**$16,111,376.59**	**$18,219,129.99**	**$18,599,578.67**
CAPEX (2040 prices)	**$25,027,572.89**	**$33,837,369.37**	**$38,264,106.58**	**$39,063,130.94**

Sewer and Water

As with all of the proposed areas, development of the Northern GIA will drive the need for significant investment in new trunk infrastructure and upgrades to existing infrastructure in the quantum of $40M – $50M. Should this result in the need for a new wastewater treatment plant and re-use facility a further $50M - $80M could be required.

Operational complexities due to the possible creation of multiple pressure zones to supply this GIA will also have ongoing costs.

Gas

While the authorities have not provided specific costs for trunk infrastructure, they have noted that the Northern GIA will require a significant amount of investment to provide supply from the existing City Gate and maintain service levels across the network.

Electricity

Powercor stated that costs associated with supplying this GIA are difficult to provide without a detailed in depth assessment. However, it was noted that costs would vary only slightly between the GIA's being considered and that there was no preference between areas.

Telecommunications

Telstra has advised that charges for new infrastructure are generally borne by the developer and vary based on:

- type and size of the development,
- location,
- services required by the developer,
- network type, and
- relative proximity of Telstra's network with spare capacity.

2.5.2 Community infrastructure costs

The unit costs for community infrastructure required to service development in the Northern GIA are outlined in Table 13. The total cost of providing infrastructure depends on the development scenario, as outlined in Section 2.4.2.

Table 13 Community infrastructure costs for Northern GIA

Category	Indicator	Unit cost	Reference	Cost in scenario			
				1	2	3	4
1 Recreation and Cultural Infrastructure							
1.1 Sport and recreation	Provision of recreation areas - active open space	$ 6.75 million	Urban Enterprise, 2014	$6,750,000	$13,500,000	$20,250,000	$20,250,000
1.4 Community centres	Provision of community centres	$ 4.4 million	Urban Enterprise, 2014	$4,400,000	$4,400,000	$8,800,000	$8,800,000
2 Educational Infrastructure							
2.1 Kindergartens	Provision of kindergartens	$ 1.3 million	City of Kingston, 2014	$1,300,000	$1,300,000	$2,600,000	$2,600,000
2.2 Long day care and occasional care	Provision of long day care and occasional care facilities	$ 4.1 million	ACT Government, 2012 McComish, 2013	$4,100,000	$4,100,000	$8,200,000	$8,200,000
2.3 Primary schools	Provision of government primary schools	$ 12.2 million	Department of Treasury and Finance, 2015	$12,200,000	$12,200,000	$24,400,000	$24,400,000
	Provision of non-government primary schools	$ 12.2 million	Department of Treasury and Finance, 2015	$-	$12,200,000	$12,200,000	$12,200,000
3 Healthcare Infrastructure							
3.1 GP clinics	Provision of GP clinics	$ 1.4 million	Selesnew, 2008	$4,200,000	$5,600,000	$7,000,000	$9,800,000
3.3 Dental practices	Provision of dentist sites	$ 1.4 million	Selesnew, 2008	$2,800,000	$4,200,000	$4,200,000	$5,600,000

Category	Indicator	Unit cost	Reference	Cost in scenario			
				1	2	3	4
3.4 Aged care	Provision of aged care facilities	$ 17.9 million	Department of Treasury and Finance, 2014	$-	$17,900,000	$17,900,000	$17,900,000
	Provision of aged care places	$ 595,000 per place	Department of Treasury and Finance, 2014	$43,435,000	$65,450,000	$81,515,000	$108,885,000
3.5 Community health centres	Provision of community health centres	$ 50.2 million	Department of Treasury and Finance, 2014	$-	$50,200,000	$50,200,000	$50,200,000
3.6 Hospitals	Provision of hospital beds	$ 844,000 per bed	Department of Treasury and Finance, 2015	$27,008,000	$40,512,000	$50,640,000	$67,520,000

The demand for community infrastructure is driven by the population and the associated costs are influenced by which scenario is implemented. It has been noted that the indicative healthcare infrastructure may be provided by the public sector. Further the costs identified are relatively similar across the GIAs given the influence of population.

2.5.3 Developer costs for local infrastructure

The engineering estimated developer costs associated with the construction of local infrastructure have been determined following consideration of the following:

- The standard industry rates for construction in Melbourne (Rawlinsons, 2015); and
- The fees and charges stipulated by Central Highlands Water for land development (Central Highlands Water, 2014).

For information regarding the design and cost assumptions please refer to Appendix C. Cost estimates have been determined based on 2015 prices and the construction prices anticipated for 2040. The anticipated 2040 costs have been determined based on the assumption that the inflation rate for construction from 2015 to 2040 will be equal to that experienced between 2004 and 2014. This rate is 4.4% per year.

Table 14 Northern GIA combined cost estimate – 2015 prices

Northern GIA combined cost estimate - 2015 prices				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Roads	$41,518,500	$45,317,760	$45,317,760	$49,117,020
Water Supply	$14,706,042	$18,649,408	$21,104,361	$25,866,045
Sewer	$9,405,194	$11,179,007	$11,463,942	$13,140,534
Total	**$65,629,736**	**$75,146,175**	**$77,886,063**	**$88,123,599**

Table 15 Northern GIA combined cost estimate – 2040 prices

Northern GIA combined cost estimate - 2040 prices				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Roads	$87,197,814	$95,177,080	$95,177,080	$103,156,347
Water Supply	$30,885,863	$39,167,783	$44,323,715	$54,324,279
Sewer	$19,752,937	$23,478,328	$24,076,753	$27,597,958
Total	**$137,836,614**	**$157,823,192**	**$163,577,549**	**$185,078,584**

3 Western GIA

3.1 Land capability assessment

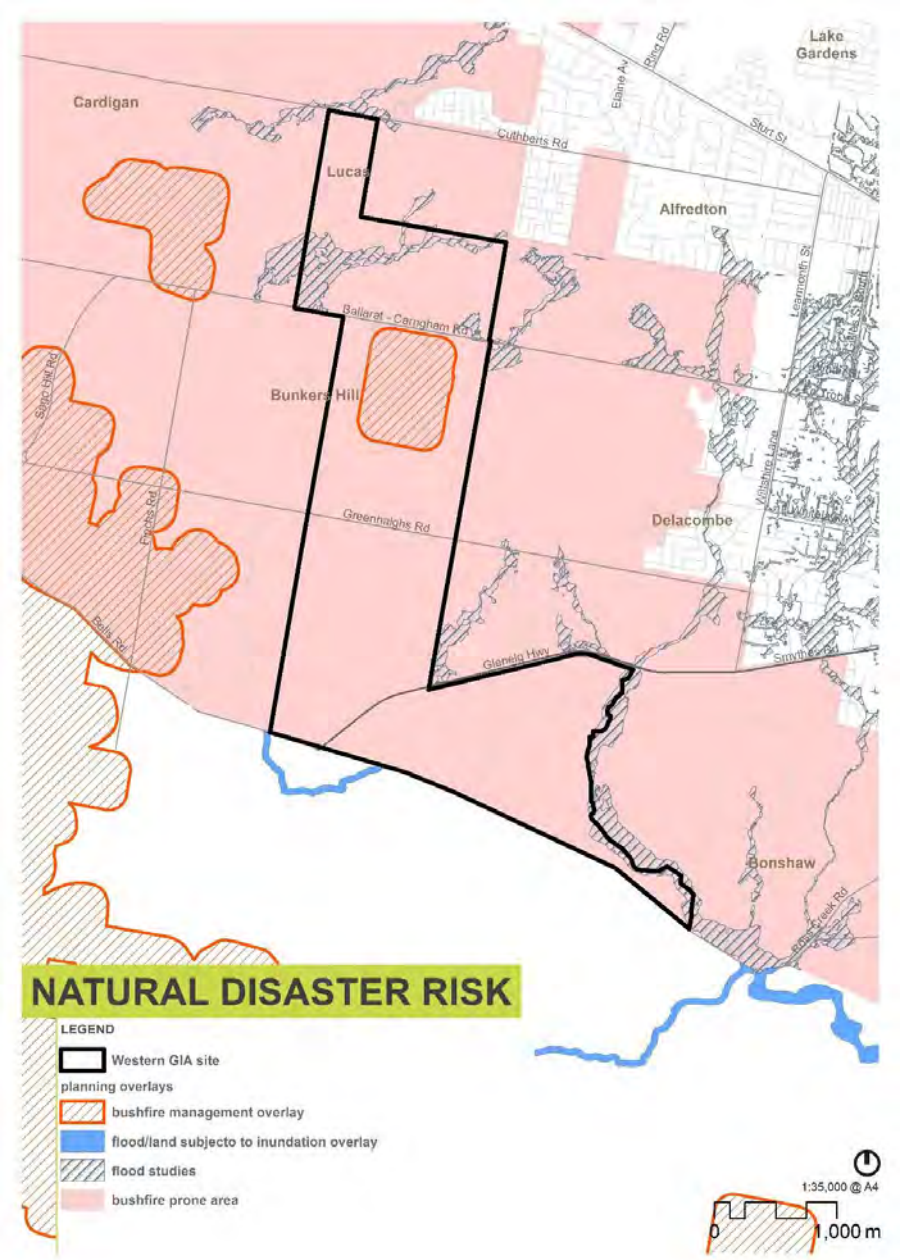

Figure 12 Western GIA – Natural disaster risk

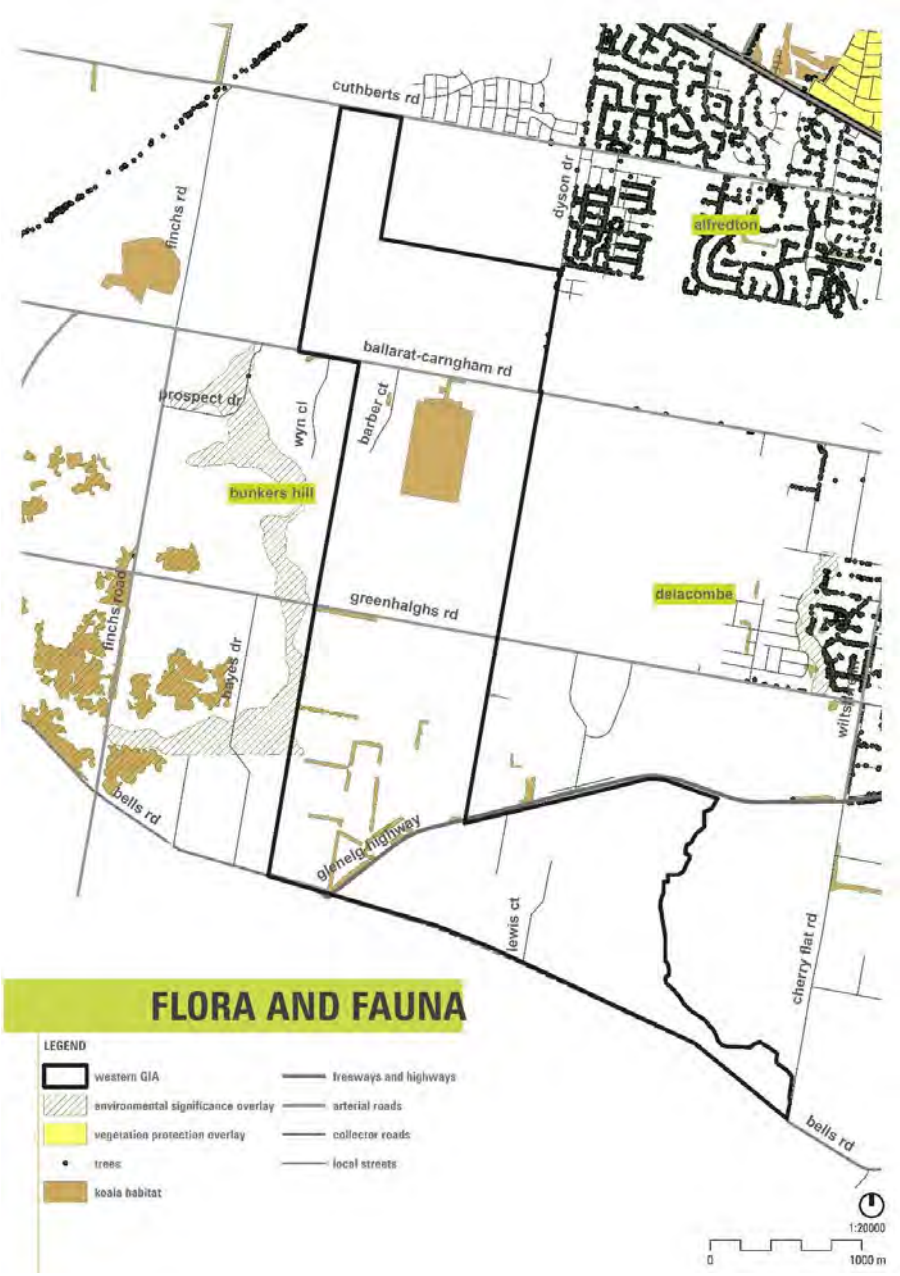

Figure 13 Western GIA – Flora and fauna

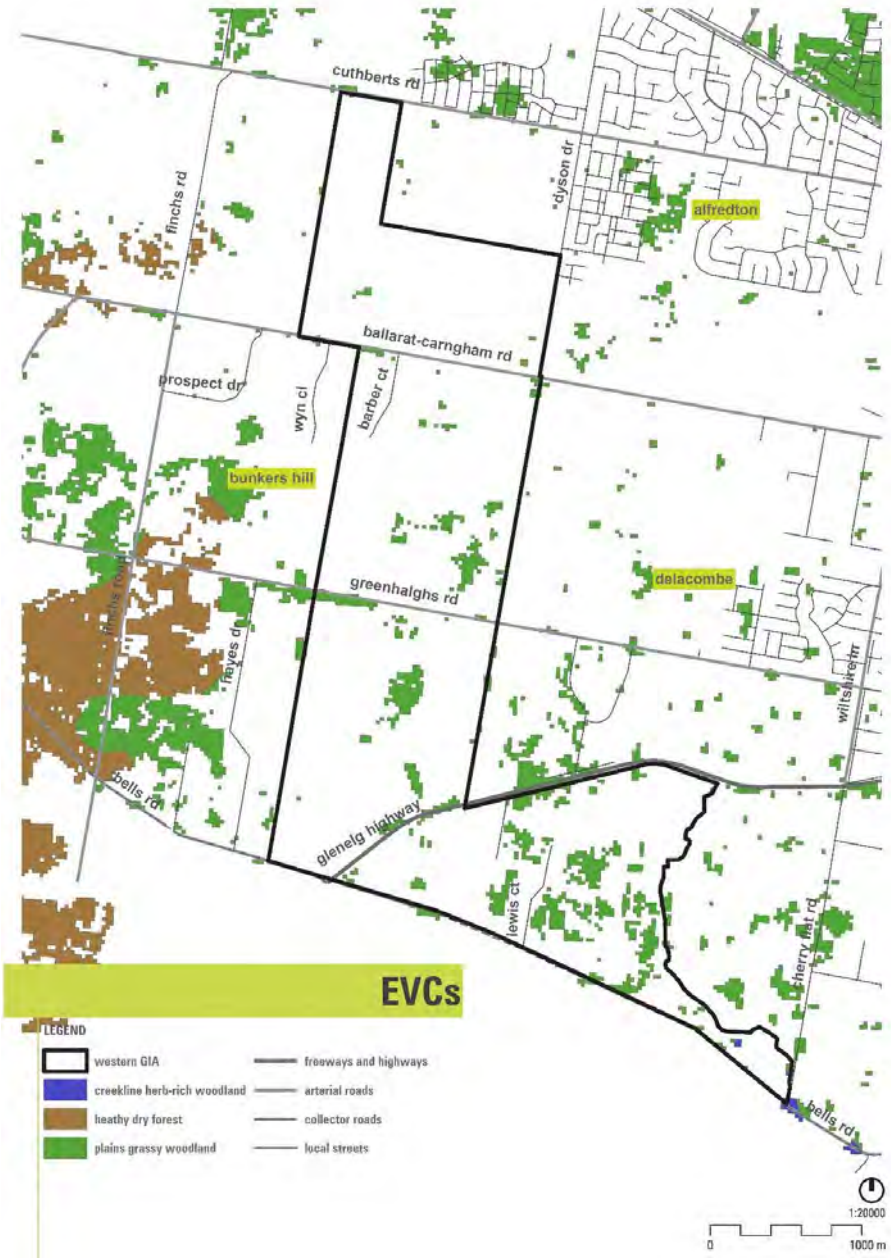

Figure 14 Western GIA – EVCs

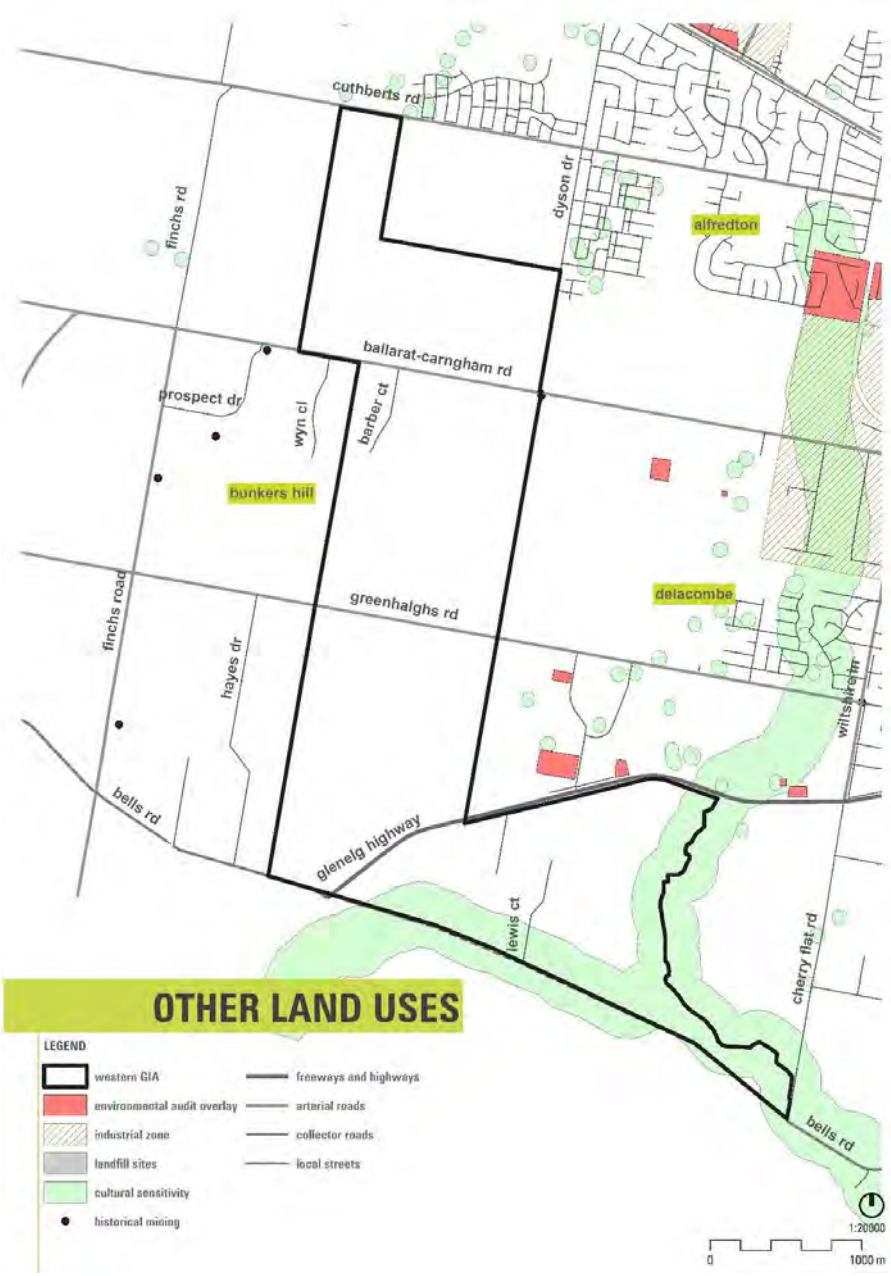

Figure 15 Western GIA – Other land uses and cultural heritage

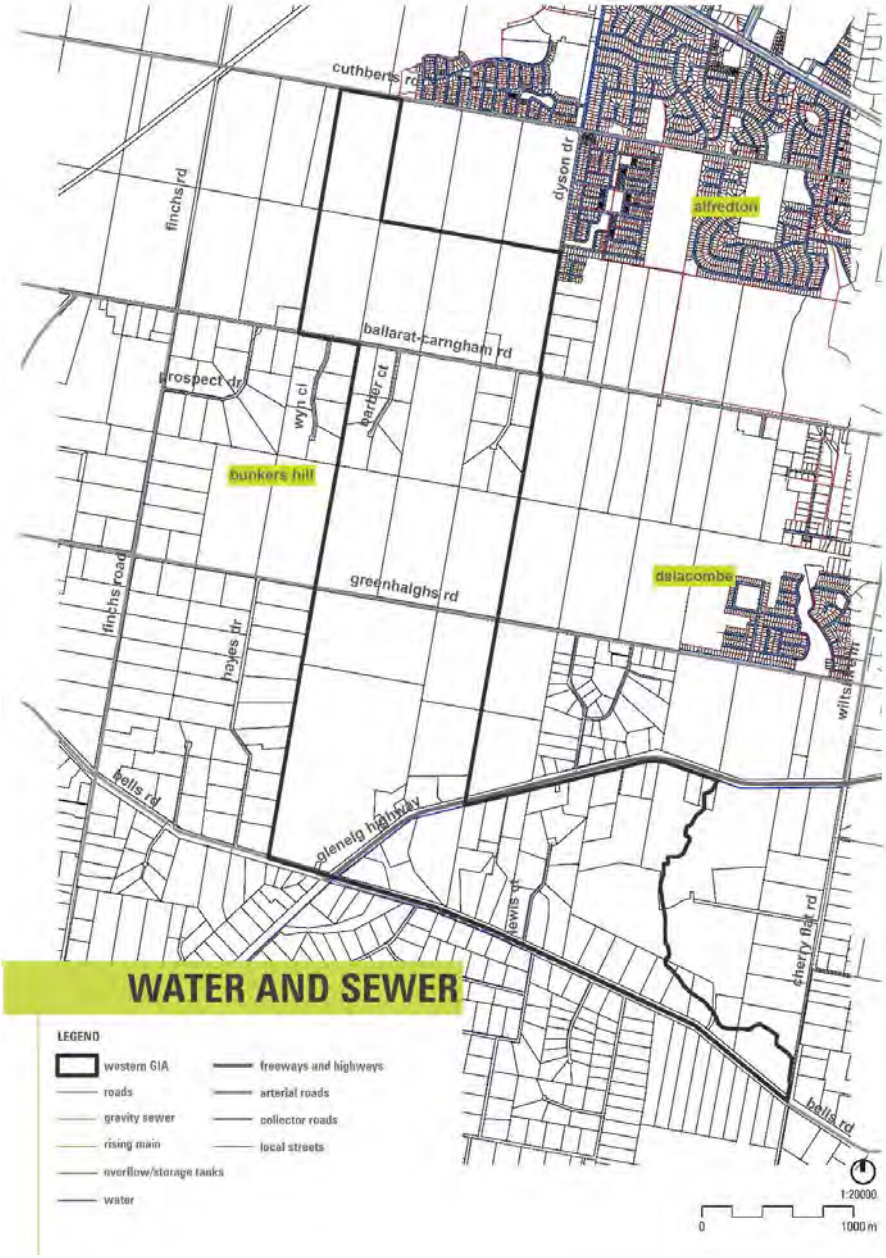

Figure 16 Western GIA – Water and sewer trunk infrastructure

3.1.1 Natural disaster risk

Bushfire

The Wildfire Management Overlay does not apply to any land within the Western GIA. It does apply so a parcel of land approximately 1 kilometre to the west of the GIA.

The Western GIA sits entirely within the Bushfire Prone Area. The south west corner of the site was affected by a bushfire between 1950 and 1974. This data was sourced through the Visualising Ballarat mapping tool[7].

Flooding

The Rural Floodway Overlay does not apply to any land within or surrounding the Western GIA.

The Land Subject to Inundation Overlay does not apply to any land within or surrounding the Western GIA.

The Erosion Management Overlay does not apply to any land within or surrounding the Western GIA.

According to the 100 year ARI flood extent as mapped in the Ballarat Civil Infrastructure Assessment report, there are areas in the north of the Western GIA that are likely be impacted by a 100 year flood. There are also areas adjacent to the east of the GIA that will be impacted (SMEC, 2014).

3.1.2 Protected flora and fauna

Vegetation Protection Overlay

The Vegetation Protection Overlay does not apply to any land within the Western GIA.

Environmental Significance Overlay

The Environmental Significance Overlay applies to some land within the Western GIA. These are narrow strips of vegetation in the south western portion of the GIA. This land is subject to Schedule 5 of the Environmental Significance Overlay, which sets out requirements regarding Koala and Koala Habitat Protection. This Schedule applies where koala habitat and food sources have been identified. For developments on sites that contain koala habitat an assessment of the habitat must be undertaken, and a proposal must be made on how the impacts to koalas will be managed. A permit is required: to construct any buildings or carry out works where native trees are to be removed, to construct a fence, to remove native trees or to subdivide land.

There is also a large area of land to the west of the GIA which is covered by the Environmental Significance Overlay. This land is which is subject to Schedule 2, relating to streamside and watercourse protection. This overlay is designed to maintain the quality of watercourses and protect habitat. A permit is required to construct a building in this area.

Significant Landscape Overlay

[7] www.visualisingballarat.org.au

The Significant Landscape Overlay does not apply to any land within or surrounding the Western GIA.

Salinity Management Overlay

The Salinity Management Overlay does not apply to any land within or surrounding the Western GIA.

Ecological Vegetation Classes

There are patchy areas of Plains Grassy Woodland within the Western GIA. This EVC is classed as Endangered in this area.

Koala Habitat

Koala habitat has been identified in the Western GIA. This includes a 22 hectare patch of 'Likely Primary Habitat'. There are also many linear fragments of vegetation that have not been identified as preferred koala habitat (Schlagloth & Thomson, 2006).

Environment Protection and Biodiversity Conservation (EPBC) Act Register

According to the EPBC register, there are several matters of national significance known to occur within a 500 metre buffer of the Western GIA (Australian Government Department of the Environment, 2014). These are outlined in the table below.

Table 16 EBPC matters in the Western GIA

Type	Name	Status	Type of presence
Wetlands of International Importance	Port Phillip bay (western shoreline) and Bellarine		Upstream from Ramsar
	Western district lakes		Upstream from Ramsar
Listed Threatened Ecological Communities	Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area
Listed Migratory Species – Terrestrial Listed Marine Species - Birds	*Hirundapus caudacutus* White-throated Needletail	Threatened	Species or species habitat known to occur within area
	Myiagra cyanoleuca Satin Flycatcher	Threatened	Species or species habitat known to occur within area
Listed Migratory Species – Wetland Listed Marine Species - Birds	Ardea alba Great Egret, White Egret	Threatened	Species or species habitat known to occur within area

There are many additional species that are likely to or may occur in the area. The full list is contained in the EPBC report in Appendix A.

Strategic Biodiversity Score

The Strategic Biodiversity Score measures the importance of native vegetation for Victoria's biodiversity at a landscape scale, relative to other locations across the state. It is measured on a linear scale between 0 and 100, with 100 indicating the most important areas of habitat. The land in the Western GIA has a relatively low habitat value, with a maximum score of 23 and the majority below 20. The strategic biodiversity score is used to assess and minimise the impact of vegetation removal and also to determine offset requirements for the removal of native vegetation.

Ballarat Urban Forest Strategy and Living Corridors

Outlined in the Ballarat Strategy (City of Ballarat, 2015), the Urban Forest Strategy highlights the importance of canopy cover within Ballarat (City of Ballarat, 2015). GIS mapping of trees and the urban forest map in the Ballarat Strategy indicate that there are several trees along the border of the GIA, in the north eastern section.

The Ballarat Strategy also introduces the 'Living Corridors' concept for Ballarat, a network to provide recreational and biological connection of natural areas (City of Ballarat, 2015). The Western Link Road Corridor runs along the east boundary of the GIA in the northern section, then cuts through the GIA and follows the south boundary to the south east corner of the GIA. The Kensington Creek Corridor follows the east boundary in the southern section of the GIA, meeting the Western Link Road Corridor on the south boundary.

This Visualising Ballarat mapping tool does not identify any significant tree cover within or around the Western GIA.

Waterways

There are numerous creeks that run through the Western GIA. There are also several dams along the waterways particularly in the southern section of the GIA. The majority of these waterways are not identified by name on maps (GIS data or the Visualising Ballarat tool). Identifiable creeks on the site are Kensington Creek, which runs along the southern section of the eastern boundary, and Winter Creek, which runs along the southern boundary of the GIA.

3.1.3 Buffers from sites that require separation from sensitive uses

Airport Environs Overlay

The Airport Environs Overlay does not apply to any land within the Western GIA. The airport is located approximately 3 kilometres north of the GIA.

Industrial zoned land and proximity to sites

There is no industrial zoned land within or in close proximity to the Western GIA. The closest industrial land is approximately 1.6 kilometres east of the GIA.

3.1.4 Noise impacts

Aircraft Noise

The Western GIA is located under the Ballarat Aerodrome primary runway 18/36 flight tracks and will be impacted by aircraft noise.

The Airport Environs Overlay and the (unendorsed) Ballarat Aerodrome 20 ANEF[8] contour are well outside the GIA and do not apply any restrictions.

The maximum event noise levels due to aircraft flyover are predicted to be up to 80 dB(A) at locations within the GIA. On this basis aircraft noise may cause some complaint from future residential use.

Road traffic noise

The Western GIA is affected by road traffic noise from the Glenelg Highway and will be affected by noise from the new Ballarat Western Link Road.

Based on year 2031 traffic estimates and VicRoads requirements[9], the following noise mitigation measures apply to the GIA:

- A noise wall between 2 and 3 m high at the GIA boundaries with the Glenelg Highway.
- A noise wall up to 5 m high may be required along the Ballarat West Link Road.
- Consideration of buffer zones, building restrictions (planning), building treatment or landscaping in cases where noise walls cannot be applied to the boundaries with Glenelg Highway (eg access requirements).

Industrial noise

There are no industrial zones or industrial operation adjacent to the Western GIA. The GIA is not considered to be affected by industrial noise.

Industrial noise affecting the GIA will be assessed under the EPA NIRV[10]

Railway noise

Railway noise does not affect the Western GIA.

3.1.5 Contaminated sites

Environmental Audit Overlay

The Environmental Audit Overlay does not apply to any land within the Western GIA. It does apply to some land parcels within 100 metres of the boundary to the east of the GIA.

[8] City of Ballarat, *Ballarat Aerodrome Noise Modelling Study*, 2010
[9] VicRoads, *Requirements for Developers – Noise Sensitive Uses*, 2004
[10] EPA, Noise from Industry in Regional Victoria – Publication 1411,

3.1.6 Sites with past mining activities

Historical mining activity

There are no locations of recorded historical mining activity within the Western GIA. There is one site just outside the eastern border of the GIA.

Expired mining licenses and leases

There are no expired mining licenses or leases within the Western GIA.

3.1.7 Topography

The land on this site generally slopes downhill from the north east to the south west of the GIA. Some areas in the south east of the site have a reasonably steep gradient (around 10%), but generally the gradient is gentle.

3.1.8 Access to existing utility infrastructure

The Western GIA is predominantly comprised of undeveloped farming and grazing land. Information regarding the existence of major utility services has been ascertained by conducting a 'Dial Before You Dig' enquiry and contacting the asset owners directly. The major utility services present in some capacity in the study area include:

- Water Supply;
- Electricity (Distribution); and
- Telecommunications.

Formal drainage and sewer infrastructure is not present within the GIA and information from the gas distribution authorities has not been provided. Consequently, it is unknown if gas mains and reticulation pipes exist within the GIA.

Drainage

Land use planning and drainage management for the Western GIA are the responsibilities of the City of Ballarat. This area is located within the Winter Creek Catchment and the Glenelg Hopkins Catchment Management Authority is responsible for the floodplain management.

All stormwater within the GIA drains via a number of small creeks towards Winter Creek, which flows parallel to the western side of the GIA and within the GIA along the southern edge. A large water body located just west of the GIA, detains stormwater from the northern and central catchments during peak flows. A number of waterbodies located within the southern portion of the GIA achieve the same objective. The capacity of waterbodies has not been confirmed by City of Ballarat or by Glenelg Hopkins Catchment Management Authority. According to the 100 year ARI flood extent as mapped in the Ballarat Civil Infrastructure Assessment report, there are areas in the north of the Western GIA that will be impacted by a 100 year flood.

Formal stormwater infrastructure does not currently exist within the Western GIA.

Sewer

There is currently no existing sewer infrastructure within the Western GIA. In the event that this study area is developed, future infrastructure will be provided and managed by Central Highlands Water.

A 525mm diameter gravity trunk main connected directly to the outfall sewer is located approximately 800m east of the study area along Ballarat-Carngham Road. As part of the upgrade works proposed for the Ballarat West PSP area, this main is to be extended west to the Western GIA. Similarly, as part of the Ballarat West development, sewer mains are planned to extend to the Western GIA at the Glenelg Highway and Greenhalghs Road. It is anticipated that these mains could be tapped into and upsized if necessary.

Effluent within the GIA and the surrounding areas is transferred to the Ballarat South Wastewater Treatment Plant (WwTP). The Ballarat South WwTP is licensed for an Average Daily Flow of 35 ML/day (SMEC, 2014). Central Highlands Water have stated that this plant currently has limited spare capacity.

Water

Central Highlands Water provides and manages the existing water supply infrastructure within Ballarat and the outlying areas. The Ballarat water supply is primarily comprised of two headwork systems: the Ballarat System and the Lal Lal System. Potable water to the Western GIA and the surrounding areas is derived from the Ballarat System and delivered via the Ballarat Central Zone network. All mains supplying water within this zone originate from the White Swan clear water storage facility and the 9ML Wilson Street tank (Central Highlands Water, 2014).

The Western GIA encompasses few water assets, with water supply provided to just two residential streets via 80mm diameter and 125mm diameter pipes. Trunk mains do not cross the study area, and the only other pipes are 150mm and 225mm diameter pipes, which run east-west along the Glenelg Highway and Ballarat-Carngham Road. A new water main is proposed along Greenhalghs Road as part of the adjacent Ballarat West PSP area but the size and proposed capacity of this has not been made available.

Gas

APA Group Transmission is responsible for the high gas pressure transmission assets and SP AusNet is responsible for the distribution supply assets.

A new 150mm diameter high pressure grid main is proposed to be located along the eastern boundary and most of the southern boundary as shown in the Ballarat West PSP (Jones, 2012). It would be anticipated that this grid main could be upsized if necessary or tapped into.

SP AusNet have advised that there is approximately 20% additional capacity to service the existing network but cannot confirm that the current network will be able to service the projected population of Ballarat in 2040 (SMEC, 2014).

Electricity

SP AusNet operates and maintains the Ballarat Terminal Station (BATS) and the electrical transmission lines that feed into the zone substations. The BATS is located in Warrenheip, in the east of Ballarat. Powercor is the electrical network distributor for the western Ballarat and power is supplied from the Ballarat South (BAS) zone substation. BATS-BAS sub-transmission loop supplies the BAS zone substation fed at 66kV and the total combined capacity of the lines is this loop is 147.5 MVA (Powercor Australia, 2014).

The electrical network within the Western GIA is currently largely underdeveloped. The existing high voltage distribution network in the study areas consists of 22kV overhead power lines that are predominantly located within the road reserves of Cuthberts Road, Ballarat-Carngham Road, the Glenelg Highway and Bells Road. Limited high voltage is also distributed via overhead lines in the south of study area, to the rural properties west of the Glenelg Highway. High voltage underground cabling does not exist within the site area, however, it is located immediately outside of the northern and eastern boundaries, along Cuthberts Road and Dyson Drive.

Powercor has confirmed that some capacity exists to service this GIA.

Powercor is planning a number of future infrastructure projects to cater for the Western GIA. The upgrades to the electrical network that are expected to directly affect the capacity to the Western GIA include:

- A number of new 22kV feeders from the BAS zone substation to the Ballarat West PSP area (BAS11, BAS21, BAS22, BAS24);
- A number of new 22kV feeders from the BAS zone substation that will offload the existing and proposed 22kV feeders supplying the Ballarat West PSP area (BAS31, BAS33);
- A new Ballarat West (BAW) zone substation and 66kV sub transmission line from the BAS zone substation to it; and
- A new 66kV sub transmission line from the BATS-BAN 66kV sub transmission line to the BAW zone substation (Powercor Australia, 2014).

Telecommunications

Optus and Telstra are the main distributors of communication services to residential and commercial customers within the Western GIA.

Information regarding where the cables identified as part of the Dial Before You Dig (DBYD) enquiry are managed has not been provided by the utility companies.

The National Broadband Network (NBN) has been rolled out in most of the Western GIA. Limited information has been provided with regard to the existing network capacity however it is anticipated that communications providers will

upgrade and expand networks in line with regional growth profiles pending developer applications.

3.1.9 Geotechnical conditions

Geotechnical considerations for the Western GIA are presented below. The geology overlay for the area is shown in Figure 17 below. Further details on geotechnical considerations based on the inferred geology are provided in Appendix B.

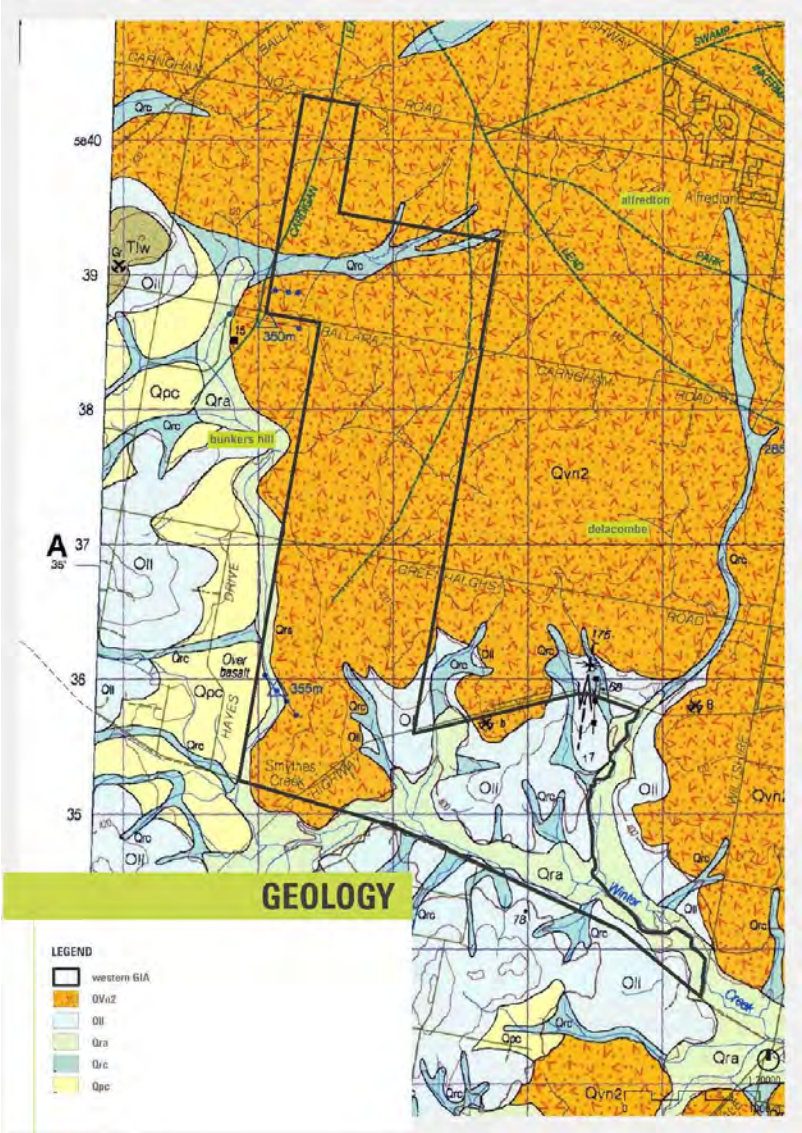

Figure 17 Western GIA geology based on the 1:50,000 Ballarat Geology Map (Geological Survey of Victoria, June 1996).

The majority of the northern and western portions of the GIA consist of newer volcanic material (Qvn2), which typically consist of basaltic clay overlying basalt rock. The south eastern portion of the site is a combination of hills of the underlying Castlemaine Supergroup bedrock (Oll) with overlying recent alluvium (Qra, water deposited) and colluvium (Qrc, Qpc, hillside erosion sediments) filling valleys and gullies.

Soil Shrink Swell Potential for Residential Development (AS 2870, 2011)

- Alluvial/colluvial areas and the underling bedrock will have a Moderate (M) to High (H1) soil reactivity.
- The basaltic clay has a High (H1) to Very High (H2) shrink swell soil reactivity, or in some cases extreme (E) (Peck, Neilson, Olds, & Seddon, 1992).

In recent history (The Age, 2014), large areas of residential development around the north west of Melbourne have had significant issues with building damage and cracking on basaltic clays as a result of inadequate site classification and foundation construction.

For development in this GIA on basaltic clay, we recommend a strong regime of requirements for geotechnical investigation, site classification and foundation design in accordance with AS 2870 Residential Slabs and Footings is implemented.

Excavation and potential to encounter rock

- Shallow excavation for residential developments should be able to be completed with light earthmoving plant in the basaltic clay, Castlemaine Supergroup and alluvial/colluvial deposits.
- Deeper excavations/trenches in the basaltic clay may encounter boulders requiring localised removal, or basalt rock which may require heavy earthmoving equipment and ripping.
- Deeper excavations in the Castlemaine Supergroup may encounter rock, although this can generally be excavated easily with medium to heavy earthmoving equipment.
- Deeper excavation in the alluvial/colluvial deposits may be unstable and/or require dewatering.

Land Instability Potential

Based on topographical contours and geology, the potential for land instability over the GIA is generally considered to be very low. Areas of localised instability may occur, particularly adjacent to the colluvial deposits in existing creeks and waterways. Land instability risk should be able to be managed through good practice for development on sloping sites.

General considerations

Other general considerations include:

- Basaltic clay material can degrade quickly when exposed and wet and it is advised that earthworks should not be undertaken in winter and care should be taken in wet shoulder seasons.
- The basaltic clay may have a low CBR requiring improvement of soft zones for pavement construction.
- Castlemaine Supergroup could be a good source of site won material for general filling.

3.2 Heritage assessment

3.2.1 Cultural heritage

Heritage Overlay

The Heritage Overlay does not apply to any land within the Western GIA.

Cultural Sensitivity

There are areas of Aboriginal cultural sensitivity along the east and south boundaries of the south eastern section of the GIA. These are approximately 200 metre buffers from Winter Creek and Kensington Creek, which run along the GIA boundaries in this section. Areas of cultural heritage sensitivity have been designated where Aboriginal cultural places and objects are known or are likely to exist. The presence of these areas indicate the need for a Cultural Heritage Management Plan (CHMP) under the Aboriginal Heritage Act 2006.

Historical Landscape

Mapping Ballarat's Historic Urban Landscape outlines the character of the landscapes within Ballarat (Context Pty Ltd, 2013). The Western GIA lies across three Indicative Character areas. Key community concerns in all these area, as identified in the Ballarat Imagine consultation process, include landscape, views, bushland, and native flora and fauna.

Most of the GIA is located within the Burrumbeet Plains Rural Character area. This area is a flat, largely pastoral area with little tree cover. From this area there are panoramic views to the hills and mountains of the north and west.

The south west section of the GIA is located in the Haddon Hills and Common Rural Character area. This area is characterised by forested, low rolling hills/ There are some rural residential properties and paddocks interspersed in the forested areas.

The south east section of the GIA is in the Bonshaw/Magpie/Scotchman's Lead Mining Landscape Rural Character area. This landscape is characterised by an undulating open topography, with evidence of former mining activities. There are open views to the south and east of the surrounding forested ridgelines.

Heritage Inventory

The Western GIA does not have any sites identified on the Heritage Inventory, under the Victorian Heritage Act 1995.

3.2.2 Comparison of the heritage assessment

When considering the heritage assessment for the Western GIA, it has the most favourable conditions of the GIAs the results of the multi-criteria analysis shown in .

3.3 Accessibility assessment

3.3.1 Existing and planned future road network

The key features of the existing road network surrounding the site are outlined as follows:

- The site is bounded by Cuthberts Road to the north and Bells Road to the south both for which Ballarat City Council are the responsible authority. The key roads that bisect the site include Glenelg Highway and Ballarat-Carngham Road (VicRoads are the responsible authority) as well as Greenhalghs Road (Ballarat City Council are the responsible authority). These roads and the associated road hierarchy as shown in
- The Western Link Road is planned to run through the site. The first stage is generally at least 900m north of the site and is under construction. Stage 1 from the Western Freeway to The Terrace is nearing completion. The remaining sections further south are not funded at this time but are expected to be broadly aligned to the east of the site. Development of the Western Link Road will enhance accessibility to the north and south of the Western GIA.
- Information contained within the report "Victorian Integrated Transport Model – City of Ballarat, Phase 3A Investigation" dated July 2014 (Ballarat VITM Report) indicates that the road network which provides access to the site generally operates well within capacity during the AM peak period in 2011.
- The assessment of transport forecasts contained within the Ballarat VITM Report indicates that in 2041, the network experiences some levels of congestion along key routes providing access to the site during the AM peak period. Using the base case future land use and network assumptions within the Victoria Integrated Transport Model, the following points are noted for 2041 (and shown in):
  - Medium levels of congestion on the on Ballarat-Carngham Road and Cuthberts Road; and
  - Medium levels of congestion on the Ballarat Western Link Road, in the vicinity of the intersections of Gillies Street and Sturt Street.

  It is likely that upgrades of Ballarat-Carngham Road and Cuthberts Road would be required to connect the site with the network providing access to the Ballarat CBD.

A comparison of the assumptions within VITM indicate that the number of households for the site in 2041 are consistent with the Scenario 1 (low development scenario). Additional levels of development associated with the medium and high scenarios would exacerbate the impacts identified above.

3.3.2 Public transport network and facilities

The public transport facilities that provide access to the site are shown in with the key points noted as follows:

- The closest point of the site is located approximately 2.5km from Wendouree Station and approximately 4.8km from Ballarat Station.
- There are no bus routes that currently service the site. The nearest services include bus route 13, 14, 15, 18, 19 and are all located between 800m and 900m east of the site.

3.3.3 Walking and cycling networks

The key walking and cycling features of the site are noted as follows:

- The site is generally located at least 5.5km to 6km from the Ballarat CBD. Accordingly, the majority of walking trips and cycling trips are expected to remain either internal to the site or be limited to the immediate surrounding suburbs.
- There are no existing routes with dedicated cycling facilities that provide access to the site.
- The Ballarat Cycling Action Plan 2017 include future cycling route with dedicated on-road bicycle facilities along the Glenelg Highway, Cuthberts Road and, Ballarat-Carngham Road.
- With the inclusion of the planned cycling routes, the catchment remains limited as shown in Figure 18.
- There is an opportunity for the planned route along Greenhalghs Road (currently terminating at Wiltshire Lane) to be extended to the site to improve access to Ballarat CBD.

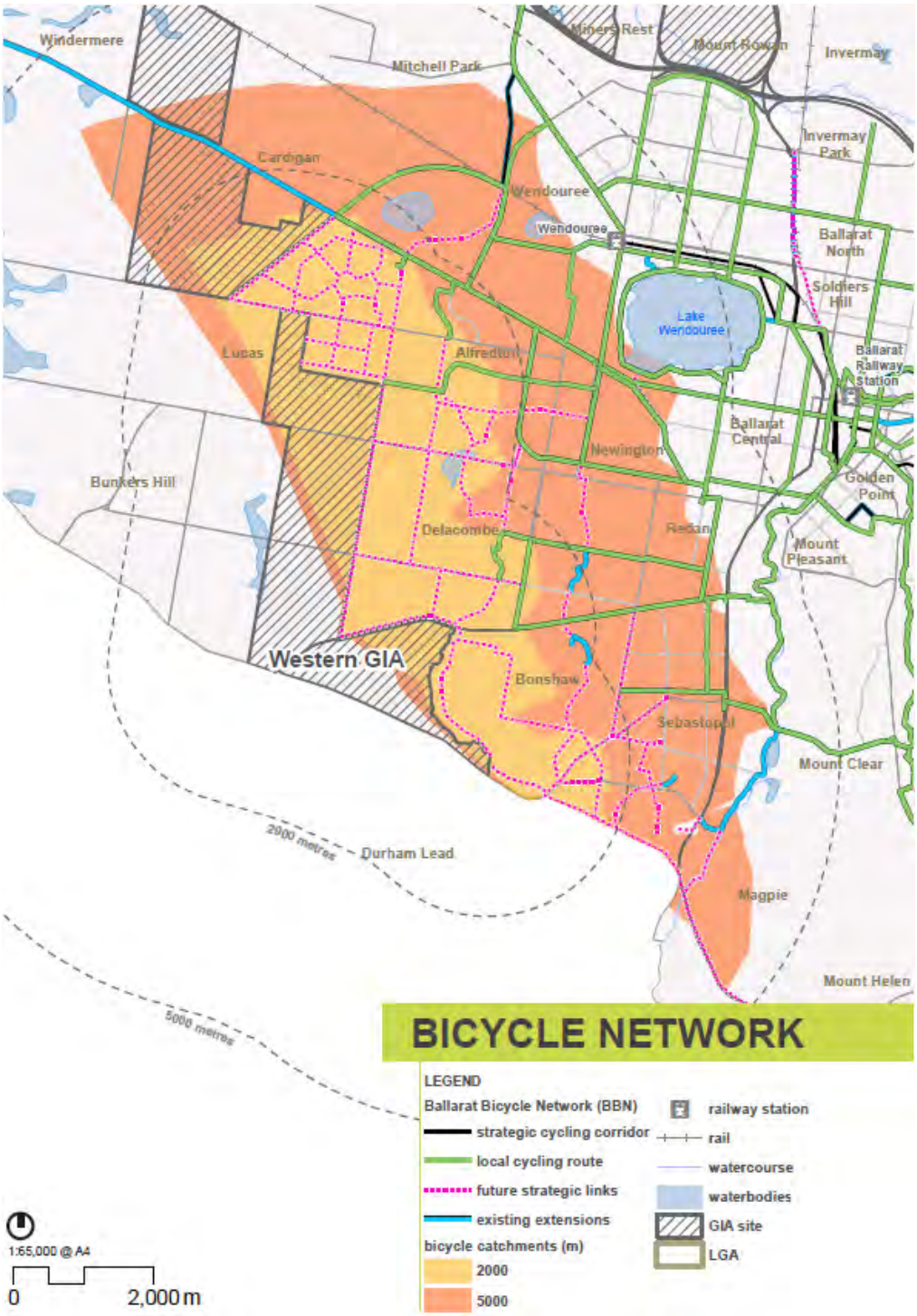

Figure 18 Western GIA cycling catchment of existing and planned routes

3.3.4 Accessibility to employment and services

The Ballarat VITM Report has been reviewed in relation to the access of each of the sites to employment retail services with the key points noted as follows:

- Based on current planning, the site will have a high level of access to employment and retail services by private vehicle for the foreseeable future. It is expected that between 90% and 100% of employment opportunities and retail services will be able to be accessed within a 20 minute private vehicle trip from now until the year 2041.
- Based on current planning, the site will have negligible access to employment or retail services by public transport for the foreseeable future. It is expected that there will be very limited employment opportunities and retail services that will be able to be accessed by public transport within a 20 minute public transport trip both now and until the year 2041 (the access to employment opportunities is shown in). It is noted that a public transport trip includes walking time, waiting and in-vehicle time.
- The employment distribution forecasts outlined in the Ballarat VITM report suggest that more jobs will be located in the west of Ballarat in the future. On this basis there is an opportunity to provide increased public transport services to connect with these locations of employment.

While access by private vehicles is high, there is an opportunity to provide additional transport choice and increased access to employment and retail services through the provision of additional public transport services outlined in Section 1.1. It is noted that some of these services may be required for equity and social inclusion.

3.4 Deliverability / Implementation

3.4.1 New trunk utility infrastructure

Drainage

A high level assessment of the trunk drainage infrastructure required for the urbanisation of the Western GIA has been completed in accordance with the standards stated in the Infrastructure Design Manual (IDM) and by the Corangamite Catchment Management Authority. Accordingly, the following key parameters have been applied to the proposed drainage design:

- The flows are to be maintained at pre-development levels for the peak flow rate in a 100 year ARI event.
- The minor drainage (underground pipes and channels) are sized to convey the 10 year ARI in residential and industrial areas.
- The water discharged into the existing waterways is treated to the Best Practice Environmental Guideline Targets for Stormwater Treatment, such that removal of the following is achieved:
    - 80% of total suspended solids;

- 45% of total phosphorus;
- 45% of total nitrogen; and
- 70% of gross pollutants.

Demand requirements

Catchment areas were identified and runoff and time of concentration coefficients were determined in accordance with the land use of each catchment. The existing land use within the study area was determined based on the GIS information provided by City of Ballarat. As per the IDM, the overland flow for the existing and proposed conditions has been calculated using the Rational Method for Rural Hydrology described in Austroads "Guide to Road Design: Part 5 General and Hydrology Considerations." The design has adopted the runoff coefficients stated in Table 9 of the IDM. For catchment types not identified in the IDM, runoff coefficients defined in AS3600.3 has been adopted.

Table 17 states the minimum detention volume required to ensure that the flow is maintained to pre-development levels for the peak flow rate in a 100 year ARI event.

Table 17 Western GIA estimated required stormwater detention volumes

Detention volume required (m^3)				
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
Catchment 1	14308	19613	21542	23583
Catchment 2	16445	22567	24794	27148
Catchment 3	17853	24294	26637	29114
Catchment 4	5540	7706	8564	9472
Catchment 5	15968	22136	24379	26751
Catchment 6	14892	20732	22856	25103
Catchment 7	115	169	189	210
Total	**85122**	**117219**	**128961**	**141381**

New Trunk Infrastructure

The new trunk infrastructure required includes:

- A number of retention basins located throughout the study area. The size and location of individual basins will largely be dependent on the topography and proposed land use of the study area and should be determined in collaboration with civil engineers and town planners.
- Wetlands that will be incorporated into the floor of each retarding basin to improve water quality. The application of this treatment measure ensures that land acquisition cost to meet WSUD requirements can be minimised.
- A network of stormwater drainage pipes that will convey the post-development 10 year ARI event flow to the retention basin.
- Stormwater drainage pipes that will convey the pre-development 100 year ARI event flow from the retention basins to the outfall creeks.

Detailed modelling of the performance of the proposed wetlands has not been conducted as part of this study. Consequently, while the design and cost evaluation assumes that WSUD requirements can be satisfied with the wetlands and green spaces, it is noted that additional tertiary water treatment may be required.

Sewer

A high level sewer network has been designed in accordance with the design principles outlined in the MRWA WSAA Sewage Code, Pressure Sewer Code and Sewerage Pump Station Code, as required by Central Highlands Water. While the design intent has been for a gravity network, the location of the outfall mains and the predominantly westward grading of the site have meant that three additional pump stations and rising mains will be required.

Demand requirements

The effluent flow is based on the assumption that residential land use will account for 85% of the overall effluent flow. This value was determined based on engineering industry experience and advice provided within the MRWA WSAA Sewer Code. The values derived were informally provided to Central Highlands Water who advised that they are consistent with the degree of development investigated. Table 18 and 19 list the estimated effluent flows for sizing mains and the demand flows for wastewater treatment.

Table 18 Western GIA estimated effluent flow for sizing of mains

Proposed Sewer Flows (L/s)				
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
Western GIA	207.55	263.20	301.70	361.94

Table 19 Western GIA estimated effluent flow for wastewater treatment

	Peak Dry Weather Flow (L/s)	**Peak Dry Weather Flow (ML/d)**
Scenario 1	53.66	4.60
Scenario 2	80.50	6.90
Scenario 3	100.62	8.62
Scenario 4	134.16	11.50

New trunk infrastructure

The trunk infrastructure required for the development of the Western GIA have been designed based on the following principles and parameters:

- The mains have been sized assuming PVC pipes.
- The network design should aim to avoid the use of pressure sewers and rising mains.

Table 20 and Table 28 provide an indication of the size of trunk mains and pump stations required within the GIA to service each scenario.

Table 20 Western GIA estimated sewer trunk mains

Meters of trunk mains				
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
Rising Mains				
150mm diameter	1500	0	0	0
225mm diameter	0	1500	1500	1500
300mm diameter	1100	1100	1100	0
375mm diameter	0	0	0	1100

Table 21 Western GIA estimated pump stations

New pump station required				
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
Pump station 1 (kL)	15.8	19.9	23.8	28.1
Pump station 2 (kL)	6.3	7.9	9.3	11.3

The network design assumes that connection will be made to the pump stations and connecting rising mains proposed for the Ballarat West PSP area. This approach would require these assets to be upsized prior to construction to ensure capacity for effluent flow from the Western GIA. The sewer mains proposed for the Ballarat West PSP area, which may require upgrading include:

- The rising main that extends from eastern boundary at the Glenelg Highway to the existing trunk main located on Webb Road. This is approximately 6.5km.
- The rising main that extends to the eastern boundary along Ballarat-Carngham Road. This main is approximately 750m.
- Sewer Pump Station proposed for Ballarat West PSP

It is also noted that due to the lack of peak wet weather capacity in the downstream network (beyond the Ballarat West PSP area), if significant downstream upgrades are not undertaken, peak flows will need to be contained within the GIA which would require space for detention networks.

Infrastructure required for wastewater treatment

The additional effluent produced as a result of the development of the Western GIA is expected to be transferred for treatment to the Ballarat South Wastewater Treatment Plant (WwTP). Central Highlands Water has confirmed that this plant has capacity limitations and would require upgrade or detention space to manage wet weather peak flows. Similarly to the Northern GIA, the buffer zone and discharge licence of the Ballarat South WwTP would need to be reviewed.

It is possible that development in this growth area would drive the need for a new wastewater treatment plant.

Water

A high level proposed potable water network has been calculated in accordance with MRWA WSAA Water Code, as per the requirements stated by Central Highlands Water. As further reference, the design has also considered the requirements that Central Highlands Water has stipulated in the Ballarat West Precinct Structure Plan (PSP) 2012 for water demand and network design. It would be anticipated that the additional requirements stated within the PSP will also apply to all other future development within Ballarat.

Demand requirements

The water demand has been determined for the residential properties only, and does not consider the water required for the function of the commercial or landscaped precincts. This decision was made on account of the absence of information regarding the type of commercial and landscape areas proposed for each scenario and their demand requirements.

In accordance with the MRWA WSAA Water Code, the peak daily and hourly demands have been determined.

The peak hourly flow rates for residential density types (high, medium, low) have been provided by Central Highlands Water and are in accordance with those stated by MRWA (MRAW, 2011). Arup has extrapolated these values to ascertain values for the allotment types used in the scenarios.

The peak daily demand has been determined on the assumption that potable water demand reduction measures will not be implemented in the development areas. This approach was applied to ensure that water demand requirements can be achieved when the residential water systems are unable to function as designed, such as during drought and when the residential systems are not maintained. This design measure was proposed and supported verbally by Central Highlands Water.

Table 22 provides a summary of the estimated water demand for each land development scenario. Central Highlands Water has been provided with the estimated demands and have advised that the derived demands are consistent with the degree of development investigated.

Table 22 Western GIA estimated water demand

Proposed water demand for residential development areas		
	Water Demand (m^3/s)	Water Demand (ML/day)
Scenario 1	1.00	2.52
Scenario 2	1.14	3.77
Scenario 3	1.25	4.72
Scenario 4	1.43	6.29

In the absence of detailed residential and existing service information, quantitative analysis of the existing potable water demand has not been conducted as part of this study. Consequently, direct comparisons between water demands can only be drawn for different development scenarios and not with the existing demand. As indicated in Table 22, the peak water demand increases by approximately 43% when the development increases from 8 lots/ha to 20 lots/ha.

New trunk infrastructure

Central Highlands Water has stated that it may be possible to upgrade and extend the network within the Ballarat West PSP area to supply the Western GIA. Infrastructure within and to the east of the Western GIA that may require upsizing include:

- The existing 225mm diameter main that runs along Ballarat-Carngham Road.
- The trunk mains from Ballarat-Carngham Road to the 675mm principal supply main at Victoria Park on Eyre Street. This includes the upgrade of approximately 12.5km of pipeline.
- The water main proposed along Greenhalghs Road as part of the Ballarat West PSP area development prior to its construction. This is approximately 2.4km.

It is noted that there are existing level of service issues in Alfredton, north east of the Western GIA. These issues would be exacerbated by the additional demand of this growth area therefore requiring upgrades to Alfredton's network infrastructure. Services the Western GIA may also impact the level of service of the Haddon and Smythesdale areas if no upgrades are undertaken.

The proposed Ring Road water main upgrade is planned to address the current deficiencies in the system. This asset may need to be upgraded if growth occurs in the Western GIA.

To reduce demand, Central Highlands Water has indicated a desire to mandate household scale rainwater harvesting and the use of untreated groundwater however the viability of these services requires further investigation.

Infrastructure required for water treatment

Central Highlands Water has advised that the Ballarat System is capable of sourcing adequate raw water supply for the next 30 to 50 years and that the two treatment plants in the area have sufficient capacity for the next 20 years.

Gas

Demand requirements

The gas demand for each of the development scenarios has been determined based on the current gas usage per person in Ballarat. In the absence of information pertaining the proposed industrial and commercial development for each scenario, the gas demand calculated consider only the residential demand. The proposed gas demand is shown in Table 23.

Table 23 Western GIA estimated gas demand

Proposed gas demand for residential development areas	
	Gas Demand (GJ/year)
Scenario 1	14570
Scenario 2	21855
Scenario 3	27319
Scenario 4	36426

New trunk infrastructure

AusNet Services has advised that the location of the Western GIA would mean that supply would have to travel across Ballarat resulting in significant pressure reductions. This suggests that significant upgrades and new trunk infrastructure would be required to provide reliable supply to this area.

Long term infrastructure requirements

AusNet Services has advised that two new field regulators are currently being installed to enhance network pressures to ensure capacity for the immediate future. These upgrades do not consider future growth in this area.

Electricity

New trunk infrastructure

Powercor has confirmed that there is limited supply available to the Western GIA, however 22kV feeder augmentation works would be required to support significant growth in demand. Such augmentation works are included in Powercor's 10 year forward plan.

It is noted that Powercor's longer term plan is to establish a substation in Ballarat West. This substation is proposed to cater for growth in the industrial demand in the area but could also have advantages for the Western GIA.

It is likely that the following infrastructure works would be required to support the GIA:

- New transmission lines to supply the existing Ballarat Terminal Station (BATS) or a new terminal station;
- New sub-transmission lines to fed the Ballarat South (BAS) or Ballart West (BAW) zone substation;
- New 22kV feeders from either the BAS or BAW zone substations to the GIA
- New electricity distribution network within the GIA.

It would be anticipated that at least one new 22kV feeder would be required to support the supply of electricity for Scenario 1 and up to 4 new 22kV feeders for Scenario 4. Similarly, given the proposed sub-transmission lines to the BAW zone substation, additional sub-transmission lines may only be necessary for Scenarios 3 and 4.

Telecommunications

Telstra has advised that trunk infrastructure in growth areas will be dictated by developer applications. These protocols are spelt out by both Telstra and NBN Co and are at a cost to the developer.

3.4.2 New community infrastructure

The new community infrastructure required to provide for the future residents of the Western GIA was determined based on benchmark recommendations for the provision of facilities. The requirements were determined under four population projection scenarios. Existing facilities in adjacent areas have been documented, as this may reduce the requirement for new community infrastructure.

Table 24 Community infrastructure required for the Western GIA

Category	Indicator	Benchmark	Access distance	Reference	Scenario				Provider	Existing facilities	Distance from GIA
					1	2	3	4			
1 Recreation and Cultural Infrastructure											
1.1 Sport and recreation	Provision of recreation areas - active open space	One Level 1 active open space reserve (8 ha per active open space reserve) per 6,000 people	1000 metres for 95% of dwellings	ASRR 2008 GAA 2013	1.9	2.9	3.6	4.8	Local council		
	Provision of indoor sports venues	1 (2 court) facility per 20,000 to 30,000 people		ASRR 2008	0.5	0.7	0.9	1.1	Local council		
1.4 Community centres	Provision of community centres	Level 1 Provision ratios up to 10,000 people		GAA 2009	1.1	1.7	2.1	2.9	Local council		
2 Educational Infrastructure											
2.1 Kindergartens	Provision of kindergartens	Provision ratios up to 10,000 people	600 metres	GAA 2009 Barton et al 2010	1.1	1.7	2.1	2.9	Private		
2.2 Long day care and occasional care	Provision of long day care and occasional care facilities	Provision ratios up to 10,000 people	600 metres	GAA 2009 Barton et al 2010	1.1	1.7	2.1	2.9	Private		
2.3 Primary schools	Provision of government primary schools	1 government primary school per 8,000 to 10,000 people	800 metres	ASRR 2008 Barton et al 2010	1.1	1.7	2.1	2.9	State government	Alfredton Primary School	1500 metres
	Provision of non-government	Provision ratios between 10,000 and 30,000 people	800 metres	GAA 2009 Barton et al 2010	0.6	0.9	1.1	1.4	Private	St Thomas More School	1500 metres

Category	Indicator	Benchmark	Access distance	Reference	Scenario				Provider	Existing facilities	Distance from GIA
					1	2	3	4			
	primary schools										
2.4 Secondary schools	Provision of government secondary schools	1 government secondary school per 25,000 to 30,000 people	1200 metres	ASRR 2008 Barton et al 2010	0.4	0.6	0.8	1.0	State government		
3 Healthcare Infrastructure											
3.1 GP clinics	Provision of GP clinics	0.34 general practices per 1000 people (Victorian average)		Dept of Health 2011	3.9	5.8	7.3	9.7	Private		
3.3 Dental practices	Provision of dentist sites	0.20 dental services per 1000 people (Victorian average)		Dept of Health 2011	2.3	3.4	4.3	5.7	Private		
3.4 Aged care	Provision of aged care facilities	Provision ratios between 10,000 and 30,000 people		GAA 2009	0.6	0.9	1.1	1.4	Private	Kallara Residential Care	1300 metres
	Provision of aged care places	88 beds per 1000 people aged 70+		ANAO 2015	102	153	191	254	Private		
3.5 Community health centres	Provision of community health centres	Provision ratios between 10,000 and 30,000 people		GAA 2009	0.6	0.9	1.1	1.4	State government		
3.6 Hospitals	Provision of hospital beds	3.9 hospital beds per 1000 people (Australian average)		AIHW 2014	44	67	83	111	State government		

The demand for community infrastructure is driven by the population and the provision of existing facilities and services. It has been noted that the healthcare infrastructure may be provided by the public sector. The potential costs associated with the delivery of such community infrastructure is discussed in Table 26.

3.4.3 Comparison of delivery and implementation

When considering the Western GIA the delivery and implementation is comparable to the other GIAs shown by the ratings of the multi-criteria analysis shown in .

3.5 Financial and economic assessment

3.5.1 Development infrastructure costs for trunk infrastructure

The costs associated with the drainage trunk infrastructure are stated below. For information regarding the design and cost assumptions please refer to Appendix C.

Cost estimates have been determined based on 2015 prices and the construction prices anticipated for 2040. The anticipated 2040 costs have been determined based on the assumption that the inflation rate for construction from 2015 to 2040 will be equal to that experienced between 2004 and 2014. This rate is 4.4% per year.

Table 25 Western GIA estimated drainage trunk infrastructure costs

Item	Scenario 1	Scenario 2	Scenario 3	Scenario 4
New pipes and pits	$5,289,695.57	$7,284,297.72	$8,014,012.92	$8,785,827.08
Retention Basins / Wetlands	$12,342,623.00	$16,996,694.68	$18,699,363.49	$20,500,263.19
Council Fees	$617,131.15	$849,834.73	$934,968.17	$1,025,013.16
CAPEX (2015 prices)	**$18,249,449.72**	**$7,284,297.72**	**$27,648,344.59**	**$30,311,103.43**
CAPEX (2040 prices)	**$38,327,784.55**	**$16,996,694.68**	**$58,067,493.05**	**$63,659,861.53**

Sewer and Water

As with all of the proposed areas, development of the Western GIA will drive the need for significant investment in new trunk infrastructure and upgrades to existing infrastructure in the quantum of $40M – $50M. Should this result in the need for a new wastewater treatment plant and re-use facility a further $50M - $80M could be required.

It should be noted that the need to convey sewer flows from this GIA across currently built up areas may introduce further complexities and in turn costs for any related upgrades.

Gas

While the authorities have not provided specific costs for trunk infrastructure, they have noted that the Western GIA will require a significant amount of investment to provide supply from the existing City Gate and maintain service levels across the network.

Electricity

Powercor stated that costs associated with supplying this GIA are difficult to provide without a detailed in depth assessment. However, it was noted that costs would vary only slightly between the GIA's being considered and that there was no preference between areas.

Telecommunications

Telstra has advised that charges for new infrastructure are generally borne by the developer and vary based on:

- type and size of the development,
- location,
- services required by the developer,
- network type, and
- relative proximity of Telstra's network with spare capacity.

3.5.2 Community infrastructure costs

The unit costs for community infrastructure required to service development in the Western GIA are outlined in Table 26. The total cost of providing infrastructure depends on the development scenario, as outlined in Section 3.4.2.

Table 26 Community infrastructure costs for the Western GIA

Category	Indicator	Unit cost	Reference	Cost in scenario			
				1	2	3	4
1 Recreation and Cultural Infrastructure							
1.1 Sport and recreation	Provision of recreation areas - active open space	$ 6.75 million	Urban Enterprise, 2014	$13,500,000	$20,250,000	$27,000,000	$33,750,000
	Provision of indoor sports venues	$ 9 million	Urban Enterprise, 2014	$9,000,000	$9,000,000	$9,000,000	$9,000,000
1.4 Community centres	Provision of community centres	$ 4.4 million	Urban Enterprise, 2014	$4,400,000	$8,800,000	$8,800,000	$13,200,000
2 Educational Infrastructure							
2.1 Kindergartens	Provision of kindergartens	$ 1.3 million	City of Kingston, 2014	$1,300,000	$2,600,000	$2,600,000	$3,900,000
2.2 Long day care and occasional care	Provision of long day care and occasional care facilities	$ 4.1 million	ACT Government, 2012 McComish, 2013	$4,100,000	$8,200,000	$8,200,000	$12,300,000
2.3 Primary schools	Provision of government primary schools	$ 12.2 million	Department of Treasury and Finance, 2015	$12,200,000	$24,400,000	$24,400,000	$36,600,000
	Provision of non-government primary schools	$ 12.2 million	Department of Treasury and Finance, 2015	$12,200,000	$12,200,000	$12,200,000	$12,200,000
2.4 Secondary schools	Provision of government secondary schools	$ 20 million	Department of Treasury and Finance, 2014	$-	$20,000,000	$20,000,000	$20,000,000
3 Healthcare Infrastructure							

Category	Indicator	Unit cost	Reference	Cost in scenario			
				1	2	3	4
3.1 GP clinics	Provision of GP clinics	$ 1.4 million	Selesnew, 2008	$5,600,000	$8,400,000	$9,800,000	$14,000,000
3.3 Dental practices	Provision of dentist sites	$ 1.4 million	Selesnew, 2008	$2,800,000	$4,200,000	$5,600,000	$8,400,000
3.4 Aged care	Provision of aged care facilities	$ 17.9 million	Department of Treasury and Finance, 2014	$17,900,000	$17,900,000	$17,900,000	$17,900,000
	Provision of aged care places	$ 595,000 per place	Department of Treasury and Finance, 2014	$60,690,000	$91,035,000	$113,645,000	$151,130,000
3.5 Community health centres	Provision of community health centres	$ 50.2 million	Department of Treasury and Finance, 2014	$50,200,000	$50,200,000	$50,200,000	$50,200,000
3.6 Hospitals	Provision of hospital beds	$ 844,000 per bed	Department of Treasury and Finance, 2015	$37,136,000	$56,548,000	$70,052,000	$93,684,000

The demand for community infrastructure is driven by the population and the associated costs are influenced by which scenario is implemented. It has been noted that the indicative healthcare infrastructure may be provided by the public sector. Further the costs identified are relatively similar across the GIAs given the influence of population.

3.5.3 Developer costs for local infrastructure

The developer costs associated with the construction of local infrastructure have been determined following consideration of the following:

- The standard industry rates for construction in Melbourne (Rawlinsons, 2015); and
- The fees and charges stipulated by Central Highlands Water for land development (Central Highlands Water, 2014).

For information regarding the design and cost assumptions please refer to Appendix C. Cost estimates have been determined based on 2015 prices and the construction prices anticipated for 2040. The anticipated 2040 costs have been determined based on the assumption that the inflation rate for construction from 2015 to 2040 will be equal to that experienced between 2004 and 2014. This rate is 4.4% per year.

Table 27 Western GIA combined cost estimate – 2015 prices

Western GIA combined cost estimate - 2015 prices				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Roads	$57,955,413	$64,393,048	$64,393,048	$70,091,938
Water Supply	$20,683,710	$26,372,536	$29,787,577	$30,792,720
Sewer	$13,492,328	$15,777,584	$16,575,001	$18,985,829
Total	**$92,131,451**	**$106,543,168**	**$110,755,626**	**$119,870,486**

Table 28 Western GIA combined cost estimate – 2040 prices

Western GIA combined cost estimate - 2040 prices				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Roads	$121,718,879	$135,239,303	$135,239,303	$147,208,202
Water Supply	$43,440,256	$55,388,020	$62,560,343	$64,671,359
Sewer	$28,336,803	$33,136,333	$34,811,081	$39,874,341
Total	**$193,495,938**	**$223,763,656**	**$232,610,727**	**$251,753,902**

4 Eastern GIA

4.1 Land capability assessment

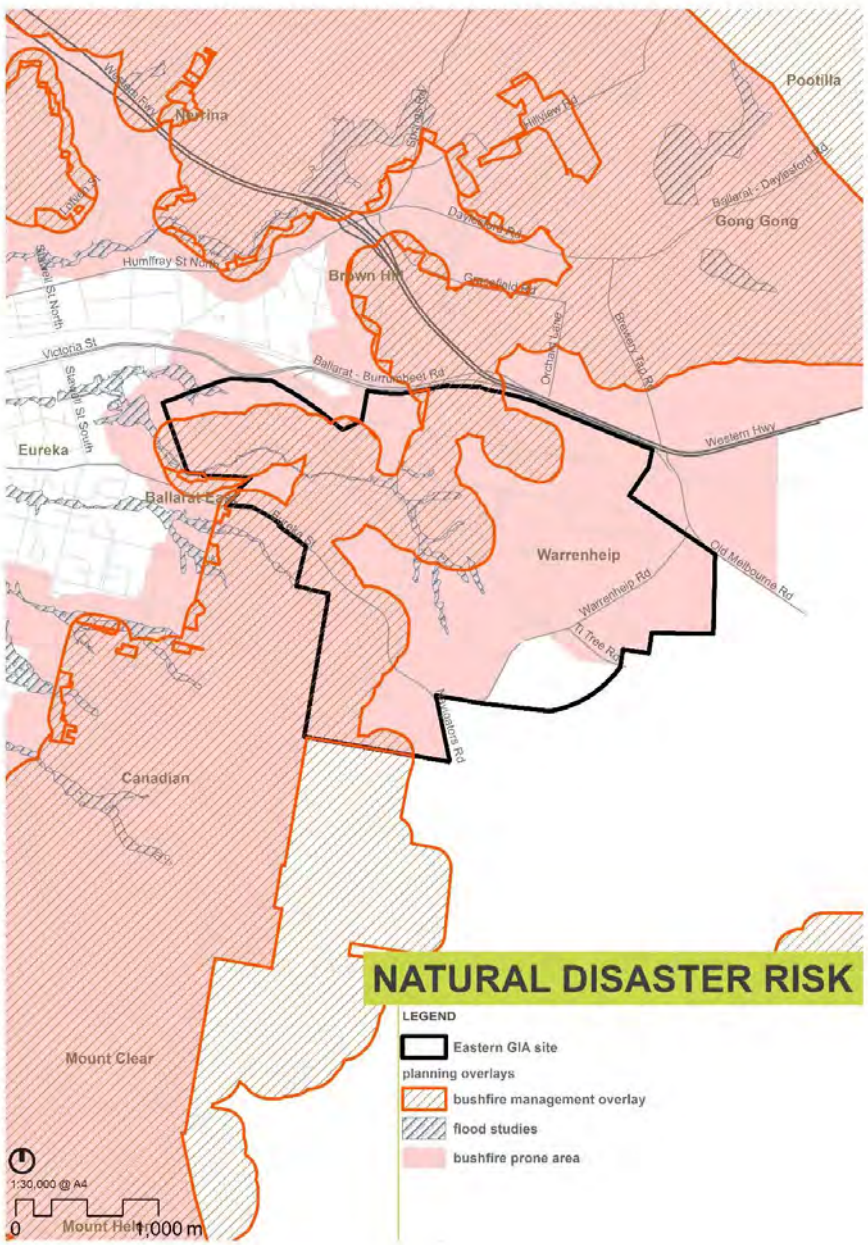

Figure 19 Eastern GIA – Natural disaster risk

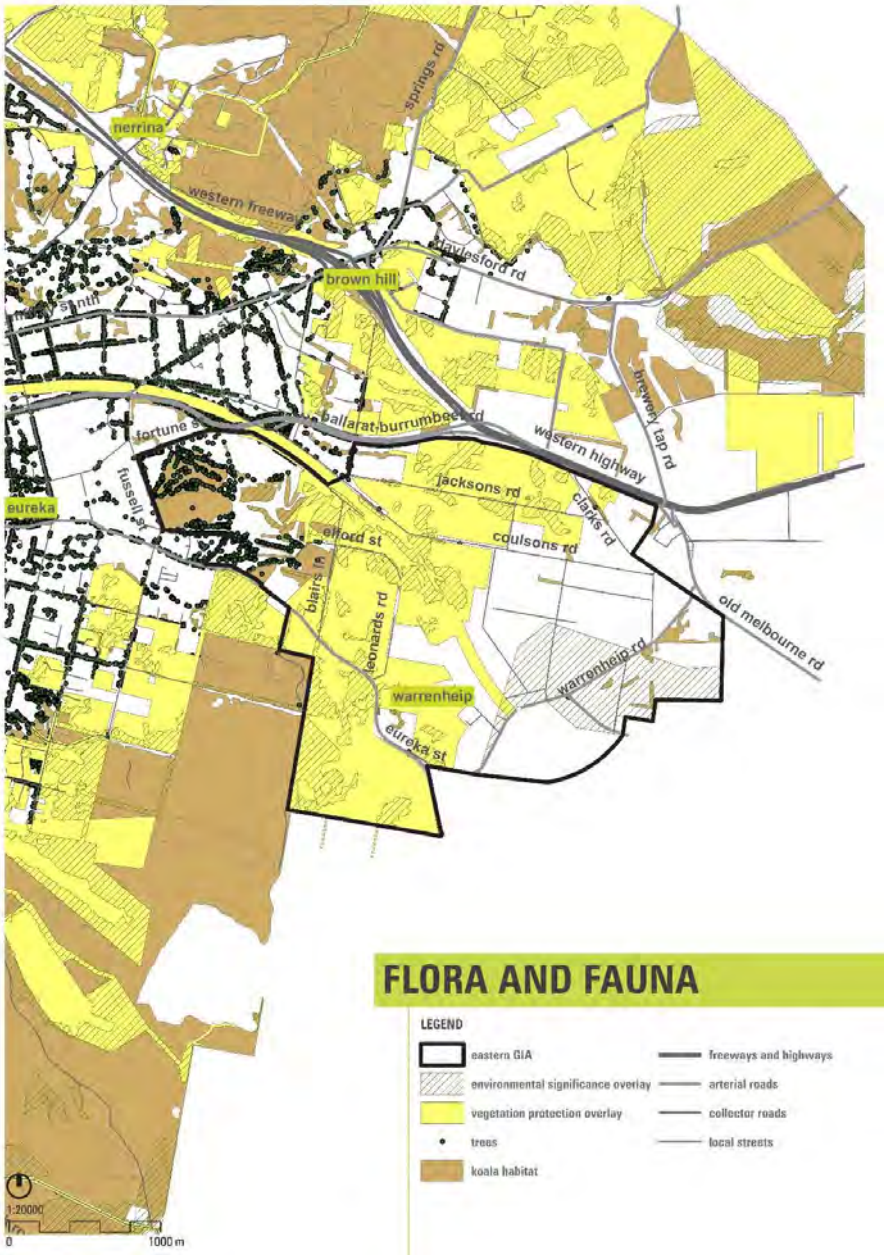

Figure 20 Eastern GIA – Flora and fauna

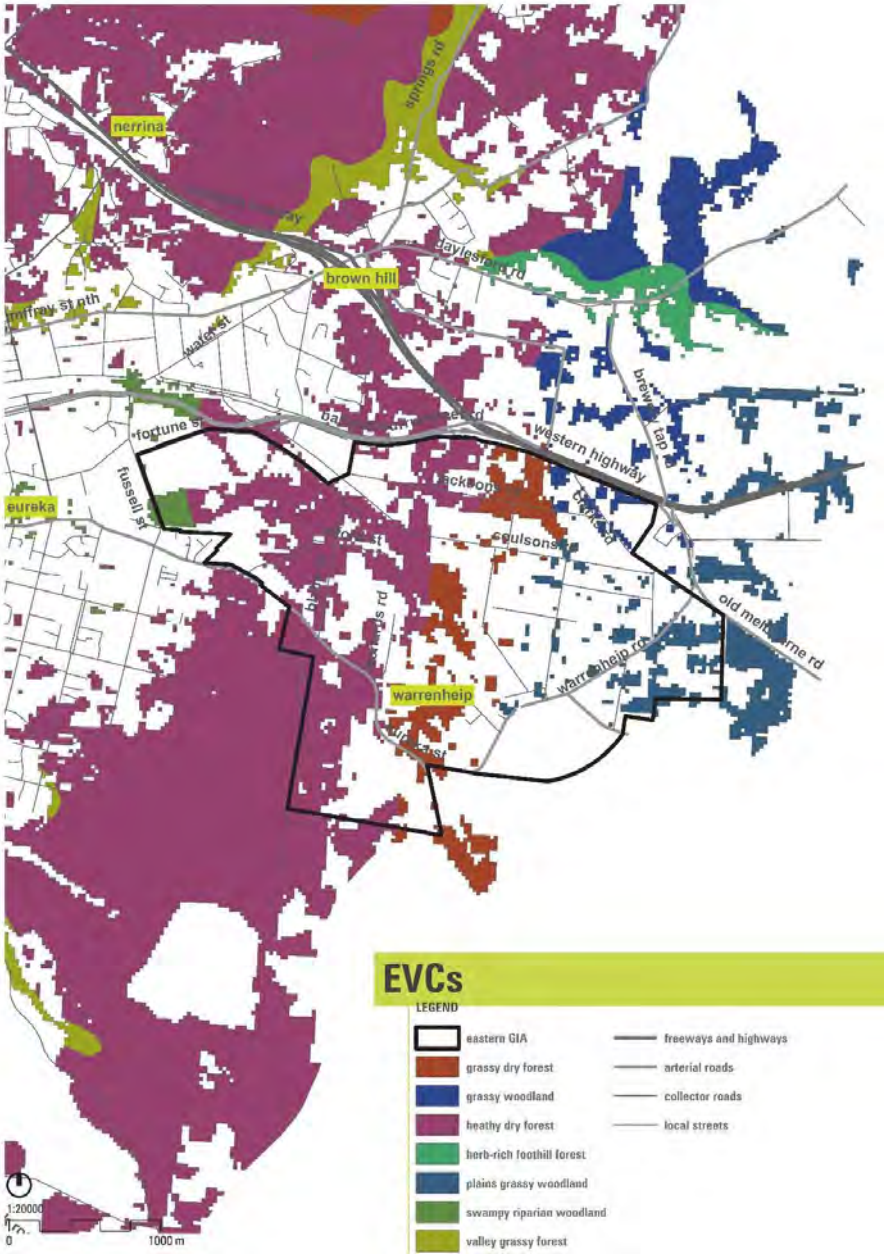

Figure 21 Eastern GIA – EVCs

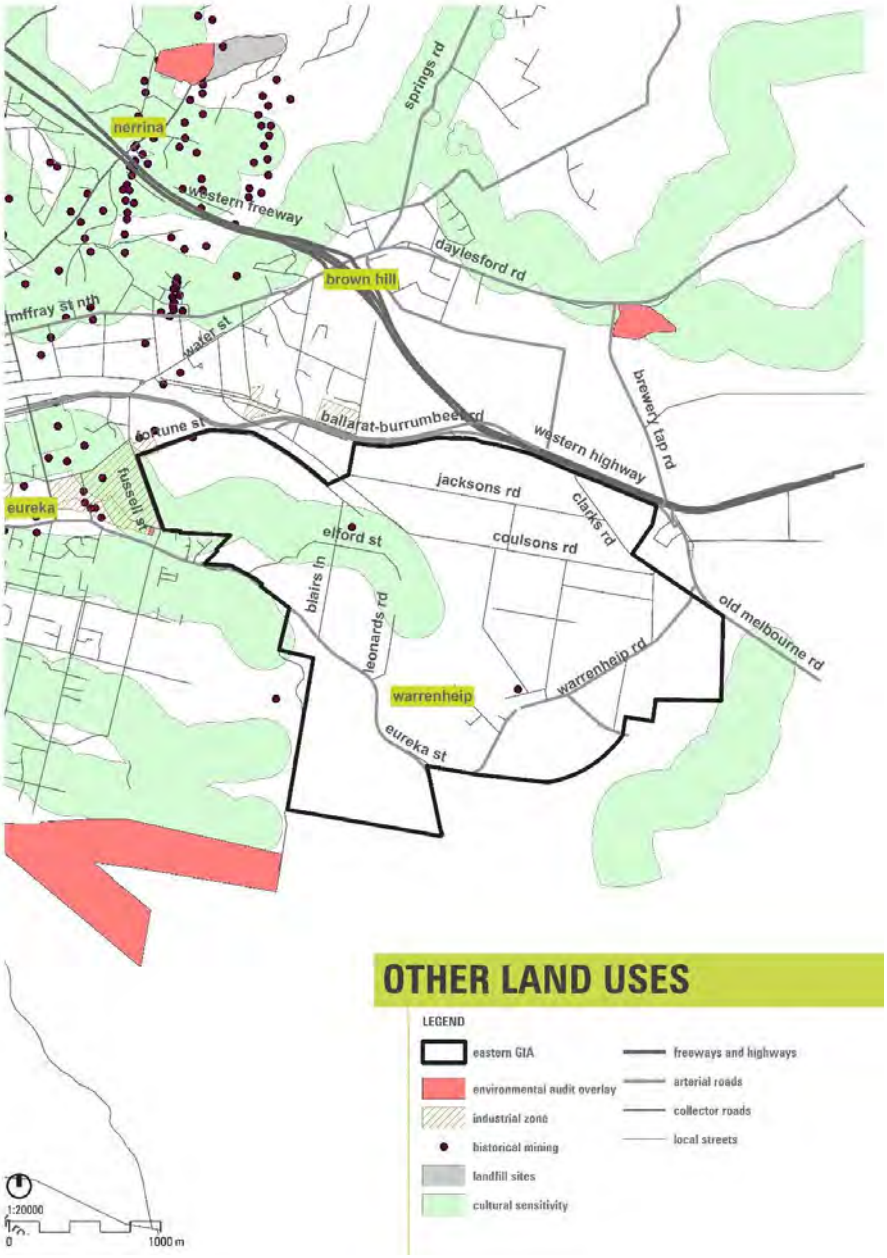

Figure 22 Eastern GIA – Other land uses and cultural heritage

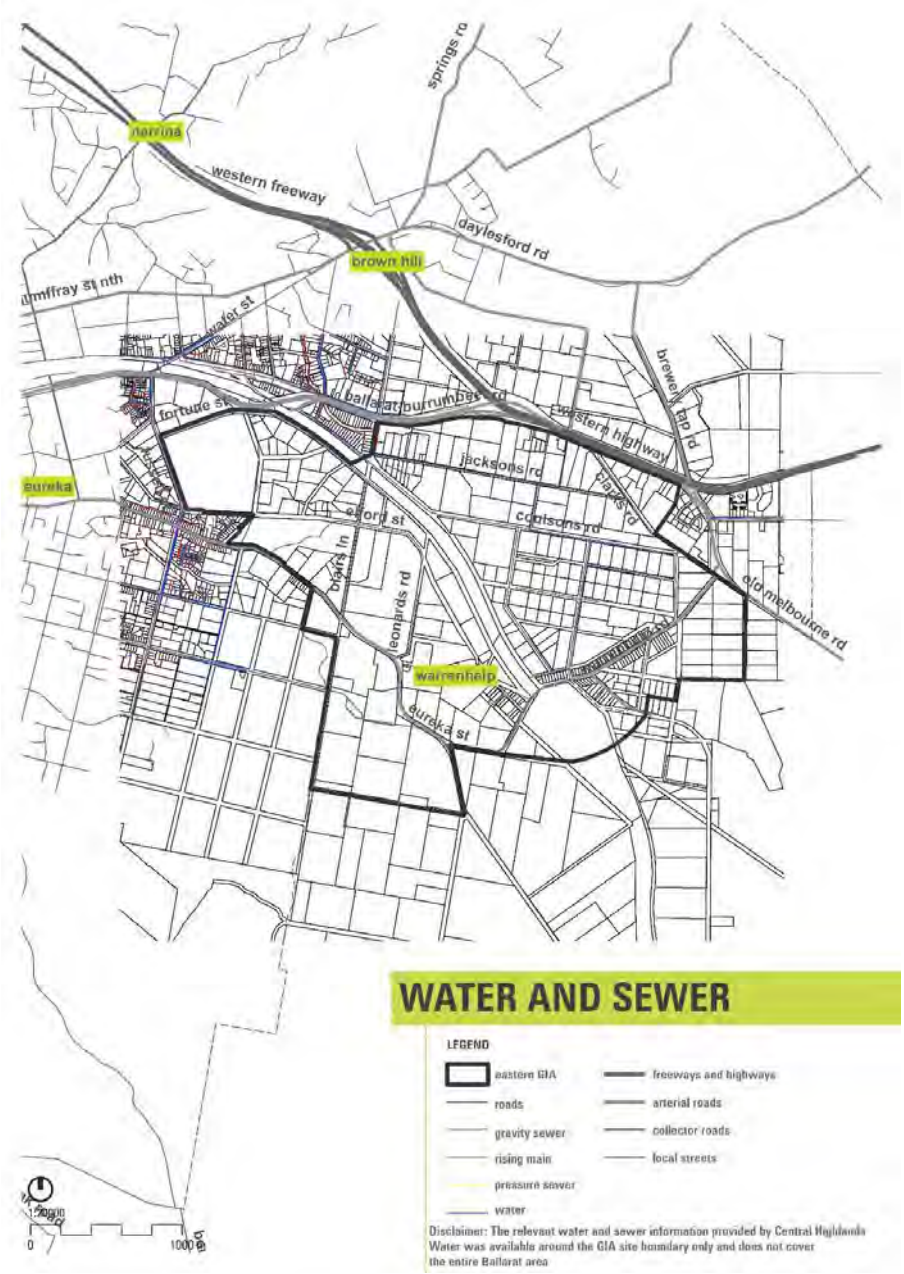

Figure 23 Eastern GIA – Water and sewer trunk infrastructure

4.1.1 Natural disaster risk

Bushfire

The Wildfire Management Overlay applies to some land within the Eastern GIA. This areas are in the vicinity of vegetation in the north and west of the GIA. There are also large areas of land covered by this overlay adjacent to the north and south

of the GIA. The purpose of the Wildfire Management Overlay is to identify areas of bushfire hazard.

The Eastern GIA is entirely within the Bushfire Prone Area. The majority of the site was affected by bushfire between 1925 and 1949. More recently, there was a bushfire since 2000 that affected the south west corner of the GIA and the Canadian Forest to the south of the GIA. This data was sourced through the Visualising Ballarat mapping tool[11].

Flooding

The Rural Floodway Overlay does not apply to any land within or surrounding the Eastern GIA.

The Land Subject to Inundation Overlay does not apply to any land within or surrounding the Eastern GIA.

The Erosion Management Overlay does not apply to any land within or surrounding the Eastern GIA.

According to the 100 year ARI flood extent as mapped in the Ballarat Civil Infrastructure Assessment report, there are no areas within the Eastern GIA that are likely to be impacted by a 100 year flood (SMEC, 2014).

Flood investigations undertaken in the Canadian Creek Catchment indicate that land adjacent to the Specimen Vale Creek is subject to inundation by a 100 year flood (City of Ballarat, 2015).

4.1.2 Protected flora and fauna

Vegetation Protection Overlay

The Vegetation Protection Overlay applies to almost half the area of the Eastern GIA. This land is subject to Schedule 1 to the Vegetation Protection Overlay, which relates to native vegetation protection. A permit is required to remove, destroy or lop any native vegetation protected by this overlay.

Environmental Significance Overlay

The Environmental Significance Overlay applies to some land within the Eastern GIA. Most of the land covered by this overlay is subject to Schedule 5 of the Environmental Significance Overlay, which sets out requirements regarding Koala and Koala Habitat Protection. For developments on sites that contain koala habitat an assessment of the habitat must be undertaken, and a proposal must be made on how the impacts to koalas will be managed. A permit is required: to construct any buildings or carry out works where native trees are to be removed, to construct a fence, to remove native trees or to subdivide land.

There is a large parcel of land in the east of the GIA subject to Schedule 3, relating to water catchment areas. This overlay is applied to land within

[11] www.visualisingballarat.org.au

catchments, to ensure potable water supply to Ballarat. A permit is required where facilities are to be provided for the onsite disposal and treatment of wastewater.

Significant Landscape Overlay

The Significant Landscape Overlay does not apply to any land within or surrounding the Eastern GIA.

Salinity Management Overlay

The Salinity Management Overlay does not apply to any land within or surrounding the Eastern GIA.

Ecological Vegetation Classes

There are multiple EVCs present in the Eastern GIA, as outlined in Table 29.

Table 29 Eastern GIA EVCs

Ecological Vegetation Class	Bioregional Conservation Status	Distribution
Swampy Riparian Woodland	Endangered	Approximately 5 hectares in the west of the GIA
Heathy Dry Forest	Least Concern	Large patches across west half of GIA
Grassy Dry Forest	Depleted	Patchy across central-east section of GIA
Plains Grassy Woodland	Endangered	Patchy across east section of GIA

Koala Habitat

Numerous patches of koala habitat have been identified in the Eastern GIA. These include areas of primary and secondary koala habitat classes (Schlagloth & Thomson, 2006).

Environment Protection and Biodiversity Conservation (EPBC) Act Register

According to the EPBC register, there are several matters of national significance known to occur within a 500 metre buffer of the Eastern GIA (Australian Government Department of the Environment, 2014). These are outlined in the table below.

Table 30 EBPC matters in the Eastern GIA

Type	Name	Status	Type of presence
Wetlands of International Importance	Port Phillip bay (western shoreline) and Bellarine		Upstream from Ramsar
Listed Threatened Ecological Communities	Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area

Type	Name	Status	Type of presence
Listed Threatened Species - Frogs	*Litoria raniformis* Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog	Vulnerable	Species or species habitat known to occur within area
Listed Migratory Species – Terrestrial Listed Marine Species - Birds	*Myiagra cyanoleuca* Satin Flycatcher	Threatened	Breeding known to occur within area
Listed Migratory Species – Wetland Listed Marine Species - Birds	*Ardea alba* Great Egret, White Egret	Threatened	Species or species habitat known to occur within area

There are many additional species that are likely to or may occur in this area. The full list is contained in the EPBC report in Appendix A.

Strategic Biodiversity Score

The Strategic Biodiversity Score measures the importance of native vegetation for Victoria's biodiversity at a landscape scale, relative to other locations across the state. It is measured on a linear scale between 0 and 100, with 100 indicating the most important areas of habitat. The land in the Eastern GIA has a relatively low habitat value, with a maximum score of 35 and the majority below 20. The strategic biodiversity score is used to assess and minimise the impact of vegetation removal and also to determine offset requirements for the removal of native vegetation.

Ballarat Urban Forest Strategy and Living Corridors

Outlined in the Ballarat Strategy (City of Ballarat, 2015), the Urban Forest Strategy highlights the importance of canopy cover within Ballarat (City of Ballarat, 2015). GIS mapping of trees and the urban forest map in the Ballarat Strategy indicate that there is an assemblage of trees in the western part of the GIA. These are mostly concentrated along the creeks including the Specimen Vale Creek. There are also individual trees scattered in the remainder of the site.

The Ballarat Strategy also introduces the 'Living Corridors' concept for Ballarat, a network to provide recreational and biological connection of natural areas. The Strategic Habitat Connection which connects the Canadian Forest with the Creswick Forests along the east of Ballarat runs through the western section of the Eastern GIA (City of Ballarat, 2015).

The Canadian State Forest is located directly adjacent to the west of the southern section of the GIA. Canadian State Forest is becoming part of Canadian Park, along with the adjacent former plantation land (DELWP, 2015).

The Visualising Ballarat mapping tool maps the tree cover across the south west corner of the Eastern GIA. This tress cover extends into the Canadian Forest to the south of the site.

Waterways

The Eastern GIA is within the Canadian Creek catchment. The waterways within the GIA run from the east to the west, predominantly in the northern section of the GIA. There are also numerous dams along the creeks. The Specimen Vale Creek is the only creek in the GIA identified by name.

4.1.3 Buffers from sites that require separation from sensitive uses

Airport Environs Overlay

The Airport Environs Overlay does not apply to any land within the Eastern GIA. The airport is located approximately 10 kilometres north east of the GIA.

Industrial zoned land and proximity to sites

There is no industrial zoned land within the Eastern GIA. There are parcels of industrial zoned land to the adjacent to the west and to the north of the GIA boundary.

4.1.4 Noise impacts

Aircraft Noise

The Eastern GIA is located over 10 km south east of the Ballarat Aerodrome and is not located under any significant flight paths.

The Airport Environs Overlay and the (unendorsed) Ballarat Aerodrome 20 ANEF[12] contour are well outside the GIA and do not apply any restrictions.

The GIA is not considered to be significantly affected by aircraft noise.

Road traffic noise

The Eastern GIA is affected by road traffic noise from the Western Freeway and Victoria Street.

Based on year 2031 traffic estimates and VicRoads requirements[13], the following noise mitigation measures apply to the GIA:

- A 30 m buffer zone from the Western Freeway and Victoria Street at the northern GIA boundary for residential dwellings.
- A noise wall between 2 and 4 m high at the GIA northern boundary with the Western Freeway and Victoria Street.
- Consideration of buffer zones, building restrictions (planning), building treatment or landscaping in cases where noise walls cannot be applied to the northern boundary (eg access requirements).

[12] City of Ballarat, *Ballarat Aerodrome Noise Modelling Study*, 2010
[13] VicRoads, *Requirements for Developers – Noise Sensitive Uses*, 2004

Industrial noise

There are two small isolated industrial zones separated from the Eastern GIA by Victoria Street. The GIA is not considered to be affected by industrial noise.

Industrial noise from the small isolated industrial zones is expected to be inaudible during most time periods and is expected to meet noise limits when assessed under the EPA NIRV[14]

Railway noise

Noise from the Ararat railway line is expected to exceed the Investigation Threshold provided in the Passenger Rail Noise Policy[15]. On this basis, residential dwellings adjacent to the railway line must have noise mitigation options considered. Noise mitigation options to be considered include:

- Buffer zones or landscaping;
- Building treatment to meet internal noise levels; and
- Noise barriers.

The noise mitigation options are not required to meet any specific noise criteria.

4.1.5 Contaminated sites

Environmental Audit Overlay

The Environmental Audit Overlay does not apply to any land within the Eastern GIA. It does apply to a parcel of land to the south-west of the GIA within 300 metres of the boundary.

4.1.6 Sites with past mining activities

Historical mining activity

There are two point locations of recorded historical mining activity within the Eastern GIA. These sites are in the north-west and south-east sections of the GIA. Given the intrusive nature of historical mining activities, they could potentially give rise to issues with the geology. The geotechnical conditions are further discussed in Section 4.1.9.

Expired mining licenses and leases

There are no expired mining licenses or leases within the Eastern GIA

4.1.7 Topography

The Eastern GIA generally slopes downhill from the east to the west. The gradient of the slope is steeper in the west of the site and less steep towards the east.

[14] EPA, *Noise from Industry in Regional Victoria – Publication 1411*, 2014
[15] Victoria State Government, *Passenger Rail Infrastructure Noise Policy*, 2013.

4.1.8 Access to existing utility infrastructure

The Eastern GIA can be considered rural residential in nature with some spill over from the urban development from the north of the site. Information regarding the existence of major utility services has been ascertained by conducting a 'Dial Before You Dig' (DBYD) enquiry and contacting the asset owners directly. All major utility services are present in some capacity in the study area, namely:

- Drainage;
- Sewerage;
- Water Supply;
- Gas;
- Electricity (Distribution); and
- Telecommunications.

Drainage

Land use planning and drainage management for the Eastern GIA are the responsibilities of the City of Ballarat. This area is located within the Corangamite Catchment Management Authority, who are responsible for the floodplain management in this region.

Stormwater drainage predominantly consists of a number of drainage depressions and creeks grading east to west towards larger water bodies within the Canadian Catchment outside the GIA to Bungal Dam. The extent of formal stormwater drainage infrastructure is largely limited to the higher density rural residential areas surrounding Warrenheip Rd. According to the 100 year ARI flood extent as mapped in the Ballarat Civil Infrastructure Assessment report, there are no areas within the Eastern GIA that will be impacted by a 100 year flood (SMEC, 2014).

Sewer

The existing sewerage infrastructure within the Eastern GIA is provided and managed by Central Highlands Water.

There are no trunk sewer mains and smaller reticulation pipes within the GIA, with the exception of a single 500m (approximate) 150mm diameter uPVC pipe, which services the detached homes in the north of the GIA. City of Ballarat has advised that a number of properties are not connected to a sewer reticulation network and instead use a septic treatment system.

Information provided by Central Highlands Water shows that the sewerage network outside the study area is well developed. (Central Highlands Water, 2014). However, these assets are over 50 years old and therefore have increased inflow and infiltration. This limits their capacity in conveying increased upstream wet weather flows.

Effluent within the GIA and the surrounding areas is transferred to the Ballarat South Wastewater Treatment Plant (WwTP). The Ballarat South WwTP is licensed for an Average Daily Flow of 35 ML/day (SMEC, 2014). Central Highlands Water have stated that this plant currently has limited spare capacity.

Water

Central Highlands Water provides and manages the existing water supply infrastructure within Ballarat and the outlying areas. The Ballarat water supply is primarily comprised of two headwork systems: the Ballarat System and the Lal Lal System. Potable water to the Eastern GIA and the surrounding areas is supplied from the Ballarat System and delivered via the White Swan/Warrenheip Zone network. All mains supplying water within this zone originate from the White Swan clear water storage facility and the 30ML Warrenheip Basin (Central Highlands Water, 2014).

Trunk infrastructure in the Eastern GIA is limited with the nearest water mains being small 100mm dia. and 150mm dia. reticulation services.

Gas

APA Group Transmission is responsible for the high pressure gas transmission assets and SP AusNet is responsible for the distribution supply assets.

Gas is supplied to the Ballarat City Gate, located at the Old Melbourne Road/Warrenheip Road intersection, via the dual Ballan to Ballarat High Pressure Transmission Pipelines. Gas pipes are present along the major roadways within the GIA, namely the Western Freeway, Warrenheip Road, Coulsons Road and Eureka Street, where small amounts of urbanisation exists.

SP AusNet have advised that there is approximately 20% additional capacity to service the existing network but cannot confirm that the current network will be able to service the projected population of Ballarat in 2040 (SMEC, 2014).

Electricity

SP AusNet operates and maintains the Ballarat Terminal Station (BATS) and the electrical transmission lines that feed into the zone substations. The BATS is located in the north of the study area, which is worth considering given that it would be expected that significant easements will run within the site along the transmission and sub-transmission mains, which may impact possible future development. SP AusNet and Powercor have not confirmed the width of easements with the GIA.

Powercor is the electrical network distributor for the Eastern GIA and power is supplied from the Ballarat North (BAN) zone substation. The BATS-BAN sub-transmission loop supplies the BAN zone substation feed at 66kV and the total combined capacity of the lines is this loop is 167 MVA (Powercor Australia, 2014).

Information provided by Powercor is response to a DBYD enquiry show that existing high voltage distribution network in the area consists of 22kV overhead power lines that are largely located in the road reserves of the major roadways. Low voltage reticulation is dispersed widely across the GIA. There is very little underground 22kV high voltage cabling within the study area, and where existent,

it is limited to the northern boundary along the Western Highway. Powercor has confirmed that some capacity exists to service this GIA.

Telecommunications

Optus, Telstra, Nextgen, TransACT, and VicTrack are the main distributors of communication services to residential and commercial customers within the Eastern GIA.

Information regarding where the cables identified as part of the Dial Before You Dig (DBYD) enquiry are managed has not been provided by the utility companies.

The National Broadband Network (NBN) has been rolled out in most of the Eastern GIA. Limited information has been provided with regard to the existing network capacity however it is anticipated that communications providers will upgrade and expand networks in line with regional growth profiles pending developer applications.

4.1.9 Geotechnical conditions

Geotechnical considerations for the Eastern GIA are presented below. The geology overlay for the area is shown in Figure 24 below. Further details on geotechnical considerations based on the inferred geology are provided in Appendix B.

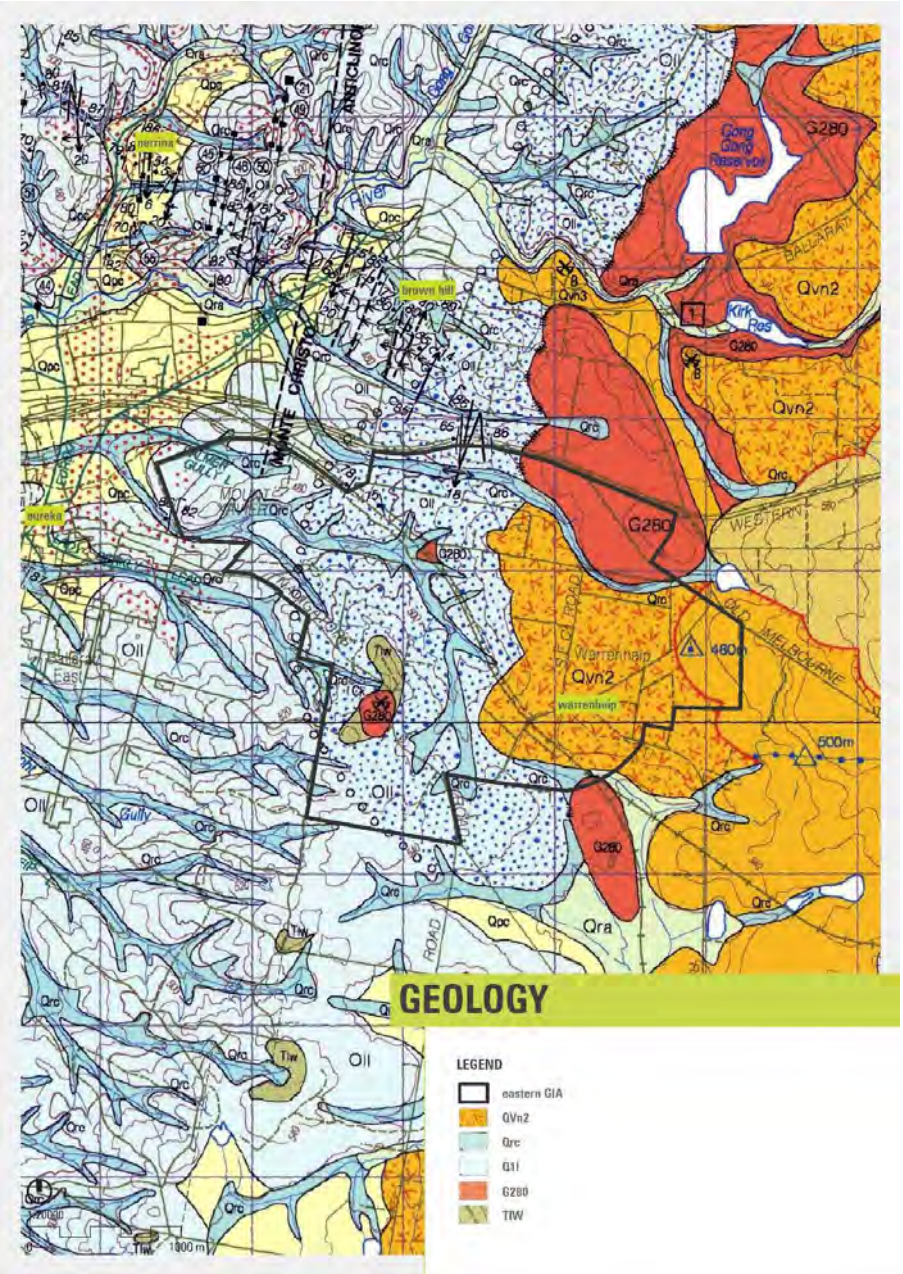

Figure 24 Eastern GIA geology based on the 1:50,000 Ballarat Geology Map (Geological Survey of Victoria, June 1996).

The western and central portions of the site typically consist of Castlemaine Supergroup bedrock (Oll) with overlying recent colluvial (Qrc, hillside erosion sediments) filling valleys and gullies adjacent to watercourses**.** The geology map indicates the Castelemaine Supergroup in this area has been altered into hornfels, which can be tough and very hard.

The eastern portion of the site is overlain by newer volcanic material (Qvn2), which typically consist of basaltic clay overlying basalt rock. A large intrusion of Mount Egerton Granodiorite (G280) occurs in the north east of the site, with two smaller central intrusions. A small zone of White Hills Gravel (Tlw, alluvial material) is located in the central portion of the site.

Soil Shrink Swell Potential for Residential Development (AS 2870, 2011)

- Colluvial material, Castlemaine Supergroup and granodiorite areas will have a Moderate (M) to High (H1) soil reactivity.
- The basaltic clay has a High (H1) to Very High (H2) shrink swell soil reactivity, or in some cases extreme (E) (Peck, Neilson, Olds, & Seddon, 1992).

In recent history (The Age, 2014), large areas of residential development around the north-west of Melbourne have had significant issues with building damage and cracking on basaltic clays as a result of inadequate site classification and foundation construction.

For development in this GIA on basaltic clay, we recommend a strong regime of requirements for geotechnical investigation, site classification and foundation design in accordance with AS 2870 Residential Slabs and Footings is implemented.

Excavation and potential to encounter rock

- Shallow excavation for residential developments should be able to be completed with light earthmoving plant in the basaltic clay, granodiorite and colluvial deposits.
- Deeper excavations/trenches in the basaltic clay and/or granodiorite may encounter boulders/corestones requiring localised removal, or basalt rock which may require heavy earthmoving equipment and ripping.
- Deeper excavation in the alluvial deposits may be unstable and/or require dewatering.
- Shallow excavations in the Castlemaine Supergroup should encounter weaker, residual material, however deeper excavations/trenches or harder surface outcrops may require medium to heavy earthmoving equipment, potentially with ripping.

Land Instability Potential

Based on topographical contours and geology, the potential for land instability over significant areas in the GIA is generally considered to be very low. Areas of localised instability may occur in areas of colluvial deposits. Land instability risk

should be able to be managed through good practice for development on sloping sites.

General considerations

Other general considerations include

- Basaltic clay material can degrade quickly when exposed and wet and it is advised that earthworks should not be undertaken in winter and care should be taken in wet shoulder seasons.
- The basaltic clay may have a low CBR requiring improvement of soft zones for pavement construction.

4.1.10 Comparison of the land capability assessment

The Eastern GIA had the lowest score for land capability assessment due to the results shown in Table 31.

Table 31 Multi-criteria analysis scoring for the Land Capability Assessment of the Eastern GIA

	Criteria	Suitability Rating Criteria			Rating
		1	2	3	Warrenheip Growth
Land capability assessment					
Disaster	Wildfire management overlay	Overlay applies within the land area	Overlay applies within 500m of land area	Overlay doesn't apply within 500m of land area	1
	Bushfire prone area	Overlay covers the entire land area	Overlay applies to more than 75% of land area	Overlay applies to less than 75% of land area	1
	Flood studies	100 year flooding occurs to more than 25% of land	100 year flooding occurs to 10-25% of land	100 year flooding occurs to less than 10% of land	3
	Rural floodway overlay	Overlay applies within the land area	Overlay applies within 500m of land area	Overlay doesn't apply within 500m of land area	3
	Erosion management overlay	Overlay applies within the land area	Overlay applies within 500m of land area	Overlay doesn't apply within 500m of land area	3
Flora and fauna	Environmental significance overlay	Overlay applies to more than 20% of land	Overlay applies to 10-20% of land	Overlay applies to less than 10% of land	1
	Significant landscape overlay	Overlay applies within the land area	Overlay applies within 500m of land area	Overlay doesn't apply within 500m of land area	3
	Vegetation protection overlay	Overlay applies within the land area	Overlay applies within 500m of land area	Overlay doesn't apply within 500m of land area	1
	Koala habitat	Primary or likely primary habitat found	Secondary or likely secondary habitat	Other vegetation within the land area	1
	Ecological Vegetation Classes	Endangered EVCs cover more than 25% of land	Endangered EVCs cover 10-25% of land	Endangered EVCs cover less than 10% of land	2
	Strategic Biodiversity Score	SBS above 20 for majority of area	SBS above 10 for majority of area	SBS below 10 for majority of area	1
Noise	Maximum aircraft noise level	Maximum event noise level above 100 dB	Maximum event noise level 80-100 dB	Maximum event noise level below 80 dB	3
	Road traffic noise	Noise wall more than 3m required	Noise wall less than 3m required	No mitigation measures apply	1
Land contamination	Environmental audit overlay	Overlay applies within the land area	Overlay applies within 500m of land area	Overlay doesn't apply within 500m of land area	2
Mining activities	Historical mining activity	More than 10 sites of historical mining activity	Less than 10 of historical mining activity	No sites of historical mining activity	2
Geotechnical	Land Instability Potential	High to medium potential for land instability	Low land instability	Very low land instability	2
	Shrink swell reactive soils	More than 50% of the land classed as very high	15-50% of the land classified as very high	Less than 15% classified as very high	2
				Subtotal	**32**

4.2 Heritage assessment

4.2.1 Cultural heritage

Heritage Overlay

The Heritage Overlay does not apply to any land within the Eastern GIA.

Cultural Sensitivity

There is an area of Aboriginal cultural sensitivity along the Specimen Vale Creek in the west of the GIA. The area is a buffer of approximately 200 metres either side of the waterway. Areas of cultural heritage sensitivity have been designated where Aboriginal cultural places and objects are known or are likely to exist. The presence of these areas indicate the need for a Cultural Heritage Management Plan (CHMP) under the Aboriginal Heritage Act 2006.

Historical Landscape

Mapping Ballarat's Historic Urban Landscape outlines the character of the landscapes within Ballarat (Context Pty Ltd, 2013). The Eastern GIA is located within the Creswick and Canadian Forested Ridge Rural Character area. This area is characterised by the wide ridge of continuous forest cover which stretches from the north to the south along the edge of Ballarat. This visually prominent ridge is of high landscape value to Ballarat residents. A key feature of the area if the extensive forest cover, with rural residential and paddock areas interspersed. The Ballarat Image community consultation process identified the following community concerns in the area: landscape, views, bushland, native flora and fauna, accessible trails, parks and open spaces and Canadian Forest.

Heritage Inventory

There is one site within the Eastern GIA that has been identified on the Heritage Inventory, under the Victorian Heritage Act 1995. This is the site of the Jenkins Barn/Dairy, located in the north of the GIA near the corner of Clarks Rd and Western Highway. Features of this site include the brick dairy, tall corrugated iron shed, a small shed and a concrete courtyard. The small shed was built in the 1800s followed by the tall shed. The site is currently used for farming. This identified archaeological site does not constrain development, however additional planning will be required to assess and excavate the site.

4.2.2 Comparison of the heritage assessment

When considering the heritage assessment for the Eastern GIA, it had the middle rating in the multi-criteria analysis due to the results shown in Table 32.

Table 32 Multi-criteria analysis scoring for the heritage assessment of the Eastern GIA

	Criteria	Suitability Rating Criteria			Rating
		1	2	3	Warrenheip Growth
Planning assessment					
Cultural heritage	Heritage overlay	Overlay applies within the land area	Overlay applies within 500m of land area	Overlay doesn't apply within 500m of land area	2
	Cultural sensitivity	Areas apply to more than 20% of land	Areas apply to 10-20% of land	Areas apply to less than 10% of land	2
	Heritage Inventory	More than 5 sites within land	Sites present within the land	Sites not present within the land	3
				Subtotal	**7**

4.3 Accessibility assessment

4.3.1 Existing and planned future road network

The key features of the existing road network surrounding the site are outlined as follows:

- The site is bounded by the Western Freeway and Ballarat-Burrumbeet Road (Victoria Street) to the north both for which VicRoads are the responsible authority. The key roads that bisect the site include Eureka Street and Warrenheip Road for which Ballarat City Council is the responsible authority. These roads and the associated road hierarchy as shown in Figure 7. It is noted that Eureka Street includes sections with steeper gradients, numerous curves and traffic calming treatments which limits its suitability to carry significant additional traffic volumes.
- A public acquisition overlay applies to the north-eastern section of the site and is understood to provide for a future upgrade of the Western Freeway in the vicinity of Brewery Tap Road.
- Information contained within the report "Victorian Integrated Transport Model – City of Ballarat, Phase 3A Investigation" dated July 2014 (Ballarat VITM Report) indicates that the road network which provides access to the site generally operates well within capacity during the AM peak period in 2011.
- The assessment of transport forecasts contained within the Ballarat VITM Report indicates that in 2041, the network experiences some levels of congestion along key routes providing access to the site during the AM peak period. Using the base case future land use and network assumptions within the Victoria Integrated Transport Model, the following points are noted for 2041 (and shown in):
    - Low levels of congestion on Victoria Street between the site and Barkly Street and Mair Street.
- The existing rail corridor presents a barrier to providing access from the site to the external road network with the existing crossing points limited to Victoria Street and Warrenheip Road. Depending on the intensity of development

within the site, there is a potential that additional capacity across the rail corridor would be required to facilitate the development of this site.

A comparison of the assumptions within VITM indicate that the number of households for the site in 2041 are consistent with the Scenario 1 (low development scenario). Additional levels of development associated with the medium and high scenarios would exacerbate the impacts identified above.

4.3.2 Public transport network and facilities

The public transport facilities that provide access to the site are summarised in and shown in with the key points noted as follows:

- The closest point of the site is located approximately 7.0km from Wendouree Station and approximately 3.0km from Ballarat Station.
- The Melbourne to Ballarat rail line bisects the site.
- Bus Route 8 and 9 operate along Fussell Street and provides a catchment that is localised to east of the site.
- Bus Route 7 operates immediately west of the site, though catchment for these services does not extend into the site.
- There is an opportunity to extend the existing Bus Route 8 and 9 as well as reroute Bus Route to operate within the site. There is also an opportunity to plan for a new station to be provided within the site.

Table 33 Bus services summary

Services	Weekday		Weekend Services
	Services	Hours	
Bus Route 8 Ballarat to Eureka	13 (circular operation)	6:05am-6:40pm	10 Saturday No services Sunday
Bus Route 9 Ballarat to Canadian	14 (circular operation)	5:42am-7:10pm	11 Saturday 7 Sunday
Bus Route 7 Ballarat to Brown Hill	28 to Ballarat 28 to Brown Hill	5:45am-9:10pm	11 Sat, 2 Sun 11 Sat, 2 Sun

4.3.3 Walking and cycling networks

The key walking and cycling features of the site are noted as follows:

- The site is generally located at least 2.5km from the Ballarat CBD. Accordingly, walking trips expected to remain either internal to the site or be limited to the immediate surrounding suburbs. The distance to the CBD is such that these trips are particularly conducive to cycling. However, the existing rail corridor limits permeability within the site and would create a barrier to walking and cycling.

- The Ballarat Cycling Action Plan 2017 shows that there existing cycling routes along Victoria Street and Eureka Street. While on-road cycling lanes are provided along Eureka Street, the facilities along Victoria Street include a mix of on-road cycling lanes or cyclists sharing the service road with vehicles.
- The cycling catchment covers the Ballarat CBD and extends to Lake Wendouree as shown in .
- There is an opportunity to provide additional rail crossing treatments for pedestrian and cyclists to improve permeability within the site.

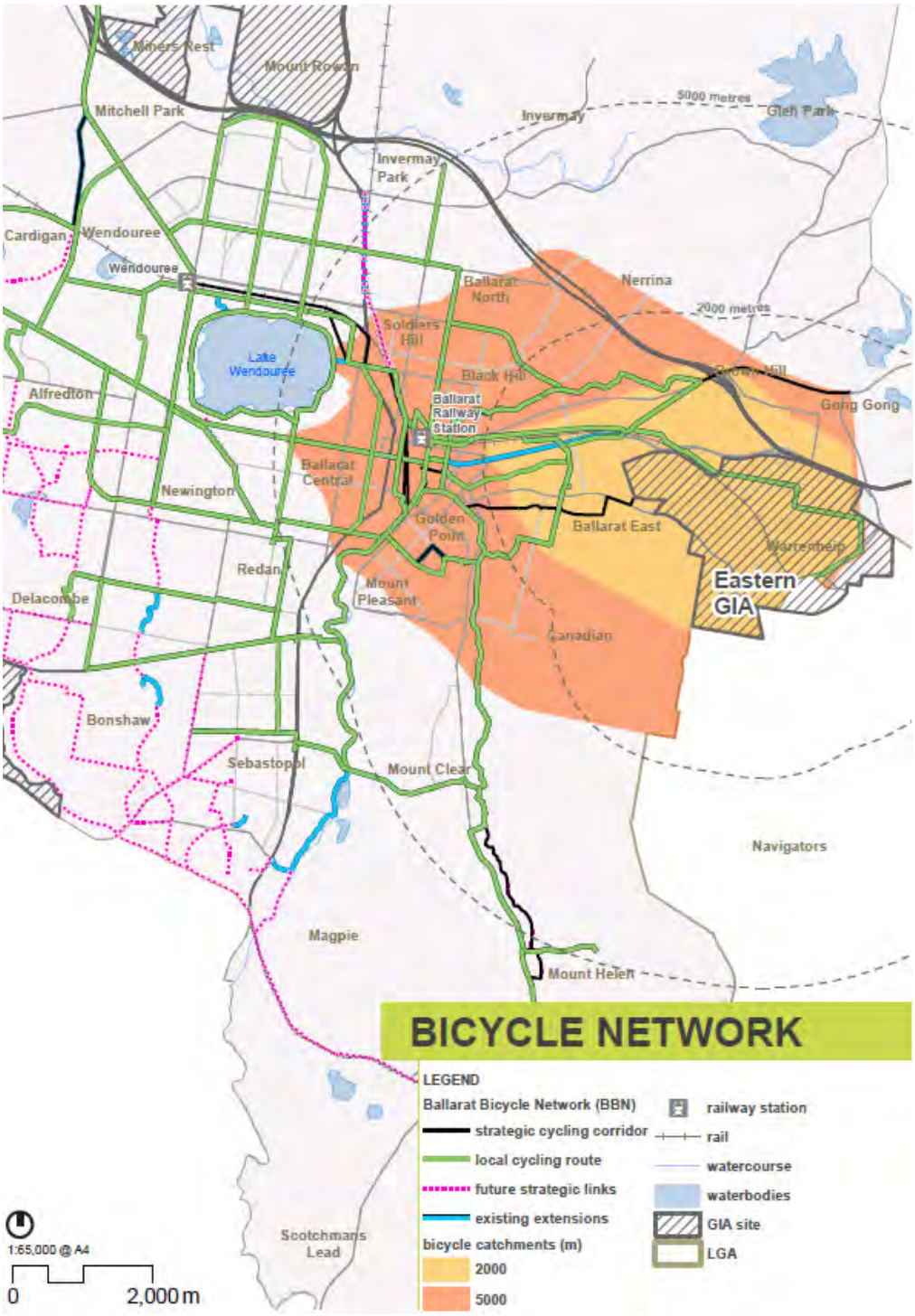

Figure 25 Eastern GIA cycling catchment of existing and planned routes

4.3.4 Accessibility to employment and services

The Ballarat VITM Report has been reviewed in relation to the access of each of the sites to employment retail services with the key points noted as follows:

- Based on current planning, the site will have a high level of access to employment and retail services by private vehicle for the foreseeable future. It is expected that between 90% and 100% of employment opportunities and retail services will be able to be accessed within a 20 minute private vehicle trip from now until the year 2041.
- Based on current planning, the site will have negligible access to employment or retail services by public transport for the foreseeable future. It is expected that there will be very limited employment opportunities and retail services that will be able to be accessed by public transport within a 20 minute public transport trip both now and until the year 2041 (the access to employment opportunities is shown in). It is noted that a public transport trip includes walking time, waiting and in-vehicle time.
- The employment distribution forecasts outlined in the Ballarat VITM report suggest that more jobs will be located in the west of Ballarat in the future. The site will have good private vehicle access to these jobs due to the proximity and access to the Western Freeway which effectively provides a bypass of the Ballarat CBD.

While access by private vehicles is high, there is an opportunity to provide additional transport choice and increased access to employment and retail services through the provision of additional public transport services outlined in Section 1.1. It is noted that some of these services may be required for equity and social inclusion.

4.4 Deliverability / Implementation

4.4.1 New trunk utility infrastructure

Drainage

A high level assessment of the trunk drainage infrastructure required for the urbanisation of the Eastern GIA has been completed in accordance with the standards stated in the Infrastructure Design Manual (IDM) and by the Corangamite Catchment Management Authority. Accordingly, the following key parameters have been applied to the proposed drainage design:

- The flows are to be maintained at pre-development levels for the peak flow rate in a 100 year ARI event.
- The minor drainage (underground pipes and channels) are sized to convey the 10 year ARI in residential and industrial areas.
- The water discharged into the existing waterways is treated to the Best Practice Environmental Guideline Targets for Stormwater Treatment, such that removal of the following is achieved:

- 80% of total suspended solids;
- 45% of total phosphorus;
- 45% of total nitrogen; and
- 70% of gross pollutants.

Demand requirements

Catchment areas were identified and runoff and time of concentration coefficients were determined in accordance with the land use of each catchment. The existing land use within the study area was determined based on the GIS information provided by City of Ballarat. As per the IDM, the overland flow for the existing and proposed conditions has been calculated using the Rational Method for Rural Hydrology described in Austroads "Guide to Road Design: Part 5 General and Hydrology Considerations." The design has adopted the runoff coefficients stated in Table 9 of the IDM. For catchment types not identified in the IDM, runoff coefficients defined in AS3600.3 has been adopted.

Table 34 states the minimum detention volume required to ensure that the flow is maintained to pre-development levels for the peak flow rate in a 100 year ARI event.

Table 34 Eastern GIA estimated required stormwater detention volumes

Detention volume required (m3)				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Catchment 1	12774	18132	20081	22288
Catchment 2	46312	63410	69627	76203
Catchment 3	1471	2100	2328	2655
Catchment 4	1087	1581	1761	1951
Total	61644	85223	93797	103098

New Trunk Infrastructure

The new trunk infrastructure required includes:

- A number of retention basins located throughout the study area. The size and location of individual basins will largely be dependent on the topography and proposed land use of the study area and should be determined in collaboration with civil engineers and town planners.
- Wetlands that will be incorporated into the floor of each retarding basin to improve water quality. The application of this treatment measure ensures that land acquisition cost to meet WSUD requirements can be minimised.
- A network of stormwater drainage pipes that will convey the post-development 10 year ARI event flow to the retention basin.
- Stormwater drainage pipes that will convey the pre-development 100 year ARI event flow from the retention basins to the outfall creeks.

Detailed modelling of the performance of the proposed wetlands has not been conducted as part of this study. Consequently, while the design and cost evaluation assumes that WSUD requirements can be satisfied with the wetlands and green spaces, it is noted that additional tertiary water treatment may be required.

Sewer

A high level sewer network has been designed in accordance with the design principles outlined in the MRWA WSAA Sewage Code, Pressure Sewer Code and Sewerage Pump Station Code, as required by Central Highlands Water. The topography and location of the existing rail corridor has resulted in the design of two gravity feed networks with outfall locations at Mahers Road and Eureka Street. Pump stations are required at the outfall points in order to connect to the existing sewer mains outside of the GIA.

Demand requirements

The sewer demand is based on the assumption that residential land use will account for 85% of the overall sewer demand. This value was determined based on engineering industry experience and advice provided within the MRWA WSAA Sewer Code. The values derived were informally provided to Central Highlands Water who advised that they are consistent with the degree of development investigated. Table 35 and Table 36 list the estimated sewer flows for sizing mains and the demand flows for wastewater treatment.

Table 35 Eastern GIA estimated effluent flow for sizing of mains

Proposed Sewer Flows (L/s)				
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
Eastern GIA	165.35	209.74	240.45	288.49

Table 36 Eastern GIA estimated effluent flow for wastewater treatment

	Peak Dry Weather Flow (L/s)	**Peak Dry Weather Flow (ML/d)**
Scenario 1	42.62	3.65
Scenario 2	63.93	5.48
Scenario 3	79.92	6.85
Scenario 4	106.55	9.13

New trunk infrastructure

The trunk infrastructure required for the development of the Eastern GIA have been designed based on the following principles and parameters:

- The mains have been sized assuming PVC pipes.
- The network design should aim to avoid the use of pressure sewers and rising mains.

Table 37 below provides an indication of the size of trunk mains required to service each scenario.

Table 37 Eastern GIA estimated sewer trunk mains

Meters of trunk mains				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
150mm diameter	2750	2750	0	0
225mm diameter	3100	3100	5850	2750
300mm diameter	0	0	0	3100

While it is likely that this GIA can be serviced by a gravity network, multiple connection points to the existing system may be required. It is noted that there is a lack of peak wet weather capacity in the aging downstream network and significant upgrades will need to be undertaken or peak flows will need to be contained within the GIA which would require space for detention networks. Upgrade of downstream networks will be complex due to existing mains passing through highly built up areas and Ballarat CBD.

Infrastructure required for wastewater treatment

The additional effluent produced as a result of the development of the Eastern GIA is expected to be transferred for treatment to the Ballarat South Wastewater Treatment Plant (WwTP). Central Highlands Water has confirmed that this plant has capacity limitations and would require upgrade or detention space to manage wet weather peak flows. Similarly to the Northern GIA, the buffer zone and discharge licence of the Ballarat South WwTP could need to be reviewed.

It is possible that development in this growth area would drive the need for a new wastewater treatment plant.

Water

A high level proposed potable water network has been calculated in accordance with MRWA WSAA Water Code, as per the requirements stated by Central Highlands Water. As further reference, the design has also considered the requirements that Central Highlands Water has stipulated in the Ballarat West Precinct Structure Plan (PSP) 2012 for water demand and network design. It would be anticipated that the additional requirements stated within the PSP will also apply to all other future development within Ballarat.

Demand requirements

The water demand has been determined for the residential properties only, and does not consider the water required for the function of the commercial or landscaped precincts. This decision was made on account of the absence of information regarding the type of commercial and landscape areas proposed for each scenario and their demand requirements.

In accordance with the MRWA WSAA Water Code, the peak daily and hourly demands have been determined.

The peak hourly flow rates for residential density types (high, medium, low) have been provided by Central Highlands Water and are in accordance with those stated by MRWA (MRAW, 2011). Arup has extrapolated these values to ascertain values for the allotment types used in the scenarios.

The peak daily demand has been determined on the assumption that potable water demand reduction measures will not be implemented in the development areas. This approach was applied to ensure that water demand requirements can be achieved when the residential water systems are unable to function as designed, such as during drought and when the residential systems are not maintained. This design measure was proposed and supported verbally by Central Highlands Water.

Table 38 provides a summary of the estimated water demand for each land development scenario. Central Highlands Water has been provided with the estimated demands and have advised that the derived demands are consistent with the degree of development investigated.

Table 38 Eastern GIA estimated water demand

Proposed water demand for residential development areas		
	Water Demand (m^3/s)	Water Demand (ML/day)
Scenario 1	0.78	1.95
Scenario 2	0.89	2.93
Scenario 3	0.97	3.66
Scenario 4	1.11	4.89

New trunk infrastructure

Installation of new trunk mains will be required due to the small size of surrounding assets. Central Highlands Water have also advised that new tanks, booster pump stations will also be required to service the Eastern GIA. This new network may need to create several pressure zones and multiple water supply zones causing various operational complexities.

Due to the age and condition of the existing infrastructure in central Ballarat and lack of spare Peak Day Demand capacity, significant upgrades are required to the system external to the Eastern GIA.

It is noted that there are existing level of service issues in the eastern extremity of Ballarat, along the western edge of this GIA. These issues would be exacerbated by the additional demand of this growth area therefore requiring further upgrades to the existing network. These upgrades could prove costly and complex due to existing mains passing through highly built up areas.

To reduce demand, Central Highlands Water has indicated a desire to mandate household scale rainwater harvesting.

Infrastructure required for water treatment and storage

Central Highlands Water has advised that the Ballarat System is capable of sourcing adequate raw water supply for the next 30 to 50 years and that the two treatment plants in the area have sufficient capacity for the next 20 years.

Gas

Demand requirements

The gas demand for each of the development scenarios has been determined based on the current gas usage per person in Ballarat. In the absence of information pertaining the proposed industrial and commercial development for each scenario, the gas demand calculated consider only the residential demand. The proposed gas demand is shown in Table 39.

Table 39 Eastern GIA estimated gas demand

Proposed gas demand for residential development areas	
	Gas Demand (GJ/year)
Scenario 1	11320
Scenario 2	16980
Scenario 3	21225
Scenario 4	28300

New trunk infrastructure

In the absence of specific information regarding the size and capacity of the existing gas pipelines it is not possible to determine the extent of new trunk infrastructure required for each scenario.

AusNet Services have advised that the Eastern GIA could be supplied by the existing City Gate given its close proximity to this area.

Infrastructure required in the longer term

AusNet Services has advised that two new field regulators are currently being installed to enhance network pressures to ensure capacity for the immediate future. These upgrades do not consider future growth in this area.

Electricity

New trunk infrastructure

Powercor has confirmed that there is limited supply available to the Eastern GIA, however 22kV feeder augmentation works would be required to support significant growth in demand. Such augmentation works are included in Powercor's 10 year forward plan.

It is noted that Powercor's longer term plan is to establish a substation in Ballarat West. This substation is proposed to cater for growth in the industrial demand in the area but could also have advantages for the Eastern GIA.

It is likely that the following infrastructure works would be required to support the GIA:

- New transmission lines to supply the existing Ballarat Terminal Station (BATS);
- New sub-transmission lines to fed the revelvant zone substation;
- New 22kV feeders from the relevant zone substation to the GIA
- New electricity distribution network within the GIA.

It would be anticipated that at least one new 22kV feeder would be required to support the supply of electricity for Scenario 1 and up to 4 new 22kV feeders for Scenario 4. Similarly, given the proposed sub-transmission lines to the BAW zone substation, additional sub-transmission lines may only be necessary for Scenarios 3 and 4.

Telecommunications

Telstra has advised that trunk infrastructure in growth areas will be dictated by developer applications. These protocols are spelt out by both Telstra and NBN Co and are at a cost to the developer.

4.4.2 New community infrastructure

The new community infrastructure required to provide for the future residents of the Eastern GIA was determined based on benchmark recommendations for the provision of facilities. The requirements were determined under four population projection scenarios. Existing facilities in adjacent areas have been documented, as this may reduce the requirement for new community infrastructure.

Table 40 Community infrastructure required for the Eastern GIA

Category	Indicator	Benchmark	Access distance	Reference	Scenario				Provider	Existing facilities	Distance from GIA
					1	2	3	4			
1 Recreation and Cultural Infrastructure											
1.1 Sport and recreation	Provision of recreation areas - active open space	One Level 1 active open space reserve (8 ha per active open space reserve) per 6,000 people	1000 metres for 95% of dwellings	ASRR 2008 GAA 2013	1.5	2.2	2.8	3.7	Local council	Playground and sports field	800 metres
1.4 Community centres	Provision of community centres	Level 1 Provision ratios up to 10,000 people		GAA 2009	0.9	1.3	1.7	2.2	Local council	Community Hall	Within GIA
										Brown Hill Community Hall	800 metres
2 Educational Infrastructure											
2.1 Kindergartens	Provision of kindergartens	Provision ratios up to 10,000 people	600 metres	GAA 2009 Barton et al 2010	0.9	1.3	1.7	2.2	Private		
2.2 Long day care and occasional care	Provision of long day care and occasional care facilities	Provision ratios up to 10,000 people	600 metres	GAA 2009 Barton et al 2010	0.9	1.3	1.7	2.2	Private		
2.3 Primary schools	Provision of government primary schools	1 government primary school per 8,000 to 10,000 people	800 metres	ASRR 2008 Barton et al 2010	0.9	1.3	1.7	2.2	State government	Warrenheip Primary School	Within GIA
										Caledonian Primary School	580 metres

	Provision of non-government primary schools	Provision ratios between 10,000 and 30,000 people	800 metres	GAA 2009 Barton et al 2010	0.4	0.7	0.8	1.1	Private	St Francis Xavier School	Within GIA
3 Healthcare Infrastructure											
3.1 GP clinics	Provision of GP clinics	0.34 general practices per 1000 people (Victorian average)		Dept of Health 2011	3.0	4.5	5.7	7.5	Private		
3.3 Dental practices	Provision of dentist sites	0.20 dental services per 1000 people (Victorian average)		Dept of Health 2011	1.8	2.7	3.3	4.4	Private		
3.4 Aged care	Provision of aged care facilities	Provision ratios between 10,000 and 30,000 people		GAA 2009	0.4	0.7	0.8	1.1	Private	Geoffrey Cutter Centre	200 metres
										Eureka Village Hostel	310 metres
										Begonia Residential Aged Care	440 metres
										Hemsley Park Retirement Village	620 metres
	Provision of aged care places	88 beds per 1000 people aged 70+		ANAO 2015	79	119	148	198	Private		
3.5 Community health centres	Provision of community health centres	Provision ratios between 10,000 and 30,000 people		GAA 2009	0.4	0.7	0.8	1.1	State government		
3.6 Hospitals services	Hospital beds	3.9 hospital beds per 1000 people (Australian average)		AIHW 2014	35	52	65	86	State government		

The demand for community infrastructure is driven by the population and the provision of existing facilities and services. It has been noted that the healthcare infrastructure may be provided by the public sector. The potential costs associated with the delivery of such community infrastructure is discussed in Table 42.

4.5 Financial and economic assessment

4.5.1 Development infrastructure costs for trunk infrastructure

Drainage

The costs associated with the drainage trunk infrastructure are stated below. For information regarding the design and cost assumptions please refer to Appendix C.

Table 41 Eastern GIA estimated drainage trunk infrastructure costs

Item	Scenario 1	Scenario 2	Scenario 3	Scenario 4
New pipes and pits	$ 3,830,700.00	$ 5,296,000.00	$ 5,828,800.00	$ 6,406,800.00
Retention Basins / Wetlands	$ 8,938,400.00	$ 12,357,300.00	$ 13,600,600.00	$ 14,949,200.00
Council Fees	$ 447,000.00	$ 617,900.00	$ 680,100.00	$ 747,500.00
CAPEX (2015 pricing)	**$ 13,216,100.00**	**$ 18,271,200.00**	**$ 20,109,400.00**	**$ 22,103,400.00**
CAPEX (2040 pricing)	**$ 27,756,490.00**	**$ 38,373,313.00**	**$ 42,233,975.00**	**$46,421,864.00**

Sewer and Water

As with all of the proposed areas, development of the Eastern GIA will drive the need for significant investment in new trunk infrastructure and upgrades to existing infrastructure in the quantum of $40M – $50M. Should this result in the need for a new wastewater treatment plant and re-use facility a further $50M - $80M could be required.

It should be noted that the need to convey sewer flows from this GIA across currently built up areas may introduce further complexities and in turn costs for any related upgrades.

Operational complexities due to the possible creation of multiple pressure zones to supply this GIA will also have ongoing costs.

Gas

While the authorities have not provided specific costs for trunk infrastructure, they have noted that the Eastern GIA will require significantly less investment due to its proximity to the City Gate.

Electricity

Powercor stated that costs associated with supplying this GIA are difficult to provide without a detailed in depth assessment. However, it was noted that costs

would vary only slightly between the GIA's being considered and that there was no preference between areas.

Telecommunications

Telstra has advised that charges for new infrastructure are generally borne by the developer and vary based on:

- type and size of the development,
- location,
- services required by the developer,
- network type, and
- relative proximity of Telstra's network with spare capacity.

4.5.2 Community infrastructure costs

The unit costs for community infrastructure required to service development in the Eastern GIA are outlined in Table 42. The total cost of providing infrastructure depends on the development scenario, as outlined in Section 4.4.2.

Table 42 Community infrastructure costs for Eastern GIA

Category	Indicator	Unit cost	Reference	Cost in scenario			
				1	2	3	4
1 Recreation and Cultural Infrastructure							
1.1 Sport and recreation	Provision of recreation areas - active open space	$ 6.75 million	Urban Enterprise, 2014	$13,500,000	$13,500,000	$20,250,000	$27,000,000
1.4 Community centres	Provision of community centres	$ 4.4 million	Urban Enterprise, 2014	$4,400,000	$4,400,000	$8,800,000	$8,800,000
2 Educational Infrastructure							
2.1 Kindergartens	Provision of kindergartens	$ 1.3 million	City of Kingston, 2014	$1,300,000	$1,300,000	$2,600,000	$2,600,000
2.2 Long day care and occasional care	Provision of long day care and occasional care facilities	$ 4.1 million	ACT Government, 2012 McComish, 2013	$4,100,000	$4,100,000	$8,200,000	$8,200,000
2.3 Primary schools	Provision of government primary schools	$ 12.2 million	Department of Treasury and Finance, 2015	$12,200,000	$12,200,000	$24,400,000	$24,400,000
	Provision of non-government primary schools	$ 12.2 million	Department of Treasury and Finance, 2015	$-	$12,200,000	$12,200,000	$12,200,000
3 Healthcare Infrastructure							
3.1 GP clinics	Provision of GP clinics	$ 1.4 million	Selesnew, 2008	$4,200,000	$7,000,000	$8,400,000	$11,200,000
3.3 Dental practices	Provision of dentist sites	$ 1.4 million	Selesnew, 2008	$2,800,000	$4,200,000	$4,200,000	$5,600,000

Category	Indicator	Unit cost	Reference	Cost in scenario			
				1	2	3	4
3.4 Aged care	Provision of aged care facilities	$ 17.9 million	Department of Treasury and Finance, 2014	$-	$17,900,000	$17,900,000	$17,900,000
	Provision of aged care places	$ 595,000 per place	Department of Treasury and Finance, 2014	$47,005,000	$70,805,000	$88,060,000	$117,810,000
3.5 Community health centres	Provision of community health centres	$ 50.2 million	Department of Treasury and Finance, 2014	$-	$50,200,000	$50,200,000	$50,200,000
3.6 Hospitals	Provision of hospital beds	$ 844,000 per bed	Department of Treasury and Finance, 2015	$29,540,000	$43,888,000	$54,860,000	$72,584,000

The demand for community infrastructure is driven by the population and the associated costs are influenced by which scenario is implemented. It has been noted that the indicative healthcare infrastructure may be provided by the public sector. Further the costs identified are relatively similar across the GIAs given the influence of population.

4.5.3 Developer costs for local infrastructure

The developer costs associated with the construction of local infrastructure have been determined following consideration of the following:

- The standard industry rates for construction in Melbourne (Rawlinsons, 2015); and
- The fees and charges stipulated by Central Highlands Water for land development (Central Highlands Water, 2014).

Cost estimates have been determined based on 2015 prices and the construction prices anticipated for 2040. The anticipated 2040 costs have been determined based on the assumption that the inflation rate for construction from 2015 to 2040 will be equal to that experienced between 2004 and 2014. This rate is 4.4% per year.

Table 43 Eastern GIA combined cost estimate 2015 prices

Eastern GIA combined cost estimate - 2015 prices				
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
Roads	$42,482,855	$47,443,000	$47,443,000	$52,455,913
Water Supply	$14,933,566	$19,346,025	$21,999,234	$27,305,403
Sewer	$10,025,508	$11,793,113	$12,181,175	$14,088,151
Total	**$67,441,930**	**$78,582,138**	**$81,623,410**	**$93,849,466**

Table 44 Eastern GIA combined cost estimate 2040 prices

Eastern GIA combined cost estimate - 2040 prices				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Roads	$89,223,168	$99,640,543	$99,640,543	$110,168,742
Water Supply	$31,363,713	$40,630,829	$46,203,142	$57,347,241
Sewer	$21,055,732	$24,768,083	$25,583,098	$29,588,158
Total	**$141,642,613**	**$144,606,043**	**$171,426,783**	**$197,104,141**

5 Summary of Findings

In summary, the desktop assessment and multi-criteria analysis has allowed for the comparison of the three GIAs based on criteria focused around the assessment of land capability, planning and accessibility alongside considerations for delivery and implementation.

5.1 Land capability assessment

The land capability assessment was one of the key influences for differentiating between the GIAs. Planning overlays were particularly important for the feasibility of site, specifically those related to natural disaster and flora and fauna. There was less variability evident in the noise levels and historical influences such as contamination, mining and geotechnical conditions between the three GIAs. The Western GIA was determined to be the most suitable and the Eastern GIA was the least suitable in this assessment.

5.1.1 Northern GIA

5.1.1.1 Natural disaster risk

With regards to natural disaster risk, both fires and flooding are potential issues in the Northern GIA. The Wildfire Management Overlay does not apply to any land within the GIA boundary, however the Bushfire Prone Area applies to all of the land. The Erosion Management Overlay applies to some land within the GIA including 100 metre buffer zone either side of the Burrumbeet Creek and Mount Rowan. Further, there are some areas to the south and west of the Northern GIA that will be impacted by a 100 year flood. The proposed flood overlays indicate that areas adjacent to the Burrumbeet Creek, as well as the south-west corner of the GIA will be impacted by flooding.

5.1.1.2 Protected flora and fauna

Fewer constraints are presented by flora and fauna than in other GIAs. The Vegetation Protection Overlay, Salinity Management Overlay and likely koala habitat has not been identified within the GIA. The Environmental Significance Overlay is located around the Ballarat North Water Reclamation Plant (Schedule 4) and around Burrumbeet Creek (Schedule 2) and the Significant Landscape Overlay applies to Mount Rowan. There are patches of Endangered EVCs in the GIA and according to the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) register, there are several matters of national significance known to occur within a 500 metre buffer of the Northern GIA. The majority of the site has a relatively low Strategic Biodiversity Score, with the exception of the south-west and north-east of the GIA and the most significant waterways on the site are Burrumbeet Creek and the North Common Wetland Reserve.

5.1.1.3 Buffers from sensitive uses

In terms of site buffers the Airport Environs Overlay applies to the land directly to the west of the GIA and the 15 ANEF contour extends into the GIA. The majority of the GIA is located within the Horizontal Surface RL 480.5 metres contour, with the RL 470 contour extending into the west of the site which is equivalent to a building height of approximately 50metres. It is noted that there is a small parcel of industrial zoned land in the south east corner of the GIA and there is a former landfill in the southern section of the GIA. Although an Environmental Audit Overlay has not been applied by the EPA, there is the potential for this to be applied to the former landfill and industrial zoned land at some point in the future by the EPA, however the likelihood of this cannot be determined at this stage.

The Ballarat North Water Reclamation Plant is adjacent to the GIA and there is currently an ESO in place which is intended to prevent development within proximity to wastewater treatment plants that may impact the operation of the plant. Based on EPA Publication 1518, *Recommended separation distances for industrial residual air emissions*, there is the potential for an increased buffer distance based on an interpretation of the type of wastewater treatment plant and the default buffer. A developer has commissioned GHD to undertake a site specific assessment which has indicated a reduced buffer. It is understood that Central Highlands Water are not progressing an amendment to the current buffer and as such it is considered that the existing ESO be used to guide future development in the Northern GIA.

5.1.1.4 Noise impacts

Noise is relatively high in comparison to the other GIAs as both aircraft and traffic are expected to impact on noise levels in the GIA. The Northern GIA is located under the Ballarat Aerodrome runway 05/32 flight tracks and the maximum event noise levels due to aircraft flyover are predicted to be up to 95 dB(A). The Northern GIA is affected by road traffic noise from the Western Freeway and Midland Highway and noise mitigation measures would apply in the GIA including noise walls and buffer zones from the Western Freeway. Industrial noise from the two operational INZ1 industrial zones and the water treatment facility will also require a buffer of 150 metres.

5.1.1.5 Contaminated sites and past mining activities

Land contamination is relatively low in comparison to the other sites. No potentially contaminated land has been identified by the Environmental Audit Overlay within or surrounding the Northern GIA. However it is noted that a former landfill site exists on the south east of the GIA and past mining activities on the site include six point locations in the eastern part of the GIA. This has the potential for contamination and the exacerbation of geological issues, however this has not been evident within the GIA. There are no expired mining licenses or leases within the GIA boundary.

5.1.1.6 Geotechnical conditions

The geotechnical conditions are moderate in comparison to the other GIAs. Land instability is moderate as there are steep contours around Mount Rowan with potential rockfall hazard and there are pockets where localised instability may occur, particularly adjacent to the existing Creek and waterways. The potential for highly reactive heavy clay which can result in widespread cracking and settlement to buildings is also relatively high, however this is expected to be managed through best practice measures.

5.1.1.7 Access to existing utility infrastructure

The major utility services present in some capacity in the study area include:

- Sewerage;
- Water Supply;
- Electricity (Distribution); and
- Telecommunications.

Formal drainage assets are not present in the GIA and information has not been provided by the gas distribution authorities to confirm the existence of gas mains or reticulation pipes within the site. Minimal trunk utility infrastructure exists within the GIA, with the exception of the sewer outfall mains that direct effluent to the Ballarat North WRP (located along the southern boundary). Reticulation infrastructure is predominantly limited to the eastern half of the GIA to service the rural properties. Fixed wireless as part of the National Broadband Network (NBN) is accessible in all areas east of Gillies Road and south of Burrumbeet Creek.

5.1.1.8 Access to existing community infrastructure

The following existing community infrastructure facilities have been identified in proximity to the GIA:

- Community hall approximately 1km from the site;
- Forest Street Primary School (and Forest Street Deaf Facility) approximately 580metres from the site; and
- Yuille Park Community Collefe approximately 600metres from the site

5.1.2 Western GIA

5.1.2.1 Natural disaster risk

Natural disaster risk is less of an issue for the Western GIA in comparison to the other GIAs. The majority of the site sits within the Bushfire Prone Area, however the Wildfire Management Overlay, the Rural Flood Overlay, the Land Subject to Inundation Overlay and the Erosion Management Overlay does not apply within this GIA. It is worth noting that there are also areas in the north of the Western GIA that will be impacted by a 100 year flood.

5.1.2.2 Protected flora and fauna

There are limited constraints posed by flora and fauna characeristics of this GIA. The Vegetation Protection Overlay, Significant Landscape Overlay and Salinity Management Overlay are not present within the boundary of the site. However the Environment Significance Overlay applies to some narrow strips in the south-west of the site (Schedule 5) and to a large area to the west (Schedule 2).A 22 hectare likely primary koala habitat has been identified and there are several matters of national significance known to occur within a 500 metre buffer of the Western GIA. There is a relatively low Strategic Biodiversity Score. There are also several dams along waterways to the south and identifiable creeks including Kensington Creek, along the southern section of the eastern boundary, and Winter Creek, along the southern boundary of the GIA.

5.1.2.3 Buffers from sensitive uses

There are no buffers required for separation from sensitive sites for the Western GIA.

5.1.2.4 Noise impact

The Western GIA is located under the Ballarat Aerodrome primary runway 18/36 flight tracks and will be impacted by aircraft noise, with the maximum event noise levels due to aircraft flyover predicted to be up to 80dB(A). Road traffic noise from the Glenelg Highway and future Western Link is also moderate and noise mitigation measures such as noise walls and buffer zones may be required. Noise from industrial and railways is not estimated to impact on the GIA.

5.1.2.5 Contaminated sites & past mining activities

Land contamination is unlikely to be an issue for this GIA as potentially contaminated land, as per the Environmental Audit Overlay designation has not been identified within the site. However it does apply to some land parcels within 100 metres of the site. Further, historical mining activities and expired licenses and leases have not been identified on the site.

5.1.2.6 Geotechnical conditions

With regards to the geotechnical conditions, they are generally poorer than the other GIAs. The land instability is moderate as there are areas of localised instability, particularly adjacent to the colluvial deposits in existing creeks and waterways however this should be able to be managed through good practice. Further, the potential for highly reactive heavy clay which can result in widespread cracking and settlement to buildings is relatively high, however this is expected to be managed by good practice.

5.1.2.7 Access to existing utility infrastructure

The Western GIA is predominantly comprised of undeveloped farming and grazing land. The major utility services present in some capacity include:

- Water Supply;
- Electricity (Distribution); and
- Telecommunications.

Formal drainage and sewer infrastructure is not present and information from the gas distribution authorities has not been provided for this assessment. Consequently, it is unknown if gas mains and reticulation pipes exist within the GIA. It has been determined that trunk utility infrastructure does not currently exist within the site and reticulation networks are largely absent. However, the proposed development of the adjacent Ballarat West PSP area will result in the construction of water, sewer, gas and electrical mains along parts on the eastern boundary of the Western GIA. Fixed wireless service as part of the National Broadband Network (NBN) is widely available across the study area.

5.1.2.8 Access to existing community infrastructure

The following existing community infrastructure facilities have been identified in proximity to the GIA:

- Alfredton Primary (State Government) School approximately 1.5km from the site;
- St Thomas More (Private) School approximately 1.5km from the site; and
- Kallara Residential Care approximately 1.3km from the site.

5.1.3 Eastern GIA

5.1.3.1 Natural disaster risk

Natural disaster risk is moderate for the Eastern GIA in comparison to the other GIAs. The GIA is entirely within Bushfire Prone Area and the Wildfire Management Overlay applies to large areas covering the north, west and south of the GIA. Flooding is unlikely to be an issue as there are no areas within the Eastern GIA impacted by a 100 year flood studies and the Rural Floodway, Land Subject to Inundation and Erosion Management Overlay does not apply within the GIA.

5.1.3.2 Protected flora and fauna

Protected flora and fauna is more of an issue for the Eastern GIA in comparison to the other GIAs. The Vegetation Protection Overlay applies to almost half the area and the Environmental Significance Overlay applies to large portions of the GIA. There are also numerous patches of primary and secondary koala habitats and almost a tenth of the land area is covered by endangered EVCs. According to the EPBC register, there are also several matters of national significance known to

occur within a 500 metre buffer of the site. The land in the Eastern GIA has a relatively low Strategic Biodiversity Score, with a maximum score of 35 and the majority below 20. Tree cover to the south-west corner is identified as important and the Eastern GIA is within the Canadian Creek catchment. The Specimen Vale Creek has been identified in the GIA.

5.1.3.3 Buffers from sensitive uses

There are no buffers required for separation from sensitive sites within the Eastern GIA. However, it is noted that there are parcels of industrial zoned land to the adjacent to the west and to the north of the GIA boundary.

5.1.3.4 Noise impacts

The Eastern GIA is affected by moderate road traffic noise from the Western Freeway and Victoria Street. Mitigation measures required for the GIA would include noise walls and buffer zones. The GIA is not considered to be significantly affected by aircraft or industrial noise, however railway noise from the Ararat railway line may impact the site and mitigation measures would need to be considered.

5.1.3.5 Contaminated sites and past mining activities

Contamination within the site is unlikely to be an issue as the Environmental Audit Overlay has been not identified within the site. However it does apply to land parcels within 300 metres of the site boundary. There are two point locations of recorded historical mining activity within the Eastern GIA, to the north-west and south-east of the GIA.

5.1.3.6 Geotechnical conditions

The geotechnical conditions for the Eastern GIA are more favourable than the other GIAs. There is relatively low potential for land instability and the potential for highly reactive heavy clay which can result in widespread cracking and settlement to buildings is relatively low.

5.1.3.7 Access to existing utility infrastructure

The Eastern GIA can be considered rural residential in nature with some spill over from the urban development in the north. Consequently, all major utility services are present in some capacity in the study area including:

- Drainage;
- Sewerage;
- Water Supply;
- Gas;
- Electricity (Distribution); and
- Telecommunications.

Minimal trunk utility infrastructure exists within the GIA, with the exception of the trunk water mains, which run east and north through the study area from the Warrenheip Basin. Reticulation infrastructure is predominantly limited to the higher density rural residential areas in the north and east of the GIA. Fixed wireless service as part of the National Broadband Network (NBN) is widely available, with the exception of the north-western corner at the St Francis Xavier Primary School and the Mount Xavier Golf Course, where a fixed line is available.

5.1.3.8 Access to existing community infrastructure

A large range of community infrastructure facilities that have been identified in proximity to the GIA including:

- Playground and sports field 800metres from the site;
- Brown Hill Community Centre 800 metres from the site;
- Warrenheip Primary School within the GIA;
- Caledonian Primary School approximately 580metres from the site;
- St Francis Xavier School within the GIA;
- Geoffrey Cutter Centre 200metres from the site;
- Eureka Village Hostel 310metres from the site;
- Begonia Residential Aged Care 440metres from the site; and
- Hemsley Park Retirement Village 620metres from the site.

5.2 Heritage assessment

The heritage assessment encompassed the cultural heritage influence for each of the GIAs. There was less variability between the GIAs and cultural sensitivity and/or significant heritage was common. Western GIA was determined to be the most suitable and the Northern GIA was the least suitable in this assessment.

5.2.1 Northern GIA

5.2.1.1 Cultural heritage

Cultural heritage is a relatively important issue for the Northern GIA in comparison to the other GIAs. The Heritage Overlay does not apply to any land within the Northern GIA, however it is present within 500metres of the site boundary. Cultural sensitivity is also relatively high due to areas of Aboriginal cultural sensitivity along the Burrumbeet Creek and several circular parcels of land, approximately 100 metres in diameter across the site. The Northern GIA lies across two Indicative Character areas identified in identified in Mapping Ballarat's Historic Urban Landscape (Context Pty Ltd, 2013). The Mount Rowan Rural Character Area is found on the eastern section and the Wendouree and Miners Rest Urban Character area is found on the western section of the GIA.

There are two sites that have been identified on the Heritage Inventory which is relatively high in comparison to the other GIAs. The Mount Rowan Mullock Heap 1 indicates the presence of a former mining site in the east of the GIA near Creswick Rd and the Mount Rowan House remains site is located near the corner of Gillies Road and Olliers Road in the centre of the GIA.

5.2.2 Western GIA

5.2.2.1 Cultural heritage

Cultural heritage is generally less prominent in the Western GIA in comparison to the other GIAs. The Heritage Overlay does not apply to any land within the boundary or within 500 metres of the site boundary. Cultural sensitivity is moderate as there are areas of Aboriginal cultural sensitivity along the east and south boundaries of the south eastern section of the GIA. These are approximately 200 metre buffers from Winter Creek and Kensington Creek, which run along the GIA boundaries in this section. The Western GIA also lies across three Indicative Character areas identified in Mapping Ballarat's Historic Urban Landscape (Context Pty Ltd, 2013). Most of the GIA is located within the Burrumbeet Plains Rural Character area whilst the south-west section is located in the Haddon Hills and Common Rural Character Area and the south-east section is in the Bonshaw/Magpie/Scothman's Lead Mining Landscape Rural Character Area. The Western GIA does not have any sites identified on the Heritage Inventory, under the Victorian Heritage Act 1995.

5.2.3 Eastern GIA

5.2.3.1 Cultural heritage

The Heritage Overlay does not apply to any land within the Eastern GIA. The Eastern GIA is located within the Creswick and Canadian Forested Ridge Rural Character area identified in Mapping Ballarat's Historic Urban Landscape (Context Pty Ltd, 2013). Further, there is one site within the Eastern GIA that has been identified on the Heritage Inventory, under the Victorian Heritage Act 1995. This is the site of the Jenkins Barn/Dairy, located in the north of the GIA near the corner of Clarks Rd and Western Highway.

5.3 Accessibility assessment

Congestion levels were the most influential factor in differentiating between the GIAs for the accessibility assessment. All of the GIAs have access to employment opportunities and services within a 20 minute private vehicle trip (up to 2041). The Eastern GIA was determined to be the most suitable and the Northern GIA was the least suitable in this assessment.

5.3.1 Northern GIA

5.3.1.1 Existing and planned future road network

There is an extensive road network as the site is bounded by the Western Freeway to the south, Midland Highway to the east and is located in close proximity to Ballarat-Maryborough Road (Howe Street). Congestion levels are currently relatively high and the assessment of transport forecasts contained within the Ballarat VITM Report indicates that in 2041, the network experiences some levels of congestion along key routes providing access to the site during the AM peak period.

5.3.1.2 Public transport network and facilities

The public transport network and facilities are relatively poor given the proximity of Wendouree Station and Ballarat Station (2.5km and 4.8km respectively). Bus Route 3 operates along the Midland Highway and provides limited catchment that is localised to east of the site. Bus Route 17 operates immediately west of the site, though the catchment for these services only extends marginally into the site.

5.3.1.3 Walking and cycling networks

The Western Freeway presents a significant barrier for walking and on this basis, the majority of walking trips are expected to remain internal to the site. Generally the cycling catchment remains limited, however there is an existing cycle route with facilities along Gillies Street. Cycling has only limited viability for trips to the CBD with the remainder of trips expected to be internal to the site or to the immediately surrounding suburbs.

5.3.1.4 Accessibility to employment and services

Based on current planning, the site will have a high level of access to employment and retail services by private vehicle for the foreseeable future, however there will be limited access by public transport. There is an opportunity to provide additional transport choice and increased access to employment and retail services through the provision of additional public transport services and improvements to the bicycle network.

5.3.2 Western GIA

5.3.2.1 Existing and planned future road network

The site is bounded by Cuthberts Road to the north and Bells Road to the south whilst Glenelg Highway and Ballarat-Carngham Road bisect the site. The Western Link Road is planned to run through the site. Congestion levels are moderate and the assessment of transport forecasts contained within the Ballarat VITM Report indicates that in 2041, the network will experience some levels of congestion along key routes providing access to the site during the AM peak period. It is also likely that upgrades of Ballarat-Carngham Road and Cuthberts

Road would be required to connect the site with the network providing access to the Ballarat CBD.

5.3.2.2 Public transport network and facilities

The closest point of the site is located approximately 2.5km from Wendouree Station and approximately 4.8km from Ballarat Station. There are no bus routes that currently service the site.

5.3.2.3 Walking and cycling networks

The site is generally located at least 5.5km to 6km from the Ballarat CBD. Accordingly, the majority of walking trips and cycling trips are expected to remain either internal to the site or be limited to the immediate surrounding suburbs. There are no existing routes with dedicated cycling facilities that provide access to the site and with the inclusion of the planned cycling routes, the catchment still remains limited. There is an opportunity for the planned route along Greenhalghs Road (currently terminating at Wiltshire Lane) to be extended to the site to improve access to Ballarat CBD.

5.3.2.4 Accessibility to employment and services

Based on current planning, the site will have a high level of access to employment and retail services by private vehicle for the foreseeable future, however there is negligible access by public transport for the foreseeable future. The employment distribution forecasts outlined in the Ballarat VITM report suggest that more jobs will be located in the west of Ballarat in the future. On this basis there is an opportunity to provide increased public transport services to connect with these locations of employment. There is an opportunity to provide additional transport choice and increased access to employment and retail services through the provision of additional public transport services.

5.3.3 Eastern GIA

5.3.3.1 Existing and planned future road network

The site is bounded by the Western Freeway and Ballarat-Burrumbeet Road (Victoria Street) to the north and the key roads that bisect the site include Eureka Street and Warrenheip Road. A public acquisition overlay applies to the north-eastern section of the site and is understood to provide for a future upgrade of the Western Freeway in the vicinity of Brewery Tap Road. Congestion levels are relatively low and the assessment of transport forecasts contained within the Ballarat VITM Report indicates that in 2041, the network experiences some levels of congestion along key routes providing access to the site during the AM peak period. It is also worth noting that the existing rail corridor presents a barrier to providing access from the site to the external road network with the existing crossing points limited to Victoria Street and Warrenheip Road.

5.3.3.2 Public transport network and facilities

The closest point of the site is located approximately 7.0km from Wendouree Station and approximately 3.0km from Ballarat Station and the Melbourne to Ballarat rail line bisects the site. Bus Route 8 and 9 operate along Fussell Street and provides a catchment that is localised to east of the site. Bus Route 7 operates immediately west of the site, though catchment for these services does not extend into the site. There is an opportunity to extend the existing Bus Route 8 and 9 as well as reroute Bus Route to operate within the site. There is also an opportunity to plan for a new station to be provided within the site.

5.3.3.3 Walking and cycling networks

The site is generally located at least 2.5km from the Ballarat CBD. Accordingly, walking trips expected to remain either internal to the site or be limited to the immediate surrounding suburbs. The distance to the CBD is such that these trips are particularly conducive to cycling. However, the existing rail corridor limits permeability within the site and would create a barrier to walking and cycling. There are existing cycling routes along Victoria Street and Eureka Street and there are opportunities to extend the existing cycling routes to further within the site to maximise connectivity to the CBD and provide additional rail crossing treatments for pedestrian and cyclists to improve permeability within the site.

5.3.3.4 Accessibility to employment and services

Based on current planning, the site will have a high level of access to employment and retail services by private vehicle for the foreseeable future, however there is negligible access by public transport. The employment distribution forecasts outlined in the Ballarat VITM report suggest that more jobs will be located in the west of Ballarat in the future. The site will have good private vehicle access to these jobs due to the proximity and access to the Western Freeway which effectively provides a bypass of the Ballarat CBD. There is an opportunity to provide additional transport choice and increased access to employment and retail services through the provision of additional public transport services and improvements to the bicycle network.

5.4 Delivery and Implementation

It is noted that most authorities confirmed that growth in any of these areas has a relatively similar cost implication. Each GIA presents it's own challenges in regards to trunk infrastructure development however some do have operational complexities that may be the key differentiator.

5.4.1 Northern GIA

5.4.1.1 New trunk utility infrastructure

On account of the minimal existing trunk utility infrastructure within the GIA it is anticipated that significant new trunk mains will be required within the GIA to deliver all services to the area.

Stormwater

In the absence of formal stormwater drainage infrastructure, all stormwater within the GIA currently drains to Burrumbeet Creek. This, in conjunction with the fact that City of Ballarat and the Glenelg Hopkins Catchment Management Authority require stormwater flows to be maintained at pre-development levels for the peak flow rate in a 100 year ARI event, means that significant new stormwater detention infrastructure capable of detaining 55.6-86.8ML of stormwater will be required. It is expected that the addition of wetlands within each of the retained basins will ensure that Best Practice Environmental Guidelines Targets for Stormwater Treatment is also achieved.

Sewer

Despite the immediate proximity of the Ballarat North Water Reclamation Plant, the topography of the area indicates that a new pump station and a 1.3km (approximate) rising main, as well as a new 1km gravity main, will be required. Given the current capacity constraints of the Ballarat North WRP, upgrade works will be required to supply this area. Growth in the Northern GIA may drive the need for a new wastewater treatment facility.

Water

It is anticipated that connection will be made into the existing 450mm diameter DICL trunk main along the Western Highway, such that only 1km (approximate) of new trunk water mains will be required. Central Highlands Water have informally advised that the Northern Tanks Zone, where potable water is currently sourced, will have insufficient capacity for the peak flows, such that a new water storage tanks, pumps and supply zones will need to be constructed. Upstream upgrades will be necessary to supply this GIA and limit the impact on downstream areas. These upgrades will be constrained by the built up terrain that existing assets pass through.

Gas

Extensive gas infrastructure will be required to supply the Northern GIA and ensure adequate pressures are maintained across the network, this is primarily due to the areas distance from the City Gate.

Electricity

Upgrades to the existing 22kV feeders and construction of new 22kV feeders could be required to service this GIA. The additional supply demand presented by this growth could be provided by the proposed substation in Ballarat West.

Telecommunication

As the telecommunications services are provided as commercial enterprise it is anticipated that the development and expansion of the required network assets will occur in line with the development demands.

It is anticipated that by the time urbanisation of this region occurs NBN rollout will have been completed in the study area and that communication trunk infrastructure will be included within the construction of major road corridor and utility easements within the development.

5.4.1.2 New community infrastructure

The new community infrastructure required for the various scenarios for the Northern GIA has been identified in Table 24.

5.4.2 Western GIA

5.4.2.1 New trunk utility infrastructure

Given that there is no trunk utility infrastructure currently within the GIA it is anticipated that significant new trunk mains will be required within the GIA to deliver all services to the area. It is anticipated that the trunk mains proposed for the Ballarat West PSP area can be upsized prior to construction if necessary, to avoid the need to duplicate trunk mains for the development of the Western GIA.

Stormwater

In the absence of formal stormwater drainage infrastructure, all stormwater within the GIA currently drains to Winter Creek. This, in conjunction with the fact that City of Ballarat and the Catchment Management Authority require stormwater flows to be maintained at pre-development levels for the peak flow rate in a 100 year ARI event, means that significant new stormwater detention infrastructure capable of detaining 85–141ML of stormwater will be required. It is expected that the addition of wetlands within each of the retained basins will ensure that Best Practice Environmental Guidelines Targets for Stormwater Treatment is also achieved.

Sewer

The westward grading of the study area indicates that at least two pump stations and approximately 2.6km of new trunk rising mains will be required within the Western GIA. However, it is expected that connection will be made to the trunk infrastructure directly adjacent to the GIA. Given the current capacity constraints of the Ballarat South WwTP, upgrade works will be required to supply this area. Growth in the Northern GIA may drive the need for a new wastewater treatment facility.

Water

Insufficient capacity to convey peak flows means that upstream upgrades will be necessary to supply this GIA and limit the impact on downstream areas. These

upgrades will be constrained by the built up terrain that existing assets pass through.

Central Highlands Water have stated that it may be possible to upgrade and extend the network within the Ballarat West PSP area to supply the Western GIA. Infrastructure within and to the east of the Western GIA that may require upsizing include:

- The existing 225mm diameter main that runs along Ballarat-Carngham Road.
- The trunk mains from Ballarat-Carngham Road to the 675mm principal supply main at Victoria Park on Eyre Street. This includes the upgrade of approximately 12.5km of pipeline.
- The water main proposed along Greenhalghs Road as part of the Ballarat West PAP area development prior to its construction. This is approximately 2.4km.

Gas

Extensive gas infrastructure will be required to supply the Western GIA and ensure adequate pressures are maintained across the network, this is primarily due to the areas distance from the City Gate.

Electricity

Upgrades to the existing 22kV feeders and construction of new 22kV feeders could be required to service this GIA. The additional supply demand presented by this growth could be provided by the proposed substation in Ballarat West.

Telecommunication

As the telecommunications services are provided as commercial enterprise it is anticipated that the development and expansion of the required network assets will occur in line with the development demands. Communication trunk infrastructure will be included within the construction of major road corridor and utility easements within the development.

5.4.2.2 New community infrastructure

The new community infrastructure required for the various scenarios for the Western GIA has been identified in Table 24.

5.4.3 Eastern GIA

5.4.3.1 New trunk utility infrastructure

It is anticipated that new trunk utility infrastructure will be required to ensure delivery of each of the utility services.

Stormwater

City of Ballarat and the Corangamite Catchment Management Authority require stormwater flows to be maintained at pre-development levels for the peak flow

rate in a 100 year ARI flood event. To ensure that this is achieved, a number of new trunk pipes and retention basins capable of detaining 62-103ML of stormwater will be required. It is expected that the addition of wetlands within each of the retained basins will ensure that Best Practice Environmental Guidelines Targets for Stormwater Treatment is also achieved.

Sewer

It is anticipated that approximately 5.85km of new sewer gravity trunk mains will be required within the GIA and additional upgrades will be required to the downstream sewer network. Additional upgrades may involve the construction of a pump station that can store effluent and periodically pump it to the existing gravity network or an upgrade of the existing 7km gravity main to a pressurised main.
Given the current capacity constraints of the Ballarat South WwTP, upgrade works will be required to supply this area. Growth in the Eastern GIA may drive the need for a new wastewater treatment facility.

Water

Installation of new trunk mains, tanks and booster pumps will be required to service the Eastern GIA. This new network may need to create several pressure zones and multiple water supply zones causing various operational complexities.

Due to existing level of service issues in in nearby areas, small size of surrounding pipes and age of trunk infrastructure significant upgrades to nearby areas will be required. These upgrades could prove costly and complex due to existing mains passing through highly built up areas and Ballarat CBD.

Gas

The proximity of this GIA to the City Gate means that limited infrastructure is required to supply the area with Gas.

Electricity

Upgrades to the existing 22kV feeders and construction of new 22kV feeders could be required to service this GIA. The additional supply demand presented by this growth could be provided by the proposed substation in Ballarat West.

Telecommunication

As the telecommunications services are provided as commercial enterprise it is anticipated that the development and expansion of the required network assets will occur in line with the development demands. Communication trunk infrastructure will be included within the construction of major road corridor and utility easements within the development.

5.4.3.2 New community infrastructure

The new community infrastructure required for the various scenarios for the Eastern GIA has been identified in Table 40.

5.5 Financial and economic assessment

5.5.1 Northern GIA

5.5.1.1 Development infrastructure costs for trunk infrastructure

The trunk infrastructure costs for the various scenarios in the Northern GIA have been identified in Table 12.

5.5.1.2 Community infrastructure costs

The community infrastructure costs for the various scenarios in the Northern GIA have been identified in Table 13.

5.5.1.3 Developer costs for local infrastructure

The developer costs for local infrastructure for the various scenarios in the Northern GIA have been identified in Table 14 and Table 15.

5.5.2 Western GIA

5.5.2.1 Development infrastructure costs for trunk infrastructure

The trunk infrastructure costs for the various scenarios in the Western GIA have been identified in Table 25.

5.5.2.2 Community infrastructure costs

The community infrastructure costs for the various scenarios in the Western GIA have been identified in Table 26.

5.5.2.3 Developer costs for local infrastructure

The developer costs for local infrastructure for the various scenarios in the Western GIA have been identified in Table 27 and Table 28.

5.5.3 Eastern GIA

5.5.3.1 Development infrastructure costs for trunk infrastructure

The costs for trunk infrastructure for the various scenarios in the Eastern GIA have been identified in Table 41.

5.5.3.2 Community infrastructure costs

The community infrastructure costs for the various scenarios in the Eastern GIA have been identified in Table 42.

5.5.3.3 Developer costs for local infrastructure

The developer costs for local infrastructure for the various scenarios in the Eastern GIA have been identified in Table 43 and Table 44.

5.6 Preferred Option

Specifically the multi-criteria analysis has allowed for the scoring of each option based on the key attributes and the Western GIA achieved the highest overall rating, indicating that it has the most amenable existing conditions. Further it is worth noting that this GIA also has the largest site area of the three options.

The following key attributes and the scores illustrated in make the site more suitable than the Northern, North Western or Eastern GIAs:

- Relatively low number of planning overlays present on the site;
- Relatively low abundance of endangered EVCs on the site;
- Absence of historical mining activities;
- Relatively low cultural and heritage sensitivities;
- Ability to leverage trunk infrastructure from current growth front in west Ballarat.

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Appendix A

EPBC Act Reports

A1 Northern GIA

A2 Ballarat West Option GIA

A3 Eastern GIA

Appendix B

Preliminary Geotechnical Desk Study Assessment

B1 General Geotechnical Considerations

Arup have completed a preliminary desk study to advice on the geotechnical risks associated with the development of each of the GIA identified in this report. As part of this review, Arup has reviewed the geology and topography within each GIA and categorised the soils to provide advice on the potential for;

1. Reactive shrink swell soil conditions;
2. Inferred excavation conditions including encountering rock;
3. Potential for landslide instability; and
4. General development considerations

As the same geology may occur at multiple sites, to avoid repetition of the same considerations for each Option, a more detailed assessment of geotechnical considerations for each geology are presented in this Appendix. GIA specific geotechnical summaries are provided in each relevant section of the report, along with figures of the GIA's showing geology and geotechnical considerations.

Information sources used include Australian Standards, various geology maps and geology references.

It should be noted that the assessment is based on the inferred surface geology and soil properties from a desk based study only. No onsite inspections or testing have been completed. Different conditions may be encountered and areas may be overlain by fill from historic site usage. The soil profiles for each GIA should be checked by a site visit and necessary geotechnical investigations before detailed design proceeds.

Table 1 summarises the different geologies of material encountered along with their typical engineering considerations with respect to residential site development.

B1.1 Shrink Swell Potential

The shrink swell potential for each geology has been assessed in accordance with AS2870, Residential Slabs and footings, Table D1 to provide preliminary advice on potential geotechnical issues. AS2870 defines all three sites and falling within Climatic Zone 2.

The majority of the material encountered have a Moderate (M) to High (H1) reactivity for foundation design except for the Newer Volcanics basaltic clay which has High (H1) to Very High (H2). It should be noted that basaltic clay can often be classified as Extremely (E) reactive (Peck, Neilson, Olds, & Seddon, 1992).

B1.2 Land Stability

Land stability has been inferred based on general topographic contours, considering the typical slope angle. Geology has not specifically been considered, on the basis that even rock is likely to have a surface layer of residual clay which could be susceptible to landslide instability. No material geologies identified as having a particularly high risk of instability (eg Gellibrand Marl) were encountered in any of the GIA's.

The following generalised slope angles have been used to infer the potential for instability:

Slope Angle (V:H)	Land Instability potential	Development Considerations
< 11° (1:5)	Very low	Land stability is not considered to be an issue for site development
11° – 18° (1:5 – 1:3)	Low	Land stability is unlikely to be an issue for land development providing good practice for developments on sloping sites is consider, but should be considered in further stages.
> 18° (1:3)	Moderate to High	Land stability could influence the feasibility of site development and should be investigated further.

The following should be noted:

- Even for Very Low or Low potential sites, areas of locally steeper, weaker or saturated ground may be encountered and may result in instability; and
- In all cases, the potential for land instability should be assessed in future design stages in accordance with the AGS Landslide Risk Management Guidelines (AGS, 2007).

Appendix C

Infrastructure Demand and Costs

C1 Demand

C1.1 Development Scenarios

In order to gain a greater understanding of the impact of various levels of land development, Arup have investigated four density profiles and applied these to each GIA. The degree of residential land development within the GIAs was determined to be 75% for each of the scenarios. This figure and the scenario densities were advised by Hansen and is based on their industry experience in land development. Arup was asked to investigate the following density scenarios:

- Scenario 1: 8 lots/ha
- Scenario 2: 12 lots/ha
- Scenario 3: 15 lots/ha
- Scenario 4: 20 lots/ha

Please note, the densities cited were to be achieved for the residential land development only and were not to be taken as the overall density across the GIA. The proposed allotment composition and overall number of allotments for each of the four scenarios for the GIAs are stated in Tables 1 to 12 below.

C1.2 Drainage demand

Analysis has been conducted for each development scenario. In the absence of detailed information regarding the proposed locations of the residential precincts within the GIA for each scenario, the assumptions listed below have been asserted and implemented to the drainage design.

- The breakdown of allotment type within the residential developments areas has been sourced from the breakdown listed for each scenario.
- The proportion of residential development and the type of allotments will be evenly distributed across the site, such that each catchment will encompass 75% residential development regardless of its size and suitability for residential land development.
- The proportion of land that is not going to be developed for residential purposes is 25% for all scenarios. It is assumed that of this, 50% will be utilised for commercial purposes and 50% will be green spaces. Whether these land uses are existing and will be maintained or if they are to be new as part of the overall development will not affect the overall drainage requirements.
- The drainage flow direction and catchment areas following development will match the existing conditions.

The design risks associated with methodology implemented include:

- The drainage runoff anticipated for each development scenario has been calculated on the assumption that residential development will be evenly distributed across the GIA. However, the location of residential development will be determined based on a number of factors including the area's geology, major transport routes, utility services and environmental protection. Hence, residential land development will be greater than 75% is areas deemed suitable for development and less in areas deemed unsuitable. Consequently, there is a risk that should residential development be significantly higher than 75% within a catchment area, the detention basin volume calculated will be undersized.

C1.3 Sewer demand

Central Highlands Water was contacted as part of the analysis to confirm specific design parameters. Where specific values could not be defined by Central Highlands Water without conducting further analysis of the site, industry default values were assumed. The following assumptions were applied to the sewer demand calculations based on the information that was obtained:

- The average number of people per household will be 2.4. This value is applied to all density scenarios and is independent of the portion of dwellings types. This figure is in accordance with the average number of people per household in Ballarat, as per the 2011 Census.
- The portion of the sewer system that is below the groundwater table is 1. A conservative approach was assumed given the absence of geotechnical information and the presence of extensive waterways within each of the GIAs.

- The Leakage Severity Coefficient was nominated as 0.9 for all GIAs. This value can vary between 0.4 and 1.6, and is defined by the impact of soil movement and effectiveness of Central Highlands Water's long-term strategy for maintenance and managing the impact of sanitary sewers. Advice on these factors was not provided by Central Highlands and as such a default value was assumed.
- The ARI of sewerage outflows will be 5 years for all GIAs, as specified by Central Highlands Water.

C1.4 Water Demand

The water demand has been determined for the residential properties only, and does not consider the water required for the function of the commercial or landscaped precincts. This decision was made on account of the absence of information regarding the type of commercial and landscape areas proposed for each scenario and their demand requirements.

In accordance with the MRWA WSAA Water Code, the peak daily and hourly demands have been determined.

The peak hourly flow rates for residential density types (high, medium, low) have been provided by Central Highlands Water and are in accordance with those stated by MRWA (MRAW, 2011). Arup has extrapolated these values to ascertain values for the allotment types used in the scenarios.

The peak daily demand has been determined on the assumption that potable water demand reduction measures will not be implemented in the development areas. This approach was applied to ensure that water demand requirements can be achieved when the residential water systems are unable to function as designed, such as during drought and when the residential systems are not maintained. This design measure was proposed and supported verbally by Central Highlands Water.

C1.5 Gas Demand

The gas demand for each of the development scenarios has been determined based on the current gas usage per person in Ballarat (1.28 GJ/pp/year). In the absence of information pertaining the proposed industrial and commercial development for each scenario, the gas demand calculated consider only the residential demand.

C2 Trunk infrastructure costs

C2.1 Drainage

The following assumptions are based on engineering industry experience and have been used to determine the cost associated with the trunk infrastructure required:

- The depth to the spillway of all retention basins will be 1.5m;
- The wetlands will have approximately 15% of the volume of the retention basins;
- The wetlands will have a permanent detention of 0.5m;
- The cost of the combined wetland and retention basin, including the cost associated with the civil works, materials and construction is $145 per m^3 of basin;
- The pipework required contributes 30% towards the overall cost of the drainage infrastructure;
- The City of Ballarat drainage fee associated with new development is 3.5% of the overall infrastructure cost;
- The designated green areas and grass swales, which contribute towards achieving WSUD requirements, are not to be priced as part of the drainage infrastructure required; and
- The cost derived for the stormwater trunk infrastructure does not include the land acquisition cost required for each retention basin.

C3 Local infrastructure costs

The developer costs associated with the construction of local infrastructure have been determined following consideration of the following:

- The standard industry rates for construction in Melbourne (Rawlinsons, 2015); and
- The fees and charges stipulated by Central Highlands Water for land development (Central Highlands Water, 2014).

Cost estimates have been determined based on 2015 prices and the construction prices anticipated for 2040. The anticipated 2040 costs have been determined based on the assumption that the inflation rate for construction from 2015 to 2040 will be equal to that experienced between 2004 and 2014. This rate is 4.4% per year.

The design and costing assumptions for each item are stated next to that item in the tables in the sections below.

C3.1 Roads

C3.2 Sewer

C3.3 Water

City of Ballarat

Ballarat Greenfields Investigation Areas Review – North Western Update

Part A - Analysis Report

Final | 18 June 2018

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Arup
Arup Pty Ltd ABN 18 000 966 165

Arup
Level 17
1 Nicholson Street
Melbourne VIC 3000
Australia
www.arup.com

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			Prepared by	Checked by	Approved by
		Name			
		Signature			
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1 Introduction

1.1 Purpose

The purpose of this *Ballarat Greenfields Investigations Areas Review Update – Part A – Analysis Report* (the Report) is to document a desktop assessment of land constraints and opportunities for a greenfield investigation area (GIA) known as the North Western. The outcomes of this report will inform consideration of locations for future residential development for Ballarat beyond 2040.

This assessment has been prepared by Arup Pty Ltd (Arup) to inform the overarching assessment report prepared by Hansen Partnership Pty Ltd for the City of Ballarat (CoB). This report assesses a fourth GIA, building upon the *Ballarat Long Term Growth Option Investigation* report, published in 2016, which considered three other GIAs.

The Report, consistent with previous GIA investigations, considers the following aspects of the North Western GIA:

- Land capability, encompassing:
  - Natural disaster risk
  - Protected flora and fauna
  - Buffers from sites that require separation from sensitive uses
  - Noise impacts
  - Contaminated sites
  - Sites with past mining activities
  - Topography
  - Access to existing utility infrastructure
  - Geotechnical conditions
- Heritage assessment, encompassing:
  - Cultural heritage
- Accessibility assessment, encompassing:
  - Existing and planned future road network
  - Public transport network and facilities
  - Walking and cycling networks
  - Accessibility to employment and services
- Deliverability, encompassing:
  - New trunk utility infrastructure
  - New community infrastructure
- Financial and economic assessment, encompassing:
  - Development infrastructure costs for trunk infrastructure

- Community infrastructure costs
- Developer costs for local infrastructure

1.2 Background

Initially the CoB identified three GIAs to be considered for potential future development:

- Northern GIA
- Western GIA
- Eastern GIA.

Following the recommendations of an independent Planning Panel, the CoB resolved to consider another potential parcel of land as part of their future growth areas investigations, known as the North Western GIA. The North Western GIA has been assessed for the same characteristics as the three previously considered GIAs, and this assessment is provided in the remainder of the Report.

1.3 Development Scenarios

The assessment has been based on four development scenarios, with each assuming 75% of the land area within the site is developable. Table 1 shows the estimated number of lots capable of being developed under each density scenario.

Table 1 North Western GIA - Development scenarios

Scenario (Lots/ha)	North Western GIA (Lots)
Site Area (ha)	668
Scenario 1 **8 Lots/ha**	4,008
Scenario 2 (Lots) **12 Lots/ha**	6,012
Scenario 3 (Lots) **15 Lots/ha**	7,515
Scenario 4 (Lots) **20 Lots/ha**	10,020

These scenarios only consider the gross land area and not other constraints that may limit development capacity. When factoring in these constraints, the number of lots per hectare may be reduced. Therefore these scenarios represent the highest potential development capacity.

1.4 Limitations and assumptions

This assessment is based on a desktop review of relevant publically available databases, as well as technical reports provided by Hansen Partnership Pty Ltd. Relevant references have been provided throughout the report.

2 Land Capability Assessment

2.1 Natural disaster risk

The natural disaster risk for the North Western site has been determined based on a review of flood and bush fire data, as well as the Ballarat Planning Scheme Bushfire and Erosion Management Overlays. This information is shown on Figure 1 and is summarised below.

Bushfire

The Bushfire Management Overlay does not apply to any land within the North Western GIA. The nearest land affected by the Bushfire Management Overlay is located approximately two kilometres south of the North Western site, south of Ballarat-Carngham Road and five kilometres to the east, abutting the Western Freeway.

The Bushfire Prone Area applies to the whole site. Historically, there have been no recorded fires on the site since 1900. This data was sourced through the Visualising Ballarat mapping tool[1].

Flooding

The Floodway Overlay does not affect any land within the North Western site, nor does it affect any land within 500 metres of the North Western area boundary. The nearest land affected by the Floodway Overlay is located in excess of five kilometres to the east. Figure 1 shows the absence of the floodway overlay across the North Western site. It does however denote where flood studies have been conducted in the past. This flood study area aligns with a remnant creek which has been significantly degraded due to rural activity in the area.

The Land Subject to Inundation Overlay does not affect any land within or surrounding the North Western site, with the nearest land affected by the Land Subject to Inundation Overlay approximately three kilometres to the south-west.

The Erosion Management Overlay affects a portion of land within the North Western site in the vicinity of a remnant creek, north of Smart Hill Road between Whites and Finches Road. The purpose of this overlay is to protect areas prone to erosion by minimising land disturbance. A permit is required to construct a building, carry out works, remove vegetation or subdivide land in areas affected by the Erosion Management Overlay.

[1] www.visualisingballarat.org.au

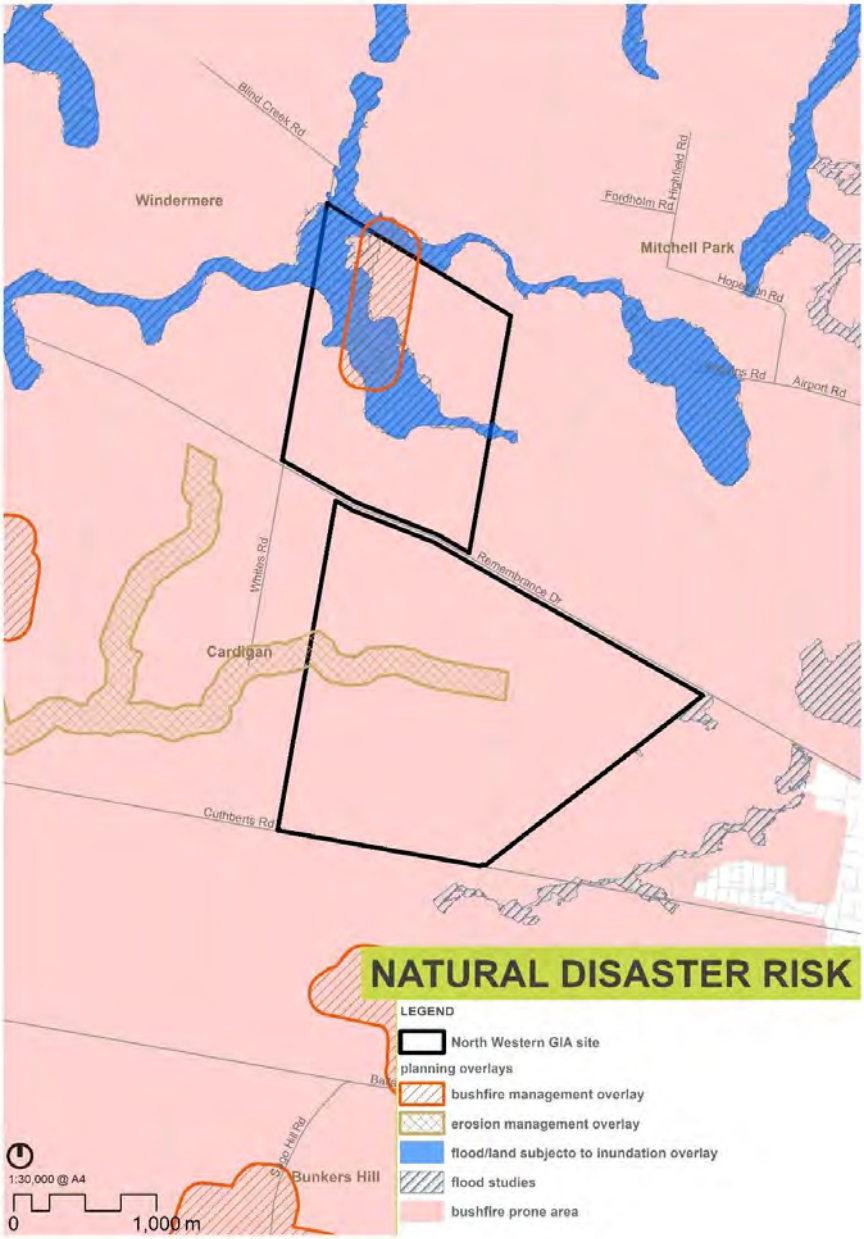

Figure 1 Natural disaster risk

2.2 Protected flora and fauna

The potential for protected flora and fauna to be found within the North Western site has been assessed by a review of the Environmental Significance, Salinity, Significant Landscape and Vegetation Protection Overlays of the Ballarat Planning Scheme. Tree and Koala habitat data as provided by Council and

included in the Planning Scheme as Clause 22.04 (Koala and Koala Habitat Protection) respectively, have also been reviewed. These findings are shown in Figure 2.

Environmental Significance Overlay

The Environmental Significance Overlay affects a strip of land in the eastern corner, between Old Western Highway and the Skipton-Ballarat Trail. This area is subject to Schedule 5 of the overlay (Koala and Koala Habitat Protection), which is intended to prevent development within proximity of koala populations. The Environmental Significance Overlay Schedule 5 and Koala Habitat Protection areas geographically overlap on the North Western site in the eastern corner (south of Remembrance Drive). This is shown on Figure 2. Figure 2 also shows the Environmental Significance Overlay (Schedule 4: Wastewater Treatment Plant Buffer Area) associated with the Cardigan Waste Water Treatment Plant west of the North Western site.

Under the Environmental Significance Overlay a permit is required to construct a building or carry out works where native trees are to be removed, construct a fence, remove native trees or subdivide land.

If a permit is required then the applicant must provide

- An assessment of koala habitat, by a suitably qualified person, in accordance with the City of Ballarat's Guidelines for Koala Habitat Assessment.
- Clear and precise details concerning which vegetation is to be cleared or disturbed and that which is to be retained.
- Details of any proposed building envelopes and the means by which they are to be enforced.
- Proposed measures to restore koala habitat, facilitate the safe movement of koalas across the site, measures to mitigate the impacts on koalas by dogs and programs to monitor koalas and koala habitat, during and following development activity on the site

Salinity Management Overlay

The Salinity Management Overlay does not affect land within the North Western GIA site area or any land within a five kilometre radius.

Significant Landscape Overlay

The Significant Landscape Overlay affects land north of Smart Hill Road between Whites and Finchs Road and aligns with the Erosion Management Overlay. The purpose of this overlay is to conserve and enhance the character of significant landscapes, in this scenario a remnant creek. The Significant Landscape Overlay covers an area of approximately 31 hectares in the centre of the North Western GIA.

A permit is required under the Significant Landscape Overlay to construct a building or construct or carry out works and to remove, destroy or lop any

vegetation. However, under Schedule 1 to the Significant Landscape Overlay, a permit is not required to construct a building or to construct or carry out works shown on the *Lake Federation Resort Detailed Development Plan*, approved under Schedule 1 to the Comprehensive Development Zone (which the North Western site is zoned). Further, a permit is not required to remove, destroy or lop vegetation that is nominated to be removed on the Landscape Plan approved under Schedule 1 to the Comprehensive Development Zone.

Vegetation Protection Overlay

The Vegetation Protection Overlay does not affect any land within the North Western site. The nearest Vegetation Protection Overlay is approximately two and a half kilometres east of the North Western site.

Koala Habitat

The Koala Overlay is based on the recommendations contained in a study titled Ballarat Comprehensive Koala Plan of Management, Parts 1 and 2 (Schlagloth & Thomson, 2006). The study was prepared by Council and the Australian Koala Foundation and it aims at providing for the long term survival of Ballarat's koala population. The Koala Overlay was adopted into Ballarat Planning Scheme through the Environmental Significance Overlay – Schedule 5, therefore there will be some geographic overlap between the two overlays.

There are several small areas of land in the North Western site identified by the Koala Overlay. These areas contain significant koala habitat, in particular an area adjacent to Remembrance Drive, in the eastern corner of the North Western site, has been identified as preferred koala vegetation. Building and works within the area of Preferred Koala Habitat (ie. overlay) will trigger the need for a planning permit under the Ballarat Planning Scheme Clause 22.04 (Koala and Koala Habitat Protection).

A permit exemption may be granted if the development demonstrates the works cannot be located elsewhere on site, that subdivision is designed to retain and enhance kola habitats and/or a kola survey is used to determine the most appropriate location for development. The Koala Habitat area in the sites north east is shown on Figure 2 and aligns with the Environmental Significance Overlay (Schedule 5: Koala and Koala Habitat Protection).

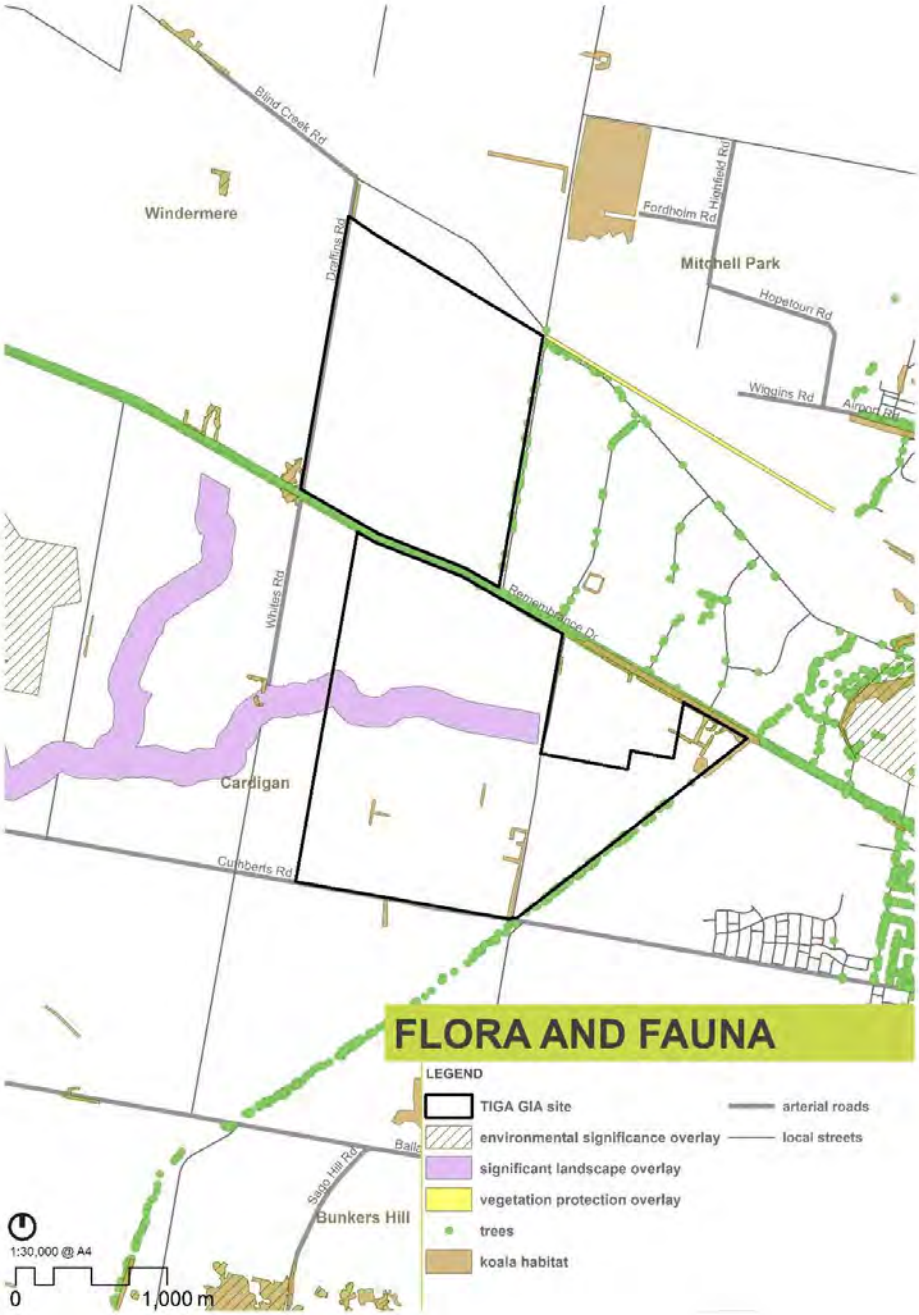

Figure 2 Flora and fauna

Ecological Vegetation Classes

Practical Ecology Pty Ltd (Practical Ecology) have completed a Flora and Fauna Assessment and Net Gains Analysis (ecology report) of this site. This report was completed in 2009, so there is potential for ecological values to have changed since the surveys were completed.

The analysis found a mosaic of Plains Grassy Woodland, Plains Grassland, Plains Grassy Wetlands and Aquatic Herbland Ecological Vegetation Classes (EVCs), concentrated mainly in the south eastern part of the site, between Finch's Road and the Ballarat-Skipton Rail Trail (Practical Ecology, 2009). According to the ecology report, these vegetation types found in the Victorian Volcanic Plain Bioregion are endangered and have a threatened species rating of high or very high. Removal of this vegetation is likely to trigger the need for a planning permit and potentially offsets.

The location of these EVC's is shown on Figure 3.

Environment Protection and Biodiversity Conservation (EPBC) Act Register

According to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) the ecology report, the critically endangered ecological community Natural Temperate Grassland of the Victorian Volcanic Plain is known to be found within the North Western site (Practical Ecology, 2009). The ecology report also identified the potential for other EPBC Act listed threatened species to occur on the site, as provided in Table 2 with the report also provided in Appendix A.

An updated ecological report should be prepared for the site as there is potential for significant environmental change since 2009.

Table 2 Potential EBPC Act matters within North Western site

Type	Name	EPBC Status	Presence within North Western site
Listed Threatened Ecological Communities	Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area
Listed Threatened Species	Wetland Blown-grass	Threatened	Species known to occur in the area
	Spiny Rice-flower	Critically Endangered	Potentially occur in the study area
	Golden Sun Moth	Critically Endangered	Further survey required to determine presence
	Adamson's Blown-grass	Endangered	
	Maroon Leek-orchid	Endangered	
	Matted Flax-lily	Endangered	
	Striped Legless Lizard	Vulnerable	
	Growling Grass Frog	Vulnerable	
	Clover Glycine	Vulnerable	
	Swamp Everlasting	Vulnerable	
	Curly Sedge	Vulnerable	

Development of the site has the potential to result in significant impacts on EPBC Act protected matters, including a critically endangered ecological community and several threatened species. Further surveys are recommended to confirm the presence of these species and the potential impact of development. If a significant impact is likely on a matter of national environmental significance (MNES), then a referral to the Department for the Environment and Energy would be required in accordance with the EPBC Act.

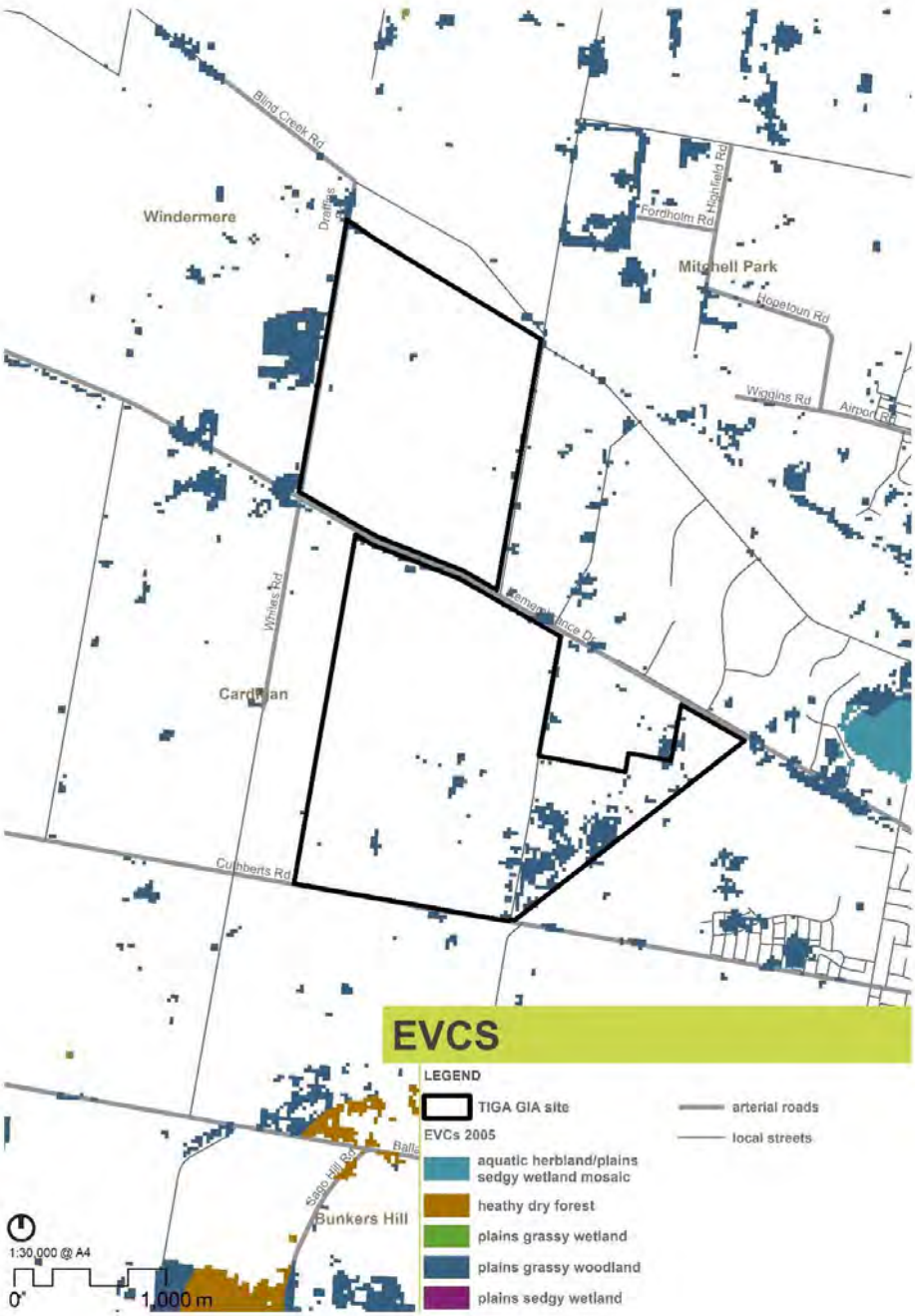

Figure 3 Ecological Vegetation Classes

Strategic Biodiversity Score

The Strategic Biodiversity Score measures the importance of native vegetation for Victoria's biodiversity at a landscape scale, relative to other locations across the state. It is measured on a linear scale between 0 and 100, with 100 indicating the most important areas of habitat. The Strategic Biodiversity Score is used to assess and minimise the impact of vegetation removal and determine offset requirements for the removal of native vegetation.

The majority of the site has a relatively low value, below 20. The northern, eastern and western boundaries as well as parts of Remembrance Drive have moderate Strategic Biodiversity Score, with values between 20 and 45. Portions of the centre have a score of 0.

Ballarat Urban Forest Strategy and Living Corridors

Outlined in the Draft *Ballarat Strategy*, the Urban Forest Strategy highlights the importance of canopy cover within Ballarat. GIS mapping of trees and the urban forest map in the Ballarat Strategy indicate that there is an assemblage of trees running parallel to Remembrance Drive and the Ballarat – Skipton Rail Trail.

The *Our Living City Discussion Paper* (2017) also identifies the 'Living Corridors' concept for Ballarat, a network to provide recreational and biological connection of natural areas. The Ballarat – Skipton Rail Trail has been identified as a living corridors

Waterways

There are no significant waterways in the North Western site, however there are small water bodies scattered across the whole site and a small creek in the north eastern region.

2.3 Buffers from sites that require separation from sensitive uses

Ballarat Airport

The City of Ballarat have prepared a revised 20 year Master Plan for the airport. Ballarat Airport Master Plan 2013-2033, which was prepared by Kneebush Planning Pty Ltd and Airports Plus Pty Ltd found the use of the airport had increased over the past 2-3 years largely due to the commencement of a major commercial pilot training school, but also due to the organic growth of other activities. The report also found the airport had the potential to continue to generate direct income for the local economy, produce direct and indirect employment opportunities for the region and become an emergency services hub for regional Victoria. In light of this, the report recommended that

- both taxiways be widened by 93m
- one taxiway extended 555m to the south
- an emergency services hub be developed
- helicopter parking area be developed

- new hangars be constructed
- a new access road and entry into airport be constructed

(Kneebush Planning Pty Ltd & Airports Plus Pty, 2013)

Despite the Ballarat airport proximity, the Airport Environs Overlay does not apply to any land within the North Western GIA. The Ballarat Airport is located to the north east of the TGIA, with the closest runway over one kilometre from the GIA boundary. This airport does not carry commercial airplane traffic and is not expected to cause any significant constraint to development. This overlay and the North Western site is shown in Figure 4.

Ballarat Aerodrome Obstacle Limitation Surfaces (OLS) applies to the land within the North Western GIA. This surface defines the highest Australian Height Datum (AHD) levels to which obstacles may project into the airport airspace. The majority of the site is located within the Horizontal Surface RL 480.5 metre contour, with the RL 540 metre contour extending into the south west of the site. These contours are based on the AHD, and are equivalent to a building height of approximately 50 metres (Kneebush Planning Pty Ltd and Airports Plus Pty Ltd, 2013).

Noise impacts from the airport are discussed further in Section 2.4.

Industrial zoned land

There is no industrial zoned land within the North Western GIA nor immediately adjacent to the boundary. The closest industrial zoned land is over two kilometres from the eastern boundary of the GIA. This is shown in Figure 4.

Former landfill

The nearest landfill site at Sago Hill, near the intersection of Sago Hill and Kopkes Roads is located approximately three kilometres south of the North Western site. This site is no longer active. The nearest active landfill site is located in Smythesdale at 1380 Glenelg Highway. This site is located in excess of five kilometres from the North Western site.

The Cardigan Village Wastewater Treatment Plants

The Cardigan Village Wastewater Treatment Plant is located near the intersection of Haddon/Windermere Road and Smarts Hill Road two kilometres to the west of the North Western site. It covers 29.05 hectares and comprises four treatment ponds. The four treatment ponds are comprised of two facultative ponds, an aerobic pond and maturation pond. There is an Environmental Significance Overlay surrounding the plant.

Based on current guidelines by the EPA and the *Odour Buffer Distances for Ballarat North, Ballarat South and Cardigan Village WWTPs Report* (Beca Pty Ltd., 2007), a 700 metre buffer is required for facultative ponds, 350 metre buffer for aerobic pond systems (being the aerobic pond, maturation pond, and winter storage pond) and a 200 metre buffer for effluent application to land by spraying serving an estimated population of 4000.

As the Cardigan Village Wastewater Treatment Plant is located two kilometres from the western boundary of the North Western site and therefore satisfies the EPA's criteria.

2.4 Noise impacts

Aircraft Noise

The North Western GIA is located under the Ballarat Aerodrome secondary runway 15/23 flight tracks and will be impacted by aircraft noise.

The Airports Envions Overlay and the (unendorsed) Ballarat Aerodrome 20 ANEF contour for year 2030 is over 1km from the from the eastern extents of the GIA and does not apply any restrictions.

AS2021 recommends that sites near the 20 ANEF contour are assessed for 'conditional acceptability' and building treatment is to be provided where required to meet internal noise levels. The maximum event noise levels due to aircraft flyover are predicted to be up to 85dB(A) at locations within the GIA. While this noise level is based on year 2030 operation, it is representative of expected existing noise levels.

On this basis, the acoustic performance of the building construction in the GIA must be considered to meet the AS2021 requirements.

The proposed airport upgrade including extended and widened runway are not expected to directly impact on the noise levels used for the assessment above, however, combined with potential upgrade of airspace control, it is likely that the capacity of the aerodrome will increase and therefore the number of 'noise events' will increase. Available data is not sufficient to include number of events in the MCA.

Road traffic noise

The North Western site is affected by road traffic noise from Remembrance Drive (arterial road) and Cuberts Road (sub-arterial). Based on year 2031 traffic estimates and VicRoads requirements, there is no specific requirement for noise mitigation. Boundary fencing and building layout should consider road traffic noise to minimise impact.

Industrial noise

As discussed in Section 2.3, there are no industrial zones or industrial operations adjacent to the North Western site. The site is not considered to be affected by industrial noise. Industrial noise affecting the North Western site would be assessed under the EPA Noise from Industry in Regional Victoria (NIRV) policy.

Railway noise

Noise from the Serviceton railway line is expected to exceed the Investigation Threshold provided in the Passenger Rail Noise Policy. On this basis, residential dwellings adjacent to the railway line may require noise mitigation such as:

- Buffer zones or landscaping;

- Building treatment to meet internal noise levels; and
- Noise barriers

The noise mitigation is not required to meet any specific noise criteria.

Noise emissions is relatively high for the North Western site in comparison to the previously assessed GIAs as the land is impacted by rail, road and aircraft noise.

2.5 Contaminated sites

Environmental Audit Overlay

The Environmental Audit Overlay does not affect land within the TGIA site. The nearest Environmental Audit Overlay is approximately two and a half kilometres to the east. This is shown on Figure 4.

2.6 Sites with past mining activities

Historical mining activity

There are no recorded historical mining activities within the North Western GIA. There is one site located very close to the boundary, near the corner of Dowling Road and Blind Creek Road, just north of the railway line. Given the intrusive nature of historical mining activities, they could potentially give rise to issues with the geology. The geotechnical conditions are further discussed in Section 2.9. Known sites of historical mining activity are shown on Figure 4.

Expired mining licenses and leases

According to the Visualising Ballarat Tool, there is a mineshaft located at the north east corner of the site. It is unknown if this site is operational. The site ID is 377047 and is shown in the north east corner of the site in Figure 4.

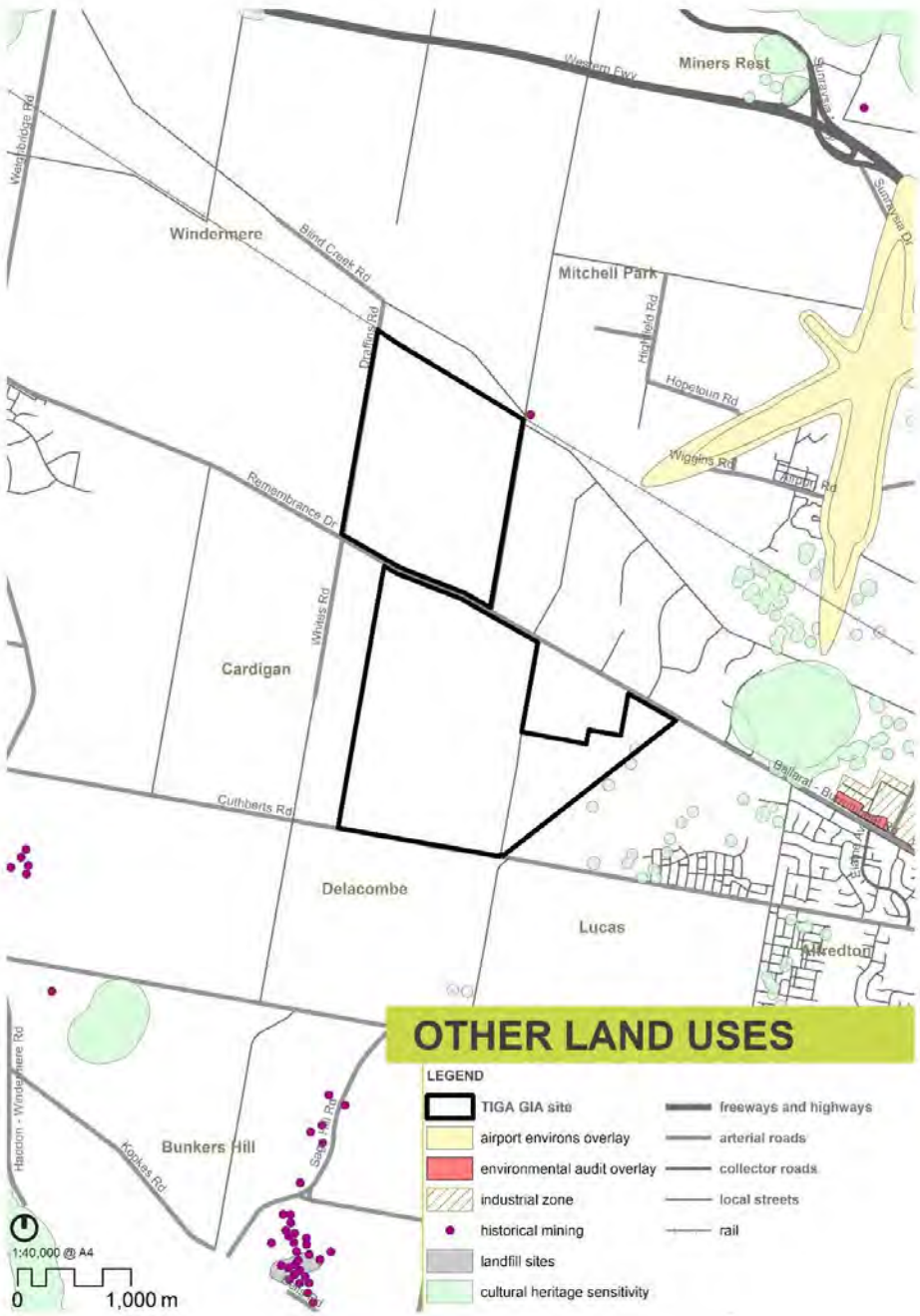

Figure 4 North Western GIA – Other land uses and cultural heritage

2.7 Topography

The North Western site elevation is generally 410 – 430 metres, rising to the east towards Ballarat. The relative flat nature of the site is partially broken by the remnant creek north of Smart Hill Road between Whites and Finchs Road.

2.8 Access to existing utility infrastructure

The North Western site is predominantly comprised of undeveloped farming and grazing land. Information regarding the existence of major utility services has been ascertained by conducting a 'Dial Before You Dig' enquiry and contacting the asset owners directly. The major utility services present in some capacity in the study area include:

- Water Supply;
- Electricity (Distribution); and
- Telecommunications.

Drainage

Land use planning and drainage management for the North Western site are the responsibilities of the City of Ballarat. At present, this authority has no drainage assets with the North Western area.

The northern part of the North Western GIA is located within the Burrumbeet Creek Catchment which drains to Lake Burumbeet via a number of small creeks. This area is managed by the Glenelg-Hopkins Catchment Management Authority.

Coorangamite Catchment Management Authority is responsible for the southern part of the North Western site which lies within the Woady Yallock River catchment. This catchment area drains via a number of small creeks to Lake Coorangamite.

Outside of these natural overland flow paths, formal stormwater infrastructure does not currently exist within the North Western GIA.

Sewer

There is currently no existing sewer infrastructure within the North Western site. In the event that this study area is developed, future infrastructure will be provided and managed by Central Highlands Water.

A gravity sewer network has been established to south east of the North Western site to service the Ballarat West PSP growth area. This network currently terminates approximately 850 metres from the North Western site boundary.

Effluent within the surrounding areas is transferred to the Ballarat South Wastewater Treatment Plant (WwTP). The Ballarat South WwTP is licensed for an Average Daily Flow of 35 ML/day (SMEC, 2014). Central Highlands Water have stated that this plant currently had limited spare capacity.

Existing sewer assets near the North Western site are shown on Figure 5.

Water

Central Highlands Water provides and manages the existing water supply infrastructure within Ballarat and the outlying areas. The Ballarat water supply is primarily comprised of two headwork systems: the Ballarat System and the Lal Lal System. Potable water to the North Western site and the surrounding areas is derived from the Ballarat System and delivered via the Ballarat Central Zone network. All mains supplying water within this zone originate from the White Swan clear water storage facility and the 9ML Wilson Street tank (Central Highlands Water, 2014).

A 200 mm dia. trunk main splits the North Western site along Remembrance Drive. This main extends west beyond the site towards Cardigan Village. A 75 mm dia. pipe also runs from this trunk main part way along Dowling Road to the north.

Existing water assets are shown on Figure 5.

Gas

APA Group Transmission is responsible for the high gas pressure transmission assets and AusNet Services is responsible for the distribution supply assets.

AusNet Services has not provided asset information for this size area but have advised that there is approximately 20% additional capacity to service the existing network but cannot confirm that the current network will be able to service the projected population of Ballarat in 2040 (SMEC, 2014).

Electricity

AusNet Services operates and maintains the Ballarat Terminal Station (BATS) and the electrical transmission lines that feed into the zone substations. The BATS is located in Warrenheip, in the east of Ballarat. Powercor is the electrical network distributor for the western Ballarat and power is supplied from the Ballarat South (BAS) zone substation. BATS-BAS sub-transmission loop supplies the BAS zone substation fed at 66kV and the total combined capacity of the lines is this loop is 147.5 MVA (Powercor Australia, 2014).

The electrical network within the North Western site is currently largely underdeveloped. The existing high voltage distribution network in the study areas consists of 22kV overhead power lines that are predominantly located within the road reserves of Cardigan School Road, Dowling Road, Remembrance Drive, Draffins Road and Cuthberts Road. High voltage underground cabling does not exist within the site.

Telecommunications

Optus and Telstra are the main distributors of communication services to residential and commercial customers within the North Western site.

Telstra assets currently exist along Cuthberts Road, Finchs Road, Old Western Highway, Dowling Road and Draffins Road.

Optus has a major optic fibre asset that runs through the southern section of the North Western site. This asset enters the site along Cuthberts Road before running north along Finchs Road and west along Smarts Hill Road.

The National Broadband Network (NBN) has been rolled out in most of the North Western GIA. Limited information has been provided with regard to the existing network capacity however it is anticipated that communications providers will upgrade and expand networks in line with regional growth profiles pending developer applications.

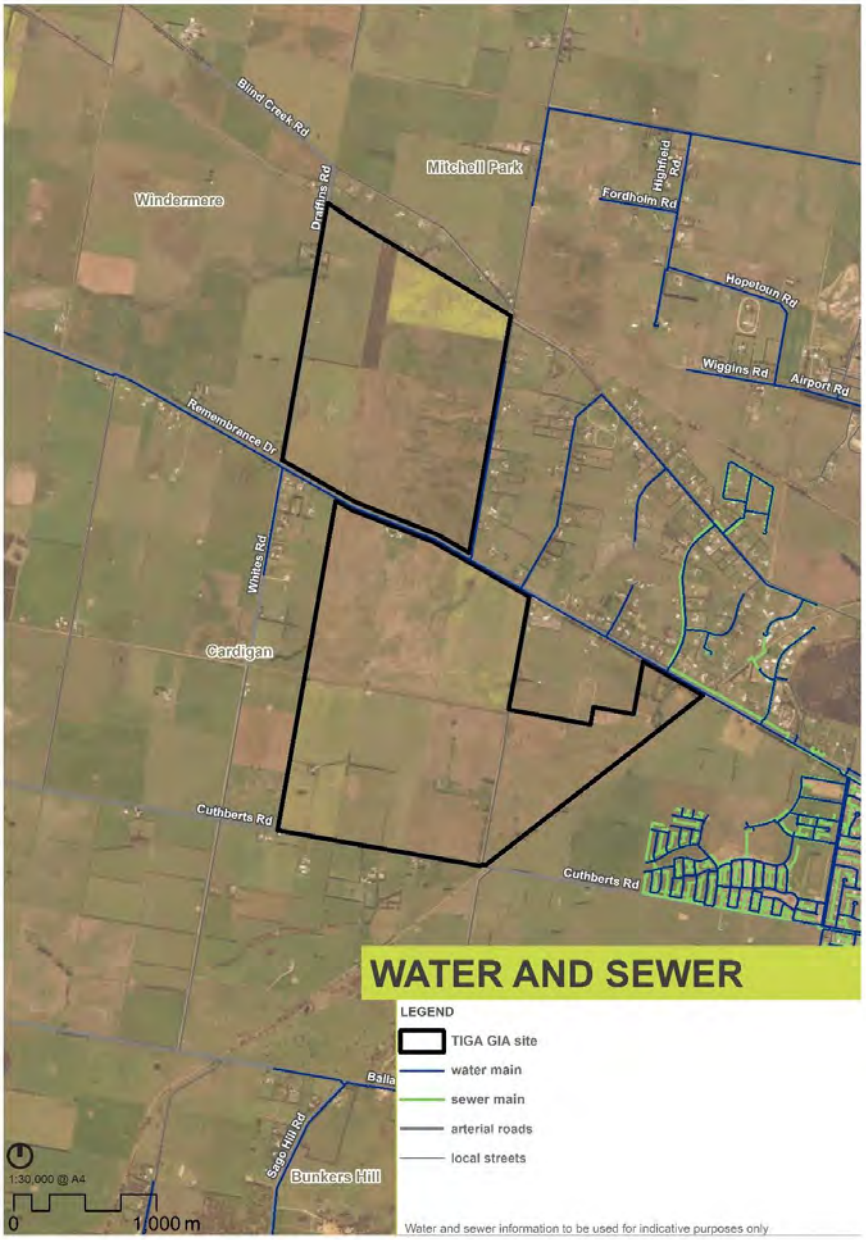

Figure 5 Water and sewer trunk infrastructure

2.9 Geotechnical conditions

Soil Shrink Swell Potential for Residential Development (AS 2870, 2011)

A desktop assessment of soil shrink well potential has found:

- Alluvial/colluvial areas and the underling bedrock will have a Moderate (M) to High (H1) soil reactivity
- The basaltic clay has a High (H1) to Very High (H2) shrink swell soil reactivity, or in some cases extreme (E) (Peck, Neilson, Olds, & Seddon, 1992)

In recent history (The Age, 2014), large areas of residential development around the north west of Melbourne have had significant issues with building damage and cracking on basaltic clays as a result of inadequate site classification and foundation construction.

For development on the basaltic clay, it is recommended a strong regime of requirements for geotechnical investigation, site classification and foundation design in accordance with AS 2870 Residential Slabs and Footings is undertaken.

Excavation and potential to encounter rock

A desktop assessment of excavation and potential to encounter rock identified:

- Shallow excavation for residential developments should be able to be completed with light earthmoving plant in the basaltic clay and alluvial/colluvial deposits
- Deeper excavations/trenches in the basaltic clay may encounter boulders requiring localised removal, or basalt rock which may require heavy earthmoving equipment and ripping
- Deeper excavation in the alluvial/colluvial deposits may be unstable and/or require dewatering.

Land Instability Potential

Based on topographical contours and geology, the potential for land instability over the North Western GIA is generally considered to be very low. Areas of localised instability may occur, particularly adjacent to the colluvial deposits in existing creeks and waterways. Land instability risk should be able to be managed through good practice for development on sloping sites.

General considerations

Other general geotechnical considerations include:

- Basaltic clay material can degrade quickly when exposed and wet and it is advised that earthworks should not be undertaken in winter and care should be taken in wet shoulder seasons.
- The basaltic clay may have a low CBR requiring improvement of soft zones for pavement construction.

Geotechnical considerations for the North Western site are shown on Figure 6, with further details on geotechnical considerations, based on the inferred geology, provided in Appendix B.

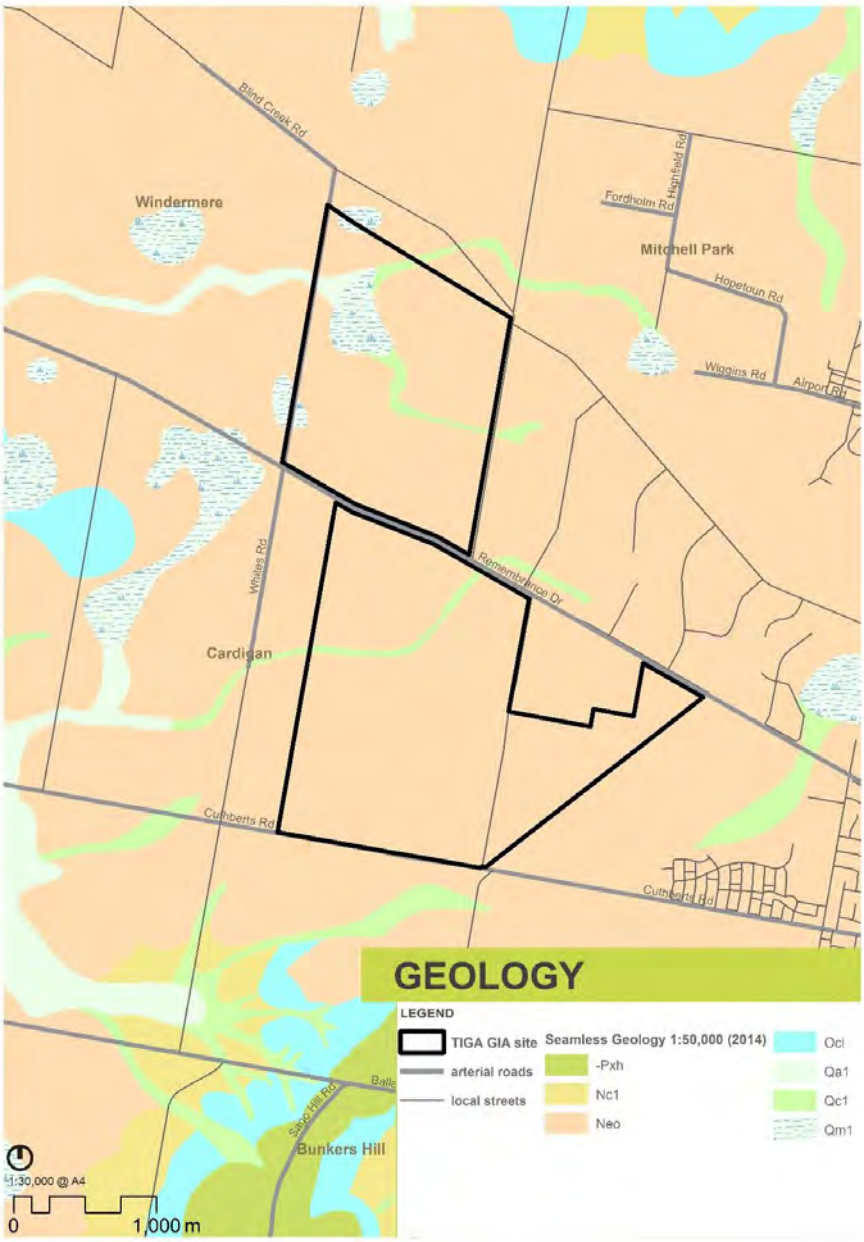

Figure 6 North Western GIA geology based on the 1:50,000 Ballarat Geology Map

3 Heritage assessment

3.1 European cultural heritage

Heritage Overlay and Victorian Heritage Register

The Ballarat-Burrumbeet Road bisects the North Western site with the associated road reserve affected by The Heritage Overlay Schedule HO154 – Avenue of Honour (1917-1919) and Arch of Victory (1920). The road is also listed on the Victorian Heritage Register (VHR H2089). The heritage overlay applies to the entire road reserve.

The former Primary School, Cardigan State School/Windermere Town School, is located on the corner of Remembrance Drive and Draffins Road. This site is within 5-10 metres of the project boundary, and is listed under the Ballarat Planning Scheme (HO136) as well as the Victorian Heritage Register (H763). A report undertaken by TerraCulture Archaeologists Pty Ltd (TerraCulture) (Appendix A) concluded these places must not be disturbed by works associated with any development and there is the possibility of other European historical remains occurring as a result of former rural land use.

As the landmark is listed on the Victorian Heritage Register, the provisions of the *Heritage Act 1995* supersede the Ballarat Planning Scheme; which may need to be considered depending on the extent of development in the road reserve of Remembrance Drive and Draffins Road.

Heritage Inventory

There are no Victorian Heritage Inventory (VHI) sites in the North Western site.

Historical Landscape

Mapping Ballarat's Historic Urban Landscape outlines the character of the landscapes within Ballarat (Context Pty Ltd, 2013). The North Western GIA lies wholly in one Indicative Character area, Burrumbeet Plains.

Burrumbeet Plains is characterised by very flat, large pastoral areas. It has an extensive agricultural landscape with little tree cover, large rectangular grazing paddocks and networks of small creeks and drainage channels. The area has some isolated residential development along Remembrance Drive, with older farmsteads, boundary walls and hedges. The 22 kilometre Ballarat Avenue of Honour runs through the area and creates a prominent landscape feature with great social value.

3.2 Aboriginal cultural heritage

There are areas of Aboriginal cultural sensitivity within the North Western site including the Ballarat Skipton Rail Trail and four circular parcels of land, approximately 100 metres in diameter, adjoining the trail. Areas of cultural heritage sensitivity have been designated where Aboriginal cultural places and objects are known or are likely to exist.

TerraCulture however found through their desktop research in 2008, there are no Aboriginal Cultural Heritage sites registered within the study area. TerraCultutre identified one site (7622-0037) is mistakenly listed as within the area. Given this, they suggest a CHMP is not mandatory however given the strong possibility that Aboriginal Cultural Heritage material will occur in the area, a voluntary CHMP should be undertaken. Areas of Cultural Heritage Sensitivity are shown on Figure 4.

Since the TerraCulture report, amendments have been made to the *Aboriginal Heritage Act 2006*. Given this, it is recommended that a suitably qualified heritage consultant be engaged to provide a recommendation on whether a Cultural Heritage Management Plan (CHMP) would be required for development of the site.

4 Accessibility assessment

4.1 Existing and planned future road network

Remembrance Drive completely bisects the site from east to west. The northern section of the site is bound by Draffins Road to the west, Dowling Road to the east, while to the north it is bound by the Melbourne to Ararat Railway line, preventing a direct road connection in this direction. The southern section of the site is bound by Cutherberts Road to the south and is in close proximity the Whites Road to the west. VicRoads is the responsible roads authority for Remembrance Drive, while Ballarat City Council are responsible for all other surrounding roads. The associated road hierarchy is shown in .

Given the existing function of Remembrance Drive as a high speed, connecting rural arterial, design of its integration into the North Western GIA local road network will need to be carefully considered. Direct access to the road is currently limited, with lot servicing accommodated by parallel service roads. This is not considered to be a significant impediment to development however. At a minimum, access could be facilitated following the same service road and/or signalised collector road intersection approach adopted for the nearby Lucas and Alfredton developments. Alternatively, collaboration with VicRoads could be sought to deliver a more integrated outcome in line with their Movement and Place framework, addressing vehicle access and movement needs while avoiding severance and road safety issues for active travel modes posed by high speed multi-way arterials through developed areas.

The Ballarat Link road is planned to follow an alignment east of the site, crossing Remembrance Drive approximately 1km from the most eastern boundary. Ultimately, upon completion of stage 2, the Link Road will create a new north-south bypass of central Ballarat, connecting the Western Freeway with the Midland Highway. Stage 1 from the Western Freeway to The Terrace (opposite the Lucas Neighbourhood Activity Centre) is largely complete. Stage 2, completing the connection to the Midland Highway is a longer term prospect which is not currently funded and is expected to be completed over a number of decades. Upon completion, the Ballarat Link Road is expected to attract a substantial proportion of north-south cross city traffic (including heavy traffic) which currently travels through the centre of the city. The road will also open up the western fringe of Ballarat, providing access to new development and distributing radial traffic not headed to/from the CBD. The Link Road will enhance accessibility from the North Western GIA to the north and south and to the regional strategic road network.

Information contained within the report *Victorian Integrated Transport Model – City of Ballarat, Phase 4: Preferred Scenario* (AECOM, 2016) dated March 2016 (Ballarat VITM Report) indicates that in the near term (2021), the road network providing access to the site will operate well within available capacity during the AM peak period. Only a low level of congestion is noted at the confluence of Sturt Street and Cuthberts Road.

Longer term transport forecasts contained within the Ballarat VITM Report indicate that by 2041, the road network will experience low to medium levels of congestion along routes providing access to the site during the AM peak period. shows predicted 2041 AM peak period volume to capacity (V/C) to ratios across the Ballarat Road network. V/C ratio is a measure of road capacity utilisation for a particular section of the road network and provides an indication of where congestion is likely to occur. Values closer to 0 indicate free flow conditions while values approaching 1.0 (shown in orange and red) indicate the section of road is approaching capacity, with long delays and unreliable travel times expected. Based on , the following is noted regarding forecast performance of the road network:

- Low to medium levels of congestion is predicted to occur on Remembrance Drive / Sturt Street from Ring Road towards the Ballarat Town Centre
- Low to medium levels of congestion is predicted to occur on Cuthberts Road from Dyson Drive to Sturt Street.

A review of the forecast land use assumptions made for the analysis presented in the Ballarat VITM report shows that only a limited number households within the site area, far below the low development scenario, are included in the 2041 forecast. Inclusion of additional levels of development at the site would exacerbate the noted congestion issues.

4.2 Public transport network and facilities

The public transport network servicing the site, based on bus network and timetabling information sourced from Public Transport Victoria and effective from January 2017, is summarised in . Key points are:

- The closest point of the site is located approximately 4.5km from Wendouree Station and approximately 8km from Ballarat Station
- There are no existing bus services with any catchment within the site boundary. The closest service is Route 10, which stops approximately 1.2km from the closest point of the site
- To provide the site with connectivity to the Ballarat bus network, there is opportunity to extend Route 10 and 26. Lengthening of either route by at least 6km would be required to provide reasonable coverage of the site, with a corresponding increase in vehicles assigned to the route should the existing service frequency be maintained
- There is potential opportunity to plan for a new railway station at the northern boundary of the site. However, the viability of such a station would likely be limited as its catchment would only cover a small part of the site and the existing train service frequency is low.

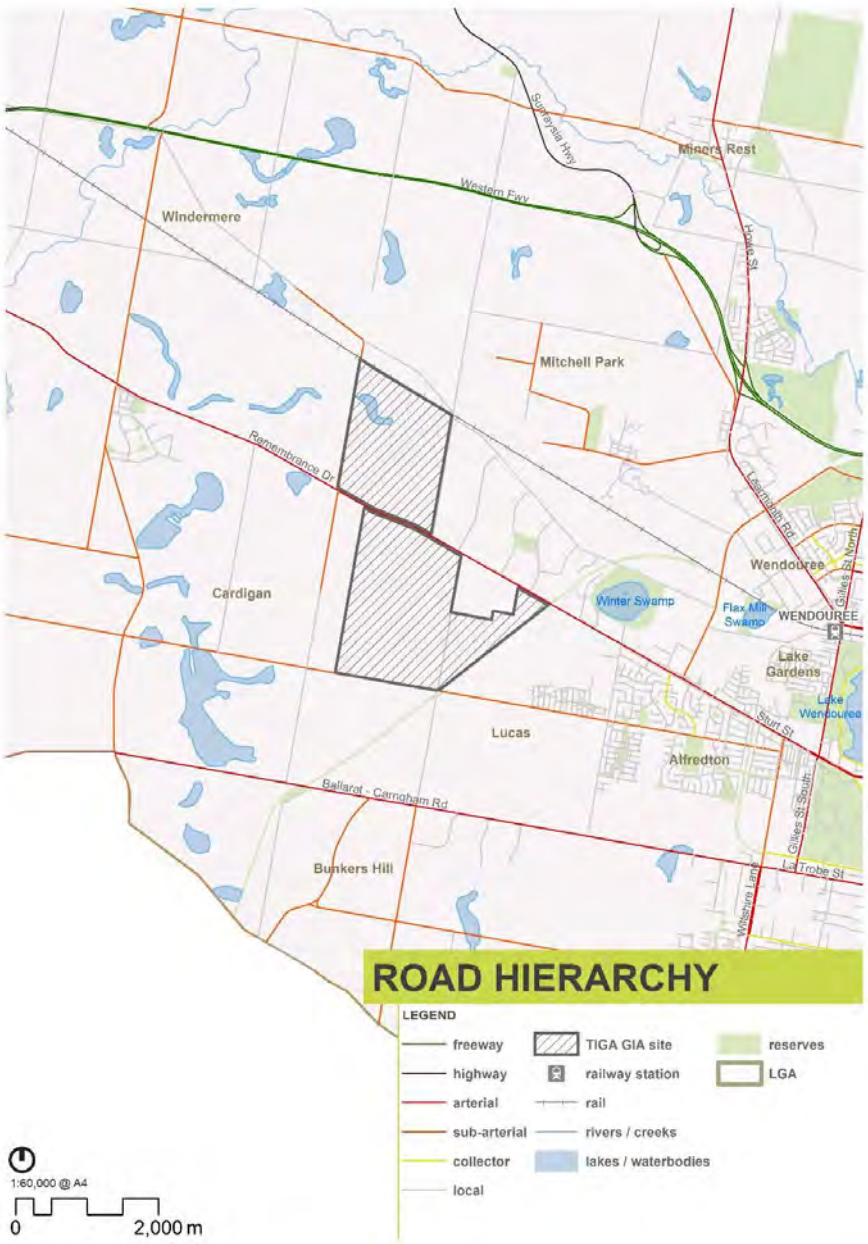

Figure 7 Road hierarchy

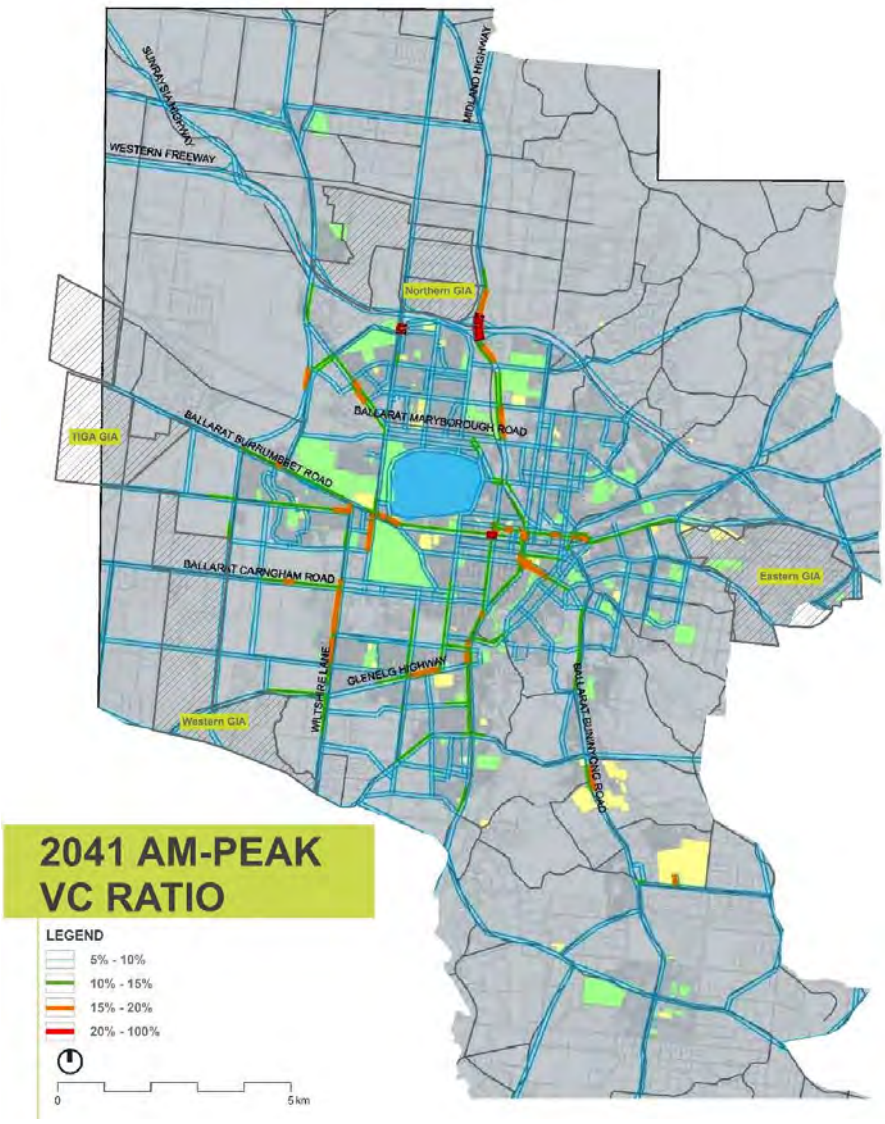

Figure 8 VITM forecast volume to capacity ratio 2041 (AM peak period)

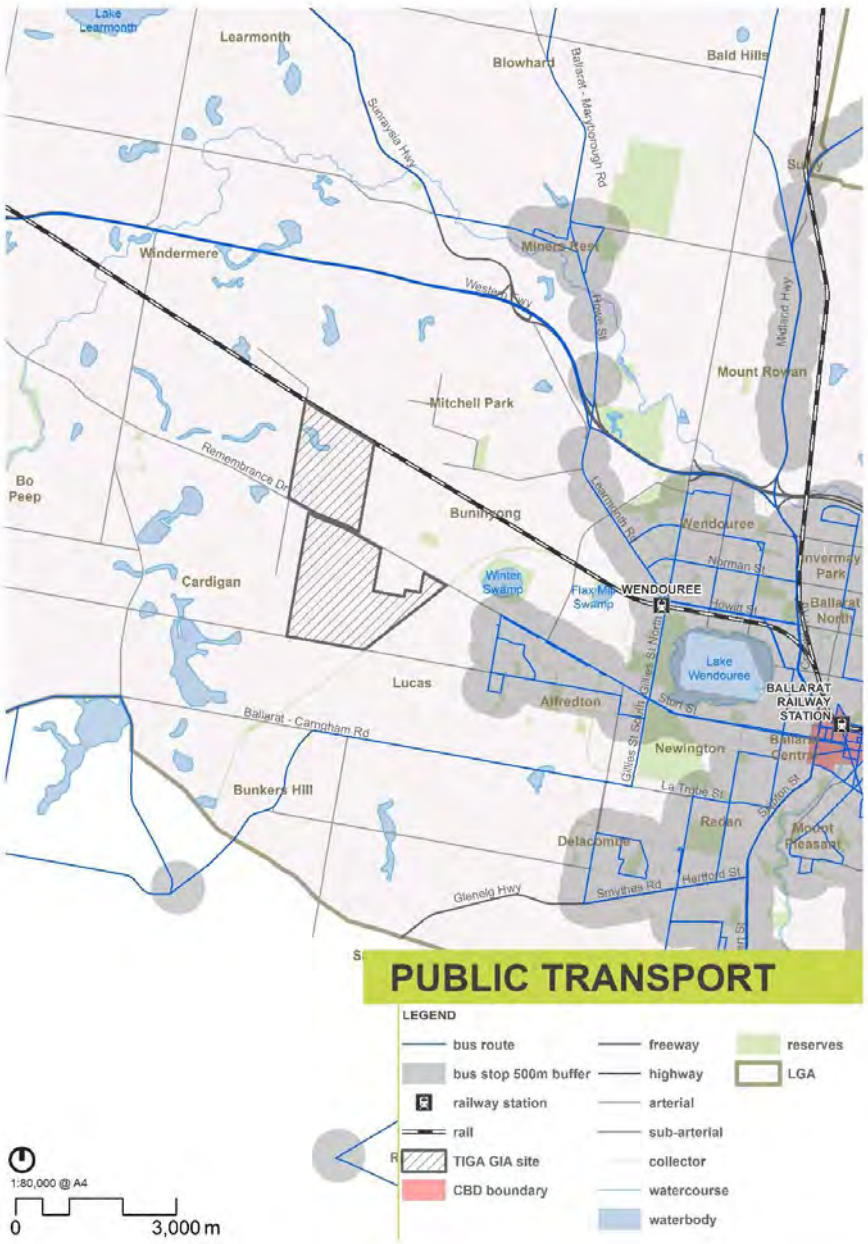

Figure 9 Public transport network and bus frequency

4.3 Walking and cycling networks

The key walking and cycling features of the site are:

- The centre of the site is located at least 9 kilometres from the Ballarat CBD, as such walking and cycling will have only limited viability for these trips and the majority of walk trips are expected to remain internal to the site or to the immediate nearby suburbs.
- There are no existing dedicated bicycle facilities between the site and the Ballarat CBD. The Ballarat-Skipton Rail Trail, which provides an unsealed dedicated cycleway, borders the south east edge of the site. However, the trail terminates at Ring Road and does not provide a complete connection to the CBD. An unsealed shared path is provided along the south side of Remembrance Drive. This path also terminates before the CBD at Dyson Drive, becoming a standard pedestrian footpath on which cycling is not permitted for anyone over the age of 12. As such, any route for this trip would require travel along a roadway without dedicated cycling facilities for at least part of the trip.
- The Ballarat Cycling Action Plan 2017 includes extension of cycling facilities along Remembrance Drive / Sturt Street and Cuthberts Road, as shown in . This would provide a direct bicycle connection between the site and the Ballarat CBD.

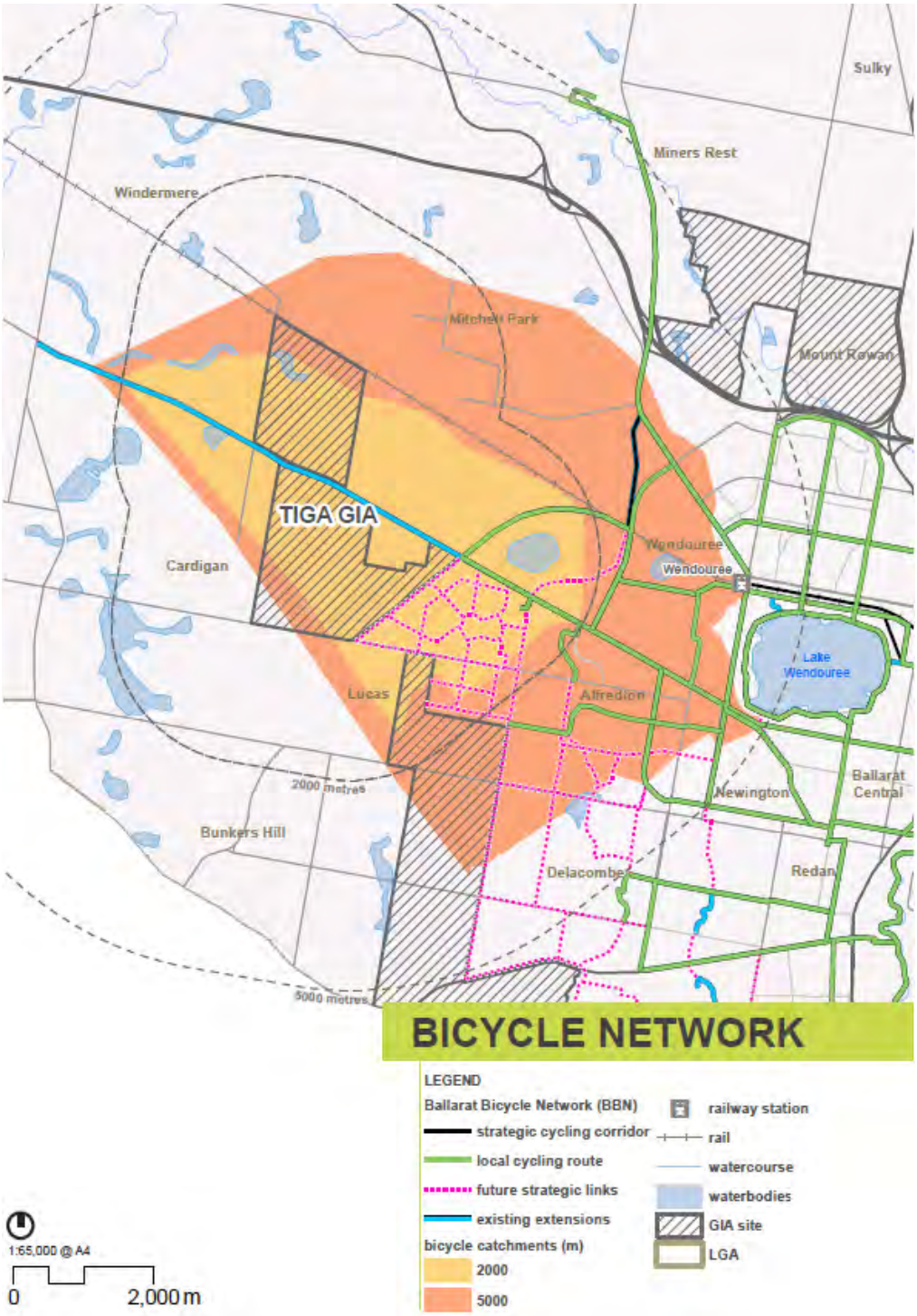

Figure 10 North Western GIA cycling catchment of existing and planned routes

4.4 Accessibility to employment and services

The most recent Ballarat VITM Report does not provide information in relation to access to employment and retail services. As such, a version of the report from a prior project phase titled *Victorian Integrated Transport Model – City of Ballarat, Phase 3A Investigation* (AECOM, 2014) dated July 2014 has been reviewed for this purpose.

Based on current planning, the site will have a high level of access to employment and retail services by private vehicle for the foreseeable future. It is expected that between 90% and 100% of employment opportunities and retail services will be able to be accessed within a 20 minute private vehicle trip from now until the year 2041.

Based on current planning, the site will have negligible access to employment or retail services by public transport for the foreseeable future. It is expected that there will be limited employment opportunities and retail services that will be able to be accessed by public transport within a 20 minute public trip both now and until the year 2041 (the access to employment opportunities is shown in). shows the percentage of employment opportunities that will be able to be accessed using public transport within 20 minutes. Higher levels of public transport accessibility are shown in green, while low levels are shown in red or grey. Although this site is not explicitly included in this analysis, it will be situated immediately adjacent to the Proposed Lucas Large Neighbourhood Centre, which is rated as having low PT accessibility. As such, it is reasonable to conclude that the site will likely have a similar level of accessibility. It is noted that a public transport trip includes walking time, waiting and in-vehicle time.

The employment distribution forecasts outline in the Ballarat VITM report suggests that more jobs will be located in the west of Ballarat in the future. On this basis, there is an opportunity to provide increased public transport services with these locations of employment (e.g. Ballarat West Employment Zone)

While access by private vehicle is high, there is an opportunity to provide additional transport choice and increased access to employment and retail services through the provision of additional public transport services outlined in Section 1. It is noted that some of these services may be required for equity and social inclusion.

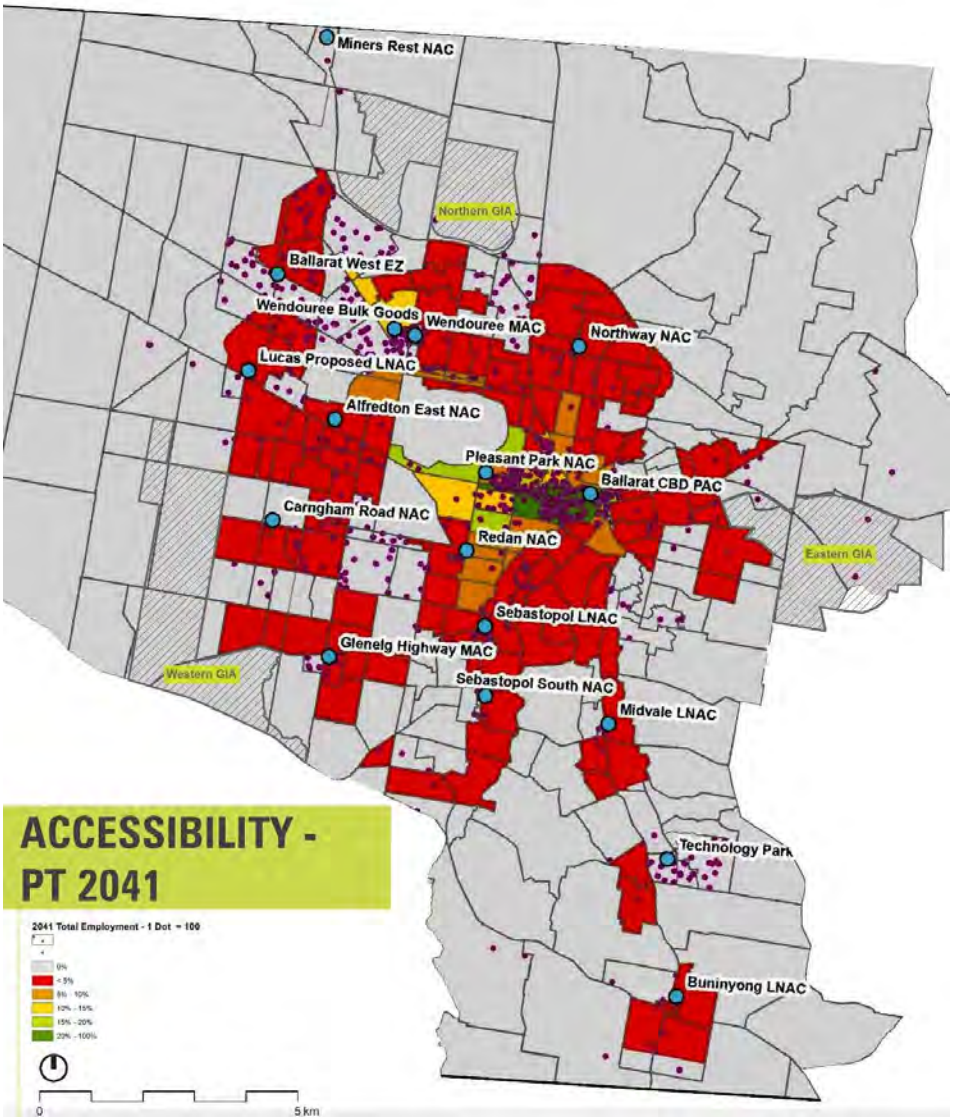

Figure 11 Total accessibility to employment by public transport (2041)

5 Deliverability / implementation

5.1 New trunk utility infrastructure

Drainage

A high level assessment of the trunk drainage infrastructure required for the urbanisation of the North Western GIA has been completed in accordance with the standards stated in the Infrastructure Design Manual (IDM). Accordingly, the following key parameters have been applied to the proposed drainage design:

- The flows are to be maintained at pre-development levels for the peak flow rate in a 100 year ARI event
- The minor drainage (underground pipes and channels) are sized to convey the 10 year ARI in residential and industrial areas
- The water discharged into the existing waterways is treated to the Best Practice Environmental Guideline Targets for Stormwater Treatment, such that removal of the following is achieved:
  - 80% of total suspended solids;
  - 45% of total phosphorus;
  - 45% of total nitrogen; and
  - 70% of gross pollutants.

Demand requirements

Catchment areas were identified and runoff and time of concentration coefficients were determined in accordance with the land use of each catchment. The existing land use within the study area was determined based on the GIS information provided by City of Ballarat. As per the IDM, the overland flow for the existing and proposed conditions has been calculated using the Rational Method for Rural Hydrology described in Austroads "Guide to Road Design: Part 5 General and Hydrology Considerations." The design has adopted the runoff coefficients stated in Table 9 of the IDM. For catchment types not identified in the IDM, runoff coefficients defined in AS3500.3 has been adopted.

Table 3 states the minimum detention volume required to ensure that the flow is maintained to pre-development levels for the peak flow rate in a 100 year ARI event.

Table 3 Estimated required stormwater detention volumes

Detention volume required (m^3)				
Catchment	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
Catchment 1	34,254	45,645	50,337	56,045
Catchment 2	30,138	40,952	44,884	49,044
Catchment 3	7,534	10,518	11,645	12,836
Catchment 4	3,774	5,236	5,846	6,491

Detention volume required (m^3)				
Catchment 5	744	1,061	1,210	1,367
Total	**76,443**	**103,412**	**113,992**	**125,783**

New Trunk Infrastructure

The new trunk infrastructure required includes:

- A number of retention basins located throughout the study area. The size and location of individual basins will largely be dependent on the topography and proposed land use of the study area and should be determined in collaboration with civil engineers and town planners.
- Wetlands that will be incorporated into the floor of each retarding basin to improve water quality. The application of this treatment measure ensures that land acquisition cost to meet WSUD requirements can be minimised.
- A network of stormwater drainage pipes that will convey the post-development 10 year ARI event flow to the retention basin.
- Stormwater drainage pipes that will convey the pre-development 100 year ARI event flow from the retention basins to the outfall creeks.

Detailed modelling of the performance of the proposed wetlands has not been conducted as part of this study. Consequently, while the design and cost evaluation assumes that WSUD requirements can be satisfied with the wetlands and green spaces, it is noted that additional tertiary water treatment may be required.

Sewer

A high level sewer network has been designed in accordance with the design principles outlined in the MRWA WSAA Sewage Code, Pressure Sewer Code and Sewerage Pump Station Code, as required by Central Highlands Water. While the design intent has been for a gravity network, the location of the outfall mains and the predominantly westward grading of the site have meant that additional pump stations and rising mains will be required.

Demand requirements

The effluent flow is based on the assumption that residential land use will account for 85% of the overall effluent flow. This value was determined based on engineering industry experience and advice provided within the MRWA WSAA Sewer Code. The values derived were informally provided to Central Highlands Water who advised that they are consistent with the degree of development investigated. Table 4 and Table 5 list the estimated effluent flows for sizing mains and the demand flows for wastewater treatment

Table 4 Estimated effluent flows for sizing of mains

Proposed Sewer Flows (L/s)			
Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**

180.04	228.26	261.58	313.69

Table 5 Estimated effluent flow for wastewater treatment

Scenario	Peak Dry Weather Flow (L/s)	Peak Dry Weather Flow (ML/d)
Scenario 1	45.89	3.96
Scenario 2	68.84	5.95
Scenario 3	86.04	7.43
Scenario 4	114.73	9.91

New trunk infrastructure

Extensive new trunk infrastructure will be required to service the North Western GIA. The topography of the site presents two options: gravity feed to Cardigan Wastwater Treatment Plant (WwTP) or a series of sewer pump stations that conveys flows to either the Ballarat South WwTP.

It is also noted that due to the lack of peak wet weather capacity in the downstream network, if significant downstream upgrades are not undertaken, peak flows will need to be contained within the GIA which would require space for detention networks.

Table 6 Estimated sewer trunk mains

Meters of trunk mains				
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
Gravity Mains				
225mm diameter	3100	3100	5850	2750
300mm diameter	0	0	0	3100

Infrastructure required for wastewater treatment

As Cardigan WwTP is a small localised asset, significant upgrades would be required to service this GIA. These upgrades would also require regulatory approvals and have an impact upon the plants odour buffer zone and therefore surrounding residents.

It should also be noted that tapping into the Ballarat South WwTP would require flows to travel up to 25km resulting in high construction and operational costs. Central Highlands Water has confirmed that this plant has capacity limitations and would require upgrade or detention space to manage wet weather peak flows. Similarly to the Cardigan WwTP, the buffer zone and discharge licence of the Ballarat South WwTP would need to be reviewed.

It is possible that most effective solution would be to commission a new wastewater treatment facility to service this growth area.

Water

A high level proposed potable water network has been calculated in accordance with MRWA WSAA Water Code, as per the requirements stated by Central Highlands Water. As further reference, the design has also considered the requirements that Central Highlands Water has stipulated in the Ballarat West Precinct Structure Plan (PSP) 2012 for water demand and network design. It would be anticipated that the additional requirements stated within the PSP will also apply to all other future development within Ballarat.

Demand requirements

The water demand has been determined for the residential properties only, and does not consider the water required for the function of the commercial or landscaped precincts. This decision was made on account of the absence of information regarding the type of commercial and landscape areas proposed for each scenario and their demand requirements.

In accordance with the MRWA WSAA Water Code, the peak daily and hourly demands have been determined.

The peak hourly flow rates for residential density types (high, medium, low) have been provided by Central Highlands Water and are in accordance with those stated by MRWA (MRWA, 2011). Arup has extrapolated these values to ascertain values for the allotment types used in the scenarios.

The peak daily demand has been determined on the assumption that potable water demand reduction measures will not be implemented in the development areas. This approach was applied to ensure that water demand requirements can be achieved when the residential water systems are unable to function as designed, such as during drought and when the residential systems are not maintained. This design measure was proposed and supported verbally by Central Highlands Water.

Table 7 provides a summary of the estimated water demand for each land development scenario. Central Highlands Water has been provided with the estimated demands and have advised that the derived demands are consistent with the degree of development envisaged.

Table 7 Estimated water demand

Proposed water demand for residential development areas		
	Water Demand (m^3/s)	Water Demand (ML/day)
Scenario 1	0.84	2.12
Scenario 2	0.96	3.18
Scenario 3	1.05	3.98
Scenario 4	1.20	5.30

New trunk infrastructure

Central highlands water has advised that the existing trunk main in Remembrance Drive does not have the capacity to service the entire GIA. It may be possible to extend the mains proposed as part of the Ballarat West Urban Growth Zone development to service the North Western GIA however significant new infrastructure will still be required. Development in this area may trigger the need for new pressure zones which increases the operation complexities of the area.

It is notes that the ring Road water main upgrade is planned to address current level of service deficiencies in the nearby Alfredton area. This main would need to be upsized to service the North Western GIA.

Infrastructure required for water treatment

Central Highlands Water has advised that the Ballarat System is capable of sourcing adequate raw water supply for the next 30 to 50 years and that the two treatment plants in the area have sufficient capacity for the next 20 years.

Gas

Demand requirements

The gas demand for each of the development scenarios has been determined based on the current gas usage per person in Ballarat. In the absence of information pertaining the proposed industrial and commercial development for each scenario, the gas demand calculated consider only the residential demand. The proposed gas demand is shown in Table 8.

Table 8 Estimated gas demand

Proposed gas demand for residential development areas	
	Gas Demand (GJ/year)
Scenario 1	12,284
Scenario 2	18,426
Scenario 3	23,032
Scenario 4	30,710

New trunk infrastructure

AusNet Services have advised that the location of the North Western GIA would mean that supply would have to travel across Ballarat resulting in significant pressure reductions. This suggests that significant upgrades and new trunk infrastructure would be required to provide reliable supply to this area.

Long term infrastructure requirements

AusNet Services has advised that two new field regulators are currently being installed to enhance network pressures to ensure capacity for the immediate future. These upgrades do not consider future growth in this area.

Electricity

New trunk infrastructure

Powercor has confirmed that there is limited supply available to the North Western GIA, however 22kV feeder augmentation works would be required to support significant growth in demand. Such augmentation works are included in Powercor's 10 year forward plan.

It is noted that Powercor's longer term plan is to establish a substation in Ballarat West. This substation is proposed to cater for growth in the industrial demand in the area but could also have advantages for the North Western GIA.

It is likely that the following infrastructure works would be required to support the GIA:

- New transmission lines to supply the existing Ballarat Terminal Station (BATS) or a new terminal station;
- New sub-transmission lines to fed the Ballart West (BAW) zone substation;
- New 22kV feeders from BAW zone substations to the GIA
- New electricity distribution network within the GIA.

It would be anticipated that at least one new 22kV feeder would be required to support the supply of electricity for Scenario 1 and up to 4 new 22kV feeders for Scenario 4. Similarly, given the proposed sub-transmission lines to the BAW zone substation, additional sub-transmission lines may only be necessary for Scenarios 3 and 4.

Telecommunications

Telstra has advised that trunk infrastructure in growth areas will be dictated by developer applications. These protocols are spelt out by both Telstra and NBN Co and are at a cost to the developer.

5.2 New community infrastructure

The new community infrastructure required to provide for the future residents of the North Western site was determined based on benchmark recommendations for the provision of facilities. The requirements were determined under four population projection scenarios. Existing facilities in adjacent areas have been documented, as this may reduce the requirement for new community infrastructure.

Table 9 Community infrastructure required for the North Western GIA

Category	Indicator	Benchmark	Access distance	Reference	Number required under scenario				Provider	Existing facilities	Distance from GIA
					1	2	3	4			
1 Recreation and Cultural Infrastructure											
1.1 Sport and recreation	Provision of recreation areas - active open space	One Level 1 active open space reserve (8 ha per active open space reserve) per 6,000 people	1000 metres for 95% of dwellings	ASRR 2008 GAA 2013	1.5	2.2	2.8	3.7	Local council		
1.4 Community centres	Provision of community centres	Level 1 Provision ratios up to 10,000 people		GAA 2009	0.9	1.3	1.7	2.2	Local council		
2 Educational Infrastructure											
2.1 Kindergartens	Provision of kindergartens	Provision ratios up to 10,000 people	600 metres	GAA 2009 Barton et al 2010	0.9	1.3	1.7	2.2	Private	Alfredton Early Learning & Kinder	Approx. 2.5km
2.2 Long day care and occasional care	Provision of long day care and occasional care facilities	Provision ratios up to 10,000 people	600 metres	GAA 2009 Barton et al 2010	0.9	1.3	1.7	2.2	Private	Goodstart Early Learning Alfredton	Approx. 2.5km
2.3 Primary schools	Provision of government primary schools	1 government primary school per 8,000 to 10,000 people	800 metres	ASRR 2008 Barton et al 2010	0.9	1.3	1.7	2.2	State government	Alfredton Primary School	Approx. 2.5km

Category	Indicator	Benchmark	Access distance	Reference	Number required under scenario				Provider	Existing facilities	Distance from GIA
					1	2	3	4			
	Provision of non-government primary schools	Provision ratios between 10,000 and 30,000 people	800 metres	GAA 2009 Barton et al 2010	0.4	0.7	0.8	1.1	Private	Siena Catholic Primary School	Approx.1km
2.4 Secondary schools	Provision of government secondary schools	1 government secondary school per 25,000 to 30,000 people	1200 metres	ASRR 2008 Barton et al 2010	0.3	0.5	0.6	0.8	State government	Ballarat High School	Approx. 5km
3 Healthcare Infrastructure											
3.1 GP clinics	Provision of GP clinics	0.34 general practices per 1000 people (Victorian average)		Dept of Health 2011	3.0	4.5	5.7	7.5	Private	Alfredton Medical Centre	Approx. 4km
3.3 Dental practices	Provision of dentist sites	0.20 dental services per 1000 people (Victorian average)		Dept of Health 2011	1.8	2.7	3.3	4.4	Private	Ballarat Family Dental	Approx. 1.5km
3.4 Aged care	Provision of aged care facilities	Provision ratios between 10,000 and 30,000 people		GAA 2009	0.4	0.7	0.8	1.1	Private		
	Provision of aged care places	88 beds per 1000 people aged 70+		ANAO 2015	79	119	148	198	Private		
3.5 Community health centres	Provision of community health centres	Provision ratios between 10,000 and 30,000 people		GAA 2009	0.4	0.7	0.8	1.1	State government		
3.6 Hospitals	Hospital beds	3.9 hospital beds per 1000 people (Australian average)		AIHW 2014	35	52	65	86	State government		

6 Financial and economic assessment

6.1 Development infrastructure costs for trunk infrastructure

Drainage

The costs associated with the drainage trunk infrastructure are stated below. For information regarding the design and cost assumptions please refer to Appendix C.

Cost estimates have been determined based on 2015 prices and the construction prices anticipated for 2040. This assessment has continued to use 2015 prices in order to offer a like for like comparison with the previous GIA assessments. The anticipated 2040 costs have been determined based on the assumption that the inflation rate for construction from 2015 to 2040 will be equal to that experienced between 2004 and 2014. This rate is 4.4% per year.

Table 10 Estimated drainage trunk infrastructure cost

Item	Scenario 1	Scenario 2	Scenario 3	Scenario 4
New pipes and pits	$4,8000,000	$6,400,000	$7,100,000	$7,200,000
Retention Basins / Wetlands	$11,100,00	$15,000,000	$16,500,000	$18,200,000
Council Fees	$600,000	$700,000	$800,000	$900,000
CAPEX (2015 prices)	**$16,400,000**	**$22,200,000**	**$24,400,000**	**$27,000,000**
CAPEX (2040 pricing)	**$34,400,000**	**$46,600,000**	**$51,300,000**	**$56,600,000**

Sewer and Water

As with all of the proposed areas, development of the North Western GIA will drive the need for significant investment in new trunk infrastructure and upgrades to existing infrastructure in the quantum of $40M – $50M. Should this result in the need for a new wastewater treatment plant and re-use facility a further $50M - $80M could be required.

Operational complexities due to the possible creation of multiple pressure zones to supply this GIA will also have ongoing costs.

Central highlands Water have also advised that this growth area presented the highest per lot development cost.

Gas

While the authorities have not provided specific costs for trunk infrastructure, they have noted that the North Western GIA will require a significant amount of

investment to provide supply from the existing City Gate and maintain service levels across the network.

Electricity

Powercor stated that costs associated with supplying this GIA are difficult to provide without a detailed in depth assessment. However, it was noted that costs would vary only slightly between the GIA's being considered and that there was no preference between areas.

Telecommunications

Telstra has advised that charges for new infrastructure are generally borne by the developer and vary based on:

- type and size of the development,
- location,
- services required by the developer,
- network type, and
- relative proximity of Telstra's network with spare capacity.

6.2 Community infrastructure costs

The unit costs for community infrastructure required to service development in the North Western GIA are outlined in Table 11. The total cost of providing infrastructure depends on the development scenario, as outlined in Section 5.2.

Table 11 Community infrastructure costs

Category	Indicator	Unit cost	Reference	Cost in scenario			
				1	2	3	4
1 Recreation and Cultural Infrastructure							
1.1 Sport and recreation	Provision of recreation areas - active open space	$ 6.75 million	Urban Enterprise, 2014	$13,500,00	$13,500,00	$20,250,00	$27,000,000
1.4 Community centres	Provision of community centres	$ 4.4 million	Urban Enterprise, 2014	$4,400,000	$4,400,000	$8,800,000	$8,800,000
2 Educational Infrastructure							
2.1 Kindergartens	Provision of kindergartens	$ 1.3 million	City of Kingston, 2014	$1,300,000	$1,300,000	$2,600,000	$2,600,000
2.2 Long day care and occasional care	Provision of long day care and occasional care facilities	$ 4.1 million	ACT Government, 2012 McComish, 2013	$4,100,000	$4,100,000	$8,200,000	$8,200,000
2.3 Primary schools	Provision of government primary schools	$ 12.2 million	Department of Treasury and Finance, 2015	$12,200,000	$12,200,000	$24,400,000	$24,400,000
	Provision of non-government primary schools	$ 12.2 million	Department of Treasury and Finance, 2015	$ 12,200,000	$12,200,000	$12,200,000	$12,200,000
2.4 Secondary schools	Provision of government secondary schools	$ 20 million	Department of Treasury and Finance, 2014	$ -	$20,000,000	$20,000,000	$20,000,000
3 Healthcare Infrastructure							

Category	Indicator	Unit cost	Reference	Cost in scenario			
				1	2	3	4
3.1 GP clinics	Provision of GP clinics	$ 1.4 million	Selesnew, 2008	$4,200,000	$7,000,000	$8,400,000	$11,200,000
3.3 Dental practices	Provision of dentist sites	$ 1.4 million	Selesnew, 2008	$2,800,000	$4,200,000	$4,200,000	$5,600,000
3.4 Aged care	Provision of aged care facilities	$ 17.9 million	Department of Treasury and Finance, 2014	$ -	$17,900,000	$17,900,000	$17,900,000
	Provision of aged care places	$ 595,000 per place	Department of Treasury and Finance, 2014	$47,005,000	$70,805,000	$88,060,000	$117,810,000
3.5 Community health centres	Provision of community health centres	$ 50.2 million	Department of Treasury and Finance, 2014	$ -	$50,200,000	$50,200,000	$50,200,000
3.6 Hospitals	Provision of hospital beds	$ 844,000 per bed	Department of Treasury and Finance, 2015	$29,540,000	$43,888,000	$54,860,000	$72,584,000

The demand for community infrastructure is driven by the population and the associated costs are influenced by which scenario is implemented. It has been noted that the indicative healthcare infrastructure may be provided by the public sector. Further the costs identified are relatively similar across the GIAs given the influence of population.

6.3 Developer costs for local infrastructure

The engineering estimated developer costs associated with the construction of local infrastructure have been determined following consideration of the following:

- The standard industry rates for construction in Melbourne (Rawlinsons, 2015); and
- The fees and charges stipulated by Central Highlands Water for land development (Central Highlands Water, 2014).

Cost estimates have been determined based on 2015 prices and the construction prices anticipated for 2040. This assessment has continued to use 2015 prices in order to offer a like for like comparison with the previous GIA assessments. The anticipated 2040 costs have been determined based on the assumption that the inflation rate for construction from 2015 to 2040 will be equal to that experienced between 2004 and 2014. This rate is 4.4% per year.

The developer costs for local infrastructure for 2015 and 2040 scenarios in the North Western GIA have been identified in Table 12 and Table 13

Table 12 Combined cost estimate – 2015 prices

North Western GIA combined cost estimate - 2015 prices				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Roads	$ 48,700,000	$ 53,900,000	$ 53,900,000	$ 58,800,000
Water Supply	$ 17,300,000	$ 22,100,000	$ 24,900,000	$ 30,600,000
Sewer	$ 11,100,000	$ 13,000,000	$ 13,700,000	$ 15,700,000
Total	**$ 77,100,000**	**$ 89,000,000**	**$ 92,500,000**	**$ 105,100,000**

Table 13 Combined cost estimate – 2040 prices

North Western GIA combined cost estimate - 2040 prices				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Roads	$ 102,400,000	$ 113,300,000	$ 113,300,000	$ 123,500,000
Water Supply	$ 36,300,000	$ 46,300,000	$ 52,400,000	$ 64,300,000
Sewer	$ 23,300,000	$ 27,300,000	$ 28,700,000	$ 33,000,000
Total	**$ 162,000,000**	**$ 186,900,000**	**$ 194,400,000**	**$ 220,800,000**

7 Summary of Findings

A high level multi-criteria assessment (MCA) has been created to give an overview of the attributes needed to be considered for the development of each site. Suitability rating criteria are provided in the table (below) and are weighted as followed in the multi-criteria assessment. A higher score shows higher implementation of the Ballarat strategy and fewer critical and secondary issues. Given the high level assessment being undertaken, the multi-criteria assessment measures are at times broad with many not having specific parameters defined. This can mean that terms such as "low" or "potential" have been interpreted with best judgement.

Table 14 Suitabiltiy rating criteria and weighting values

Suitability rating criteria	Ballarat Strategy – Implementation of Platform 1: The '10 Minute City' Weighting values	Other Critical Issues and Considerations Weighting values	Ballarat Strategy – Implementation of Platform 2: The 'City in the Landscape' Weighting values	Other Secondary Issues and Considerations Weighting values
Minor issue or consideration / High degree of Compliance (refer to comments)	4.5	4.5	3	3
Moderate issue or consideration / Moderate degree of Compliance (refer to comments)	3	3	2	2
Significant issue or consideration / Low degree of Compliance (refer to comments)	1.5	1.5	1	1
Information not available	0	0	0	0

A comparison of each GIA and assessment is discussed below.

7.1 Land capability assessment

7.1.1 Natural disaster risk

The natural disaster assessment highlights the risks associated with each site as set out by various legislative documents. The assessment determined the Western GIA was least constrained by natural disaster risk, in comparison to the Northern which was the most. The results of the MCA for natural disaster risk are shown on .

The North Western GIA is affected by the Wildfire Management and Erosion Management Overlays and 10-25% of the site affected by the 1-in-100 year flooding overlay. Additionally the entire site is considered prone to bushfires. In comparison the Northern GIA, which received the least favourable score of the four GIAs for natural disaster risk, is affected by the same overlays as the North

Western site however to a greater degree, therefore resulting in a poor score. The Western GIA, the least constrained in terms of natural disaster risk, was only considered to be prone to bushfires (as is typical of this area in Victoria), however it was not affected by any other natural disaster planning overlays or considerations.

7.1.2 Protected flora and fauna

The assessment of native species that are protected under various legislation determined that the Western and Northern GIAs were the least constrained by flora and fauna, while the Eastern GIA was the most. This is shown in .

The North Western GIA includes an area of Natural Temperate Grassland of the Victorian Volcanic Plain, which is critically endangered under the EPBC Act. This being the key difference with this site and the Northern and Western GIAs, which received a slightly more favourable score, as EPBC Act listed matters occur outside the area. The Eastern GIA was the most constrained site by far due to the Vegetation Protection and Environmental Significance Overlays applying to large portions of the site in addition to almost a tenth of the Eastern GIA affected by endangered EVCs.

7.1.3 Noise impacts

The noise assessment highlights the impact aircraft noise from Ballarat Airport and traffic nuisance from surrounding roads will impact each site. This assessment has determined that the North Western GIA is the least constrained in terms of noise impacts, while the Northern GIA the most. Consideration was given to the noise impacts arising from the proposed airport runway extension on each site. This is shown on .

The significant difference between the North Western GIA, which received the most favourable score and the lowest scoring GIA, being the Northern, was the difference in noise from the Ballarat Airport. While the maximum event noise levels for land within the North Western GIA are predicted to be up to 85dB(A) which would require acoustic performance of building construction in accordance with, AS2021 requirements, the site fared better than the Northern GIA where maximum event noise levels, due to aircraft flyover, are predicted to be up to 95 dB(A). Additionally the Northern GIA is expected to be greatly impacted by the nearby industrial land uses.

7.1.4 Contaminated sites and past mining activities

The land contamination and mining activity assessment determined the North Western GIA has the least constraints, while the Eastern GIA the most. This is shown in .

The North Western GIA scored highly in this section due to the lack of either the environmental audit overlay on site or records of mining leases, active or historical within the site bounds. This is in comparison to the other GIAs which

either featured former landfills or mining leases on site or were in proximity to the environmental audit overlay on nearby land.

7.1.5 Geotechnical conditions

The geotechnical assessment considered the land stability and shrink swell for each of the GIAs. All sites scored relatively similar, however the Eastern GIA proved more geotechnical stable, while the Western GIA was the least. This is shown in Table 15.

Table 15 Geotechnical Conditions MCA

The geotechnical conditions for the Eastern GIA are the most favourable of the four GIAs. There is relatively low potential for land instability and the potential for highly reactive heavy clay which can result in widespread cracking to settlement of buildings is relatively low. The western GIA scored poorly due to areas of localised instability, particularly adjacent to the colluvial deposits in existing creeks and waterways and the potential for highly reactive heavy clay which can result in widespread cracking and settlement to buildings. While the North Western GIA scored less favourably than the Eastern due to the high geotechnical requirements arising from predominantly basaltic clay foundations but scored better than the Western GIA due to the relative flat topography of the site.

7.1.6 Access to existing utility infrastructure

Due to its proximity to existing developed areas, the Eastern GIA has the greatest access to existing utility infrastructure with all major utility services present on the site. The North Western and Western GIAs fared less in this area, due to their distance from the existing urban development front and therefore only had access to water supply, electricity (distribution) and telecommunications infrastructure, in some capacity.

This aspect of the GIAs was not ranked in the MCA as the need for new infrastructure has been incorporated in to the cost assessment. Costs associated with new trunk infrastructure were provided in the high level costing for development, as per Section 6.1 and 6.3.

7.1.7 Access to existing community infrastructure

Once again the Eastern GIA scored the best result in terms of proximity to existing community infrastructure, due to its proximity to areas of existing urban development. For comparison the North Western GIA was located at least 4 kilometres from the nearest medical centre, whereas one exits within 1 kilometre of the Eastern GIA.

7.1.8 Cultural heritage

The heritage assessment considered the cultural heritage values for each of the GIAs. Cultural sensitivity and/or significant heritage values were found at all sites, however the North Western and Western GIAs were determined to be the most suitable for development and the Northern GIA the least. This is shown in .

The North Western and Western GIAs were considered the most favourable for heritage values as they are relatively devoid of any areas of cultural sensitivity in comparison to the Northern GIA, which includes the Burrumbeet Creek (cultural sensitivity) and two Victorian Heritage Inventory sites.

7.2 Accessibility assessment

Congestion levels were the most influential factor in differentiating between the GIAs for the accessibility assessment. All GIAs have access to employment opportunities and services within a 20 minute private vehicle trip (up to 2041).

The Eastern GIA scored a high rating due to its proximity to existing and future road infrastructure which coincidently resulted in reduced congestion levels, based on the ability to disperse traffic. All sites fared well in terms of access to employment opportunities however the Eastern GIA proximity to existing development reduced the extent of new road infrastructure required.

7.3 Delivery and implementation

For every site, major infrastructure upgrades and expansions that may be required to the wastewater treatment facilities, transmission pipelines, electrical substation and communication assets have not been considered in this assessment. This is due to the fact that upgrade and expansion of these assets will be required to ensure utility service to Ballarat beyond 2040, irrespective of which potential GIA is urbanised.

7.4 Financial and economic assessment

7.4.1 North Western GIA

The trunk and community infrastructure costs for the various scenarios in the North Western GIA have been identified in Table 10 and Table 11 respectively.

The developer costs for local infrastructure for the various scenarios in the North Western GIA have been identified in Table 12 and Table 13

7.4.2 North Western, Northern, Western and Eastern GIA

For the purpose of comparison, this assessment compared the combined cost estimates for each scenario in each GIA. The engineering estimated developer costs associated with the construction of local infrastructure have been determined based on 2015 prices for each scenario in each GIA. Table 16 shows the Western GIA is likely to be the most expensive site to construct, while the Northern GIA will be the cheapest.

Table 16: Combined cost estimate based on 2015 prices

GIA	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Northern	$65,629,736	$75,146,175	$77,886,063	$88,123,599
Western	$92,131,451	$106,543,168	$110,755,626	$119,870,486
Eastern	$67,441,930	$78,582,138	$81,623,410	$93,849,466
North Western	$77,100,000	$89,000,000	$92,500,000	$105,100,000

7.5 Preferred Option

The multi-criteria analysis has provided a score for each GIA option the attributes identified in the desktop assessment, with the scores provided in Table 17. The Western GIA achieved the highest overall rating, indicating that it has the most amenable existing conditions. This site also has the largest site area of the four options. The Western GIA has:

- Relatively low number of planning overlays present on the site
- Relatively low abundance of endangered EVCs on the site
- Absence of historical mining activities
- Relatively low cultural and heritage sensitivities
- Ability to leverage trunk infrastructure from current growth front in west Ballarat.

Table 17 Results of the multi-criteria analysis of the GIAs

(Insert revised matrix here)

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Appendix A

Flora & Fauna Assessment and Net Gain Analysis, Ballarat Resort Site, Cardigan (Practical Ecology Pty Ltd) 2009.

Practical Ecology Pty Ltd
Contracting and Consulting in Ecological Restoration and Environmental Planning
ABN 88 082 911 377

Flora & Fauna Assessment and Net Gain Analysis, Ballarat Resort Site, Cardigan

24 February 2009

George Appleby

Phone: 9484 1555 Fax: 9484 9133
Email: enquiries@practicalecology.com.au
Address: PO Box 228 Preston 3072 Office: 2B Stott Street Preston

Flora & Fauna Assessment and Net Gain Analysis, Ballarat Resort Site, Cardigan

24 February 2009

George Appleby

PRACTICAL ECOLOGY Pty Ltd
ACN: 082 911 377 ABN: 88 082 911 377
PO Box 228 Preston VIC 3072
(2B Stott Street Preston Vic 3072)
P: 9484 1555 F: 9484 9133
www.practicalecology.com.au

Cover Photograph: Wetland and adjacent native grassland (Nic McCaffrey)

Report prepared on behalf of the Tiga (Ballarat) Pty Ltd

Practical Ecology project number: 904

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Version	Date Sent	Reviewed by:
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2	2/12/2008	Lincoln Kern
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Nic McCaffrey, Practical Ecology	flora survey (this study)
Staci Timms, Practical Ecology	GIS mapping

SUMMARY

The purpose of this report is to provide information on the flora and fauna of the proposed Ballarat Resort site at Cardigan. The report includes an analysis of Net Gain requirements to guide the subdivision of a large area of agricultural land into a new suburb. A previous flora assessment and associated report was completed by Practical Ecology for the site in 2004.

A large amount of the study area is cultivated or grazed by domestic livestock. One small section has been used as a plantation of non-local eucalypts. Native vegetation mainly consists of widely scattered remnant trees and small patches of grassland or wetland vegetation. The east end of the study area contains a series of native grassland and grassy woodland patches within a relatively small area.

The proposal for the subdivision of the site and construction of residences, commercial premises, recreational facilities and infrastructure such as roads will require the clearance of native vegetation and non-native vegetation. With this in mind, the approach of avoiding, minimising and offsetting any losses of native vegetation in accordance with the Net Gain provisions of *Victoria's Native Vegetation Management Framework* needs to be considered. The development proposal would incur the loss of 2.4 hectares of native vegetation. With management and protection of other native vegetation within the study area taken into account, there will be an excess of offsets for loss of native vegetation on-site.

One flora species and one fauna species of state or national significance were found in the study area: Wetland Blown-grass *Lachnagrostis filiformis* var. 2 (Insufficiently Known in Victoria) and the Brolga *Grus rubicundus* (Vulnerable in Victoria and listed under the Flora and Fauna Guarantee) respectively. Some other threatened fauna species may potentially occur on site, so further survey is required to determine any potential occurrences.

The loss of native vegetation from residential, commercial and recreational development may have impacts on matters of national significance under the Environment Protection and Biodiversity Conservation (EPBC) Act, namely, effects on the Golden Sun Moth, Striped Legless Lizard, Growling Grass Frog and the Natural Temperate Grassland of the Victorian Volcanic Plain ecological community. A number of other birds that are listed as migratory and/or marine under the EPBC Act are not expected to be particularly affected by the proposed subdivision. Since there is potential habitat for the Golden Sun Moth, Striped Legless Lizard and Growling Grass Frog, an area of Natural Temperate Grassland that may be affected by habitat loss, and an increase in pollution and predators, a referral of the proposed works under the EPBC Act is recommended, pending further detailed flora and fauna survey work. This referral should be submitted by Tiga (Ballarat) Pty Ltd.

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MAPS

1. INTRODUCTION

1.1 Project Background

Practical Ecology Pty Ltd was commissioned by Tiga (Ballarat) Pty Ltd in May 2008 to provide a flora and fauna assessment and Net Gain analysis for a proposed subdivision and development of associated infrastructure within several conjoined blocks of agricultural land at Cardigan.

Previous studies on the flora and fauna have been undertaken at the study area by Practical Ecology Pty Ltd: Bennett and Kern (2003) and Kennedy and Kern (2004). This current study is intended to update the flora assessment of 2004 and to address fauna issues in more detail.

1.2 Aims

This report aims to:

- establish the biological values of the study area;
- determine the significance and quality of flora and fauna, remnant vegetation and habitat
- document significant habitats, plants and animals;
- assess all fieldwork data and information from relevant literature and databases against relevant policy and legislation; and
- provide recommendations to ensure that retained vegetation and habitats within the study area are at least maintained within the context of the proposed land use.

This information will be used to inform the planning process required for applications to rezone the study area and for subsequent development plans.

1.3 Scope of Works

The scope of works proposed by Practical Ecology Pty Ltd and agreed to by Tiga (Ballarat) Pty Ltd included:

- a review of all previous studies and database information relevant to the site's flora and fauna values, including but not limited to:
    - previous flora and fauna studies of the local area; and

  - any other material identified as relevant by Practical Ecology

- discussion of findings within a policy and legislative context with regard to:
  - the Victorian Planning Provisions;
  - Victoria's Native Vegetation Management, A Framework for Action (DNRE 2002);
  - the Environment Protection and Biodiversity Conservation (EPBC) Act 1999; and
  - Victoria's Flora and Fauna Guarantee Act 1988

- fieldwork to assess the quality of the indigenous vegetation on the site, including:
  - identification of Ecological Vegetation Classes (EVCs) on-site;
  - completion of habitat hectare assessments in these areas where applicable;
  - compilation of a list of flora of those species (both indigenous and exotic) identified during habitat hectare assessments, and any other species (either flora or fauna) as identified as relevant by Practical Ecology;
  - an analysis of scattered indigenous trees throughout the study site, if applicable (where the indigenous understorey is <25% and overall canopy cover for a group of trees is less than 20 per cent, which is not subject to habitat hectare assessments) including:
    - identification of tree species;
    - measurement of the Diameter at Breast Height (DBH) of all of the trees as critical background to an assessment of Net Gain policy implications, and
    - assessment of tree canopy health in accordance with the Vegetation Quality Assessment Manual: Guidelines for applying Habitat Hectare scoring method (DSE 2004)

- discussion and expert opinion on:
  - Net Gain implications if native vegetation was proposed for partial or complete removal;
  - options for potentially further minimising vegetation loss and avoiding key areas (if appropriate); and
  - potential impacts on rare or threatened flora and fauna.

- collaborating on design or redesign of the proposed township development;
- a Net Gain Analysis, including:
    - proposed losses of habitat zones and/or scattered trees; and
    - required Net Gain targets that are based on proposed losses.

This approach facilitates the consideration of flora and fauna that is known to occur or which potentially occurs within the study area. Such an approach is consistent with state and federal planning and biodiversity conservation policy and legislation.

1.4 Study Area

1.4.1 Locality

The study area is located at Cardigan within the City of Ballarat. It consists of several agricultural properties between the Burrumbeet-Ballarat Road and the Skipton-Ballarat Rail Trail (see Map 1).

The study area falls within the Victorian Volcanic Plain bioregion close to its boundary with the Victorian Midlands bioregion (DSE 2008b).

1.4.2 Geology

The surface geology of the study area consists of Quaternary-Neogene basalts of the Newer Volcanic Group. In surrounding areas that are dissected by drainage lines, Quaternary-Neogene non-marine alluvial and colluvial deposits occur (Taylor 1996). Soils that are probably derived from these sediments occur at or close to the surface in some parts of the study area, indicating that the basalt flows are relatively shallow.

2. METHODS

2.1 Vegetation Assessment

Vegetation was assessed for both its type and quality. Ecological Vegetation Classes are a systematic classification system defining plant communities into common types occurring in similar environmental conditions.

2.1.1 Ecological Vegetation Classes

Prior to fieldwork a review of relevant literature was undertaken including Oates and Taranto (2001) and the EVC benchmarks provided by the Department of Sustainability and Environment (DSE 2008c). Ecological Vegetation Class mapping was consulted as an indication of the vegetation of the local area (DSE 2008b). EVCs were assigned in the field according to observable attributes including dominant and characteristic species consistent with the various descriptions provided in the above mentioned studies.

2.1.2 Vegetation Condition Assessment

Vegetation condition is assessed through criteria established by the DSE. Each EVC has a particular benchmark for tree size and density. An area is assessed as either a "Remnant Patch" or as "Scattered Trees".

According to DSE (2007a), "Scattered Trees" are defined as:

- canopy trees within an area where at least 75% of the total understorey plant cover is weeds or non-native plants and the overall canopy cover for a group (i.e. three or more) of trees is less than 20%.

A "Remnant Patch" of vegetation, requiring assessment using Habitat Hectares methodology, is defined as:

- an area of vegetation, with or without trees, where less than 75 per cent of the total understorey plant cover is weeds or non-native plants (bare ground is not included), i.e. at least 25 per cent of the understorey cover is native; or
- a group (i.e. three or more) of trees where the tree canopy cover is at least 20% (DSE 2007a).

Vegetation that is not considered to be scattered trees or a remnant patch of vegetation, nor a wetland, should be treated as degraded treeless vegetation (DSE 2007a).

2.2 Flora

Plant taxonomy used in this report is derived mostly from DSE's Flora Site Database (accessed as the Flora Information System (FIS) – DSE 2005a), though some taxonomic nomenclature from Walsh & Stajsic (2007) is used.

2.2.1 Existing Information

Previous studies including Oates and Taranto (2001) and maps contained within DSE (2008) were reviewed. Data on the July 2005 version of Flora Information System from within a ten kilometre radius of the study area was examined. Only records since 1975 are used. In addition, a report on nationally threatened species that are predicted to occur within a ten kilometre radius of the study area was generated from the EPBC Act Protected Matters Search Tool (PMST) (DEWHA 2008a).

2.2.2 New Information

The study area was visited on foot by George Appleby and Michelle Savona on 10 June 2008, and by George Appleby and Nic McCaffrey on 19 June 2008. Identification of vegetation type and flora species, and Habitat Hectare assessments were undertaken during these site visits.

Rare or threatened flora species that are likely to occur in the study area were identified from the local area list generated from the FIS, and from relevant literature. Searches of suitable habitat at the study area were made during fieldwork.

2.2.3 Limitations

Flora information gathered during fieldwork for this report is not considered to be conclusive, as some species are likely to have remained undetected.

Winter is not the optimal time for plant identification, as some key identification characteristics such as flowers or vegetative growth by annual species are generally not present. It is therefore expected that many species, which can only be observed for a limited period of time may not have been recorded during the present assessment. Ongoing drought conditions have also effected the growth and flowering of numerous species during the 2007/2008 spring-summer period.

2.3 Fauna

Animal taxonomy is consistent with DSE's Atlas of Victorian Wildlife (accessed via the Victorian Fauna Database (VFD) – DSE 2005b).

2.3.1 Existing Information

Data from the July 2005 edition of VFD from within a ten kilometre radius of the study area was examined. Only records since 1975 were used. In addition, a report on nationally threatened species that are predicted to occur within a ten kilometre radius of the study area was generated from the EPBC Act PMST (DEWHA 2008a).

2.3.2 New Information

Habitats with potential to support indigenous fauna were identified in the field and from aerial photographs. Further effort was made to investigate suitable habitat for threatened species.

2.3.3 Limitations

No formal fauna survey was undertaken in the study area but incidental records of animals and their signs, such as scats, tracks, burrows and nests were collected.

2.4 Mapping

Mapping was adapted from maps supplied by Beveridge Williams Pty Ltd as used in Kennedy and Kern (2004).

2.4.1 Limitations

While information presented in maps has been presented with care, it is important to note that potential inaccuracies may have occurred through the use of data that was drawn from several sources. Hence, the location of the features presented on maps should only be used as a guide to their exact locality.

3. RESULTS

3.1 Vegetation Assessment

Native vegetation within the study area occurs as patches of sparsely wooded grassland, patches of grassland, narrow remnants of grassland along roadsides with or without remnant trees, and wet grassland/herbland in and around dams.

3.1.1 Ecological Vegetation Classes

The original vegetation of the study area has been modelled by DSE (2008b) as Plains Grassy Woodland with a small patch of Plains Sedgy Wetland. Aquatic Herbland and Plains Grassy Wetland were also mapped nearby on similar geology (DSE 2008b).

Based on surveys in late spring 2004, Kennedy & Kern (2004) determined that remnant vegetation of the study area was a mosaic of Plains Grassland and Plains Grassy Woodland. The surveys for this current study, undertaken in winter 2008 (when many native species are dormant or difficult to identify), generally support this conclusion. It should be noted that at least some of the current extent of Plains Grassland has probably resulted from the clearing of trees in former Plains Grassy Woodland.

Continuing drought conditions during 2008 and evidence from surveys undertaken in different seasons make further diagnosis of EVCs difficult within the study area. Kennedy & Kern (2004) recorded Plains Grassy Wetland from the drainage line flowing westward from the Rail Trail crossing the southern part of the site; in June 2008, this site was barely distinguishable from the surrounding Plains Grassland/Plains Grassy Woodland mosaic. Before dams and road embankments intercepted drainage, sites such as this may have supported a form of Creek line Tussock Grassland (EVC 654) which is characteristic of "low gradient ephemeral and intermittent drainage lines of the volcanic plains" and "often includes small areas of sedgeland and/or wetland" (Oates & Taranto 2001).

During this current study, additional Plains Grassy Wetland was identified in a mosaic with Plains Grassland near the Rail Trail. This patch (comprising Habitat Zone 22) contained relatively low Kangaroo Grass *Themeda triandra* cover, relatively high forb diversity and cover, and numerous small depressions that would normally hold water over winter.

Habitat Zone 23 near the Rail Trail contains low lying Plains Grassland through which the wetland of Habitat Zone 15 would drain. Further survey in late winter-spring may reveal that this area contains Plains Grassy Wetland vegetation.

Table 1. Vegetation types present

EVC No.	EVC Name*	Bioregional Conservation Significance (Victorian Volcanic Plain Bioregion)
61	Plains Grassy Woodland	Endangered
125	Plains Grassy Wetland	Endangered
132	Plains Grassland	Endangered
653	Aquatic Herbland	Endangered

*Mosaics of EVCs listed above that are found in the study area are:

- Plains Grassland/Plains Grassy Woodland (EVC 897)
- Plains Grassland/Plains Grassy Wetland
- Plains Grassy Wetland/Aquatic Herbland

Source: DSE (2008c).

3.1.2 Habitat Hectare Assessment

Kennedy & Kern (2004) identified nineteen habitat zones in the study area. Most of these habitat zones were sited in the former Little property between Finchs Road and the Rail Trail while others were located along Finchs Road and Smarts Hill Road.

Most of these habitat zones were identifiable in June 2008 despite native vegetation being relatively difficult to identify in winter. Some habitat zones in the former Little property have been greatly modified since 2004, and some parts of these habitat zones have been redescribed.

In 2004, habitat zones along roadsides were assigned on the basis of having an average cover of native vegetation of greater than 10%. Since then, the threshold for minimum understorey cover in habitat zones (under Net Gain policy) was changed to 25%. This renders parts of the roadsides as predominantly modified vegetation rather than native vegetation. For the purposes of this report, the previously identified roadside habitat zones are used but should be taken as groups of small discontinuous areas of native vegetation. Further surveys at a more suitable time of year may show that roadside vegetation still consists of an average of at least 25% understorey and is therefore identifiable as native vegetation. In June 2008, four additional habitat zones were defined.

The results of Habitat Hectare assessments from a total of 19 habitat zones are shown in Table 2. Assessments of patches of EVC mosaics were undertaken in terms of the dominant EVC of the complex.

3.1.3 Scattered Trees

A summary of scattered indigenous trees, not including those trees in habitat zones, is presented in Table 3.

Table 2.Habitat quality and significance of patches of native vegetation

Habitat Zone			HZ1	HZ2	HZ3	HZ4	HZ5	HZ6	HZ7	HZ8	HZ10	HZ11	HZ12
EVC Name/Number			PlGrWd	PlGrWd	PlGrWd	PlGrWd	PlGrWd	PlGrWd	PlGr	PlGr	PlGrWd	PlGrWd	PlGrWd
		Max. Score											
Site Condition	Large Old Trees	10	0	0	3	0	8	2	N/A	N/A	0	0	0
	Canopy Cover	5	5	0	5	5	3	0	N/A	N/A	0	0	3
	Lack of Weeds	15	6	2	11	11	11	6	11	7	2	2	4
	Understorey	25	5	5	5	5	5	5	5	5	5	15	5
	Recruitment	10	5	0	0	0	0	0	6	10	5	5	5
	Organic Litter	5	2	4	5	5	5	5	5	4	2	2	4
	Logs	5	0	0	0	0	0	0	N/A	N/A	0	0	0
	Adjustment for treeless EVC		–	–	–	–	–	–	1.36	1.36	–	–	–
	Subtotal		23	11	29	26	32	18	36.72	35.36	14	24	21
Landscape	Patch Size	10	6	2	6	6	6	6	1	6	1	1	1
	Neighbourhood	10	0	0	0	0	0	0	0	0	0	0	0
	Distance to Core Area	5	0	0	0	0	0	0	1	0	0	0	0
HABITAT SCORE %		100	29	13	35	32	38	24	38.72	41.36	15	25	22
Habitat Score (out of 1.00)		1.00	0.329	0.13	0.35	0.32	0.38	0.24	0.39	0.41	0.15	0.25	0.22
Area of the habitat zone (hectares)		(#.###)	0.050	2.400	2.290	0.107	0.179	7.689	0.614	0.627	0.019	0.71	0.12
HABITAT HECTARES		(#.###)	0.015	0.312	0.802	0.034	0.068	1.845	0.238	0.259	0.033	0.178	0.026
Bioregion			Victorian Volcanic Plain (all HZs)										
EVC Conservation Status			Endangered+ (all HZs)										
Cons. Significance	Conservation Status x Habitat Score		H	H	VH	H	VH	H	VH	VH	H	H	H
	Threatened Species Rating		H (SSL); H (GGF)	H (GGF)	VH (SSL); H (GSM)	VH (SSL); H (GSM)	VH (SSL); H (GSM)	VH (SSL); H (GSM)	VH (SSL); H (GSM)	VH (SSL); H (GSM)	H (SSL)	H (SSL)	H (SSL)
	Other Site Attribute Rating		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Overall (highest)		H	H	VH	H	VH	H	VH	VH	H	H	H
No. Large Old Trees			0	0	2	0	3	1	0	0	0	0	1

Table 2. continued

Habitat Zone			HZ14	HZ15	HZ16	HZ18	HZ20	HZ21	HZ22	HZ23
EVC			PlGrWd	AqHe/PlGrWe mosaic [1]^	PlGrWe	PlGrWe	PlGrWd [2]	PlGr [3]	PlGr/PlGrWe mosaic^	PlGr [4]
		Max. Score								
Site Condition	Large Old Trees	10	3	0	0	0	0	0	0	0
	Canopy Cover	5	3	0	0	0	0	0	0	0
	Lack of Weeds	15	11	11	11	11	6	6	7	6
	Understorey	25	5	5	5	5	5	5	5	5
	Recruitment	10	3	6	6	6	0	0	3	0
	Organic Litter	5	5	5	5	5	5	0	5	5
	Logs	5	0	0	0	0	0	5	0	0
	Adjustment for treeless EVC		–	1.36	1.36	1.36	–	–	1.36	1.36
	Subtotal		30	36.72	36.72	36.72	16	24.48	27.2	21.86
Landscape	Patch Size	10	2	1	1	6	2	1	1	1
	Neighbourhood	10	0	0	0	0	0	0	0	0
	Distance to Core Area	5	0	1	1	0	0	1	1	1
HABITAT SCORE %		100	32	38.72	38.72	42.72	18	26.48	29.2	23.76
Habitat Score	(out of 1.00)	1.00	0.32	0.39	0.39	0.43	0.18	0.26	0.29	0.24
Area of the habitat zone (hectares)		(#.###)	1.191	0.14	0.866	0.730	2.56	1.13	1.81	1.7
HABITAT HECTARES		(#.###)	0.381	0.054	0.335	0.312	0.461	0.299	0.523	0.404
Bioregion			Victorian Volcanic Plain (all HZs)							
EVC Conservation Status			Endangered+ (all HZs)							
Cons. Significance	Cons. Status x Habitat Score		VH	VH	VH	VH	H	H	H	H
	Threatened Species Rating		VH (SSL); H (GSM)	H (GGF)	H (SSL, GGF)	VH (Br), H (SSL, GGF)	VH (SSL, Br); H (GSM)	VH (SSL); H (GSM)	VH (Br); H (SSL,GSM)	VH (SSL); H (GSM)
	Other Site Attribute Rating		N/A	N/A	N/A	N/A	N/A	N/A	N/7A	N/A
	Overall (highest)		VH	VH	VH	VH	VH	VH	VH	VH
Large Old Trees			1	0	0	0	0	0	0	0

Table 2. continued

[1] HZ15 was previously regarded as being Plains Grassy Wetland.
[2] Habitat Score based on assessment of the previous HZ9.
[3] Habitat Score based on assessment of now cleared HZ9 with an adjustment for change of EVC from Plains Grassy Woodland to Plains Grassland.
[4] Habitat Score based on assessment of now cleared HZ17 with an adjustment for change of EVC from Plains Grassy Woodland to Plains Grassland: should be re-assessed in mid-late spring to determine if Plains Grassy Wetland is more correct EVC for this HZ.
^ Habitat zone assessed as for the dominant EVC in the mosaic.

Legend

EVCs

61	Plains Grassy Woodland
125	Plains Grassy Wetland
132	Plains Grassland
653	Aquatic Herbland
897	Plains Grassland/Plains Grassy Woodland Mosaic
-	Plains Grassland/Plains Grassy Wetland Mosaic
-	Plains Grassy Wetland/Aquatic Herbland

Conservation Significance

VH	Very High
H	High

Threatened Species

Br	Brolga
GSM	Golden Sun Moth
SSL	Striped Legless Lizard
GGF	Growling Grass Frog

Table 3. Summary of scattered trees outside habitat zones

Tree Size in Plains Grassy Woodland	Number	Conservation Significance^
Very Large Old Tree (VLOT) ≥105cm DBH	0	High
Large Old Tree (LOT) ≥70cm DBH	4	High
Medium Old Tree (MOT) ≥ 52.5 to <70cm DBH)	6	High
Small Tree (ST) 10<52.5cm DBH	2	-
Total	**9**	

^ Following Appendix 3, Table 5 of the Native Vegetation Framework, conservation significance is based on an effective Habitat Hectares score of 0 (since these trees don't occur in habitat zones) and the conservation status of Plains Grassy Woodland in the Victorian Volcanic Plain Bioregion (i.e. Endangered).

3.1.4 Significant Vegetation Communities Recorded in the Study Area

One vegetation community that is listed as Critically Endangered under the EPBC Act 1999, the Natural Temperate Grassland of the Victorian Volcanic Plain, occurs within the study area. The key diagnostic characteristics of this community are:

- "The grassland is mainly associated with Quaternary basalt soils within the Victorian Volcanic Plain IBRA bioregion. Pockets of similar grassland extend into the adjacent Victorian Midlands and South-east Coastal Plain bioregions. These are included in the listed ecological community if they meet the other key diagnostic characteristics and condition thresholds.

- At least one of the following grass genera is the dominant native species in the ground layer: *Themeda* (Kangaroo-grass), *Austrodanthonia* (Wallaby-grass), *Austrostipa* (Spear-grass) and/or *Poa* (Tussock-grass).

- The minimum size of the grassland patch and the maximum cover of woody vegetation depend on the native vegetation remnant within which the grassland patch occurs. The small minimum sizes take into account that land use history has resulted in generally very small and fragmented patches (Department of Sustainability and Environment 2004a) but, despite this, small patches of intact grassland can remain effective for conservation purposes (McCarthy et al. 2006). It also takes into account that grassy woodlands may include naturally open gaps amongst trees; where gaps are greater than 0.5 ha, they are considered to be natural temperate grassland.

    - For a native vegetation remnant ≤1 hectare in size, the minimum contiguous size of the grassland patch is 0.05 hectare and the crown cover of shrubs and trees over one metre tall within the grassland patch should not exceed 5%;

- For a native vegetation remnant >1 hectare in size, the minimum contiguous size of a grassland patch is 0.5 hectare and the density of mature trees within the grassland patch should not exceed 2 trees per hectare" (DEWHA 2008b)."

Natural Temperate Grassland of the Victorian Volcanic Plain is also defined by one or more of the following condition thresholds:

- "The total perennial tussock cover represented by the native grass genera *Themeda*, *Austrodanthonia*, *Austrostipa* or *Poa* is at least 50%;
- If the total perennial tussock cover represented by the above 4 native grass genera is less than 50%, then the ground cover of native forbs (wildflowers) is at least 50% of total vegetation cover during spring-summer (September to February);
- The cover of non-grass weeds is less than 30% of total vegetation cover at any time of the year" (DEWHA 2008b)."

The native vegetation of the south-eastern part of the study area includes several discrete areas of native vegetation that fulfil the criteria and thresholds above for Natural Temperate Grassland of the Victorian Volcanic Plain. These areas and their equivalent EVCs are listed in Table 4.

Table 4. Areas of Natural Temperate Grassland of the Victorian Volcanic Plain within the study area

Grassland area	1	2	3^	4	5
Component habitat zones	3, 4, 5, 6, 8, 12	20	14, 21, 7, 16	22	23
EVCs	Plains Grassland, Plains Grassy Woodland, Plains Grassy Wetland	Plains Grassy Woodland	Plains Grassland, Plains Grassy Woodland, Plains Grassy Wetland	Plains Grassland / Plains Grassy Wetland mosaic	Plains Grassland
Area (ha)	11.62	2.56	2.321	1.81	1.7
Number of mature trees	6	0	1	0	0
Density of mature trees (trees/ha)	1.94	0	2.321	0	0

^ This grassland area overlaps the study area and the neighbouring Rail Trail reserve.

The Plains Grassland EVC within the study area also falls within the definition of a vegetation community listed as threatened under the FFG Act: Western (Basalt) Plains Grasslands Community (listing number 140) (Muir 1994).

3.2 Flora

A total of 147 taxa (species or subspecies) of plants were recorded within the study area (refer to Appendix 2). Of these, 79 (54 per cent) are locally indigenous taxa. All other taxa are introduced species or indigenous to other regions of Victoria. One of the latter group, Boobialla *Myoporum insulare* occurs as a small patch of large individuals which may be locally indigenous.

3.2.1 Significant Species Recorded Within the Study Area

One species of state has been recorded within the study area: Wetland Blown-grass *Lachnagrostis filiformis* var. 2 (Insufficiently Known in Victoria).

Sixty species that are considered to be of regional significance were recorded in the study area (see Appendix 3).

Other indigenous species are considered to be of regional or high local significance.

3.2.2 Significant Species Potentially Occurring in the Study Area

Twenty-three indigenous species of state and/or national significance were recorded or are predicted to occur within a ten kilometre radius search area according to the state FIS and the federal PMST database (see Appendix 4). The likelihood of these species occurring in the study area was assessed using the following criteria:

- the presence of suitable habitat, based on a brief literature review;
- plants seen during this study; and
- plants shown in past records in the FIS database occurring near or within the study area.

Thirteen significant species have at least a moderate likelihood of occurring in the study area and are discussed further below.

Wetland Blown-grass *Lachnagrostis filiformis* var. 2 (Insufficiently Known in Victoria) was recorded in Habitat Zone 15 during this current study and could occur elsewhere in grassy wetlands, drains and dam edges within the study area. Other significant species that could occur in similar habitats on site are: Wavy Swamp Wallaby-grass *Amphibromus sinuatus*, Green-top Sedge *Carex chlorantha*, Purple Blown-grass *L. punicea* subsp. *filifolia*, Purple Blown-grass *L. punicea* subsp. *punicea* (Insufficiently Known to Vulnerable in Victoria); Swamp Everlasting *Xerochrysum palustre* and Curly Sedge *Carex tasmanica* (Vulnerable nationally); and Adamson's Blown-grass *L. adamsonii* (Endangered nationally).

Other significant species that are more likely to be found in grassland or grassy woodland are: Yarra Gum *Eucalyptus yarraensis* (Rare in Victoria); Clover Glycine *Glycine latrobeana* (Vulnerable nationally); and Maroon Leek-orchid *Prasophyllum frenchii,* Matted Flax-lily *Dianella amoena*; and Spiny Rice-flower *Pimelea spinescens* subsp. *spinescens* (Endangered or Critically Endangered nationally). Yarra Gum has been found just outside the study area (Kennedy & Kern 2004). The Matted Flax-lily and Spiny Rice-flower have both been recorded in the local area (DSE 2005a).

Yarra Gum, Clover Glycine, Adamson's Blown-grass, Purple Blown-grass, Maroon Leek-orchid, Swamp Everlasting, Curly Sedge and Spiny Rice-flower are also listed as threatened under the Flora and Fauna Guarantee Act 1988.

3.3 Fauna

Fifteen mammal species (including 5 introduced), 158 bird species (including nine introduced species), three reptile species, six frog species and thirteen fish species (including 5 introduced species) have been recorded from the local area (DSE 2005b).

It should be emphasised that no detailed fauna survey was undertaken at the study area.

3.3.1 Significant Species Recorded Within the Study Area

Two Brolgas *Grus rubicundus* (listed as Vulnerable in Victoria) were recorded in the study area on 19 June 2008. These birds ranged over a fallow, cultivated paddock close to a dam and the drainage line that passes through the south part of the study area. This species is likely to range over a large part of the study area since they are well known to forage in cultivated areas and in damper pastures. Otherwise, they will inhabit shallow wetlands and margins of deeper wetlands as well as native grasslands on plains and along drainage lines.

All other native species occurring naturally within the study area are considered to be at least locally significant.

3.3.2 Significant Species Potentially Occurring in the Study Area

A total of 45 species of fauna of state and/or national significance have been recorded or are predicted to occur within ten kilometres of the centre of the study area according to the Victorian Fauna Database (VFD) and EPBC Act Protected Matters Search Tool (see Appendix 5). The likelihood of these species occurring in the study area is assessed using the following criteria:

- the conservation status of the species and its distribution;
- previous recordings of species in the local area;

- the habitat requirements of individual species;
- the physical attributes of the study area, such as trees with hollows, the presence of rocks or boulders, logs on the ground;
- the fragmented and highly modified environment surrounding the study area.

Six significant species have at least a moderate likelihood of occurring in the study area and are discussed further below.

Latham's Snipe *Gallinago hardwickii*

Latham's Snipe is listed as near threatened by DSE (2007b) and is listed as a migratory wetland and marine species under the EPBC Act. This species is generally shy and may occur within the study area within damp grassland (such as in shallow wetlands or on the margins of deeper wetlands).

Spotted Harrier *Circus assimilis*

The Spotted Harrier is listed as near threatened by DSE (2007b) and is listed as a migratory and/or marine species under the EPBC Act. This species usually occurs in grasslands, open shrublands, open woodlands, crops and similar low vegetation in southern Victoria in summer.

White-throated Needletail *Hirundapus caudacutus*

The White-throated Needletail is listed as a migratory terrestrial and marine species under the EPBC Act. It is a mainly aerial summer migrant to Victoria and can be expected to forage over the study area (with one previous record locally - DSE 2005b), but would be very unlikely to directly use the habitat on site.

Striped Legless Lizard *Delma impar*

The Striped Legless Lizard occurs in native grasslands and grassy woodlands; within Victoria, its range is centred on the volcanic plains west of Melbourne. In this region, this species tends to use habitats with relatively dense tussock cover (for shelter, foraging and possibly breeding), with cracking clay soil and under rocks for shelter and possibly breeding. While not previously recorded in the local area, the study area could support this species since there are several suitable habitat features present:

- patches of native grassland with a high density of tussock grasses;
- a thin layer of basaltic soil (which will readily produce cracks in dry seasons) over sedimentary soils; and

- surface rock.

In Victoria, a lack of loose surface rocks in otherwise suitable habitat has been taken as indicating relatively poor habitat for the Striped Legless Lizard. However, in the ACT, native grasslands "generally lack extensive cracks in the soil, with rocks, logs and any other surface debris generally uncommon" Nunan (undated) but still support this species. Possible overwintering sites are at the base of grass tussocks, under the ground surface or thatch cover (Delma Working Group 1994 in Nunan undated). Accordingly, a lack of loose surface rocks that is allowing for cavities underground) and surface debris such as occurs in the study area does not mean that the Striped Legless Lizard does not occur on site. The density of native grasses and even exotic grasses provides potential habitat for this species in many parts of the former Little property in the study area. It is not known if narrow strips of relatively intact native grassland such as those occurring along roadsides will support this species. Cultivated areas are very unlikely to support any of these lizards although less disturbed fallow areas with persistent and recolonising native species could be used by Striped Legless Lizards in time.

Growling Grass Frog *Litoria raniformis*

The Growling Grass Frog is listed as vulnerable under the EPBC Act 1999, as threatened under the FFG Act 1988 and endangered by DSE (2007b).

This species prefers the vegetated margins of permanent and occasionally ephemeral water bodies such as farm dams, flooded quarries, sewage ponds, swamps, lakes and slow moving or still water courses for breeding and foraging. Other habitats that they use are drains and other damp areas (as links between wetland sites), and refuges such as rocks and logs near wetland areas.

There are four records of the Growling Grass Frog in the local area, at Haddon (approximately 5 kilometres from the study area) (DSE 2005b). These records are likely to be an under-representation of the frequency of occurrence of this species in the local area since there are a number of dams scattered over the local area and there are several drainage lines to facilitate dispersal of frogs.

Golden Sun Moth *Synemon plana*

The Golden Sun Moth is listed as threatened under the Victorian Flora and Fauna Guarantee (FFG) Act 1988 and as a critically endangered species under the EPBC Act.

The moth is known to occur in grassland habitats dominated by Wallaby Grasses *Austrodanthonia spp*. The species occurs in scattered and isolated locations in southern NSW, and in Victoria (Zborowski and Edwards 2007). The Wallaby Grasses that seem to be preferred by Golden Sun Moths are Short Wallaby-grass *A. carphoides*, Lobed Wallaby-grass *A. auriculata*, Hill Wallaby-grass *A. eriantha* and Bristly wallaby-grass *A. setacea*. It was generally thought that the percentage of Wallaby Grass cover must be greater than 40% in

suitable grassland patches (O'Dwyer & Attiwill 2000). However, observations of Golden Sun Moths made during 2005, west of Melbourne, were made at a property with a less than 25% cover of Wallaby Grass (R. McMahon, pers. obs.). Braby & Dunford (2006) also note that some recently discovered habitats of the Golden Sun Moths near Melbourne have relatively little Wallaby Grass cover. New *et al.* (2007) have raised the possibility that the pupae of the moths may feed on the weed species Chilean Needle-grass *Nassella neesiana* which occurs in the Ballarat district. These recent observations suggests that suitable habitat for the Golden Sun Moth may be more variable than currently accepted, being influenced by factors such as landscape position, terrain and soil type as well as host plant species.

3.3.3 Fauna habitat

The study area contains seven habitat types with a variety of opportunities for foraging, sheltering and breeding by fauna (refer to Map 4). These habitat types are outlined below.

Low rises

This habitat consists of grassland vegetation with an occasional remnant gums. Native and exotic grasses, and underneath or beside surface rocks and solid rubbish provide habitat for reptiles, invertebrates and possibly small mammals (including the introduced House Mouse **Mus musculus*). Rocks are particularly important to reptiles for subsurface shelter and for above ground basking for thermoregulation.

Drainage lines

Drainage lines in the study area are of low gradient and are only slightly lower than the surrounding landscape. In dry seasons, they are virtually indistinguishable from adjacent areas since they are visually dominated by a common suite of native and exotic grasses. In wetter seasons, the vegetation is markedly different (comprising many obligate wetland species) and may include discrete pools of water. This habitat type usually extends to the edges of dams which constitute a separate habitat type.

Frogs and snakes are likely to prefer drainage lines in wet seasons but will disperse to other areas or seek refuge under nearby shelter such as fallen wood, discarded fence posts and rocks.

Dams and wetlands

These habitats cover a variety of types including:

- dams with bare edges with open water containing variable amounts of aquatic vegetation (where heavily used by livestock);

- shallow dams dominated by tall sedges, rushes and grasses on the margins and with submerged aquatic herbs in the deepest parts; and
- seasonally inundated meadows that are superficially difficult to distinguish from surrounding grasslands but contains a suite of plant species adapted to wet conditions.

Plains

The largest areas of habitat within the study area are on the plains. Due to the low gradients in the local area, this habitat type merges into shallow wetlands and low rises, and has also been extensively cleared for agriculture.

Plains habitats may have some small areas of surface or subsurface rock as well as scattered trees.

Indigenous trees

The widely scattered remnant Swamp Gums growing within the plains habitat provide a range of microhabitats for fauna. Blackwoods *Acacia melanoxylon* also provide some microhabitats. Large native trees in the study area occur within habitat zones and as Scattered Trees within cropped paddocks.

All the trees on site have a range of hollows that may have been used by small to medium birds, such as Striated Pardalote *Pardalotus striatus* and Eastern Rosella *Platycercus eximius* and mammals such as the Common Brushtail Possum *Trichosurus vulpecula* and microbats for shelter or breeding and/or foraging.

The low density of individual trees and the lack of shrubby understorey vegetation or any native vegetation indicate that many bird species and mammal species may no longer use these habitats. It is likely that the more mobile birds and bats, and species suited to mainly cleared habitats (such as the House Mouse) still use old trees at the site. Notably, bats in farmland areas of northern Victoria and southern NSW make extensive use of scattered trees in paddocks, and are widespread throughout farmlands (Lumsden & Bennett 2003).

Blue Gum Plantation

The Blue Gum Plantation in the northern part of the study area provides habitat for a variety of woodland, forest and grassland birds when the trees are saplings through to harvestable size (including coppice growth after harvesting). Trees with dense canopy growth should also be able to support Common Brushtail Possums *Trichosurus vulpecula* and Common Ringtail Possums *Pseudocheirus peregrinus*.

In addition to the above habitat types, cultivated or grazed land may also be used by indigenous grassland bird and waterbird species such as Richard's Pipit *Anthus*

novaeseelandiae, Australian Shelduck *Tadorna tadornoides*, Australian Magpie *Gymnorhina tibicen* and the Brolga. Other bird species, frogs and reptiles also likely to use agricultural land, mainly using small areas containing native plants for foraging, shelter or while dispersing.

4. RELEVANT POLICY AND LEGISLATION

This section outlines relevant policy and legislation pertaining to biodiversity from the national level through to the local level. Where necessary, these matters are analysed further in section 5.

4.1 Environment Protection and Biodiversity Conservation Act

The *EPBC Act* 1999 was created to provide streamlined protection and management of nationally important natural and cultural features known as "matters of national environmental significance" (DEH 2006). The matters of national environmental significance that are relevant to the study area are:

- listed threatened species and ecological communities;
- listed migratory species;
- the Commonwealth marine environment; and
- wetlands of International Importance.

4.1.1 Listed threatened, migratory and marine species

Using the EPBC Act Protected Matters Search Tool (PMST), 23 threatened flora and fauna species, 13 migratory fauna species, 11 marine overfly fauna species and one threatened ecological community were predicted to occur within a ten kilometre radius of the centre of the study area (refer to Appendices 4 and 5 for predicted flora and fauna species respectively). These totals exclude obligate pelagic fauna, such as seabirds, cetaceans and seals that are not relevant to the study area. Many other species that are listed under the EPBC Act but are regarded as being vagrants, "terrestrial species that overfly the Commonwealth marine area" or "migratory species that are very widespread, vagrant, or only occur in small numbers" (DEWHA 2008a) are not included in the PMST report and are not considered within this report.

The six threatened flora species, three threatened fauna, two migratory and/or marine species and one threatened ecological community that have at least a low-moderate likelihood of occurring within the study area are examined further in Section 5.2.

4.2 Flora and Fauna Guarantee Act

The *Flora and Fauna Guarantee* (FFG) *Act 1988* was legislated to ensure the continued survival of all species of flora and fauna and communities of plants and animals in Victoria. The Act builds on broader national and international policy including the principles of

biodiversity conservation. A key component of the FFG Act is to support the sustainable use of flora and fauna resources whether they are threatened or not. The parts of the FFG Act that apply to the study area are outlined below.

4.2.1 Threatened species and communities

Eleven flora species and 26 fauna species listed as threatened under the FFG Act 1988 are predicted to occur or have been recorded within ten kilometres of the study area. Eight flora and three fauna species have at least a moderate likelihood of occurrence in the study area. One listed species, the Brolga, was recorded on site in June 2008.

Action statements have been prepared under the FFG Act 1988 for the Brolga, Striped Legless Lizard, Golden Sun Moth, Spiny Rice-flower and Western (Basalt) Plains Grassland Community No. 53 (which includes Plains Grassy Woodland and Plains Grassland).

4.2.2 Protected Flora

A number of non-threatened plant species are listed under the FFG Act 1988 as Protected Flora to regulate exploitation including removal from the wild for cultivation and the cut-flower industry. Among others the list includes all members of the Asteraceae (daisies) family, all members of Epacridaceae (heaths), all members of Orchidaceae (orchids) and all Acacias (excluding Silver, Early Black, Lightwood, Blackwood and Hedge Wattles).

Several Protected Flora species were observed within the study area. A permit would be required if the proposed works may kill, injure or disturb any listed flora species found in the study area. Such a permit is obtainable from regional DSE offices and online.

4.2.3 Potentially Threatening Processes

Schedule 3 of the FFG Act 1988 lists numerous Potentially Threatening Processes. These processes have been identified as a threat to the survival of one or more species of flora or fauna or a community. A number of threatening processes operate across Victoria and across all land tenures while some are specific to a defined locality.

Within the study area, Potentially Threatening Processes that are occurring or where the occurrence is inferred include:

- habitat fragmentation;
- predation of native wildlife by the Cat *Felis catus*;
- predation of native wildlife by the introduced Red Fox *Vulpes vulpes*;
- reduction in biomass and biodiversity of native vegetation through grazing by the Rabbit *Oryctolagus cuniculus*; and

- the invasion of native vegetation by environmental weeds.

Where practical, these Potentially Threatening Processes are addressed through a Land Management Plan including an Offset Management Plan that should be developed for the study area.

4.3 Victorian Planning Provisions

Under the *Planning and Environment Act 1997*, a permit is required to remove, destroy or lop native vegetation on parcels of land greater than 0.4 hectares. There are, however, some exemptions under clause 52.17 of all local government planning schemes.

Victorian Planning Provisions (VPPs) were introduced as part of a planning reform process in 1996 to simplify and standardise the planning process. Planning Schemes are legal instruments outlining provisions for land use, development and protection and are constructed and sourced form the VPPs. Victoria's Native Vegetation Management: A Framework for Action (DNRE 2002) is also part of all Victorian Planning Schemes.

4.3.1 Victoria's Native Vegetation Management Framework

A principle tenet of the Native Vegetation Management Framework is the objective of retention and management of native vegetation (DNRE 2002). According to the DSE (2002:14) the goal of native vegetation management in Victoria is to achieve:

A reversal, across the entire landscape, of the long-term decline in the extent and quality of native vegetation, leading to a Net Gain.

Four individual actions to achieve the above goal are outlined in the DNRE's (2002:14) Framework. These are:

- active improvement of the quality of existing vegetation;
- avoidance or minimisation of further permanent losses through clearing;
- strategic increase in the cover of native vegetation through biodiverse revegetation; and
- the flexibility that is required to support landholders as they move towards more sustainable land use.

To achieve the most strategic outcome for native vegetation across Victoria, the Framework (DNRE 2002) embraces a system of classification determining both the land protection and conservation significance of any given site. The Net Gain methodology is intended to provide a systematic approach that ensures the conservation of the majority of remnant

vegetation across Victoria. DNRE (2002:23) has established a three step approach to use when applying the Net Gain process. These steps are:

1. to avoid adverse impacts, particularly through vegetation clearance;
2. if impacts cannot be avoided, to minimise impacts through appropriate consideration in planning processes and expert input to project design or management (see Section 5.5); and
3. identify appropriate offset options (see Section 6).

Upon receiving planning applications to clear vegetation, responsible authorities make assessments relative to the conservation significance of the area. If all the preliminary processes have been correctly applied approval may be granted.

The outcome of the Net Gain process is intended to ensure that the most significant vegetation incurs no losses (exceptions do apply) and less significant vegetation is adequately managed through commensurate offsets based on the level of significance. During the process it must be ensured that every effort has been made to avoid clearing remnant vegetation and, if clearance is unavoidable, that impacts have been minimised and the most significant vegetation is protected and managed.

Within the study area, Net Gain policy applies to the habitat zones and Scattered Trees where losses are incurred. The response to this policy and the offsets required for loss of native vegetation in habitat zones is outlined in Table 5.

Table 5. Response and Offset Criteria For Loss of Native Vegetation

Conservation Significance	Responses & Offset Objectives	Like-for-like Offset Criteria
Very High	Clearing generally not permitted unless exceptional circumstances apply. Substantial net gain, at least 2.0 X the calculated loss in Habitat Hectares. Gains must be of an ongoing and secure nature	The same vegetation/habitat type. Similar or more effective ecological and protection functions as vegetation affected by the loss. The existing vegetation proposed as the basis of an offset must be at least 90% of the quality in the area being lost. Proportion of revegetation included in offset (in Habitat Hectares) is limited to 10%.
High	Clearing generally not permitted. Net gain, at least 1.5 X the calculated loss in Habitat Hectares. Gains must be of an ongoing and secure nature	The same vegetation/habitat type OR a Very High significance vegetation/ habitat in the same bioregion Similar or more effective ecological function OR land protection function as

Conservation Significance	Responses & Offset Objectives	Like-for-like Offset Criteria
		affected by the loss
High	Clearing generally not permitted. Net gain, at least 1.5 X the calculated loss in Habitat Hectares. Gains must be of an ongoing and secure nature	The existing vegetation proposed as the basis of an offset must be at least 75% of the quality in the area being lost. Proportion of revegetation included in offset (in Habitat Hectares) is limited to 25%.

The response to the loss of large old trees in habitat zones and loss of scattered trees under Net Gain policy and the required offsets are outlined in Table 6.

Table 6. Response and offset criteria for losses of old trees (I)

Conservation Significance	Response	Like-for-like Offset Criteria
Very High	Clearing not permitted unless exceptional circumstances apply.	**Remnant patches of native vegetation that contain large old trees**: protect 8 other large old trees and recruit 40 new trees for each large tree lost
	Substantial Net Gain which must be of an ongoing and secure nature.	**Parcels of land >4ha with ≥8 scattered old trees/ha**: protect 8 other large old trees and recruit 40 new trees for each large tree lost; protect 4 other large old trees and recruit 20 new trees for each medium tree lost
High	Clearing generally not permitted.	**Remnant patches of native vegetation that contain large old trees**: protect 4 other large old trees and recruit 20 new trees for each large tree lost
	Net Gain which must be of an ongoing and secure nature.	**Parcels of land >4ha with ≥8 scattered old trees/ha**: protect 4 other large old trees and recruit 20 new trees for each large tree lost; protect 2 other large old trees and recruit 10 new trees for each medium tree lost

4.3.2 Corangamite Vegetation Management Plan

The Corangamite Native Vegetation Plan (CCMA 2005) outlines offset requirements for the replacement of native vegetation proposed for clearing. These offset requirements are consistent with the Native Vegetation Management Framework; they only differ from the Framework in the method by which losses of scattered trees are offset for parcels of land

>4ha with <8 scattered old trees or land <4ha with any number of scattered old trees (see Table 7).

Table 7. Response and offset criteria for losses of old trees (II)

Conservation Significance	Response	Like-for-like Offset Criteria
Very High	Clearing not permitted unless exceptional circumstances apply.	**Parcels of land >4ha with <8 scattered old trees or land <4ha with any no. scattered old trees** (following the regional native vegetation plan (CCMA 2005):
	Substantial Net Gain which must be of an ongoing and secure nature.	Protect and Recruit option: protect 6 other large old trees and recruit 30 new trees for each very large tree lost; protect 4 other large old trees and recruit 20 new trees for each large tree lost; protect 2 other medium old trees and recruit 10 new trees for each medium old tree lost. Recruit Only option: • 400 new plants for each very large old tree lost • 200 new plants for each large old tree lost • 100 new plants for each medium old tree lost • ≤ 50 new plants for each other tree lost.
High	Clearing generally not permitted.	**Parcels of land >4ha with <8 scattered old trees or land <4ha with any no. scattered old trees** (following the regional native vegetation plan (CCMA 2005):
	Net Gain which must be of an ongoing and secure nature.	Protect and Recruit option: protect 4 other very large old trees and recruit 20 new trees for each very large tree lost; protect 2 other large old trees and recruit 10 new trees for each large tree lost; protect 1 other medium old trees and recruit 5 new trees for each medium old tree lost. Recruit Only option: 200 new plants for each very large old tree lost 100 new plants for each large old tree lost 50 new plants for each medium old tree lost ≤ 50 new plants for each other tree lost.

4.3.3 Ballarat Planning Scheme

The study area falls within a Comprehensive Development Zone (CDZ), and parts of a drainage line running through the area are covered by a Significant Landscape Overlay (SLO) and an Erosion Management Overlay (EMO) (DSE 2008a).

The schedule to the CDZ notes that the intention of the CDZ is "To provide for the integrated and environmentally sustainable use and management of the whole of the land". General environmental aims are included in the full description of the CDZ, particularly in relation to the provision of an Environmental Assessment Plan. Specific requirements relating to flora and fauna are covered in section 3.0 of the schedule (Buildings and works) which states that "A permit is required to remove, destroy or lop a tree that is shown as 'to be retained' on an approved Landscape Plan" (DSE 2008a).

The Environmental Assessment Plan is detailed in section 3.01 of the schedule to the CDZ and must address a number of matters of which the most directly relevant to ecological values and management are:

- the staging of the proposed works;
- environmentally sustainable design principles;
- a fauna assessment of the land;
- an assessment of any impact on the former Ballarat-Skipton rail trail and the identification of appropriate improvements;
- actions to be taken to ensure that negative environmental and amenity impacts and nuisance are minimised and that environmental threats are reduced;
- details of the layout of the land including proposed tree plantations, drainage systems, wetlands, irrigation systems, lakes, works related to the golf courses, roads, car parking, pedestrian links; pleasure boat facility, and proposed buildings;
- details and the basis of selection of species of trees, shrubs, grasses and other vegetation to be planted on the land;
- details of how the development will manage and enhance native vegetation on the site, including an assessment of how the plan addresses:
    - "Victoria's Native Vegetation Management – A Framework for Action" and the achievement of net gain outcomes as defined in the framework.
    - the native vegetation strategy in any relevant regional catchment management strategy."

In section 3.1.3 of the schedule, Section 173 Agreement(s), requirements that have direct implications for the ecological management of the site are:

- identification of which entity other than Ballarat City Council is to be responsible for the ongoing maintenance and management of the watercourses, lakes and wetlands created as part of the development;
- The structure for the ongoing maintenance, management and operation of the land as an integrated resort; and
- If required by Central Highlands Water, provisions dealing with:

- the supply and use of water for the development;
- the construction, ongoing maintenance and management of infrastructure relating to water supply and use in the development;
- appropriate security for relevant stages of construction and ongoing management of appropriate infrastructure relating to water supply and use in the development; and
- the establishment, management and operation of the recycled water system.

The EMO notes that a permit is generally required to remove, destroy or lop any vegetation but does not apply "If a schedule to this overlay specifically states that a permit is not required". The schedule to the EMO states that a permit is not required to either

- "construct a building or to construct or carry out works shown on a Lake Federation Resort Detailed Development Plan approved under Schedule 1 to the Comprehensive Development Zone" which implicitly requires the removal, destruction or lopping of any vegetation; or

- "to remove, destroy or lop vegetation that is nominated to be removed on the Landscape Plan approved under Schedule 1 to the Comprehensive Development Zone".

Under the SLO, a permit is normally required to

- construct a building or construct or carry out works;

- construct a fence if specified in the schedule to this overlay; and/or

- remove, destroy or lop any vegetation specified in a schedule to this overlay.

However, a permit is not required for building, construction or works within the area covered under the Lake Federation Resort Detailed Development Plan that should be approved under Schedule 1 to the Comprehensive Development Zone, nor for the removal, destruction or lopping of vegetation that is "nominated to be removed [under] the Landscape Plan approved under Schedule 1 to the Comprehensive Development Zone".

4.4 Catchment and Land Protection (CaLP) Act 1994.

4.4.1 Declared Noxious Weeds

The roadside adjacent to the study area supports a number of weed species that are declared noxious under the *Catchment and Land Protection (CaLP) Act 1994.* Declared noxious weeds are known to, or have the potential to, cause detrimental environmental and/or economic impacts.

Under the CaLP Act 1994, declared noxious weeds are categorised into four groups depending on their known and potential impact and specific circumstances for each region. These categories are:

- State Prohibited Weeds (S);
- Regionally Prohibited Weeds (P);
- Regionally Controlled Weeds (C); and
- Restricted Weeds.

State Prohibited Weeds are either currently absent in Victoria or are restricted enough to be eradicated. The Victorian Government is responsible for their control.

Regionally Prohibited Weeds in the Corangamite catchment are not necessarily widespread but have the potential to become widespread. It is expected that weeds that meet this criteria can be eradicated from the region. For weeds considered to be Regionally Prohibited it is the responsibility of the land owner to control these weeds on their land but not on adjacent roadside reserves.

Regionally Controlled weeds are usually widespread but it is important to prevent further spread. It is the responsibility of the landowner to control these weeds on their property and on adjacent roadside reserves.

Restricted Weeds occur in other states and are considered to be a serious threat to primary production, Crown land, the environment and/or community health if they were traded in Victoria. No weeds are currently listed as Restricted Weeds.

Faithfull (2006) lists the classification of each noxious species within different parts of Victoria.

The study area supports at least seven declared noxious weed species (see Table 8). The control of these weeds on private land and adjacent roadsides is the responsibility of the landholder, who must take all reasonable measures to prevent their spread and to control them.

Table 8. Declared noxious weeds recorded within the study area

Origin	Scientific Name	Common Name	Control Category (Corangamite)
Exotic	*Carduus pycnocephalus* or *C. Tenuiflorus*	Shore or Slender Thistle	regionally-controlled
Exotic	*Cirsium vulgare*	Spear Thistle	regionally-controlled
Exotic	*Cynara cardunculus*	Artichoke Thistle	regionally-controlled
Exotic	*Calicotome spinosa*	Spiny Broom	regionally-controlled

Exotic	*Genista monspessulana*	Cape or Montpellier Broom	regionally-controlled
Exotic	*Ulex europaeus*	Gorse	regionally-controlled
Exotic	*Rosa rubiginosa*	Sweet Briar	regionally-controlled

5. IMPLICATIONS OF THE PROPOSED DEVELOPMENT

This section addresses the impacts of the proposed development in the study area from activities such as vehicular access and construction works. The Habitat Hectare losses that would result from these impacts and the Net Gain targets required to mitigate these losses are also determined in this section.

5.1 Overview of Proposed Development

Native vegetation in the study area will be affected by the proposed development with small patches completely removed from the majority of the site (which is mainly cleared already) but with the largest patches largely retained in the south to south-east section mainly within the former Little property. Scattered trees in both these general areas could be retained for landscape and short-medium term fauna habitat purpose but be regarded as effectively lost for Net Gain purposes if they remain on lots smaller than 4000 m2.

Development Plan 306-015- UD MP 02 dated 20 February 2009 provides an overview of the development in its seven stages. Existing ecological conditions are displayed in Maps 2 and 3 while areas of proposed native vegetation retention and loss are displayed in Map 5. Final areas of retention and loss, including vegetation restoration zones should be fully defined in an Offset Management Plan that should be prepared as part of the planning permit for the proposed residential development.

5.2 EPBC Act

One vegetation community which is listed as Critically Endangered under the EPBC Act, Natural Temperate Grassland of the Victorian Volcanic Plain, occurs in the south-east of the study area at the former Little property. The nationally Critically Endangered Golden Sun Moth and Spiny Rice-flower, endangered Adamson's Blown-grass, Maroon Leek-orchid and Matted Flax-lily, and nationally Vulnerable Striped Legless Lizard, Growling Grass Frog Clover Glycine, Swamp Everlasting and Curly Sedge potentially occur in the study area. Accordingly, the significant impact criteria of the EPBC Act that are relevant to threatened communities and species need to be examined further.

Two listed migratory and/or marine overfly species predicted by the PMST either occur in the local area or could be expected to occur in the study area. The significant impact criteria for migratory species in the EPBC Act also need to be examined further. In considering these criteria, it should be noted that DEH (2006) defines a population of a species as an “occurrence of the species in a particular area”, with occurrence including but not limited to:

- “a geographically distinct regional population, or collection of local populations”; or

- a population, or collection of local populations, that occurs within a particular bioregion".

These definitions apply to the Golden Sun Moth, Growling Grass Frog, Striped Legless Lizard, Spiny Rice-flower, Adamson's Blown-grass, Maroon Leek-orchid, Matted Flax-lily, Clover Glycine, Swamp Everlasting and Curly Sedge since all have been recorded in the Victorian Volcanic Plain bioregion. The Growling Grass Frog, Striped Legless Lizard, Spiny Rice-flower and Matted Flax-lily have also been recorded in the local area.

5.2.1 Significant Impact Criteria for Critically Endangered and Endangered Ecological Communities

DEH (2006) lists several criteria to assess if there is a "real chance or possibility" that "an action is likely to have a significant impact on critically endangered and endangered ecological communities".

The significant impact criteria and their applicability to the Natural Temperate Grassland of the Victorian Volcanic Plain in the study area are examined below.

1. Reduce the extent of an ecological community;

Not applicable.

2. Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;

The largest patch of Natural Temperate Grassland of the Victorian Volcanic Plain in the study area is grassland area 1 as defined in Table 4 (and which comprises Habitat Zones 3-6, 8 and 12). This grassland area has links to roadside strips of vegetation which vary in quality from "remnant patches" as defined under Victoria's Native Vegetation Framework (but not fulfilling all of the diagnostic characteristics criteria for the Natural Temperate Grassland of the Victorian Volcanic Plain) to degraded vegetation with scattered native plants. These strips include Habitat Zones 1, 2, 10, 11 and 12, and are proposed to be cleared. One of these strips of vegetation is linked to Habitat Zone 20 which is referrable to Natural Temperate Grassland of the Victorian Volcanic Plain. The proposed clearing of any of these roadside strips may cut off habitat corridors for fauna (that are regarded as part of or inhabit the Natural Temperate Grassland of the Victorian Volcanic Plain community) that are able to inhabit the strips themselves or are able to disperse from other degraded habitats in the area. However, the lack of relatively good quality patches of habitat adjacent to the roadside strips (except for Habitat Zone 20) suggests that these strips may be of limited importance to local fauna populations. It is not known if the roadside strips of vegetation provide significant or viable corridors for genetic flow for plant species. The lack of links to significant patches of native vegetation (as for fauna) may count against the importance of these strips for native flora.

Restoration zones are proposed in within the cleared areas in the former Little property to link patches of Natural Temperate Grassland of the Victorian Volcanic Plain within the study area (i.e. grassland areas 1, 3-5 as listed in Table 4 and shown in Map 5).

3. Adversely affect habitat critical to the survival of an ecological community;

Not known but grassland area 2 that is proposed to be cleared may support a number of flora and fauna species that make a significant genetic contribution to adjacent patches of native grassland.

4. Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;

The land surrounding the grassland areas is proposed to be changed to residential or recreational use. This will be likely to alter recharge to the local groundwater system and drainage to the lower lying grassland areas. The magnitude of these changes is not known but is being considered in further site planning in terms of storm water management.

5. Cause a substantial change in the species composition of an ecological community, including decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;

Biomass reduction (with consequences for growth and reproduction in a variety of plant species, and for fauna habitat) is likely to have previously occurred by grazing and possibly deliberate burning. It is unclear if either of these practices could be undertaken within or on the edge of residential and recreational zones beyond the short term.

Residential and recreational land use are likely to result in changes (probably increases) to the populations of domestic and feral predators such as cats, dogs and foxes which will affect native fauna including reptiles, frogs and mammals. Furthermore, accidental or deliberate introduction of exotic plants from residential and recreational areas is likely to change the composition of the ecological community.

6. Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- assisting invasive species, that are harmful to the listed ecological community, to become established; or
- causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or

Changes to hydrology and nutrient input to local soils will affect growing conditions for native plants and invertebrate populations, with consequences for vertebrate fauna.

See also under Criteria 5.

7. Interfere with the recovery of an ecological community.

A change in management from agricultural use to managed natural parkland has negative and positive implications for the relevant grasslands in the study area.

A reduction or change in grazing and burning will alter the relative dominance of weed species and native species, with possible consequences including new weed problems and over dominance by native tussock grasses (inhibiting less vigorous native species). However, with a reduction or cessation of livestock using the grassland, some suppressed native species may show improved growth, and the introduction of new agricultural and environmental weeds may be reduced through less livestock and vehicles movements.

As managed parkland, the grassland areas would be subject to targeted weed control through techniques such as spot spraying with herbicide. This should result in better management of at least some weed species than by grazing pressure as in the past.

Overall, the grassland areas have historically been managed for agriculture which has highly modified the original vegetation community. A change in management of these grasslands to managed parkland will change the composition and structure of the ecosystem, and if managed properly, could result in an improved condition of all areas of Natural Temperate Grassland of the Victorian Volcanic Plain.

5.2.2 Significant Impact Criteria for Critically Endangered and Endangered Species

DEH (2006) lists several criteria to assess if there is a "real chance or possibility" that "an action is likely to have a significant impact on a critically endangered and endangered species".

The significant impact criteria and their applicability to the Golden Sun Moth, Adamson's Blown-grass, Maroon Leek-orchid and Matted Flax-lily in the study area are examined below.

1. Lead to a long-term decrease in the size of a population;

2. Reduce the area of occupancy of the species;

3. Fragment an existing population into two or more populations;

4. Adversely affect habitat critical to the survival of a species;

5. Disrupt the breeding cycle of a population;

6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; and

9. Interfere with the recovery of the species.

Not known. Presence/absence of these species in the study area needs to be determined.

7. Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat; and

8. Introduce disease that may cause the species to decline.

Not known.

5.2.3 Significant Impact Criteria for Vulnerable Species

DEH (2006) lists several criteria to assess if there is a "real chance or possibility" that "an action is likely to have a significant impact on a vulnerable species".

The significant impact criteria and their applicability to the Striped Legless Lizard, Growling Grass Frog, Clover Glycine, Swamp Everlasting and Curly Sedge in the study area are examined below.

1. Lead to a long-term decrease in the size of an important population;

Not known for any species. Presence/absence in the study area needs to be determined.

2. Reduce the area of occupancy of an important population of the species;

While "significant" habitat for Growling Grass Frogs is usually defined as core breeding areas which have permanent water, other habitats such as seasonal wetlands and drainage lines can be used for foraging, some breeding and dispersal. Wetland and stream systems on the Victorian Volcanic Plain should be regarded as providing habitat for an important population of this species. The study site has a good cover of native grass in the south east section which is connected via narrow corridors to other potential grassland and woodland habitat. It is not known if the Striped Legless /Lizard inhabits this apparently suitable habitat. Not known for all of the listed plant species.

3. Fragment an existing important population into two or more populations;

As for Criteria 1 and 2.

4. Adversely affect habitat critical to the survival of a species;

As for Criteria 1 and 2.

5. Disrupt the breeding cycle of an important population;

As for Criteria 1 and 2.

With regard to Growling Grass Frogs, it is likely that with several years of prevailing drought conditions in the area, there has probably been little breeding during this time. It is not known if these frogs could reappear from local refuges or recolonise from elsewhere to breed if suitable wet conditions reoccurred.

Fragmentation of habitat will particularly limit genetic exchange between local plant populations.

6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

With the local-regional population of the Growling Grass Frog possibly being inactive due to persistent drought, the importance of local habitat to this species is difficult to assess. However, this species was known to occur in nearby catchments and thus could be present in the south-west flowing creeks of the local area and may have been able to disperse north-east to Winter Swamp and beyond. Without the information required, as for Criteria 1, Criteria 6 cannot be adequately addressed for both the Growling Grass Frog and Striped Legless Lizard.

Not known for all of the listed plant species.

7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;

Not known.

Increased densities of domestic or feral predators such as cats and dogs, and Red Foxes could occur with residential subdivision and could put pressure on the populations of the Growling Grass Frog and Striped Legless Lizard if present.

8. Introduce disease that may cause the species to decline; or

Not known.

9. Interfere substantially with the recovery of the species.

Not known.

5.2.4 Significant Impact Criteria for Migratory Species

DEH (2006) presents several criteria to assess if there is a "real chance or possibility" that "an action is likely to have a significant impact on a migratory species". These criteria are listed below.

The significant impact criteria and their applicability to Latham's Snipe and the White-throated Needletail in the study area are examined below.

1. Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;

The study area cannot be considered to be important habitat for either species since the area of habitat for Latham's Snipe is very small and the White-throated Needletail is mainly an aerial species.

2. Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species;

Increased densities of domestic or feral predators such as cats and dogs, and Red Foxes could occur with residential subdivision and could put pressure on the population of the Latham's Snipe. Not applicable to the White-throated Needletail.

3. Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species."

Not applicable to either species.

In considering these criteria, an area of 'important habitat' for a migratory species is defined as:

"a) habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or

b) habitat that is of critical importance to the species at particular life-cycle stages; and/or

c) habitat utilised by a migratory species which is at the limit of the species range; and/or

d) habitat within an area where the species is declining (DEH 2006)".

An "ecologically significant proportion" of the population of a migratory species varies with different life cycles and population sizes, and will depend on individual circumstances at a site (DEH 2006). "Some factors that should be considered include the species' population

status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates)" (DEH 2006).

DEH (2006) further defines a population of a migratory species as "the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia".

None of the species found or predicted in the local area fulfil the significant impact criteria for migratory species under the EPBC Act.

5.2.5 Summary of Impacts

In the context of the study area, the Golden Sun Moth and Striped Legless Lizard and Growling Grass Frog fulfil several of the significant impact criteria for critically endangered and vulnerable species respectively. Other listed migratory and/or marine overfly species do not fulfil the relevant significant impact criteria.

5.3 FFG Act

Action statements have been prepared under the FFG Act for several species and one community that occur or potentially occur in the study area: Brolga, Striped Legless Lizard, Golden Sun Moth and Western (Basalt) Plains Grassland Community No. 53 (which includes Plains Grassy Woodland and Plains Grassland).

No specific recommendations in these Action Statements apply to the study area.

5.4 Native Vegetation Management Framework

The assessment process for applications involving the loss of native vegetation follow decision guidelines explained in *Guide for Assessment of Referred Planning Permit Applications* (DSE 2007a). These guidelines are:

Decision guideline 1

- The referral authority (DSE) should consider the Native Vegetation Management Framework in the assessment of referred applications.

Decision guideline 2

- Whether the proposed development can be located and designed to avoid the removal of native vegetation.

Decision guideline 3

- Whether the proposed development is located and designed to minimise the removal of native vegetation.

Decision guideline 4

- The need to offset the loss of native vegetation having regard to the conservation significance of the vegetation.

Decision Guideline 1 is inevitable in these types of assessments, so discussion will focus on the application of the Framework. Decision Guideline 4 for offsetting for unavoidable losses can only be considered when other factors, including the decision guidelines for avoidance and minimisation, are appropriately addressed. Further discussion decision guidelines 3-4 is provided below.

5.4.1 Avoiding Impacts on Native Vegetation

Avoidance of most impacts on native vegetation can be achieved if the proposed development focuses on the areas excluding the following:

- several contiguous and fragmented habitat zones and scattered trees in the former Little property;
- narrow fragmented habitat zones along two roads and which are connected to the main group of habitat zones above; and
- scattered trees along roadsides and within paddocks; and
- by adding appropriate buffer zones.

The patches of native vegetation and scattered native trees have significant ecological values. One state significant flora species occurs in a habitat zone and could be expected to occur in other habitat zones. One state significant fauna species recorded in the study area may range over agricultural land, wetlands and native grassland. There is also the potential for several state and nationally significant species to occur native grasslands in the study area.

The types of facilities, infrastructure and roads proposed in the Ballarat Resort Draft Staging Plan 306-015- UD MP 02 (20/2/2009) will probably result in the loss of some native vegetation in the study area. If clearing is approved, offset requirements will need to be met and should preferably be located within the property as per current DSE policy (DNRE 2002). Areas to be set aside for revegetation in the study area are displayed on Map 5.

5.4.2 Minimising Impacts on Native Vegetation

While clearing of native vegetation is expected if the works are undertaken, there are some mechanisms for minimising the impacts on native vegetation in the study area. These mechanisms are applicable from the planning stage through to construction and ongoing management of the study area.

Where clearing of native vegetation cannot always be avoided, it is generally preferable that any losses occur from the edges of habitat zones or the edges of groups of contiguous habitat zones. This minimises the fragmentation of the native vegetation which would decrease the incursion levels of weed invasion and erosion.

Retention of very high to high conservation value native vegetation would reduce the amount of offsets required under Net Gain policy and would also provide space for on site offset credits. Further retention of currently degraded land within buffer strips to high quality native vegetation would be beneficial for future management and improved ecological viability of retained vegetation as well as providing scope for potential offsets.

Options for minimising impacts on native vegetation are (from high to low priority):

- retention of any single or grouped habitat zones and scattered trees abutting or adjacent to the Rail Trail;
- retention of groups of habitat zones (such as in the west paddock of the former Little property);
- retention of parts of the Finchs Road and Smarts Hill Road reserves; and
- retention of dams and fringing native grass or sedge rich vegetation.

Proposals to enhance retained native vegetation could include:

- reconnecting single or grouped habitat zones, including
    - the habitat zones in the west paddock and east paddock (abutting the Rail Trail) in the former Little property
    - habitat zones close to or contiguous with the Rail Trail

Decisions on which areas of native vegetation are to be retained or recreated need to take into account the potential nutrient and pollution loads from urban runoff, the golf course and sports fields, and natural wetting and drying regimes of seasonal natural wetlands.

5.4.3 Offsetting Losses of Native Vegetation

The preparation of an Offset Management Plan for the entire Ballarat Resort development site or for the main area of native vegetation within the former Little property is an appropriate way of minimising the impact on native vegetation within the study area. This plan would outline the land-use commitments, guidelines and the management actions that are relevant to broader vegetation, infrastructure and recreation management within the area of the proposed development.

5.5 Proposed Losses of Native Vegetation

Under the proposed Main Components Plan presented at a project coordination meeting on 28 October 2008, several habitat zones and scattered trees will be lost. Most scattered trees could be retained within streetscapes, the golf course and parkland.

Several of the habitat zones that are proposed to be cleared were assessed as having High conservation significance in 2004 (Kennedy & Kern 2004) and during this current assessment. Clearing of native vegetation of High conservation significance is "generally not permitted" (DNRE 2002).

In order to accommodate the proposed subdivision of the study area, there will be a loss of native vegetation from Habitat Zones 1, 2, 10, 11 and 12.

5.5.1 Losses in Habitat Hectares and Net Gain Targets

It has been assumed for the purposes of calculating Net Gain offsets that the proportion of vegetation lost from Habitat Zones 1, 2, 10, 11 and 12 will be 100%.

An indication of the losses in Habitat Hectares from the relevant habitat zones is presented in Table 9.

Table 9. Proposed Losses in Habitat Hectares

Habitat zone subject to losses	Area of proposed loss in ha (A)	Habitat Score (B)	% total vegetation lost (C)	Loss in Habitat Hectares (AxBxC)
1	0.05	0.33	100	0.01
2	0.13	0.13	100	0.17
10	0.22	0.18	100	0.03
11	0.71	0.28	100	0.18
12	0.12	0.26	100	0.03
Totals	**2.40 ha**			**0.42**

The total Net Gain targets to offset the clearing of native vegetation in the study area are presented in Table 10.

Table 10. Net Gain Targets

Habitat Zone	Conservation Significance	Habitat Hectares Target				Large Tree Target				
		Target EVC	Total Losses in Habitat Ha	Net Gain Multiplier	Net Gain Target (Habitat Ha)	Total Losses	Multiplier for protection	Trees to be protected	Multiplier for recruitment	Total trees to be recruited
1	H	PlGrWd	0.01	1.5	0.02	0	2	0	10	0
2	H	PlGrWd	0.31	1.5	0.25	0	2	0	10	0
10	H	PlGrWd	0.03	1.5	0.05	0	2	0	10	0
11	H	PlGrWd	0.18	1.5	0.27	0	2	0	10	0
12	H	PlGrWd	0.03	1.5	0.04	1	2	2	10	10
		Totals	**0.42**		**0.63**	**1**		**2**		**10**

6. NET GAIN ANALYSIS

This section describes the methods by which offsets for vegetation loss will be met. It deals with offsets for losses in Habitat Hectares in the study area and the protection and recruitment/installation of vegetation separately, in sections 6.1 and 6.2 respectively.

The Net Gain targets associated with proposed development at the study site are

- 0.63 Habitat Hectares;
- the protection of 2 large old trees of high conservation significance; and
- the recruitment of 10 new trees.

Additional offsets for the loss of scattered trees cannot be accurately determined at present since the Draft Staging (Plan 306-015- UD MP 02) is intended to supply only a broad level of detail as is appropriate for a Master Plan for rezoning purposes.

6.1 Gaining Habitat Hectare Credits

Where an offset is required to account for losses in native vegetation there are several mechanisms to ensure an appropriate offset is achieved. The most straightforward way of achieving offsets for vegetation loss in the study area is through rehabilitation and greater legal protection of vegetation on the property itself. Each of these methods is discussed in further detail below.

6.1.1 Rehabilitation of areas of native vegetation within the study area

Rehabilitation of the vegetation in the remainder of each habitat zone that will sustain a reduction in area is the most logical action for gaining habitat-hectare credits in the study area. Rehabilitation of existing vegetation as offsets for native vegetation needs to occur for a ten year period: an Offset Management Plan that is to be prepared is designed to cater for rehabilitation during this period.

The gains that may be attained through *maintenance* are regarded as the (habitat) score increase that will be attained by land owners agreeing to forego existing land use rights that may otherwise have a detrimental effect on the existing vegetation. This includes forgoing certain entitled activities that would otherwise damage or remove native vegetation, such as grazing, fire break construction or maintenance and firewood collection. Maintenance gains also typically require a commitment to ensure no further spread of environmental weeds that may otherwise result in loss of vegetation quality over time. Controlling rabbits may also contribute to *maintenance* gains within an offset area.

Gains from an area of remnant vegetation can be achieved from a range of protection and management actions agreed for the area (DSE 2006b). Where land managers agree to

positive actions to achieve an improvement in the condition of vegetation that are beyond their current legal obligations, they will qualify for *improvement* gains. The following examples are of the activities that could be undertaken by the proponents to increase the quality of native vegetation in habitat zones that are to be retained and rehabilitated:

- elimination and control high threat environmental weeds beyond duty of care or that are not prescribed weeds under the *Catchment and Land Protection Act 1994*;;
- control of vermin beyond legal duty of care;
- establishment and maintenance of perimeter fencing; and
- supplementary planting of canopy and/or understorey species as required.

6.1.2 Recognition of increased security

Credit for prior management acknowledges the fact that landowners have retained the vegetation on their property prior to state-wide planning permit controls for native vegetation removal were introduced in 1989.

Security of an offset site refers to the likelihood that an active management plan is implemented over a 10 year period, and that the offset site will be managed for its conservation values in perpetuity.

An offset can be secured by a range of mechanisms, with each offering a different degree of security based on the ability of the mechanism to be enforced, revoked or removed, the authority by which that revocation or removal transpires, and the likelihood that there may be inadvertent damage to the offset site. The typical method used for greater legal protection on private land is a registered on-title agreement. This may be an agreement under Section 173 of the *Planning and Environment Act 1989* or a conservation covenant under the *Victoria Conservation Trust Act 1972*. As per DSE policy (DSE 2006a), increased security will give a credit of 10% of the habitat-hectares to be protected.

6.1.3 Habitat Hectare Credits Available within the study area

Table 11 outlines the expected gains in Habitat Hectares over a 10 year period as a result of rehabilitation at the study area. It also presents offset credits available for recognition of past management and increased security at the property through greater legal protection of vegetation.

The total gain in Habitat Hectares as a result of rehabilitation of existing vegetation within the study site is 2.20 Habitat Hectares (as calculated in Table 11).

Table 11. Habitat gain scoring for rehabilitation of vegetation within the study area

Habitat Zones		HZ3			HZ4			HZ5			HZ6			HZ14			HZ20		
EVC Name		PlGrWd			PlGrWd			PlGrWd			PlGrWd			PlGrWd			PlGrWd		
Habitat Score (out of 1.0)		35			32			38			24			32			18		
	Possible Score	Current Scores	Maintenance	Improvement	Current Scores	Maintenance	Improvement	Current Scores	Maintenance	Improvement	Current Scores	Maintenance	Improvement	Current Scores	Maintenance	Improvement	Current Scores	Maintenance	Improvement
Large Old Trees	10	3	3	0	0	0	0	8	2	0	2	1	0	3	3	0	0	0	0
Canopy Cover	5	5	1	0	5	1	0	3	0.6	0.4	0	0	0.6	3	0.6	0.4	0	0	0.6
Understorey	25	5	0.5	2.5	5	0.5	2.5	5	0.5	2.5	5	0.5	2.5	5	0.5	2.5	5	0.5	2.5
Lack of Weeds	15	11	0	2	11	0	2	11	0	2	6	0	2	11	0	2	6	0	2
Recruitment	10	0	0	2	0	0	2	0	0	2	0	0	2	3	0.3	2	0	0	0
Organic Matter	5	5	0.5	0	5	0.5	0	5	0.5	0	5	0.5	0	5	0.5	0	5	0.5	0
Logs	5	0	0.4	1	0	0.4	1	0	0.4	1	0	0.4	1	0	0.4	1	0	0.4	1
Subtotals of Maintenance & Improvement columns			5.4	7.5		2.4	7.5		4	7.9		2.4	8.1		5.3	7.9		1.4	6.1
Sum of Maintenance + Improvement Gain	##.##	12.9			9.9			11.9			10.5			13.2			7.5		
Recognition for past management (0.1 hab. score)	#.##	3.5			3.2			3.8			2.4			3.2			1.8		
Improved security gain (0.1 hab. score)	#.##	3.5			3.2			3.8			2.4			3.2			1.8		
Total Gain Points per hectare	##.#	19.9			16.3			19.5			15.3			19.6			11.1		
Convert gain points to habitat score gained per ha OR Rate of gain per hectare	#.##	0.20			0.16			0.20			0.15			0.20			0.11		
Area of the proposed offset (ha)	#.##	2.29			0.11			0.18			7.69			1.19			2.56		
Net Gain (hab-ha)	#.##	0.46			0.02			0.03			1.18			0.23			0.28		
Total Net Gain in habitat hectares		2.20																	

6.2 Summary of Offsets Available

For Plains Grassy Woodland, the only EVC definitely affected by the proposed development, the Habitat Hectares target is exceeded by the credits available from gains in the improvement and security of the remaining native vegetation within the study area (see Table 12). In addition, there are substantial credits available from revegetation.

Table 12. Balance of Habitat Hectare Target and Available Credits

EVC	Net Gain Target	Available Credits	Available Credit- Net Gain Target	Overall Deficit or Credit
Plains Grassy Woodland	0.63	2.20	1.57	credit

7. CONCLUSIONS AND RECOMMENDATIONS

It is proposed that some native vegetation be cleared within the Ballarat Resort site. Offsets for these losses as required under Net Gain policy would be addressed in an Offset Management Plan to be prepared for remnant vegetation and revegetation areas in the south-east part of the study area (the former Little property). These areas are contiguous to the native grassland reserved within the Skipton-Ballarat Rail Trail and would collectively form a more sustainable extent of native vegetation. An Offset Management Plan would present recommendations for the conservation of the flora and fauna within the retained native vegetation from the construction phase for up to 10 years after development.

One threatened flora species, Wetland Blown-grass (insufficiently known in Victoria), and one threatened fauna species, the Brolga (vulnerable in Victoria), were found within the study area. Many regionally threatened plant species also occur in the study area. The native vegetation within the study area (including an area proposed to be cleared) constitutes Natural Temperate Grassland of the Victorian Volcanic Plain which is a nationally threatened ecological community.

Habitat for Wetland Blown-grass and regionally threatened plant species would be protected in retained grassland areas which consist of the Natural Temperate Grassland of the Victorian Volcanic Plain ecological community.

In western Victoria, Brolgas typically range widely over agricultural land generally in the vicinity of wetlands and drainage lines (G. Appleby pers. obs.). While a large area of potential habitat for this species would be lost with the proposed development, there is extensive habitat in the local area. The proposed development would only be a significant effect on this species if a nest site or flocking area was cleared on site or in an adjacent area.

Several other flora and fauna species that are threatened at the national and state level potentially occur within the Ballarat Resort site. The proposed subdivision of this area will result in the loss of native vegetation which is potential habitat of the nationally critically endangered Golden Sun Moth and Spiny Rice-flower as well as several nationally endangered or vulnerable flora and fauna species. For all of these species, it is not known if they are present in the study area. It will be important to adequately assess their actual presence or absence in the study area in order to determine if the proposed development needs to be referred to the federal environment department as required under the EPBC Act 1999. Accordingly, it is recommended that further work be undertaken as follows:

- targeted surveys for threatened flora in likely habitat and proposed areas of native vegetation loss during spring-early summer;
- targeted surveys for threatened fauna in likely habitat and proposed areas of native vegetation loss during spring-early summer, including:

- pitfall trapping and/or funnel trapping, and tile survey for Striped Legless Lizards (these techniques are also suitable for detecting other less threatened reptile, frog and mammal species);
- nocturnal call census and spotlighting (supplemented by call playback) for Growling grass Frogs;
- searches for Golden Sun Moths in suitable conditions in spring-early summer.

The preliminary examination of the significant impact criteria for the Natural Temperate Grassland of the Victorian Volcanic Plain ecological community in Section 5.2.1 of this report indicates that significant impacts will occur. However, further information gleaned from additional flora and fauna survey and documentation of historic land use of the main area of interest (the former Little property) will be critical in adequately assessing whether significant impacts will occur.

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APPENDIX 1. Methodology for Defining Significance

This section outlines the assessment methods or criteria used to determine the significance of species, plant communities, fauna habitats and sites. Criteria are consistent with government policies, legislation and publications.

Flora

The level of significance of flora species is determined according to the definitions below:

Nationally Significant	Species listed under the *Environment Protection and Biodiversity Conservation Act 1999* as extinct, extinct in the wild, critically endangered, endangered or vulnerable.
	Species listed as rare in *Rare or Threatened Australian Plants* (Briggs and Leigh 1996)
State Significance	Species listed as Threatened under Schedule 2 of Victoria's *Flora and Fauna Guarantee Act 1988*
	Species listed as extinct, endangered, vulnerable, rare in Victoria in *Advisory List of Rare or Threatened Plants in Victoria – 2005* (DSE 2005c)
Regional Significance	Flora species recorded in <5% of all quadrats, defined areas and incidental records in a given bioregion. Generated from DSE's *Flora Information System* – 2005 version. Flora species believed to be under-sampled or oversampled in a bioregion are edited at the discretion of Practical Ecology.
	Species listed as poorly known in *Advisory List of Rare or Threatened Plants in Victoria – 2005* (DSE 2005c)
	Species considered limited in distribution, uncommon or on the edge of the natural range within a given bioregion or area by author or reference to previous studies.
Local Significance	Species considered rare, threatened or uncommon within the local area (5km radius from the study area) by the authors with consideration given to previous studies. Many native species are considered to be locally significant within urban areas due to typically high levels of habitat alteration.

Fauna

The level of significance of flora species is determined according to the definitions below:

International Significance	Migratory species protected under international treaties (JAMBA, CAMBA and Bonn) or listed on the IUCN Red Data List 2006 as threatened
National Significance	Species listed under the *Environment Protection and Biodiversity Conservation Act 1999* as extinct, extinct in the wild, critically endangered, endangered or vulnerable.

State Significance	Species listed as Threatened under Schedule 2 of Victoria's *Flora and Fauna Guarantee Act 1988*
	Species listed as extinct, critically endangered, endangered, vulnerable in Victoria *Advisory List of Threatened Vertebrate Fauna in Victoria – 2007* (DSE 2007d)
Regional Significance	Species listed as data deficient or near threatened in Victoria *Advisory List of Threatened Vertebrate Fauna in Victoria – 2007* (DSE 2007b)
	Species not listed in the above categories that have a limited range in a bioregion
Local Significance	Species considered rare, threatened or uncommon within the local area (5km radius from the study area) by the authors with consideration given to previous studies. Many native species are considered to be locally significant within urban areas due to typically high levels of habitat alteration.

Plant Communities

The level of significance of plant communities and/or Ecological Vegetation Classes is determined according to the definitions below:

National Significance	Communities listed as critically endangered, endangered or vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*.
	Communities listed as Threatened under Schedule 2 of Victoria's *Flora and Fauna Guarantee Act 1988* that are endemic to Victoria.
State Significance	Communities listed as Threatened under Schedule 2 of Victoria's *Flora and Fauna Guarantee Act 1988* that are found in other states.
	Communities or Ecological Vegetation Classes (EVCs) listed as endangered, vulnerable or rare throughout all Victorian Bioregions according to DSE (2008c).
	EVCs with a conservation significance of Very High or High. This must be consistent with the methodology in Appendix 3 of Victoria's *Native Vegetation Management Framework* DNRE (2002) to defining conservation significance.
Regional Significance	EVCs with a conservation significance of Medium. This must be consistent with the methodology in Appendix 3 of Victoria's *Native Vegetation Management Framework* (DNRE 2002) to defining conservation significance.
	Communities considered depleted, naturally restricted across Victoria and within the subject bioregion.
Local Significance	EVCs with a conservation significance of Low. This must be consistent with the methodology in Appendix 3 of Victoria's *Native Vegetation Management Framework* DNRE (2002) to defining conservation significance.
	EVCs or communities considered rare, threatened or uncommon within the local area (5km radius from the study area) by the authors with consideration given to previous studies. Most native vegetation is considered to be locally significant within urban areas due to typically high levels of clearance and modification.

Fauna Habitats

The level of significance of fauna habitats and/or zoological significance is determined according to the definitions below:

National Significance	Regularly supports a population of a fauna species listed as endangered in DSE (2007b).
	Regularly supports a population of a fauna species listed under the *Environment Protection and Biodiversity Conservation Act 1999* as extinct, extinct in the wild, critically endangered, endangered or vulnerable. This also includes species listed as migratory under the EPBC Act.
	≥1% of national breeding or national population of species
State Significance	Regularly supports a population of taxon listed as Threatened under Schedule 2 of Victoria's *Flora and Fauna Guarantee Act 1988*.
	Regularly supports a population of taxon listed as extinct, critically endangered, endangered, vulnerable in Victoria *Advisory List of Threatened Vertebrate Fauna in Victoria – 2007* (DSE 2007b).
	≥1% of state breeding or state population of species
	Represents an intact primary habitat link to two connecting sites of State or higher zoological significance
Regional Significance	Regularly supports a population of taxon classified as significant within a bioregion
	≥5% of bioregional breeding or bioregional population of species
	Regularly supports a disjunct, unusual or declining population within a bioregion.
	Represents an intact habitat link to two connecting sites of regional or higher zoological significance or partial link two connecting sites of state or higher zoological significance
Local Significance	Regularly supports a population of taxon declining locally, though apparently still secure elsewhere
	≥25% of local breeding or local population of species (within 5km radius)
	Represents an partial habitat link to two connecting sites of regional or higher zoological significance

Site Significance

Site significance is a rating of the contribution that the biological attributes of a sites makes to biodiversity at national, state, regional and local geographic scales. The standard criteria for defining sites of biological significance in Victoria follow that in Amos (2004). The primary objective of the criteria is to provide DSE staff with a standard set of criteria for the rating of biological significance. These criteria are summarised as follows:

Ecological integrity and viability

- High degree of naturalness
- Importance in maintaining existing ecological processes
- Site important for restoration of disrupted ecological processes

Richness and high biodiversity values

- Sites with unusually high native species
- Sites with endemic taxon or genetically distinctive form
- Sites with a high diversity of vegetation, habitat types or communities in a relatively small area

Conservation status

- Sites supporting a population of rare or threatened taxon
- Sites with examples of rare or threatened ecological communities
- Sites with rare or uncommon combinations of ecological communities
- Sites with examples of ecological communities which are of exceptional age

Representativeness

- Represents restricted or uncommon ecological communities in an IBRA bioregion
- Represents a significant variant or marginal form of an ecological community

Scientific or educational values

- Importance in development of ecological understanding, research and benchmark sites

These criteria are a detailed, standardised method for determining sites of biological significance. For the detail on the criteria used, refer to the document Amos (2004) – http://www.dse.vic.gov.au follow links to DSE Home>Conservation and Environment>Standard Criteria for Sites of Biological Significance in Victoria.

The above criteria is not necessary to apply in all cases as there are a number of comprehensive reports undertaken in Victoria which have studied the sites of biological significance of a given area, including DSE's register of Biosites database. The standard criteria will be applied to a site at the discretion of Practical Ecology where there have been no extensive studies carried out or where a site's significance is thought to be under or overstated.

The geographical scale to determine sites of significance are as follows:

Local	within 5km of the chosen study area
Regional	bioregion (for example, Gippsland Plains Bioregion)
State	Victoria
National	Australia

High local significance can also be used to describe those sites which have intermediate values between local and regional significance.

APPENDIX 2. Habitat Zones within the study area

Legend: PlGr = Plains Grassland; PlGrWd = Plains Grassy Woodland; PlGrWe = Plains Grassy Wetland; AqHe = Aquatic Herbland; G1-15 = grassland sites; W1-10 = wetland sites; IT1-29 = individual trees

Habitat Zones	Approximate location	Preliminary EVC^	Revised EVC (this study)	Preliminary description^	Revised description of native vegetation
HZ1	East side of Finchs Rd reserve	PlGrWd	PlGrWd	IT1- extended Nth 43m	1 tree and patchy grassland understorey
HZ2	Smarts Hill Rd reserve	PlGrWd	PlGrWd	IT2, IT3, IT5, IT6, IT24	Very few trees with patchy grassland understorey (may include patches of PlGrWe)
HZ3	West paddock, Former Little property, contiguous with Finchs Rd reserve	PlGrWd	PlGrWd	IT9, G5, G6, IT10	2 trees with dense grassland understorey
HZ4	West paddock, Former Little property, contiguous with Finchs Rd reserve	PlGrWd	PlGrWd	IT11, G1	1 tree with dense grassland understorey
HZ5	West paddock, Former Little property	PlGrWd	PlGrWd	IT12, IT13, G2, G3	1 tree with dense grassland understorey
HZ6	Majority of west paddock, Former Little property	PlGrWd	PlGrWd	IT14, G8, G4	1 tree with dense grassland understorey; may now comprise homogeneous habitat with adjacent HZ3-5
HZ7	Former Little property backing onto Rail Trail	PlGr	PlGr	G9	Dense grassland; part of previous area now included in HZ16 as PlGrWe
HZ8	West paddock, former Little property	PlGr	PlGr	G11	Dense grassland
HZ10	East side of Finchs Rd reserve, north of Smarts Hill Rd	PlGrWd	PlGrWd	IT28	Several trees with patchy grassland understorey
HZ11	East side of Finchs Rd reserve, north of Smarts Hill Rd	PlGrWd	PlGrWd	IT29	Several trees with patchy grassland understorey
HZ12	West side of Finchs Rd reserve	PlGrWd	PlGrWd	IT8- extended Nth 114m	1 tree and patchy grassland understorey

Habitat Zones	Approximate location	Preliminary EVC^	Revised EVC (this study)	Preliminary description^	Revised description of native vegetation
HZ14	South end of south paddock, former Little property	PlGrWd (including small area of AqHe)	PlGrWd	IT18, IT19, IT20, G14, G15, W10	5 trees and grassland
HZ15	NE part of former Little property	PlGrWe (including small area of AqHe)	AqHe/ PlGrWe mosaic	W1	An artificially deep wetland that is linked to HZ23, which is mapped as Plains Grassland but may possibly be Plains Grassy Wetland
HZ16	East paddock, former Little property	PlGrWe (including small area of AqHe at dam)	Probably PlGrWe	W3, W4, W5	Mostly not distinct from surrounding native grassland in dry conditions in June 2008
HZ18	West paddock, former Little property	PlGrWe (including AqHe)	Probably PlGrWe	W8, W9	Not distinct from surrounding grassland in dry conditions in June 2008
HZ20 (new-2008)	Former Little property backing onto Rail Trail	-	PlGr	Previously part of HZ17	Grassland of patchy quality
HZ21 (new-2008)	NW corner of south paddock, former Little property	-	PlGrWd	Previously part of HZ17	Relatively poor quality grassland with a single tree; 1 of 2 remnants of cleared
HZ22 (new-2008)	NW corner of east paddock, former Little property	-	PlGr/PlGrWe mosaic	Included in G7 (PlGrWd)	A small-scale mosaic of depressions in degraded grassland. May have been continuous with former W6.
HZ23 (new-2008)	NE part of former Little property	-	PlGrWe	Included in G7 (PlGrWd)	A noticeably graded depression in grassland that probably drains HZ15.

^ Source: Kennedy & Kern (2004).

APPENDIX 3. Vascular Plants Recorded Within the Study Area

Legend

K = Insufficiently Known in Victoria
R = Regional significance
* = exotic
# = indigenous elsewhere in Victoria

Group	Family	Origin	Status	Scientific Name	Common Name
CONIFERS					
	Cupressaceae				
		*		*Cupressus macrocarpa*	Monterey Cypress
	Pinaceae				
		*		*Pinus radiata*	Radiata Pine
MONOCOTYLEDONS					
	ANTHERICACEAE				
			R	*Arthropodium spp.*	Chocolate/Vanilla Lily
	CYPERACEAE				
			R	*Carex appressa*	Tall Sedge
			R	*Carex breviculmis*	Common Grass-sedge
		*		*Cyperus eragrostis*	Drain Flat-sedge
			R	*Eleocharis acuta*	Common Spike Sedge
			R	*Eleocharis pusilla*	Small Spike-rush
			R	*Eleocharis sphacelata*	Tall Spike-rush
			R	*Schoenus apogon*	Common Bog-rush
				Schoenus sp.	Bog-rush
	COLCHICACEAE				
			R	*Burchardia umbellata*	Milkmaids
	IRIDACEAE				
				Iridaceae spp.	Irid
		*		*Romulea rosea*	Onion Grass
	JUNCACEAE				
			R	*Juncus amabilis*	Hollow Rush
		*		*Juncus articularis*	Jointed Rush
		*		*Juncus capitatus*	Capitate Rush
			R	*Juncus flavidus*	Rush
			R	*Juncus holoschoenus*	Joint-leaf Rush
			R	*Juncus pallidus*	Pale Rush
			R	*Juncus usitatus*	Billabong Rush
				Juncus sp.	Rush
	LILIACEAE				
		*		*Allium vineale*	Wild Garlic
	POACEAE				
				Agrostis aemula	Blown-grass
		*		*Agrostis capillaris*	Brown-top Bent
		*		*Agrostis stolonifera*	Creeping Bent

Group	Family	Origin	Status	Scientific Name	Common Name
		*		*Aira elegantissima*	Delicate Hair-grass
			R	*Amphibromus neesii*	Southern Swamp Wallaby-grass
		*		*Anthoxanthum odoratum*	Sweet Vernal-grass
			R	*Austrodanthonia auriculata*	Lobed Wallaby-grass
			R	*Austrodanthonia caespitosa*	Common Wallaby-grass
			R	*Austrodanthonia duttoniana*	Brown-back Wallaby-grass
			R	*Austrodanthonia geniculata*	Kneed Wallaby-grass
			R	*Austrodanthonia laevis*	Smooth Wallaby-grass
			R	*Austrodanthonia setacea*	Bristly Wallaby-grass
				Austrodanthonia sp.	Wallaby-grass
			R	*Austrostipa nodosa*	Knotty Spear-grass
			R	*Austrostipa sp.*	Spear-grass
		*		*Avena fatua*	Wild Oats
		*		*Bromus catharticus*	Prairie Grass
		*		*Bromus diandrus*	Great Brome
		*		*Bromus mollis*	Soft Brome
		*		*Briza minor*	Small Quaking Grass
		*		*Cynodon dactylon*	Couch
		*		*Cynosurus echinatus*	Rough Dog's-tail
		*		*Dactylis glomerata*	Cocksfoot
			R	*Dichelachne micrantha*	Short-hair Plume-grass
			R	*Elymus scaber var. scaber*	Common Wheat-grass
		*		*Elytrigia repens*	English Couch
		*		*Festuca arundinacea*	Tall fescue
			R	*Glyceria australis*	Australian Sweet-grass
			R	*Hemarthria uncinate var. uncinata*	Mat Grass
		*		*Holcus lanatus*	Yorkshire Fog
		*		*Hordeum murinum s.l.*	Sea Barley-grass
			R	*Lachnagrostis filiformis var. 1*	Common Blown-grass
			K	*Lachnagrostis filiformis var. 2*	Wetland Blown-grass
		*		*Lolium perrenae*	Rye Grass
		*		*Lolium rigidum*	Annual Rye Grass
				Microlaena stipoides	Weeping Grass
		*		*Paspalum dilatatum*	Paspalum
		*		*Phalaris aquatica*	Phalaris
			R	*Phragmites australis*	Common Reed
			R	*Poa labillardierei*	Common Tussock-

Group	Family	Origin	Status	Scientific Name	Common Name
					grass
			R	*Poa sieberiana*	Grey Tussock-grass
				Themeda triandra	Kangaroo Grass
		*		*Tribolium acutiflorum s.l.*	Desmazeria
		*		*Triticum aestivum*	Wheat
		*		*Vulpia bromoides*	Squirrel-tail Fescue
	PHORMIACEAE				
			R	*Tricoryne elatior*	Yellow Rush-lily
	XANTHORRHOEACEAE				
			R	*Lomandra filiformis ssp. coriacea*	Wattle Mat-rush
			R	*Lomandra micrantha ssp. micrantha*	Small-flowered Mat-rush
			R	*Lomandra nana*	Dwarf Mat-rush
DICOTYLEDONS					
	APIACEAE				
			R	*Eryngium ovinum*	Blue Devil
			R	*Eryngium vesiculosum*	Prickfoot
	ASTERACEAE				
		*		*Arctotheca calendula*	Capeweed
			R	*Calocephalus lacteus*	Milky Beauty-heads
		*		*Carduus sp.*	Thistle
			R	*Centipeda cunninghamii*	Common Sneezeweed
		*		*Cirsium vulgare*	Spear Thistle
		*		*Cotula coronopifolia*	Water Buttons
		*		*Hypochoeris radicata*	Cats Ear
			R	*Leptorhynchos squamatus*	Scaly Buttons
		*		*Scolymus hispanicus*	Golden Thistle
		*		*Silybum marianum*	Variegated Thistle
		*		*Sonchus asper s.l.*	Soft Sow-thistle
		*		*Taraxacum officinale*	Dandelion
	BRASSICACEAE				
		*		*Brassica napus*	Canola
	CAMPANULACEAE				
			R	*Isotoma fluviatilis subsp. australis*	Swamp Isotome
	CARYOPHYLLACEAE				
		*		*Stellaria media*	Chickweed
	CLUSIACEAE				
		*		*Hypericum perforatuum*	St John's Wort
	CONVOLVULACEAE				
			R	*Convolvulus erubescens*	Pink Bindweed
			R	*Dichondra repens.*	Kidney Weed
	CRASSULACEAE				
			R	*Crassula decumbens var decumbens*	Spreading Crassula

Group	Family	Origin	Status	Scientific Name	Common Name
	DROSERACEAE				
			R	*Drosera peltata var. auriculata*	Tall Sundew
	FABACEAE				
			R	*Bossiaea prostrata*	Creeping Bossiaea
		*		*Calicotome spinosa*	Spiny Broom
		*		*Genista monspessulana*	Cape Broom
		*		*Medicago sp.*	Medic
		*		*Trifolium subterraneum*	SubterraneanClover
		*		*Trifolium sp.*	Clover
		*		*Ulex europaeus*	Gorse
		*		*Vicia sp.*	Vetch
	FAGACEAE				
		*		*Quercus rober*	English Oak
	GERANIACEAE				
		*		*Erodium moschatum*	Musky Stork's-bill
			R	*Geranium spp.*	Geranium
	HALORAGACEAE				
			R	*Gonocarpus elatus*	Tall Gonocarpus
			R	*Gonocarpus tetragynus*	Common Raspwort
			R	*Myriophyllum simulans*	Amphibious Water-milfoil
				Myriophyllum sp.	Water-milfoil
	LEMNACEAE				
			R	*Lemna sp.*	Duckweed
	LYTHRACEAE				
				Lythrum hyssopilfolia	Small Loosetrife
	MALVACEAE				
		*		*Malva parviflora*	Small-flowered Mallow
	MIMOSACEAE				
				Acacia melanoxylon	Blackwood
	MYOPORACEAE				
		#?	R	*Myoporum insulare*	Boobialla
	MYRTACEAE				
		#		*Eucalyptus botryoides*	Southern Mahogany
		#		*Eucalyptus globulus ssp. globulus*	Southern Blue Gum
			R	*Eucalyptus ovata*	Swamp Gum
				Eucalyptus spp.	
	ONAGRACEAE				
				Epilobium billardiarinianum	Variable Willow-herb
	OXALIDACEAE				
		*		*Oxalis corniculata s.s*	Creeping Wood-sorrel
		*		*Oxalis latifolia*	Large Leaf Wood Sorrel
		*		*Oxalis sp.*	Sorrel

Group	Family	Origin	Status	Scientific Name	Common Name
	PLANTAGINACEAE				
		*		*Plantago coronopus*	Buck's Horn Plantain
		*		*Plantago lanceolata*	Ribwort
	POLYGALACEAE				
		*		*Polygala monspeliaca*	Annual Milkwort
	POLYGONACEAE				
		*		*Acetosella vulgaris*	Sheep Sorrel
		*		*Rumex conglomeratus*	Clustered Dock
		*		*Rumex crispus*	Curled Dock
		*		*Rumex sp.*	Dock
			R	*Persicaria prostrata*	Creeping Knotweed
				Polygonum aviculare s.l.	Prostrate Knotweed
	POTAMOGETONACEAE				
			R	*Potamogeton tricarinatus*	Pondweed
				Potamogeton sp.	Pondweed
	RANUNCULACEAE				
			R	*Ranunculus amphitichus*	River Buttercup
			R	*Ranunculus inundatus*	River Buttercup
				Ranunculus sp.	Buttercup
	ROSACEAE				
				Acaena echinata	Sheep's Burr
			R	*Acaena novae-zelandiae*	Bidgee-widgee
			R	*Acaena ovina*	Australian Sheep's Burr
		*		*Crataegus monogyna*	Hawthorn
		*		*Rosa rubiginosa*	Sweet Briar
	RUBIACEAE				
			R	*Asperula conferta*	Common Woodruff
	SCROPHULARIACEAE				
			R	*Veronica gracilis*	Slender Speedwell
	SOLONACEAE				
		*		*Lycium ferrocissimum*	African Boxthorn
	THYMELAEACEAE				
			R	*Pimelea curviflora s.l.*	Curved Rice-flower
			R	*Pimelea glauca*	Smooth Rice-flower
			R	*Pimelea humilis*	Common Rice-flower

Source: Kennedy & Kern (2004) and Nic McCaffrey (current study).

APPENDIX 4. Fauna Recorded Within the Study Area

Origin	Common Name	Scientific Name	Practical Ecology 2004	Practical Ecology 2008
	Mammals			
*	Brown Hare	*Lepus capensis*		●
*	European Rabbit	*Oryctolagus cuniculus*		●
	Short-beaked Echidna	*Tachyglossus aculeatus*		●
	Birds			
	parrot sp.			●
	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*		●
	Brown Thornbill	*Acanthiza pusilla*		●
*	Skylark	*Alauda arvensis*		●
	Pacific Black Duck	*Anas superciliosa*		●
	Red Wattlebird	*Anthochaera carunculata*		●
	Richard's Pipit	*Anthus novaeseelandiae*		●
	Long-billed Corella	*Cacatua tenuirostris*		●
	Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*		●
*	European Greenfinch	*Carduelis chloris*		●
*	Rock Dove	*Columba livia*		●
	Little Raven	*Corvus mellori*		●
	Black-shouldered Kite	*Elanus notatus*	●	●
	Brown Falcon	*Falco berigora*		●
	Magpie-lark	*Grallina cyanoleuca*		●
	Brolga	*Grus rubicunda*		●
	Australian Magpie	*Gymnorhina tibicen*		●
	Little Eagle	*Hieraaetus morphnoides*		●
	Welcome Swallow	*Hirundo neoxena*		●
	Superb Fairy-wren	*Malurus cyaneus*		●
	Crested Pigeon	*Ocyphaps lophotes*		●
*	House Sparrow	*Passer domesticus*		●
	Willie Wagtail	*Rhipidura leucophrys*		●
*	Common Starling	*Sturnus vulgaris*		●
	Australian Shelduck	*Tadorna tadornoides*		●
*	Common Blackbird	*Turdus merula*		●
	Amphibians			
	Common Froglet	*Crinia signifera*		●

Origin	Common Name	Scientific Name	Practical Ecology 2004	Practical Ecology 2008
	Spotted Marsh Frog (race unknown)	*Limnodynastes tasmaniensis*		●
	Southern Brown Tree Frog	*Litoria ewingii*		●
	Reptiles			
	Skink sp.			●

* introduced or domesticated

APPENDIX 5. Significant Flora Species Potentially Occurring in the Study Area

Conservation Status: National: EN – Endangered VU – Vulnerable (EPBC Act – DEWHA 2008a)
State: EN – Endangered, VU – Vulnerable, R –Rare, K –poorly known (Advisory List – DSE 2005c); L – threatened (FFG Act – DSE 2006a)

Source: FIS – Flora Information System; PMST – EPBC Act Protected Matters Search Tool **Likelihood of Occurrence**: see Section 3.2.2.

Conservation Status			Common Name	Scientific Name	Source	Freq	Habitat	Likelihood of Occurrence
EPBC Act	DSE	FFG Act						
	VU		Wavy Swamp Wallaby-grass	*Amphibromus sinuatus*	FIS	0.21%	Swamps and margins of dams	low-moderate
	K		Green-top Sedge	*Carex chlorantha*	FIS	0.21%	Permanently wet-moist soils	low-moderate
VU	VU	L	Curly Sedge	*Carex tasmanica*	PMST		Grassy wetlands and streamsides	moderate
EN	EN		Matted Flax-lily	*Dianella amoena*	FIS	0.07%	Plains grassland and plains grassy woodland	moderate
	VU		Golden Cowslips	*Diuris behrii*	FIS	0.07%	High quality plains grassland and plains grassy woodland	low
VU	VU		Trailing Hop-bush	*Dodonaea procumbens*	PMST		Dry grassland and grassy woodland	low
	R		Grampians Peppermint	*Eucalyptus willisii subsp. falciformis*	FIS	0.07%	Forests with poorer soils	low
	R	L	Yarra Gum	*Eucalyptus yarraensis*	FIS	1.29%	Grassy and swampy woodland	low-moderate
	X		Purple Eyebright	*Euphrasia collina subsp. speciosa*	FIS	0.07%	Forests with heathy component	low
VU	VU	L	Clover Glycine	*Glycine latrobeana*	PMST		Grassland and grassy woodland	low-moderate
EN	VU	L	Adamson's Blown-grass	*Lachnagrostis adamsonii*	PMST		Plains grassy wetlands	low-moderate
	K		Wetland Blown-grass	*Lachnagrostis filiformis var. 2*	FIS	0.14%	Plains grassy wetlands	high – present
	R	L	Purple Blown-grass	*Lachnagrostis punicea subsp. filifolia*	FIS	0.07%	Plains grassy wetlands	low-moderate

Conservation Status			Common Name	Scientific Name	Source	Freq	Habitat	Likelihood of Occurrence
EPBC Act	DSE	FFG Act						
	R		Purple Blown-grass	*Lachnagrostis punicea subsp. punicea*	FIS	0.07%	Plains grassy wetlands	low-moderate
	K		Ivy-leaf Duckweed	*Lemna trisulca*	FIS	0.07%	Wetlands and streams	low
CR	VU	(L)	Spiny Rice-flower	*Pimelea spinescens subsp. spinescens*	PMST,FIS	0.07%	Plains grassland and plains grassy woodland	moderate
VU	VU	N	Salt-lake Tussock-grass	*Poa sallacustris*	PMST		Edges of salt lakes	low
EN	EN	L	Maroon Leek-orchid	*Prasophyllum frenchii*	PMST		Grassland, heathland and grassy woodland	low-moderate
EN	EN	L	Fragrant Leek-orchid	*Prasophyllum suaveolens*	PMST, FIS	0.21%	Grassland, generally on basalt soils	low
EN	EN	L	Stiff Groundsel	*Senecio behrianus*	PMST		Swampy areas	low
VU	VU		Swamp Fireweed	*Senecio psilocarpus*	PMST		Swamps and margins of dams	low
VU	VU	L	Spiral Sun-orchid	*Thelymitra matthewsii*	PMST		A variety of open forests and woodlands in well-drained sand and clay loams	low
VU	VU	L	Swamp Everlasting	*Xerochrysum palustre*	PMST		Swamp scrub, riparian scrub and wet grasslands in lowlands.	low-moderate

APPENDIX 6. Significant Fauna Species Potentially Occurring in the Study Area

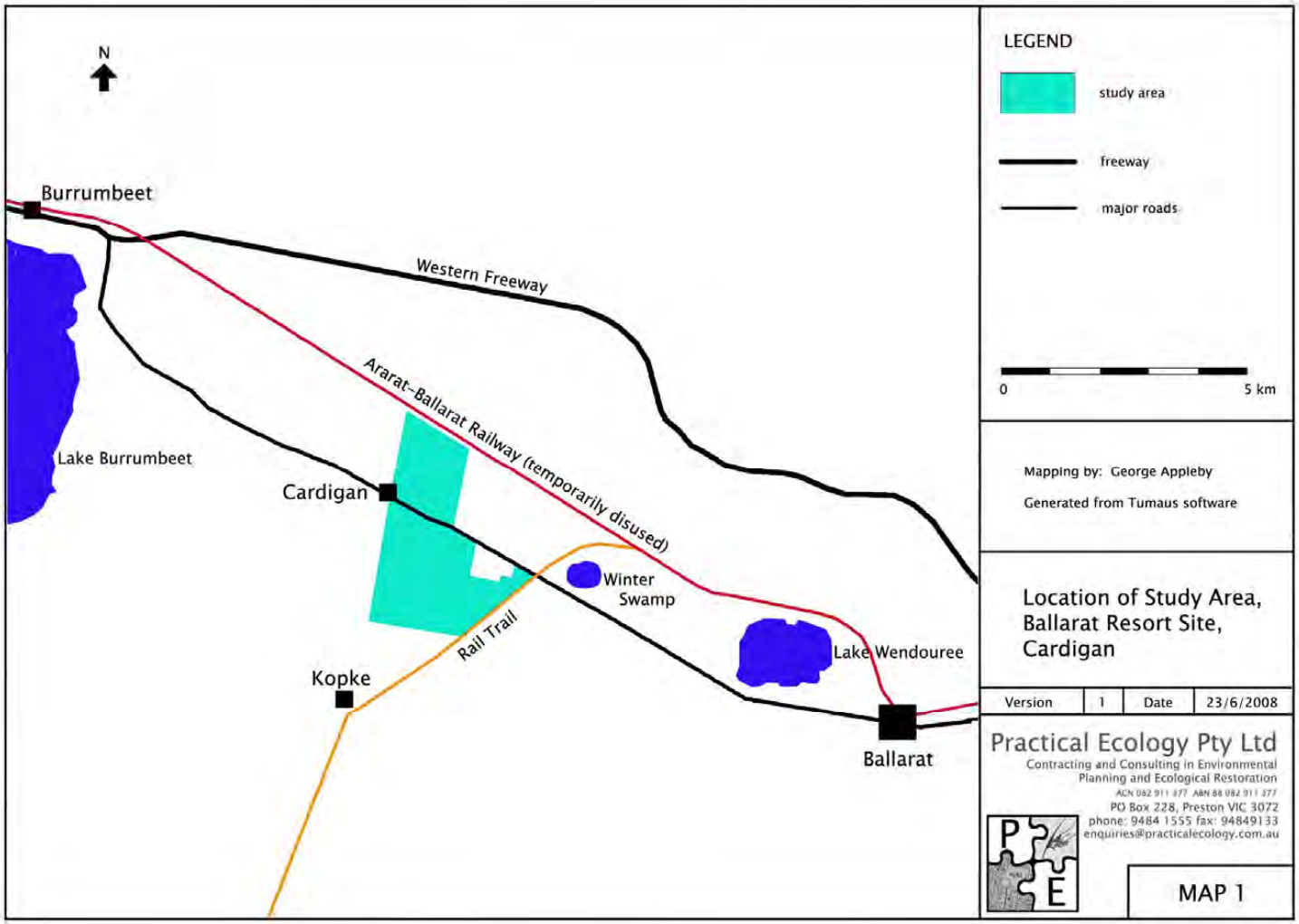
Conservation Status: National: EN – Endangered, VU – Vulnerable, M – listed migratory and/or marine taxon (EPBC Act – DEWHA 2008a)
State: CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened (Advisory List – DSE 2007b); L – threatened (FFG Act – DSE 2006a)
Source: VFD – Victorian Fauna Display; PMST – EPBC Act Protected Matters Search Tool **Likelihood of Occurrence:** see Section 3.3.2.

Conservation Status EPBC Act	DSE	FFG Act	Common Name	Scientific Name	Source	Freq.	Habitat	Likelihood of Occurrence
			Mammals					
EN	EN	L	Spot-tailed Quoll	*Dasyurus maculatus*	PMST		Forest, woodland, heathland and shrubland/scrub with complex groundcover	very low
EN	EN	L	Smoky Mouse	*Pseudomys fumeus*	PMST		Forest and woodland with heathy understorey, heathland and also fern gullies, in coastal to sub-alpine areas.	nil
VU	VU	L	Grey-headed Flying-fox	*Pteropus poliocephalus*	PMST		Colonially roosting in various habitats, mainly riparian or modified vegetation in urban areas; forages in many habitats.	very low
	VU	L	Brush-tailed Phascogale	*Phascogale tapoatafa*	VFD	0.25%	Lowland woodlands and grassy woodlands in intermediate rainfall areas; hollow dependant	very low
			Birds					
MI/MA	VU		Common Sandpiper	*Actitis hypoleucos*	VFD	0.25%	Coasts and shorelines of rivers and inland wetlands	very low
MI/MA	VU		Australasian Shoveler	*Anas rhynchotis*	VFD	5.75%	Large to small, fresh-saline wetlands and coasts	low
MI/MA	VU		Magpie Goose	*Anseranas semipalmata*	VFD	0.25%	Wetlands and flooded grasslands	low
MI,MA			Fork-tailed Swift	*Apus pacificus*	PMST		Presumed to be completely aerial, nomadic occurrences dependent on weather conditions	low
MI/MA	VU	L	Great Egret	*Ardea alba*	PMST, VFD	3.50%	Margins of large to small, fresh-saline wetlands and coasts; also temporarily flooded grassland	low
MI,MA			Cattle Egret	*Ardea ibis*	PMST		Margins of large to small, fresh-saline wetlands and coasts, damper pasture	low
MI/MA	CR	L	Intermediate Egret	*Ardea intermedia*	VFD	0.25%	Margins of large to small, fresh-saline wetlands and coasts	low

Conservation Status EPBC Act	DSE	FFG Act	Common Name	Scientific Name	Source	Freq.	Habitat	Likelihood of Occurrence
	CR	L	Australian Bustard	*Ardeotis australis*	VFD	0.50%	Drier grassland and grassy woodland; vagrant to southern Victoria from inland-northern regions	very low
MI/MA	VU		Hardhead	*Aythya australis*	VFD	8%	Large to small, fresh-saline wetlands and coasts	low
MI/MA	VU		Musk Duck	*Biziura lobata*	VFD	13.75%	Large to small, fresh-saline wetlands and coasts	very low
MI/MA	NT		Whiskered Tern	*Chlidonias hybridus*	VFD	0.75%	Coasts, inland wetlands and adjacent pasture and grasslands	low
MI/MA	NT		Spotted Harrier	*Circus assimilis*	VFD	0.25%	Grassland, grassy woodland, chenopod shrubland, drier cropland and pasture	moderate
	NT		Brown Treecreeper	*Climacteris picumnus*	VFD	0.25%	Drier woodlands, preferably with a good cover of organic litter and fallen wood; may persist around a single isolated tree	nil
MI/MA	NT		Latham's Snipe	*Gallinago hardwickii*	PMST,VFD	1.50%	Wet and rank grasslands, wetland margins	low-moderate
	VU	L	Brolga	*Grus rubicunda*	VFD	2.25%	Grasslands, pasture, crop stubble, shallow wetlands in grassland and forest areas	recorded on site
MI,MA	VU	L	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	PMST		Large rivers & lakes and coasts; also found in transit over land	very low
MI,MA			White-throated Needletail	*Hirundapus caudacutus*	PMST		Aerial over most habitats, commonly in coastal / mountainous areas	moderate
MI/MA	EN	L	Little Bittern	*Ixobrychus minutus*	VFD	2.25%	Shallow wetlands or margins of deep wetlands, with tall dense vegetation such as graminoids, rushes and sedges	nil
EN,MI, MA	EN	L	Swift Parrot	*Lathamus discolor*	PMST		Mainly in box-ironbark forests and woodlands; also uses habitats with similar tree species to the Regent Honeyeater	low
	NT		Black-chinned Honeyeater	*Melithreptus gularis*	VFD	0.25%	Drier forests and woodlands, and isolated trees near these habitats	low
MI,MA			Rainbow Bee-eater	*Merops ornatus*	PMST		Drier woodlands, preferably with sandy soil for nesting burrows	low
MI,MA			Satin Flycatcher	*Myiagra cyanoleuca*	PMST		Forest and woodland in high rainfall areas	low
	VU	L	Powerful Owl	*Ninox strenua*	VFD	0.25%	Damper forests and woodlands or damp sites in drier forests, usually in proximity to habitat for prey such as	very low

Conservation Status EPBC Act	DSE	FFG Act	Common Name	Scientific Name	Source	Freq.	Habitat	Likelihood of Occurrence
							possums and gliders	
MI/MA	NT		Nankeen Night Heron	*Nycticorax caledonicus*	VFD	1%	Margins of large to small, generally fresh wetlands	low
MI/MA	EN	L	Blue-billed Duck	*Oxyura australis*	VFD	6.50%	Large to small, fresh-saline wetlands	very low
	NT		Pied Cormorant	*Phalacrocorax varius*	VFD	1.75%	Coasts and inland wetlands	very low
	VU		Royal Spoonbill	*Platalea regia*	VFD	0.25%	Coasts and shorelines of inland wetlands	very low
MI/MA	VU	L	Baillon's Crake	*Porzana pusilla*	VFD	2.50%	Densely vegetated wetlands	low
	VU	L	Lewin's Rail	*Rallus pectoralis*	VFD	0.75%	Densely vegetated wetlands; also wet and rank grasslands	low
MI,MA			Rufous Fantail	*Rhipidura rufifrons*	PMST		Rainforest to damp gully vegetation in drier forest or woodland; also in drier habitats while migrating	very low
VU,MI, MA	CR	L	Australian Painted Snipe	*Rostratula australis (syn. R. benghalensis s. lat.)*	PMST		Wetland margins; also flooded grassy depressions	very low
MI/MA	NT	L	Caspian Tern	*Sterna caspia*	VFD	0.50%	Coastal areas, larger inland wetland and major rivers	very low
MI/MA	EN	L	Freckled Duck	*Stictonetta naevosa*	VFD	1%	Large to small, fresh-saline wetlands	very low
EN	CR	L	Regent Honeyeater	*Xanthomyza phrygia*	PMST		Mainly in box-ironbark forests and woodlands; also in Banksia forest and woodland	very low
			Reptiles					
VU	EN	L	Striped Legless Lizard	*Delma impar*	PMST		Grasslands and grassy woodlands	moderate
			Amphibians					
VU	EN	L	Growling Grass Frog	*Litoria raniformis*	PMST,VFD	1%	Wetlands and adjacent damp niches in woodlands, shrublands, grassland and disturbed areas	low-moderate
			Ray-finned Fish					
		L	Mountain Galaxias	*Galaxias olidus*	VFD	0.25%	Usually in clear flowing streams with a sand, gravel or boulder bottom in higher reaches but may be found in lowlands	very low
VU	VU	L	Dwarf Galaxias	*Galaxiella pusilla*	PMST		Shallow water amongst heavy vegetation at the edges of still or slow flowing water in ponds, billabongs, swamps, backwaters and drains.	very low

Conservation Status			Common Name	Scientific Name	Source	Freq.	Habitat	Likelihood of Occurrence
EPBC Act	DSE	FFG Act						
EN	EN	L	Macquarie Perch	*Macquaria australasica*	VFD	0.50%		nil
VU	VU	L	Australian Grayling	*Prototroctes maraena*	PMST		Upper reaches of rivers, typically in gravel-bottomed pools (Allen et al. 2004)	nil
			Invertebrates					
CR	EN	L	Golden Sun Moth	*Synemon plana*	PMST			low-moderate


N
Burrumbeet
Western Freeway
Ararat–Ballarat Railway (temporarily disused)
Lake Burrumbeet
Cardigan
Winter Swamp
Rail Trail
Kopke
Lake Wendouree
Ballarat
LEGEND
study area
freeway
major roads
0
5 km
Mapping by: George Appleby
Generated from Tumaus software
Location of Study Area, Ballarat Resort Site, Cardigan
Version 1 Date 23/6/2008
Practical Ecology Pty Ltd
Contracting and Consulting in Environmental Planning and Ecological Restoration
ACN 082 911 377 ABN 88 082 911 377
PO Box 228, Preston VIC 3072
phone: 9484 1555 fax: 94849133
enquiries@practicalecology.com.au
P
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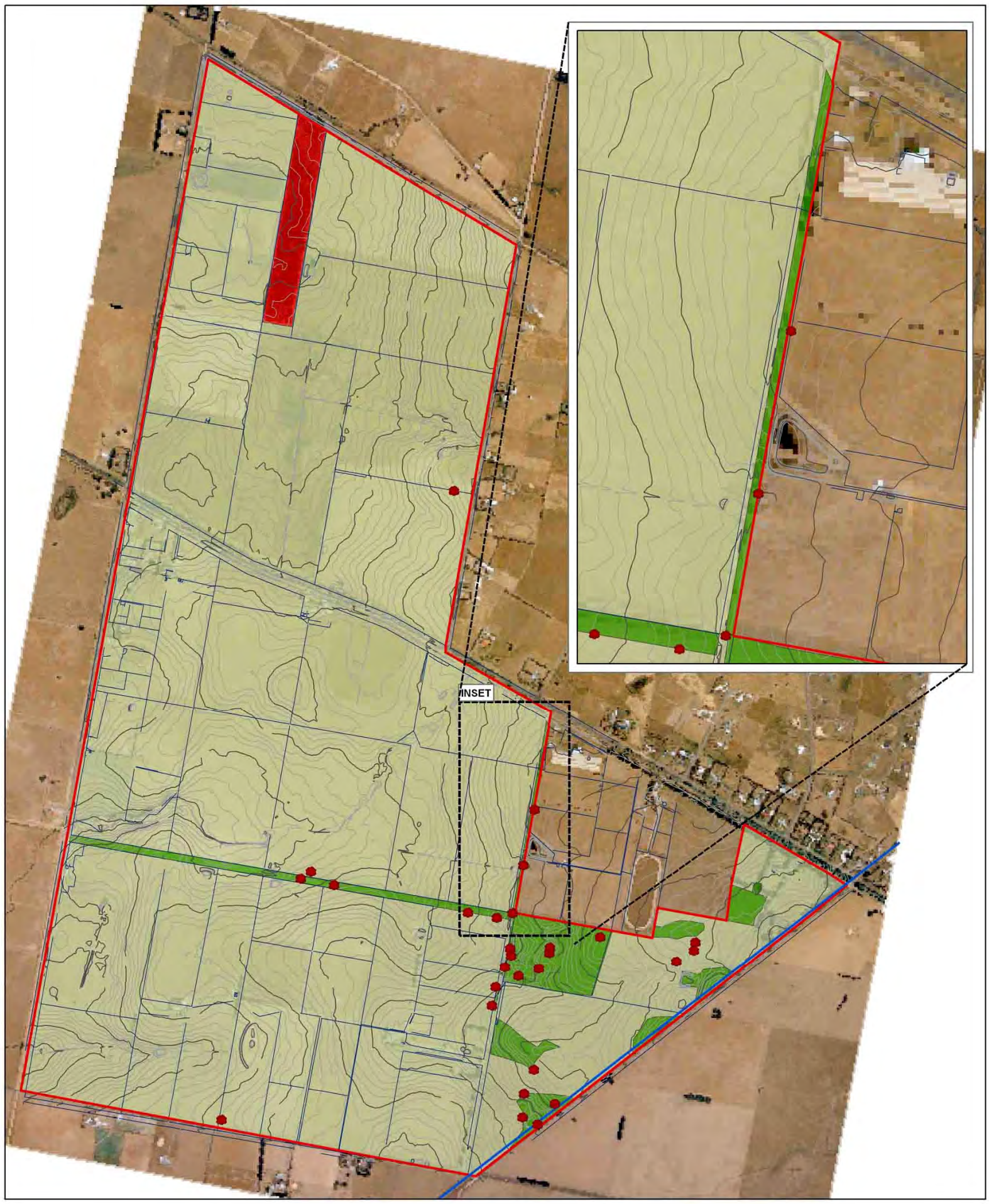
MAP 1



MAP 02
EXISTING CONDITIONS
Ballarat Resort Site
Flora and Fauna Assessment and Net Gain Report

Practical Ecology Pty Ltd
Contracting and Consulting in Environmental Planning and Ecological Restoration
ACN 052 911 377 ABN 55 052 911 377
PO Box 228, Preston VIC 3072
phone: 9484 1555 fax: 94849133
enquiries@practicalecology.com.au

DATUM: GDA 94 MGA Zone 54

N

0 200 400 600 800
Metres
1:15,000

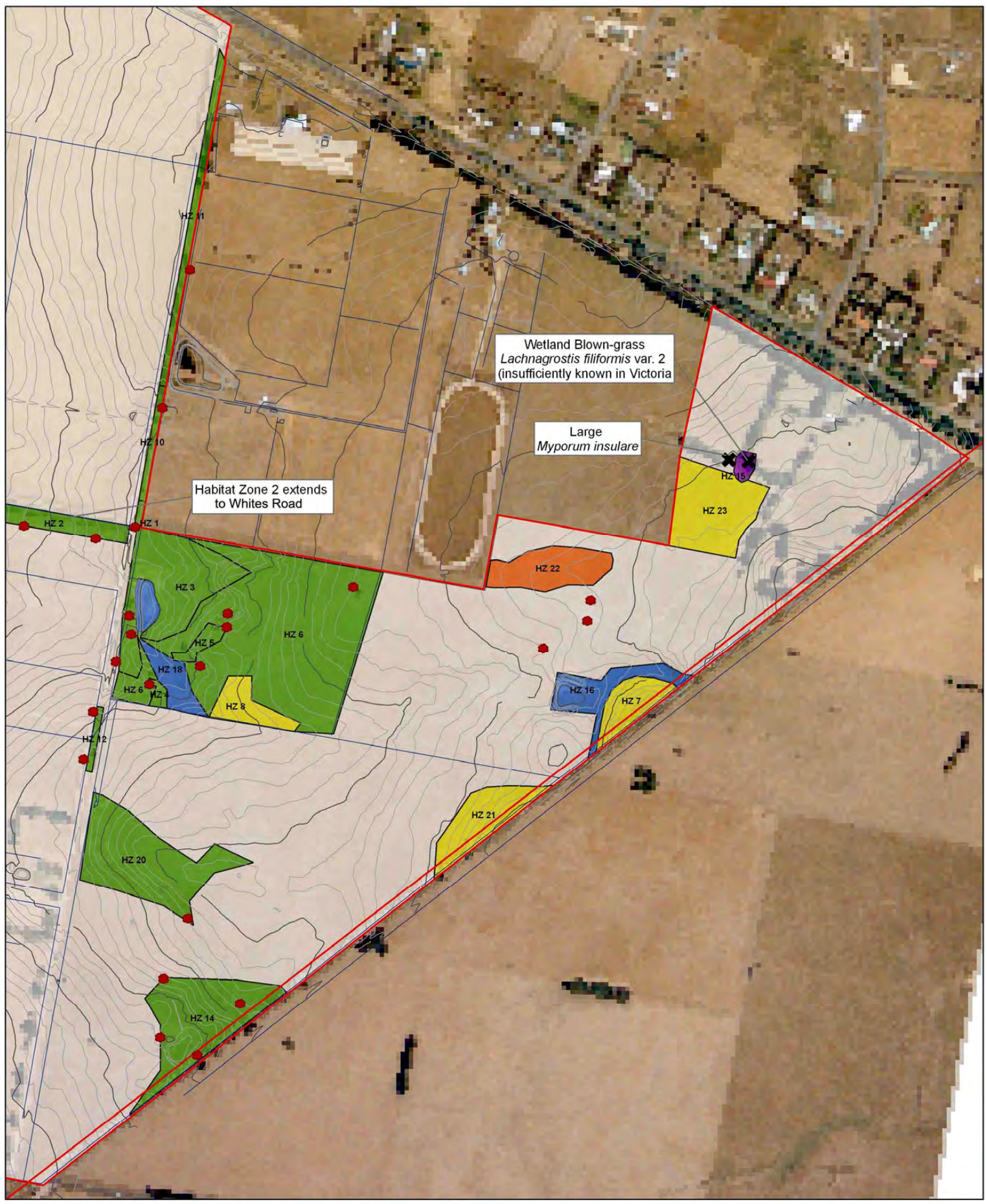
VERSION	01	DATE	11/08/08

MAP AND SURVEY DETAILS

Surveyed by: George Appleby, June 2008
Mapping by: Staci Timms, July 2008
Generated from: Aerial Photograph Interpretation, AutoCAD base maps and field data collected with a hand held Garmin GPS unit.

NOTES:
Practical Ecology bears no responsibility for the accuracy and completeness of this information and any decisions or actions taken on the basis of the map. While information appears accurate at publication, nature and circumstances are constantly changing.

LEGEND
- Study Boundary
- Property Boundaries
- 0.5m Contours
- 2.5m Contours
- Rail Trail
- Scattered Indigenous Trees
- Agricultural Land and Roads
- Indigenous Vegetation
- Blue Gum Plantation



MAP 03
NATIVE VEGETATION
SOUTH EAST SECTION
Ballarat Resort
Flora and Fauna Assessment
and Net Gain Report

Practical Ecology Pty Ltd
Contracting and Consulting in Environmental Planning and Ecological Restoration
ACN 62 911 377 ABN 83 062 911 377
PO Box 225, Preston VIC 3072
phone: 9484 1555 fax: 94849133
enquiries@practicalecology.com.au

DATUM: GDA 94 MGA Zone 54

N

0 50 100 150 200 250 300
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VERSION	01	DATE	11/08/08

MAP AND SURVEY DETAILS

Surveyed by: George Appleby, June 2008
Mapping by: Staci Timms, July 2008
Generated from: Aerial Photograph Interpretation, AutoCAD base maps and field data collected with a hand held Garmin GPS unit.

NOTES:
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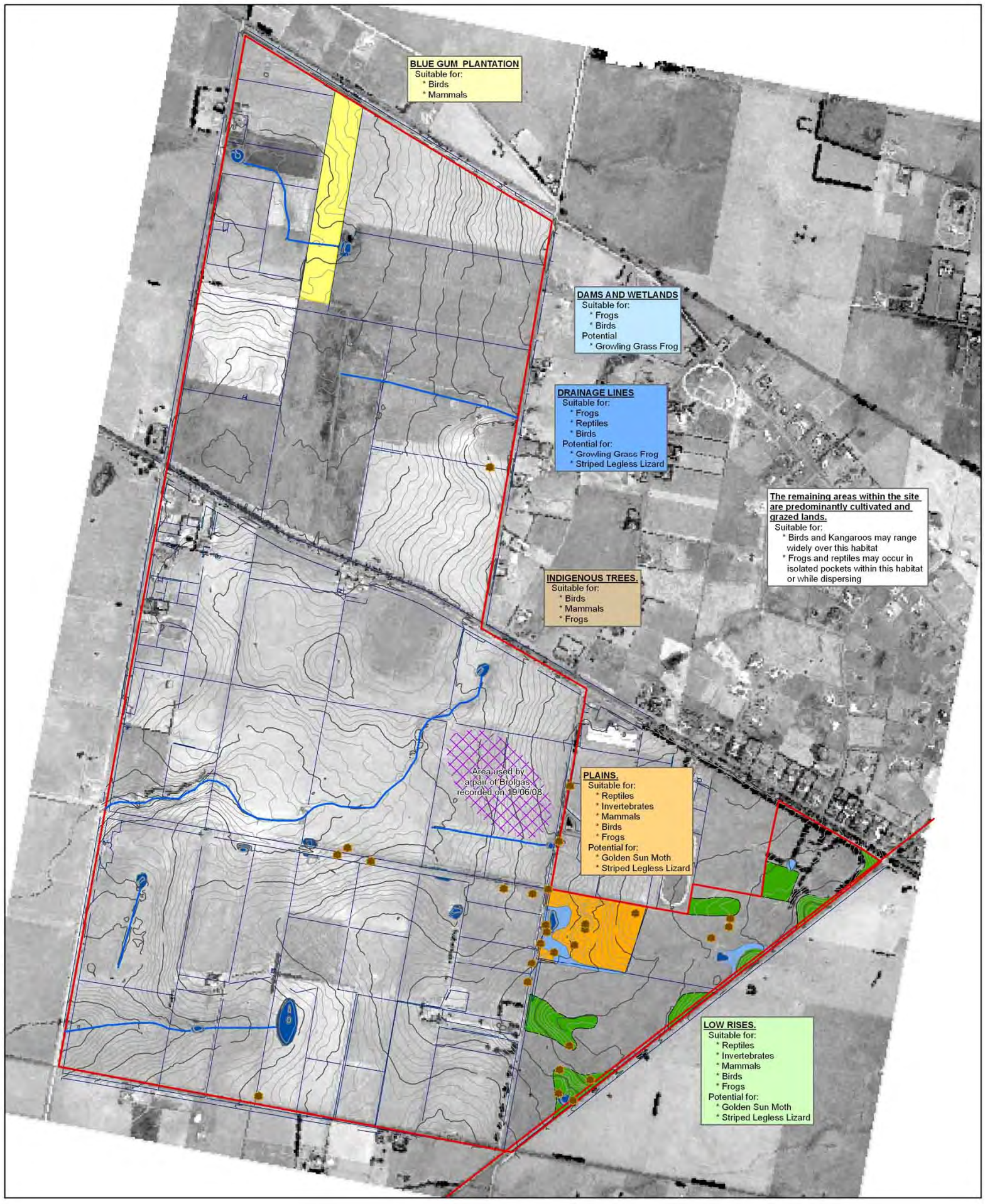
LEGEND
- Study Boundary
- Property Boundaries
- 2.5m Contours
- 0.5m Contours
- Scattered Trees
- Agricultural Land

Ecological Vegetation Classes
- Plains Grassland
- Plains Grassland/Plains Grassy Wetland Mosaic
- Plains Grassy Wetland
- Plains Grassy Wetland/Aquatic Herbland Mosaic
- Plains Grassy Woodland



MAP 04
FAUNA HABITAT
Ballarat Resort
Flora and Fauna Assessment and Net Gain Report

Practical Ecology Pty Ltd
Contracting and Consulting in Environmental Planning and Ecological Restoration
ACN 052 911 377 ABN 95 052 911 377
PO Box 228, Preston VIC 3072
phone: 9484 1555 fax: 94849133
enquiries@practicalecology.com.au

DATUM: GDA 94 MGA Zone 54

N

0 200 400 600 800
Metres
1:15,000

VERSION	01	DATE	11/08/08

MAP AND SURVEY DETAILS

Surveyed by: George Appleby, June 2008
Mapping by: Staci Timms, July 2008
Generated from: Aerial Photograph Interpretation, AutoCAD base maps and field data collected with a hand held Garmin GPS unit.

NOTES:
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LEGEND
- Study Boundary
- Cadastral Property Boundaries
- 2.5m Elevation Contours
- 0.5m Elevation Contours

Fauna Habitat
- Scattered Indigenous Trees
- Brolga Habitat
- Dam
- Wetland
- Drainage Lines
- Low Rises
- Plains
- Blue Gum Plantation

MAP 05
PROPOSED GRASSLAND AND GRASSY WOODLAND RESTORATION ZONES
Ballarat Resort Site
Flora and Fauna Assessment and Net Gain Report

LEGEND

- Scattered Trees
- Site Boundary
- Rail Trail
- Property Boundaries
- 2.5m Elevation Contours
- 0.5m Elevation Contours
- Grassland/Grassy Woodland Restoration Zones
- Native Vegetation Retained
- Native Vegetation Loss

MAP AND SURVEY DETAILS

Surveyed by: George Appleby, June 2008
Mapping by: Staci Timms, July 2008
Generated from: Aerial Photograph Interpretation, AutoCAD base maps and field data collected with a hand held Garmin GPS unit.

DATUM: GDA 94 MGA Zone 55

N

0 100 200 300 400 500
Metres

1:10,000

NOTES:
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VERSION	02	DATE	17/11/08

Practical Ecology Pty Ltd
Contracting and Consulting in Environmental Planning and Ecological Restoration
ACN 092 991 377 ABN 92 092 991 377
PO Box 228, Preston VIC 3072
phone: 9484 1555 fax: 94849133
enquiries@practicalecology.com.au

Appendix B

Preliminary Geotechnical
Desktop Study Assessment

B1 General Geotechnical Considerations

B1.1 Shrink Swell Potential

Arup have completed a preliminary desk study to advice on the geotechnical risks associated with the development of the GIA identified in this report. As part of this review, Arup has reviewed the geology and topography within each GIA and categorised the soils to provide advice on the potential for;

1. Reactive shrink swell soil conditions;
2. Inferred excavation conditions including encountering rock;
3. Potential for landslide instability; and
4. General development considerations.

As the same geology may occur at multiple sites, to avoid repetition of the same considerations for each Option, a more detailed assessment of geotechnical considerations for each geology are presented in this Appendix. GIA specific geotechnical summaries are provided in each relevant section of the report, along with figures of the GIA's showing geology and geotechnical considerations.

Information sources used include Australian Standards, various geology maps and geology references.

It should be noted that the assessment is based on the inferred surface geology and soil properties from a desk based study only. No onsite inspections or testing have been completed. Different conditions may be encountered and areas may be overlain by fill from historic site usage. The soil profiles for each GIA should be checked by a site visit and necessary geotechnical investigations before detailed design proceeds.

B1.2 Land Stability

The following generalised slope angles have been used to infer the potential for instability:

Slope Angle (V:H)	Land Instability potential	Development Considerations
< 11° (1:5)	Very low	Land stability is not considered to be an issue for site development
11° – 18° (1:5 – 1:3)	Low	Land stability is unlikely to be an issue for land development providing good practice for developments on sloping sites is consider, but should be considered in further stages.
> 18° (1:3)	Moderate to High	Land stability could influence the feasibility of site development and should be investigated further.

The following should be noted:

- Even for Very Low or Low potential sites, areas of locally steeper, weaker or saturated ground may be encountered and may result in instability; and

In all cases, the potential for land instability should be assessed in future design stages in accordance with the AGS Landslide Risk Management Guidelines (AGS, 2007).

Appendix C

Infrastructure Demand and Costs

C1 Demand

C1.1 Development Scenarios

In order to gain a greater understanding of the impact of various levels of land development, Arup have investigated four density profiles and applied these to the North Western GIA. The degree of residential land development within the GIA was determined to be 75% for each of the scenarios. This figure and the scenario densities were advised by Hansen and is based on their industry experience in land development. Arup was asked to investigate the following density scenarios:

- Scenario 1: 8 lots/ha
- Scenario 2: 12 lots/ha
- Scenario 3: 15 lots/ha
- Scenario 4: 20 lots/ha

Please note, the densities cited were to be achieved for the residential land development only and were not to be taken as the overall density across the GIA. The proposed allotment composition and overall number of allotments for each of the four scenarios for the GIAs are stated in Tables 1 to 12 below.

C1.2 Drainage demand

Analysis has been conducted for each development scenario. In the absence of detailed information regarding the proposed locations of the residential precincts within the GIA for each scenario, the assumptions listed below have been asserted and implemented to the drainage design.

- The breakdown of allotment type within the residential developments areas has been sourced from the breakdown listed for each scenario.
- The proportion of residential development and the type of allotments will be evenly distributed across the site, such that each catchment will encompass 75% residential development regardless of its size and suitability for residential land development.
- The proportion of land that is not going to be developed for residential purposes is 25% for all scenarios. It is assumed that of this, 50% will be utilised for commercial purposes and 50% will be green spaces. Whether these land uses are existing and will be maintained or if they are to be new as part of the overall development will not affect the overall drainage requirements.
- The drainage flow direction and catchment areas following development will match the existing conditions.

The design risks associated with methodology implemented include:

- The drainage runoff anticipated for each development scenario has been calculated on the assumption that residential development will be evenly distributed across the GIA. However, the location of residential development

will be determined based on a number of factors including the area's geology, major transport routes, utility services and environmental protection. Hence, residential land development will be greater than 75% is areas deemed suitable for development and less in areas deemed unsuitable. Consequently, there is a risk that should residential development be significantly higher than 75% within a catchment area, the detention basin volume calculated will be undersized.

C1.3 Sewer demand

Central Highlands Water was contacted as part of the analysis to confirm specific design parameters. Where specific values could not be defined by Central Highlands Water without conducting further analysis of the site, industry default values were assumed. The following assumptions were applied to the sewer demand calculations based on the information that was obtained:

- The average number of people per household will be 2.4. This value is applied to all density scenarios and is independent of the portion of dwellings types. This figure is in accordance with the average number of people per household in Ballarat, as per the 2011 Census.
- The portion of the sewer system that is below the groundwater table is 1. A conservative approach was assumed given the absence of geotechnical information and the presence of extensive waterways within each of the GIAs.
- The Leakage Severity Coefficient was nominated as 0.9 for all GIAs. This value can vary between 0.4 and 1.6, and is defined by the impact of soil movement and effectiveness of Central Highlands Water's long-term strategy for maintenance and managing the impact of sanitary sewers. Advice on these factors was not provided by Central Highlands and as such a default value was assumed.
- The ARI of sewerage outflows will be 5 years for all GIAs, as specified by Central Highlands Water.

C1.4 Water Demand

The water demand has been determined for the residential properties only, and does not consider the water required for the function of the commercial or landscaped precincts. This decision was made on account of the absence of information regarding the type of commercial and landscape areas proposed for each scenario and their demand requirements.

In accordance with the MRWA WSAA Water Code, the peak daily and hourly demands have been determined.

The peak hourly flow rates for residential density types (high, medium, low) have been provided by Central Highlands Water and are in accordance with those stated by MRWA (MRAW, 2011). Arup has extrapolated these values to ascertain values for the allotment types used in the scenarios.

The peak daily demand has been determined on the assumption that potable water demand reduction measures will not be implemented in the development areas. This approach was applied to ensure that water demand requirements can be achieved when the residential water systems are unable to function as designed, such as during drought and when the residential systems are not maintained. This design measure was proposed and supported verbally by Central Highlands Water.

C1.5 Gas Demand

The gas demand for each of the development scenarios has been determined based on the current gas usage per person in Ballarat (1.28 GJ/pp/year). In the absence of information pertaining the proposed industrial and commercial development for each scenario, the gas demand calculated consider only the residential demand.

C2 Trunk infrastructure costs

C2.1 Drainage

The following assumptions are based on engineering industry experience and have been used to determine the cost associated with the trunk infrastructure required:

- The depth to the spillway of all retention basins will be 1.5m;
- The wetlands will have approximately 15% of the volume of the retention basins;
- The wetlands will have a permanent detention of 0.5m;
- The cost of the combined wetland and retention basin, including the cost associated with the civil works, materials and construction is \$145 per m^3 of basin;
- The pipework required contributes 30% towards the overall cost of the drainage infrastructure;
- The City of Ballarat drainage fee associated with new development is 3.5% of the overall infrastructure cost;
- The designated green areas and grass swales, which contribute towards achieving WSUD requirements, are not to be priced as part of the drainage infrastructure required; and
- The cost derived for the stormwater trunk infrastructure does not include the land acquisition cost required for each retention basin.

C3 Local infrastructure costs

The design and costing assumptions for each item are stated next to that item in the tables in the sections below.

The developer costs associated with the construction of local infrastructure have been determined following consideration of the following:

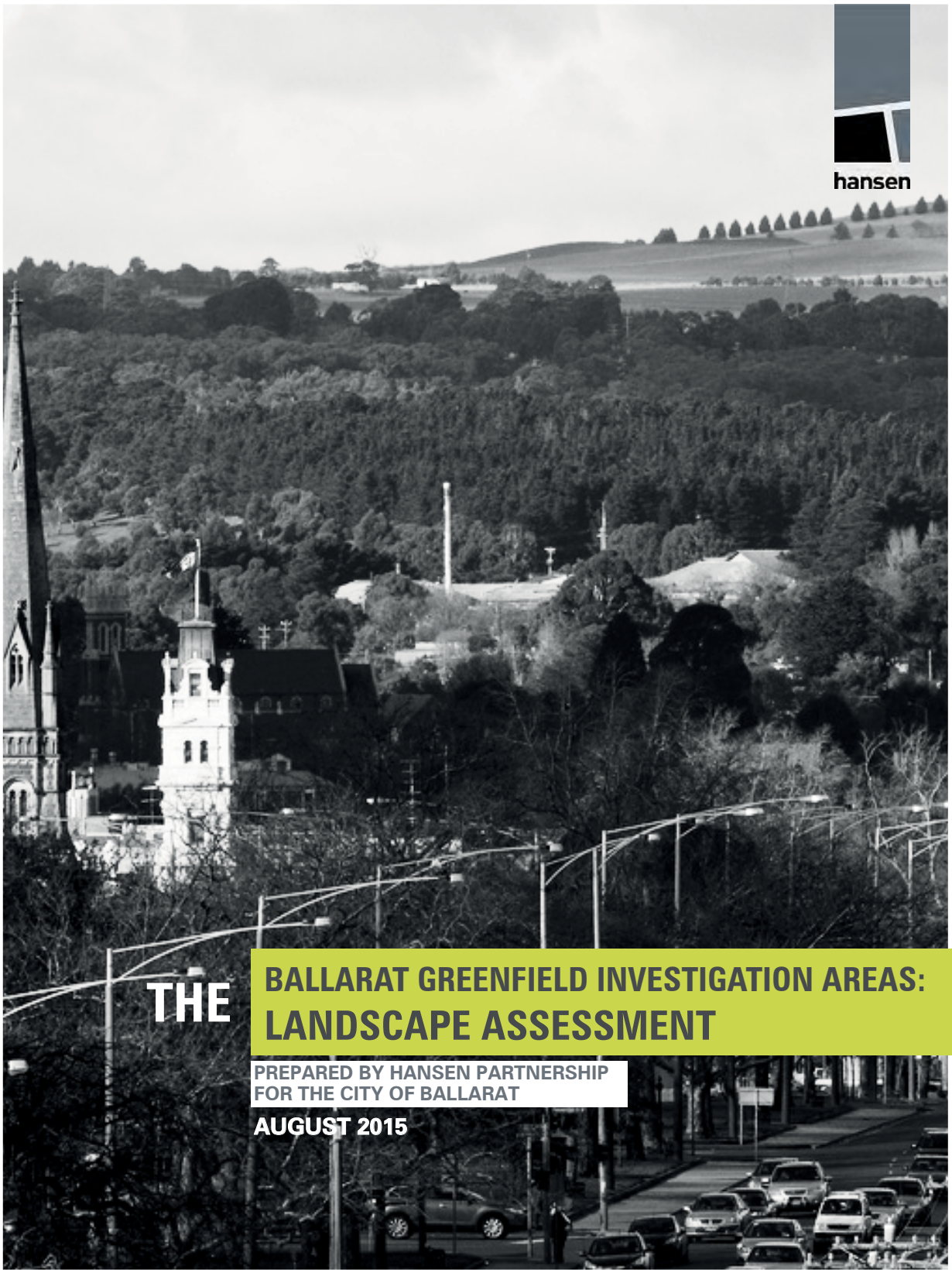
- The standard industry rates for construction in Melbourne (Rawlinsons, 2015); and
- The fees and charges stipulated by Central Highlands Water for land development (Central Highlands Water, 2014).

Cost estimates have been determined based on 2015 prices with the design and costing assumptions for each item stated next to that item in the tables in the following sections.

C3.1 Roads costs

C3.2 Sewer costs

C3.3 Water costs



hansen

THE BALLARAT GREENFIELD INVESTIGATION AREAS: LANDSCAPE ASSESSMENT

PREPARED BY HANSEN PARTNERSHIP
FOR THE CITY OF BALLARAT

AUGUST 2015

2

CONTENTS

1. INTRODUCTION

The report documents the Landscape Assessment undertaken by Hansen Partnership for the three Ballarat Greenfields Investigation Areas (GIAs). This assessment aims to provide further rigour to the assessment of the GIAs in terms of their suitability for future development with respect to visual landscape issues. The methodology for this project is based on Hansen's experience with similar projects and approaches to landscape assessments as outlined in relevant benchmarking documents, specifically: Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design (November 2007).

Desktop analysis of the study area previously covered in GIA assessments for items such as planning, access, land use and environmental matters were used to inform this landscape assessment. Additionally, a site inspection specifically for this component of the project was conducted as a basis for this assessment.

The methodology for the project is divided into the following phases:

LANDSCAPE CHARACTER ASSESSMENT

As a starting point, landscape character units will be mapped and assessed based on desktop and field-work analysis.

VIEWSHED ANALYSIS

Using 3D modelling software, it will be determined from where and to what extent the study is visible based on topography. These findings will then be tested against fieldwork, which take into account factors such as vegetation and buildings to determine the on-ground visibility of the GIAs.

LANDSCAPE VALUES ASSESSMENT

The identified character areas will be assessed in terms of their relative landscape value, which will be determined predominantly through comparison to benchmarking documents and analysis conducted through field-work.

VISUAL SENSITIVITY ASSESSMENT

Visual sensitivity will then be determined through overlaying the results of the viewshed analysis and landscape values assessment to determine areas most sensitive to change in the GIAs. This will formulate the basis for any recommendations for the GIAs based on the landscape assessment.

ASSESSMENT OF
2. LANDSCAPE CHARACTER

This section of the report focuses on describing the visual landscape character of the investigation areas as a basis for the landscape assessment by identifying their natural, rural and built characteristics.

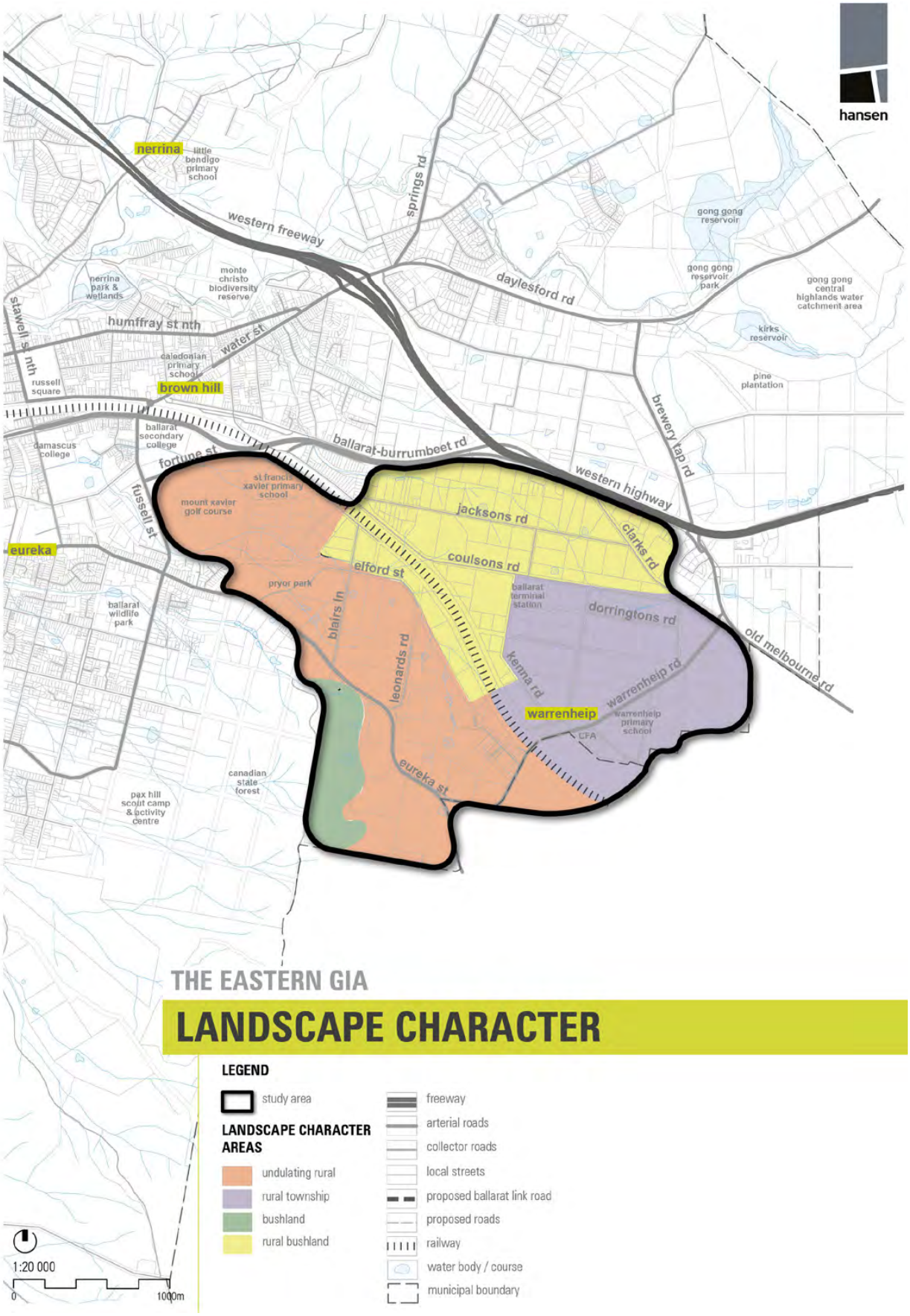
The character areas have been defined through a combination of fieldwork and desktop assessments. The planning scheme has also been referenced for this assessment, including landscape descriptions in the Significant Landscape Overlay (SLO) and the Environmental Significance Overlays (ESO). Additionally, the 'Visualising Ballarat' (Federation University Australia and City of Ballarat, 2015, Source: http://www.visualisingballarat.org.au/) online mapping resource has also been referenced.

Another previous study which this Landscape Character Assessment has referenced is 'Mapping Ballarat's Historic Urban Landscape' (Context Pty Ltd, 2013). The Context (2013) report comprises broad scale studies for the entire municipality including a number of indicative character areas which cover the three GIAs. This Landscape Character Assessment aims to interrogate the landscape characteristics of each GIA in further detail and map this accordingly. Is therefore intended to build on the findings of the Context (2013) report, which have been used as a broad-scale guide for this assessment.

The study area contains a unique mixture of distinct land uses and natural features which have an impact on prevailing landscape character. Landscape character areas have been identified within the three investigation areas as follows:

1. **PLAINS**
2. **PLAINS RURAL LIVING**
3. **RURAL PASTURE**
4. **ELEVATED PASTURE**
5. **UNDULATING RURAL**
6. **RURAL BUSHLAND**
7. **BUSHLAND**
8. **RURAL TOWNSHIP**

These are shown graphically in the Landscape Character plans, a description of each area follows, accompanied by photographs typical of the specific character area.


hansen
nerrina
little bendigo primary school
springs rd
western freeway
gong gong reservoir
gong gong reservoir park
gong gong central highlands water catchment area
daylesford rd
nerrina park & wetlands
monte christo biodiversity reserve
stawell st nth
humffray st nth
water st
kirks reservoir
caledonian primary school
russell square
brown hill
pine plantation
brewery tap rd
ballarat secondary college
damascus college
fortune st
ballarat-burrumbeet rd
western highway
st francis xavier primary school
mount xavier golf course
fussell st
jacksons rd
clarks rd
eureka
coulsons rd
elford st
pryor park
ballarat terminal station
dorringtons rd
ballarat wildlife park
blairs ln
leonards rd
old melbourne rd
kenna rd
warrenheip rd
warrenheip
warrenheip primary school
CFA
eureka st
canadian state forest
pax hill scout camp & activity centre
THE EASTERN GIA
LANDSCAPE CHARACTER
LEGEND
study area
LANDSCAPE CHARACTER AREAS
undulating rural
rural township
bushland
rural bushland
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
railway
water body / course
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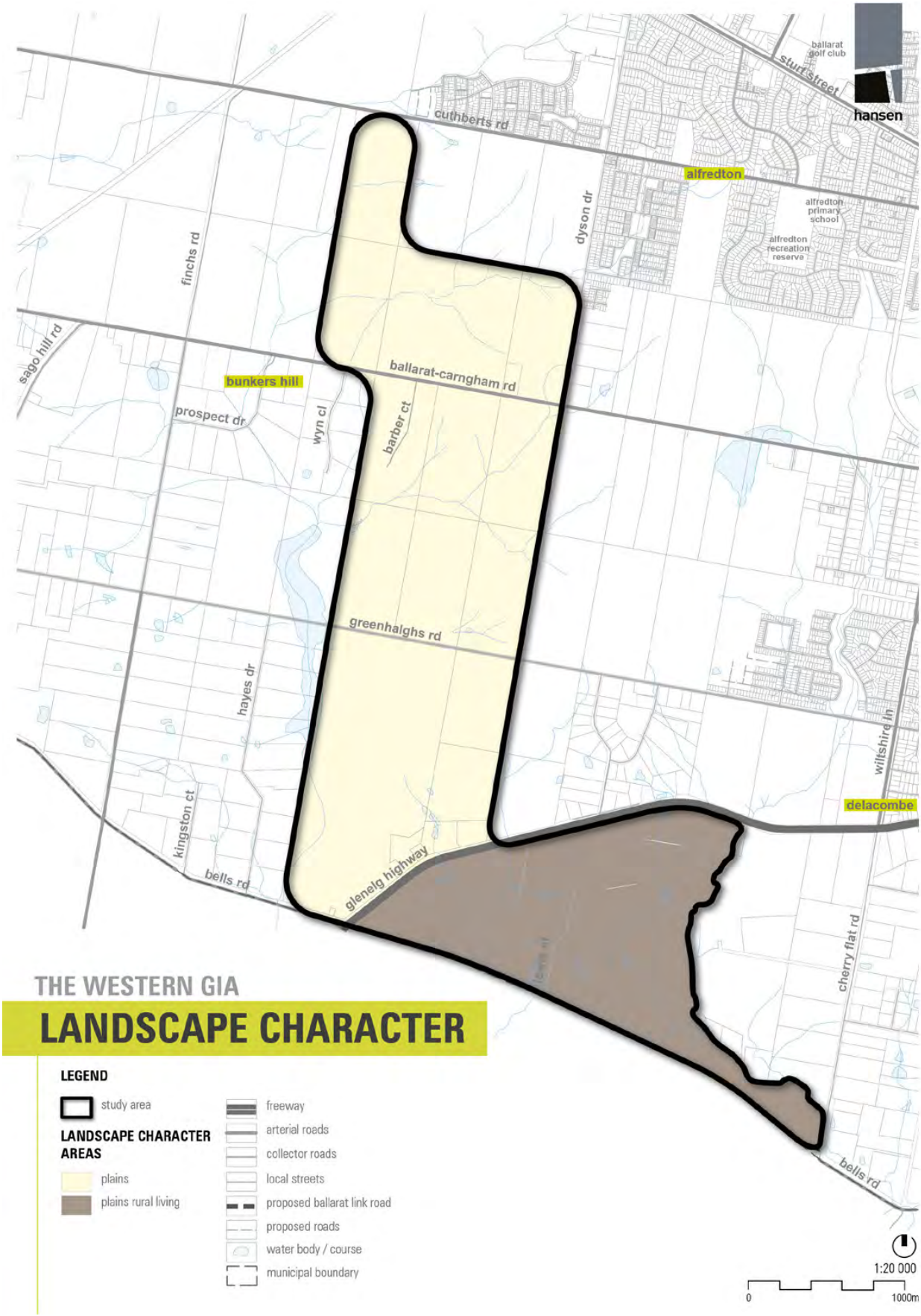
hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
dyson dr
alfredton primary school
alfredton recreation reserve
finchs rd
sago hill rd
bunkers hill
ballarat-carngham rd
prospect dr
wyn cl
barber ct
greenhalghs rd
hayes dr
wiltshire ln
delacombe
kingston ct
bells rd
glenelg highway
cherry flat rd
bells rd
THE WESTERN GIA
LANDSCAPE CHARACTER
LEGEND
study area
LANDSCAPE CHARACTER AREAS
plains
plains rural living
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
municipal boundary
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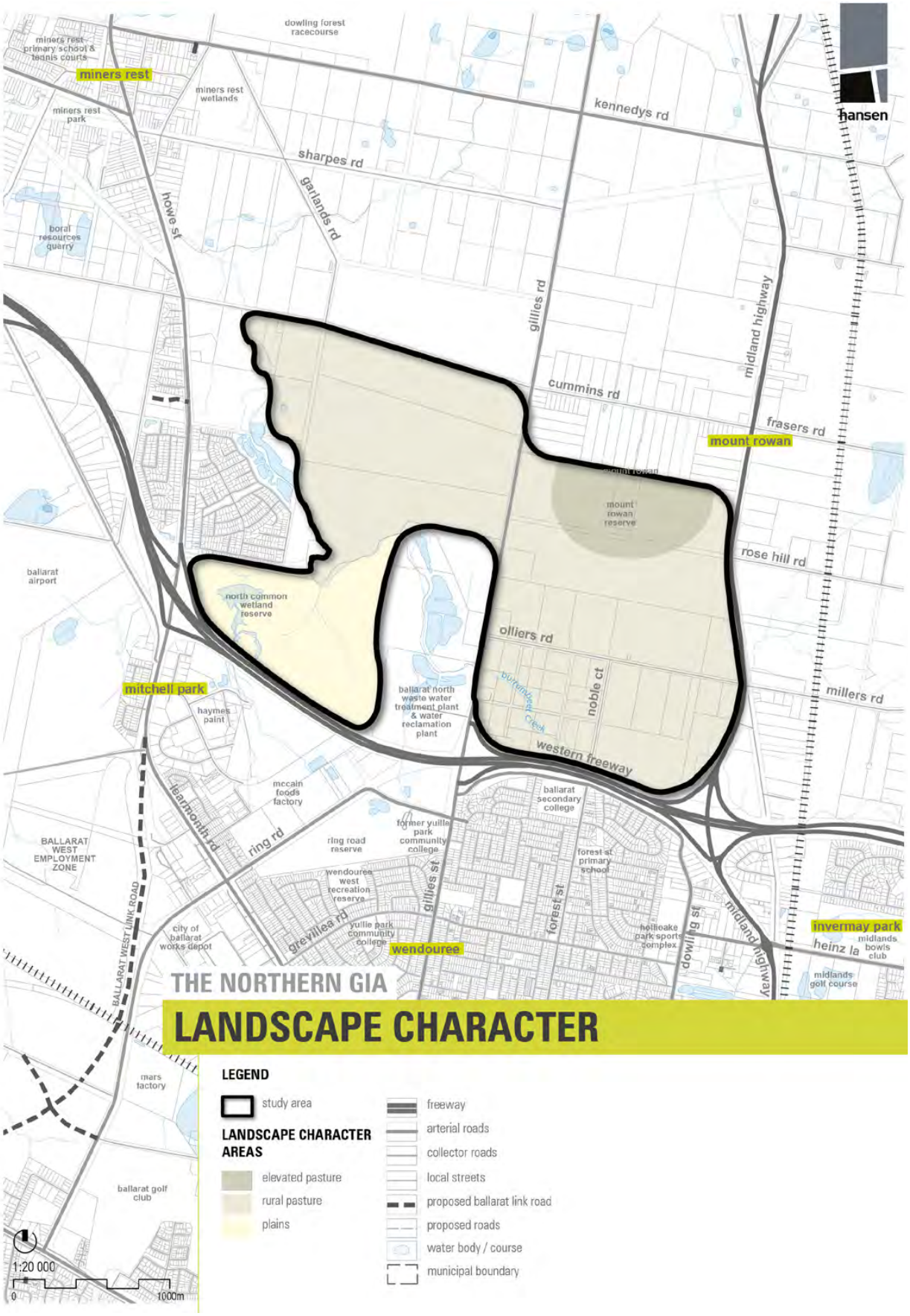
hansen
THE NORTHERN GIA
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LANDSCAPE CHARACTER AREAS
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rural pasture
plains
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
municipal boundary
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1000m
miners rest
mount rowan
mitchell park
wendouree
invermay park
kennedys rd
sharpes rd
howe st
garlands rd
gillies rd
midland highway
cummins rd
frasers rd
rose hill rd
olliers rd
noble ct
millers rd
western freeway
learmonth rd
ring rd
grevillea rd
gillies st
forest st
dowling st
heinz la
ballarat airport
BALLARAT WEST EMPLOYMENT ZONE
BALLARAT WEST LINK ROAD
ballarat golf club
mars factory
city of ballarat works depot
mccain foods factory
haymes paint
ballarat north waste water treatment plant & water reclamation plant
north common wetland reserve
mount rowan reserve
ballarat secondary college
forest st primary school
former yuille park community college
ring road reserve
wendouree west recreation reserve
yuille park community college
holleoake park sports complex
midlands bowls club
midlands golf course
miners rest primary school & tennis courts
miners rest wetlands
miners rest park
boral resources quarry
dowling forest racecourse

1 PLAINS

The 'Plains' landscape character area comprises flatter terrain with expansive grassed grazing lands, typical of the wider Burrumbeet Plains. Canopy vegetation is sparse, but where present it is typically established exotic or native windbreaks along property boundaries and roadsides, with some scattered native vegetation in paddocks present.

Elements such as scattered agricultural infrastructure, livestock, post-and-wire fencing, occasional small scale dwellings, sheds and agricultural facilities, help to reinforce a distinctively active and functioning rural landscape character set within a flat to mildly undulating landscape.

The combination of sparse vegetation and low grazing land often allows distant views when within or adjacent to the character area. Drainage lines and waterways can also be seen, but they are not a visually dominant character element.

Applicable GIAs:

- Western
- Northern

2 PLAINS RURAL LIVING

The 'Plains Rural Living' landscape character area comprises typically cleared areas, similar to the 'Plains' character area, but with a higher concentration of rural living dwellings. Denser native and exotic garden planting is typical in the land adjoining the dwellings, which contrast somewhat to the surrounding spacious, cleared allotments reminiscent of the surrounding plains. Terrain is gently undulating, with unmade roads reinforcing the rural character of the area. Drainage lines and waterways can also be seen, but they are not a dominant character element, and are often edged by vigorous exotic vegetation.

Applicable GIAs:

- Western

3 RURAL PASTURE

'Rural Pasture' refers to predominantly cleared grazing land accompanied by a moderate presence of canopy vegetation and rural style dwellings (more so than the 'Plains' character area). This vegetation is a mixture of exotic and native species that are most prominent as windbreaks or screen planting along roadsides / property boundaries or as garden planting adjacent to the scattered rural dwellings and out-buildings. Views are often constrained by this vegetation and the gently undulating terrain, however occasional views to distant high points are visible across the pasture areas. Scattered large native trees can be seen throughout the pasture areas, and a number of minor waterways typically lined by exotic vegetation. Additionally, the mixture of made and unmade roads with in the area reinforces its rural character.

Applicable GIAs:

- Northern

4 ELEVATED PASTURE

'Elevated Pasture' refers to land that is a significant highpoint or elevated above surrounding terrain, specifically Mt. Rowan. This character area is largely devoid of vegetation, with pastoral grasslands / grazing land comprising the ground plane. The lack of canopy vegetation reveals the distinct elevated and undulating topography of the highpoint / character area to surrounding viewpoints. The boundary for this character area has been defined by a review of topographical mapping and the extents of the SLO outlined in the planning scheme.

Applicable GIAs:

- Northern

5 UNDULATING RURAL

'Undulating Rural Pasture' refers to rural areas sited on distinctly undulating terrain. This topographical variety is revealed to viewers across cleared pasture and grazing areas. There is an eclectic mixture of exotic and native vegetation, typical on roadsides, property boundaries and as often formal garden planting adjoining the occasional rural dwelling. This mixture of species and its comparatively lesser density also differentiates it from surrounding character areas defined by a prevalence of bushland planting. Views are often constrained due to this vegetation but between tree rows and where the terrain allows, occasional distant views across the pasture areas can be seen. Unmade roads with wide grassed verges and earth swales are often present and contribute to the dominant rural character.

There are also a number of areas of dense exotic tree planting, often of pine species. The form and colour of this vegetation when planted on mass provides a stark contrast to surrounding areas where species are predominantly native, or a mixture of native and exotic vegetation.

Applicable GIAs:

- Eastern

6 RURAL BUSHLAND

'Rural Bushland' refers to the vegetated land set within the undulating hills throughout the Eastern GIA. It is characterised by the presence of vegetation in the form of established native trees and pockets of bushland. Roads into or adjacent to the character area are a mixture of sealed or gravel roads lined with native vegetation and unmade verges / drainage swales. Rural residences are often present off these roads, and are typically well setback from the roads, with visible gates, entrances, low scale fencing and sometimes contrasting garden planting, while being within a setting of native canopy vegetation. The dense vegetation creates a sense of visual enclosure and combines with the effect of the undulating terrain to restrict views to the wider landscape.

Applicable GIAs:

- Eastern

7 BUSHLAND

'Bushland' refers to the areas of distinctly dense native vegetation associated with the Canadian State Forest, present in the south-western extents of the Eastern GIA. The vegetation comprises a thick coverage of Eucalyptus canopy species, with a understorey of native shrubs, grasses and groundcovers. Terrain through this area is typically undulating, and in combination with the dense vegetation creates a sense of enclosure, where views are typically constrained to the immediate area.

Applicable GIAs:

- Eastern

8 RURAL TOWNSHIP

'Rural Township' refers to areas that have a relatively higher concentration of dwellings, such as Warrenheip, in a somewhat semi-rural setting. Typical of this area are low scale dwellings with outlying structures set amongst spacious lots with often cleared lawns or small grazing areas accompanied by eclectic gardens containing both native and exotic plantings. Numerous canopy trees and wide sealed roads with spacious grass verges reinforce the rural character of the area. Terrain is typically flat, providing a contrast to surrounding undulating rural areas. A number of high voltage transmission lines also cross this character area.

Applicable GIAs:

- Eastern

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ASSESSMENT OF 3. VIEWSHEDS

This section of the report describes the outcomes of the viewshed analysis which is undertaken to inform the landscape assessment. The viewshed analysis is undertaken as a means to ascertain the full extent of technically feasible views to and within the study area from the surrounding landscape.

A viewshed is defined as the surface area or terrain visible from a given viewpoint. It is also the area from which that viewpoint or series of viewpoints may be seen. This is referred to as the 'intervisibility' relation. Although the viewshed plans shown only the visible terrain from a specific viewpoint, the visibility between two points depends upon the presence of on-ground obstacles, such as trees and buildings along the sight-line which connects the two points. Such obstacles may obstruct or reduce the reciprocal vision of the same two points.

The approach used in this assessment is to identify this extent of potentially visible terrain from a specific point as a basis for proofing the results through extensive fieldwork. It is important to emphasise that the viewshed analysis will yield a much broader extent of views as it is based on topography only and does not take into consideration the restrictive impact on views from factors such as built form and vegetation. This will be further discussed for each GIA in the proceeding Visual Exposure section of the report.

VIEWSHED METHODOLOGY

The viewshed analysis of the study areas was developed using computer software packages (Autocad, Rhinoceros & Adobe) to develop a three-dimensional terrain model of the region within which the subject land is contained. The model used topographical data obtained from Council's GIS database, comprising elevation information with a 1m contour interval.

Following development of the terrain model and its surrounds, a series of points were selected based on the desktop analysis of likely sensitive viewing locations.

Utilising Rhino terrain and based on the concept of intervisibility described above, a projection was simulated at a height of 1.6m above the ground radially to the surrounding terrain. This height was selected to represent the height of an average viewer. The objective of this process is to ascertain all locations that are conceivably visible from a particular location. This analysis is based on topography only and does not consider built form, vegetation or any other potential visual obstruction.

The resultant map provides an illustrative description of the viewshed from a specific point, whereby the potentially visible terrain is shown coloured in red, and not visible areas are white.

FIELD WORK ASSESSMENTS

Each viewpoint has also been assessed through subsequent field work to review the outcomes of the viewshed analysis. This process is necessary in order to account for the potential screening and filtering effect on views caused by existing vegetation and built form.

The field work was conducted on the 1st of June 2015 between 10am and 4pm.

It is important to reinforce that the viewshed analysis maps are based on topography only and do not take into account the screening effects of other elements in the landscape such as existing vegetation and built structures that further obscure views. Typically the actual view from the ground will be reduced once these factors are taken into consideration.

VIEWSHED MAPPING

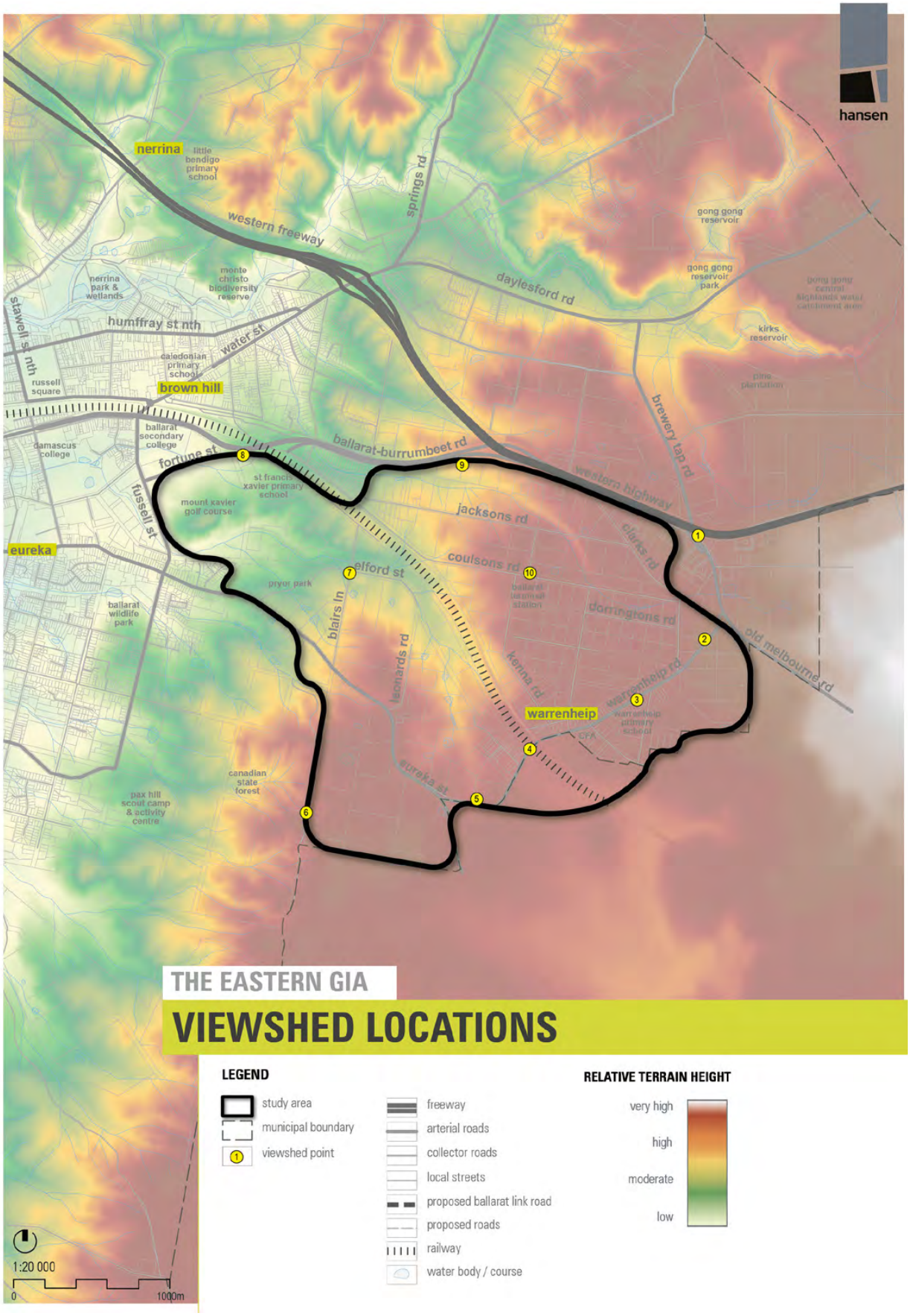
The following demonstrates the ten veiwshed conducted for each of the GIAs. Each map provides an illustrative description of the viewshed from a specific point, whereby the potentially visible terrain is shown coloured in red, and not visible areas are white.

A broad discussion of the viewsheds, their accompanying photography and the relationship between the viewpoints and topography is included in the Visual Exposure Section of the report. The following mapping presents data and findings from the site investigations which are used as a basis for this later discussion. This discussion will reveal key patterns and facets of the viewshed assessment, as required for the subsequent values / visual sensitivity assessment.

VIEWSHED LOCATIONS

The viewshed locations selected are generally located within publically accessible areas, including within road and recreational reserves. The purpose of this task is to develop a picture of the extent of views from a range of locations spread evenly around and within the study area. The viewpoints covered are shown in the table / mapping opposite.

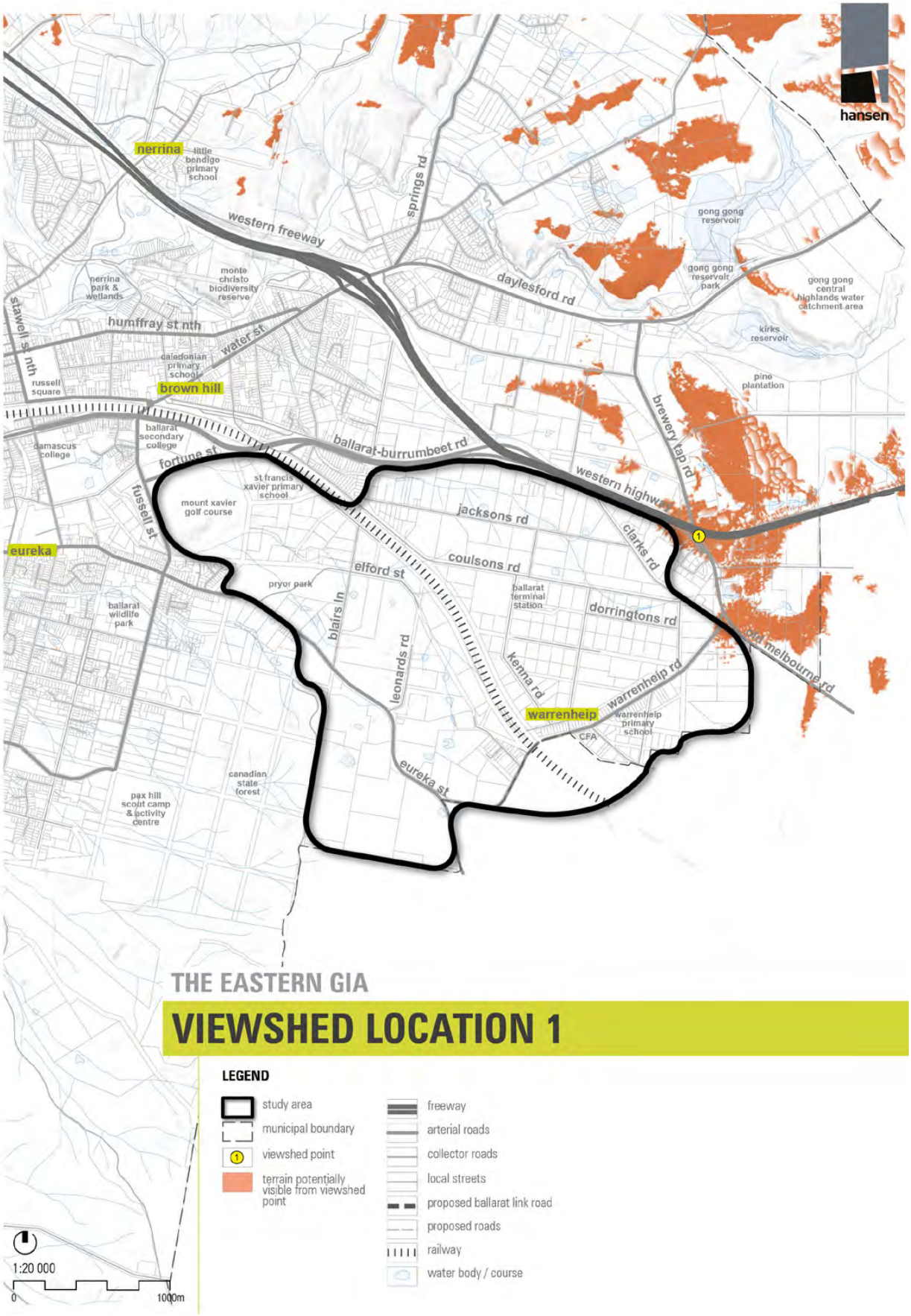
The mapping also demonstrates relative terrain height of each of the GIAs which comprises shaded graphic of the collated 1m contour data. This assists to understand the relative changes in level and the landform which contributes to the composition of the landscape. On this basis the study area has been shaded to indicate topography ranging from low (light green) to very high land (red).


hansen
nerrina
little bendigo primary school
western freeway
springs rd
gong gong reservoir
gong gong reservoir park
daylesford rd
nerrina park & wetlands
monte christo biodiversity reserve
stawell st nth
humffray st nth
water st
caledonian primary school
russell square
brown hill
kirks reservoir
pine plantation
brewery tap rd
ballarat secondary college
damascus college
fortune st
ballarat-burrumbeet rd
western highway
st francis xavier primary school
mount xavier golf course
fussell st
jacksons rd
clarks rd
eureka
coulsons rd
elford st
prior park
ballarat wildlife park
blairs ln
dorrington rd
old melbourne rd
leonards rd
kerna rd
warrenheip rd
warrenheip
warrenheip primary school
CFA
canadian state forest
eureka st
pax hill scout camp & activity centre
1
2
3
4
5
6
7
8
9
10
THE EASTERN GIA
VIEWSHED LOCATIONS
LEGEND
study area
municipal boundary
viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
railway
water body / course
RELATIVE TERRAIN HEIGHT
very high
high
moderate
low
1:20 000
0
1000m

THE EASTERN GIA

VIEWSHED LOCATIONS

EASTERN GIA	
VIEWSHED NO.	**LOCATION**
1	Old Melbourne Road and Zenith Drive
2	Warrenheip Road and Clarkes Road
3	Warrenheip Road 1
4	Warrenheip Road 2
5	Warrenheip Road 3
6	Boundary Road
7	Blairs Lane
8	Fortune Street
9	Victoria Street and Ballarat-Burrumbeet Road
10	Coulsons Road



THE EASTERN GIA

VIEWSHED LOCATION 1

LEGEND

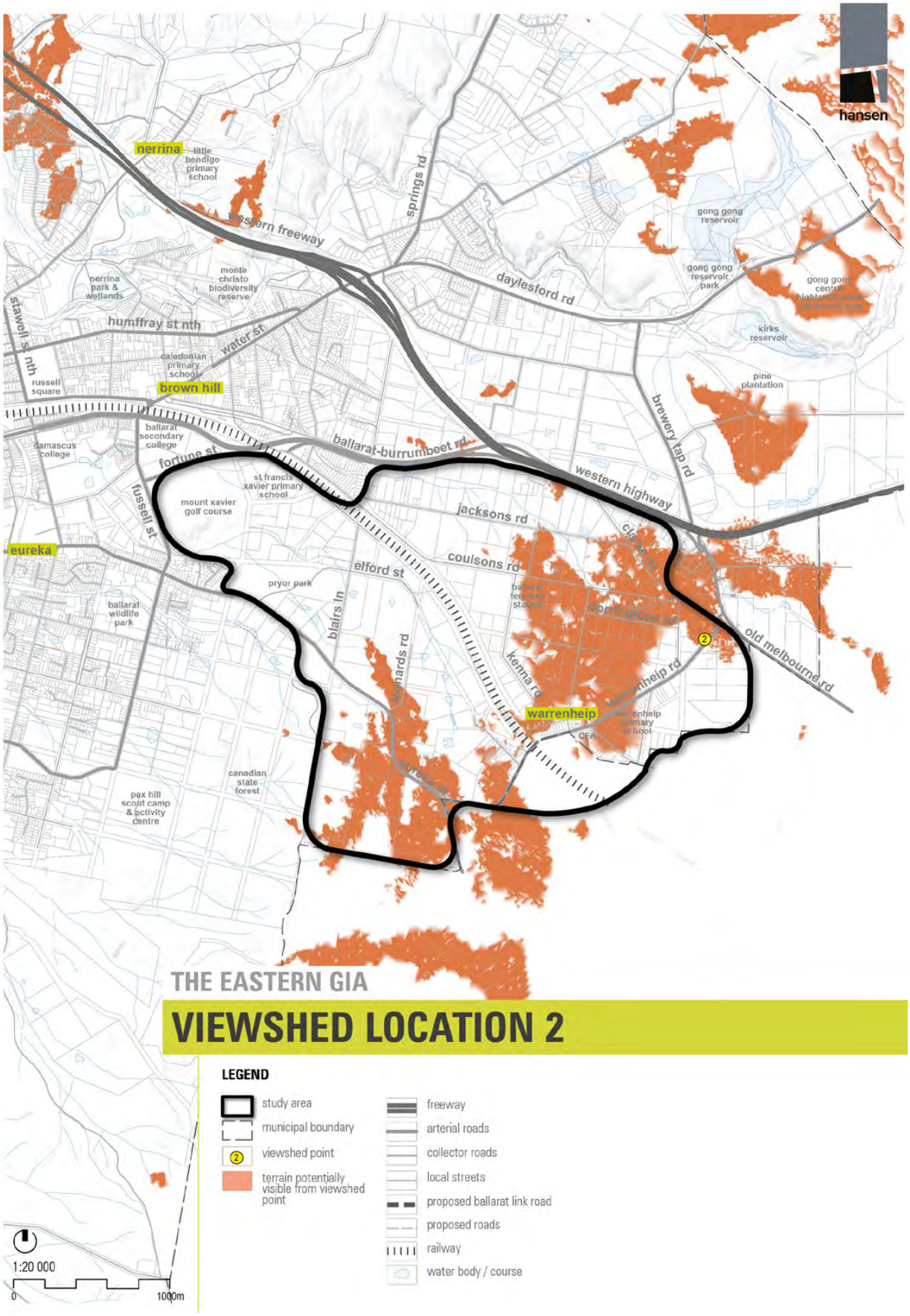
- study area
- municipal boundary
- viewshed point
- terrain potentially visible from viewshed point
- freeway
- arterial roads
- collector roads
- local streets
- proposed ballarat link road
- proposed roads
- railway
- water body / course

VIEWSHED LOCATION 1

View 1 from Old Melbourne Road and Zenith Drive intersection looking south west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- N/A – outside study area, views obscured by terrain.



THE EASTERN GIA

VIEWSHED LOCATION 2

LEGEND

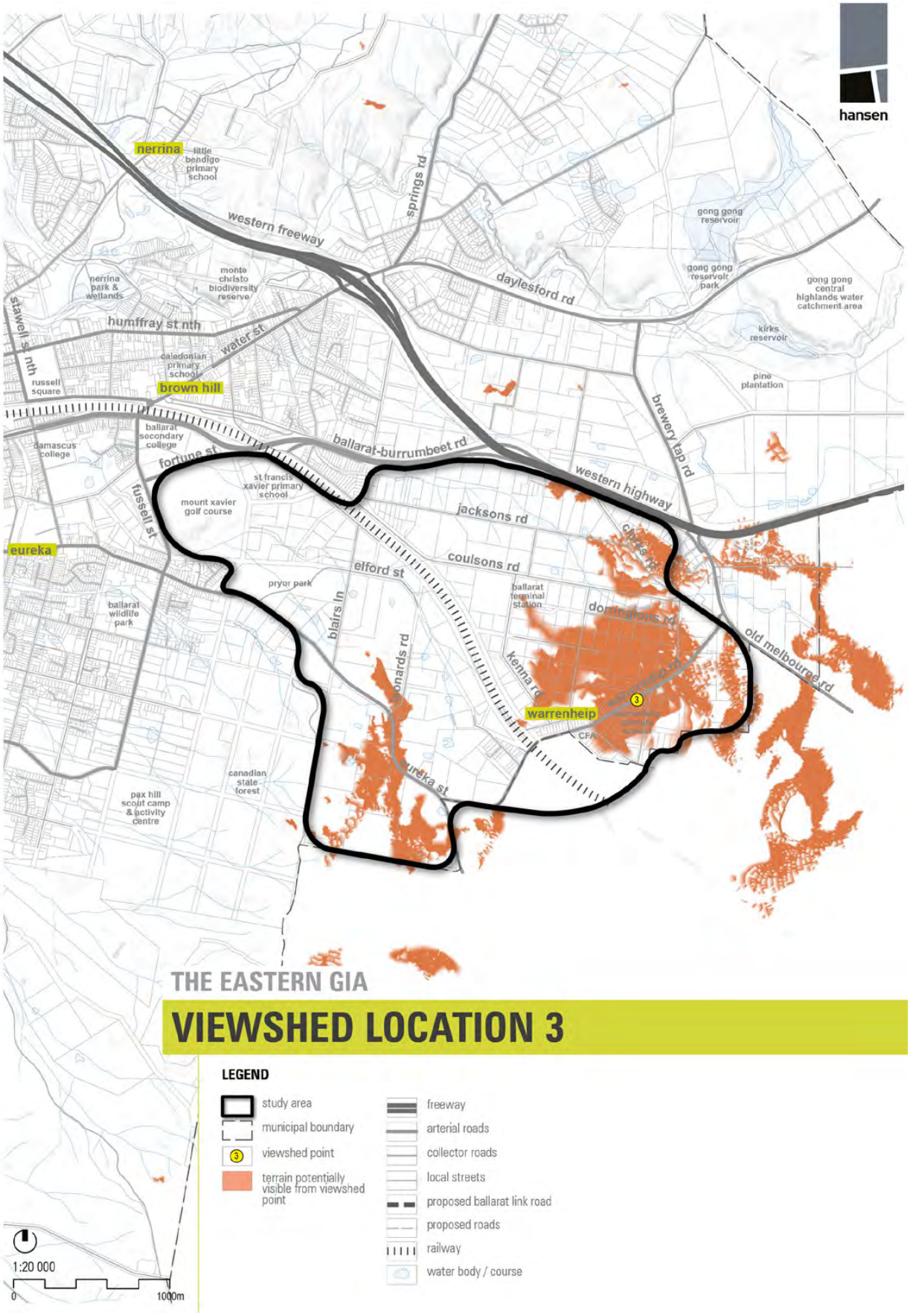
- study area
- municipal boundary
- viewshed point
- terrain potentially visible from viewshed point
- freeway
- arterial roads
- collector roads
- local streets
- proposed ballarat link road
- proposed roads
- railway
- water body / course

VIEWSHED LOCATION 2

View 2 from Warrenheip Road and Clarkes Road intersection looking west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 8: Rural Township

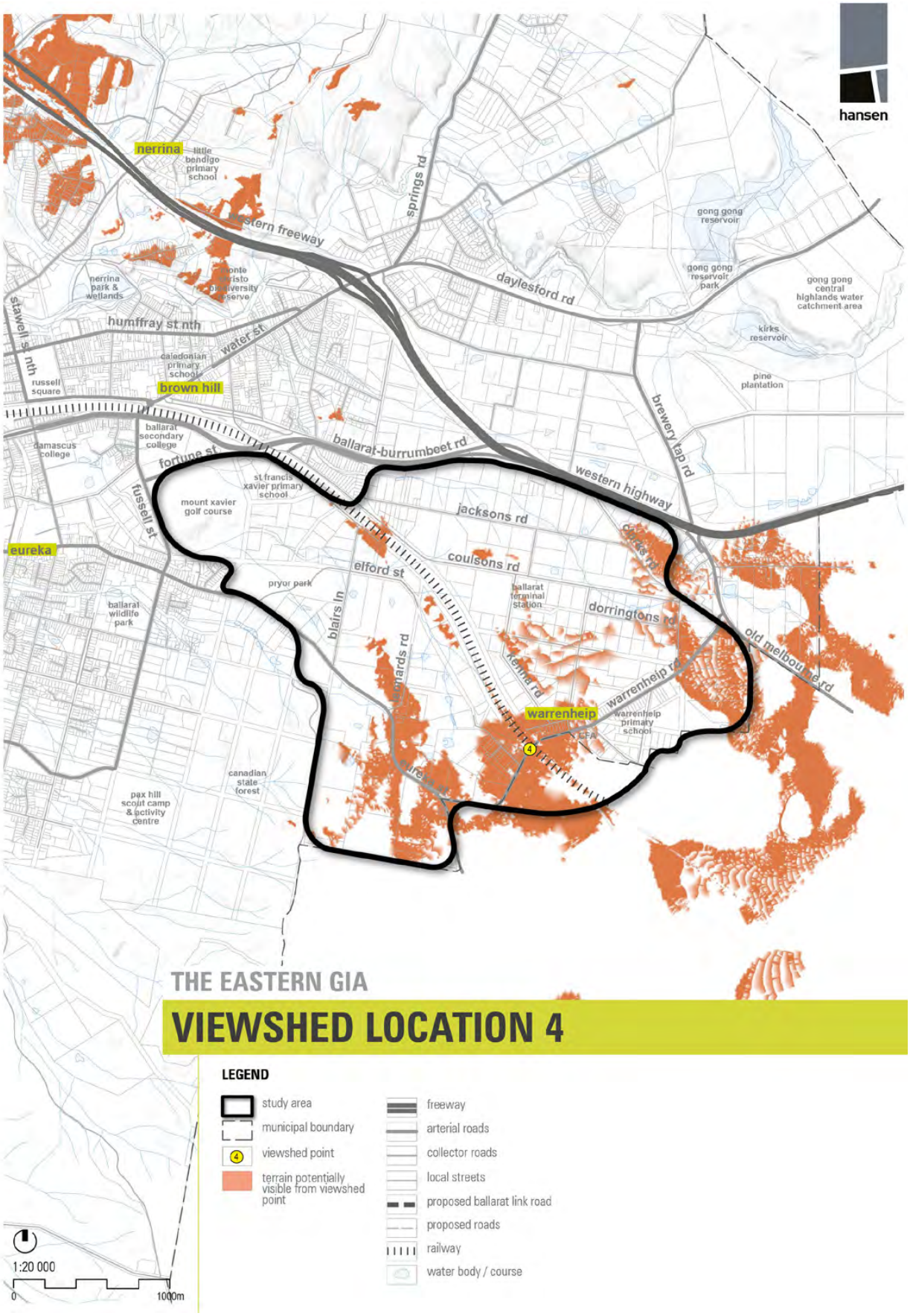

hansen
nerrina
little bendigo primary school
western freeway
springs rd
gong gong reservoir
gong gong reservoir park
gong gong central highlands water catchment area
daylesford rd
nerrina park & wetlands
monte christo biodiversity reserve
stawell st nth
humffray st nth
water st
kirks reservoir
caledonian primary school
russell square
brown hill
pine plantation
brewery tap rd
ballarat secondary college
damascus college
fortune st
ballarat-burrumbeet rd
western highway
st francis xavier primary school
mount xavier golf course
fussell st
jacksons rd
eureka
coulsons rd
elford st
pryor park
ballarat terminal station
ballarat wildlife park
blairs ln
leonards rd
kenna rd
old melbourne rd
warrenheip
eureka st
canadian state forest
pax hill scout camp & activity centre
THE EASTERN GIA
VIEWSHED LOCATION 3
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
railway
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 3

View 3 from Warrenheip Road in Warrenheip looking west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 8: Rural Township



THE EASTERN GIA

VIEWSHED LOCATION 4

LEGEND

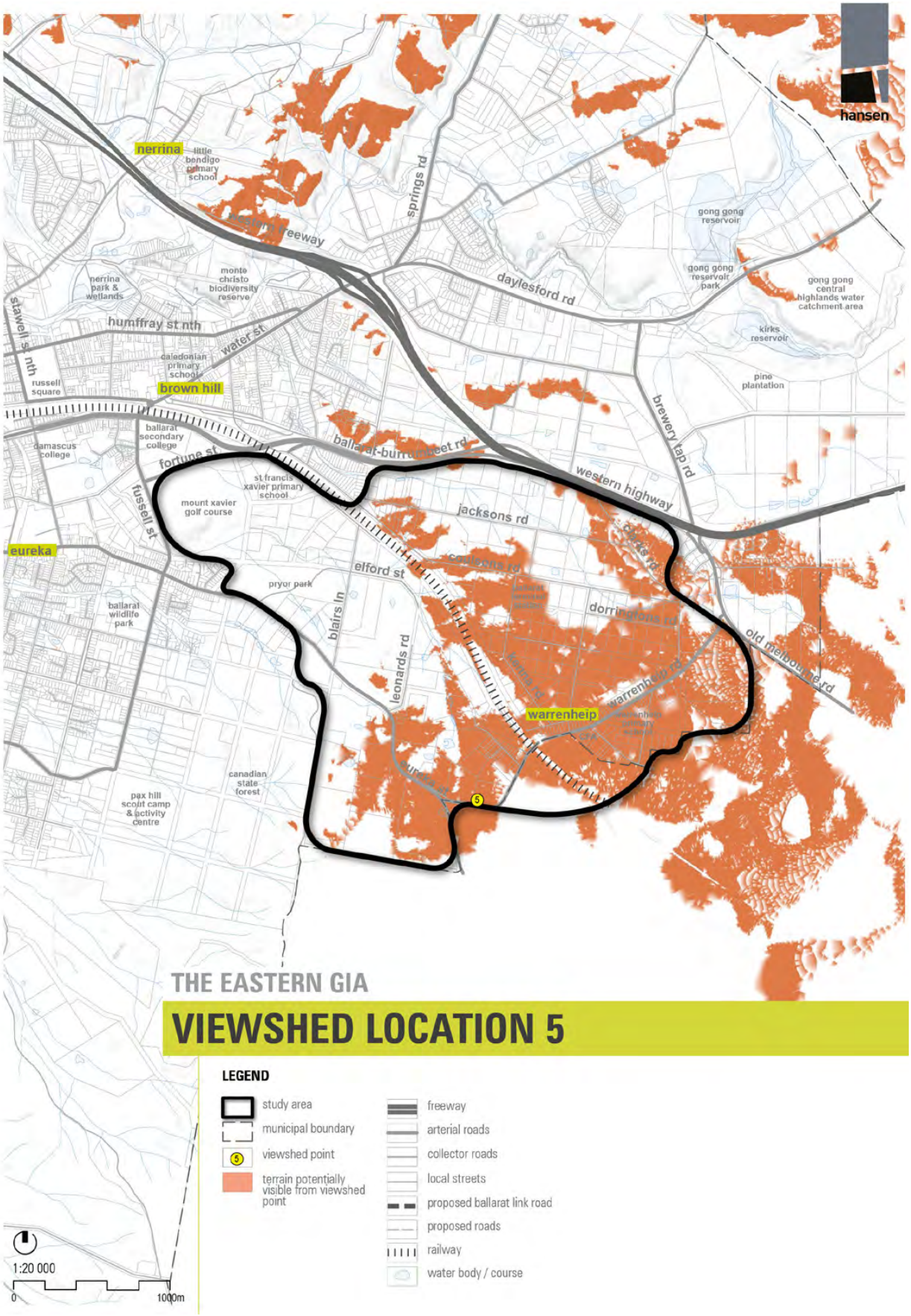
- study area
- municipal boundary
- viewshed point
- terrain potentially visible from viewshed point
- freeway
- arterial roads
- collector roads
- local streets
- proposed ballarat link road
- proposed roads
- railway
- water body / course

VIEWSHED LOCATION 4

View 4 from view from Warrenheip Road rail overpass looking north west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 5: Undulating Rural


hansen
nerrina
little bendigo primary school
springs rd
freeway
daylesford rd
gong gong reservoir
gong gong reservoir park
gong gong central highlands water catchment area
kirks reservoir
pine plantation
nerrina park & wetlands
monte christo biodiversity reserve
stawell st nth
humffray st nth
water st
caledonian primary school
russell square
brown hill
brewery tap rd
ballarat secondary college
damascus college
fortune st
ballarat-burrumbeet rd
western highway
st francis xavier primary school
mount xavier golf course
fussell st
jacksons rd
eureka
elford st
pryor park
ballarat wildlife park
blairs ln
leonards rd
dorringtons rd
old melbourne rd
warrenheip
canadian state forest
pax hill scout camp & activity centre
5
THE EASTERN GIA
VIEWSHED LOCATION 5
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
railway
water body / course
1:20 000
0
1000m

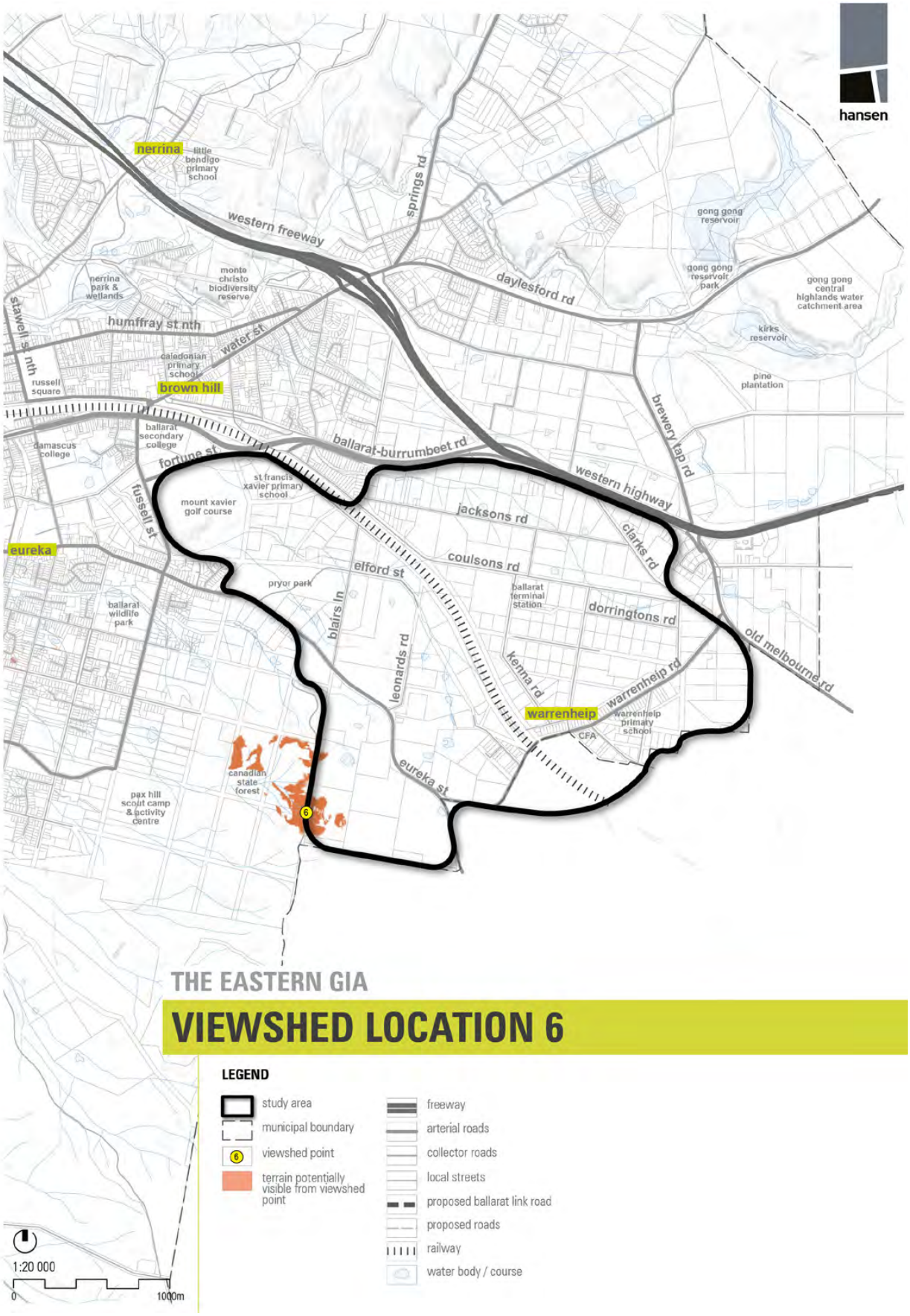
VIEWSHED LOCATION 5

View 5 (Photo 1 - Top) from Warrenheip Road looking north east.

View 5 (Photo 2 – Bottom) from Warrenheip Road looking west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 5: Undulating Rural



THE EASTERN GIA

VIEWSHED LOCATION 6

LEGEND

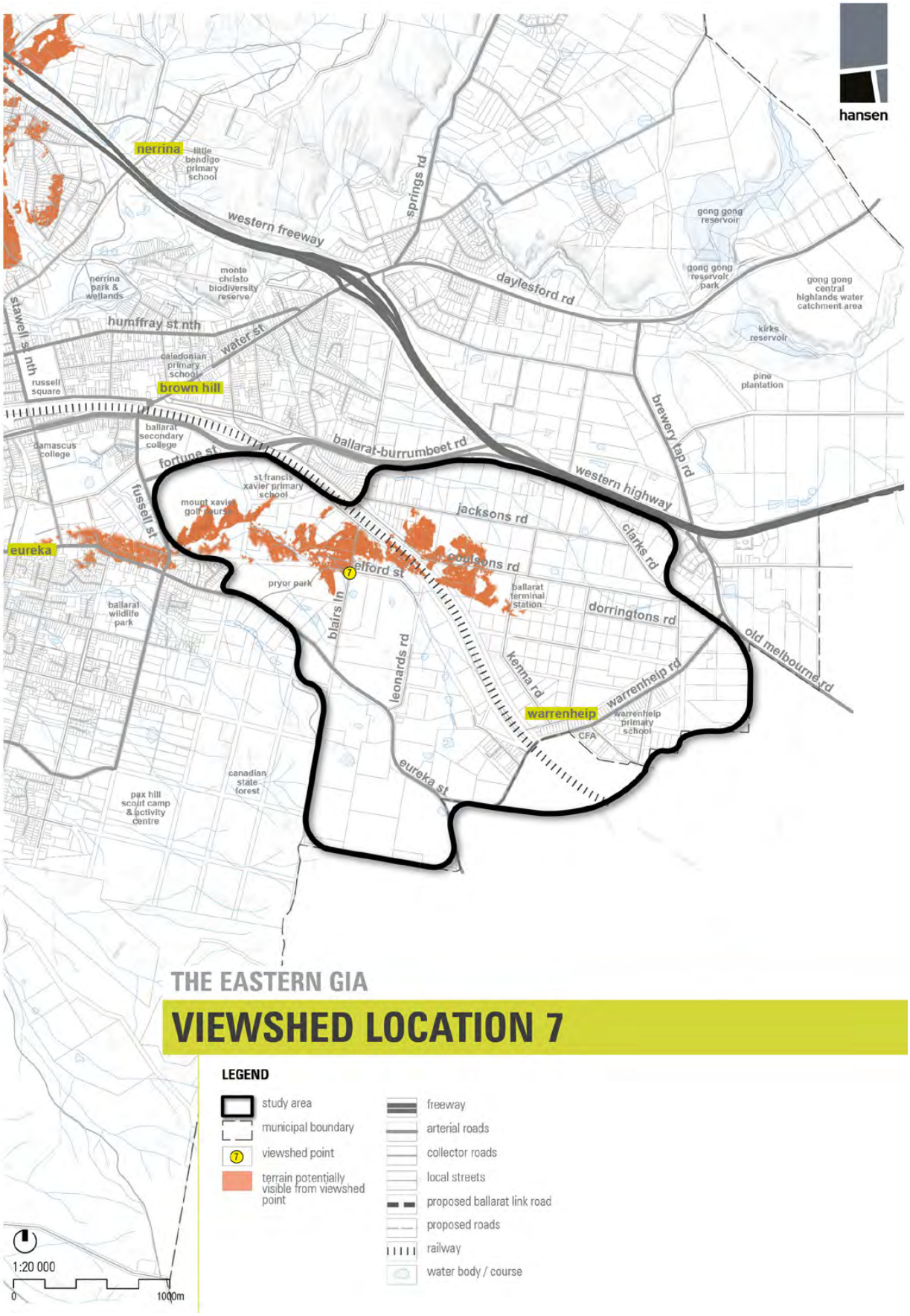
- study area
- municipal boundary
- viewshed point
- terrain potentially visible from viewshed point
- freeway
- arterial roads
- collector roads
- local streets
- proposed ballarat link road
- proposed roads
- railway
- water body / course

VIEWSHED LOCATION 6

View 6 from Boundary Road looking north east.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 7: Bushland

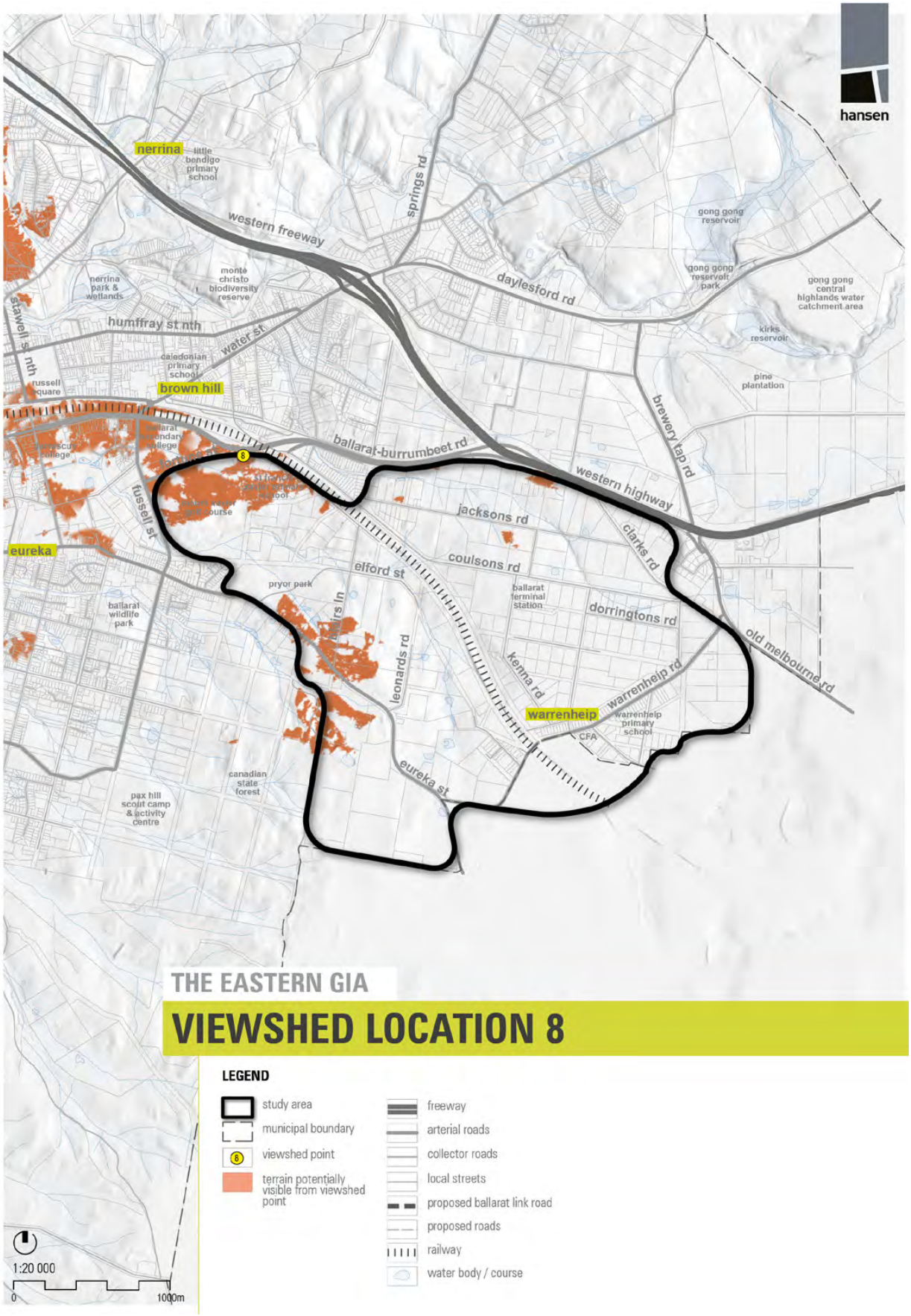

hansen
nerrina
little bendigo primary school
western freeway
springs rd
gong gong reservoir
gong gong reservoir park
gong gong central highlands water catchment area
daylesford rd
nerrina park & wetlands
monte christo biodiversity reserve
stawell st nth
humffray st nth
water st
kirks reservoir
caledonian primary school
russell square
brown hill
pine plantation
brewery tap rd
ballarat secondary college
damascus college
ballarat-burrumbeet rd
fortune st
western highway
st francis xavier primary school
mount xavier golf course
fussell st
jacksons rd
clarks rd
eureka
goldsons rd
elford st
pryor park
ballarat terminal station
ballarat wildlife park
blairs ln
dorringtons rd
old melbourne rd
leonards rd
kenna rd
warrenheip rd
warrenheip
warrenheip primary school
CFA
canadian state forest
eureka st
pax hill scout camp & activity centre
THE EASTERN GIA
VIEWSHED LOCATION 7
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
railway
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 7

View 7 from Blairs Lane looking west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 5: Undulating Rural



THE EASTERN GIA

VIEWSHED LOCATION 8

LEGEND

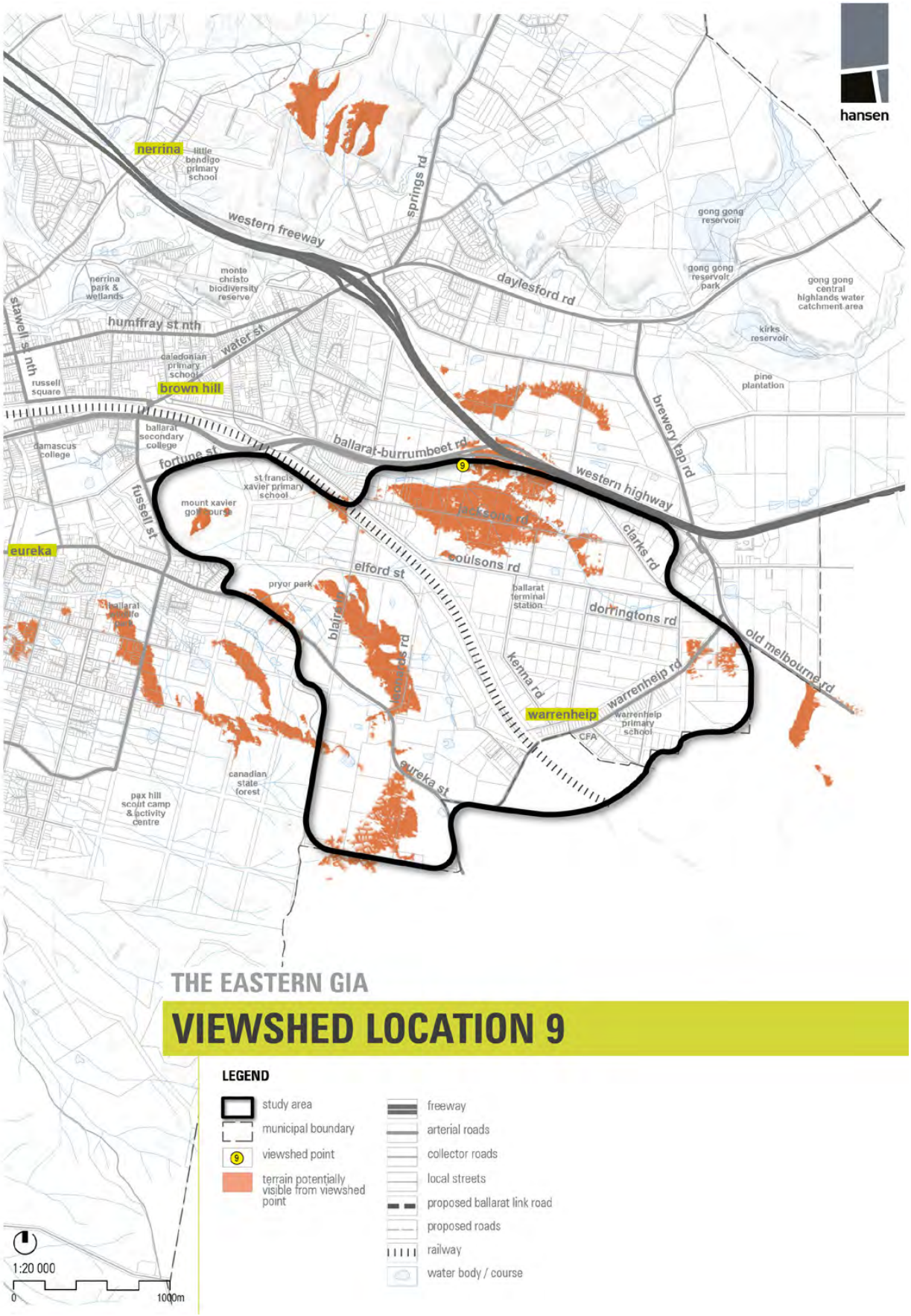
- study area
- municipal boundary
- viewshed point
- terrain potentially visible from viewshed point
- freeway
- arterial roads
- collector roads
- local streets
- proposed ballarat link road
- proposed roads
- railway
- water body / course

VIEWSHED LOCATION 8

View 8 from Fortune Street looking south east, across Mount Xavier Golf Course and its perimeter vegetation.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 5: Undulating Rural

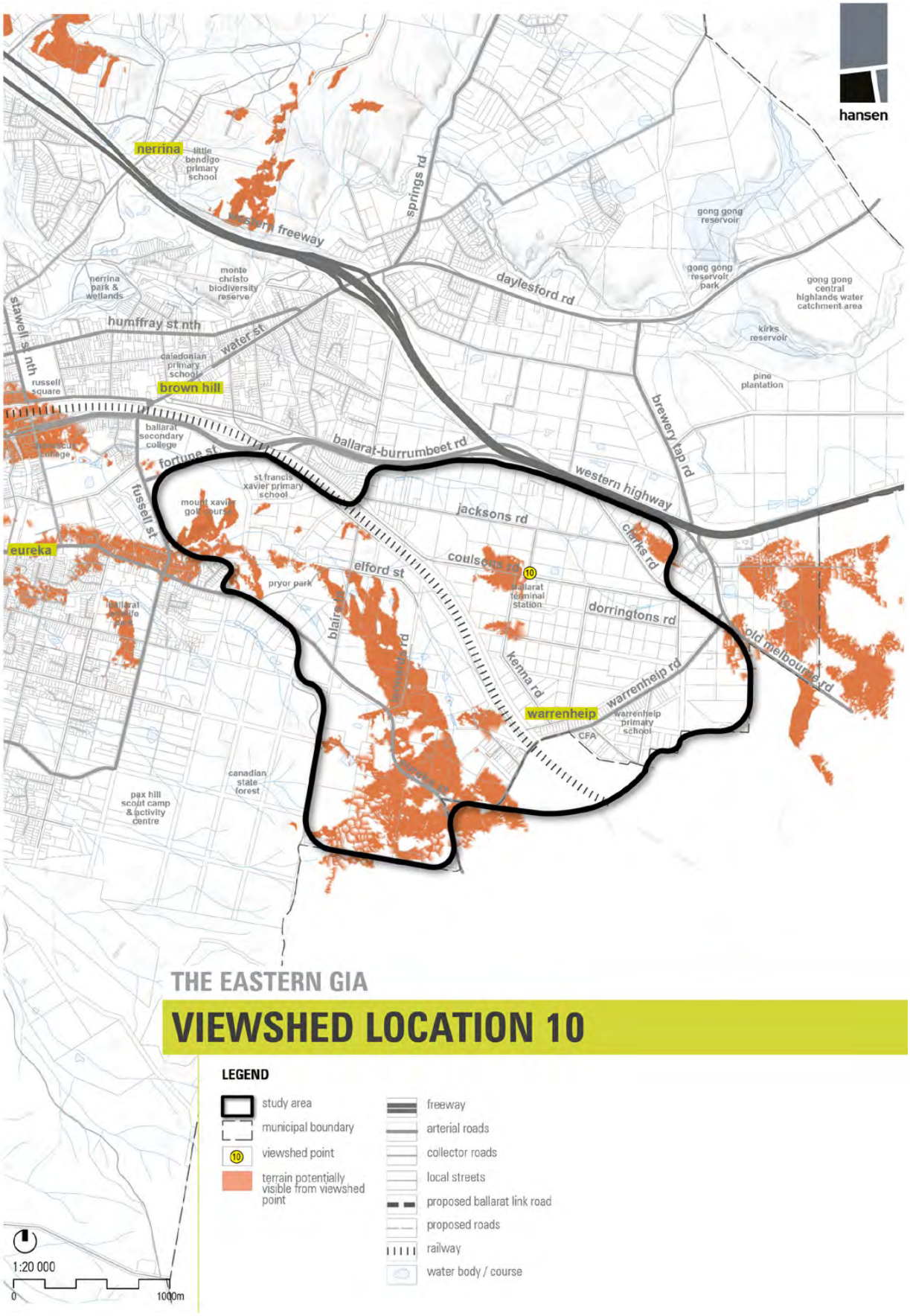

hansen
nerrina
little bendigo primary school
western freeway
springs rd
gong gong reservoir
gong gong reservoir park
gong gong central highlands water catchment area
daylesford rd
nerrina park & wetlands
monte christo biodiversity reserve
stawell st nth
humffray st nth
water st
kirks reservoir
caledonian primary school
russell square
brown hill
pine plantation
brewery tap rd
ballarat secondary college
damascus college
fortune st
ballarat-burrumbeet rd
9
western highway
st francis xavier primary school
mount xavier golf course
fussell st
jackson rd
clarks rd
eureka
coulsons rd
elford st
pryor park
ballarat terminal station
dorringtons rd
blair st
old melbourne rd
kenna rd
warrenheip rd
warrenheip
warrenheip primary school
CFA
eureka st
canadian state forest
pax hill scout camp & activity centre
THE EASTERN GIA
VIEWSHED LOCATION 9
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
railway
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 9

View 9 from Victoria Street and Ballarat-Burrumbeet Road intersection looking south east.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 6: Rural Bushland

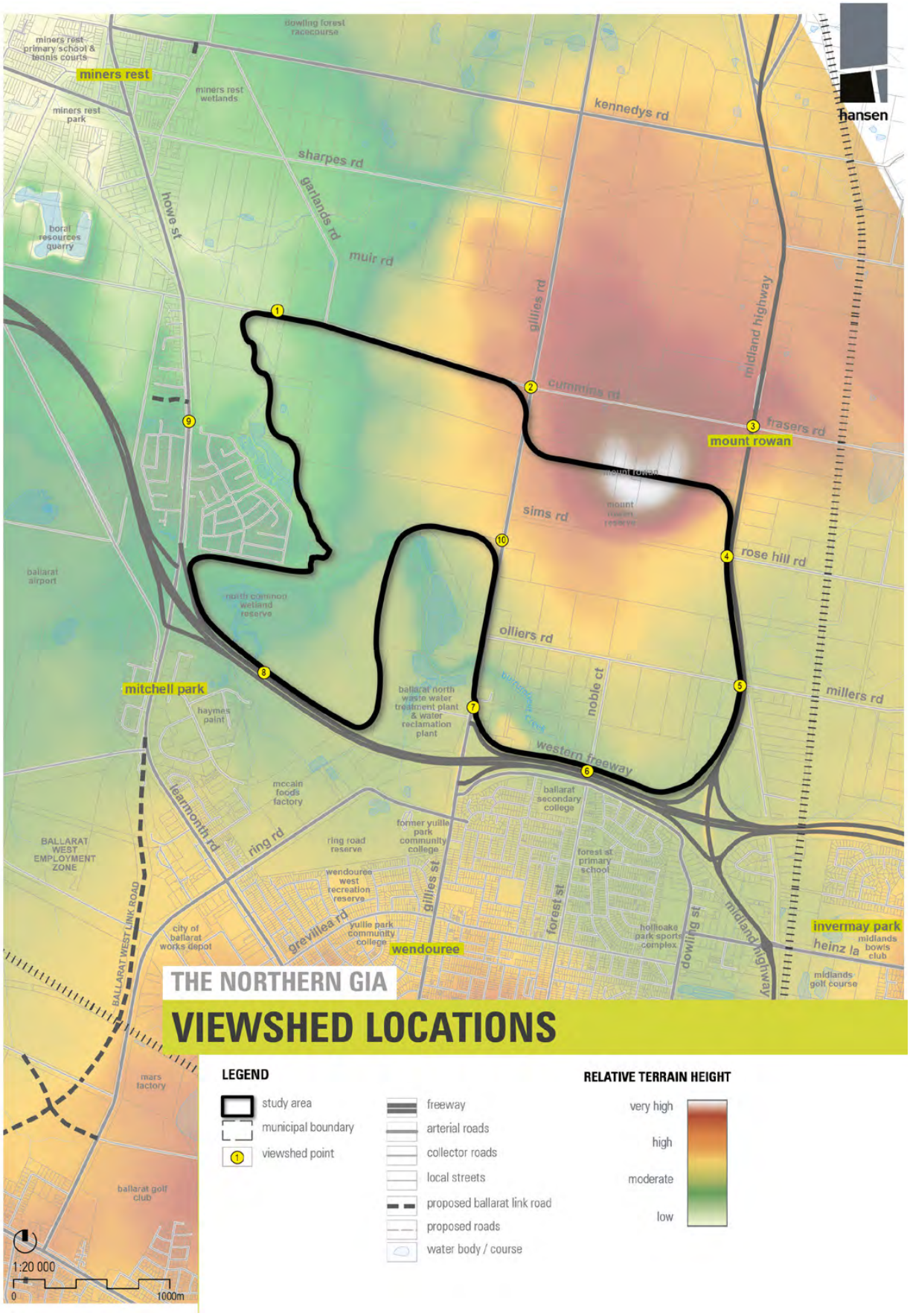

hansen
nerrina
little bendigo primary school
springs rd
gong gong reservoir
gong gong reservoir park
gong gong central highlands water catchment area
daylesford rd
nerrina park & wetlands
monte christo biodiversity reserve
stawell st nth
humffray st nth
water st
caledonian primary school
russell square
brown hill
kirks reservoir
pine plantation
brewery tap rd
ballarat secondary college
fortune st
ballarat-burrumbeet rd
western highway
st francis xavier primary school
mount xavier golf course
fussell st
jacksons rd
clarks rd
eureka
coulsons rd
elford st
pryor park
ballarat terminal station
dorringtons rd
blair st
old melbourne rd
kenna rd
warrenheip rd
warrenheip
warrenheip primary school
CFA
canadian state forest
pax hill scout camp & activity centre
THE EASTERN GIA
VIEWSHED LOCATION 10
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
railway
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 10

View 10 from Coulsons Road at Ballarat Terminal Station looking south west.

LANDSCAPE CHARACTER AREAS VISIBLE:

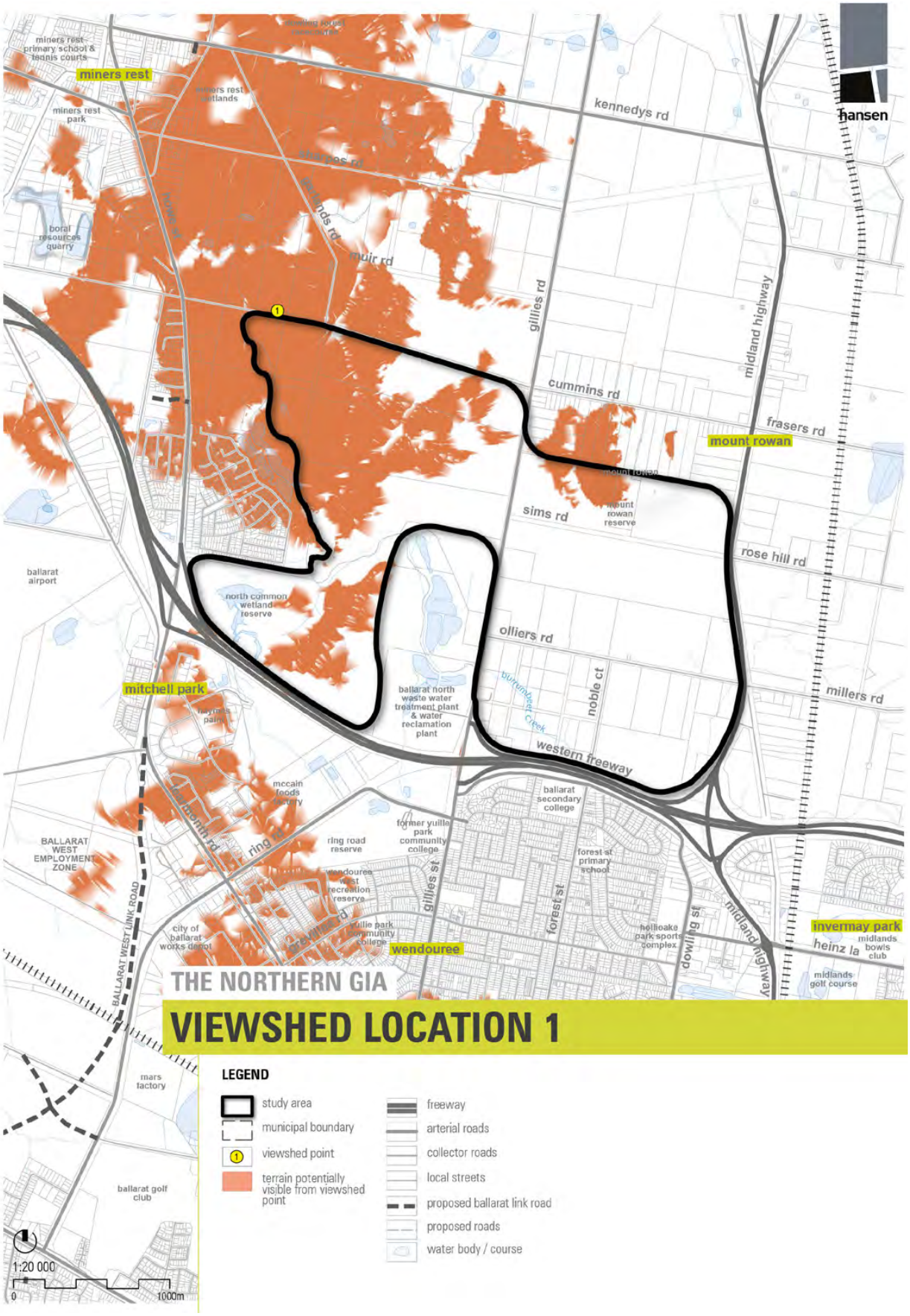
- Area 5: Undulating Rural
- Area 6: Rural Bushland


hansen
miners rest
miners rest primary school & tennis courts
miners rest park
miners rest wetlands
dowling forest racecourse
kennedys rd
sharpes rd
garlands rd
muir rd
howe st
boral resources quarry
gillies rd
midland highway
cummins rd
frasers rd
mount rowan
sims rd
rose hill rd
olliers rd
noble ct
millers rd
ballarat airport
north common wetland reserve
mitchell park
haymes paint
ballarat north waste water treatment plant & water reclamation plant
western freeway
mccain foods factory
ballarat secondary college
fairmont rd
ring rd
ring road reserve
former yulle park community college
forest st primary school
BALLARAT WEST EMPLOYMENT ZONE
wendouree west recreation reserve
gillies st
forest st
BALLARAT WEST LINK ROAD
city of ballarat works depot
grevillea rd
yulle park community college
wendouree
hollioake park sports complex
dowling st
invermay park
heinz la
midlands bowls club
midlands golf course
mars factory
ballarat golf club
1:20 000
0
1000m
THE NORTHERN GIA
VIEWSHED LOCATIONS
LEGEND
study area
municipal boundary
viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
RELATIVE TERRAIN HEIGHT
very high
high
moderate
low

THE NORTHERN GIA

VIEWSHED LOCATIONS

NORTHERN GIA	
VIEWSHED NO.	**LOCATION**
1	Cummins Road
2	Cummins and Gillies Road
3	Cummins Road and Midland Highway
4	Midland Highway and Rose Hill Road
5	Olliers Road
6	Western Freeway 1
7	Gillies Road
8	Western Freeway 2
9	Howe Street
10	Gillies Road



THE NORTHERN GIA

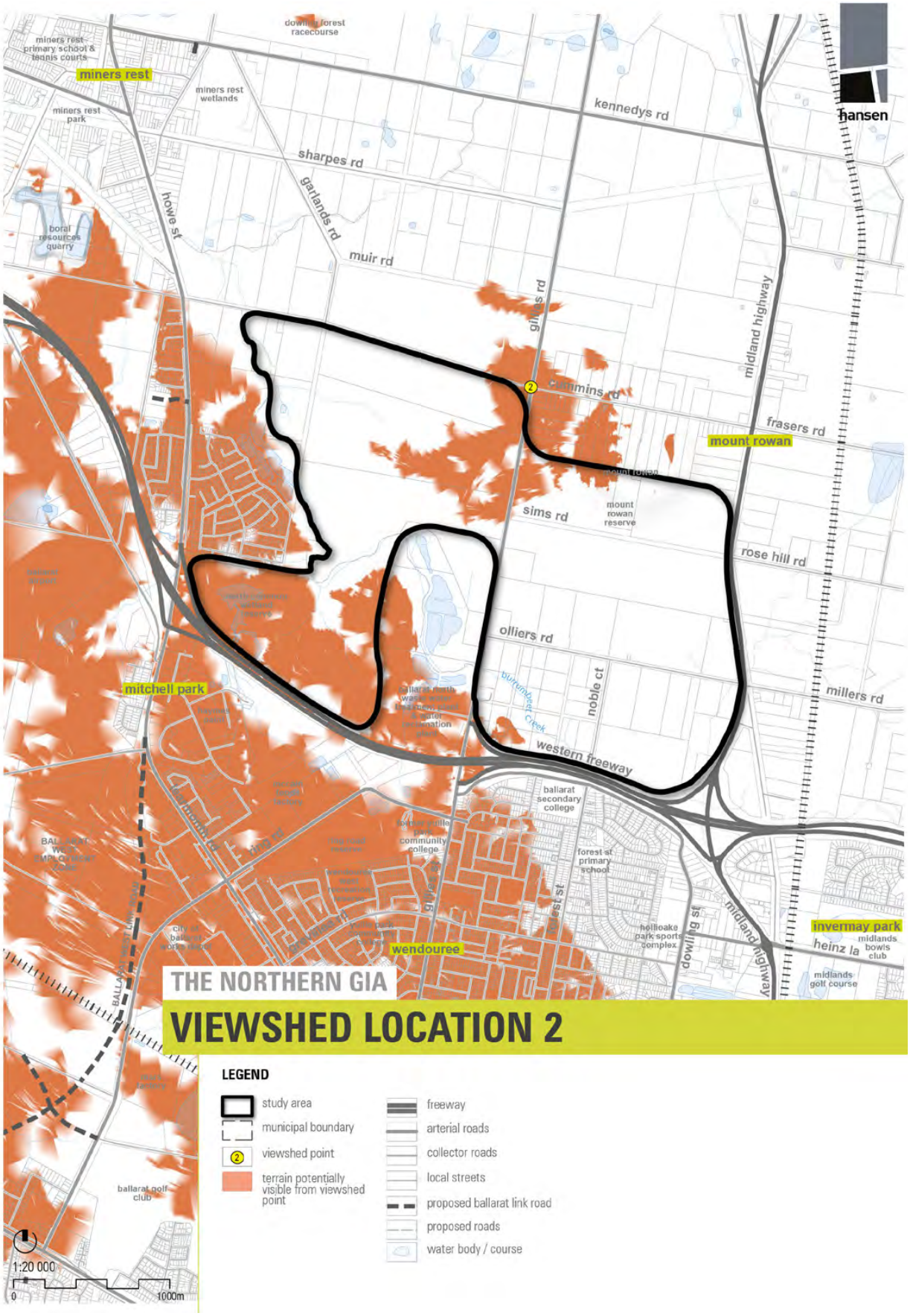
VIEWSHED LOCATION 1

VIEWSHED LOCATION 1

View 1 from Cummins Road looking south.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 3: Rural Pasture

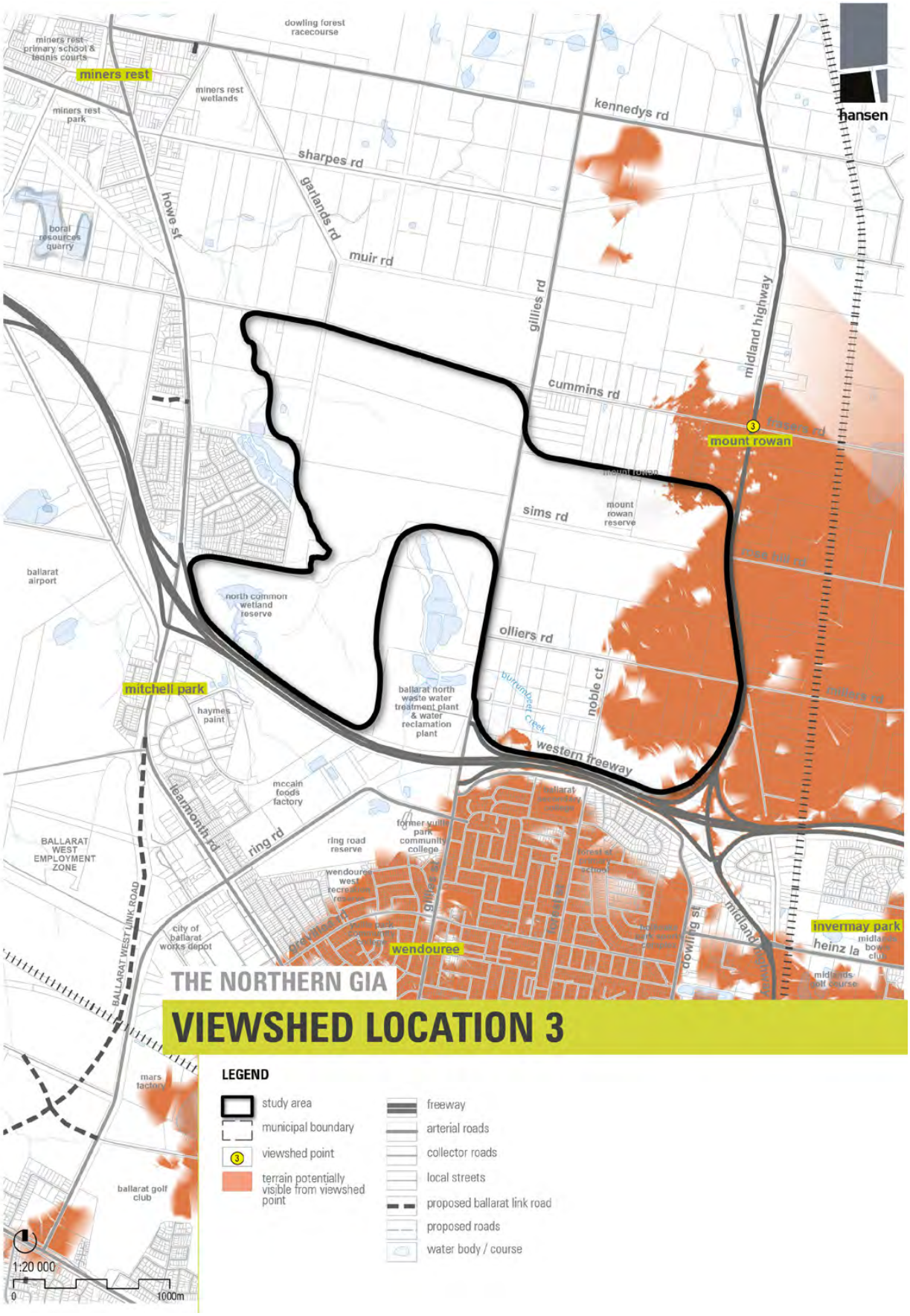

miners rest
miners rest primary school & tennis courts
miners rest wetlands
miners rest park
downing forest racecourse
kennedys rd
sharpes rd
howe st
garlands rd
muir rd
boral resources quarry
gillies rd
midland highway
cummins rd
frasers rd
mount rowan
sims rd
mount rowan reserve
rose hill rd
olliers rd
noble ct
millers rd
mitchell park
western freeway
ballarat secondary college
forest st primary school
wendouree
invermay park
heinz la
midlands bowls club
midlands golf course
hollioake park sports complex
dowling st
ballarat golf club
hansen
THE NORTHERN GIA
VIEWSHED LOCATION 2
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 2

View 1 from Cummins Road looking west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 3: Rural Pasture

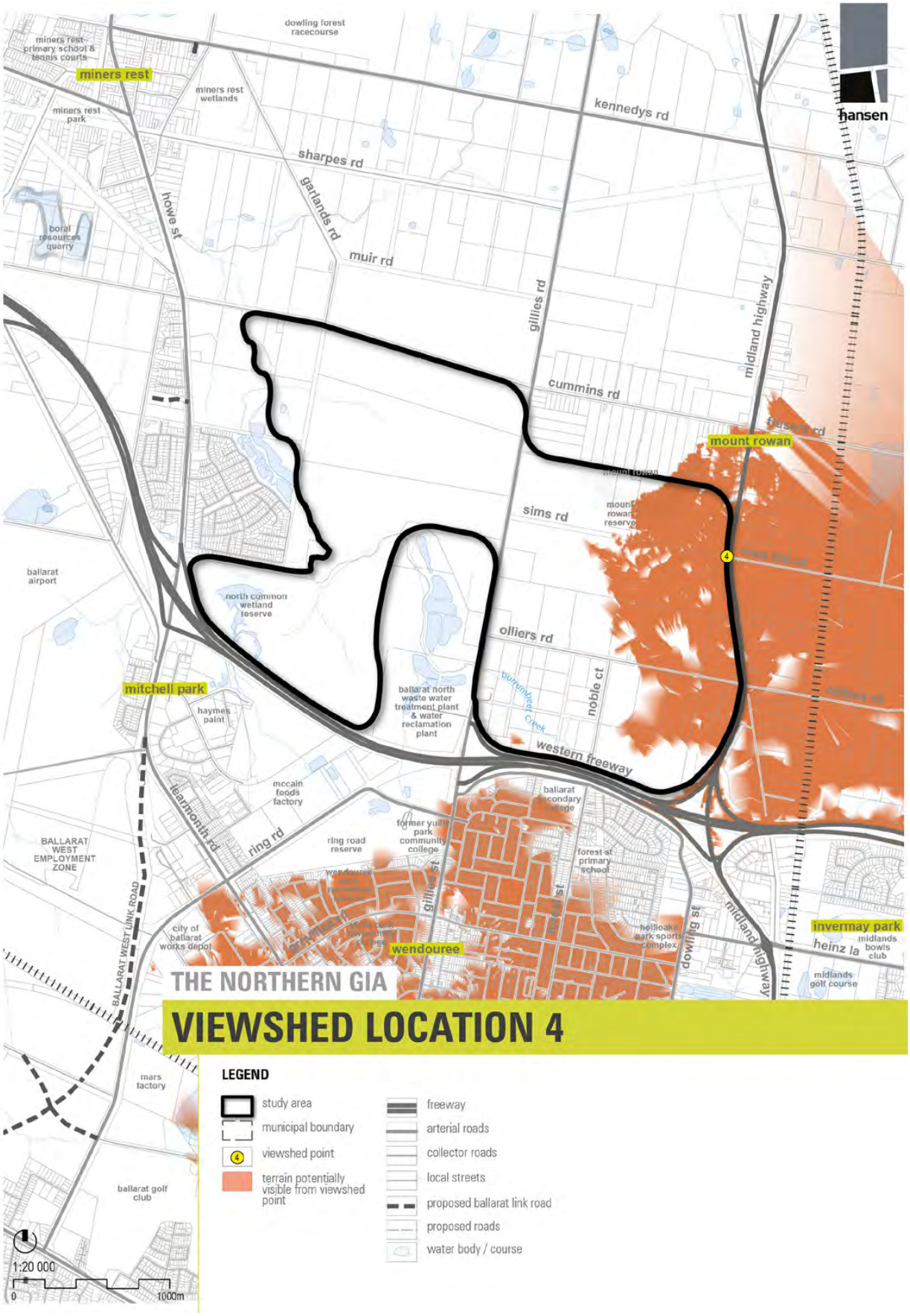

hansen
miners rest
miners rest primary school & tennis courts
miners rest park
miners rest wetlands
dowling forest racecourse
kennedys rd
sharpes rd
howe st
garlands rd
muir rd
boral resources quarry
gillies rd
midland highway
cummins rd
mount rowan
sims rd
mount rowan reserve
ballarat airport
north common wetland reserve
olliers rd
noble ct
mitchell park
haymes paint
ballarat north waste water treatment plant & water reclamation plant
western freeway
mccain foods factory
learmonth rd
ring rd
ring road reserve
former vullin park community college
BALLARAT WEST EMPLOYMENT ZONE
wendouree west recreation reserve
city of ballarat works depot
wendouree
dowling st
invermay park
heinz la
mars factory
ballarat golf club
BALLARAT WEST LINK ROAD
THE NORTHERN GIA
VIEWSHED LOCATION 3
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 3

View 3 from Cummins Road at Midland Highway looking west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- N/A – outside of study area, views obscured by terrain.

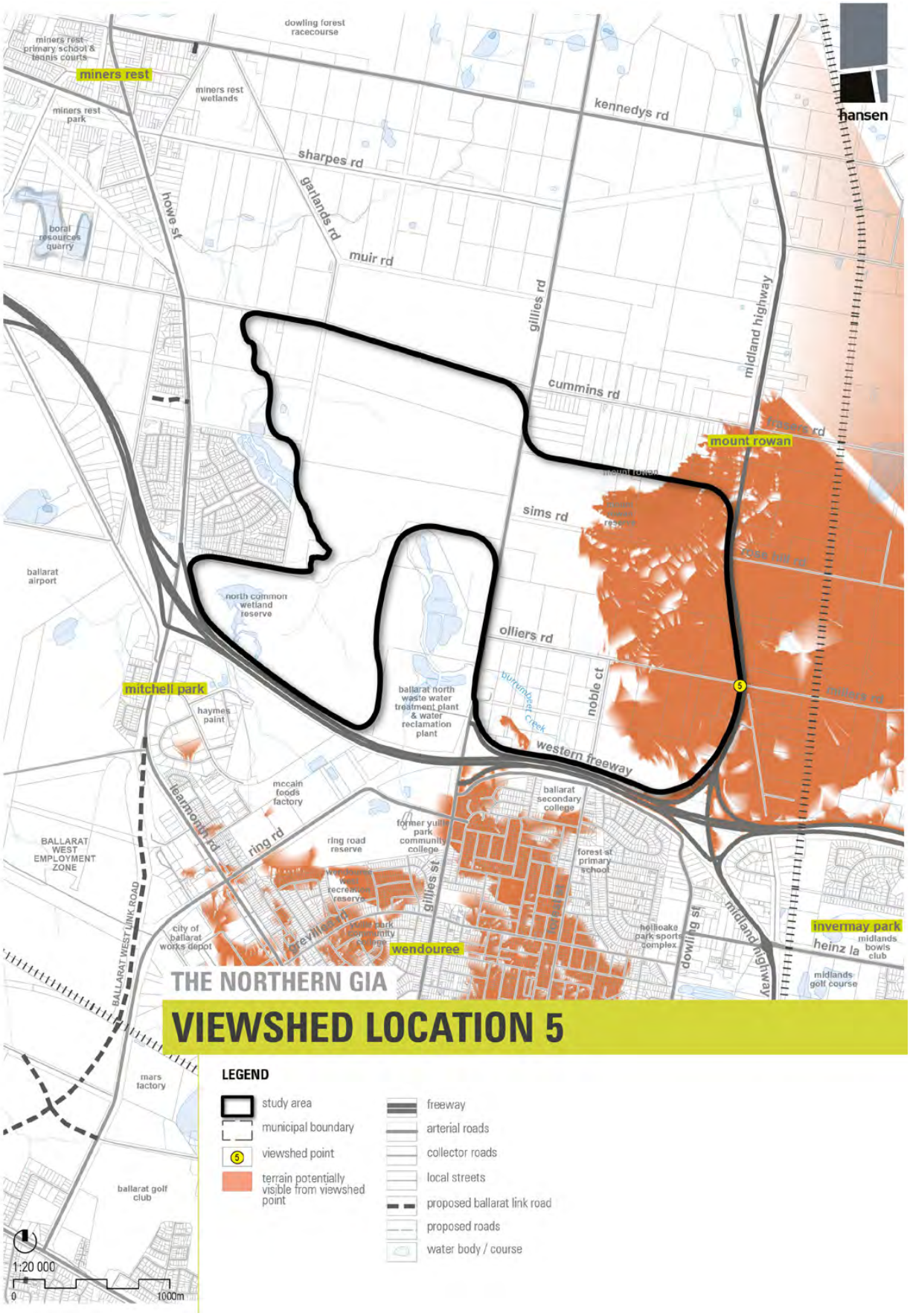

hansen
miners rest
miners rest primary school & tennis courts
miners rest park
miners rest wetlands
dowling forest racecourse
kennedys rd
sharpes rd
howe st
garlands rd
muir rd
boral resources quarry
gillies rd
midland highway
cummins rd
mount rowan
sims rd
mount rowan reserve
ballarat airport
north common wetland reserve
olliers rd
noble ct
mitchell park
haymes paint
ballarat north waste water treatment plant & water reclamation plant
western freeway
mccain foods factory
ballarat secondary college
fairmont rd
ring rd
ring road reserve
former yulli park community college
forest st primary school
BALLARAT WEST EMPLOYMENT ZONE
BALLARAT WEST LINK ROAD
city of ballarat works depot
wendouree
dowling st
invermay park
heinz la
midlands bowls club
midlands golf course
mars factory
ballarat golf club
1:20 000
0
1000m
THE NORTHERN GIA
VIEWSHED LOCATION 4
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course

VIEWSHED LOCATION 4

View 4 from the Midland Highway and Rose Hill Road intersection looking west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 3: Rural Pasture
- Area 4: Elevated Pasture

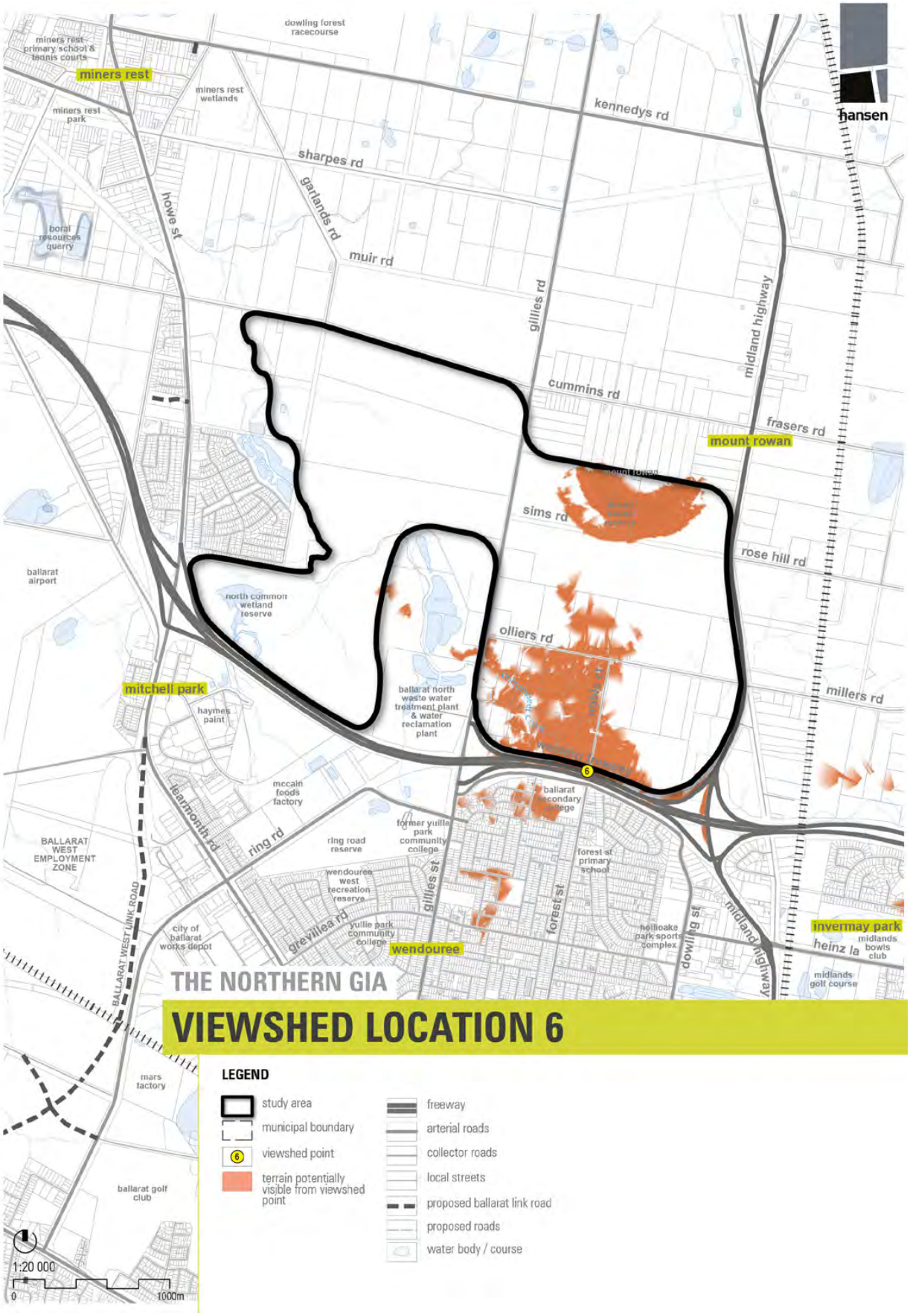

hansen
miners rest
miners rest primary school & tennis courts
miners rest park
miners rest wetlands
dowling forest racecourse
kennedys rd
sharpes rd
howe st
garlands rd
muir rd
boral resources quarry
gillies rd
midland highway
cummins rd
mount rowan
sims rd
ballarat airport
north common wetland reserve
olliers rd
noble ct
mitchell park
haymes paint
ballarat north waste water treatment plant & water reclamation plant
western freeway
mccain foods factory
ballarat secondary college
learmonth rd
ring rd
ring road reserve
former yulin park community college
forest st primary school
BALLARAT WEST EMPLOYMENT ZONE
gillies st
BALLARAT WEST LINK ROAD
city of ballarat works depot
wendouree
hellioake park sports complex
dowling st
invermay park
heinz la
midlands bowls club
midlands golf course
mars factory
ballarat golf club
1:20 000
0
1000m
THE NORTHERN GIA
VIEWSHED LOCATION 5
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course

VIEWSHED LOCATION 5

View 5 from Olliers Road looking north west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 3: Rural Pasture
- Area 4: Elevated Pasture

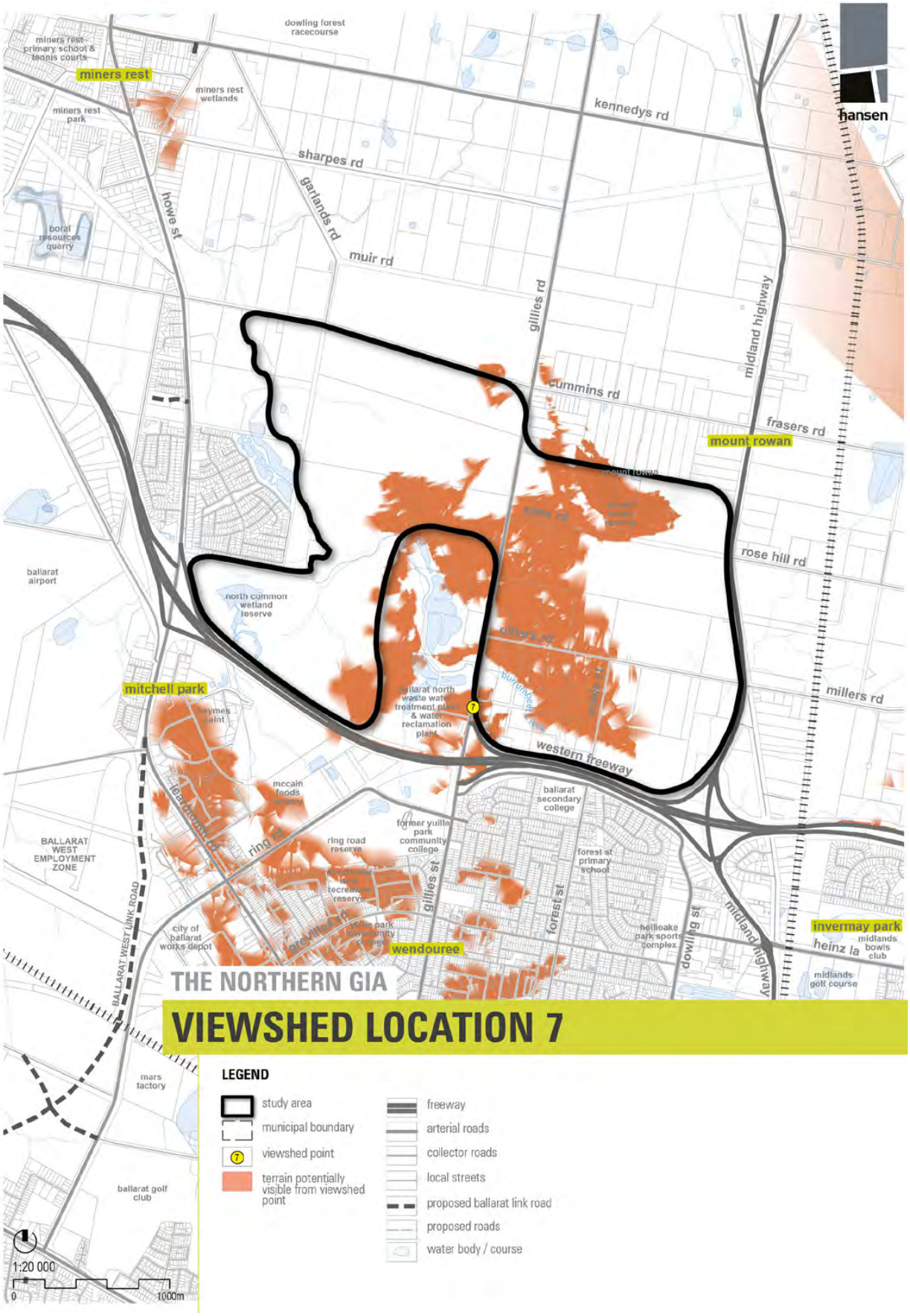

hansen
THE NORTHERN GIA
VIEWSHED LOCATION 6
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m
miners rest
mount rowan
mitchell park
wendouree
invermay park
kennedys rd
sharpes rd
gartlands rd
muir rd
howe st
gillies rd
midland highway
cummins rd
frasers rd
sims rd
rose hill rd
olliers rd
millers rd
learmonth rd
ring rd
gillies st
forest st
dowling st
grevillea rd
heinz la
ballarat airport
ballarat golf club
mars factory
BALLARAT WEST EMPLOYMENT ZONE
BALLARAT WEST LINK ROAD
dowling forest racecourse
miners rest primary school & tennis courts
miners rest wetlands
miners rest park
boral resources quarry
north common wetland reserve
haymes paint
mccain foods factory
ballarat north waste water treatment plant & water reclamation plant
ring road reserve
former yuille park community college
ballarat secondary college
forest st primary school
wendouree west recreation reserve
yuille park community college
city of ballarat works depot
heilloake park sports complex
midlands bowls club
midlands golf course

VIEWSHED LOCATION 6

View 6 from Western Freeway at Ballarat Secondary College looking north.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 3: Rural Pasture
- Area 4: Elevated Pasture

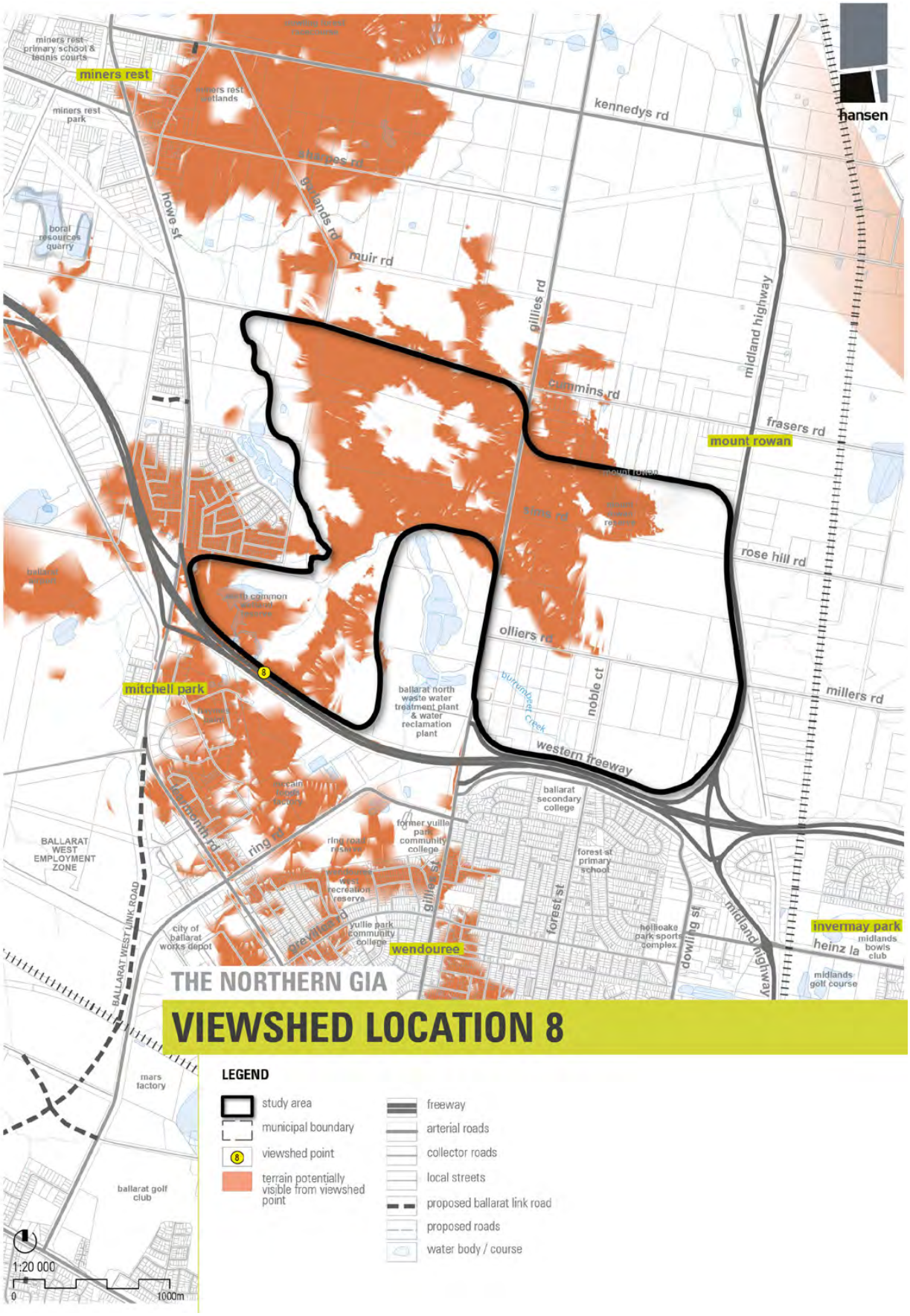

hansen
THE NORTHERN GIA
VIEWSHED LOCATION 7
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m
miners rest
miners rest primary school & tennis courts
miners rest park
miners rest wetlands
dowling forest racecourse
kennedys rd
sharpes rd
garlands rd
howe st
muir rd
boral resources quarry
gillies rd
midland highway
cummins rd
frasers rd
mount rowan
rose hill rd
millers rd
western freeway
ballarat airport
north common wetland reserve
mitchell park
ballarat north waste water treatment plant & water reclamation plant
mccain foods
ballarat secondary college
former yulli park community college
ring road reserve
forest st primary school
BALLARAT WEST EMPLOYMENT ZONE
BALLARAT WEST LINK ROAD
city of ballarat works depot
wendouree
forest st
dowling st
heilloake park sports complex
invermay park
heinz la
midlands bowls club
midlands golf course
mars factory
ballarat golf club

VIEWSHED LOCATION 7

View 7 from Gillies Road at Ballarat North Waste Water Plant looking north.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 3: Rural Pasture
- Area 4: Elevated Pasture

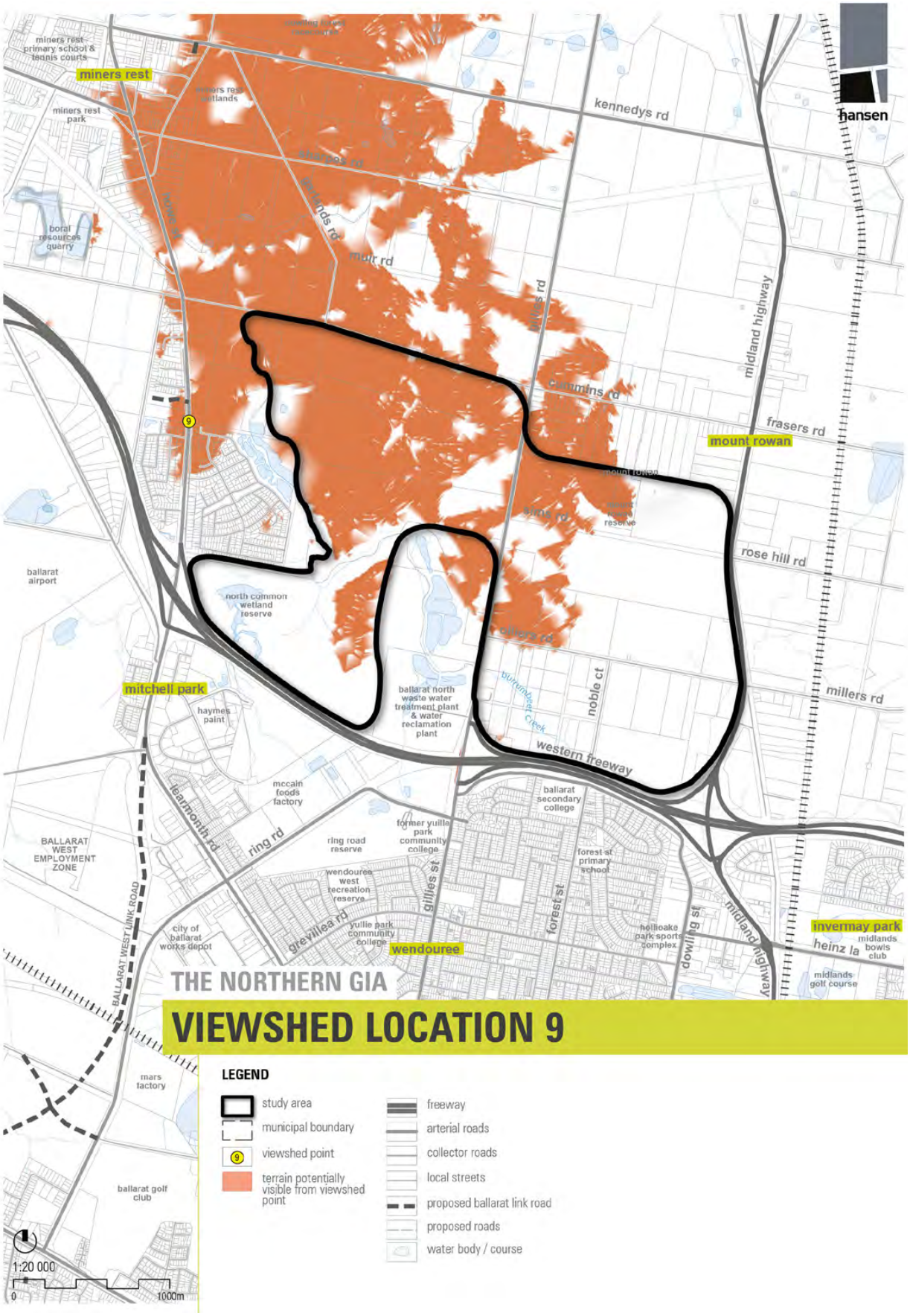

miners rest
miners rest primary school & tennis courts
miners rest park
miners rest wetlands
boral resources quarry
kennedys rd
sheppes rd
sylvands rd
muir rd
howe st
gillies rd
midland highway
cummins rd
frasers rd
mount rowan
sims rd
rose hill rd
olliers rd
noble ct
millers rd
mitchell park
ballarat north waste water treatment plant & water reclamation plant
western freeway
ballarat secondary college
former yulle park community college
forest st primary school
forest st
gillies st
dowling st
hollioake park sports complex
invermay park
midlands bowls club
heinz la
midlands golf course
BALLARAT WEST EMPLOYMENT ZONE
BALLARAT WEST LINK ROAD
ring rd
ring road reserve
west recreation reserve
yulle park community college
wendouree
city of ballarat works depot
mars factory
ballarat golf club
hansen
THE NORTHERN GIA
VIEWSHED LOCATION 8
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 8

View 8 from Western Freeway at North Common Wetland Reserve looking north.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 1: Plains



THE NORTHERN GIA

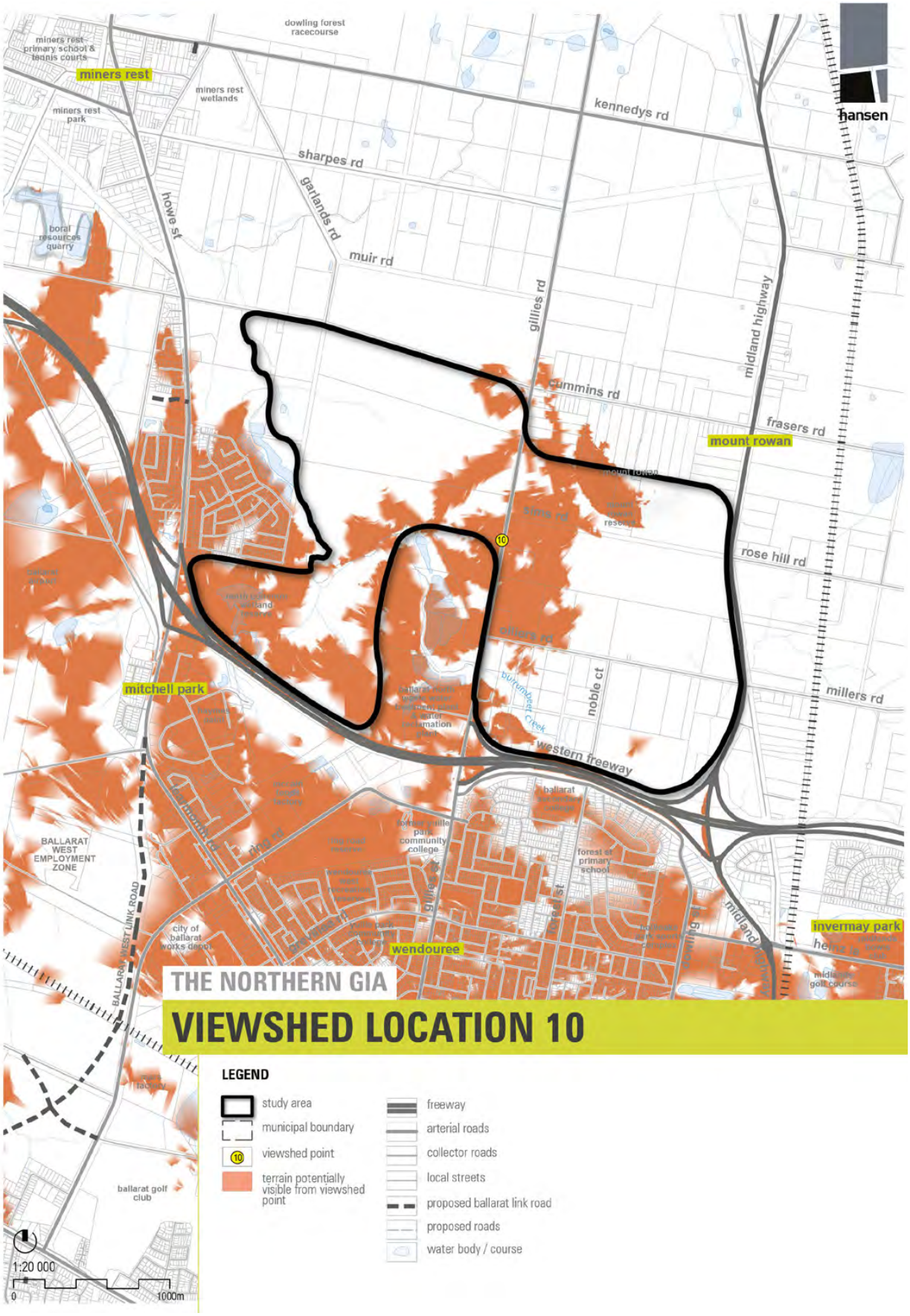
VIEWSHED LOCATION 9

VIEWSHED LOCATION 9

View 9 from Howe Street looking east.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 4: Elevated Pasture


hansen
miners rest
miners rest primary school & tennis courts
miners rest park
miners rest wetlands
dowling forest racecourse
kennedys rd
sharpes rd
garlands rd
howe st
muir rd
boral resources quarry
gillies rd
midland highway
cummins rd
frasers rd
mount rowan
rose hill rd
millers rd
noble ct
western freeway
mitchell park
BALLARAT WEST EMPLOYMENT ZONE
BALLARAT WEST LINK ROAD
city of ballarat works depot
wendouree
forest st primary school
invermay park
ballarat golf club
THE NORTHERN GIA
VIEWSHED LOCATION 10
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

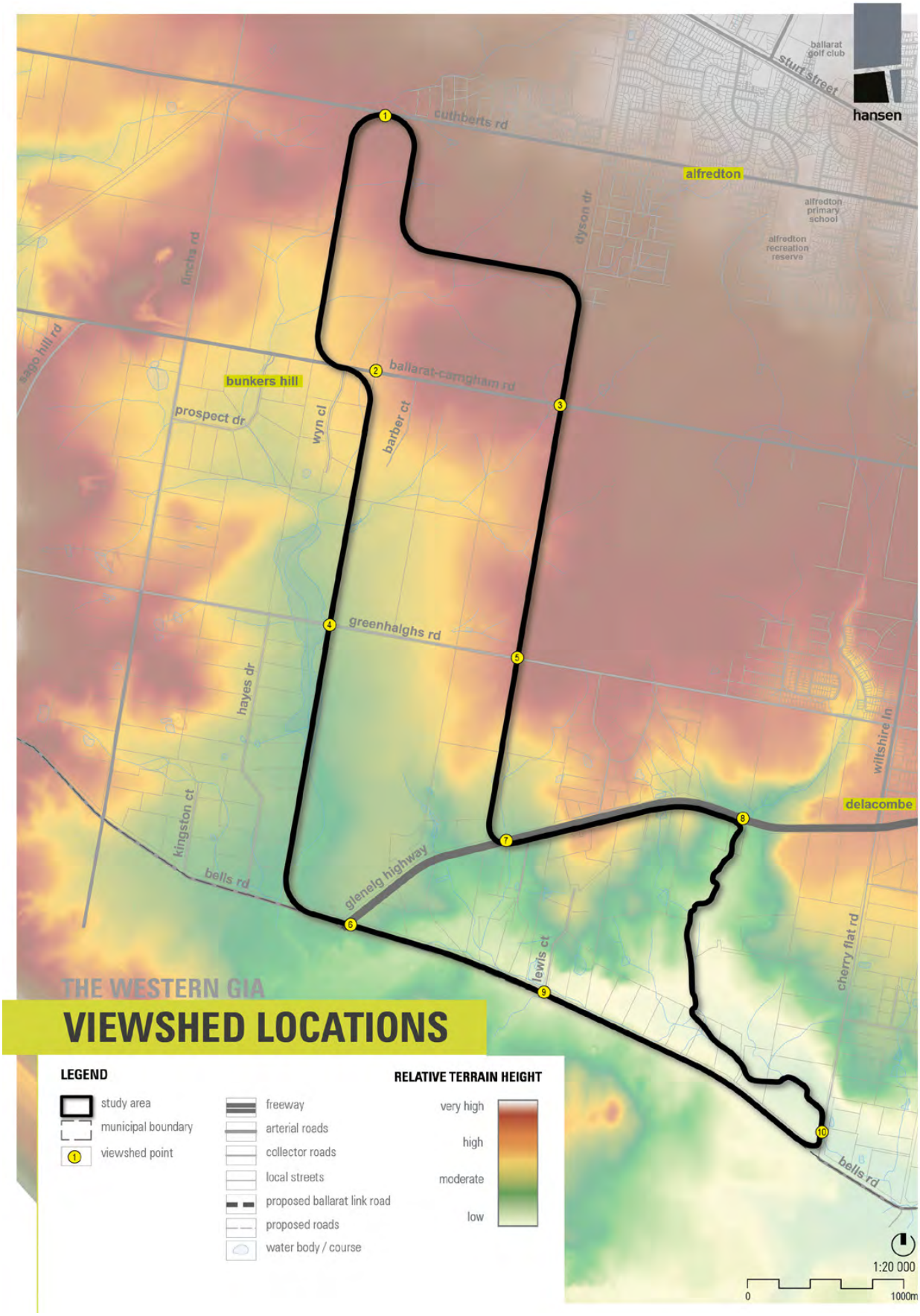
VIEWSHED LOCATION 10

View 10 (Photo 1 - Top) from Gillies Road looking south.

View 10 (Photo 2 – Bottom) from Gillies Road looking north.

LANDSCAPE CHARACTER AREAS VISIBLE:

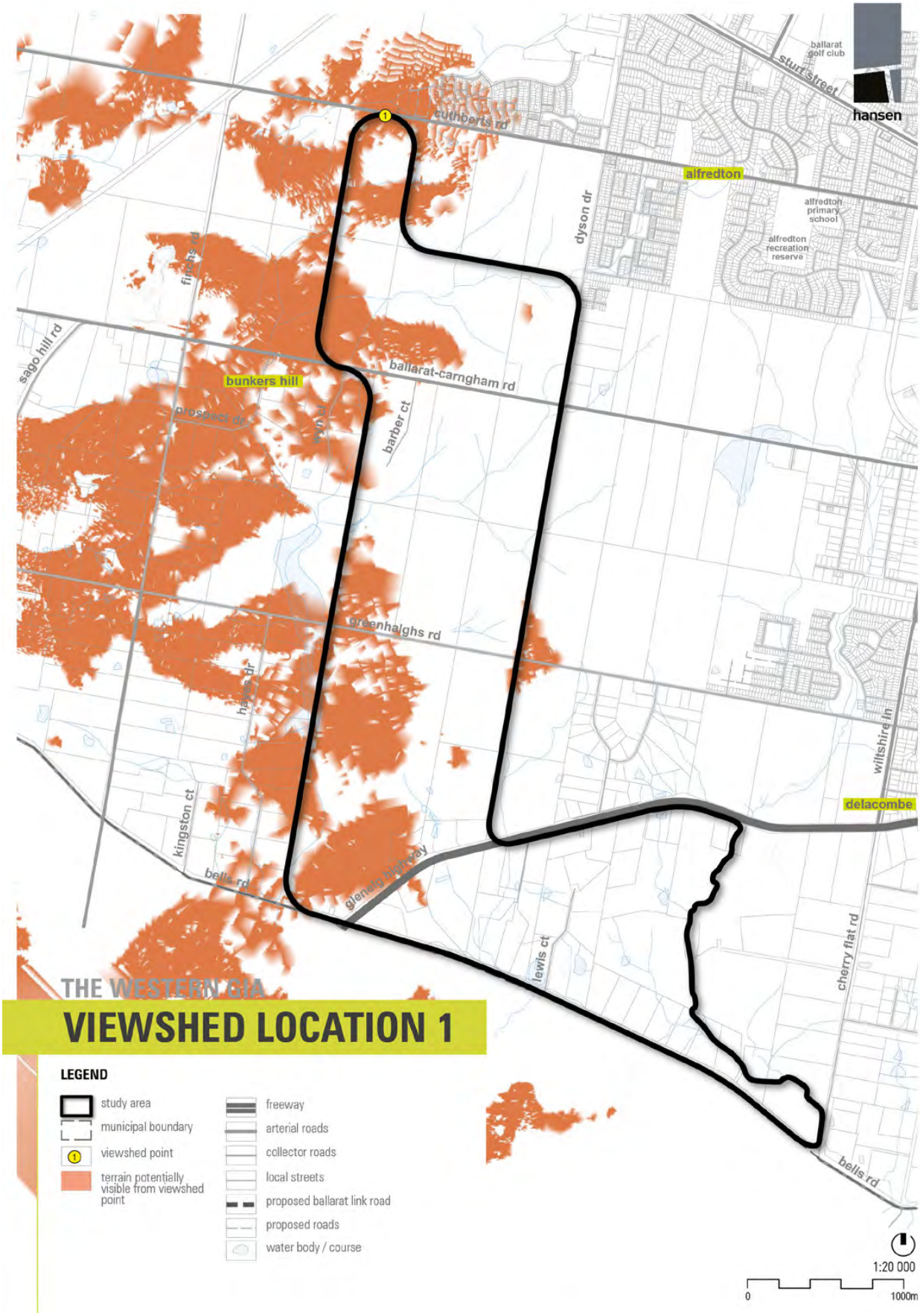
- Area 3: Rural Pasture


hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
alfredton primary school
alfredton recreation reserve
dyson dr
finsha rd
sago hill rd
bunkers hill
ballarat-carngham rd
prospect dr
wyn cl
barber ct
greenhalghs rd
hayes dr
wiltshire ln
delacombe
kingston ct
bells rd
glenelg highway
lewis ct
cherry flat rd
bells rd
THE WESTERN GIA
VIEWSHED LOCATIONS
LEGEND
study area
municipal boundary
viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
RELATIVE TERRAIN HEIGHT
very high
high
moderate
low
1:20 000
0
1000m

THE WESTERN GIA

VIEWSHED LOCATIONS

WESTERN GIA	
VIEWSHED NO.	LOCATION
1	Cuthberts Road
2	Ballarat-Carngham Road
3	Dyson Drive and Ballarat Ballarat-Carngham Road
4	Greenhalghs Road 1
5	Greenhalghs Road 2
6	Glenelg Highway and Bells Road
7	Glenelg Highway
8	Glenelg Highway and Winter Creek
9	Lewis Court and Bells Road
10	Cherry Flat Road

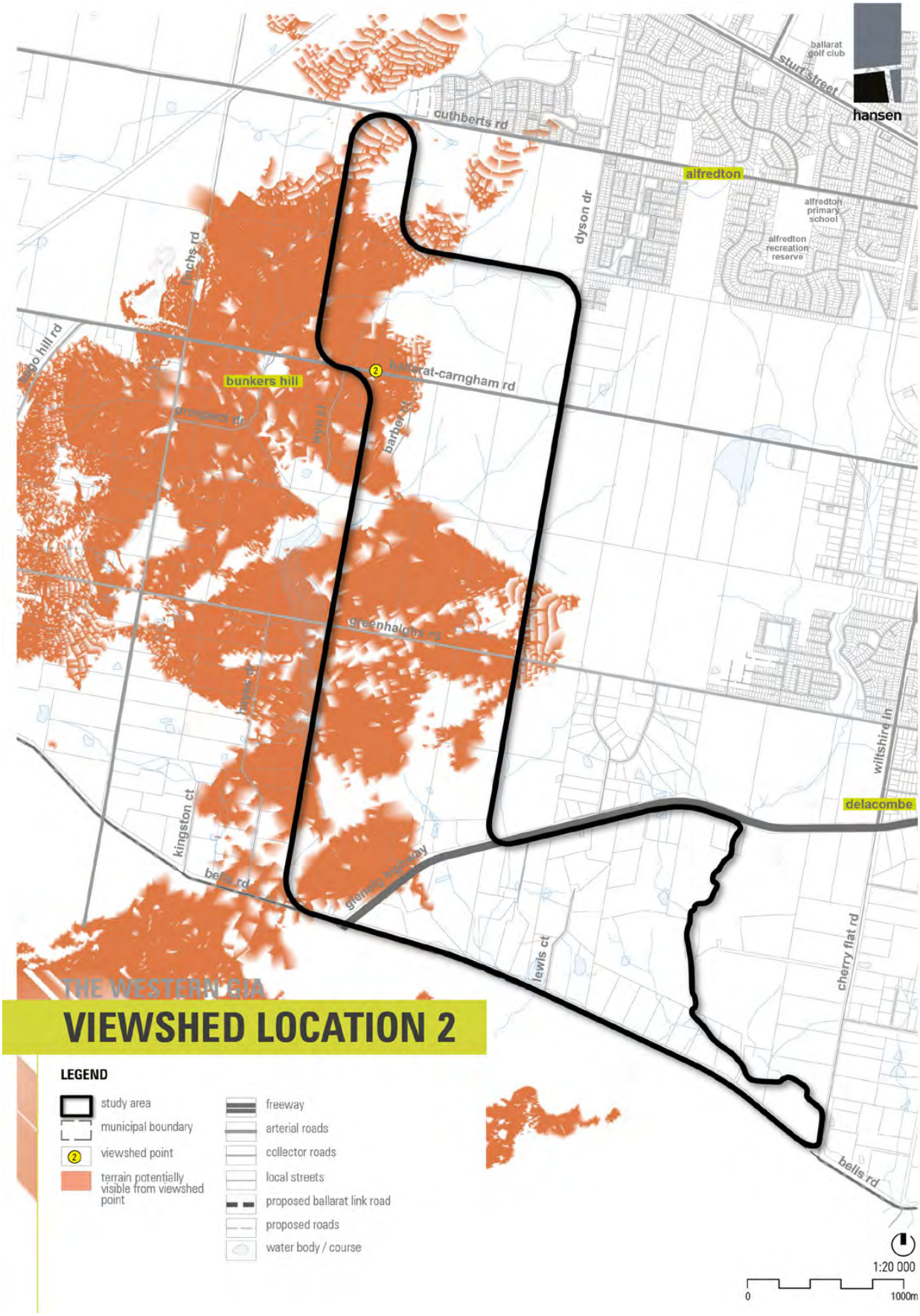

hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
dyson dr
alfredton primary school
alfredton recreation reserve
fitzgibbons rd
sago hill rd
bunkers hill
ballarat-carngham rd
prospect dr
barber ct
greenhalghs rd
hayes dr
kingston ct
bells rd
glenelg highway
lewis ct
wiltshire ln
delacombe
cherry flat rd
bells rd
THE WESTERN GIA
VIEWSHED LOCATION 1
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 1

View 1 from Cuthberts Road looking south.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 1: Plains

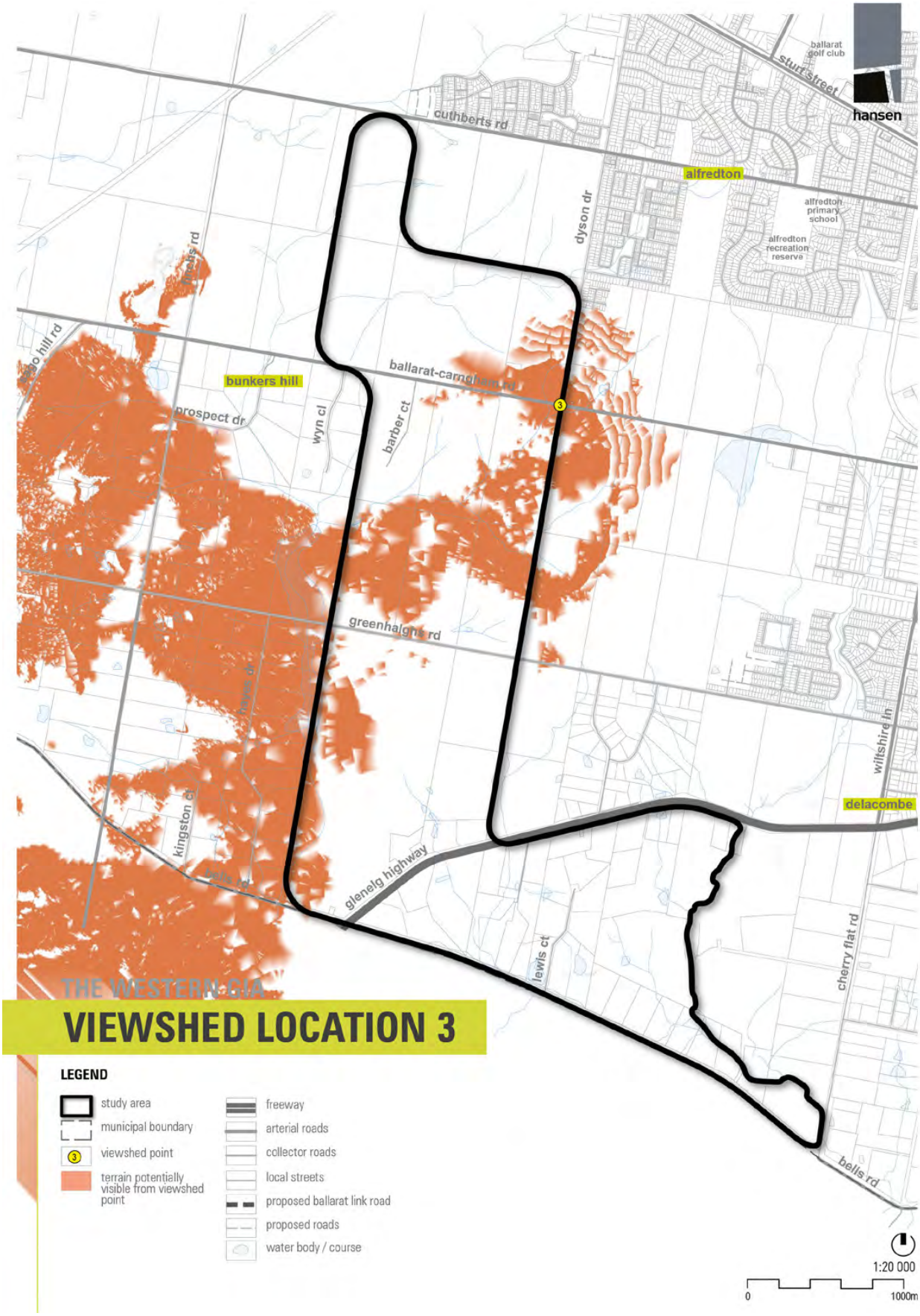

hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
dyson dr
alfredton primary school
alfredton recreation reserve
finchs rd
bogo hill rd
bunkers hill
ballarat-carngham rd
prospect dr
barber ct
greenhalghs rd
wiltshire ln
delacombe
kingston ct
bells rd
glenelg highway
lewis ct
cherry flat rd
bells rd
THE WESTERN GIA
VIEWSHED LOCATION 2
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 2

View 2 from Ballarat-Carngham Road looking east.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 1: Plains

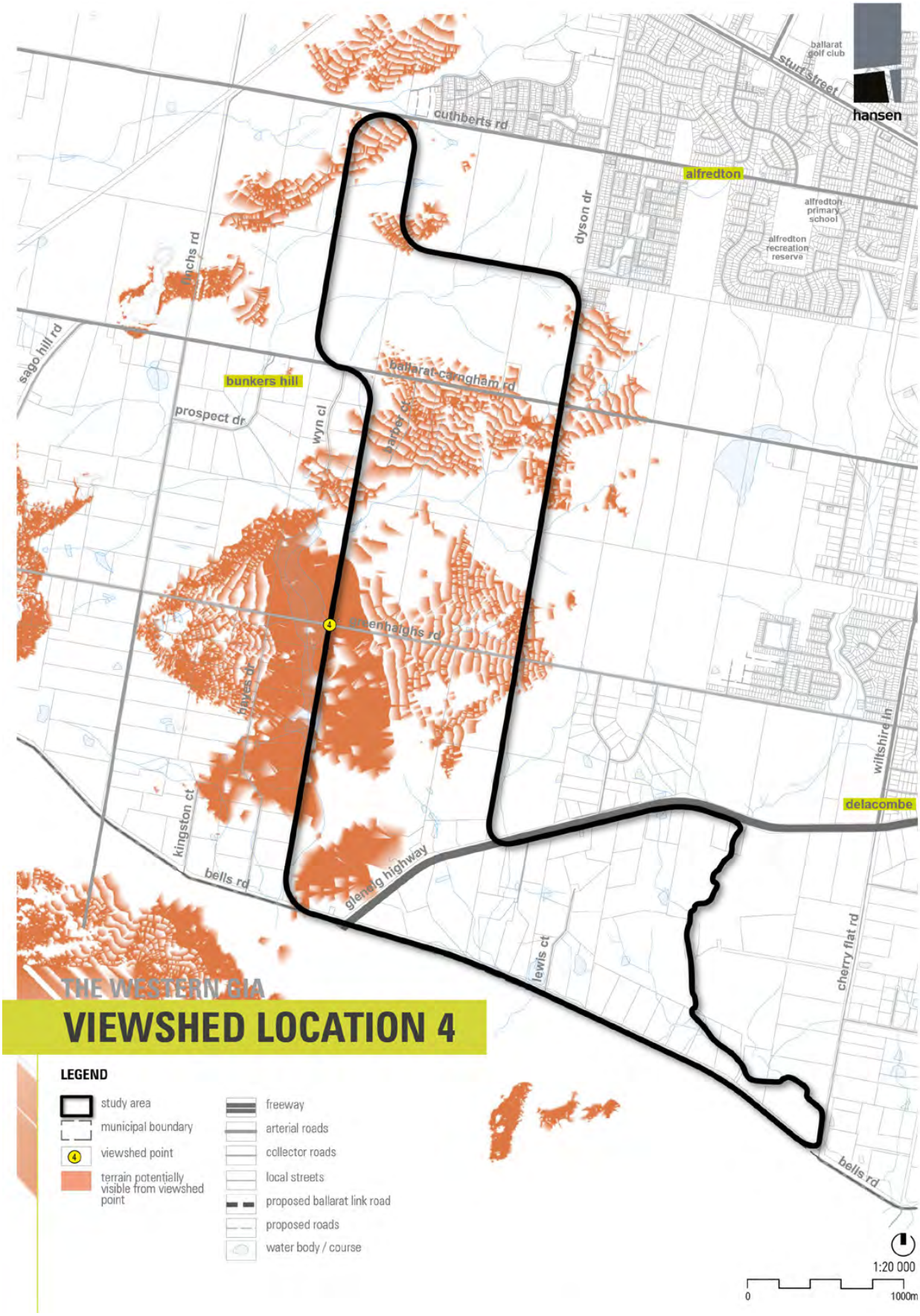

hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
dyson dr
alfredton primary school
alfredton recreation reserve
bunkers hill
ballarat-carngham rd
prospect dr
wyn cl
barber ct
greenhalghs rd
wiltshire ln
delacombe
kingston ct
glenelg highway
lewis ct
cherry flat rd
bells rd
THE WESTERN GIA
VIEWSHED LOCATION 3
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 3

View 3 from Dyson Drive and Ballarat- Carngham Road intersection looking south west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 1: Plains

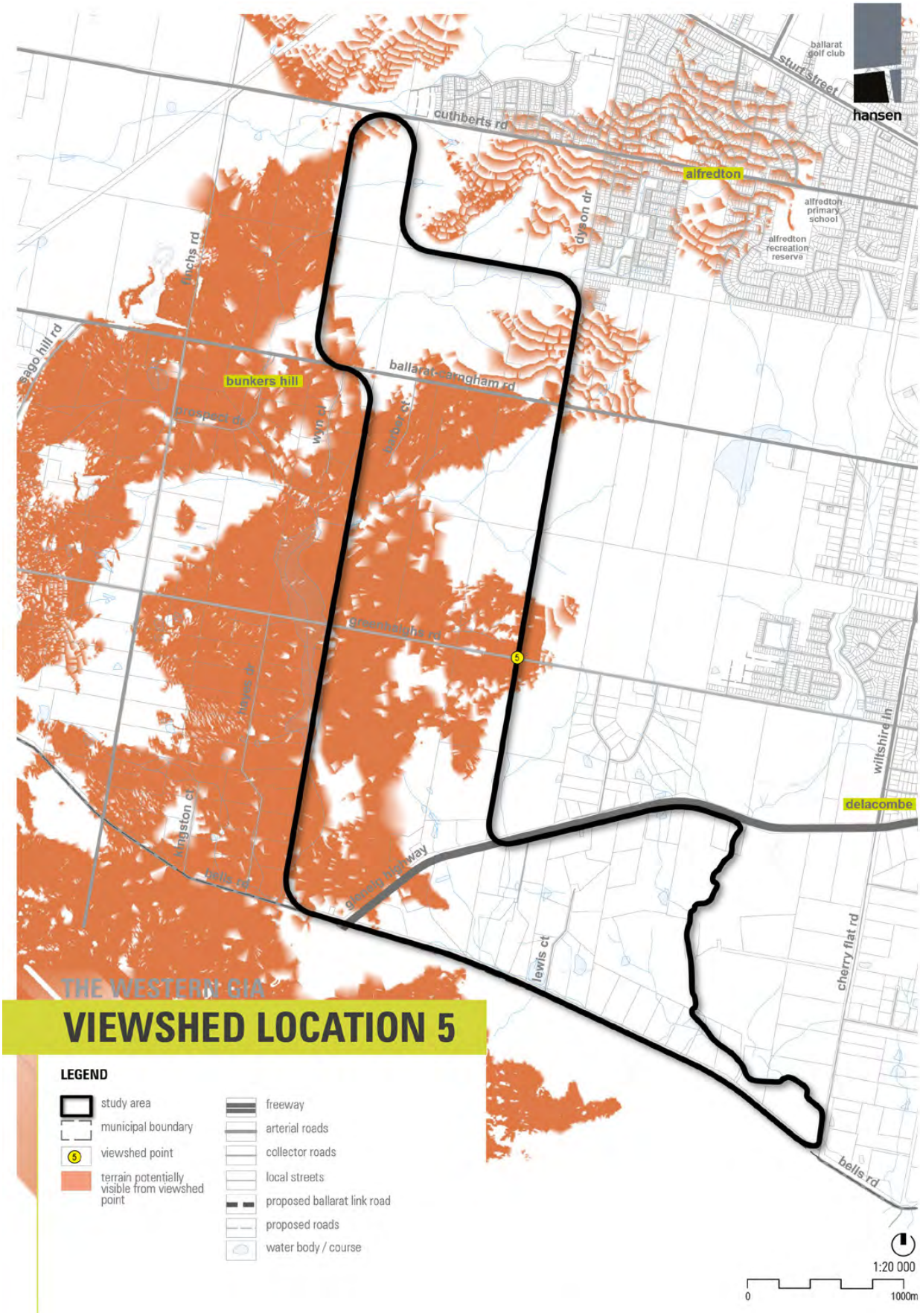

hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
dyson dr
alfredton primary school
alfredton recreation reserve
sago hill rd
bunkers hill
ballarat carngham rd
prospect dr
wyn cl
greenhalghs rd
kingston ct
bells rd
glenelg highway
delacombe
wiltshire ln
lewis ct
cherry flat rd
bells rd
THE WESTERN GIA
VIEWSHED LOCATION 4
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 4

View 4 from Greenhalghs Road looking north east.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 1: Plains


hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
alfredton primary school
alfredton recreation reserve
dyson dr
lynchs rd
sago hill rd
bunkers hill
ballarat-carngham rd
prospect dr
wyn ct
barber ct
greenhalghs rd
5
wiltshire ln
delacombe
kingston ct
bells ct
geelong-ballarat hwy
lewis ct
cherry flat rd
bells rd
THE WESTERN GIA
VIEWSHED LOCATION 5
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

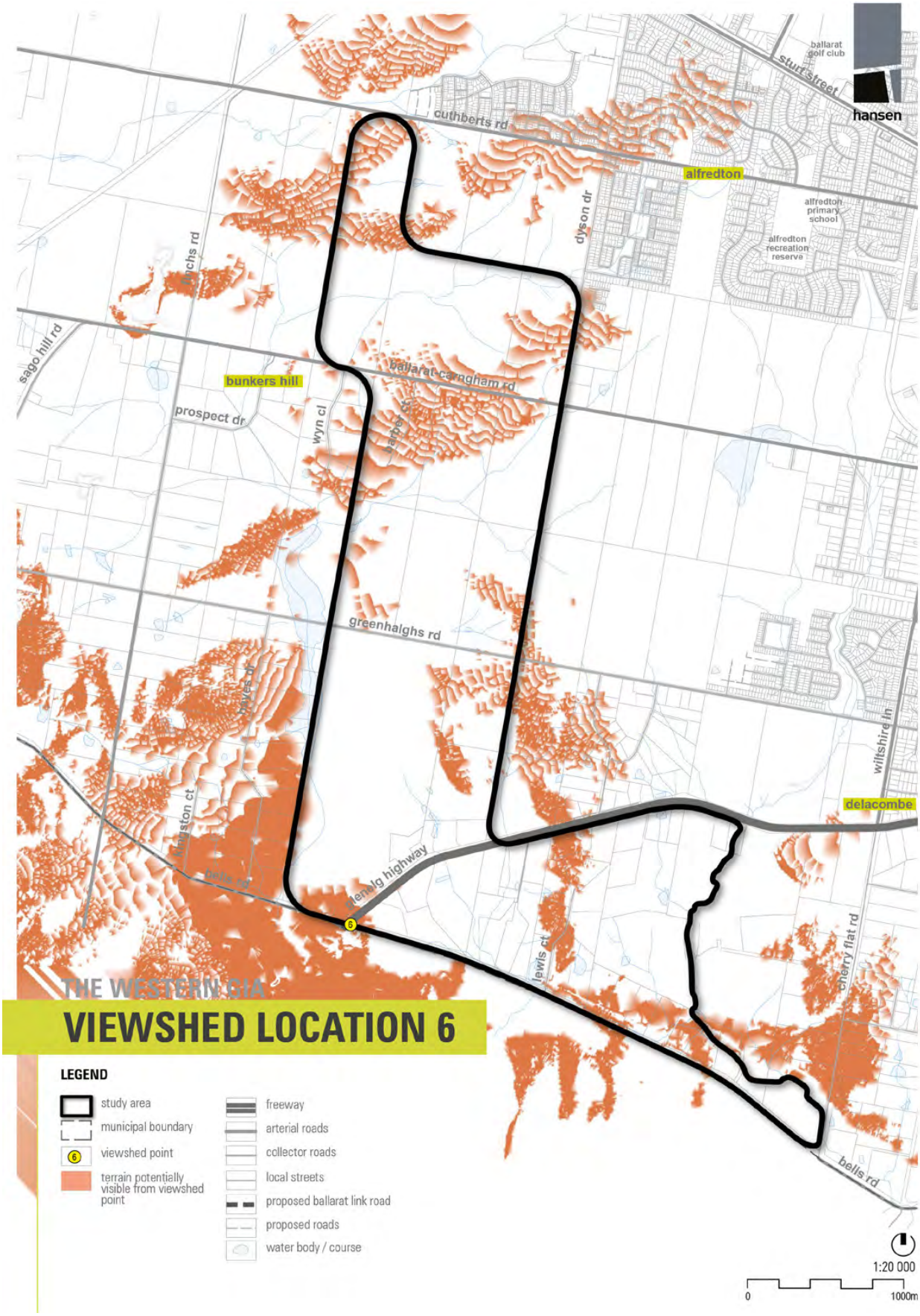
VIEWSHED LOCATION 5

View 5 (Photo 1) from Greenhalghs Road looking north west.

View 5 (Photo 2) from Greenhalghs Road looking south west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 1: Plains

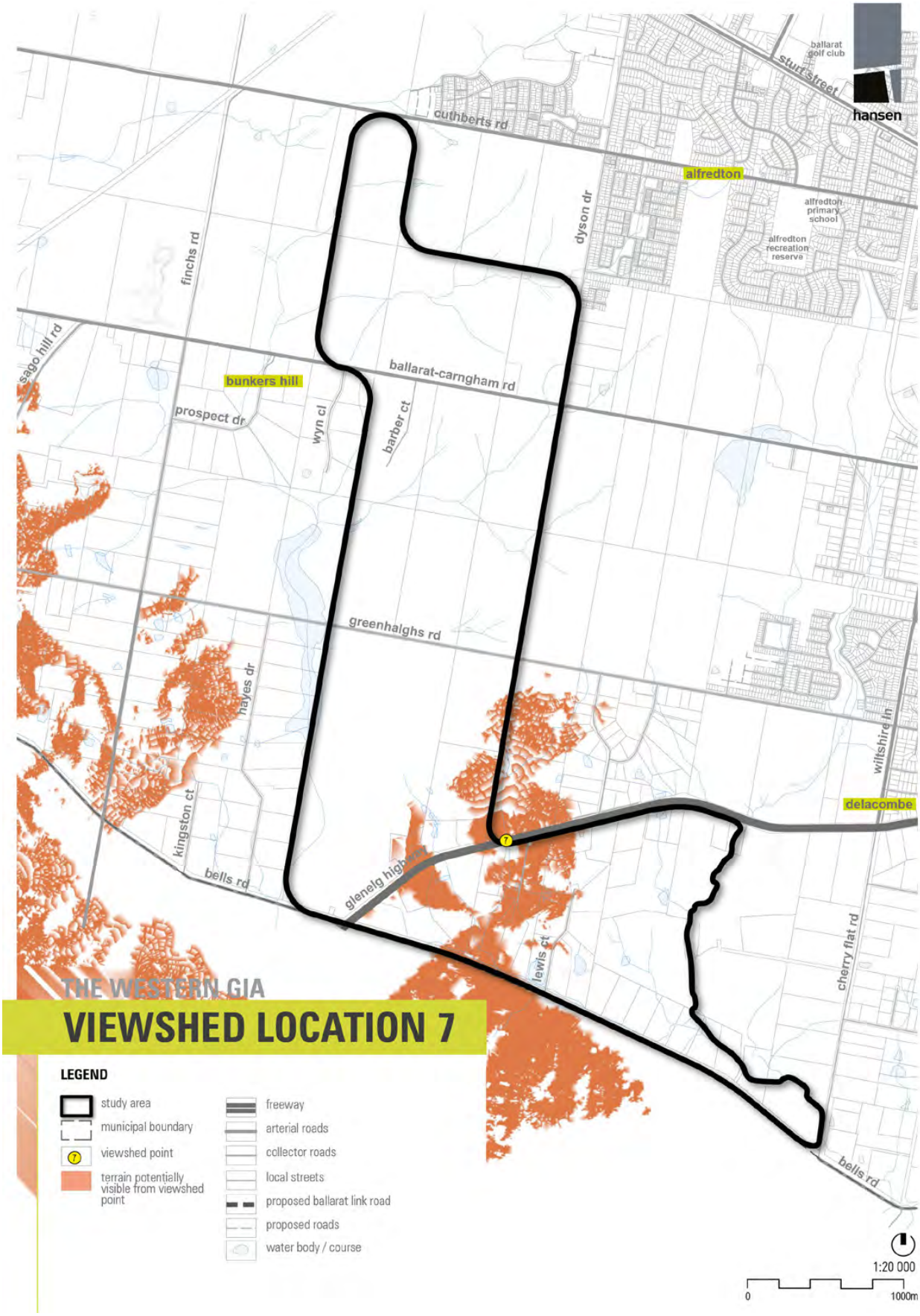

hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
alfredton primary school
alfredton recreation reserve
dyson dr
sago hill rd
bunkers hill
ballarat carngham rd
prospect dr
wyn cl
greenhalghs rd
wiltshire ln
delacombe
glenelg highway
cherry flat rd
lewis ct
bells rd
THE WESTERN GIA
VIEWSHED LOCATION 6
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 6

View 6 from Glenelg Highway and Bells Road intersection looking north east.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 2: Plains Rural Living


hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
dyson dr
alfredton primary school
alfredton recreation reserve
finchs rd
sago hill rd
bunkers hill
ballarat-carngham rd
prospect dr
wyn cl
barber ct
greenhalghs rd
hayes dr
wiltshire ln
delacombe
kingston ct
bells rd
glenelg highway
lewis ct
cherry flat rd
bells rd
THE WESTERN GIA
VIEWSHED LOCATION 7
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

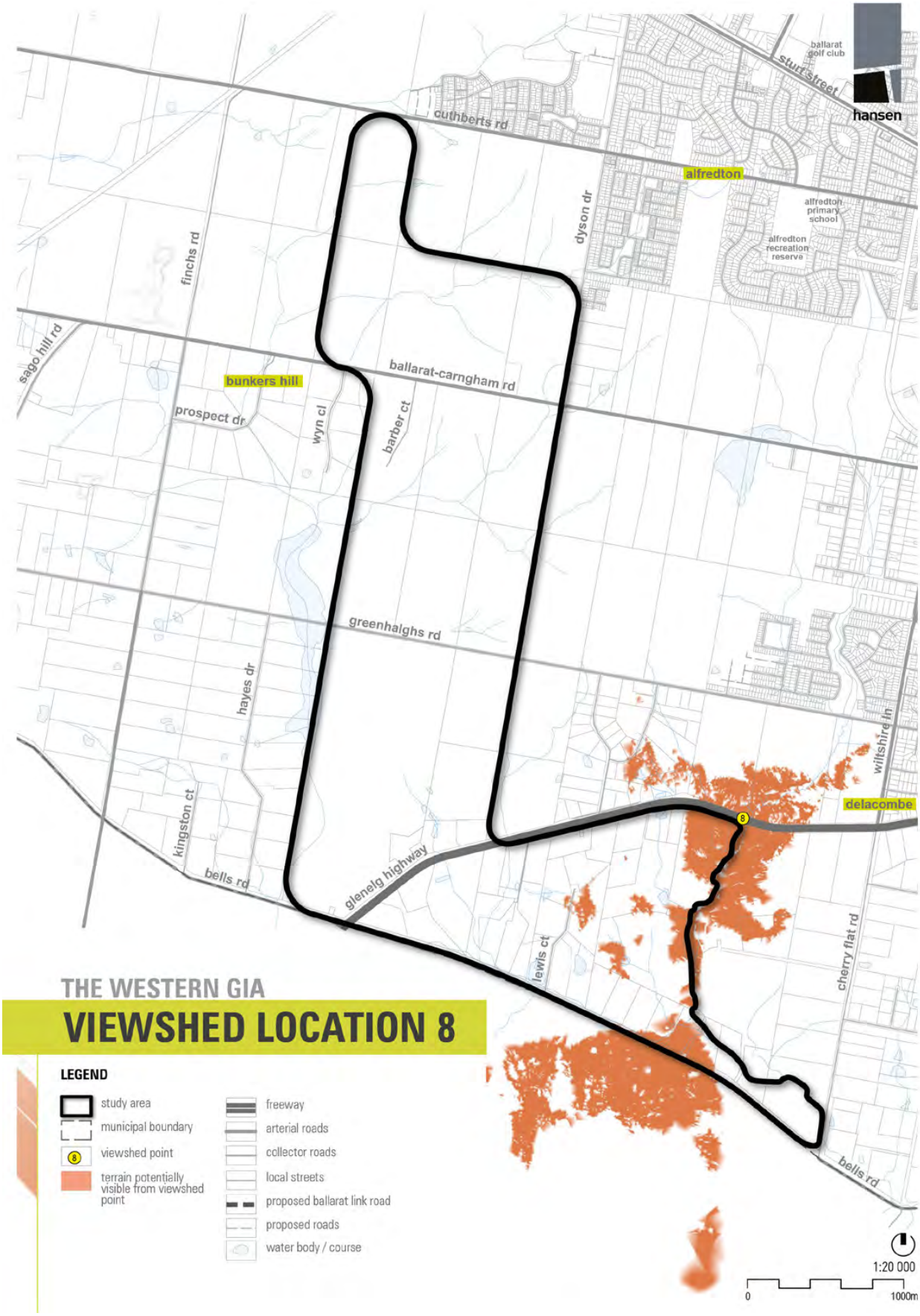
VIEWSHED LOCATION 7

View 7 (Photo 1) from Glenelg Highway looking north west.

View 7 (Photo 2) from Glenelg Highway looking south west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 1: Plains
- Area 2: Plains Rural Living

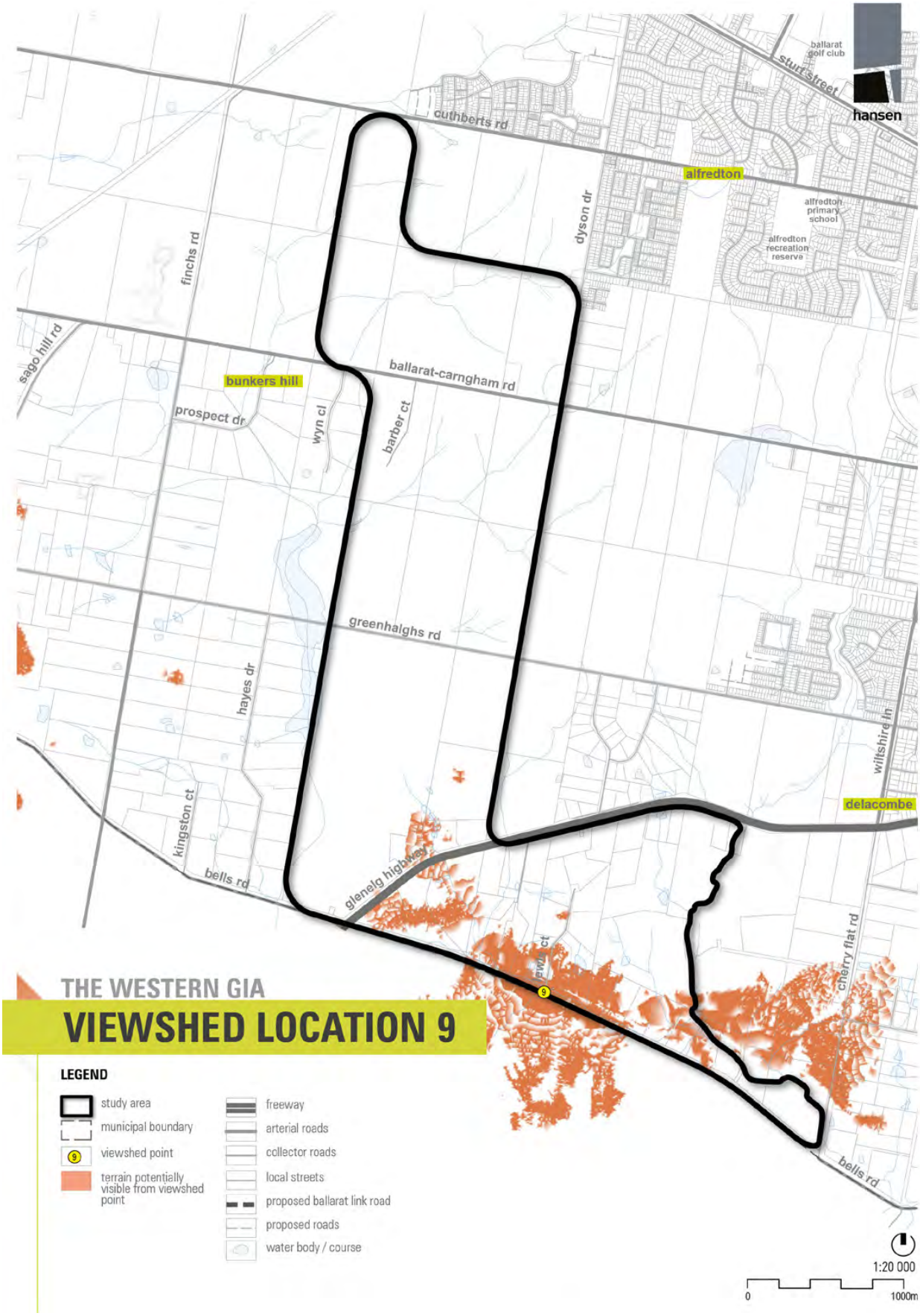

hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
dyson dr
alfredton primary school
alfredton recreation reserve
finchs rd
sago hill rd
bunkers hill
ballarat-carngham rd
prospect dr
wyn cl
barber ct
greenhalghs rd
hayes dr
wiltshire ln
delacombe
kingston ct
bells rd
glenelg highway
lewis ct
cherry flat rd
bells rd
THE WESTERN GIA
VIEWSHED LOCATION 8
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 8

View 8 from Glenelg Highway and winter creek looking west.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 2: Plains Rural Living

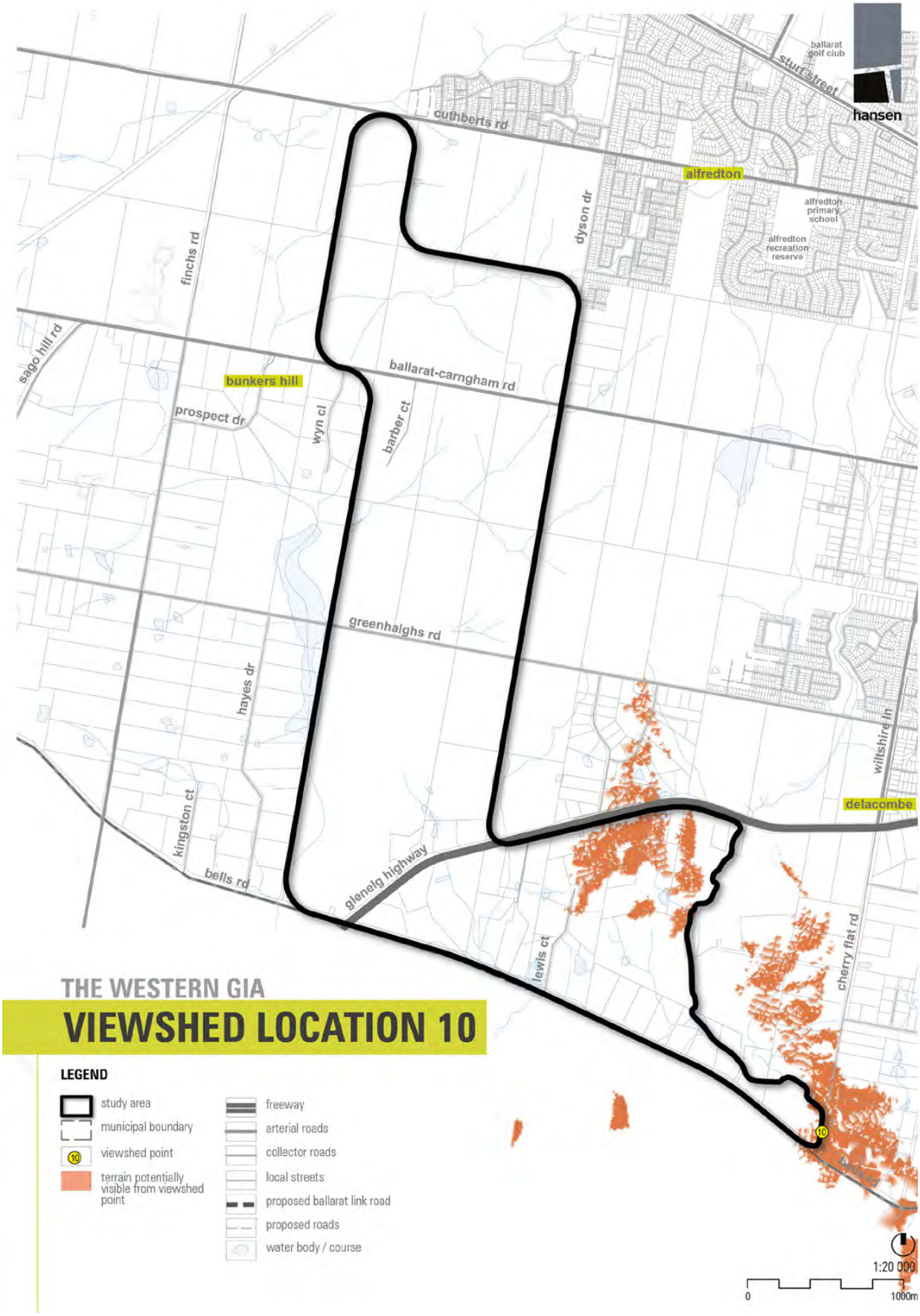

hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
dyson dr
alfredton primary school
alfredton recreation reserve
finchs rd
sago hill rd
bunkers hill
ballarat-carngham rd
prospect dr
wyn cl
barber ct
greenhalghs rd
hayes dr
wiltshire ln
delacombe
kingston ct
bells rd
glenelg highway
cherry flat rd
bells rd
THE WESTERN GIA
VIEWSHED LOCATION 9
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 9

View 9 from Lewis Court and Bells Road intersection looking north.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 2: Plains Rural Living


hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
dyson dr
alfredton primary school
alfredton recreation reserve
finchs rd
sago hill rd
bunkers hill
ballarat-carngham rd
prospect dr
wyn cl
barber ct
greenhalghs rd
hayes dr
wiltshire ln
delacombe
kingston ct
bells rd
glenelg highway
lewis ct
cherry flat rd
THE WESTERN GIA
VIEWSHED LOCATION 10
LEGEND
study area
municipal boundary
viewshed point
terrain potentially visible from viewshed point
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

VIEWSHED LOCATION 10

View 10 from Cherry Flat Road looking north.

LANDSCAPE CHARACTER AREAS VISIBLE:

- Area 2: Plains Rural Living

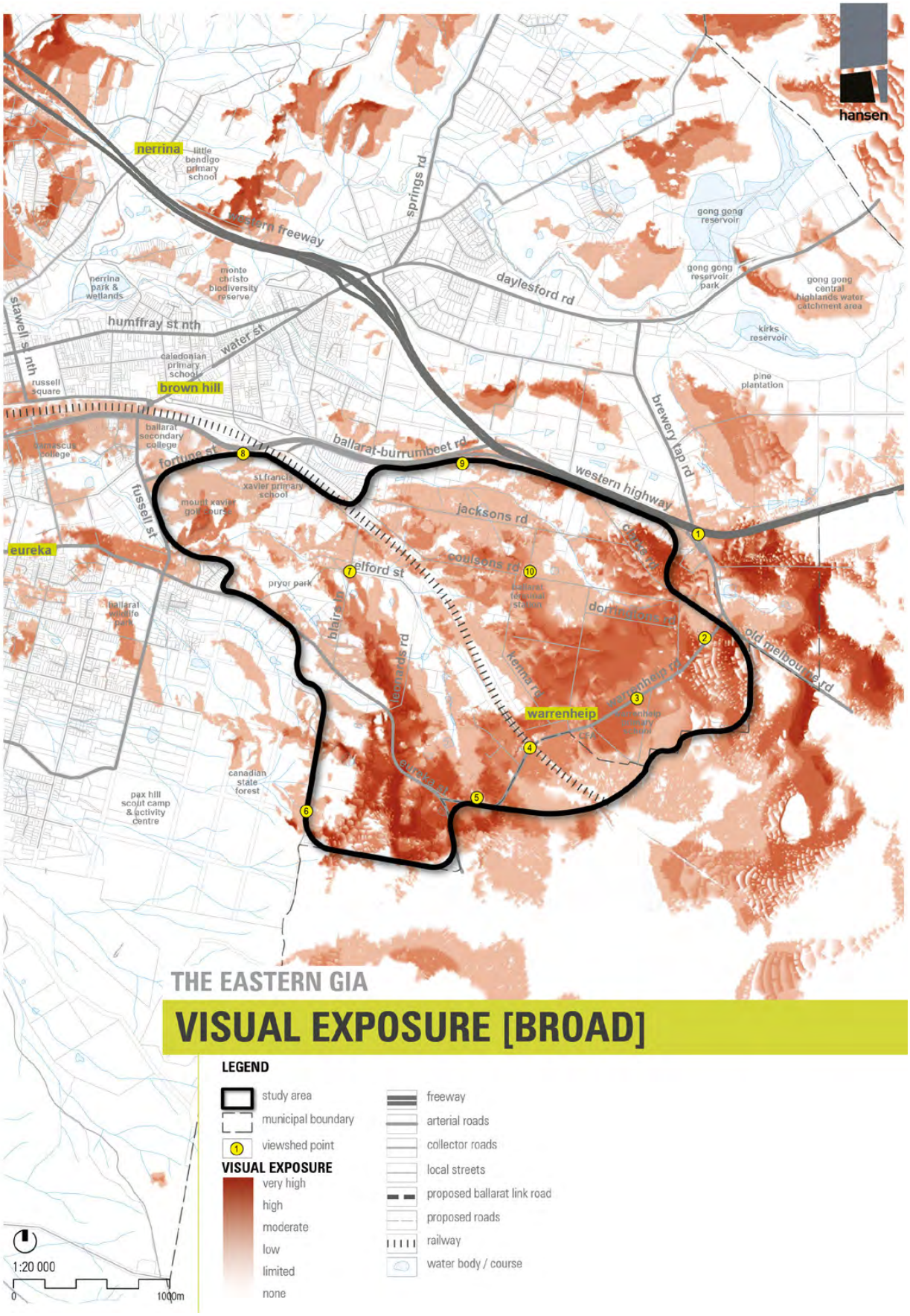
ASSESSMENT OF

4. VISUAL EXPOSURE

VISUAL EXPOSURE (BROAD)

The proceeding diagrams provide a broad graphic summary of the visual exposure achieved from all viewshed locations combined for each GIA. This mapping has been produced by overlaying all the viewshed maps for each GIA.

The areas with visual exposure are shaded in varying tones of red. The darker areas indicate locations that appear in more than one viewshed analysis map, with the darkest appearing multiple times across the viewpoints assessed. This process is not intended to be an acutely scientific or statistical data set but it does provide an indication of specific areas that warrant further investigation as part of the landscape assessment.



THE EASTERN GIA

VISUAL EXPOSURE [BROAD]

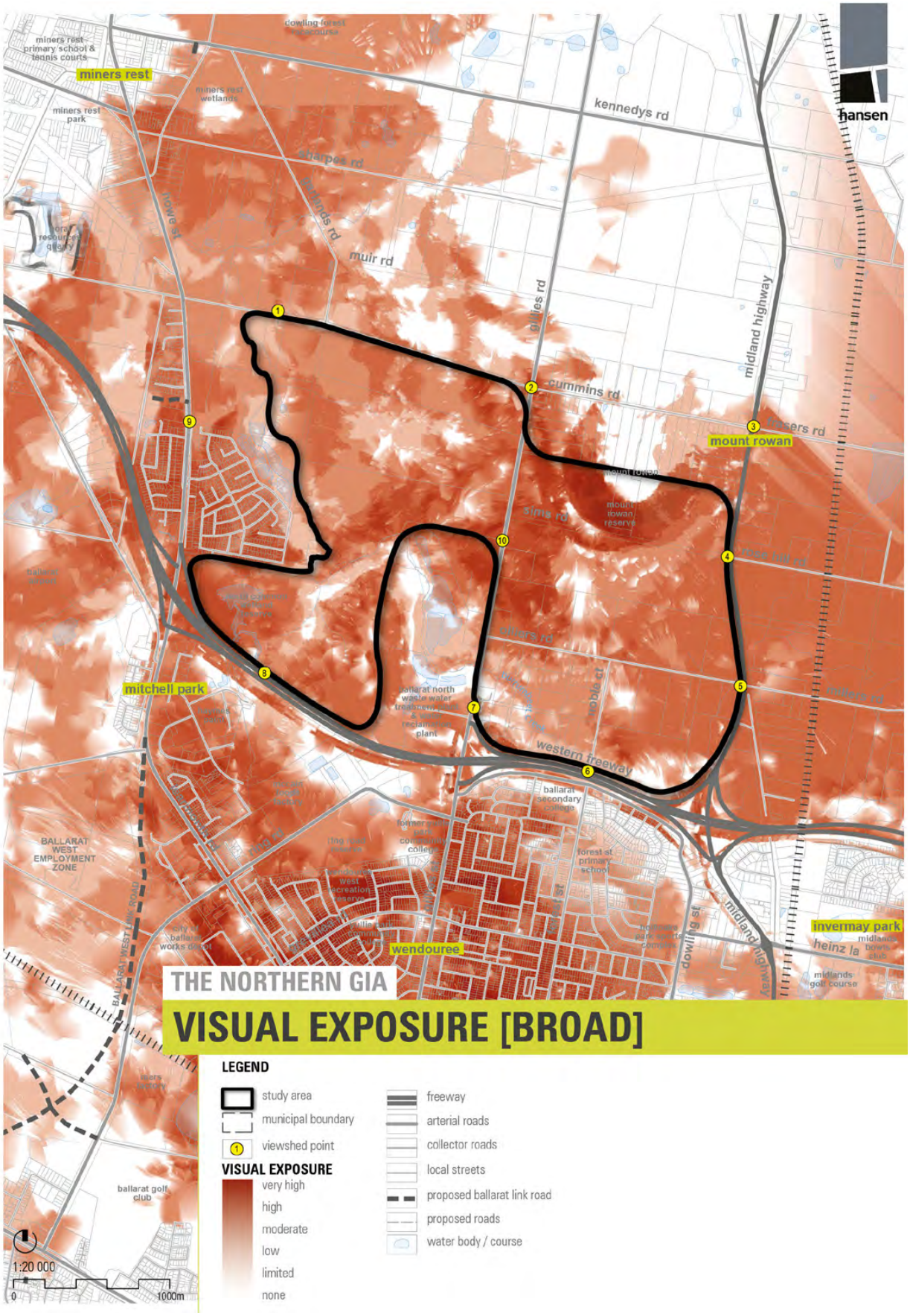
LEGEND

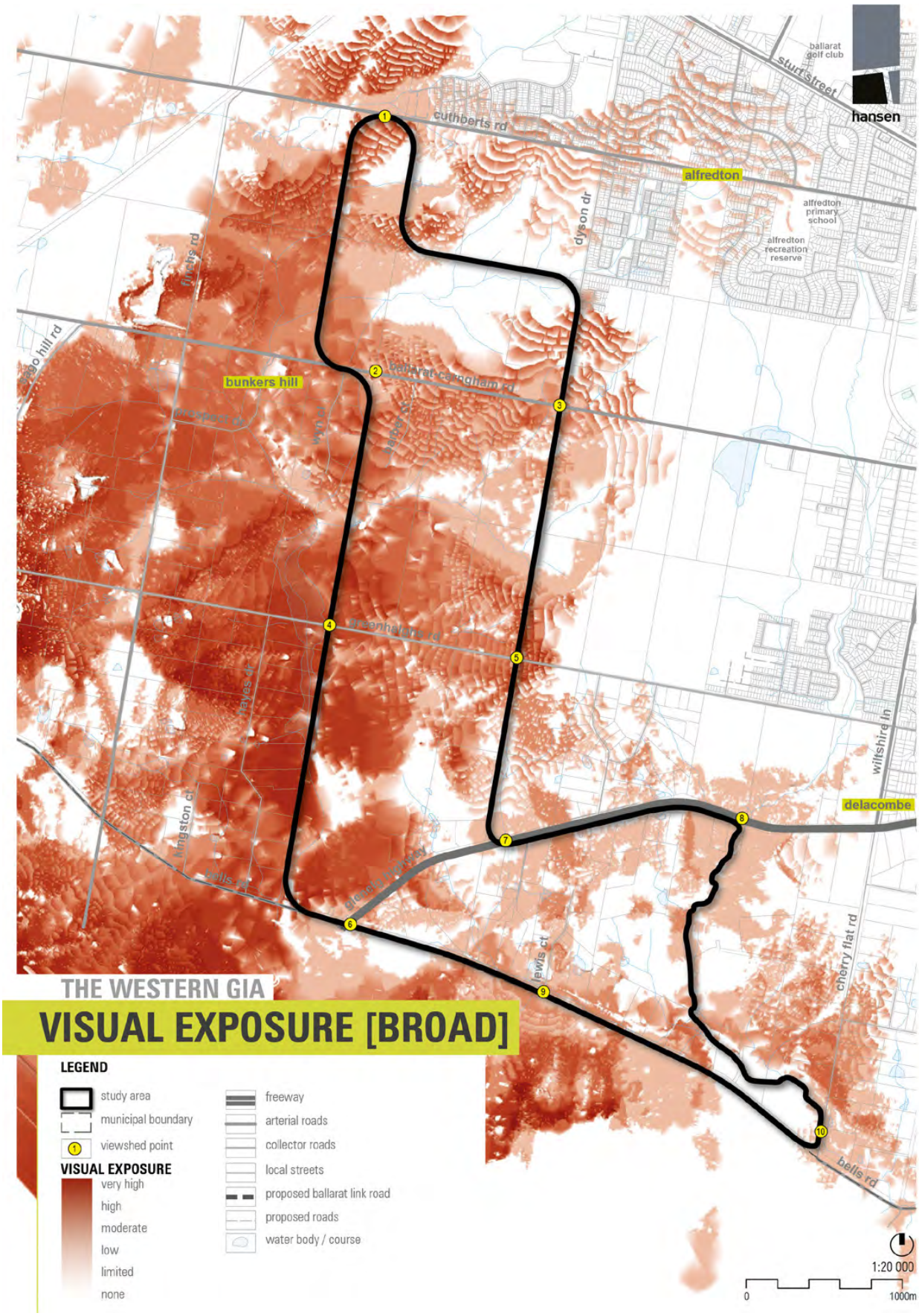
- study area
- municipal boundary
- viewshed point

VISUAL EXPOSURE

- very high
- high
- moderate
- low
- limited
- none

- freeway
- arterial roads
- collector roads
- local streets
- proposed ballarat link road
- proposed roads
- railway
- water body / course


miners rest
kennedys rd
sharpes rd
howe st
muir rd
gillies rd
midland highway
cummins rd
frasers rd
mount rowan
sims rd
oliers rd
mitchell park
western freeway
wendouree
invermay park
heinz la
dowling st
forest st
BALLARAT WEST EMPLOYMENT ZONE
BALLARAT WEST LINK ROAD
ballarat golf club
hansen
THE NORTHERN GIA
VISUAL EXPOSURE [BROAD]
LEGEND
study area
municipal boundary
viewshed point
VISUAL EXPOSURE
very high
high
moderate
low
limited
none
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m


hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
alfredton primary school
alfredton recreation reserve
dyson dr
flynns rd
bunkers hill
greenhalghs rd
wiltshire ln
delacombe
kingston ct
bells rd
cherry flat rd
lewis ct
THE WESTERN GIA
VISUAL EXPOSURE [BROAD]
LEGEND
study area
municipal boundary
viewshed point
VISUAL EXPOSURE
very high
high
moderate
low
limited
none
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
proposed roads
water body / course
1:20 000
0
1000m

VISUAL EXPOSURE MAPPING

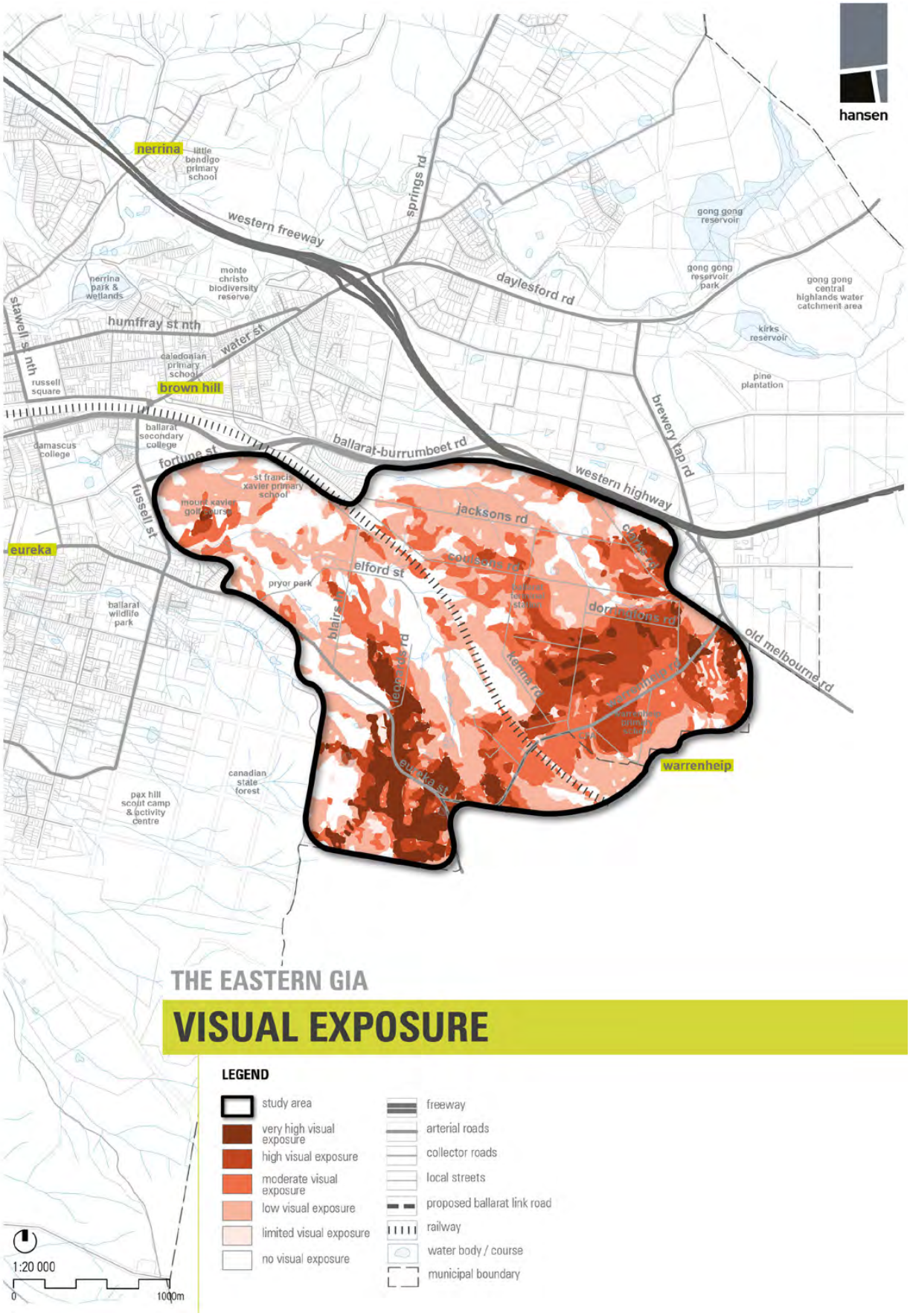
Following from the detailed viewshed assessment and broad demonstration of visual exposure, degrees of visual exposure have been more succinctly mapped. This involves accentuating the differences between the varying red colour shades that indicated visual exposure based on the previous overlaying process to enable easier distinction. The colours have been differentiated using Adobe suite automated colour identification and separation tools to ensure consistency between the three GIAs.

The purpose of this assessment is to enable a more effective comparison of this data to areas of landscape value.

Based on the visual exposure analysis, areas in the study area have been assigned as having either of the following:

- Very high visual exposure
- High visual exposure
- Moderate visual exposure
- Low visual exposure
- Limited visual exposure
- No visual exposure

This breakdown is shown graphically in the visual exposure mapping. The mapping reflects a number of underlying trends in the viewshed assessment which result from topography and its impact on visual exposure. The broad implications of this and a comparison to results from site inspections which take into account on-ground factors such as trees and buildings are discussed for each GIA in the following sections.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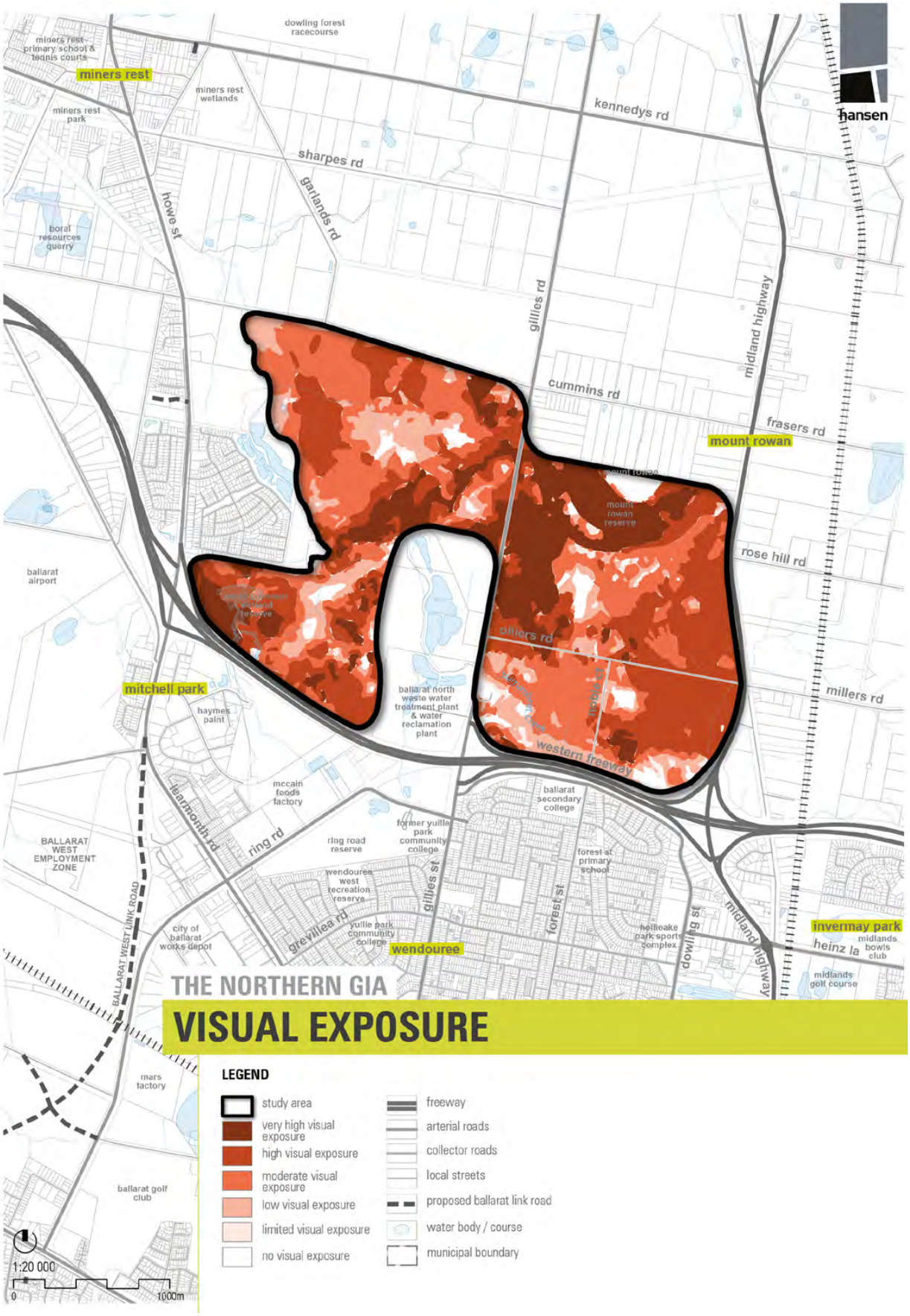
nerrina
little bendigo primary school
western freeway
springs rd
gong gong reservoir
gong gong reservoir park
gong gong central highlands water catchment area
daylesford rd
nerrina park & wetlands
monte christo biodiversity reserve
stawell st nth
humffray st nth
water st
kirks reservoir
caledonian primary school
russell square
brown hill
pine plantation
brewery tap rd
ballarat secondary college
damascus college
fortune st
ballarat-burrumbeet rd
western highway
st francis xavier primary school
mount xavier golf course
fussell st
jacksons rd
eureka
elford st
pryor park
ballarat wildlife park
blairs rd
old melbourne rd
kenna rd
warrenheip
canadian state forest
pax hill scout camp & activity centre
THE EASTERN GIA
VISUAL EXPOSURE
LEGEND
study area
very high visual exposure
high visual exposure
moderate visual exposure
low visual exposure
limited visual exposure
no visual exposure
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
railway
water body / course
municipal boundary
1:20 000
0
1000m

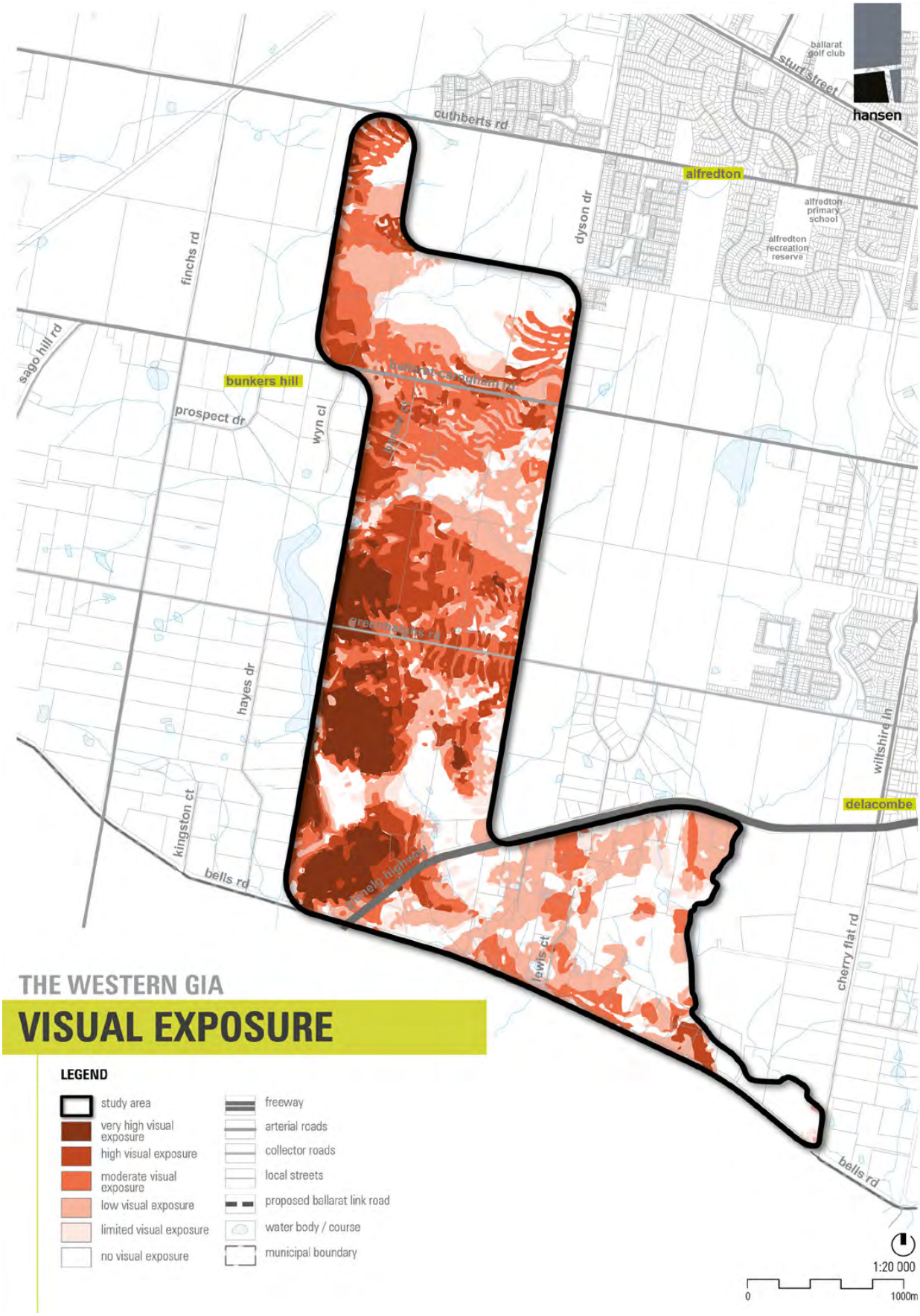
EASTERN GIA – VISUAL EXPOSURE

- Areas of very high visual exposure are present on the elevated areas near Eureka Street and the township of Warrenheip. The nature of the terrain in these areas means that the high plateaus are usually present in views from the elevated areas themselves, such as 2, 3, 4, 5 and 10. These views were typically limited by established canopy vegetation, particularly in the 'Undulating Rural' areas, but longer views were visible from the more cleared 'Rural Township' areas.
- Views from the Western Highway / Ballarat-Burrembeet Road, the major nearby roads were mainly constrained by terrain, trees and built structures (viewpoints 1, 8 and 9).
- Views from the edge of the Canadian State Forest (6) were shown as constrained by topography and vegetation, as the former rises towards the elevated plateaus to the east.
- Views from lower lying areas (7, 8 and 9) were typically constrained by terrain and vegetation. The visual exposure clearly demonstrates this, with extents of no to low visual exposure present in the lower-lying sections of the Eastern GIA.
- In summary, the undulating terrain prevalent in the study area serves to constrain a number of views, hence affording low levels of relative visual exposure throughout much of the GIA. These views were further constrained by existing vegetation and built form, as demonstrated in the site photography.


hansen
THE NORTHERN GIA
VISUAL EXPOSURE
LEGEND
study area
very high visual exposure
high visual exposure
moderate visual exposure
low visual exposure
limited visual exposure
no visual exposure
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
water body / course
municipal boundary
1:20 000
0
1000m
miners rest
miners rest primary school & tennis courts
miners rest park
miners rest wetlands
dowling forest racecourse
kennedys rd
sharpes rd
howe st
garlands rd
boral resources quarry
gillies rd
midland highway
cummins rd
frasers rd
mount rowan
mount rowan reserve
rose hill rd
ballarat airport
millers rd
mitchell park
haymes paint
ballarat north waste water treatment plant & water reclamation plant
western freeway
mccain foods factory
ballarat secondary college
former yulli park community college
ring rd
ring road reserve
BALLARAT WEST EMPLOYMENT ZONE
wendouree west recreation reserve
gillies st
forest st primary school
forest st
grevillea rd
yulli park community college
wendouree
city of ballarat works depot
BALLARAT WEST LINK ROAD
hollioake park sports complex
dowling st
invermay park
heinz la
midlands bowls club
midlands golf course
mars factory
ballarat golf club

NORTHERN GIA – VISUAL EXPOSURE

- Generally there is a prevalence of moderate to high visual exposure across the study area. This is afforded by the predominance of flatter, if mildly undulating terrain, over which elevated areas central to the study area and Mount Rowan are visible from a number of viewpoints (2, 4, 6, 7, 8, 9 and 10).
- From on-site investigations these views were occasionally obscured by tree stands (more prevalent in the north west extents of the study area), but expansive views across the pasture areas and to the higher terrain, in particular Mount Rowan, were common. Overall, a very high visual exposure on the elevated terrain of Mount Rowan was identified.
- Very high visual exposure in the elevated terrain leading up to the highpoint of Mount Rowan is prevalent in the centre of the study area. This is largely afforded by views to the south and west (7, 8, 9 and 10).
- Views from the township of Mount Rowan towards the study area were obscured by the highpoint.
- Lower areas accompanied by Burrumbeet Creek were typically less visually exposed.
- Views from the township to the west (9) were terminated in the immediate area by Mount Rowan, which was visible from the site inspection. However much of the lower-lying land was obscured by structures and vegetation in the foreground.
- Lower-lying land south of Cummins Road in the north western corner of the site was typically less visually exposed, and views constrained by vegetation.
- Views from the eastern edge of study area were generally constrained by the somewhat elevated terrain in the centre of the study area (3, 4 and 5). The land along the Midland Highway was typically cleared and allowed the full extent of available views to be seen.


hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
dyson dr
alfredton primary school
alfredton recreation reserve
finchs rd
sago hill rd
bunkers hill
prospect dr
wyn cl
greenhalghs rd
hayes dr
kingston ct
bells rd
wiltshire ln
delacombe
cherry flat rd
bells rd
THE WESTERN GIA
VISUAL EXPOSURE
LEGEND
study area
very high visual exposure
high visual exposure
moderate visual exposure
low visual exposure
limited visual exposure
no visual exposure
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
water body / course
municipal boundary
1:20 000
0
1000m

WESTERN GIA – VISUAL EXPOSURE

- Conversely to the northern GIA, lower-lying 'Plains' areas in the western extents of the study area generally display a very high to moderate visual exposure. This is afforded by viewpoints on the thresholds of the study area boundary located on elevated hillsides, as demonstrated from viewpoints 1-5 (most prominent from viewpoint 5).
- Terrain in the 'Plains' areas of this GIA slopes slightly downwards from east to west, and from north to south. This slightly undulating terrain serves to somewhat constrain views within the 'Plains' areas to hillsides and low-lying areas (as shown in viewpoints 1-4).
- The sparse vegetation in the 'Plains' character area means that views demonstrated in the viewshed mapping are generally in accordance with observed views from the site inspection.
- In the southern extents of the GIA, or the area designated as 'Plains Rural Living', views are generally constrained by the slightly undulating terrain, which affords a much lower overall relative visual exposure (viewpoints 6 – 10).
- Again, the somewhat sparse vegetation in the 'Plains Rural Living' character area means that views demonstrated in the viewshed mapping are generally in accordance with observed views from the site inspection.

ASSESSMENT OF
5. LANDSCAPE VALUES

Associating and evaluating value within landscapes can often be an abstract, subjective and difficult concept to comprehend. This section aims to assess relative landscape value of the study area in an manner that is as objective as possible. This is to be achieved through review and analysis of previous assessment work, guided by benchmarking documents, primarily *Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design. November 2007.* In this manual landscape values are broadly defined as (p.33):

"values or preferences refer to the value placed on a landscape feature by the community based primarily on its perceived visual quality."

It is important to note that the assigned landscape values derived from this assessment are relative and have been compared to the study areas context. It is also important to acknowledge the existing high level of significance attributed to some existing areas of the GIAs as identified in the planning scheme via either SLOs or ESOs for example.

The Landscape Values Assessment will use the following methodology:

- The identification, through the review of benchmarking documents, of objective criteria to assess landscape value.
- Using these criteria, the relative value of the different landscape character areas can be discussed and evaluated. Relative landscape value will be assigned as either high, moderate or low based on criteria such as:

HIGH

- Prevalence of typically valued landscape features such as: native vegetation, waterbodies and topographic variety that are, when relevant, harmonious with the built environment.

MODERATE

- Some presence of landscape features such as: vegetation, waterbodies and topographic variety that are, when relevant, harmonious with the built environment.

LOW

- Minor presence of landscape features such as vegetation or topographic variety that are at times either degraded or rarely integrated well with the built environment which can be encumbered by structures such as out-buildings or infrastructure (i.e. powerlines).

Once a level of value has been assigned to each character area, these will be compared with visually exposed areas. This in order to assign appropriate value to visually prominent areas and will be done through the subsequent Visual Sensitivity Assessment.

CRITERIA FOR THE ASSESSMENT OF LANDSCAPE VALUES

For the purposes of this study a set of broad landscape values assessment criteria have been developed through professional assessments by Hansen Partnership, an office of professional landscape architects, urban designers and planners.

These criteria ultimately take the form of landscape preference indicators, and it is intended that they be used to assess landscape value in the Ballarat GIAs in a manner that is as objective as possible. In order to achieve this several publications have been assessed and subsequently used to formulate the landscape values assessment criteria.

To ensure that the methodology for this landscape values assessment is grounded by a best practice approach, it has been based on the methodology outlined in the guidelines provided by the *Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design. November 2007* (VLPWA Manual).

The process of utilising these guidelines to establish landscape values assessment criteria, and then in turn to gauge landscape value is explained in further detail in subsequent sections of the report.

VLPWA MANUAL

The VLPWA Manual aims to provide a valuable resource for undertaking visual assessments of the landscape in lieu of often nonexistent formal local or state planning policy. This Landscape Values Assessment conducted for the Ballarat GIAs specifically refers to: *Part Two, Section 2, Identify and assess what is valued in the visual landscape (p32-33) and Appendix 7, Visual landscape character preference indicators (p175-177)* within the VLPWA Manual.

The landscape character preference indicators identified in Appendix 7 of the VLPWA Manual have been developed using community preference research and subsequently list landscape features as being either most preferred or least preferred in a generalised landscape typology. These landscape typologies are categorised broadly as being natural, rural or built.

As the study area contains natural and rural landscape typologies, it was deemed suitable to list all the applicable landscape preference indicators for them. It is intended that these preference indicators provide a structured basis for the landscape values assessment criteria, which is in keeping with the methodology outlined in the VLPWA Manual.

COMMUNITY VALUES

Community held landscape values are important to consider in the development of preference indicators to ensure the values assessment reflects community aspirations. 'Mapping Ballarat's Historic Urban Landscape' (Context Pty Ltd, 2013) identified a number of broad community landscape values through the 'Ballarat Imagine' community engagement process. These landscape values are broadly described on p47, as follows:

'Ballarat is a city 'in the landscape'. Valued landscape elements include Lake Wendouree, Mt Buninyong, views of Mt Warrenheip, Canadian Forest and the countryside that surrounds the city. Ballarat has a country feel and ambiance. And within the city, parks, gardens, street trees help create a beautiful city, bring nature into its heart. Open spaces are also valued places for recreation and leisure, and for community events. The creek systems and trails and the nearby bush are important. Even the weather, which often attracts adverse comment from outsiders, is valued.'

These community landscape values have been reflected in the preference indicators for natural and rural landscape typologies, and are listed in the following pages. It should be noted that a number of the preference indicators have been altered from the originals presented in the VLPWA Manual to reflect reoccurring landscape features specific to the Ballarat GIAs and the previous community values. Adjusting the preference indicators for site specific features and community values is encouraged in the VLPWA Manual.

NATURAL LANDSCAPE TYPOLOGY

PREFERRED LANDSCAPE FEATURES

Most preferred landscape features for this landscape typology include:

1. High degrees of perceived naturalness.

2. High degree of topography variety or vertical relief (dramatic relief, ruggedness, rock outcropping, outstanding ridgelines and beach forms).

3. Vegetative diversity (distinctive patterns, species composition, height, colour and textures within bushland).

4. Diversity of vegetation age and density (structural complexity).

5. Unusually expansive landforms or vast horizontal scale (desert landscapes, beach and dune fields, rolling hills).

6. Presence of water bodies (waterfalls, rivers, estuaries, oceans, lakes, inundated areas, creek systems).

7. Distinctive display of colours: soils, vegetation (often seasonal), topography, rock formations or water bodies.

8. Distinctive landscape features (waterfalls, unique plants, reefs, geological formations such as ranges, cliff faces and granite outcrops).

9. Outstanding combinations of landform, vegetation patterns and water features in one area.

10. Areas or sites frequently prone to ephemeral features (fauna, water or wave conditions, beach erosion scarps, climatic conditions).

11. Panoramic views to landscape features such as: Mt Warrenheip and Canadian forest.

LEAST PREFERRED LANDSCAPE FEATURES

Least preferred landscape features for this landscape typology include:

1. Disturbed areas with little evidence of naturalness.

2. Areas of diseased, dead or dying vegetation.

3. Areas with severe weed infestations in a natural landscape.

4. Areas of soil erosion (especially where human-induced).

5. Water bodies with degraded banks, weed infestations, stagnation, eutrophication, algae or litter.

6. Evidence of mining (gravel pits, sand mines, limestone).

RURAL LANDSCAPE TYPOLOGY

PREFERRED LANDSCAPE FEATURES

Most preferred landscape features for this landscape typology include:

1. Unusual diversity in agricultural landscapes (colour and contrast or species diversity of cropping).

2. Agricultural patterns, colours and textures that complement natural features.

3. Topographic variety and ruggedness, including elevated landforms and undulating terrain.

4. Presence of waterways and water bodies (dams, lakes, inundated areas, drainage lines and creeks) that borrow location, shape, scale and edge configuration for natural elements.

5. Areas or sites frequently prone to ephemeral features (presence of fauna, distinctive crop rotations, water conditions and climatic conditions).

6. Significant landscape features (established exotic windbreaks in good condition, street trees, trees and tree stands, historic relics, and areas of topographic variation).

7. Settlement patterns and individual structures that strengthen the local rural character (water tanks, historic buildings, hay bales and dams).

8. Historic features and land use patterns that strengthen the local rural character (historic farm machinery, old sheds and historic buildings).

9. Distinctive remnant or established canopy vegetation / bushland located within allotments, along streamsides, roadsides and in paddocks.

10. Design which takes account of landscape features, vegetation and landform.

11. Incorporation of significant cultural and environmental features into design.

12. Presence of natural rock features (eg limestone cliffs, granite outcrops).

13. Built developments that do not impinge on dominant natural features (for example river foreshores, bushland and coastal landscapes).

14. Well maintained gardens (native and exotic).

15. Panoramic views to landscape features such as: Mt Warrenheip and Canadian forest.

16. Well presented public open spaces including path networks

LEAST PREFERRED LANDSCAPE FEATURES

Least preferred landscape features for this landscape typology include:

1. Areas of soil salinity/salt scalds or dead, dying or diseased vegetation.

2. Areas of extensive weed infestation.

3. Eroded areas

4. Tips, dumps and landfill areas.

5. Recently harvested areas (stumps, debris, abandoned off-cuts).

6. Land use areas or buildings that contrast significantly from rural landscape characteristics (can include plantations, mines, rural settlement and/or housing, utility towers, roads and fencing).

7. Run-down areas (dead grass, bare and, dead vegetation, derelict housing and/or buildings, abandoned and/or trashed cars).

8. Abandoned structures, yards or paddocks in a state of disrepair or destruction.

9. Farm structures and buildings in a state of disrepair.

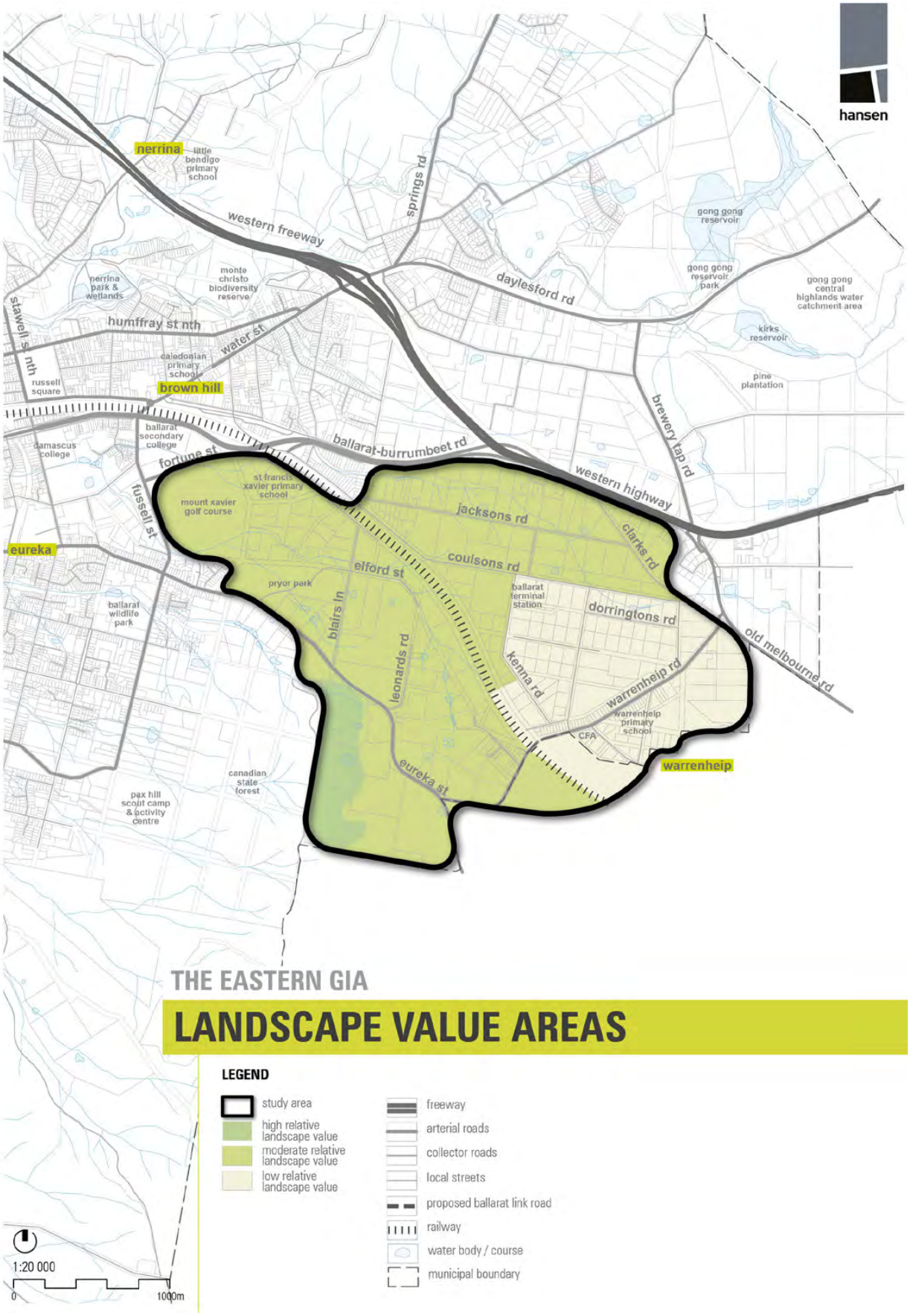
10. Unmanaged roads and access tracks in a state of disrepair.

11. Eutrophied dams, lakes and water bodies (for example; algal blooms).

12. Degraded waterways and drains prone to stagnation, pollution and littering.

13. Presence of utilities (towers, transmission line, overhead power lines).

14. Severed or badly pruned street trees.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THE EASTERN GIA
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LEGEND
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high relative landscape value
moderate relative landscape value
low relative landscape value
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railway
water body / course
municipal boundary
1:20 000
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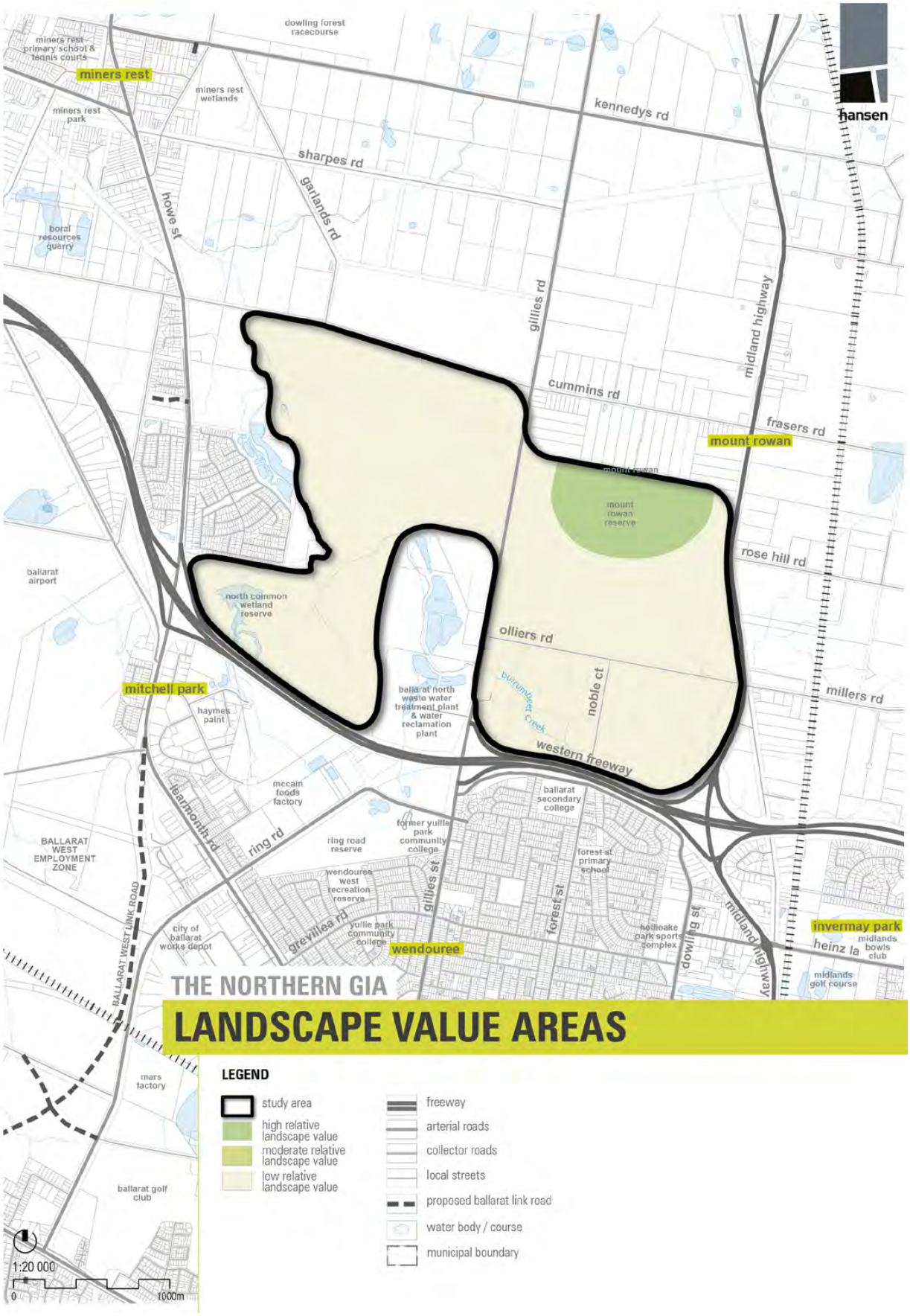
LANDSCAPE VALUES MAPPING

Mapping demonstrating assigned relative landscape value levels for each GIA is demonstrated on adjoining and the following pages.

Proceeding this is the analysis of each landscape character area in relation to the previously outlined landscape values assessment criteria. A summary of the results of this assessment is present spatially on the mapping, and in the following table.

SUMMARY TABLE

LANDSCAPE VALUES			
	LANDSCAPE CHARACTER AREA	LANDSCAPE TYPOLOGY	ASSIGNED LANDSCAPE VALUE
1	Plains	Rural	Low
2	Plains Rural Living	Rural	Low
3	Rural Pasture	Rural	Low
4	Elevated Pasture	Rural	High
5	Undulating Rural	Rural	Moderate
6	Rural Bushland	Rural	Moderate
7	Bushland	Natural	High
8	Rural Township	Rural	Low


hansen
THE NORTHERN GIA
LANDSCAPE VALUE AREAS
LEGEND
study area
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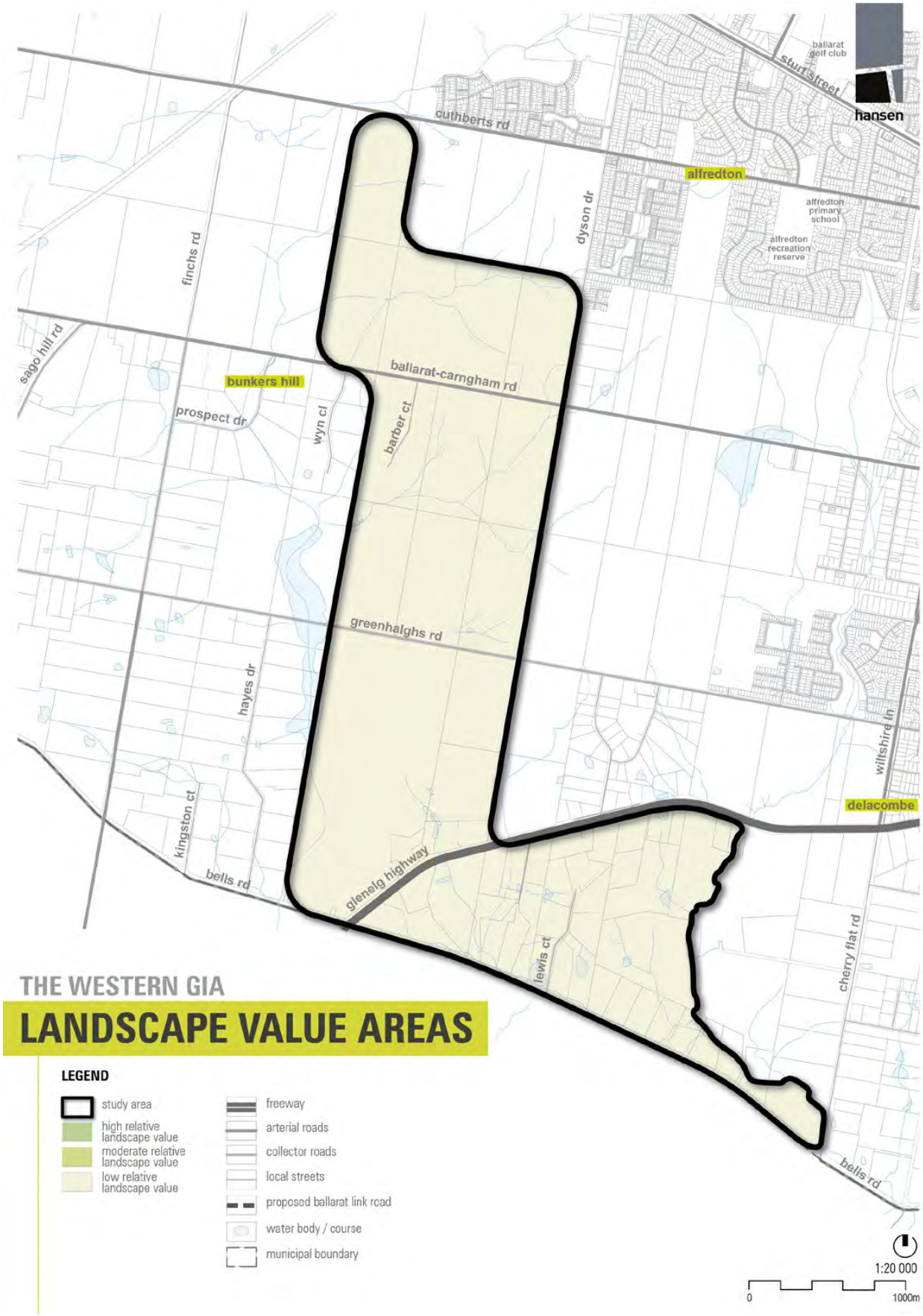
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1 PLAINS

LANDSCAPE TYPOLOGY

- Rural

PREFERRED LANDSCAPE FEATURES

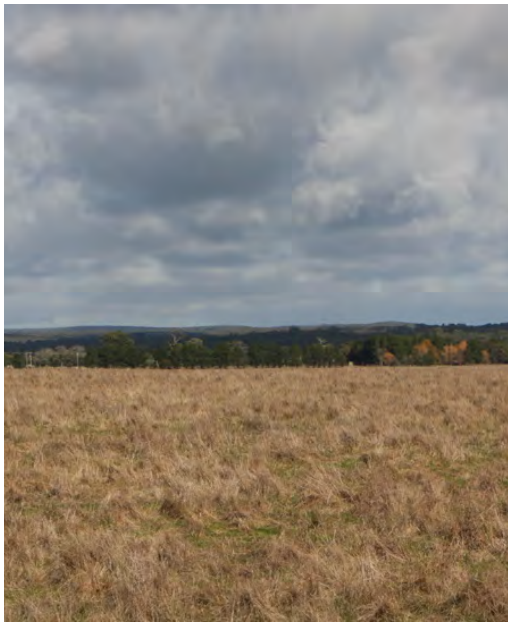
- (7) Rural structures and settlement patterns are prevalent and strengthen the local rural character.
- (9) There are some instances of existing established native vegetation, either scattered throughout the plains areas or on property boundaries.
- (6) There are a number of established exotic windbreaks in good condition.
- (4) Small scale drainage lines, wetlands and dams are present in the character area, and through a lack of nearby canopy vegetation (in most instances), these areas complement the surrounding plains character.

LEAST PREFERRED LANDSCAPE FEATURES

- (1) Dead / dying vegetation, in particular exotic windbreak species, are present.
- (7, 9) Some presence of run-down / degraded buildings, farm structures and fencing.
- (2, 12) Waterways are somewhat degraded in some instances and can be accompanied by exotic / weed species.
- (13, 14) Utilities are present, although not overly dominant, and there are some instances of severe pruning to accommodate overhead power-lines.

OVERALL RELATIVE LANDSCAPE VALUE

- Low



Scattered native vegetation in fields.

Dead/dying stands of exotic vegetation.

2 PLAINS RURAL LIVING

LANDSCAPE TYPOLOGY

- Rural

PREFERRED LANDSCAPE FEATURES

- (4) Some waterways and water bodies complementary to the surrounding landscape are present.
- (14) Gardens associated with the rural living style dwellings are generally well maintained.

LEAST PREFERRED LANDSCAPE FEATURES

- (6) The higher density of dwellings creates a settlement pattern which contrasts slightly to the surrounding rural plains areas.
- (7, 9) Some presence of run-down / degraded buildings, farm structures and fencing.
- (2, 12) There are degraded waterways which are accompanied by prolific exotic / weed species.

OVERALL RELATIVE LANDSCAPE VALUE

- Low

Contrast to surrounding plains areas.

Degraded waterways with exotic species.

3 RURAL PASTURE

LANDSCAPE TYPOLOGY

- Rural

PREFERRED LANDSCAPE FEATURES

- (7) Rural structures and settlement patterns are prevalent and strengthen the local rural character.
- (9) There are some instances of existing established native vegetation, occasionally scattered throughout the pasture areas, on property boundaries or accompanying dwellings.
- (4) Small scale drainage lines and creeks are present in the character area.
- (2) The cleared nature of the pasture areas complements nearby natural features such as Mount Rowan in some places.

LEAST PREFERRED LANDSCAPE FEATURES

- (2, 12) There are degraded waterways which are accompanied by exotic / weed species.
- (6) Some areas of fencing and structures contrast significantly to the prevailing rural landscape character.
- (7, 9) Some presence of run-down / degraded buildings, farm structures and fencing.
- (13, 14) Utilities are present, although not overly dominant, and there are some instances of severe pruning to accommodate overhead power-lines.
- (1) Dead / dying vegetation is present.

OVERALL RELATIVE LANDSCAPE VALUE

- Low

Native vegetation severely pruned for power lines.

Dead/dying vegetation.

4 ELEVATED PASTURE

LANDSCAPE TYPOLOGY

- Rural

PREFERRED LANDSCAPE FEATURES

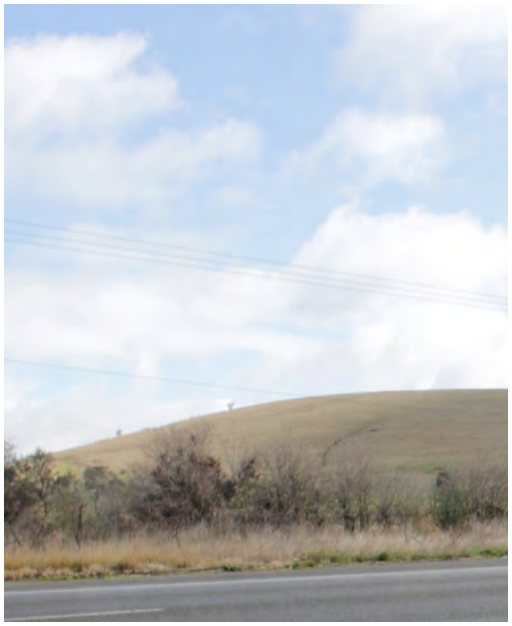
- (3, 6) Significant landscape features are present in the form of the elevated landform of Mount Rowan that is topographically varied and a distinct highpoint for the area.
- (2, 8) Cleared pastoral areas on the ground plane comprise colours and textures that complement the terrain (natural features) and strengthens the local rural character.

LEAST PREFERRED LANDSCAPE FEATURES

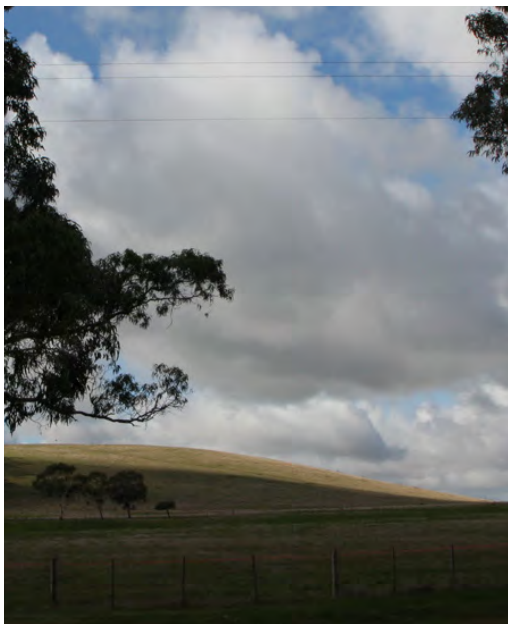
- (6, 13) A water storage tower is present at the top of the hill, which provides a contrast to nearby rural landscape characteristics (although it is not evidently visible from surrounding areas).

OVERALL RELATIVE LANDSCAPE VALUE

- High



Significant highpoint visible form a number of views.



The highpoint is complementary to surrounding plains.

5 UNDULATING RURAL

LANDSCAPE TYPOLOGY

- Rural

PREFERRED LANDSCAPE FEATURES

- (7) Some rural structures and settlement patterns are prevalent and strengthen the local rural character.
- (9) There are numerous instances of existing established native vegetation or patches of bushland. This is prevalent scattered throughout pasture areas, roadsides on property boundaries or accompanying dwellings.
- (6) There are several plantations of of exotic trees, within the Mount Xavier Golf Course and Pryor Park, which are established significant landscape features that contrast with the surrounding area.
- (3) Topographic variety is present in the form of undulating hills.
- (4) Some minor waterways and water bodies are present which borrow location, shape, scale and edge configuration from surrounding terrain.
- (14) Gardens associated with the rural living style dwellings are generally well maintained.
- (15) Panoramic views to Mt. Warrenheip are common.

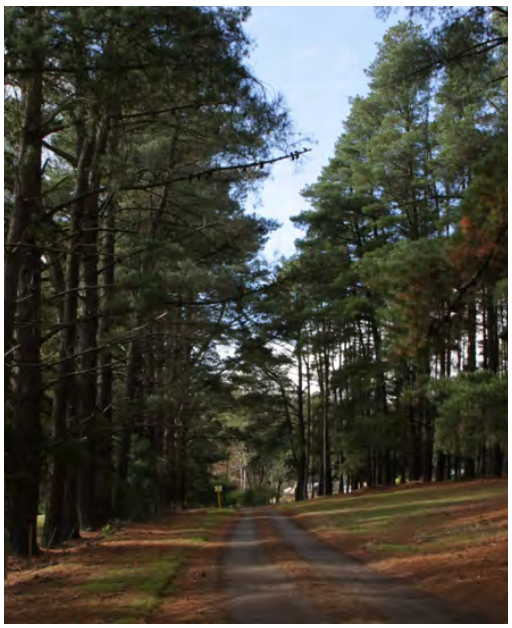
LEAST PREFERRED LANDSCAPE FEATURES

- (7) Occasional presence of run-down areas.
- (1) Some / dying vegetation is present.
- (13, 14) Utilities are present, although not overly dominant, and there are some instances of severe pruning to accommodate overhead power-lines.

OVERALL RELATIVE LANDSCAPE VALUE

- Moderate

Mixture of vegetation species and rural structures.



Established areas of exotic vegetation.

6 RURAL BUSHLAND

LANDSCAPE TYPOLOGY

- Rural

PREFERRED LANDSCAPE FEATURES

- (7, 10) Rural structures and settlement patterns are prevalent and strengthen the local rural character, while taking into account landscape features, vegetation and landform.
- (9) There are numerous instances of existing established native vegetation. This is prevalent scattered throughout pasture areas, roadsides on property boundaries or accompanying dwellings.
- (3) Topographic variety is present in the form of a number of undulating ridges.
- (4) Some minor waterways and water bodies are present which borrow location, shape, scale and edge configuration from surrounding terrain.

LEAST PREFERRED LANDSCAPE FEATURES

- (6) Some built developments contrast with the prevailing rural bushland character.
- (7) Occasional presence of run-down areas.
- (13, 14) Utilities are present, although not overly dominant, and there are some instances of severe pruning to accommodate overhead power-lines.
- (6) The railway line provides a distinct contrast to the surrounding rural areas.

OVERALL RELATIVE LANDSCAPE VALUE

- Moderate

Extensive bushland areas.

Established native vegetation.

7 BUSHLAND

LANDSCAPE TYPOLOGY

- Natural

PREFERRED LANDSCAPE FEATURES

- (1, 2 and 3)The bushland area affords a high degree of perceived naturalness to viewers. This is enhanced through the constriction of views courtesy of the diverse vegetation (in terms of species composition, height and structural complexity) and its somewhat undulating terrain.

LEAST PREFERRED LANDSCAPE FEATURES

- (1) There are small disturbed areas with little evidence of naturalness, which includes cleared areas to accommodate power lines and structures.

OVERALL RELATIVE LANDSCAPE VALUE

- High

Bushland.

Cleared areas to accommodate services.

8 RURAL TOWNSHIP

LANDSCAPE TYPOLOGY

- Rural

PREFERRED LANDSCAPE FEATURES

- (9) Presence of established canopy vegetation located within allotments and along roadsides.
- (7) Settlement patterns and structures generally strengthen the prevailing rural character.
- (14) Gardens in the rural style allotments are generally well maintained.
- (15) Panoramic views to Mt. Warrenheip are common.

LEAST PREFERRED LANDSCAPE FEATURES

- (13) Several high-voltage transmission lines are prominent due to the location of the terminal station.
- (6) The railway line, transmission lines and terminal station provide a distinct contrast to the surrounding rural areas.
- (7) A number of run-down areas and allotments are present.
- (1) Some / dying vegetation is present.
- (12) Degraded waterways and drains prone to stagnation are also present.

OVERALL RELATIVE LANDSCAPE VALUE

- Low

Prevalence of transmission lines.

Degraded waterways with exotic species.

ASSESSMENT OF
6. VISUAL SENSITIVITY

By reviewing areas of landscape value and visual exposure cumulatively we are able to explore the parts of the study area that overlap, revealing their potential for visual sensitivity.

Visual sensitivity could equally be described as an areas 'ability to accommodate change'. Landscapes with a higher visual sensitivity generally have a lower threshold beyond which changes in the landscape start to detrimentally impact on the value/significance of that landscape.

It is pivotal to establish these overlapping areas as the landscape characterisation process and the landscape values assessment were conducted in a manner that broadly classified areas based on their on-ground characteristics, and not so much on the visual exposure of specific areas.

These overlapping areas of visual sensitivity will consist of:

- Areas of no to very high visual exposure.
- Areas of low to high landscape value.

Outcomes of the Visual Sensitivity mapping and any subsequent recommendations are demonstrated in the following sections and the 'Conclusion'

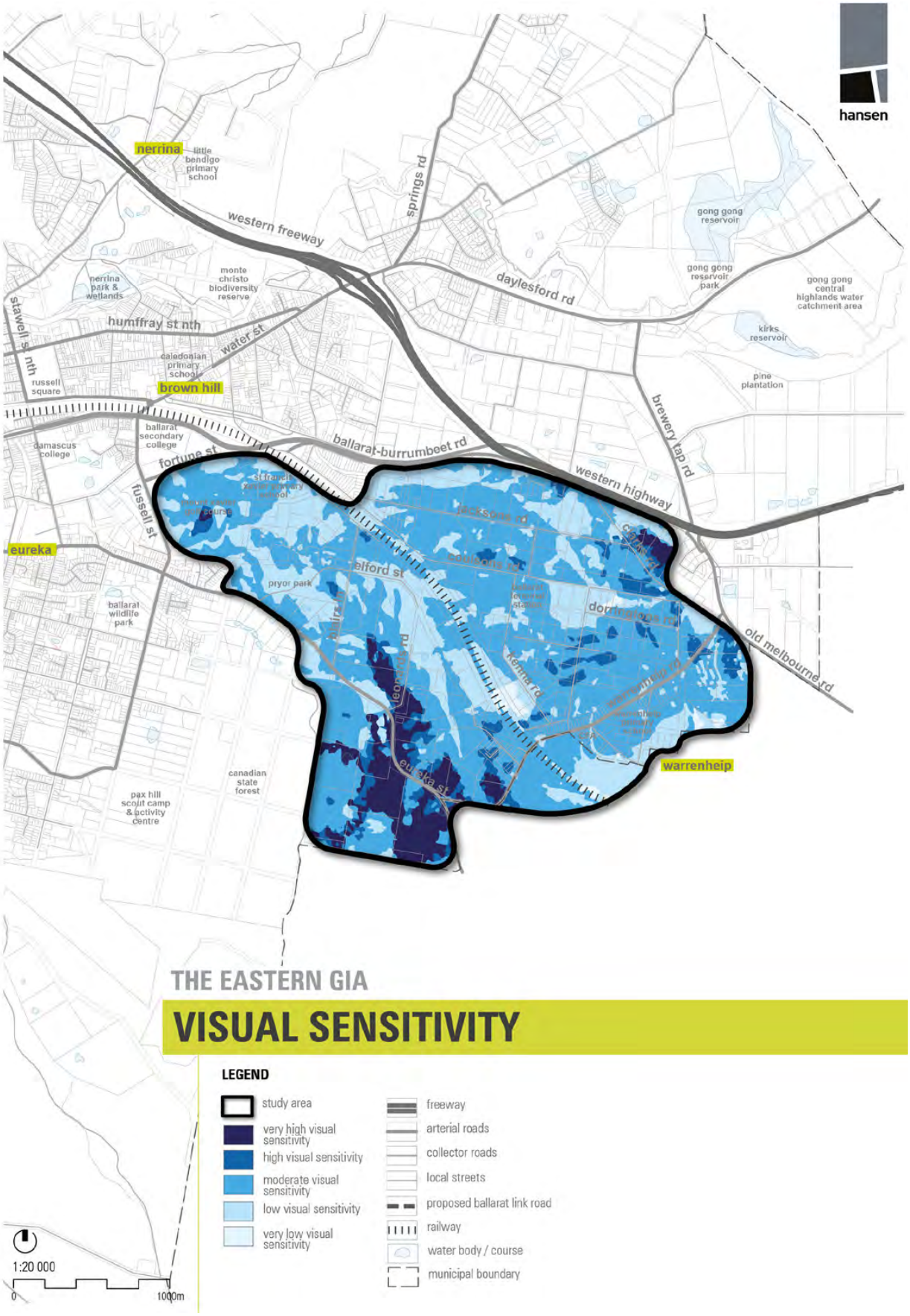
VISUAL SENSITIVITY MAPPING

Proceeding from the overlaying of areas of landscape value and areas with of visual exposure, levels of visual sensitivity have been mapped accordingly on the opposite page.

Regarding views and visual sensitivity, it should be noted that this mapping is based on visual exposure, which maps areas of visible terrain from a point regardless of the nearby on-ground obstacles such as vegetation and buildings. Fieldwork identified that these obstacles often obscured views to terrain in the study area identified by the viewshed mapping. As a result of the ever changing nature of these on-ground obstacles, for example removal of trees and houses, it was deemed suitable to base the visual exposure mapping which informs the visual sensitivity mapping on the results of the viewshed mapping. This ensures that assigned visual sensitivity ratings will continue to be appropriate in a constantly changing area.

Levels of visual sensitivity have been assigned as either very high, high, moderate, low or very low based what levels of landscape value or visual exposure overlap. This process is further described in the matrix below, where visual sensitivity is shown in the columns shaded in several tones of blue:

	LANDSCAPE VALUE		
VISUAL EXPOSURE	High	Moderate	Low
Very High	*Very High*	*Very High*	*High*
High	*Very High*	*High*	*Moderate*
Moderate	*High*	*Moderate*	*Moderate*
Low	*Moderate*	*Moderate*	*Low*
Limited	*Moderate*	*Low*	*Low*
None	*Moderate*	*Low*	*Very Low*



THE EASTERN GIA

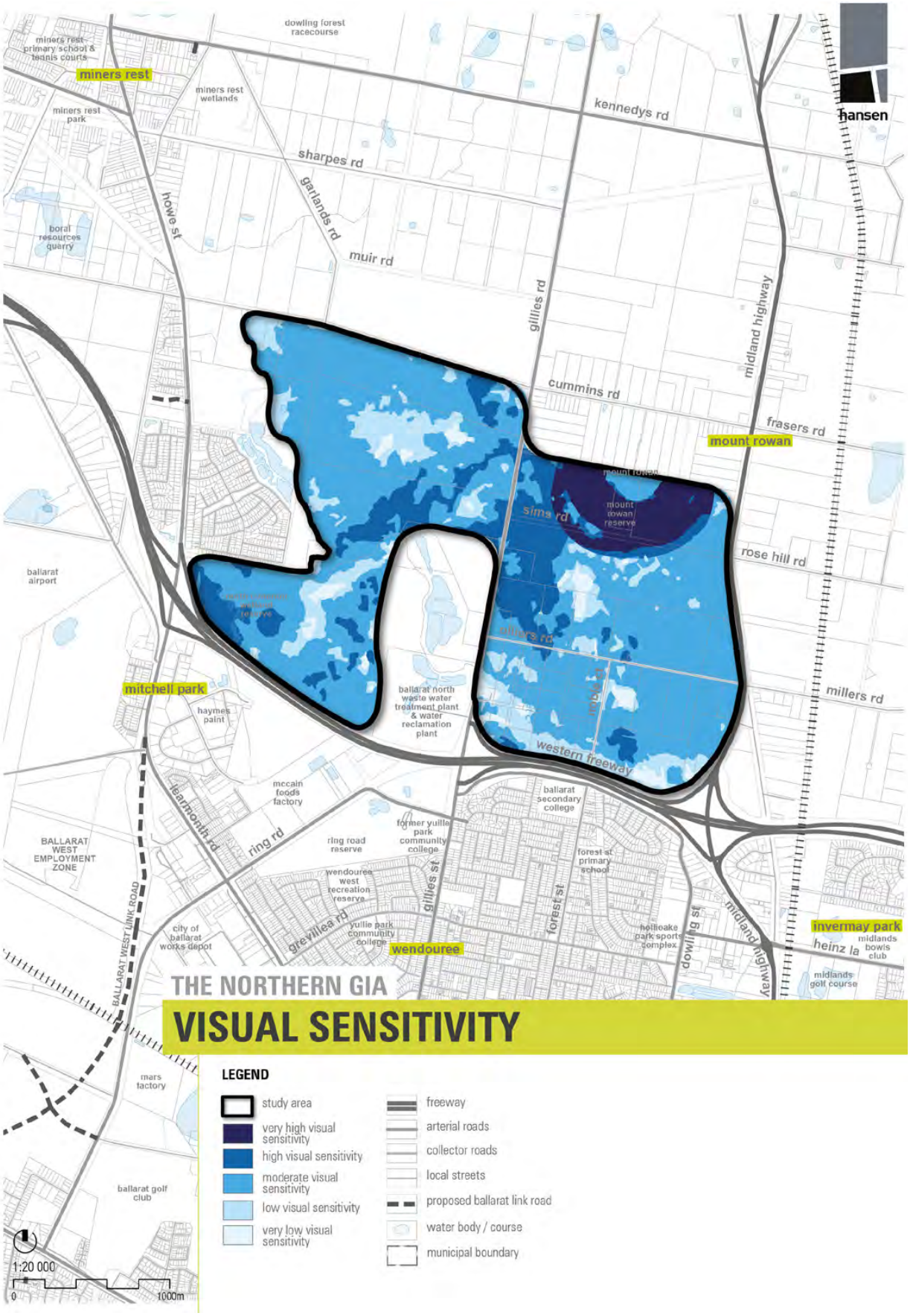
VISUAL SENSITIVITY

LEGEND

- study area
- very high visual sensitivity
- high visual sensitivity
- moderate visual sensitivity
- low visual sensitivity
- very low visual sensitivity
- freeway
- arterial roads
- collector roads
- local streets
- proposed ballarat link road
- railway
- water body / course
- municipal boundary

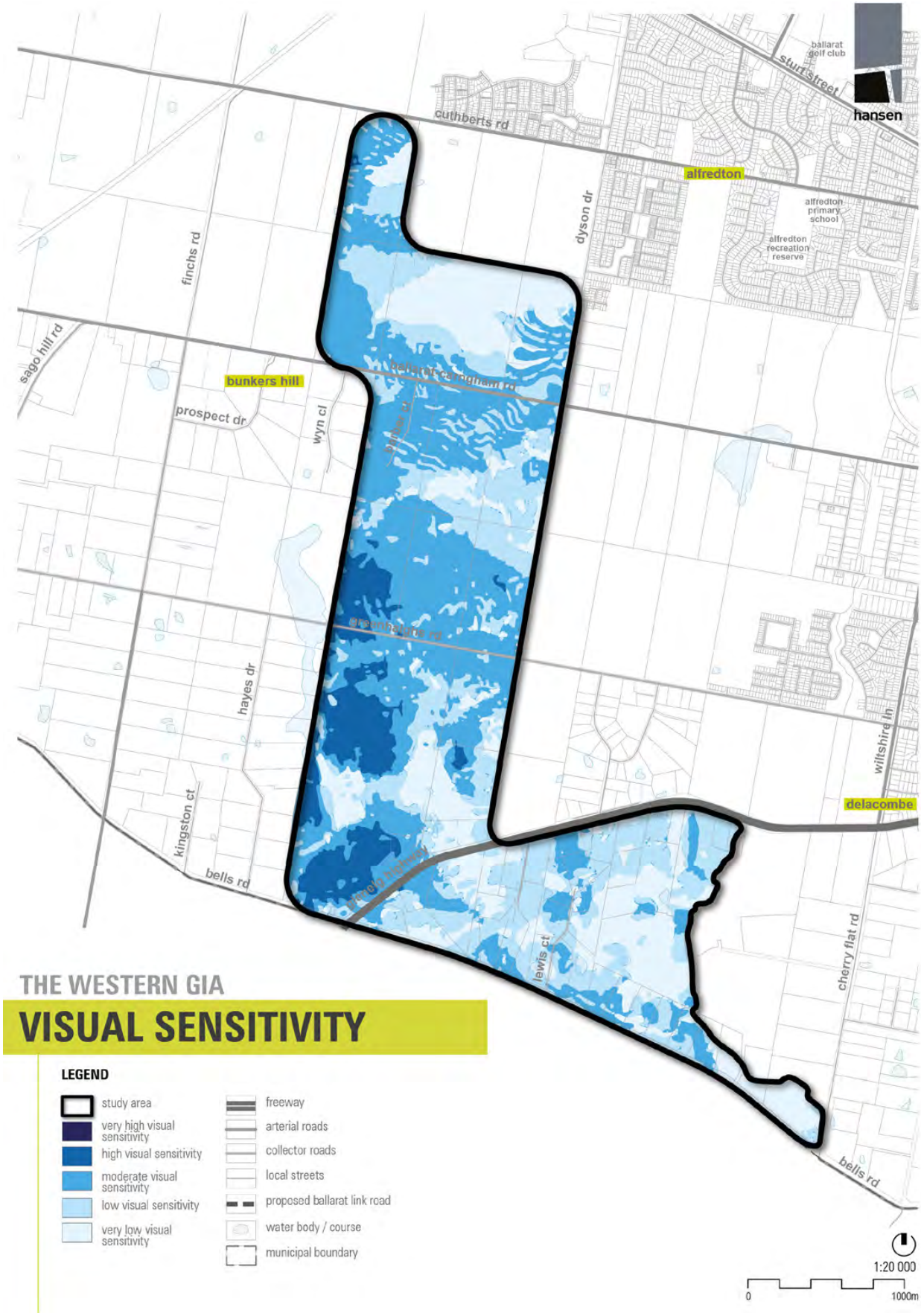
EASTERN GIA – VISUAL SENSITIVITY

- Very high visual sensitivity afforded to the elevated areas adjoining Eureka Street. This is due to the moderate landscape value associated with the 'Undulating Rural', and to a lesser extent the highly valued 'Bushland', landscape character areas and the very high degree of visual exposure on this elevated area.
- Although of relatively low landscape value, areas of 'Rural Township' around Warrenheip were typically identified with a moderate level of visual sensitivity, primarily due to the high visual exposure of the elevated plateaus as visible from numerous vantage points.
- For low lying areas in the north and western extents of the GIA a moderate to low visual sensitivity was afforded, despite the moderate level of landscape value afforded to the 'Undulating Rural' or 'Rural Bushland' areas. This is due to the prevailing low level of overall visual exposure, created by the undulating terrain which serves to constrain views.


hansen
THE NORTHERN GIA
VISUAL SENSITIVITY
LEGEND
study area
very high visual sensitivity
high visual sensitivity
moderate visual sensitivity
low visual sensitivity
very low visual sensitivity
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
water body / course
municipal boundary
1:20 000
0
1000m
miners rest
mount rowan
mitchell park
wendouree
invermay park
kennedys rd
sharpes rd
garlands rd
muir rd
howe st
gillies rd
midland highway
cummins rd
frasers rd
sims rd
rose hill rd
millers rd
western freeway
learmonth rd
ring rd
gillies st
forest st
dowling st
grevillea rd
heinz la
ballarat airport
BALLARAT WEST EMPLOYMENT ZONE
BALLARAT WEST LINK ROAD
ballarat golf club
mars factory
city of ballarat works depot
mccain foods factory
haymes paint
ballarat north waste water treatment plant & water reclamation plant
ballarat secondary college
forest st primary school
former yulli park community college
ring road reserve
wendouree west recreation reserve
yulli park community college
holleoake park sports complex
midlands bowls club
midlands golf course
dowling forest racecourse
miners rest primary school & tennis courts
miners rest wetlands
miners rest park
boral resources quarry
mount rowan reserve

NORTHERN GIA – VISUAL SENSITIVITY

- Land around and comprising Mount Rowan has been designated with a predominantly very high level of visual sensitivity. This was due to the combination of high value placed on the significant landscape feature, and that it has a very high level of visual exposure due to its elevated nature. Hence, it is visible from a number of viewpoints and forms the backdrop to many views in the Northern GIA.
- High visual sensitivity is present in the central raised area as was visible from numerous viewpoints across the flatter terrain, despite being of relatively low landscape value.
- Predominantly moderate visual sensitivity is present across the western and eastern extents of the study area, with localized patches of high, low and very low. This is predominantly due to the high and moderate visual exposure across much of the study area, as open views are afforded across the flatter terrain and the pasture areas are typically visible from more than one vantage point. This is despite much of the study area having a relatively low landscape value.


hansen
ballarat golf club
sturt street
cuthberts rd
alfredton
dyson dr
alfredton primary school
alfredton recreation reserve
finchs rd
sago hill rd
bunkers hill
prospect dr
wyn cl
greenhills rd
hayes dr
kingston ct
bells rd
wiltshire ln
delacombe
lewis ct
cherry flat rd
bells rd
THE WESTERN GIA
VISUAL SENSITIVITY
LEGEND
study area
very high visual sensitivity
high visual sensitivity
moderate visual sensitivity
low visual sensitivity
very low visual sensitivity
freeway
arterial roads
collector roads
local streets
proposed ballarat link road
water body / course
municipal boundary
1:20 000
0
1000m

WESTERN GIA – VISUAL SENSITIVITY

- Low to moderate visual sensitivity is present in the majority of the 'Plains' area north of Glenelg Road, with lower visual sensitivity afforded to relatively more elevated areas of the northern and eastern extents of the study area. This is afforded by the relatively low landscape value of the area and the limiting effect that the slightly undulating terrain has on views to more elevated areas.
- There are several areas of high visual sensitivity in the lower-lying areas in the south western extents of the study area. As the GIA is of a uniformly low landscape character, this is primarily due to the high visual exposure of these areas due to their prevalence in views from the more elevated hillsides.
- Constrained view lines in the slightly more undulating 'Rural Plains' landscape character area were the primary factor in the assignment of a predominantly low to very low visual sensitivity throughout this area, which is designated with a low landscape value.
- It should also be noted that there were no areas of very high visual sensitivity identified in this study area, with an overall predominance of low and moderate visual sensitivity.

7. CONCLUSION

The landscape assessment presented in the previous sections demonstrates a process through which the following visual and landscape facets of the three GIAs were identified and assessed:

- **LANDSCAPE CHARACTER**
- **VIEWS AND VIEWSHEDS**
- **VISUAL EXPOSURE**
- **LANDSCAPE VALUES**
- **VISUAL SENSITIVITY.**

The following presents a summary of this process and resultant findings. Following from this, broad recommendations have been developed as a conclusion to the landscape assessment.

LANDSCAPE CHARACTER

From a combination of fieldwork and desktop assessment, the following landscape character areas were identified within each GIA:

EASTERN GIA

- Undulating Rural - Land to the west of the GIA with undulating terrain, established native / exotic vegetation and numerous rural allotments.
- Rural Bushland – Land to the north of the GIA with a predominance of established native bushland vegetation set within undulating hills, accompanied by numerous rural allotments and dwellings.
- Bushland – Land to the south west of the GIA, including small areas of bushland set on undulating hills which is
- Rural Township – Land to the south east of the GIA, including the more developed, semi-rural areas of Warrenheip and the Ballarat Terminal Station.

NORTHERN GIA

- Plains – Sparsely vegetated and low-lying land north of the Western Freeway in the south western extents of the GIA.
- Rural Pasture – This character area comprises most of the flatter, rural land within the Northern GIA.
- Elevated Pasture – Land on which Mount Rowan is situated.

WESTERN GIA

- Plains - Sparsely vegetated, relatively flat and low-lying land north of the Glenelg Highway.
- Plains Rural Living – Sparsely vegetated, relatively flat and low-lying land south of the Glenelg Highway, with a higher frequency of rural living allotments.

LANDSCAPE VALUES

These landscape character areas were subsequently assigned with a landscape value, the designation of which was formulated through an assessment based on established approaches as outlined in benchmarking documents and Hansen Partnership's professional experience with similar projects. The rationale for the value designation is described in detail in the body of the landscape assessment report.

EASTERN GIA

- High Landscape Value: Bushland.
- Moderate Landscape Value: Undulating Rural and Rural Bushland.
- Low Landscape Value: Rural Township.

NORTHERN GIA

- High Landscape Value: Elevated Pasture.
- Low Landscape Value: Plains and Rural Pasture.

WESTERN GIA

- Low Landscape Value: Plains and Plains Rural Living.

VISUAL EXPOSURE

Through an analysis of views within and near to the GIAs demonstrated in the viewshed and views assessment, a picture of visual exposure, or what areas of the study area are more visible than others, was created. For the each of the GIAs, general trends of visual exposure included the following:

EASTERN GIA

- Areas of very high visual exposure on the elevated plateaus in the eastern and southern extents of the study area.
- Lower visual exposure (generally none to moderate) was afforded to the lower-lying areas, created by the undulating terrain which constricts views to a relatively immediate area.

NORTHERN GIA

- Generally, moderate to high visual exposure is present across the study area. This is afforded via distant views across the flatter and mildly undulating terrain of the Northern GIA. Fieldwork revealed vegetation occasionally constrained these views, but views were generally reflective of the viewshed assessment.
- Very high visual exposure was identified on the elevated terrain of Mount Rowan, which provided the backdrop to numerous views.

WESTERN GIA

- Lower-lying areas on the western extents of the study area afforded the highest level of visual exposure, with areas of very high visual exposure identified. This was afforded via views on the elevated hillsides throughout the 'Plains' area.
- Views near to the 'Plains Rural Living' character area were generally constrained due to undulating terrain.
- Due to a lack of prevailing canopy vegetation, the results of the fieldwork and viewshed were generally supportive of each other.

VISUAL SENSITIVITY

Areas of landscape value and visual exposure have been overlaid to explore their visual sensitivity, or the ability of a specific area to accommodate change. Landscapes with a higher visual sensitivity generally have a lower threshold beyond which changes in the landscape start to detrimentally impact on the value/ significance of that landscape. Visually sensitive landscapes for each of the GIAs are as follows:

EASTERN GIA

- Very high visual sensitivity afforded to the elevated areas adjoining Eureka Street.
- Although of relatively low landscape value, areas of 'Rural Township' around Warrenheip were typically identified with a moderate level of visual sensitivity.
- For low lying areas in the north and western extents of the GIA a moderate to low visual sensitivity was afforded.

NORTHERN GIA

- Land around and comprising Mount Rowan has been designated with a predominantly very high level of visual sensitivity. As it is visible from a number of viewpoints and forms the backdrop to many views in the Northern GIA.
- High visual sensitivity is present in the central raised area as was visible from numerous viewpoints across the flatter terrain.
- Predominantly moderate visual sensitivity is present across the western and eastern extents of the study area, with localized patches of high, low and very low. This is predominantly due to the high and moderate visual exposure across much of the study area.

WESTERN GIA

- Low to moderate visual sensitivity is present in the majority of the 'Plains' area north of Glenelg Road, with lower visual sensitivity afforded to relatively more elevated areas of the northern and eastern extents of the study area.
- There are several areas of high visual sensitivity in the lower-lying areas in the south western extents of the study area.
- Constrained view lines in the slightly more undulating 'Rural Plains' landscape character area were the primary factor in its assignment of a predominantly low to very low visual sensitivity.

RECOMMENDATIONS

Recommendations for the three Ballarat GIAs are based on assigned visual sensitivity areas, which are the outcome and synthesis of the landscape assessment. It is acknowledged that this is part of a wider assessment of the suitability of the land within the GIAs for development. However, it is intended that this assessment provide some broad guidance for potential development in these areas on the basis of visual landscape principles.

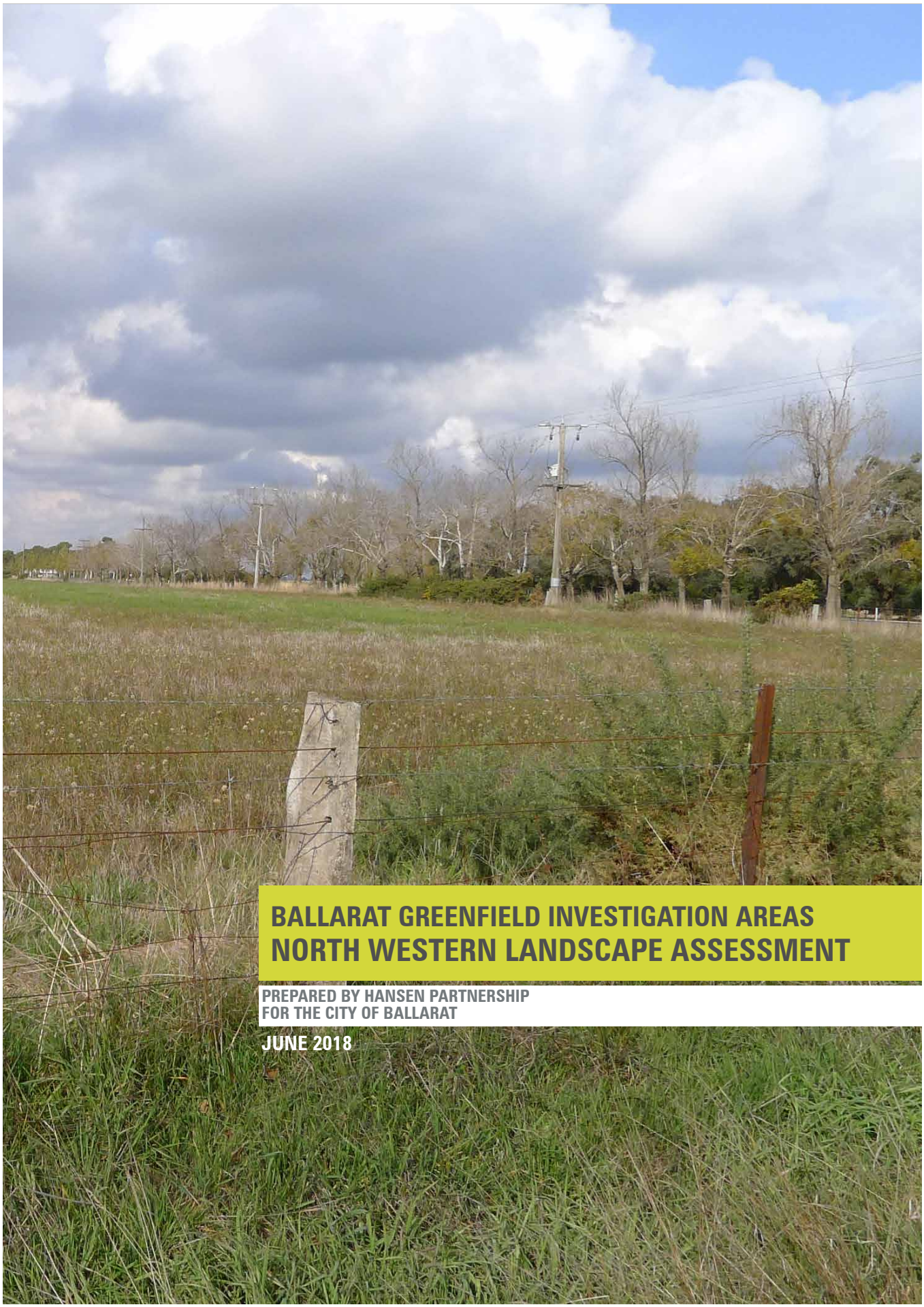
It is also aimed the following provides a broad framework to assist in potentially enhancing the character of areas which were identified as having a somewhat lower landscape value such as the 'Plains' and 'Rural Pasture' areas.

It is important to note that while valued landscapes identified in the Eastern GIA typically have been designated with either a low or moderate visual sensitivity, that they have their own inherent constraints in consideration to potential development, in particular in terms of vegetation, waterways / bodies and topography.

Recommendations based on the landscape assessment with the aim to maintain and enhance existing high quality or visually sensitive landscape areas include the following:

- Specification of lower density development or little to no development (where possible) in areas assigned with either a 'Very High' or 'High' visual sensitivity rating. This is primarily applies to land surrounding Eureka Street in the Eastern GIA and Mount Rowan in the Northern.
- Specification of a height limit for development in or adjacent to 'Very High' or 'High' areas of visual sensitivity in the Northern GIA. In particular, consider further study to designate at an appropriate development threshold and accompanying built form height controls on the land identified as having a very high level of visual sensitivity near and on Mount Rowan. This is to maintain the visual integrity of the significant landscape feature visible in the background of a number of views throughout the Northern GIA.
- Implement a range of built form guidelines that tailor controls suitable to the level of visual sensitivity in a particular area (i.e controls for 'very high' visual sensitivity areas), which focus on reducing the visual impact of development, these could include but not be limited to:
    - Locating of structures / dwellings away from significant view lines, ridgelines or high points, such as the 'forested ridge' identified in 'Mapping Ballarat's Historic Urban Landscape' (Context Pty Ltd, 2013, p 52-54). If located within a significant view line, efforts should be made to make the structure inconspicuous.
    - Development that is designed and sited to reflect the natural topography and complement the landscape character of the area.
    - Development that is of a low to medium scale while maintaining a moderate building footprint within a landscaped setting.

- Consideration to designating areas with a ' Very High' or 'High' visual sensitivity rating as public open space or for non-visually obtrusive public facilities as a means of limiting development and hence any associated visual impact in these sensitive areas. Implementation of such also means that significant views in obtained from these areas remain in the public realm.
- Protect and enhance areas of significant vegetation as a key, valued character element of the study areas, particularly at roadsides, where it references historic land uses and where groups of well-established native vegetation is present. Specific consideration should be given to established vegetation within the Eastern GIA, in the 'Undulating Rural', 'Rural Bushland' and 'Bushland' landscape character areas, as this forms part of the 'forested ridge' identified in 'Mapping Ballarat's Historic Urban Landscape' (Context Pty Ltd, 2013, p 52-54). This is important in consideration of maintaining the appearance of the 'forested ridge' from as viewed from Ballarat.
- Incorporate significant vegetation into proposed allotments, road reserves or open space areas.
- Consideration of the existing landscape character of the area as a guide to the selection of vegetation and the layout of private gardens and public spaces.
- Encourage the maintenance and protection of vegetation cover in the wider study area so it may be strengthened over time. This is to be achieved with the establishment of additional landscaping where applicable of locally appropriate native (ideally) and non-invasive exotic species.
- Development of overtly visible, large-scale utility installations should be avoided. Utilities should ideally be located underground so as to not interfere with existing and proposed landscape features, in particular established vegetation.
- Car parking, formed driveways, access tracks and roads should be visually recessive within the landscape.



BALLARAT GREENFIELD INVESTIGATION AREAS
NORTH WESTERN LANDSCAPE ASSESSMENT

PREPARED BY HANSEN PARTNERSHIP
FOR THE CITY OF BALLARAT

JUNE 2018

CONTENTS

Version	Title	Date	Issuer	Notes / changes
P	Draft Report	16.06.2017	KH	-
A	Final Report	26.06.2017	KH	Internal review
B	Updated Report	22.06.2018	KH	Extended investigation area

1. INTRODUCTION

This report documents the Landscape Assessment undertaken by Hansen Partnership for the North Western Greenfields Investigation Area (GIA).

A prior Landscape Assessment was undertaken by Hansen Partnership in 2015 which considered three other GIAs designated within The Ballarat Strategy (July 2015). Further to this work, the North Western land was designated as a GIA and this report has been prepared to feed in to the assessment and ranking of the four GIAs. This report is prepared in the same format and undertakes the same analysis as the 2015 report.

This Landscape Assessment aims to provide further rigor to the assessment of the North Western GIA in terms of its suitability for future development with respect to visual landscape issues. The methodology for this project is based on Hansen's experience with similar projects and approaches to landscape assessments as outlined in relevant benchmarking documents, specifically: Visual Landscape and Planning in Western Australia, a Manual for Evaluation, Assessment, Siting and Design (November 2007).

Desktop analysis of the study area for items such as planning, access, land use and environmental matters were used to inform this landscape assessment. Additionally, a site inspection specifically for this component of the project was conducted as a basis for this assessment.

The methodology for the project is divided into the following phases:

LANDSCAPE CHARACTER ASSESSMENT

As a starting point, landscape character units will be mapped and assessed based on desktop and field-work analysis.

VIEWSHED ANALYSIS

Using 3D modeling software, it will be determined from where and to what extent the study is visible based on topography. These findings will then be tested against fieldwork, which take into account factors such as vegetation and buildings to determine the on-ground visibility of the GIA.

LANDSCAPE VALUES ASSESSMENT

The identified character areas will be assessed in terms of their relative landscape value, which will be determined predominantly through comparison to benchmarking documents and analysis conducted through field-work.

VISUAL SENSITIVITY ASSESSMENT

Visual sensitivity will then be determined through overlaying the results of the viewshed analysis and landscape values assessment to determine areas most sensitive to change in the North Western GIA. This will formulate the basis for any recommendations for the North Western GIA based on the landscape assessment.

ASSESSMENT OF
2. LANDSCAPE CHARACTER

This section of the report focuses on describing the visual landscape character of the investigation areas as a basis for the landscape assessment by identifying their natural, rural and built characteristics.

The character areas have been defined through a combination of fieldwork and desktop assessments. The planning scheme has been referenced for this assessment, noting that the study area is zoned as Comprehensive Development Zone, Farming Zone, and Special Use Zone. It includes a Significant Landscape Overlay (SLO) applicable to a creek and a number of small Environmental Significance Overlays (ESO). It is also noted that a Heritage Overlay applies to the Remembrance Drive road reserve for the protection of the Ballarat Avenue of Honour. Additionally, the 'Visualising Ballarat' (Federation University Australia and City of Ballarat, 2015, Source: http://www.visualisingballarat.org.au/) online mapping resource has also been referenced.

Another previous study which this Landscape Character Assessment has referenced is 'Mapping Ballarat's Historic Urban Landscape' (Context Pty Ltd, 2013). The Context (2013) report comprises broad scale studies for the entire municipality including a number of indicative character areas which include coverage of the North Western GIA. This Landscape Character Assessment aims to interrogate the landscape characteristics of the North Western GIA in further detail and map this accordingly. Is therefore intended to build on the findings of the Context (2013) report, which have been used as a broad-scale guide for this assessment.

The study area contains consistent land uses and features associated with agricultural farmland, which have an impact on prevailing landscape character. While the 2015 GIA Landscape Assessment identified a number of different character areas due to mixed topography and land use, the North Western GIA is consistent in character and has been determined to have one character area:

1. PLAINS

This character area is shown graphically on the Landscape Character plan. A description of the area follows, accompanied by photographs typical of the specific character area.