FINAL REPORT:

Millers Creek Waterway Action Plan

December 2017

Document history

Revision:

Revision no.	02
Author/s	Elisa Zavadil Joshua Tait Cameron Adams Matt Gibson (Biosis)
Checked	Dom Blackham
Approved	Elisa Zavadil

Distribution:

Revision no.	01
Issue date	25 October 2017
Issued to	Jace Monaghan (WCMA)
Description:	Draft for comment
Revision no.	02
Issue date	4 December 2017
Issued to	Jace Monaghan (WCMA)
Description:	Final report

Citation:
Alluvium (2017). Millers Creek Waterway Action Plan. Report 02 by Alluvium Consulting Australia for Wimmera Catchment Management Authority, 24 Darlot St, Horsham VIC 3400.

Acknowledgements:
The project team would like to thank the following groups and individuals for their input into this study:

WCMA (Jace Monaghan, Luke Austin)
Parks Victoria (Mike Stevens)
Jallukar Landcare
Project Platypus
The Millers Creek community

Ref:
R:\Projects\2017\033_Millers_Creek_Waterway_Action_Plan\1_Deliverables\P117033_R02V01a_Millers_Creek_WAP_FINAL.docx

Contents

Figures

Tables

Abbreviations

Alluvium	Alluvium Consulting Australia Pty Ltd
Biosis	Biosis Pty Ltd
CMA	Catchment Management Authority
Cth	Commonwealth of Australia
DELWP	Department of Environment Land Water and Planning
EVC	Ecological Vegetation Class
GPBCAP	Grampians Pyrenees Biolink Conservation Action Plan
ISC	Index of Stream Condition
NRM	Natural Resource Management
MERI	Monitoring, evaluation, reporting and improvement
Vic	State of Victoria
WAP	Waterway Action Plan
WCMA	Wimmera Catchment Management Authority
WRCS	Wimmera Regional Catchment Strategy 2013 – 2019
WWS	Wimmera Waterway Strategy 2014 – 2022

Glossary

Anabranch	A secondary channel of a waterway that splits from the main channel and later re-joins it.
Confined	Channel planform is controlled by valley margins, with little or no floodplain.
Distributary system	A waterway channel that conveys water away from the main channel and distributes it to another channel or area.
Headcut	Sharp step or small waterfall at the leading edge of a gully as a result of active incision.
Incision	Process of channel deepening and widening.
Riparian zone	Any land that adjoins, directly influences or is influenced by a body of water.
Scour	A form of bank erosion caused by sediment being removed from stream banks particle by particle. Scour occurs when the force applied to a bank by flowing water exceeds the resistance of the bank surface to withstand those forces.
Unconfined	Channel planform is not restricted by valley margins, the channel is free to meander across the floodplain which often results in multiple past and current courses.

1 Background

1.1 Introduction

The Wimmera Catchment Management Authority (WCMA) engaged Alluvium Consulting Pty Ltd (Alluvium) to assist the CMA with an audit of the waterway condition across the Millers Creek catchment, and the development of a Waterway Action Plan (WAP).

Millers Creek is situated in the upper catchment of the Wimmera Basin (Figure 1) and is recognised as a priority reach in the Wimmera Waterway Strategy 2014 – 2022 (WWS) (WCMA 2014). The catchment covers 36.9 km^2, from the Grampian Ranges to the confluence with Mount William Creek. The Millers Creek catchment contains approximately 43 km of waterways, the majority of which are ephemeral. Pomonal is the main township within the catchment.

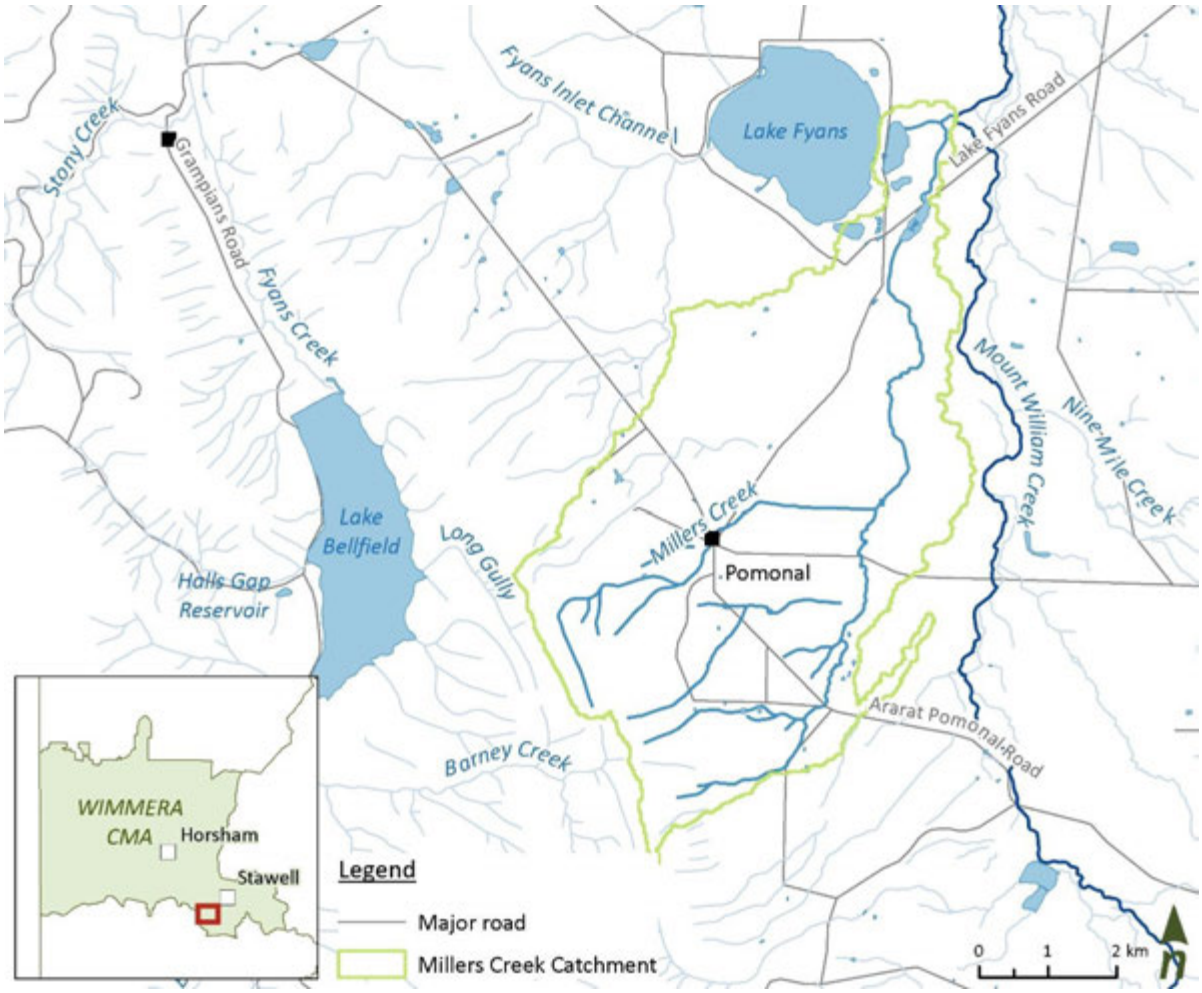


Figure 1. *Millers Creek catchment location*

As caretaker of waterway health, the WCMA develop WAPs to guide management actions and direct the implementation of waterway works across all catchments in the Wimmera region.

The development of a WAP for the Millers Creek catchment was identified as a priority management activity in the WWS. The WAP is closely linked to the objectives, directions and actions stipulated in the WWS, as well as the Wimmera Regional Catchment Strategy 2013 – 2019 (WRCS). The process involved in developing a WAP is important for creating and consolidating partnerships between the CMA, landholders and all stakeholders.

1.2 Project purpose and scope

The purpose of this WAP is to provide a condition assessment of waterways across the Millers Creek catchment, and to develop a prioritised program of management actions to protect and improve river health. Identification of reach-scale issues and the provision of a technical and financial basis for on-ground waterway works to government are important aspects of this WAP.

The scope of the condition assessment for the Millers Creek WAP is focused on desktop data review and extensive on-ground assessment of variables relating to:

- The physical form of the waterways (channel form, sediment movement, and stability)
- The riparian zone (vegetation types, condition, connectivity, fencing extent, and weeds).

The WAP consultation processes has included on-site discussions with landholders, community meetings, and discussions with stakeholder group representatives including Jallukar Landcare, Project Platypus, the WCMA and Parks Victoria.

1.3 Project approach

The approach adopted for the development and delivery of this WAP was based on the WCMA preference for a field-based catchment scale audit focused on channel form and vegetation condition. The WAP development has included the following stages.

Project definition
The project definition phase involved an inception meeting with the WCMA, and the collation and review of background information. Available desktop data (aerials, LiDAR, GIS data) was reviewed and priority areas of on-ground inspections identified.

Field inspections
The field program included four days of inspections in June/July 2017 (13-14 June and 3-4 July 2017). The purpose of the field inspections was to document on-ground observations of the majority of accessible waterway length across the Millers Creek catchment, and meet on-site with landholders.

Field inspections were undertaken by Jace Monaghan (WCMA), Elisa Zavadil (geomorphic processes, Alluvium), Joshua Tait (waterway engineering, Alluvium), and Matthew Gibson (vegetation, Biosis). In addition to documenting on-ground observations, the field inspections provided the project team with an understanding of catchment history and waterway condition from a landholder perspective, and an appreciation for the waterway health works completed to date across the catchment, and landholder perspectives on priority management actions (e.g. fencing and revegetation, weed control).

The majority of waterway length within the catchment was inspected on-ground, and data recorded for fifty-two point locations (sites) (Figure 2).

Condition variables
In addition to the assessment of desktop data, a set of condition variables were recorded on-ground during the field inspections. Riparian fencing was also mapped along left and right banks for the waterways inspected. Observations were logged in an electronic spatial database. The spatial database has been provided to the WCMA in shapefile format and contains the following information:

- Physical condition variables
- Vegetation condition variables
- Extent and condition of riparian fencing

These variables are described in more detail below. A complete list of data collected is provided in Attachment B.

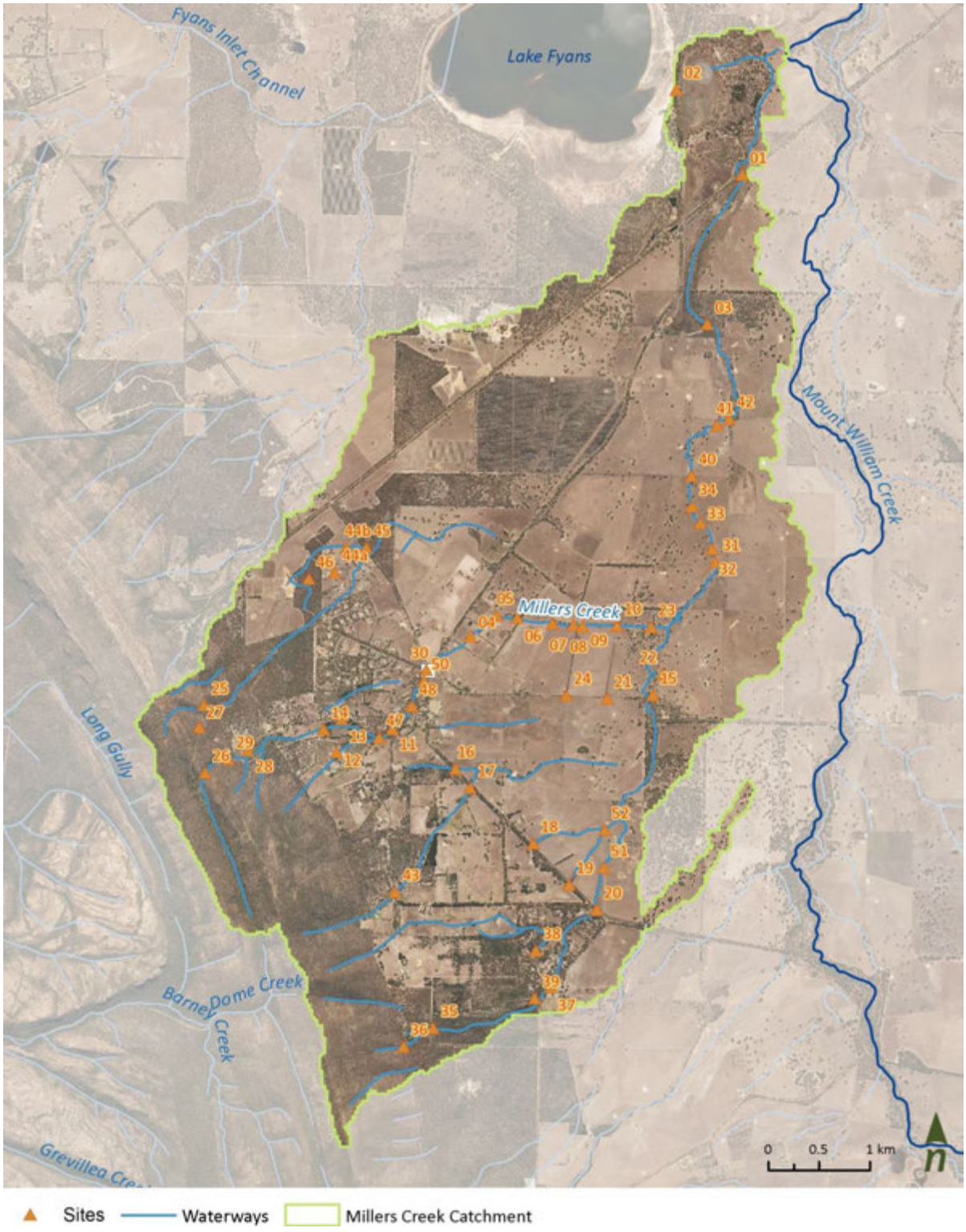


Figure 2. *Millers Creek catchment and data collection sites during June-July 2017 field inspections*

Physical condition

Physical condition variables were recorded during the assessments including aspects of:

1. Channel stability / erosion
    - Channel form
    - Channel stability

    - Geomorphic processes
    - Sediment type
2. Presence and location of existing in-stream structures (grade control, other)
3. In-stream habitat (e.g. large wood, pools)

Vegetation condition
Vegetation condition variables were collected during the assessments, including:

1. Remnant vegetation
2. Past revegetation
3. Continuity of riparian corridors
4. Noxious weeds (including blackberry, spiny emex, serrated tussock, cape tulip etc.)

Fencing and stock access
The presence / absence of fencing was recorded for both side of the waterways across the catchment. Fencing was recorded as either:

- Present both sides
- Present one side only
- Absent
- Absent but not applicable (e.g. in the town areas).

WAP development
The WAP development was based on the collation of desktop data and on-ground observations of environmental values, threats to values, and opportunities to improve waterway health within the Millers Creek catchment. Objectives for management were defined, and prioritised management actions to achieve objectives were developed. Management actions were developed at the site- and reach-scale across the catchment, including indicative cost estimates.

Stakeholder engagement
Several stakeholder presentations and meetings were conducted throughout the WAP development processes. These included two community presentations (July 2017 and Nov 2017), and meetings with representatives from Jallukar Landcare, Project Platypus, and Parks Victoria (July 2017), as well as on-site discussions with individual landholders (June-July 2017). The engagement process provided the project team with a broader understanding of catchment history, past works, catchment values, challenges, and stakeholder perspectives on priority management actions.

Project outputs
Outputs from this WAP provided to the WCMA, in addition to this report, include:

- An excel spreadsheet of on-ground data observations, cross-referenced to site numbers
- An excel spreadsheet of prioritised management actions
- GIS shapefiles of site locations and digitised data (fencing, waterway attributes)
- Georeferenced photos collected during site visits.

1.4 Relevant investigations and plans

There are several documents and investigations that address past condition of the Wimmera catchment and management options for improving river health. These include:

- Geomorphic Categorisation and Stream Condition of the Wimmera River Catchment (Earth Tech 2003)
- Grampians to Pyrenees Biolink Conservation Action Plan (Project Platypus 2016)
- Index of Stream Condition (DNRE 1999 and DSE 2004 and DEPI 2010)
- Regional Riparian Action Plan: Wimmera (DEWLP 2015)
- The Sustainable Rivers Audit 2 (ISRAG 2012)
- Wimmera Invasive Plant and Animal Management Strategy (WCMA 2010)
- Wimmera Regional Catchment Strategy 2013 -2019 (WCMA 2013)
- Wimmera River Geomorphic Investigation (Earth Tech 2001)
- Wimmera Water Quality Strategy (WCMA 2002)
- Wimmera Waterway Strategy 2014-2022 (WCMA 2014)

The documents listed above have been reviewed for this investigation to provide contextual information for the Millers Creek catchment and the greater Wimmera region. The information examines the current condition of the waterways, the environmental values and their corresponding threats, as well as the geomorphic form and processes.

The Millers Creek WAP focuses on a providing a concise overview of the current catchment condition based on current desktop data, field inspections over June-July 2017, in the context of understanding past changes to the catchment. The relevant past investigations and plans listed above provide additional detail on the region. Two of these existing strategies provide particularly important context for the Millers Creek WAP:

- **Wimmera Regional Catchment Strategy (2013 – 2019)**
  This document provides the overarching strategic framework for natural resource management (NRM) within the Wimmera region and aims to ensure a focused, integrated and coordinated direction for all NRM activities. The Regional Catchment Strategy (WRCS) includes twenty year objectives for native vegetation, rivers and streams, threatened plants and animals (etc.), which have been considered during WAP development, in particular during the objective setting phase of the project. Further, these objectives played a pivotal role in guiding the proposed management actions for this project. Importantly, the WRCS integrates with other strategic documents (i.e. the Wimmera Waterway Strategy 2014 – 2022) to improve the outcomes for the entire catchment.
- **Wimmera Waterway Strategy (2014 – 2022)**
  The Wimmera Waterway Strategy (WWS) is the guiding strategic document for the WCMA. The WWS is intended to maintain and where possible improve waterway condition, utilising previous thinking presented in existing strategies and plans. It is considered to be the primary document for community reference in order to understand the long-term approach for the security of the waterway values in the Wimmera region. It directly links to the WRCS as provides the action plan for improving the *rivers and streams* and *wetlands* as natural assets.

  The WWS also focuses on connectivity of riparian corridors, improved water quality outcomes and the high social, cultural and economic values of the region.

1.5 The Millers Creek WAP structure

This WAP is structured as follows:

Section	Content
Section 1	Background
Section 2	Catchment overview
Section 3	Waterway condition assessments
Section 4	Management strategy
Section 5	References
Attachment A	Additional context and vegetation maps
Attachment B	Waterway condition data
Attachment C	Prioritised actions

2 Catchment overview

2.1 Geomorphic context

Waterways and floodplain
The Millers Creek catchment transitions from the steep headwaters of the Grampians Ranges in the upper catchment, through undulating terrain across the mid-catchment, to the extensive lowland floodplain downstream of Pomonal (Figure 3 to Figure 6). The landscape transitions sharply from mid-catchment to the lowland floodplain around Ararat-Pomonal Road.

Figure 3. *Millers Creek catchment view from lower catchment floodplain towards mid and upper catchment (July 2017)*

The main Millers Creek waterway runs through the Pomonal township, and flows north to the confluence with Mount William Creek. Multiple smaller waterways drain the ranges and elevated mid-catchment zone, and either join Millers Creek or dissipate flow across the floodplain. Waterways are ephemeral, with the majority of waterways in the mid-lower catchment reportedly only flowing after large rainfall events every few years. The catchment is ungauged, so there are no record of streamflow.

Geology and sediments
The geology of Millers Creek comprises sandy soils that have eroded and transported from the Grampian Ranges. The Greater Grampians bioregion (upper Millers Creek catchment) is characterised by resistant sandstone forming ranges, and valleys cut into soft shales or deeply weathered granites. The deposits give rise to deep acidic yellow soils and shallow sandy soils.

The Wimmera bioregion (lower Millers Creek catchment) is characterised by relatively flatter terrain that is significantly less incised than the Greater Grampians bioregion. The soil type consists of a lighter sandy loam, and the sandy plain is evident across the lower Millers Creek catchment.

Stream types
Waterway across the upper Millers Creek catchment are predominantly steep headwater streams draining from the ranges. Across the mid-catchment zone, channels are confined (defined bed and banks, no floodplain) or valley-fill morphology (valley line depressions). Across the lower catchment floodplain, waterways are low-sinuosity or meandering sand bed channels, with several of the smaller channels dissipating on the floodplain. Channel form across the floodplain is generally comprised of sandy soils with shallow banks (Sibley 1967, Spencer-Jones 1965). Indicative channel size across the catchment is in the order of 2 – 5 m wide and 0.5 – 1.5 m deep (bankfull channel width and depth). Channels in the mid-catchment zone have the largest capacity (width and depth), before much of the flow dissipates onto the floodplain downstream.

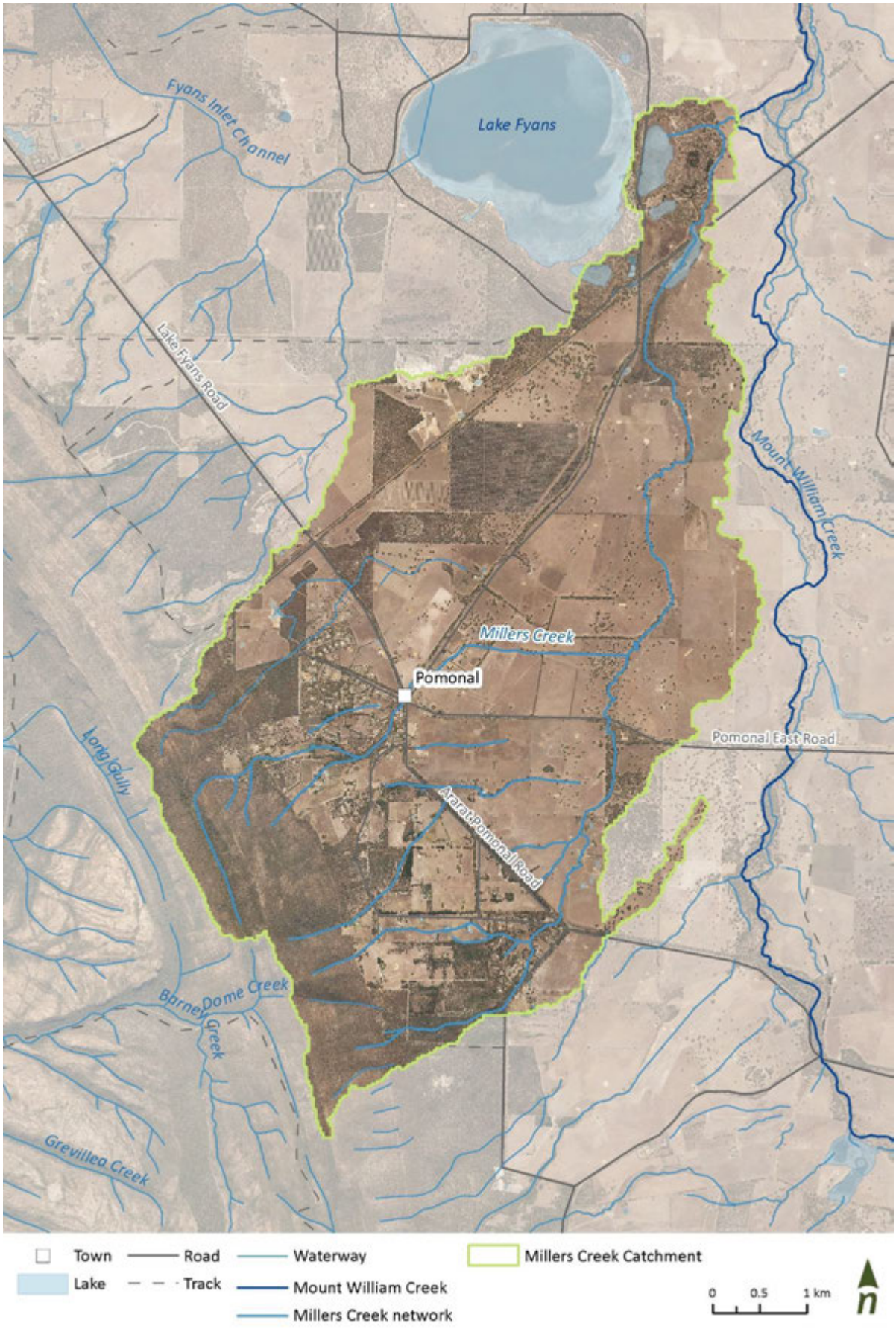


Figure 4. *Millers Creek catchment – aerial image and waterway lines*

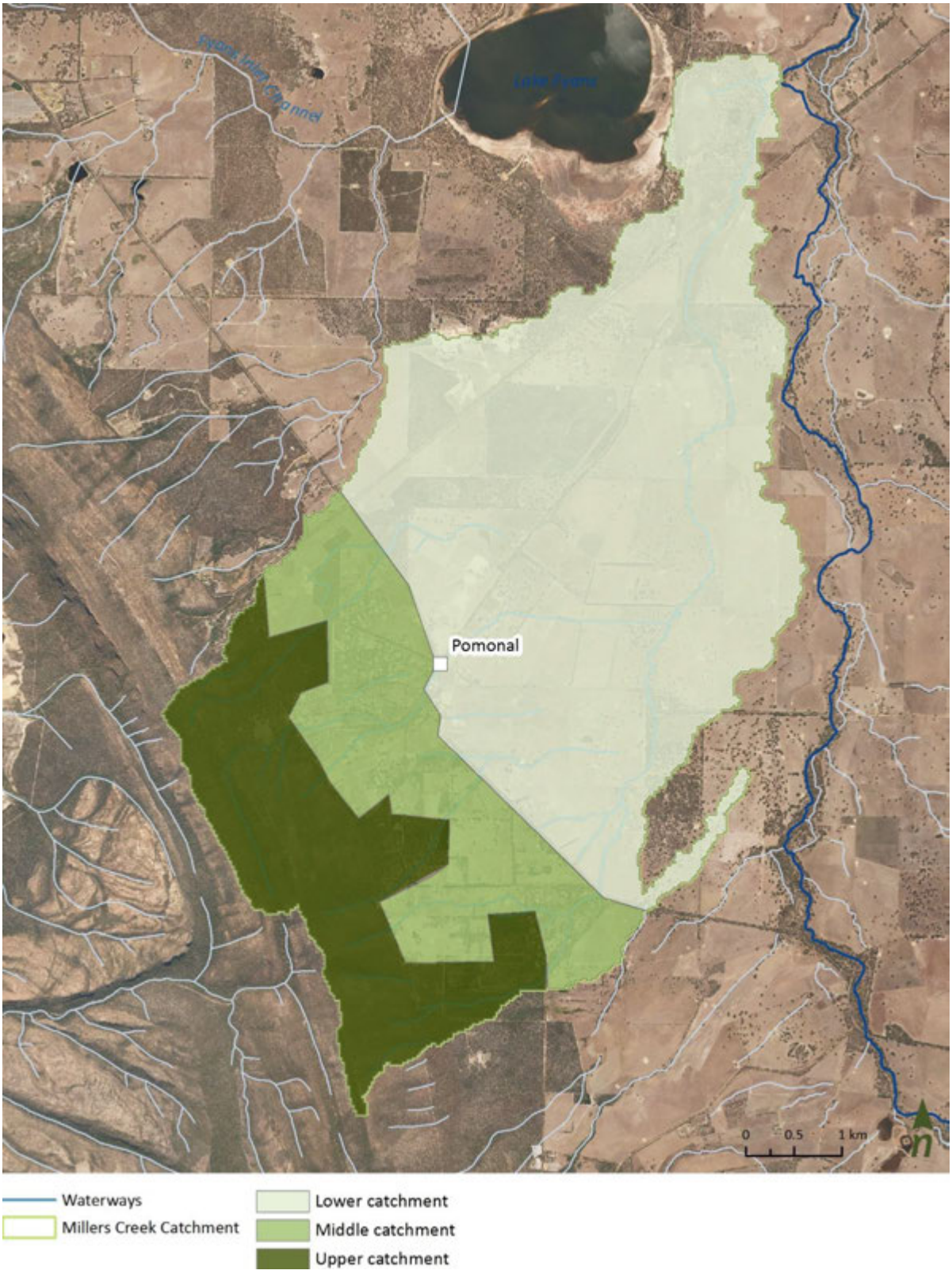


Figure 5. *Catchment delineation map*

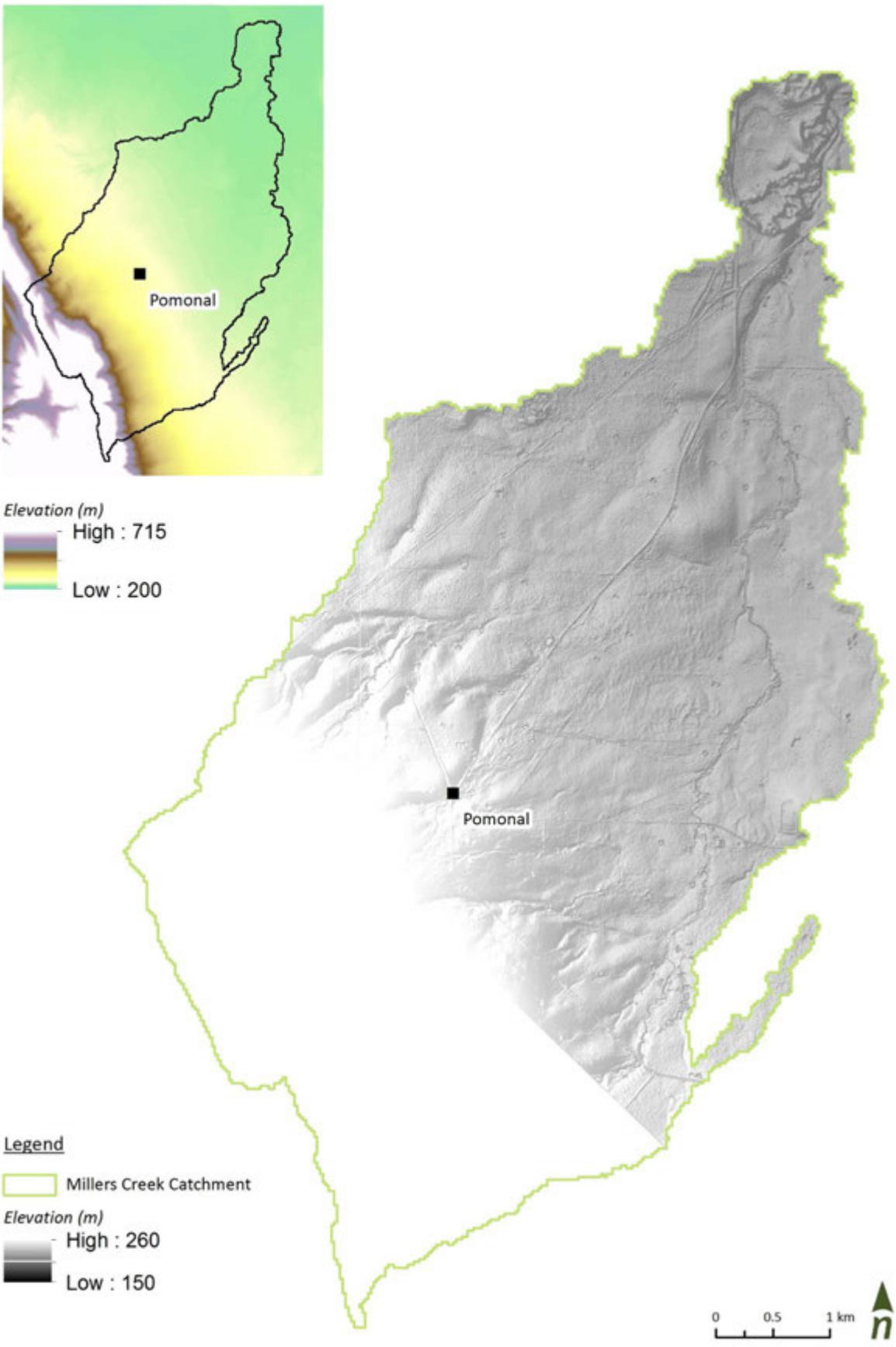


Figure 6. *Millers Creek catchment – LiDAR imagery, with a focus on the lower catchment waterways*

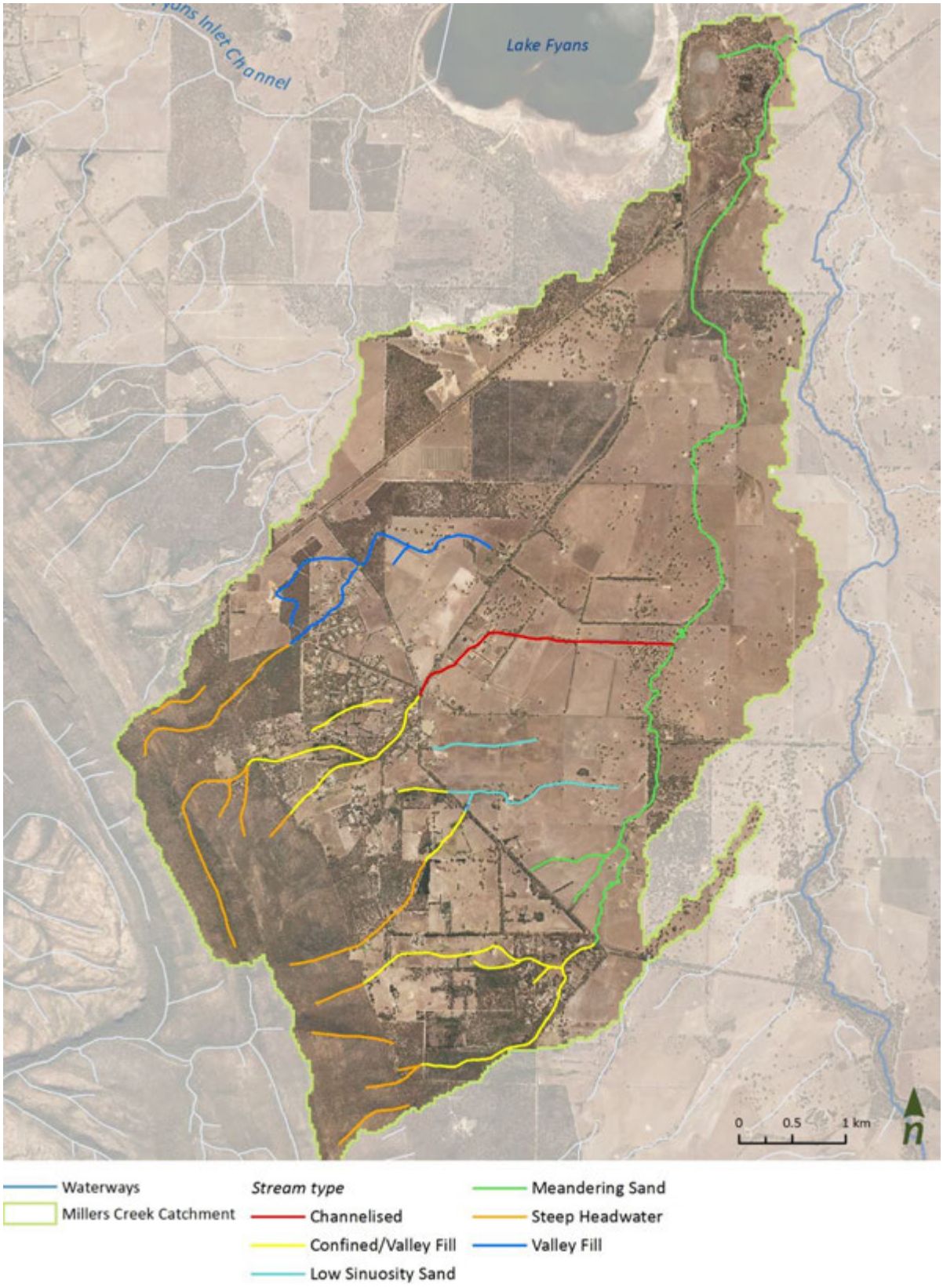


Figure 7. *Millers Creek catchment – stream types*

Channel stability
Overall, waterways across the Millers Creek catchment are relatively stable. Channels in the upper catchment are bedrock controlled, limiting any potential erosion. The low flow channels across the lower catchment zone do shift course over time, however the majority of high flows are dissipated over the floodplain, reducing erosion potential in the channels.

Changing land management practices since European settlement have influenced channel form and stability across the mid-lower catchment. It is evident from the aerial imagery and LiDAR that the section of Millers Creek immediately downstream of Pomonal has previously been channelised (i.e. straightened, created/modified channel) (Figure 4, Figure 6). As many of the minor streams running off the mid-catchment zone dissipate onto the floodplain, it is likely that historically the reach of Millers Creek in this zone was also a distributary stream. Channelisation of this reach may have been undertaken to direct and control the flow during the larger flood events. Channelisation of waterways is a common trigger for initiating incision (deepening and widening) along the upstream reaches, as a result of a shorter flow path, steeper downstream bedslope and higher velocities. For Millers Creek, moderate channel incision is evident upstream of the channelised reach, through and upstream of the Pomonal township.

2.2 Catchment landuse

Historical changes and pressures
There have been many significant changes in landuse across the Millers Creek catchment since European settlement. Changes in farming practices (plantations to grazing), droughts, bushfires and pest species (rabbits in particular) have had a range of environmental, social and economic impacts on the catchment. Figure 8 provides a snapshot of historical land use change in the Millers Creek catchment.

Between the late 1880s and 1940s there was a spike in rabbit populations and a series of rabbit plagues - the most notable occurring post-World War II. Rabbit plagues were largely controlled with the introduction of the myxoma virus in the 1950s. Fruit tree and tobacco plantations were initially introduced within the region; however, these industries saw a decline in operation towards the 1940s following droughts and the Black Friday bushfires. Since then catchment land use has largely been rural residential across the foothills with mixed grazing and farming along the lowland plains. The recent Black Saturday bushfires in February 2009 had a major impact on landholders in the catchment, and landholders report that some business have not yet fully recovered.

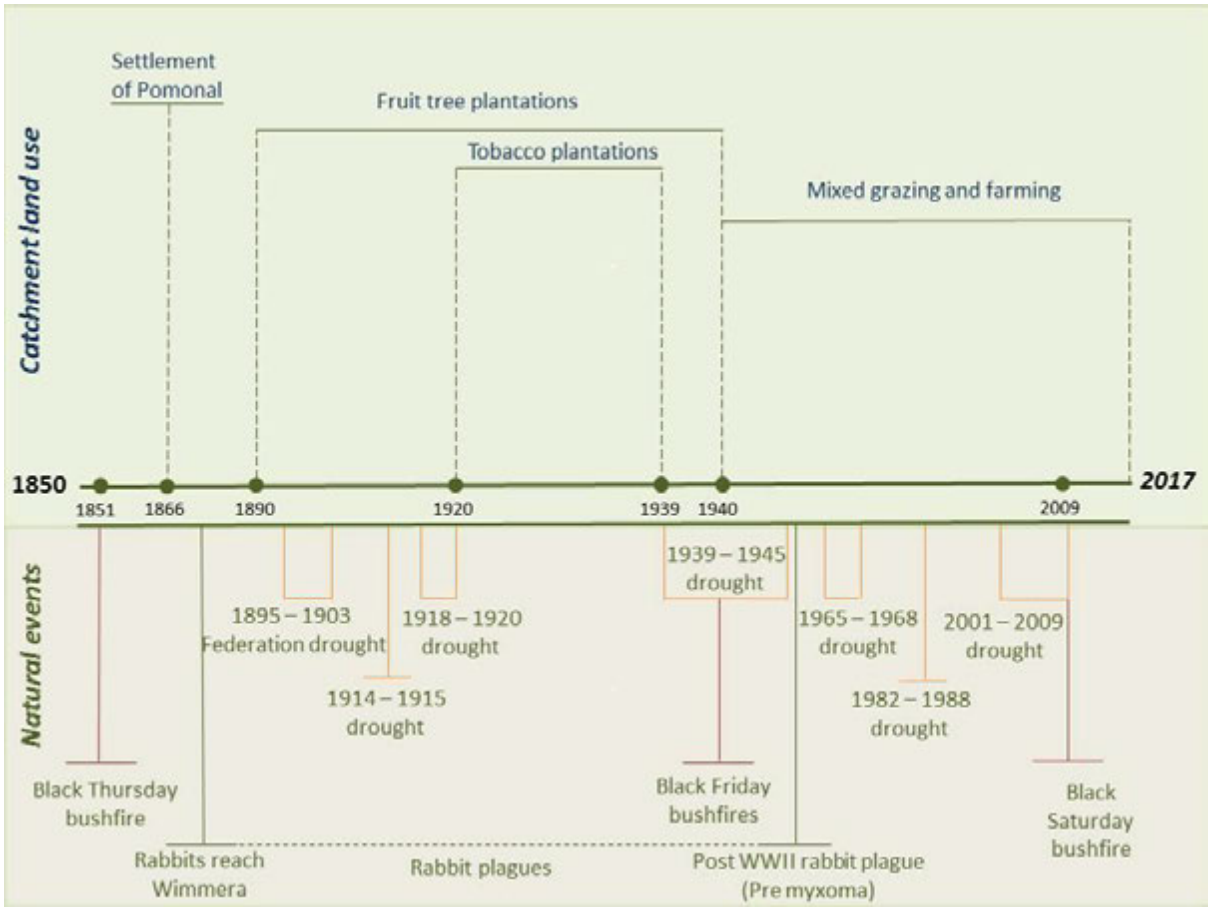


Figure 8. *Historical catchment land use change, extreme climatic events and pest infestations within the Millers Creek catchment*

Current landuse

The majority of the mid and lower catchment is used for mixed farming, cropping and grazing, with residential housing concentrated around the township of Pomonal and across the mid-catchment zone (Figure 9). The intensity of grazing is relatively low, with many landholders no longer actively farming the land, and/or residing only part-time.

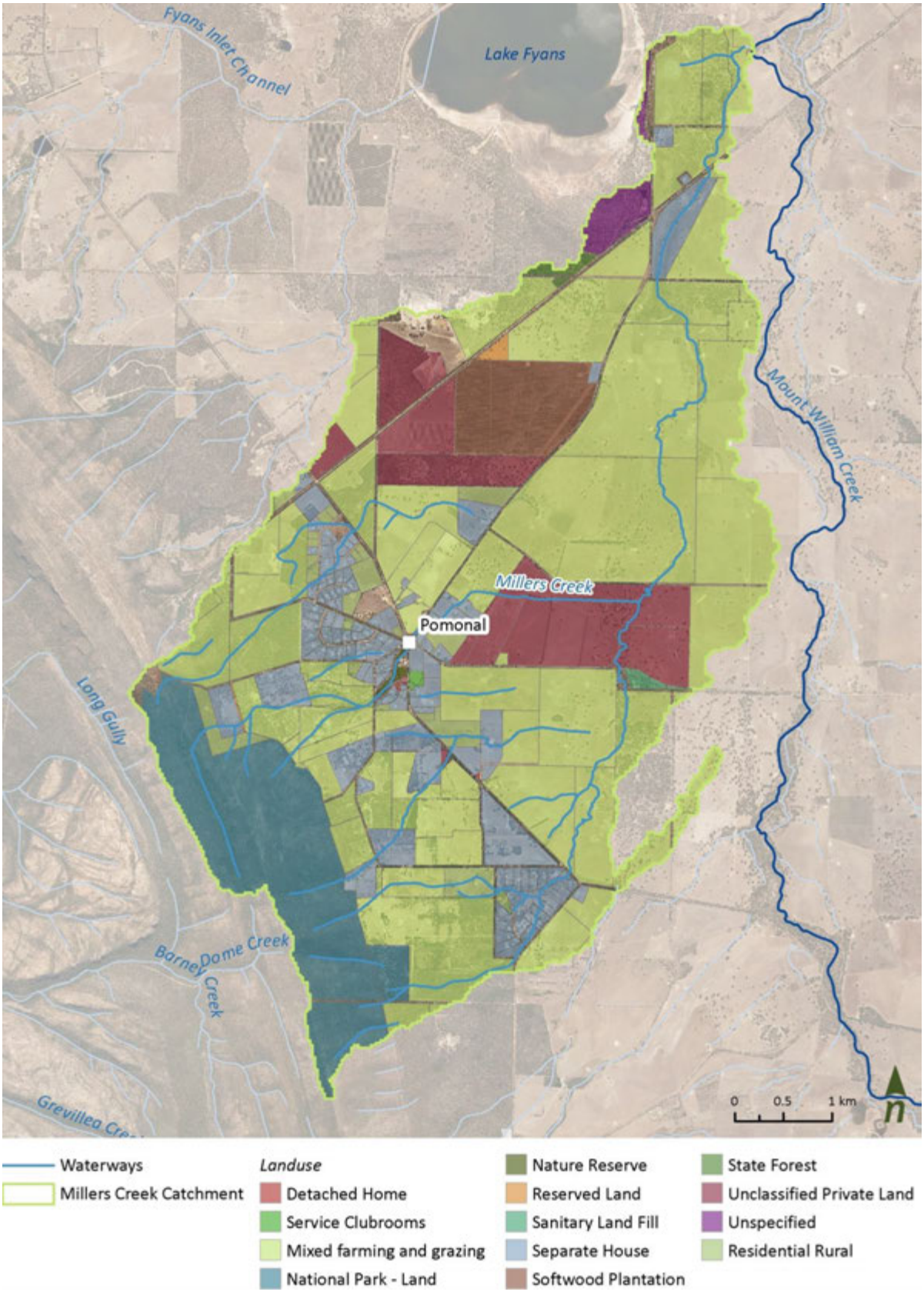


Figure 9. *Land use in the Millers Creek catchment (information provided by WCMA)*

2.3 Flora and fauna

The Millers Creek catchment is located on the eastern flank of the Grampians Range and includes sections of the Grampians National Park. Areas to the south and west of Pomonal (the Upper Catchment) support extensive remnant native vegetation, but as the creek drops onto the plains within the middle and lower Catchment, native vegetation becomes more sparse and is typically associated with road reserves, riparian corridors and blocks of public land. The middle and lower catchments are extensively cleared for agriculture, but some areas continue to support scattered paddock trees and patches of woodland.

As noted previously, the two bioregions spanning the catchment are:

- Greater Grampians Bioregion: includes the upper catchment and the south-western portion of the middle catchment
- Wimmera Bioregion: includes the lower catchment and the north-eastern portion of the middle catchment.

Within the Wimmera Bioregion, the most extensive Ecological Vegetation Class (EVC) is Plains Grassy Woodland, which typically supports an overstorey of River Red Gum *Eucalyptus camaldulensis*, and a grassy understorey (Table 1, Figure 1). Within the Greater Grampians Bioregion, the sandy and rocky soils support a diverse range of EVCs, with Heathy Woodland, Damp-Sands Herb-rich Woodland, Shrubby Woodland and Valley Grassy Forest occurring over much of the area. The upper slopes of the catchment, within the Grampians National Park, contain extensive areas of Rocky Outcrop Shrubland. Additional vegetation maps are provided in Attachment A.

Table 1. Ecological Vegetation Classes within the Millers Creek Catchment

Bioregion	EVC name	Bioregional Conservation Status	Area (ha)
Wimmera	Damp Sands Herb-rich Woodland	Vulnerable	56
	Plains Grassy Woodland	Endangered	359
	Shallow Freshwater Marsh	Vulnerable	8
	Shrubby Woodland	Least Concern	0
	Red Gum Swamp	Vulnerable	5
	Deep Freshwater Marsh	Endangered	20
	Lateritic Woodland	Vulnerable	107
	Shallow Sands Woodland	Vulnerable	36
Greater Grampians	Damp Sands Herb-rich Woodland	Least Concern	98
	Lowland Forest	Least Concern	0
	Grassy Dry Forest	Depleted	67
	Heathy Dry Forest	Least Concern	51
	Herb-rich Foothill Forest	Depleted	13
	Rocky Outcrop Shrubland	Least Concern	221
	Valley Grassy Forest	Vulnerable	126
	Heathy Woodland	Least Concern	284
	Plains Grassy Woodland	Vulnerable	1
	Rocky Outcrop Shrubland/Rocky Outcrop Herbland Mosaic	Least Concern	10
	Rocky Outcrop Herbland	Least Concern	11
	Valley Grassy Forest/Plains Grassy Woodland Complex	Endangered	7
	Shrubby Woodland	Least Concern	203
	Heathy Dry Forest/Valley Grassy Forest Complex	Vulnerable	8
	Lateritic Woodland	Depleted	1

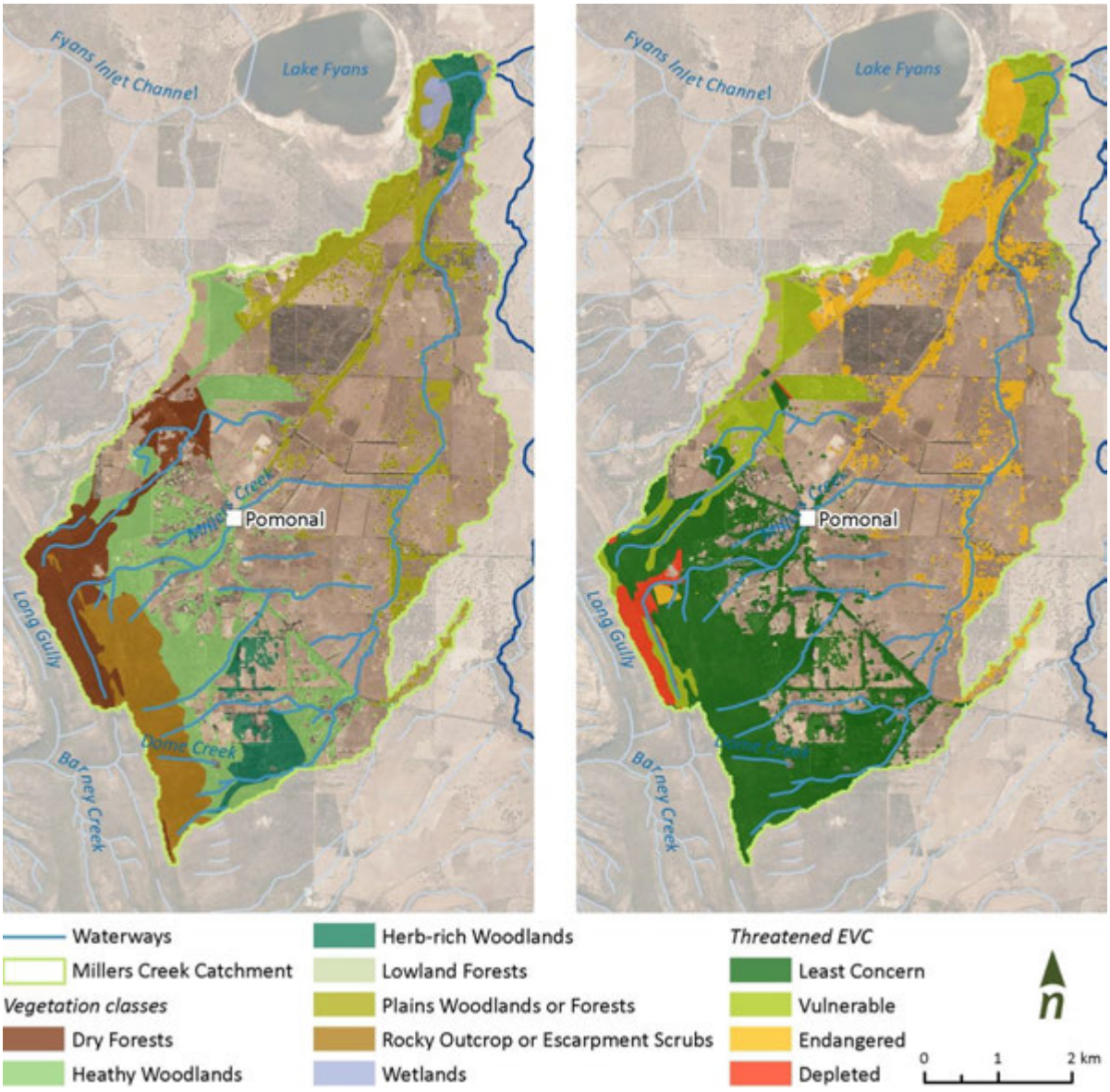


Figure 10. *Vegetation classes and endangered areas in the Millers Creek catchment (EVC 2005)*

Vegetation condition is variable throughout the catchment. Vegetation within the National Park is of high quality, with a high floristic diversity and generally low coverage of weeds. As land use intensifies lower within the catchment the condition deteriorates, with generally lower diversity of understorey vegetation and higher levels of weed infestation, particularly perennial grassy weeds.

Significant flora

The study area and surroundings (5 km buffer area) support a large number of national and state significant flora species. The flora of the Grampians range has a high level of endemism, resulting in a large number of species being listed as rare on the Victorian Advisory lists. The database search area includes records of 46 rare species, 8 vulnerable species and 4 poorly known species. Many of these species, particularly the rare and poorly known species, are largely limited to the Grampians Range and are not considered to be under immediate threat.

The project search area also includes records of nine nationally threatened species, listed under the *Environment Protection and Biodiversity Conservation Act 1999*. These are:

- Elegant Spider-orchid *Caladenia formosa* (Vulnerable)

- Candy Spider-orchid *Caladenia versicolor* (Vulnerable)
- Grampians Bitter-pea *Daviesia laevis* (Vulnerable)
- Trailing Hop-bush *Dodonaea procumbens* (Vulnerable)
- Clover Glycine *Glycine latrobeana* (Vulnerable)
- Grampians Rice-flower *Pimelea pagophila* (Vulnerable)
- Pomonal Leek-orchid *Prasophyllum subbisectum* (Endangered)
- Metallic Sun-orchid *Thelymitra epipactoides* (Endangered)
- Spiral Sun-orchid *Thelymitra matthewsii* (Vulnerable)

Most of these species prefer woodlands on sandy soils with a heathy understorey, and are therefore not likely to be associated with riparian corridors. Heathy woodlands within the catchment support known populations of Elegant Spider-orchid (south-west of Pomonal), Candy Spider-orchid (near Lake Fyans) and Metalic Sun-orchid (south-east of Pomonal).

Grampians Bitter-pea is known to occur on the flanks of the Grampians Range, and could occur along riparian sites within the upper catchment. Trailing Hop-bush and Clover Glycine occur within woodlands, potentially including riparian sites within the middle and lower catchment.

Existing revegetation works
Landholders and Landcare networks have undertaken extensive past plantings within sections of the catchment, particularly in the middle catchment. Revegetation zones exist generally as linear areas along drainage lines and fences. Early plantings have utilised native tree species, and more recent plantings have included locally indigenous trees, shrub and some understorey species. These plantations are in a range of condition states, depending on the status of fencing for exclusion of stock. Fenced sites typically show good survival of trees and shrubs, with some signs of ongoing natural regeneration, but these areas can also have high cover of introduced perennial grasses (particularly *Phalaris* spp.) due to the exclusion of grazing.

Weeds
As with all modified agricultural landscapes, the catchment has a range of problem weeds. Some of these were observed during the field inspections, and also highlighted by landholders during the community information sessions:

- **Spiny Rush** *Juncus acutus* subsp. *acutus* occurs along ephemeral waterways, and along the margins of more permanent waterways, as well as low-lying salt affected areas.
- **South African Orchid** *Disa breacteata* is known to occur in the Middle and Upper catchments. This species is a relatively new invasive species to Victoria (first recorded in the 1990's). It is known to occur in heathlands, heathy woodlands and grasslands across Victoria.
- **One-leaf Cape Tulip** *Moraea flaccida* also occurs within the Middle and Upper catchment. As with the South African Orchid, this species can spread into relatively undisturbed vegetation near existing infestations.
- **Sallow Wattle** *Acacia longifolia* occurs in the Upper catchment. This species is indigenous to coastal areas within south-eastern Australia, but has spread widely inland, and is a problem within the Grampians region.
- **Gazania** *Gazania linearis* can invade native vegetation areas, particularly along roadsides and close to source populations within household gardens.
- Perennial grasses, particularly **Toowoomba Canary-grass** *Phalaris aquatica* are common within agricultural landscapes, particularly in the Lower catchment. These species can hamper revegetation efforts, and can become a problem within fenced revegetation areas where grazing is excluded.

The catchment also includes a range of other woody weeds, including Blackberry *Rubus fruticosus* spp. agg., Cootamundra Wattle *Acacia baileyana*, Sweet Briar *Rosa rubiginosa*, Flax-leaf Broom *Genista linifolia*, Gorse *Ulex europaeus*, English Ivy *Hedera helix*, and African Box-thorn *Lycium ferocissimum*.

Significant fauna and pests

The catchment contains a diverse range of fauna habitats, including heathy woodlands, plains woodlands, riparian corridors and wetlands. As with flora, many of the records of threatened fauna species are associated with the Grampians range, although there is also a concentration of significant species records in the lower catchment near Lake Fyans.

The project search area also includes records of nine nationally threatened species, listed under the *Environment Protection and Biodiversity Conservation Act 1999*:

- Growling Grass Frog *Litoria raniformis* (Vulnerable)
- Australasian Bittern *Botaurus poiciloptilus* (Endangered)
- Red-tailed Black Cockatoo *Calyptorhynchus banksii graptogyne* (Endangered)
- Swift Parrot *Lathamus discolor* (Critically Endangered)
- Painted Honeyeater *Grantiella picta* (Vulnerable)
- Southern Brown Bandicoot (eastern) *Isoodon obesulus obesulus* (Endangered)
- Long-nosed Potoroo *Potorous tridactylus tridactylus* (Vulnerable)
- Smoky Mouse *Pseudomys fumeus* (Endangered)
- Heath Mouse *Pseudomys shortridgei* (Vulnerable)

Growling Grass Frog has potential to occur throughout the catchment. Riparian corridors are utilised for movement of this species, and breeding occurs in still or slow moving waters with high cover of floating and emergent aquatic vegetation. The Australian Bittern is also a wetland dependent species, preferring large wetlands with high cover of emergent aquatic vegetation.

Of the three listed bird species, Swift Parrot is the most likely to make regular use of woodland habitat within the catchment, where it may forage on winter flowering eucalypts during the mainland migration period. Red-tailed Cockatoo may occasionally visit Stringybark woodlands to forage on the eucalypt fruit, but this species is unlikely to regularly visit the area. Painted Honeyeater may visit the area to forage on Mistletoe.

The four nationally threatened mammal species all require large blocks of high quality vegetation, particularly heathlands and heathy woodlands. These species may occur within the Grampians National Park section of the catchment, and Southern Brown Bandicoot may inhabit the heathy woodlands near Lake Fyans.

Deer and goat are known to live within the Grampians National Park (and surrounding areas), which includes the upper headwaters of the Millers Creek catchment. Parks Victoria are actively managing the population through a number of programs.

Ecological connectivity

Ecological connectivity is a key driver for regional stakeholders in the area between the Grampians and the Pyrenees Ranges and is therefore a focus of this WAP. The stakeholder interest in this area has spurred on many projects, resulting in the formation of the Grampians to Pyrenees Biolink Conservation Action Plan (Project Platypus, 2016). The vision of the plan is to establish *'[a] healthy and connected landscape between the Grampians (Gariwerd) and the Pyrenees that supports our people and our biodiversity.'* The plan aims to achieve this through numerous objectives, including: providing strategic direction for stakeholder groups, defining and identifying key ecological and functional assets, and highlighting priority functional zones. Within this work the Millers Creek catchment is captured and prioritised in the Grampians Enhancement Zone (Zone 8). As the Millers Creek catchment falls within Zone 8 it has very high conservation value, largely resulting from the close proximity to Grampians National Park and its ability to buffer the National Park from some external

threats. In addition, the plan asserts that the area of intact vegetation within the zone provides significant habitat for arboreal ground-dwelling fauna. For these reasons opportunities to strength this buffer were explored during field inspections (and WAP development generally).

2.4 Existing fencing

As part of this current investigation, the extent of riparian fencing across the catchment has been recorded. Waterways are largely fenced both sides in areas that are at risk of impact from stock or other disturbances (Figure 11). In other areas, mainly the mid-upper catchment, waterways have minimal impact from stock or human access, and so fencing is less critical in these areas (and for the present time deemed not applicable). There is an opportunity now to fill some gaps in the fenced riparian corridors across the mid - lower catchment, with the objective of contributing to improved overall waterway health and enhanced connectivity of these corridors from the upper catchment to the lower catchment.

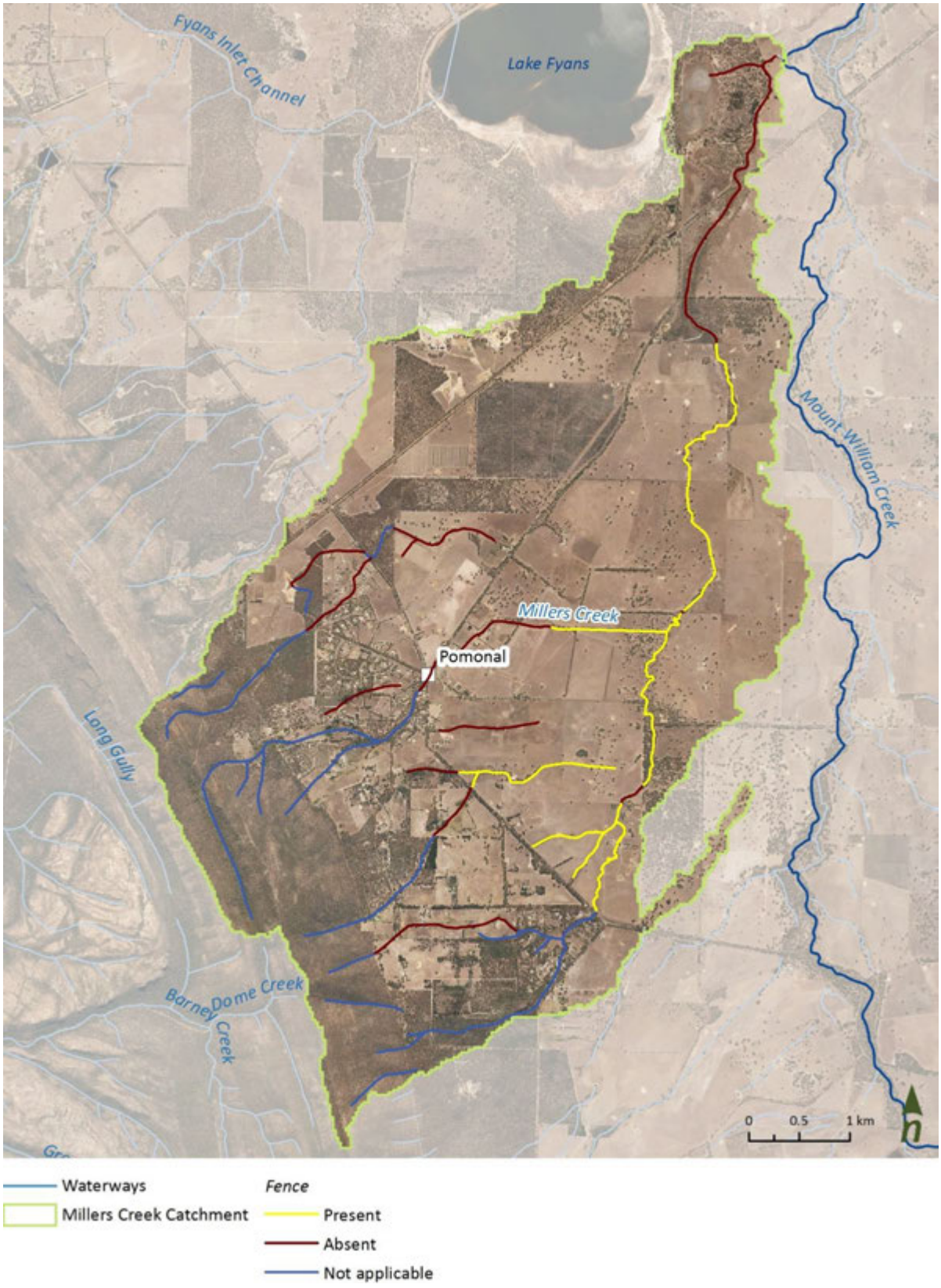


Figure 11. *Indicative fencing status across the Millers Creek catchment*

3 Waterway condition

This section provides an overview of waterway condition across each of the upper, mid and lower catchment zones in the Millers Creek catchment. Observations noted here are based on desktop and field data collected during the assessment. A summary of observations is provided below for each zone, and detailed data is provided in Attachment B and as a spatial database provided with the report.

3.1 Upper catchment

Waterways in the upper catchment (Grampians National Park) are predominantly steep headwaters with bedrock / boulder and cobble bed material (Figure 12 to Figure 14). Several spring soaks are also present draining to the bedrock channels, and providing a localised baseflow (present only in the upper catchment). Access to these waterways is limited, accessible at only a few points by 4WD tracks or on foot through dense bushland. Vegetation communities are largely in very good condition. Fire management and feral animal control (active management programs by Parks Victoria) are the main disturbance factors, periodically impacting sediment loads, native terrestrial and aquatic biota, and vegetation condition.

Figure 12. *Millers Creek upper catchment – view downstream along bedrock controlled steep headwater (site 29)*

Figure 13. *Millers Creek upper catchment – view downstream along bedrock controlled steep headwater (site 36)*

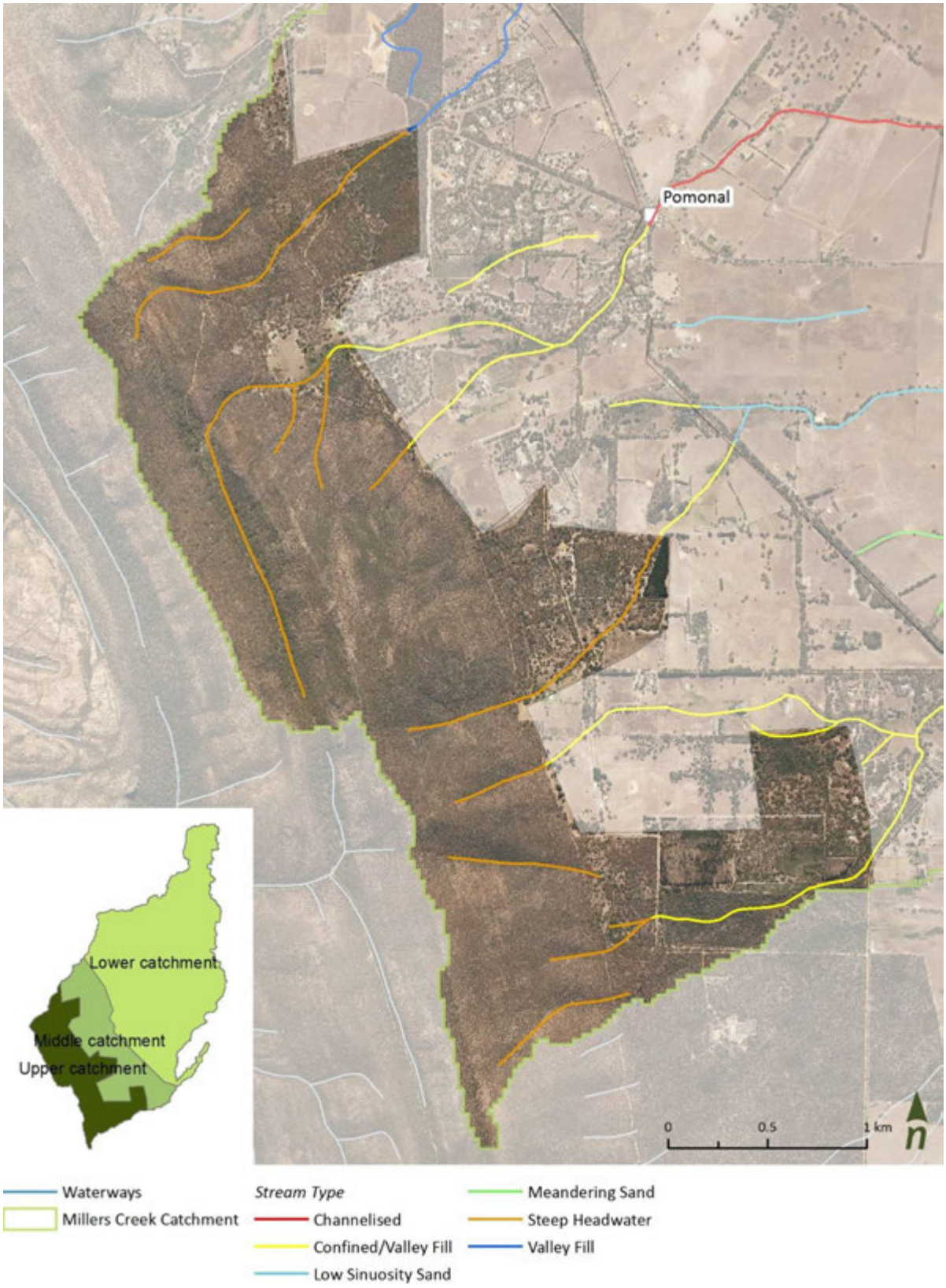


Figure 14. *Stream types across Millers Creek upper catchment*

3.2 Middle catchment

Waterways
Waterways across the mid- catchment are predominantly confined stream types, with defined channels and a mix of cobble, gravel, fine sand and silt bed materials (Figure 17). Several valley fill waterway lines are also present, with a less defined channel and a swampy valley floor.

Waterways in this zone are generally not impacted by stock, however urban development and public access have had a negative impact on channel form and riparian condition. Some minor gully and bank erosion is evident in some of the waterways towards the upper catchment, particularly in cleared areas, and channel deepening and widening is evident along the main Millers Creek channel upstream from Pomonal. Where present, remnant native vegetation along waterway lines in the mid-catchment zone is largely in good condition, however weeds are also common.

Millers Creek reserve
The erosion of the main Millers Creek channel extends approximately 1 km upstream from Pomonal to a bridge crossing with a culvert (Figure 15 to Figure 17). A bush reserve surrounds this reach, and is of high environmental, recreational and amenity value to the community. Informal walking tracks run along both sides of the creek, and there are multiple (over 12 observed during June 2017 inspections) informal paths crossing the channel.

Figure 15. *Millers Creek bush reserve reach – view downstream from culvert crossing*

Over the 1 km reach, a series of small headcuts are present in the actively deepening channel bed. These headcuts are in the order of 0.25 – 0.5 m vertical drops in bed elevation. These headcuts indicate that active incision (deepening and widening) is occurring. It is likely that this reach is still slowly adjusting to the historical channelisation downstream of Pomonal. The progression of the incision is likely to be a relatively intermittent process, with erosion occurring only during large rainfall events every few years.

The incision is currently being held by a culvert and informal bridge crossing at the top of the reach, where a headcut (vertical drop) in the order of 1 – 1.5 m is present. If this culvert were to fail, there is a high likelihood that the incision will progress further up the main stem of the channel into an area of intact and high value swampy valley fill habitat, as well as upstream into and existing gully line that is already unstable and eroding towards a road. A program of works to address the erosion in this reach of stream (grade control, vegetation), minimise informal crossing/access (fencing / signposting), and enhance and maintain the amenity value of the reach (designated paths, signage etc.) is a high priority.

Figure 16. *Failing culvert crossing at upstream extent of eroding reach*

Two grade control structures (rock chutes) are likely required in this reach to halt the incision, one near the downstream end of the reach and the other at the upper end replacing the failing culverts. The downstream chute could possibly be located next to the primary school, and designed to provide a controlled point for public access and enhanced enjoyment of the creek. Concept and detailed designs are required to explore the scope of the works.

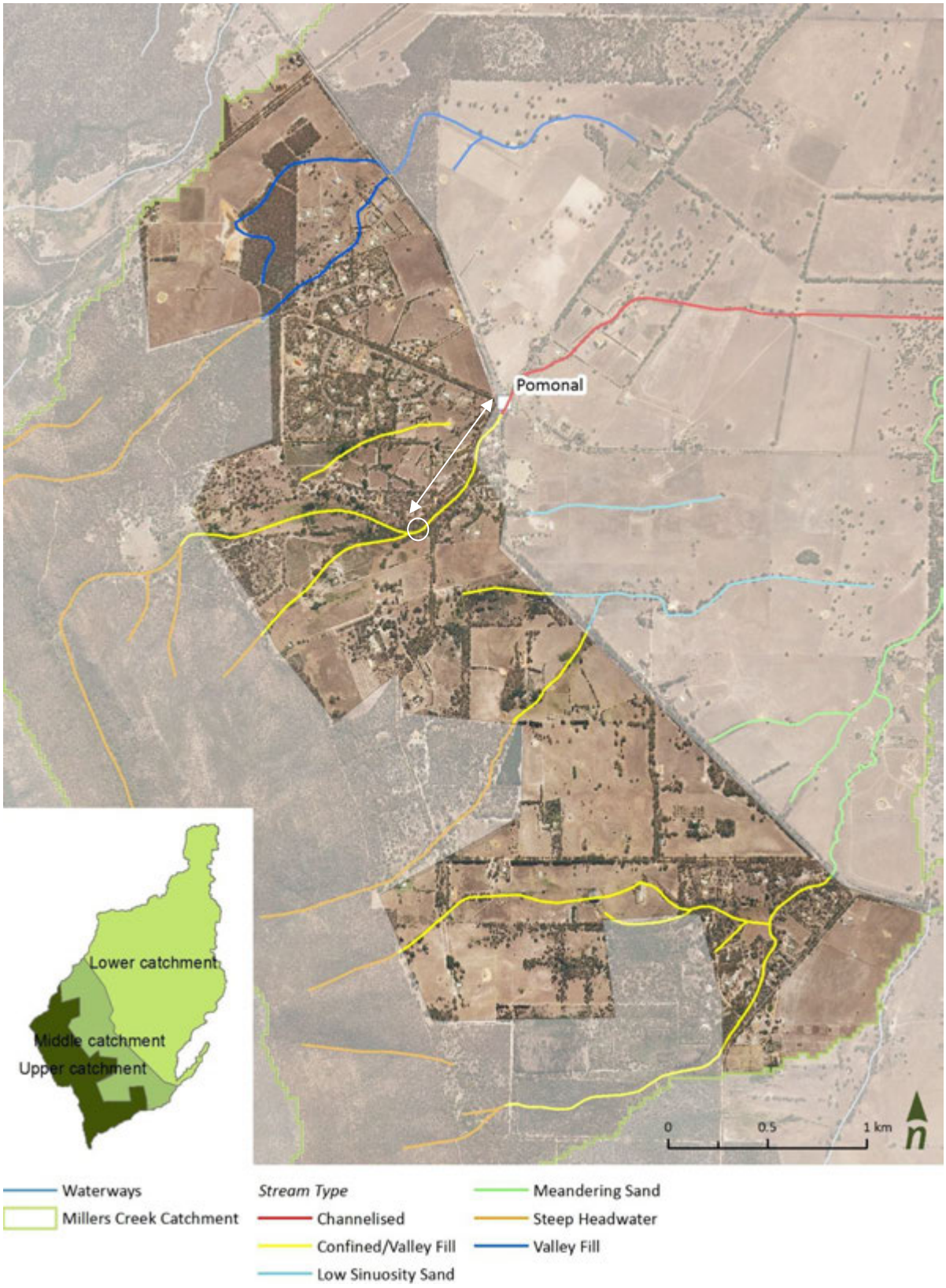


Figure 17. *Stream types across Millers Creek middle catchment. White arrow indicates extent of Millers Creek subject to active incision, and the current culvert crossing that is limiting the incision is circled at the upstream extent of the reach*

3.3 Lower catchment

Waterways across the lower catchment are predominantly low sinuosity and meandering sand bed stream types (Figure 18 to Figure 22). The defined low-flow channels are relatively shallow (0.5 – 1 m deep) and well-engaged with the floodplain. During flood events, water dissipates across the floodplain via many channels and depressions lines, characteristic of lowland sandy plains.

Figure 18. *Millers Creek – lower catchment – view along main creek line within a broad corridor of remnant vegetation*

The majority of the main waterway corridor in the lower catchment of Millers Creek has been fenced, and stock impacts are relatively low. Remaining areas to be fenced are at the upstream and downstream extents of the lower catchment zone. Overall vegetation condition is good, with a broad riparian corridor (50 + m) reserved along much of the main waterway length, and good longitudinal connectivity of remnant vegetation. Scattered recruitment of native vegetation is evident where fencing has been present for several years. Weed infestation is still problematic through this zone.

Figure 19. *Natural recruitment of native vegetation in fenced areas with no stock access*

A mix of revegetation works and weed control programs have been undertaken in the past by landholders, the WCMA and Project Platypus. Well established revegetation works along the lower end of the channelised reach of Millers Creek are assisting stabilisation and rehabilitation of the waterway.

Figure 20. *Revegetation works along the lower end of the channelised Millers Creek reach*

The remaining areas of Millers Creek where fencing is absent (Figure 21) are a priority for fencing and revegetation works, to improve bed and bank stability and overall waterway health.

Figure 21. *Channelised reach of Millers Creek – section where fencing is absent and riparian vegetation is limited*

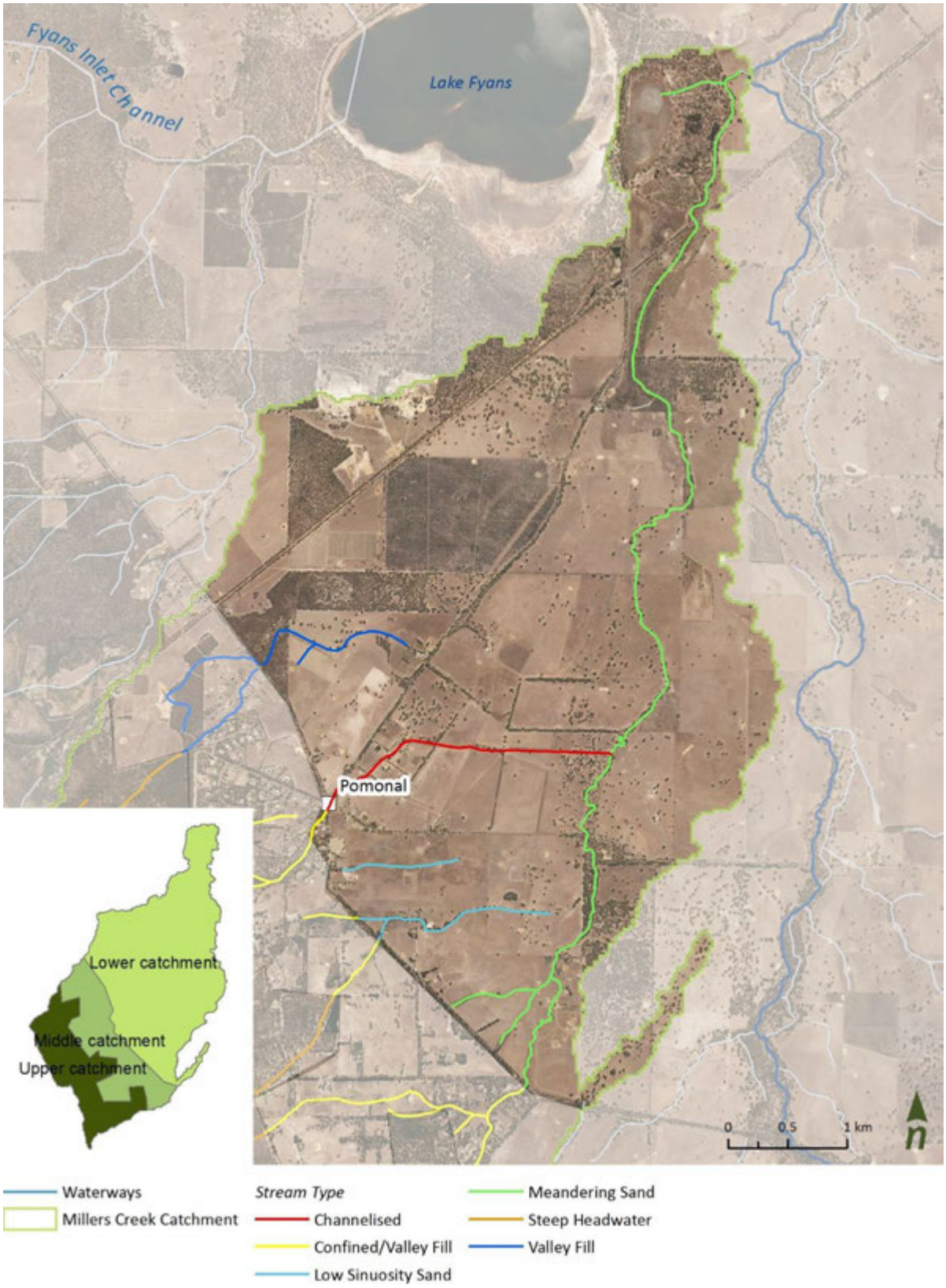


Figure 22. *Stream types across Millers Creek lower catchment*

4 Management strategy

4.1 Condition summary

Overall, waterway condition across the Millers Creek catchment is very good. Summary observations include:

- Only isolated areas of minor erosion in some mid-catchment waterways
- The majority of waterways in farmed areas are already fenced and minimal stock access
- A corridor of remnant riparian vegetation is present along the main waterway lines with good connectivity from the headwaters to the lower catchment
- There is strong community stewardship of waterway and catchment health
- Weed control has been difficult, and is the main concern for landholders and community.

4.2 Opportunities

Four main opportunities for improved management were identified:

1. Addressing existing gaps in fencing and revegetation along the main waterways and riparian zones that can (when gaps are infilled) provide a continuous connection from the headwaters to the lower catchment (biolinks) (Figure 23, Figure 24)
2. Undertaking stabilisation works to address erosion in the 1 km reach of Millers Creek upstream of Pomonal (bush reserve area), and enhancing the recreation and amenity value as part of the river health improvement works for this reach
3. Supporting a major weed control program in the catchment, with a co-ordinated effort by landholders, the CMA and other stakeholder groups to fund and support the control and eradication of noxious weeds (Figure 25). Ideally the weed control program would progress from upstream to downstream.
4. Supporting a program of maintenance to protect and enhance native vegetation establishment in new and existing fenced sections of the waterway.

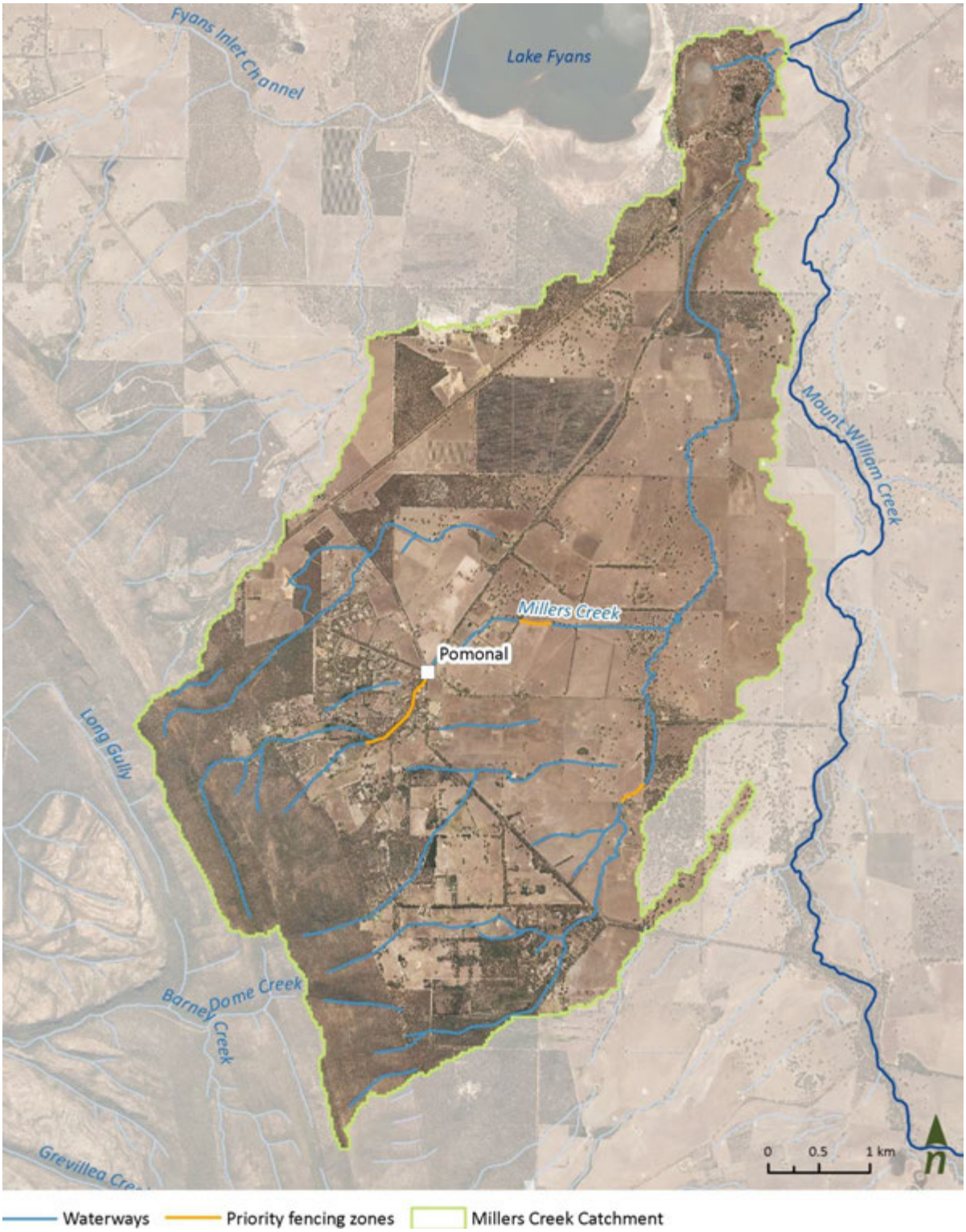


Figure 23. *Fencing priority zones*

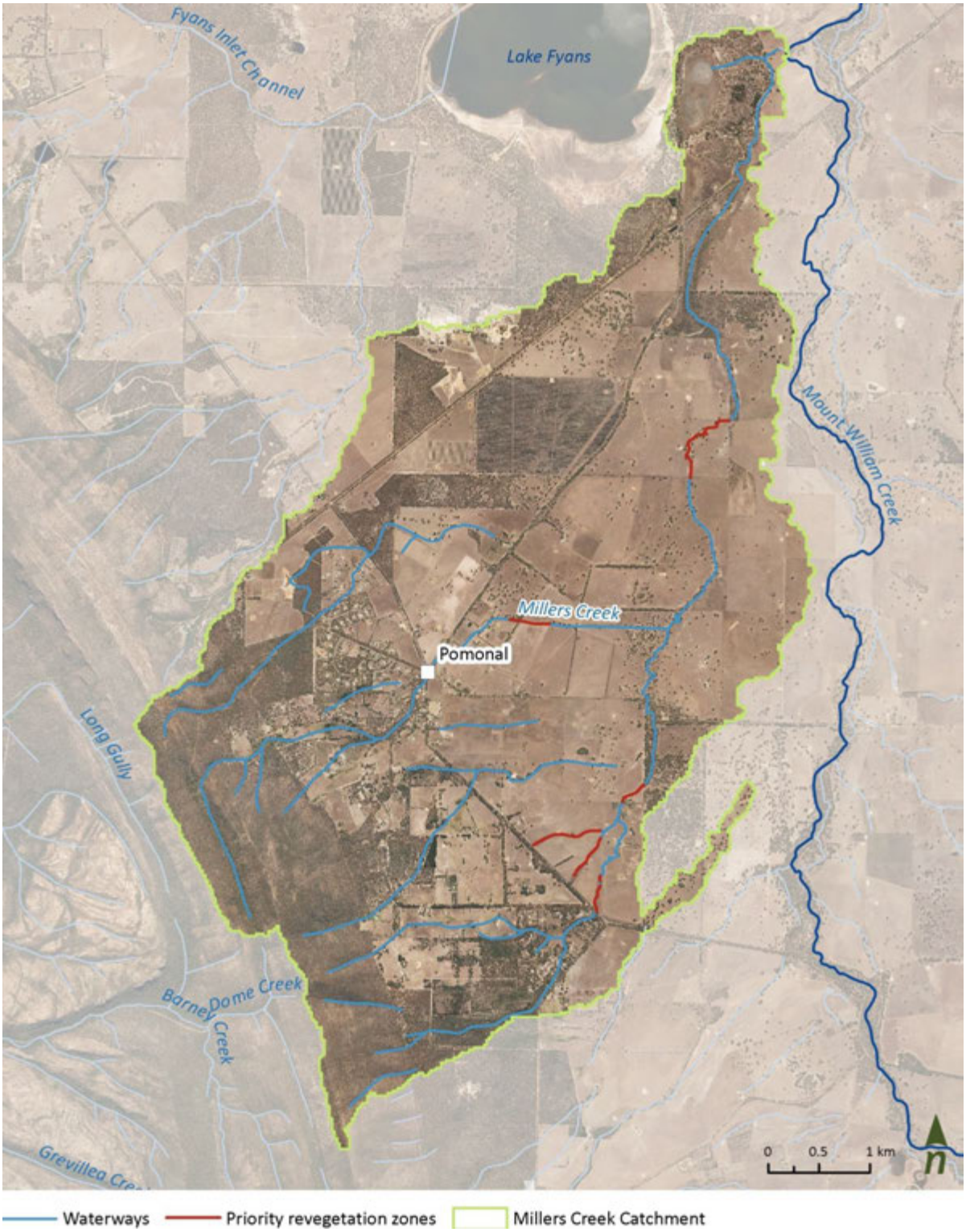


Figure 24. *Priority zones for revegetation*

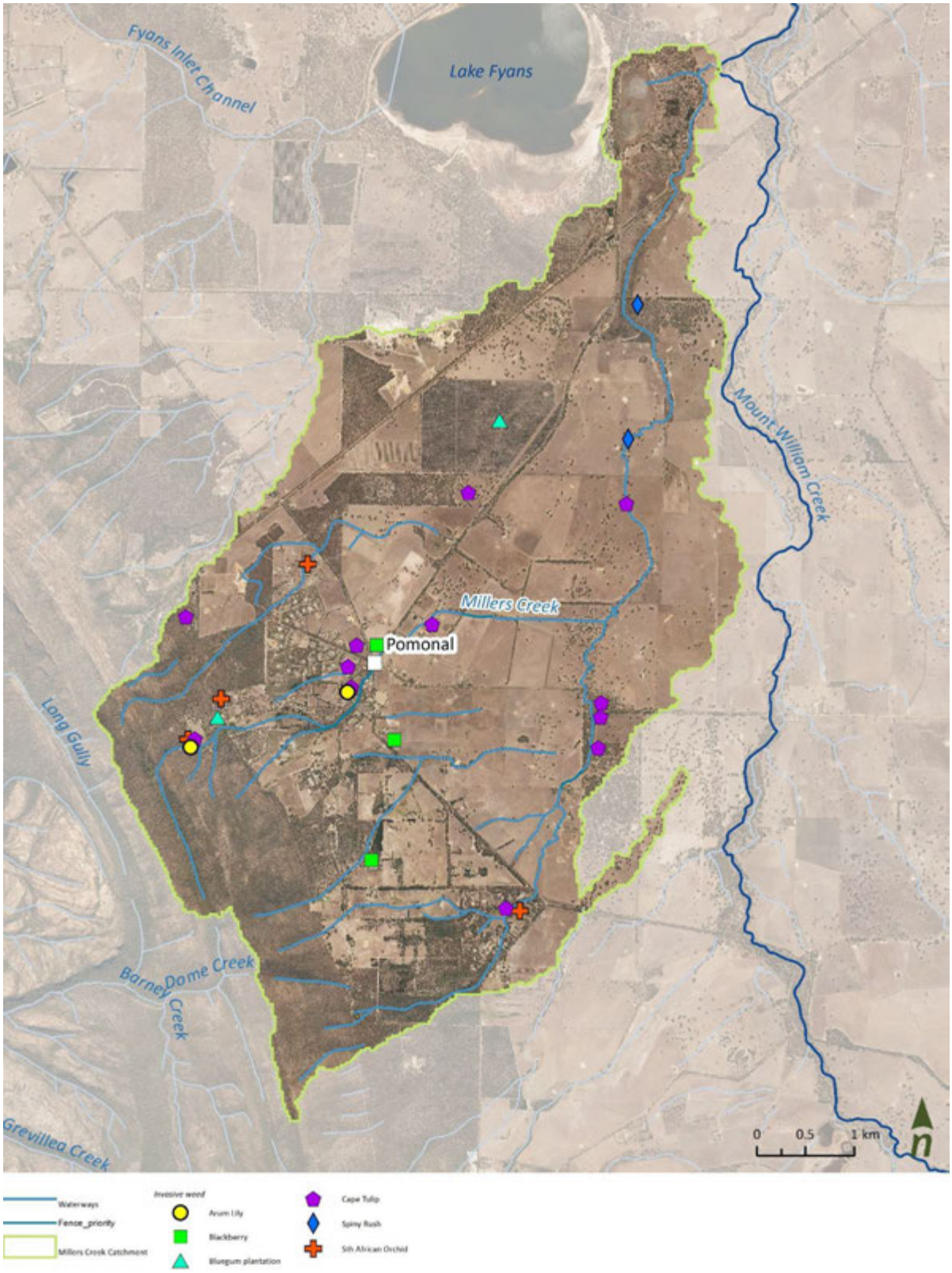


Figure 25. *Indicative locations of substantial areas of invasive weeds in the Millers Creek catchment (determined through on-ground observations and stakeholder engagement)*

4.3 Prioritised waterway actions

A prioritised program of waterway actions has been developed to inform the order of implementing on-ground works across the catchment (in other words, what should be done first, and where should it be done). The prioritisation process is based on the relative benefit of works at a particular location for achieving the overall management objectives for Millers Creek. The prioritisation process is one means of identifying the order that works should be implemented within a works program. Opportunistic works should be undertaken in parallel if particular locations have stronger landholder and community support for works.

Prioritisation process and management actions

The proposed objectives for management, and criteria for the benefit assessment are (in line with the WWS and WRCS):

1. Improvement in river health for waterways in the Millers Creek catchment
2. Protection of remnant vegetation (including endangered Plains Woodland and Forest EVCs)
3. Improving longitudinal connectivity of vegetation corridors

The objectives are largely interlinked and are therefore equally weighted.

Management options

The prioritisation process was undertaken to rank the importance of management intervention (if required) for each waterway segment[1] within the catchment (see Appendix A for a detailed plan of segment breakdown). As discussed previously, the waterway condition for the catchment's segments were assessed via desktop review and field inspections. The observations have been recorded in a database supplied to the WCMA (and shown in Appendix B).

Where required, three management actions have been recommended for waterway rehabilitation:

- Fencing
- Fencing and revegetation
- Fencing, revegetation and earthworks / structural works

For each segment of waterway, the benefit of fencing was assessed (against the objectives), and then if any additional benefit was gained by adding revegetation and additional structural works.

In some segments of the catchment, management actions were not considered to provide a significant benefit over the existing conditions, and so those segments were excluded, these included:

- Reaches that are currently effectively fenced and have significant remnant vegetation cover, existing revegetation works, and/or active vegetation recruitment
- Reaches that do not require a fence or vegetation works (i.e. the waterways within the Grampians National Park).

An ongoing monitoring and maintenance program to support the existing condition of these (and all) reaches is recommended.

Prioritisation process

Benefit was defined in this process by the improvement made relative to the objectives stated above. Each segment was given a score between one and five to indicate the relative benefit of investment at this location (Table 2). The higher the score the greater the benefit.

[1] The waterway was split into segments, which were created where a given waterway intersected property boundaries.

Table 2. Benefit scores and associated description

Benefit scores	Description of benefit
1	Very low
2	Low
3	Moderate
4	High
5	Very High

The priority ranking could then be calculated for each segment by multiplying the score achieved against each objective. Therefore, a score of 125 was the maximum score achievable, occurring where an option scores five against each of the three objectives.

The estimated associated *cost* for each action at each segment was determined, which allows for a rapid assessment of the benefit vs cost. Indicative costs for on-ground works (per metre) were supplied by the WCMA and estimated from previous works undertaken in the region (see Table 3). The prioritisation spreadsheet has been designed to allow the cost estimate to be varied as unit rates change in time.

Table 3. Estimated rate to implement on-ground waterway restoration works* (supplied by the WCMA)

Management action	Indicative cost	Comment
Fencing ($/m)	12	Indicative cost is provided in $/m and therefore length will need to be doubled where fencing is required on both sides.
Fencing and revegetation ($/m)	20	Indicative cost
Grade control ($ each)	100,000	Estimated on a site-by-site basis considering earthworks, rock volumes and geofabric. Cost approximations include both design and construction costs.

Table 4 shows an extract of the prioritisation spreadsheet, highlighting five example segments for management actions. The column on the far right indicates that segment MS17a has the top ranking, achieving the maximum score. This implies that fencing and revegetation for this segment would be highly effective at achieving the listed management objectives.

Fencing and revegetation was also identified as the preferred option for segment C8b, scoring 48 out of a possible 125. This segment was ranked 35th and therefore management actions are determined to be relatively less important in this segment compared to all other segments that ranked higher (i.e. the other segments listed). Attachment C provides additional results.

The gap areas identified in Figure 23 and Figure 24 are identified as priority sediments in the prioritisation process, and are recommended as the starting point for the program of on-ground works. Figure 26 shows how the segments have been depicted in the GIS data supplied to WCMA.

Table 4. Extract of prioritisation table

Millers Crk Waterway Action Plan - Prioritisation of Actions																										
			Fence						Fence and Revegetate						Fence, Revegetate & Earthworks / Structures											
			1 - Improvement in river health for the Millers Creek catchment waterways	2 - Protection of remnant vegetation (including endangered Plains Woodland and Forests EVC)	3 - Improving connectivity of vegetation corridors (bio-links)	All			1 - Improvement in river health for the Millers Creek catchment waterways	2 - Protection of remnant vegetation (including endangered Plains Woodland and Forests EVC)	3 - Improving connectivity of vegetation corridors (bio-links)	All			1 - Improvement in river health for the Millers Creek catchment waterways	2 - Protection of remnant vegetation (including endangered Plains Woodland and Forests EVC)	3 - Improving connectivity of vegetation corridors (bio-links)	All					
Segment	Stream length (m)	Fence length (m)	Benefit			Benefit ranking	Rate	Cost	Benefit			Benefit ranking	Rate	Cost	Benefit			Benefit ranking	Rate	Cost	Priority ranking	Cost	Ranking order
MS17a	836	836	3	4	4	48			5	5	5	125			5	5	5	125			**125**		1
MS16	283	283	4	4	5	80			5	4	5	100			5	4	5	100			**100**		8
MS7b	15	15	4	4	4	64			5	4	4	80			5	4	4	80			**80**		9
C5	21	21	3	3	4	36			4	3	5	60			4	3	5	60			**60**		28
C2	302	302	3	2	3	18			5	2	5	50			5	2	5	50			**50**		34
C8b	47	47	3	3	3	27			4	3	4	48			4	3	4	48			**48**		35

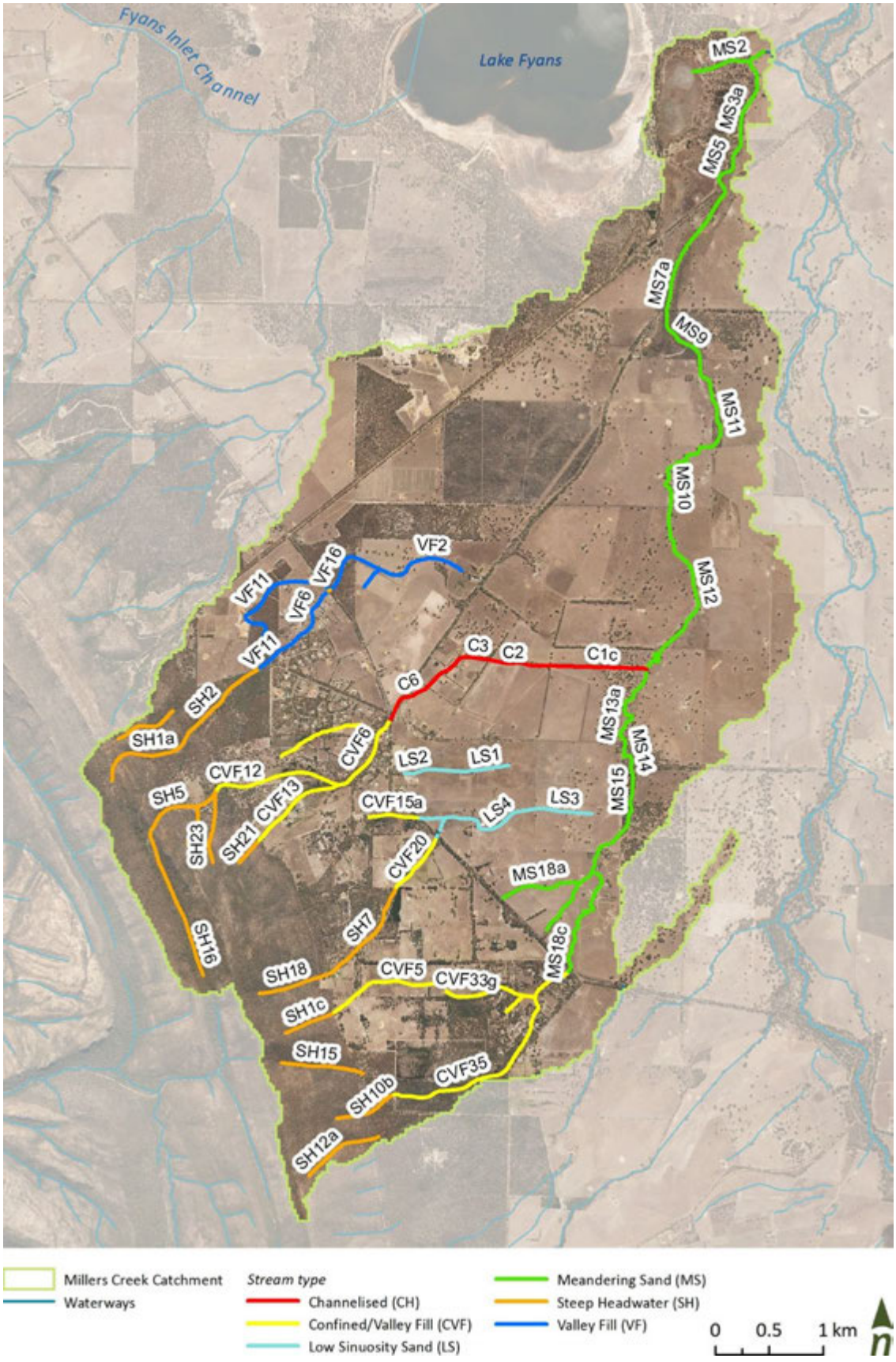


Figure 26. *Example segment referencing for site prioritisation (note: not all segment numbers are displayed at this scale – segments may be located via supplied GIS dataset)*

4.4 Implementation

There are a range of components considered to be important in the implementation Millers Creek WAP. It is recommended that these actions are undertaken as part of the WAP implementation process.

Review objectives and establish specific targets with stakeholder groups

The objectives defined in this WAP are based on the WWS and WRCS. An important part of the implementation process will be to set agreed targets and metrics for monitoring the success of future works and investment. These may include targets like: a continuous connected riparian corridor from headwaters to Mt William Creek by 2030' (continuous fencing, set metrics to define measures of connectivity etc.), and 'the eradication of noxious weeks by 2050'. These targets and metrics should be aligned with the objectives set out in this WAP.

Establish a monitoring and evaluation program

The establishment of a monitoring and evaluation program is an important component of implementing the Millers Creek WAP. The monitoring and evaluation of changes to waterway condition will be important for assessing changes to the system and the success or failure of management works. A specific monitoring program should be developed that can be used to monitor condition across all the waterways within Millers Creek. The monitoring and evaluation program should provide sufficient detail to ensure that information on target metrics (as agreed with the stakeholder group) can be routinely assessed (minimum five year intervals) and progress towards objectives can be tracked.

Review and modify incentive programs for holistic catchment management

Incentive programs are an important component of achieving long-term environmental outcomes. These programs may include incentives for landholders to manage stream frontages or sections of land for environmental purposes rather than agricultural or private purposes. Programs may include incentives associated with the retirement of marginalised land, fencing and revegetation of minor waterways, and changes to land management practices. Such programs should be reviewed and modified to ensure the most efficient strategy for long-term management of waterways within the Millers Creek catchment is implemented.

4.5 Weed management priorities

The catchment contains a range of problem weeds, as summarised in Section 2.3. In general, it is recommended to target weed management activities upon species and locations where there is the greatest chance of success, or where intervention will prevent further spread.

Priority weed management activities include:

- Undertaking weed management at sites where other investment or effort has been applied, including revegetation sites, or in high quality remnant vegetation.
- Treatment of woody weeds throughout the catchment, particularly the middle and upper catchment:
    - Woody weed removal can be highly effective, and can lead to eradication of some problem species provided monitoring and follow up weed control is applied.
    - Woody weed species to target include non-indigenous wattles (Cootamundra Wattle *Acacia baileyana* and Sallow Wattle *Acacia longifolia*), and introduced species such as Blackberry *Rubus fruticosus* spp. agg., Sweet Briar *Rosa rubiginosa*, Flax-leaf Broom *Genista linifolia*, Gorse *Ulex europaeus*, English Ivy *Hedera helix* and African Box-thorn *Lycium ferocissimum.*
- Treatment of Spiny Rush *Juncus acutus* subsp. *acutus*. This semi-aquatic species should be targeted within reaches, working from the upper sections of reaches downstream, to avoid recolonisation of downstream sites from untreated source populations upstream.
- Control of relatively new weeds with high invasive potential. Key species identified in the public consultation including the South African Orchid *Disa bracteata* and One Leaf Cape Tulip *Moraea flaccida*. These species, and a range of other Iridaceae weeds, have potential to invade relatively

intact bushland. Control of these small plants is labor intensive, involving methods such as hand digging, herbicide wiping or spot spraying. Follow-up monitoring and repeated control will be required to eradicate these species from infested areas. These species are most problematic in the upper and middle catchment. Priority should be given to removing these species from revegetation sites or high quality native vegetation, and it is also worth prioritising removal from sites where they are not fully established.

- Control of Gazania *Gazania linearis* within road reserves close to source populations in townships.

Where possible, weed management activities should be coordinated to include multiple landholders (including public land managers), to minimise the spread of weeds back into treated areas from untreated neighboring land.

4.6 Revegetation direction

Revegetation should be carried out with locally indigenous species where possible. Species selection will change depending on position within the catchment, distance from drainage lines and soil type. Advice should be sought from the local Landcare group or WCMA for site specific planting recommendations, and it is recommended to inspect nearby bushland reserves to assist in species selection if possible.

It is recommended to plant and establish the tree and shrub layers before planting understorey species, as it is easier to manage competition with introduced understorey species (such as perennial pasture grasses) for tree and shrub plantings.

A wide range of species could be used for revegetation works. Some general recommendations are in Table 5.

Table 5. Suitable species for revegetation throughout the catchment (including saline sites)

Common name	Scientific name	Catchment position			Suitable for revegetation of saline sites
		Upper	Middle	Lower	
Trees					
Brown Stringybark	*Eucalyptus baxteri*	✓			
River Red-gum	*Eucalyptus camaldulensis*		✓	✓	✓
Yellow Gum	*Eucalyptus leucoxylon*	✓	✓		
Yellow Box	*Eucalyptus melliodora*		✓	✓	
Messmate Stringybark	*Eucalyptus obliqua*	✓	✓		
Swamp Gum	*Eucalyptus ovata*	✓	✓		
Manna Gum	*Eucalyptus viminalis*	✓	✓		
Red Stringybark	*Eucalytpus macrorhyncha*	✓			
Small Trees					
Black Wattle	*Acacia mearnsii*	✓	✓	✓	✓
Blackwood	*Acacia melanoxylon*	✓	✓		✓
Drooping Sheoak	*Allocasuarina verticillata*	✓	✓		✓
Oyster Bay Pine	*Callitris rhomboidea*	✓	✓		
Large Shrubs					
Golden Wattle	*Acacia pycnantha*				
Wirilda	*Acacia retinodes*	✓	✓	✓	✓
Scrub Sheoak	*Allocasuarina paludosa*	✓			✓
Silver Banksia	*Banksia marginata*	✓	✓		
Sweet Bursaria	*Bursaria spinosa*	✓	✓		✓
Scarlet Bottlebrush	*Callistemon rugulosus*	✓	✓		✓
Woolly Tea-tree	*Leptospermum lanigerum*	✓	✓		✓
Totem Poles	*Melaleuca decussata*	✓	✓	✓	✓
Salt Paperbark	*Melaleuca halmaturorum*	✓	✓	✓	✓
Moonah	*Melaleuca lanceolata*	✓	✓	✓	✓
Understorey - shrubs					
Cranberry Heath	*Astroloma humifusum*	✓	✓		
Daphne Heath	*Brachyloma daphnoides*	✓	✓		
Red Parrot-pea	*Dillwynia hispida*	✓	✓	✓	
Sticky Hop-bush	*Dodonaea viscosa*	✓	✓	✓	
Bushy Needlewood	*Hakea decurrens*	✓	✓		
Running Postman	*Kennedia prostrata*	✓	✓	✓	
Prickly Tea-tree	*Leptospermum continentale*	✓	✓	✓	
Heath Tea-tree	*Leptospermum myrsinoides*	✓	✓		
Common Flat-pea	*Platylobium obtusangulum*	✓	✓		
Understorey grasses and grass-like plants					
Common Wheat-grass	*Anthosachne scabra*		✓	✓	
Supple Spear-grass	*Austrostipa mollis*	✓	✓		
Black-anther Flax-lily	*Dianella admixta*	✓	✓	✓	
Wattle Matt-rush	*Lomandra filiformis*	✓	✓	✓	
Weeping Grass	*Microlaena stipoides* var. *stipoides*	✓	✓		
Common Wallaby-grass	*Rytidosperma caespitosum*	✓	✓	✓	✓
Kneed Wallaby-grass	*Rytidosperma geniculatum*	✓	✓		
Bristly Wallaby-grass	*Rytidosperma setaceum*	✓	✓	✓	✓
Kangaroo Grass	*Themeda triandra*		✓	✓	
Semi-aquatic species (damp locations)					
Lignum	*Duma florulenta*			✓	✓
Nodding Club-rush	*Isolepis cernua*	✓	✓	✓	✓
Swamp Club-rush	*Isolepis inundata*	✓	✓	✓	✓
Sea Rush	*Juncus kraussii*	✓	✓	✓	✓
Common Reed	*Phragmites australis*	✓	✓	✓	✓

5 References

DELWP (2015). *Regional riparian action plan: Wimmera*. Depart of Environment, Land, Water and Planning, Melbourne. Accessed at <https://www.water.vic.gov.au/__data/assets/pdf_file/0024/52719/Riparian-Action-Plan-for-Wimmera.pdf> on 5 June 2017.

DELWP (undated). *NatureKit Victoria*. Dataset Accessed at <http://maps.biodiversity.vic.gov.au/viewer/?viewer=NatureKit> on 13 July 2017.

DEPI (undated). *Index of Stream Condition: The Third Benchmark of Victorian River Condition*. Department of Environment and Primary Industries, Melbourne. Accessed at <http://www.depi.vic.gov.au/water/water-resource-reporting/Third-Index-of-Stream-Condition-report> on 5 June 2017.

DEPI (2013). *Victorian* Waterway Management Strategy. Department of Environment and Primary Industries, Melbourne. Accessed at < https://www.water.vic.gov.au/__data/assets/pdf_file/0019/52543/VWMS-Summary_FINAL_WEB-ready.pdf> on 5 June 2017

DNRE (1999). *An Index of Stream Condition*, Melbourne. Accessed at < http://ics.water.vic.gov.au/ics/files/ISC_Reference_Manual_Complete_1999.pdf> on 5 June 2017.

DSE (2004). *Index of Stream Condition: The Second Benchmark of Victoria River Condition*. Department of Sustainability and Environment, Melbourne. Accessed at <http://ics.water.vic.gov.au/ics/files/ISC_The_second_benchmark_of_condition.pdf> on 6 June 2017.

Earth Tech (2003). *Geomorphic categorisation and stream condition assessment of the Wimmera River catchment*, Melbourne. Accessed at <http://www.wcma.vic.gov.au/docs/default-source/riversdocs/wwconditionmng/wimmera-gc-sca-report-section-one-final.pdf?sfvrsn=11> on 6 June 2017.

ID&A (2001). *Wimmera River Geomorphic Investigation: sediment sources, transport and fate*. Prepared for the Wimmera Catchment Management Authority. Accessed at <http://www.wcma.vic.gov.au/docs/default-source/riversdocs/wwconditionmng/wimmera-river-geomorphic-investigation.pdf?sfvrsn=6> on 26 May 2017.

Project Platypus (2016). *Grampians to Pyrenees Biolink Conservation Action Plan,* Victoria. Accessed at < https://www.centralvicbiolinks.org.au/wp-content/uploads/2015/10/Final-Draft-G2P-FormatedV1.pdf> on 6 June 2017

Seebeck, J. (1967). *Mammals in the Pomonal area, The Grampians*. Mammal Survey Group Contribution No. 9.

Sibley, G. (1967). *A study of the land in the Grampians area*. Soil Conservation Authority, Victoria.

Spencer-Jones, D. (1965). *The geology and structure of the Grampians area, Western Victoria.* Department of Mines, Melbourne.

WCMA (2013). *Wimmera Regional Catchment Strategy 2013 – 2019*. Wimmera Catchment Management Authority, Horsham. Accessed at <http://www.wcma.vic.gov.au/publications> on 26 May 2017.

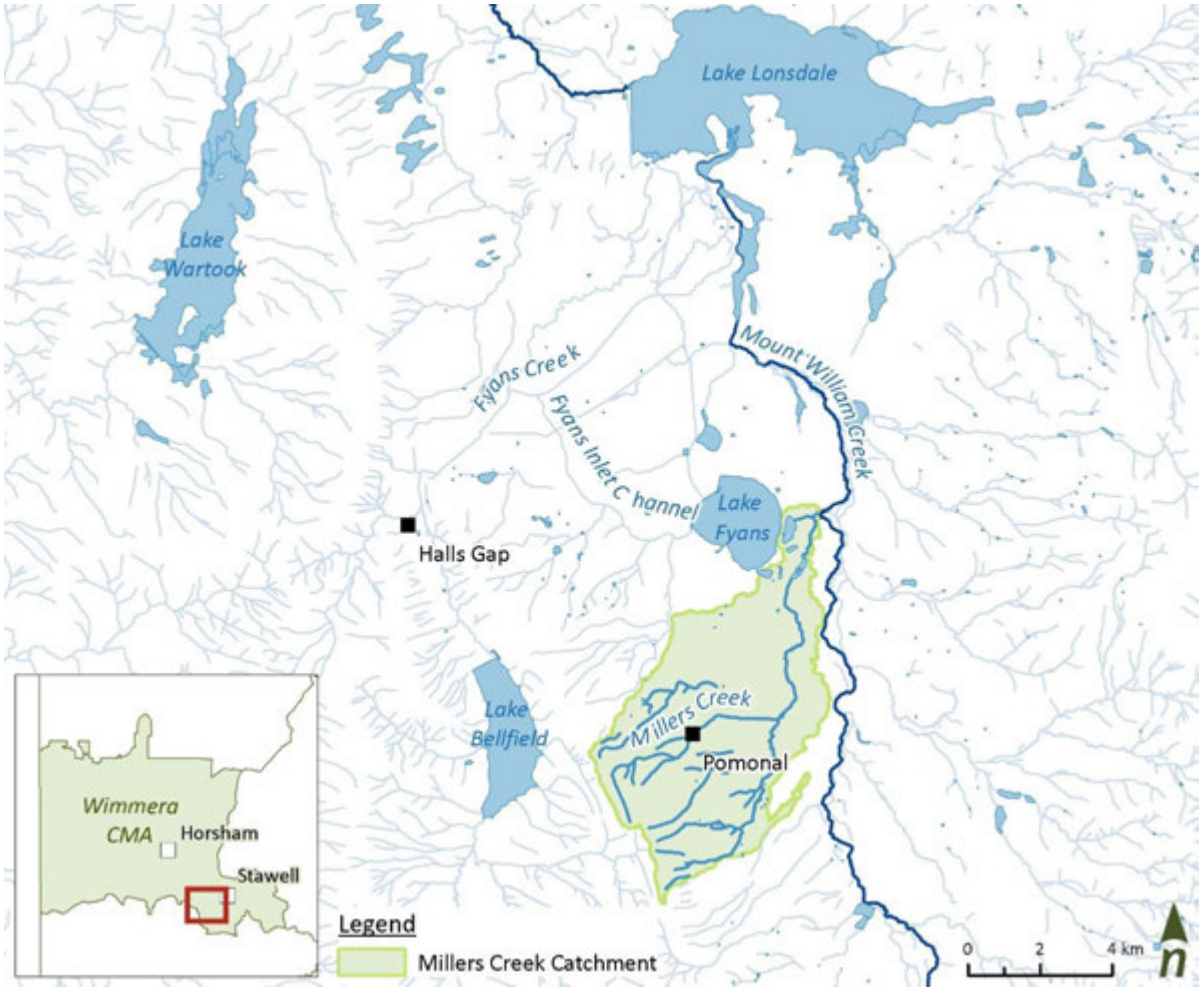
WCMA (2015). *Wimmera Invasive Plant and Animal Management Strategy*. Wimmera Catchment Management Authority, Horsham. Accessed at <http://www.wcma.vic.gov.au/publications> on 26 May 2017.

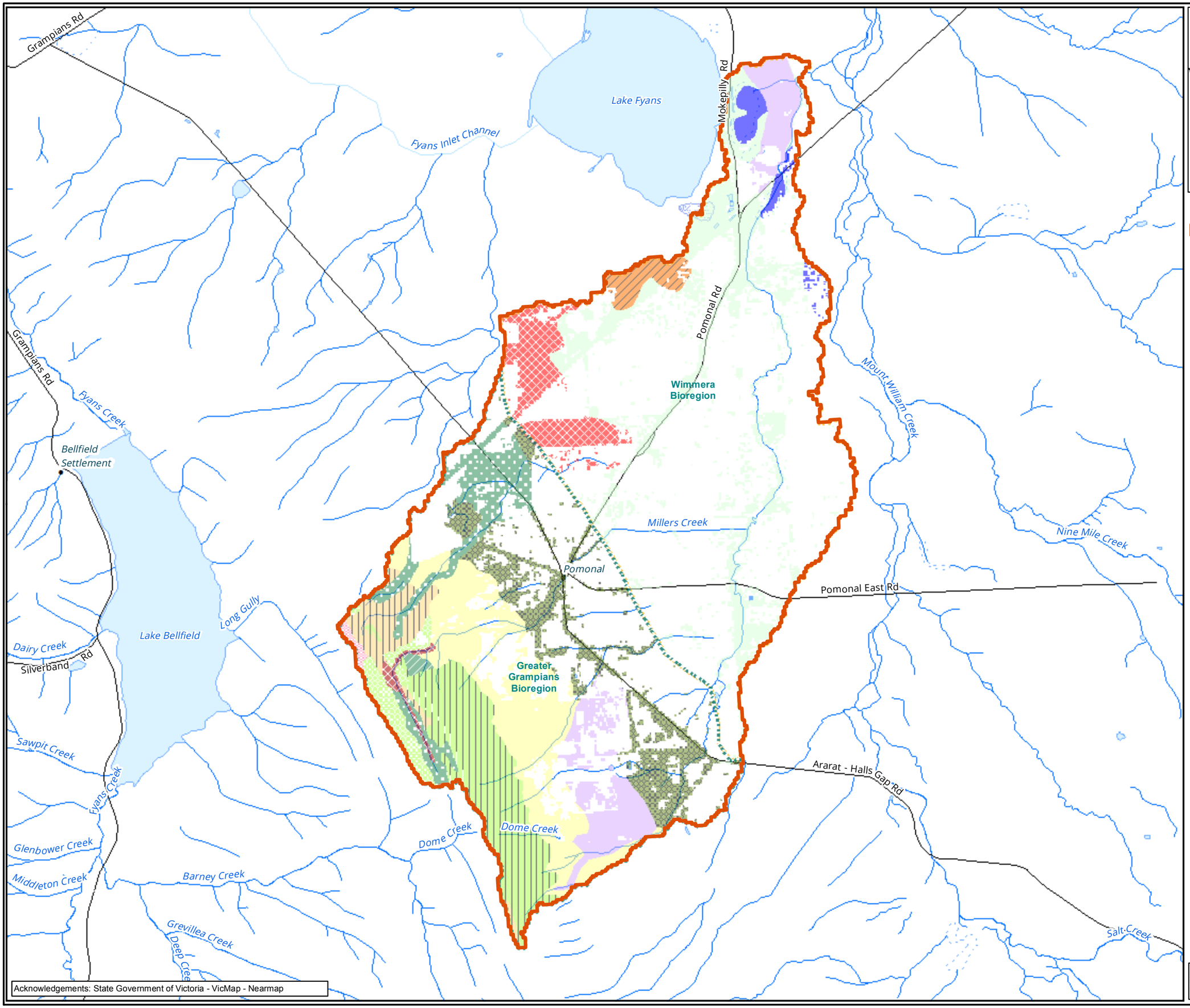
WCMA (2002). *Wimmera Water Quality Strategy*. Wimmera Catchment Management Authority, Horsham. Accessed at <http://www.wcma.vic.gov.au/publications> on 26 May 2017.

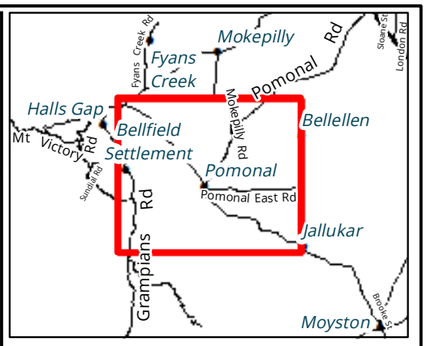
WCMA (2006). *Wimmera Waterway Health Strategy*. Wimmera Catchment Management Authority, Horsham. Accessed at <http://www.wcma.vic.gov.au/publications> on 26 May 2017.

WCMA (2014). *Wimmera Waterway Strategy 2014 – 2022.* Wimmera Catchment Management Authority, Horsham. Accessed at <http://www.wcma.vic.gov.au/publications> on 26 May 2017.

Attachment A
Additional maps – location and vegetation


Lake Lonsdale
Lake Wartook
Fyans Creek
Fyans Inlet Channel
Mount William Creek
Lake Fyans
Halls Gap
Lake Bellfield
Millers Creek
Pomonal
Wimmera CMA
Horsham
Stawell
Legend
Millers Creek Catchment
0
2
4 km
n





Legend

- Study area

Ecological vegetation class

- 16 Lowland Forest
- 193 Rocky Outcrop Herbland
- 20 Heathy Dry Forest
- 200 Shallow Freshwater Marsh
- 22 Grassy Dry Forest
- 23 Herb-rich Foothill Forest
- 241 Valley Grassy Forest/Plains Grassy Woodland Complex
- 28 Rocky Outcrop Shrubland
- 282 Shrubby Woodland
- 292 Red Gum Swamp
- 3 Damp Sands Herb-rich Woodland
- 390 Heathy Dry Forest/Valley Grassy Forest Complex
- 47 Valley Grassy Forest
- 48 Heathy Woodland
- 55 Plains Grassy Woodland
- 681 Deep Freshwater Marsh
- 704 Lateritic Woodland
- 73 Rocky Outcrop Shrubland/Rocky Outcrop Herbland Mosaic
- 882 Shallow Sands Woodland

Map 1 Ecological Vegetation Classes of the Millers Creek Catchment

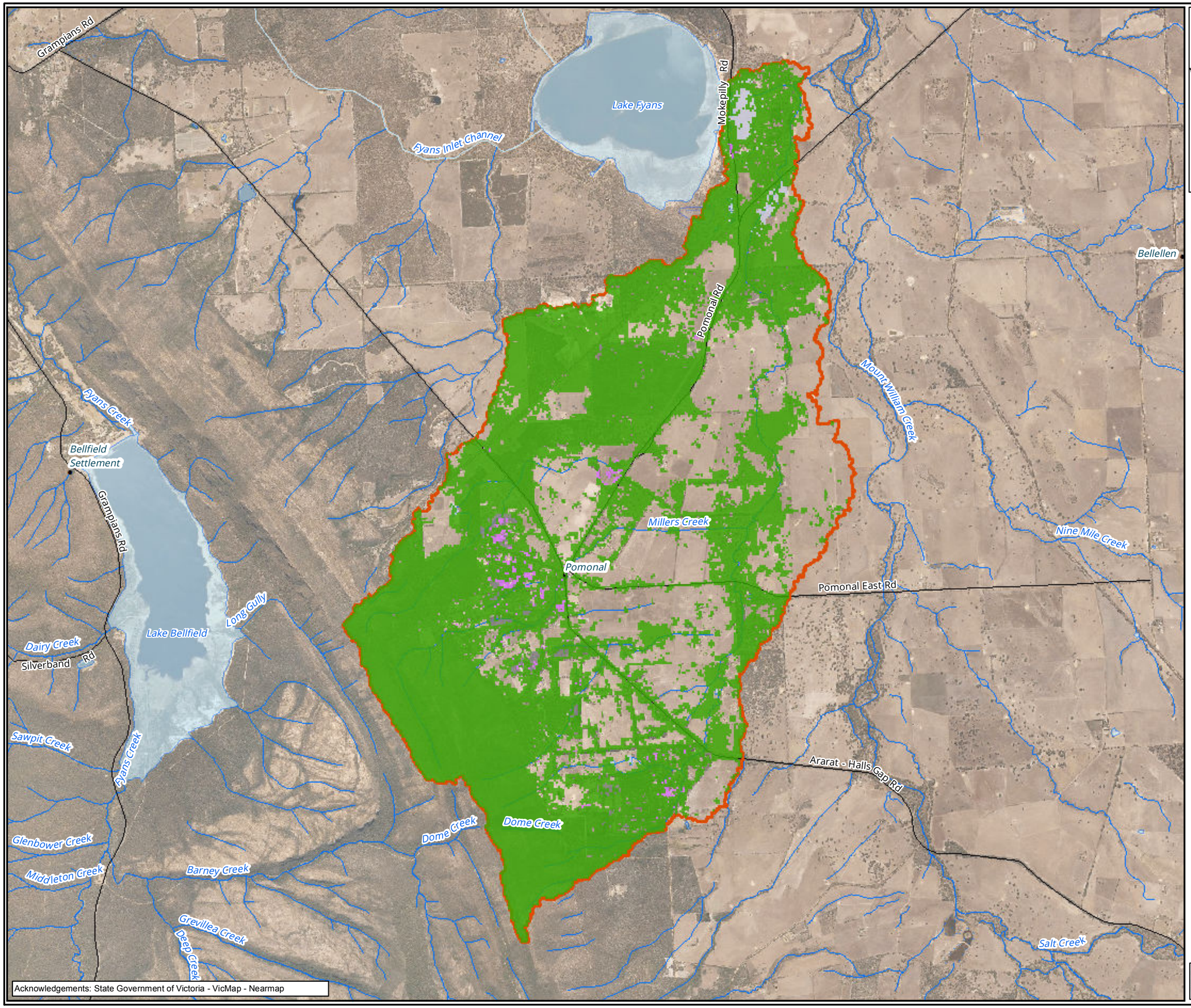
0 0.5 1 1.5 2 2.5

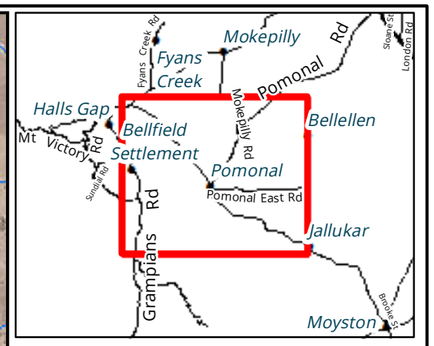
Kilometers
Scale: 1:44,421 @ A3
Coordinate System: GDA 1994 MGA Zone 55

N

Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Hobart, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 25405, Map 1 Ecological Vegetation Classes of the Millers Creek Catchment
Date: 09 October 2017,
Checked by: MG, Drawn by: GD, Last edited by: gdavies
00





Legend

- Study area

Native vegetation

- Exotic largely treeless
- Exotic tree cover
- Native vegetation cover
- Natural waterbodies
- Plantations, exotic and other

Map 4 Native vegetation extent

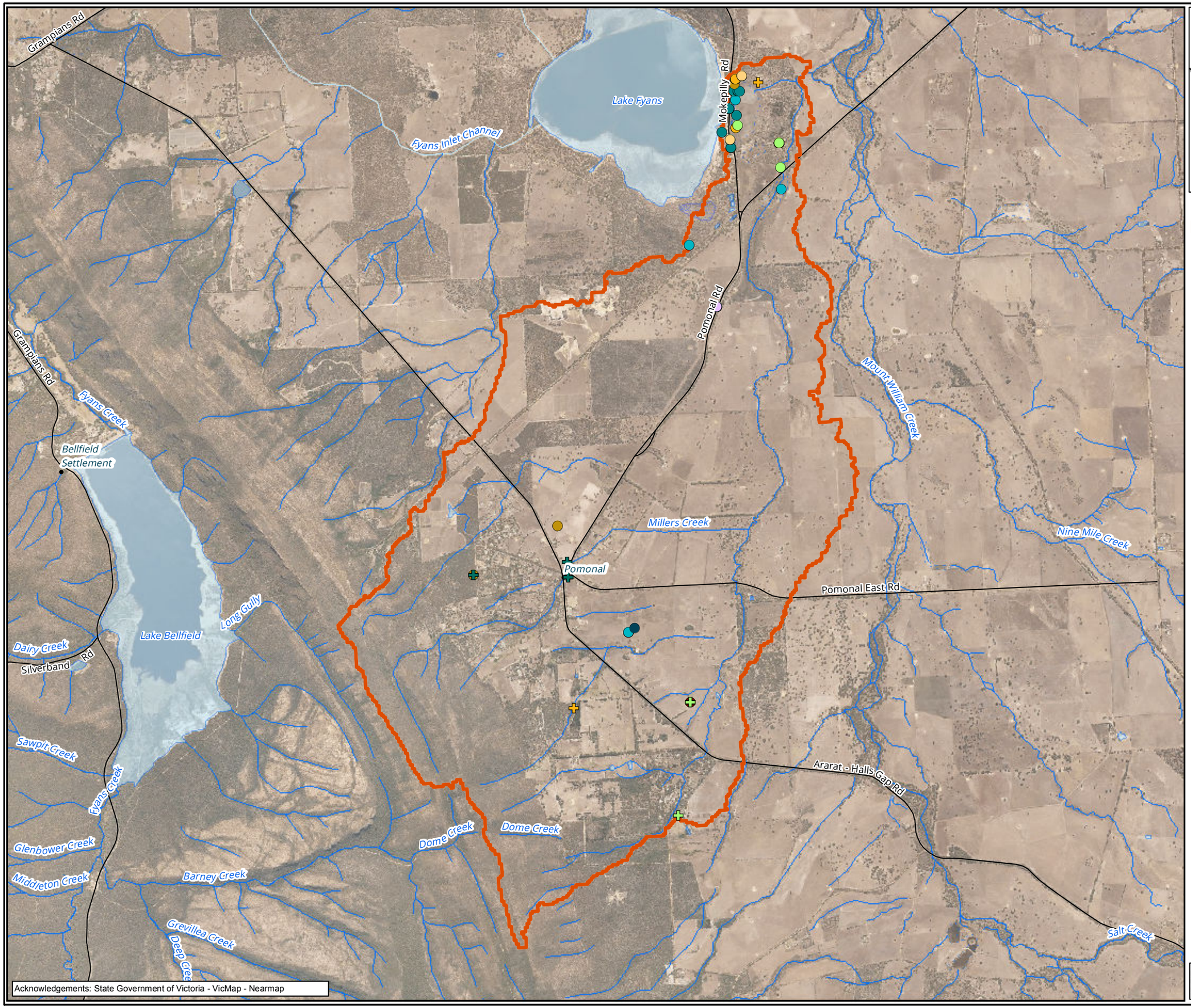
0 0.5 1 1.5 2 2.5

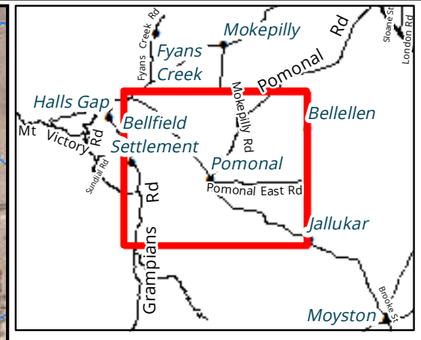
Kilometers
Scale: 1:45,000 @ A3
Coordinate System: GDA 1994 MGA Zone 55

N

Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Hobart, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 25405, Map 4 Native vegetation extent
Date: 09 October 2017,
Checked by: MG, Drawn by: GD, Last edited by: gdavies
Location:P:\24500s\24505\Mapping\24505_M4_VegRisk.mxd
00





Legend

Study area

Nationally significant fauna

- Isoodon obesulus obesulus
- Potorous tridactylus tridactylus
- Pseudomys shortridgei

State significant fauna

- Anas rhynchotis
- Ardea modesta
- Aythya australis
- Biziura lobata
- Burhinus grallarius
- Climacteris picumnus victoriae
- Dromaius novaehollandiae
- Haliaeetus leucogaster
- Hirundapus caudacutus
- Melanodryas cucullata
- Melanodryas cucullata cucullata
- Melithreptus gularis
- Merops ornatus
- Myiagra cyanoleuca
- Oxyura australis
- Phalacrocorax varius
- Platalea regia
- Pogona barbata
- Pomatostomus temporalis
- Pomatostomus temporalis temporalis
- Stagonopleura guttata

Map 3 Threatened fauna records within the Millers Creek Catchment

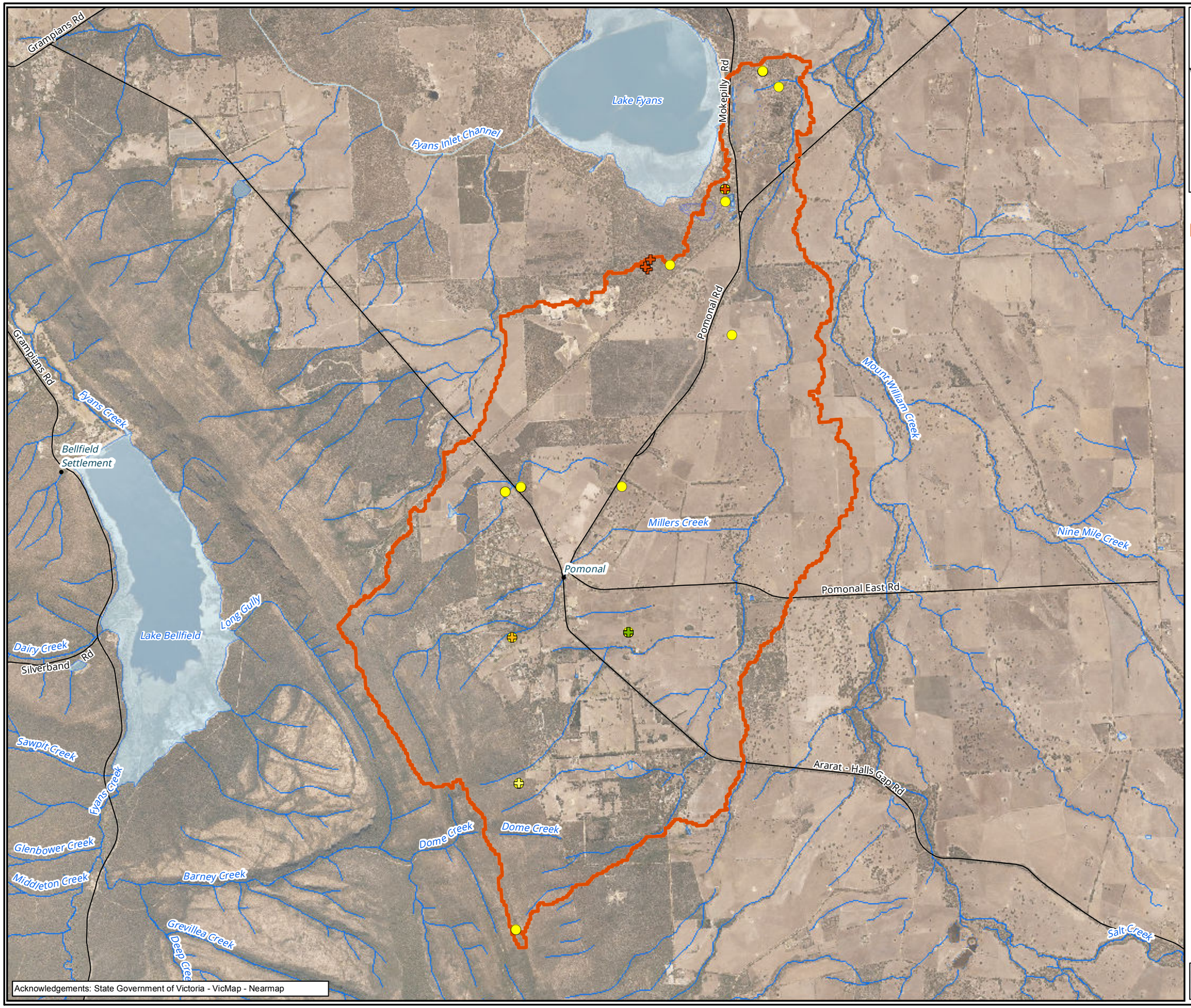
0 0.5 1 1.5 2 2.5

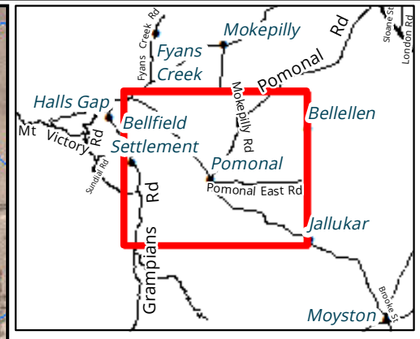
Kilometers
Scale: 1:44,421 @ A3
Coordinate System: GDA 1994 MGA Zone 55

N

Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Hobart, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 25405, Map 3 Threatened fauna records within the Millers Creek Catchment
Date: 09 October 2017,
Checked by: MG, Drawn by: GD, Last edited by: gdavies
00





Legend

- Study area

Nationally significant flora

- Caladenia formosa
- Caladenia versicolor
- Daviesia laevis
- Prasophyllum subbisectum
- Thelymitra epipactoides
- Thelymitra matthewsii

State significant flora

Map 2 Threatened flora records within the Millers Creek Catchment

0 0.5 1 1.5 2 2.5

Kilometers
Scale: 1:44,421 @ A3
Coordinate System: GDA 1994 MGA Zone 55

N

biosis

Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Hobart, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 25405, Map 2 Threatened flora records within the Millers Creek Catchment
Date: 09 October 2017,
Checked by: MG, Drawn by: GD, Last edited by: gdavies
00

Attachment B
Waterway condition data

Millers Crk Waterway Action Plan - Waterway Condition Data																
Basic Information			Channel Form				Channel Stability					Vegetation				
Reaches	Stream length	Catchment	Stream type	Substrate	Bank sediment	Pools	Incision	Erosion type	Erosion status	Erosion potential	Erosion consequence	Riparian form	Riparian continuity	Riparian health	Riparian recruitment	Largewood density
A21	25	Middle	Channelised	Med. Sand	Fine Sand	No	A3	B-Widening	Moderate	Moderate	Low	1	Fragmented	Unsure	Scattered	Poor
A44	158	Middle	Channelised	Med. Sand	Fine Sand	No	A3	B-Widening	Moderate	Moderate	Low	1	Fragmented	Unsure	Scattered	Poor
A55	47	Middle	Channelised	Med. Sand	Fine Sand	No	A3	B-Widening	Moderate	Low	High	1	Continuous	Unsure	Scattered	Moderate
B14	103	Middle	Channelised	Med. Sand	Fine Sand	No	A3	B-Widening	Moderate	Moderate	Low	1	Fragmented	Unsure	Scattered	Poor
B35	190	Middle	Channelised	Med. Sand	Fine Sand	No	A3	B-Widening	Moderate	Moderate	Low	1	Fragmented	Unsure	Scattered	Poor
B59	21	Middle	Channelised	Med. Sand	Fine Sand	No	A3	B-Widening	Moderate	Moderate	Low	1	Fragmented	Unsure	Scattered	Poor
B65	52	Middle	Channelised	Med. Sand	Fine Sand	No	A3	B-Widening	Moderate	Low	High	1	Continuous	Unsure	Scattered	Moderate
C26	420	Middle	Channelised	Med. Sand	Fine Sand	No	A3	B-Widening	Moderate	Moderate	Low	1	Fragmented	Unsure	Scattered	Poor
C43	302	Middle	Channelised	Med. Sand	Fine Sand	No	A1	B-Widening	Moderate	Moderate	Low	0	n/a	n/a	None	Very Poor
C44	204	Lower	Channelised	Med. Sand	Fine Sand	No	A1	n/a	Good	Low	Low	3	Continuous	Healthy	Scattered	Moderate
C44	9	Lower	Channelised	Med. Sand	Fine Sand	No	A1	n/a	Good	Low	Low	3	Continuous	Healthy	Scattered	Moderate
C82	38	Middle	Channelised	Med. Sand	Fine Sand	No	A3	B-Widening	Moderate	Low	High	1	Continuous	Unsure	Scattered	Moderate
A01	22	Upper	Confined/Valley Fill	Fine Sand	Fine Sand	Yes	A2	A-Headcut	Moderate	Moderate	Moderate	1	Continuous	Healthy	Healthy	Good
A63	286	Upper	Confined/Valley Fill	Fine Sand	Fine Sand	Yes	A1	n/a	Moderate	Moderate	Moderate	1	Continuous	Healthy	Scattered	Good
B62	123	Upper	Confined/Valley Fill	Fine Sand	Fine Sand	Yes	A1	n/a	Moderate	Moderate	Moderate	1	Continuous	Healthy	Scattered	Good
B63	76	Upper	Confined/Valley Fill	Fine Sand	Fine Sand	Yes	A1	n/a	Moderate	Moderate	Moderate	1	Continuous	Healthy	Scattered	Good
B73	566	Upper	Confined/Valley Fill	Fine Sand	Fine Sand	Yes	A2	A-Headcut	Poor	High	High	1	Continuous	Healthy	Healthy	Good
B73	140	Upper	Confined/Valley Fill	Fine Sand	Fine Sand	Yes	A2	A-Headcut	Poor	High	High	1	Continuous	Healthy	Healthy	Good
B82	784	Upper	Confined/Valley Fill	Fine Sand	Fine Sand	Yes	A1	n/a	Moderate	Moderate	Moderate	1	Continuous	Healthy	Scattered	Good
C11	69	Upper	Confined/Valley Fill	Fine Sand	Fine Sand	Yes	A1	n/a	Moderate	Moderate	Moderate	1	Continuous	Healthy	Scattered	Good
A24	128	Middle	Low Sinuosity Sand	Fine Sand	Fine Sand	No	A1	n/a	Good	Low	Low	1	Fragmented	Unsure	Scattered	Poor
A24	230	Middle	Low Sinuosity Sand	Fine Sand	Fine Sand	No	A1	n/a	Good	Low	Low	1	Fragmented	Unsure	Scattered	Poor
A24	220	Middle	Low Sinuosity Sand	Fine Sand	Fine Sand	No	A1	n/a	Good	Low	Low	1	Fragmented	Unsure	Scattered	Poor
A61	288	Middle	Low Sinuosity Sand	Fine Sand	Fine Sand	No	A1	n/a	Good	Low	Low	1	Fragmented	Unsure	Scattered	Poor
B22	216	Middle	Low Sinuosity Sand	Fine Sand	Fine Sand	No	A1	n/a	Good	Low	Low	0	n/a	n/a	None	Poor
B86	433	Middle	Low Sinuosity Sand	Fine Sand	Fine Sand	No	A1	n/a	Good	Low	Low	1	Fragmented	Unsure	Scattered	Poor
B87	522	Middle	Low Sinuosity Sand	Fine Sand	Fine Sand	No	A1	n/a	Good	Low	Low	1	Fragmented	Unsure	Scattered	Poor
C01	771	Middle	Low Sinuosity Sand	Fine Sand	Fine Sand	No	A1	n/a	Good	Low	Low	0	n/a	n/a	None	Poor
B02	658	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Good	Low	Low	3	Continuous	Healthy	Healthy	Good
B15	824	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B15	201	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B15	26	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B15	12	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B15	28	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B15	10	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B15	19	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B15	11	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B15	15	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B77	1342	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Good	Low	Low	1	Fragmented	Unsure	None	Poor
B78	495	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Good
B79	44	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B79	162	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B79	773	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B85	711	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A3	B-Widening	Moderate	Moderate	Moderate	2	Fragmented	Healthy	Scattered	Poor
B85	471	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A3	B-Widening	Moderate	Moderate	Moderate	2	Fragmented	Healthy	Scattered	Poor
B85	338	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A3	B-Widening	Moderate	Moderate	Moderate	2	Fragmented	Healthy	Scattered	Poor
B87	283	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Stressed	None	Moderate
B88	274	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B89	74	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
B95	233	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
C16	181	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A1	B-Widening	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Moderate
C16	177	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A1	B-Widening	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Moderate
C16	38	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A1	B-Widening	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Moderate
C16	73	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A1	B-Widening	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Moderate
C16	836	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A1	B-Widening	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Moderate
C18	599	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
C19	11	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Excellent	Low	Low	1	Continuous	Healthy	Scattered	Moderate
C27	0	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Good	Low	Low	3	Continuous	Healthy	Scattered	Good
C27	1503	Lower	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Good	Low	Low	3	Continuous	Healthy	Scattered	Good
C44	291	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Good	Low	Low	3	Continuous	Healthy	Scattered	Good
C44	146	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Good	Low	Low	3	Continuous	Healthy	Scattered	Good
C44	9	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Good	Low	Low	3	Continuous	Healthy	Scattered	Good
C44	836	Middle	Meandering Sand	Med. Sand	Fine Sand	No	A1	n/a	Good	Low	Low	3	Continuous	Healthy	Scattered	Good
A77	101	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
A77	178	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
A77	65	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
A78	118	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
A93	271	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
B16	380	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
B36	177	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
B36	129	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent

B36	146	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
B62	205	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
B62	372	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
B70	659	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
B70	591	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
B80	121	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
B80	30	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
C12	348	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
C20	743	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
C64	12	Middle	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
C73	235	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
C75	583	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
C80	26	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
C80	217	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
C80	136	Upper	Steep Headwater	Bedrock	Bedrock	Yes	A1	n/a	Excellent	Very Low	Very Low	3	Continuous	Healthy	Healthy	Excellent
A14	126	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor
A17	73	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor
A33	62	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor
A52	164	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor
A53	113	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor
A84	149	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor
A87	73	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor
B23	70	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor
B24	149	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor
B60	175	Middle	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor
B75	12	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Continuous	Healthy	Healthy	Good
B97	10	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor
C08	375	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Continuous	Healthy	Healthy	Good
C08	227	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Continuous	Healthy	Healthy	Good
C08	39	Upper	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Continuous	Healthy	Healthy	Good
C14	685	Middle	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor
C14	224	Middle	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor
C14	252	Middle	Valley Fill	Fine Sand	Fine Sand	No	A1	n/a	Moderate	Moderate	Low	1	Fragmented	Healthy	Scattered	Poor