

Appendix A: Study Reach Maps

The following pages provide reach maps of sites that are referred to as **Tiles** within this report. Tiles with no reaches are not included.



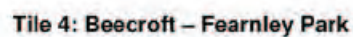
Tile 1: Epping Station

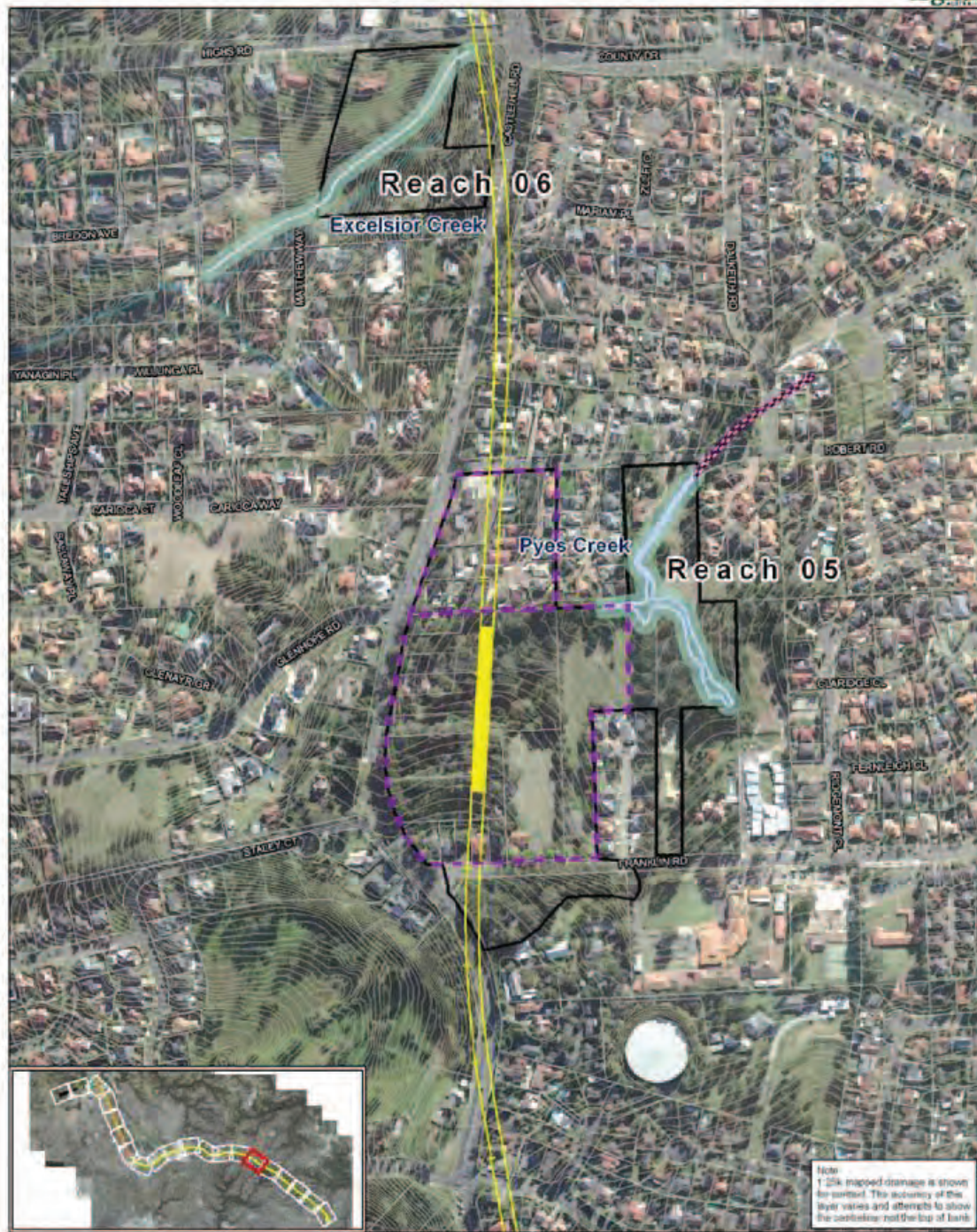


Tile 2: Cheltenham

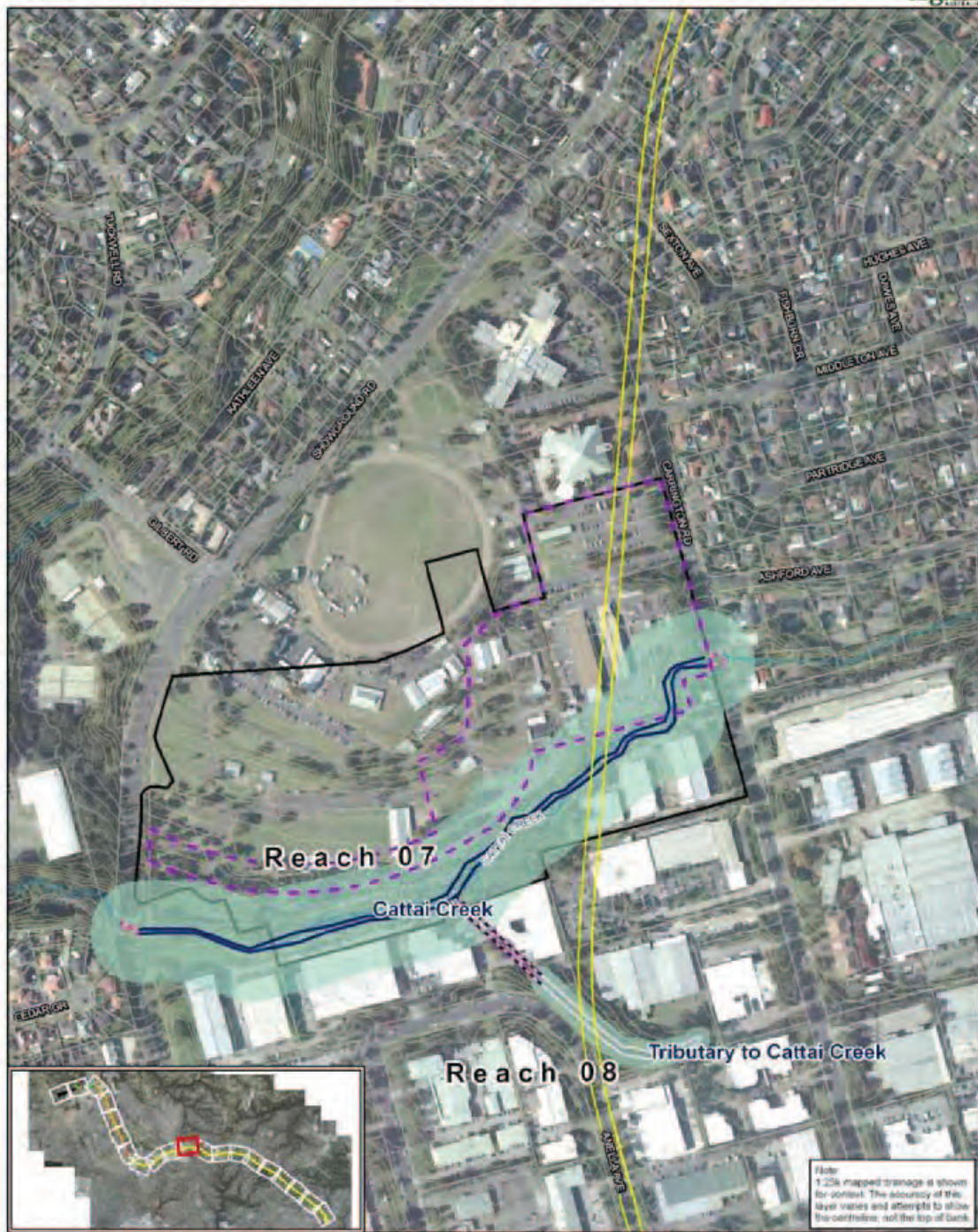


Tile 3: Beecroft - York Street





Tile 6: Cherrybrook Station



Note:
1:25k mapped drainage is shown
for context. The accuracy of this
layer varies and attempts to show
the centreline, not the top of bank.



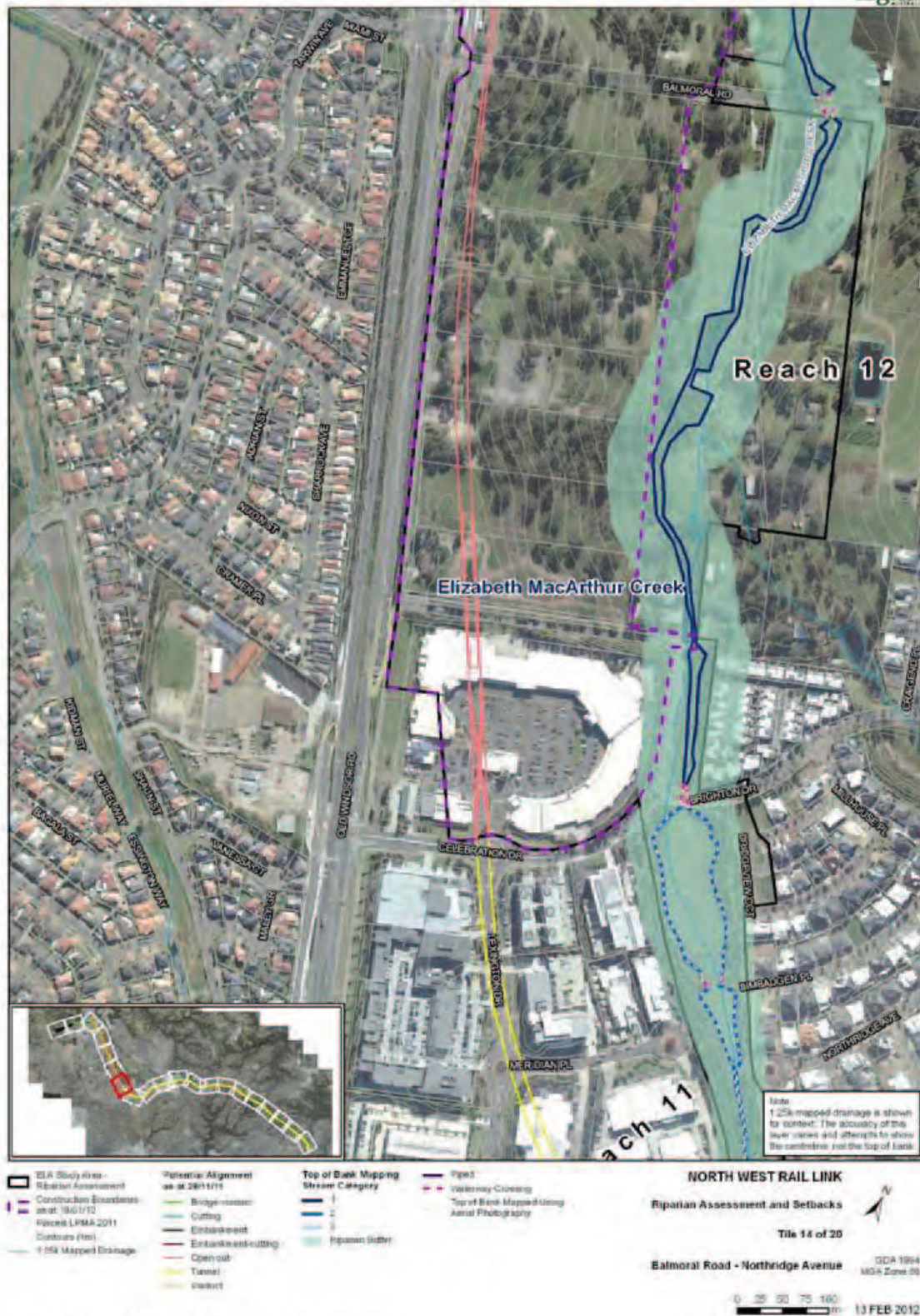
Tile 10: Hills Centre Station



Tile 12: Norwest Station



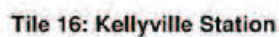
Tile 13: Northridge Avenue – Norwest Boulevard

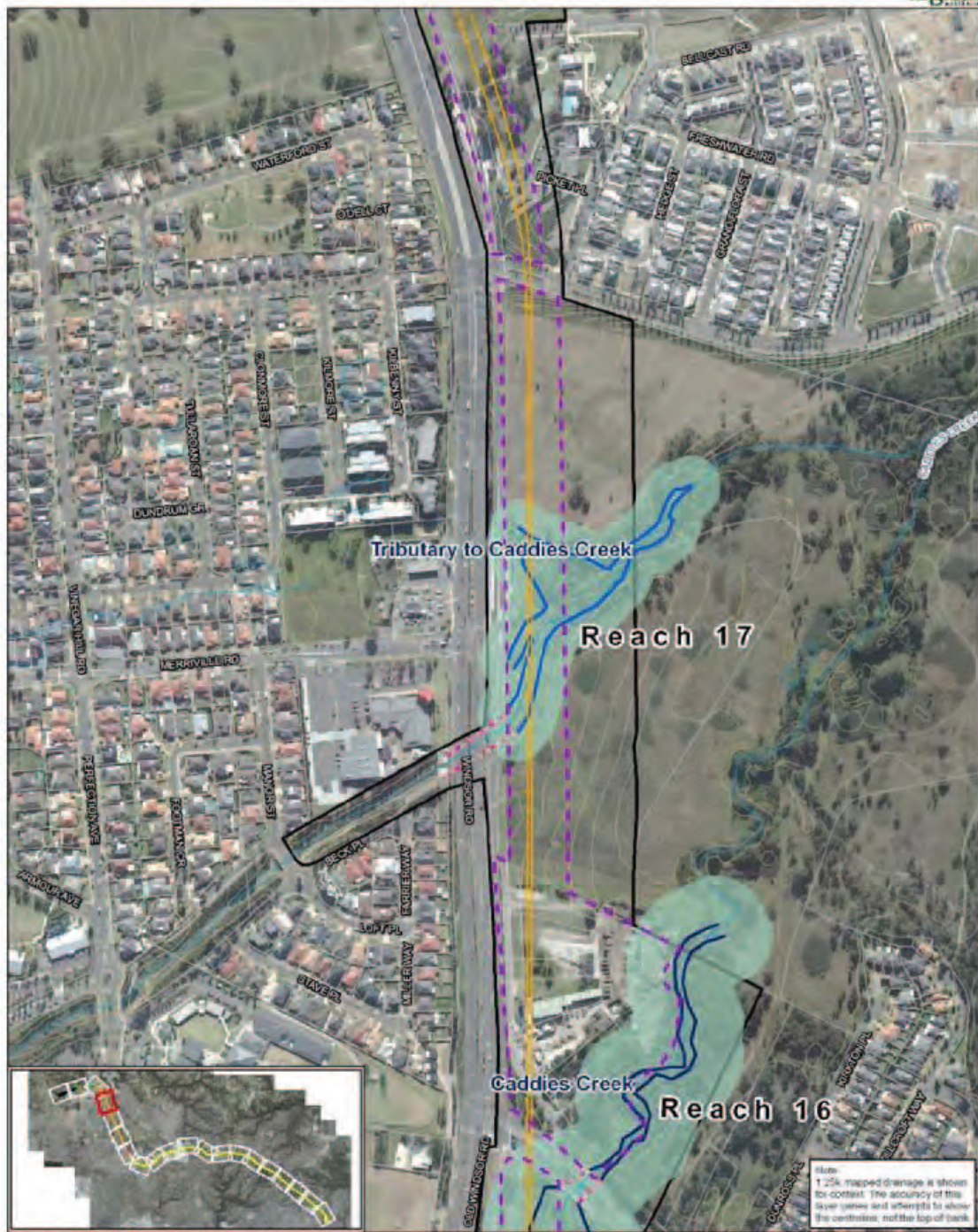


Tile 14: Balmoral Road – Northbridge Avenue

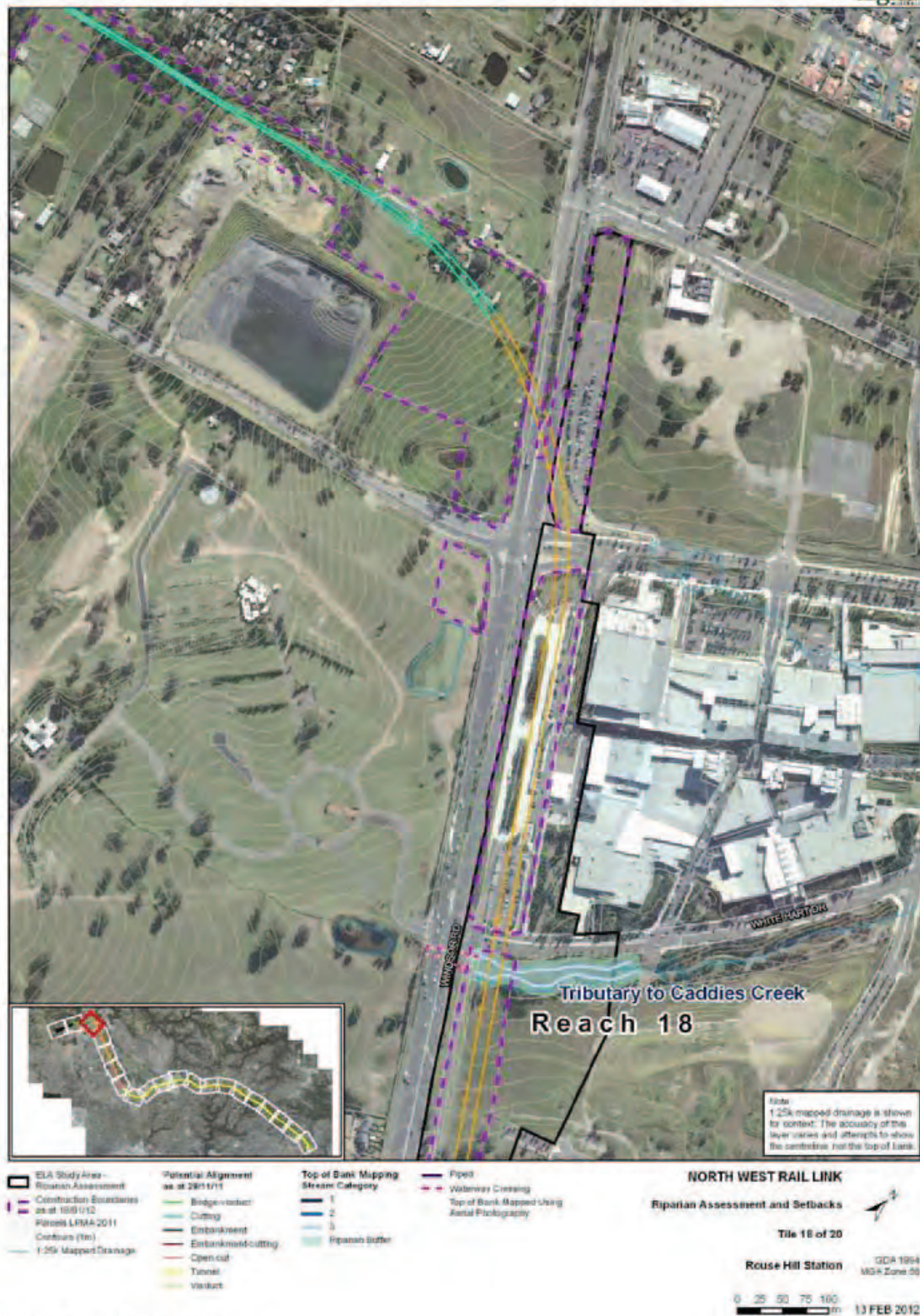


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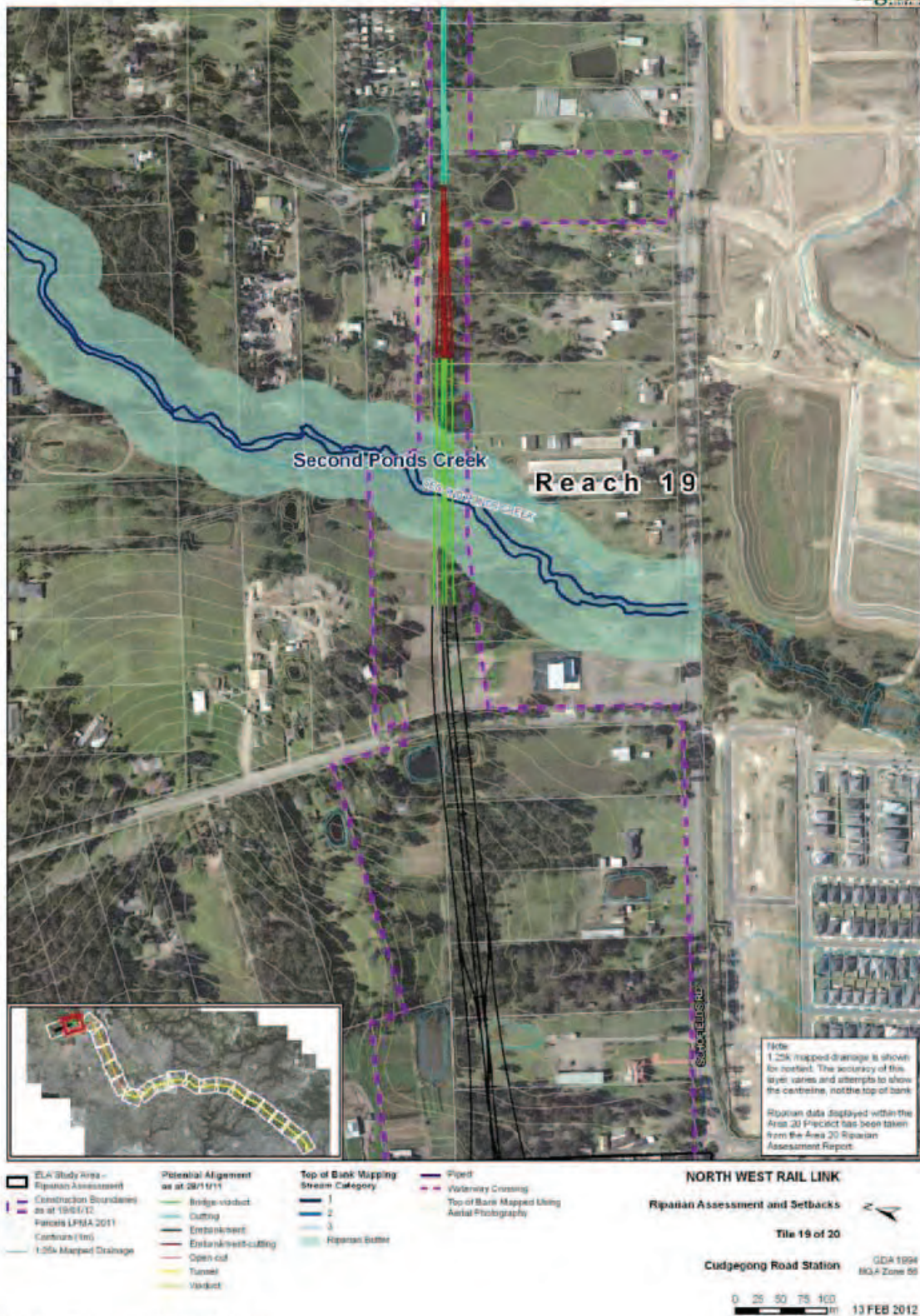




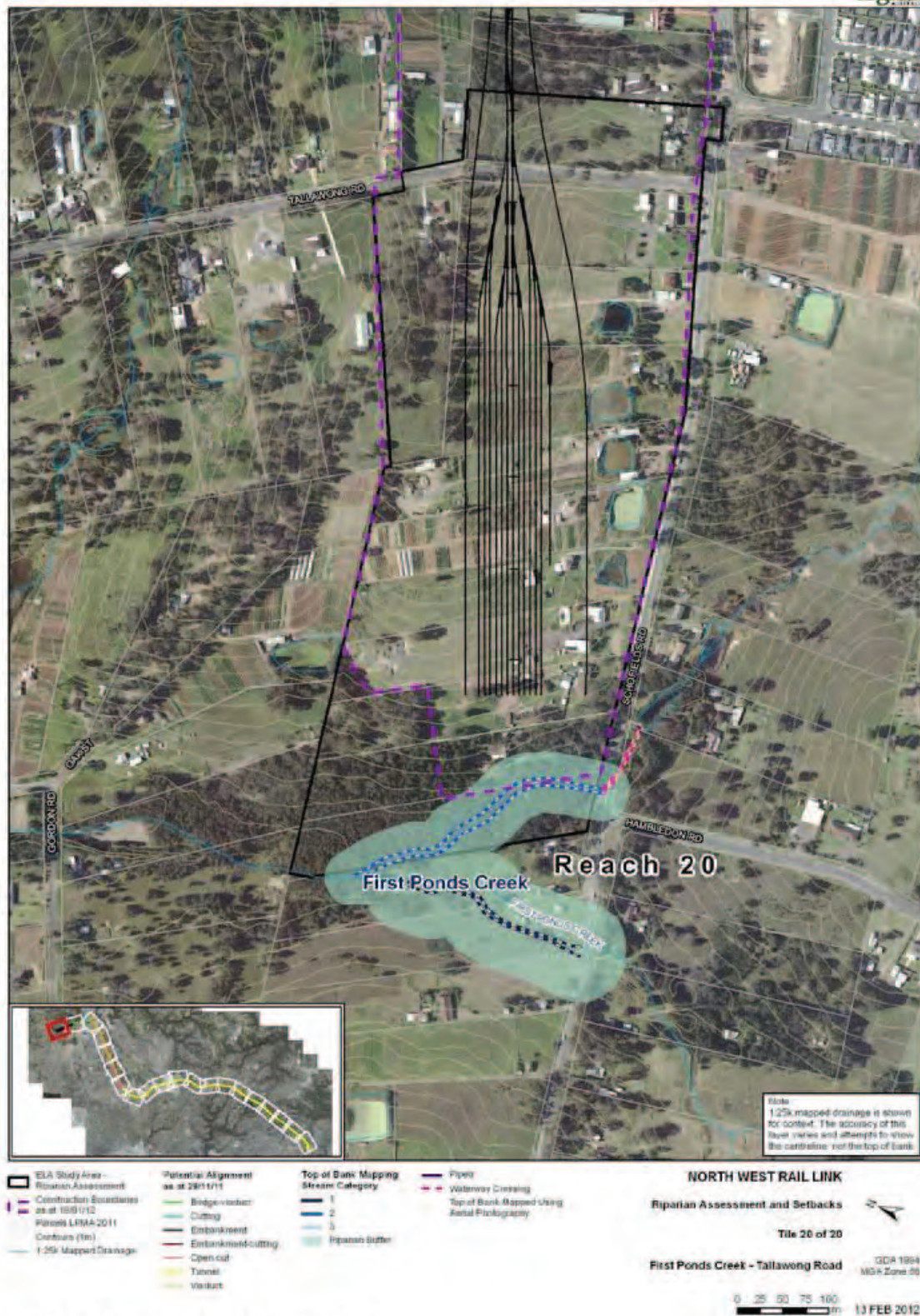
Tile 17: Windsor Road – Old Windsor Road



Tile 18: Rouse Hill Station



Tile 19: Cudgewong Road Station



Tile 20: First Ponds creek – Tallawong Road

Appendix B: Field Data Sheets

1) Rapid Assessment of Riparian Condition (DEWHA 2009)

	Largely unmodified	Slightly modified	Moderately modified	Substantially modified	Severely modified
Spatial Integrity	No or little evidence of broadscale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remain	Little or no remaining native vegetation
Nativeness	Vegetation predominantly native, few weeds and no 'high threat' species	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each similar to reference	Cover within one stratum up to 50% lower or higher than reference	One stratum missing or extra, cover within remaining strata 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (e.g. grassland shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present (juveniles, sub-adults and adults)	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (e.g. through collection of firewood, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

2) Eco Logical Australia: Rapid Assessment of Stream Condition

Site No:

RCMS category:

Waypoint:

Project: NWRL

Date:

Photos:

Hydrology

Type

Vegetated swamp/floodplain
Open water wetland
Billabong
Small drainage line
Braided channel
Creek
River
Estuary
Other

Channel Modification

Heavily modified (Concrete channel)
channel)
straightened)
straightened)
Unmodified

1
2
3
4
5

Fish Habitat Classification

(Fairfull & Witheridge 2003)

Class 1
Class 2
Class 3
Class 4

Physical Form

Bank Slope

<30
30-70
>70 or undercut
Channel incised

Ave
5
4
3
2

Erosion

Gully
Slump
Sheet
Undercut

% of

Water Quality and Aquatic Habitat

Connectivity

Major high flow barrier (e.g. large dam)
Numerous low flow barriers without fish passage
(farm dams and weirs)
One low flow barrier (e.g. farm dam or weir)
Minor barrier/s with fish passage during all flows
No barriers

1
2
3
4
5

Velocity

Stagnant
Slow (<0.1 m/s)
Medium (0.1-0.3 m/s)
Fast (0.3-0.7 m/s)
Very fast (>0.7 m/s)

1
2
3
4
5

Habitat

Riffle
Run
Pool

%

Aquatic Vegetation Richness (native & weed)

Absent
1 species
2 species
3 species
4+ species

1
2
3
4
5

Turbidity

Very turbid
Turbid
Moderate
Clear
Very clear

1
2
3
4
5

Native Aquatic Vegetation

Absent
Rare
Occasional
Common
Abundant

1
2
3
4
5

Wetted Width

Min-max
Average

m

Native Aquatic Vegetation Species (optional)

Depth

<10 cm
10-20 cm
20-30 cm
10-100 cm
>100 cm

Instream Woody Debris

Absent
Rare (e.g. 1 log/50 m)
Occasional
Common
Abundant (e.g. 5 logs/50 m)

1
2
3
4
5

Dominant instream substrate mix

Sub-dominant instream substrate mix
(e.g. rocks, cobble, gravel, sand, clay, silt)

Condition	Riparian	Stream	Overall
Not classified			
Degraded	1	1	1
Degraded-moderate	2	2	2
Moderate	3	3	3
Moderate-good	4	4	4
Good	5	5	5

Restoration Potential	Riparian	Stream	Overall
Not classified			
Low	1	1	1
Low-Moderate	2	2	2
Moderate	3	3	3
Moderate-Good	4	4	4
Good	5	5	5

3) Fish habitat classification (Fairfull & Witheridge 2003)

Classification	Characteristics of Waterway Type
Class 1 Major fish habitat	Major permanently or intermittently flowing waterway (e.g. river or major creek), habitat of a threatened fish species.
Class 2 Moderate fish habitat	Named permanent or intermittent stream, creek or waterway with clearly defined bed and banks with semi-permanent to permanent waters in pools or in connected wetland areas. Marine or freshwater aquatic vegetation is present. Known fish habitat and/or fish observed inhabiting the area.
Class 3 Minimal fish habitat	Named or unnamed waterway with intermittent flow and potential refuge, breeding or feeding areas for some aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or recognised aquatic habitats.
Class 4 Unlikely fish habitat	Named or unnamed waterway with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or free standing water or pools after rain events (e.g. dry gullies or shallow floodplain depressions with no permanent aquatic flora present).

Appendix C: Reach Site Profiles

The following pages provided site profiles for each of the 20 study reaches. A guide to terminology is below.

Site Profile Guide

Location: Provides coordinates for the location of the crossing.

Rail structure and works: Outlines the method of construction used to create the rail line and any other permanent infrastructure.

RCMS Category: RCMS classification based on the field work undertaken for this assessment.

Riparian connectivity value: An assessed value of the connectivity of the riparian areas in a broader context

Summary: Summary of riparian and aquatic condition, potential impacts and recommended mitigation.

Riparian Habitat

Condition: Riparian habitat condition rated either near intact, good, moderate or degraded.

Restoration potential: Riparian recovery potential rated very high, high, moderate, or low.

Connectivity value: Value of riparian habitat to facilitate species movement.

Spatial integrity: Ranks integrity of riparian vegetation associations within riparian areas.

Nativeness: Ranks riparian vegetation based on the proportion of 'nativeness'.

Structural integrity: Ranks number of strata represented in riparian vegetation based on a reference community.

Age structure: Ranks age structure of riparian vegetation for each of the strata present (juveniles, sub-adults, and adults).

Debris: Ranks amount of debris within riparian vegetation based on a reference community.

Aquatic Habitat

Condition: Aquatic habitat condition rated either near intact, good, moderate or degraded.

Restoration potential: Riparian receiver potential rated very high, high, moderate, or low.

Fish habitat: Fish habitat classification as per Fairfull & Witheridge (2003). Habitat ranked as major fish habitat, moderate fish habitat, minimal fish habitat and unlikely fish habitat.

Hydrology: Hydrology type (creek, river, estuary etc) and description of changes to hydrological condition.

Physical form: Description of bank slope and severity of erosion.

Water quality: Description of water velocity and turbidity.

Habitat variability: Description of aquatic habitat (riffle, pools and runs, etc).

Aquatic flora: Description of dominant vegetation species (native and non-native) in aquatic areas

Site: Reach 01, Tributary to Devlins Creek (Edensor St)

Location: -33.7681351245, 151.08098517

Rail structure and works: Bored tunnel; surface works; groundwater discharge to creek

RCMS Category: 3

Stream Order: 1

Riparian connectivity value: Low

Summary:

The riparian and aquatic habitats are highly disturbed along the entirety of this reach. Urban development has transformed the creek into a concrete/brick channel. Riparian vegetation is mostly absent on the left bank due to residential units. The right bank is mostly regrowth bushland but does not function as a true riparian zone that benefits aquatic health because of the sealed channel (e.g. no roots can penetrate the channel to provide aquatic habitat). The greatest value of the reach is this bushland which forms a narrow suburban green corridor through Epping. The creek has little aquatic value and limited biotic functions to naturally improve water quality. The proposed rail alignment at this reach will be a bored tunnel (**Tile 01**). A small area for above ground services will partially be located within the riparian buffer. The tunnel will have minimal impacts on Reach 01, but impacts arising from associated construction areas may include surface erosion and spread of weeds. Tunnel construction operations (Epping Services Facility) may discharge groundwater into the creek at a rate of 432,000 L per day. Recommendations to mitigate impacts of water discharge during construction and operation are provided in **Sections 5.3 and 5.4**.

01. Riparian Habitat

Condition:

Degraded

Restoration

Potential:

Low

Connectivity Value:

Low



Spatial Integrity - Only small patches of well-separated native vegetation remain

Nativeness - One or more strata dominated by exotic species, 'high threat' species present

Structural Integrity - One stratum missing or extra, cover within remaining strata 50% lower or higher than natural

Age Structure - Reduced cover (75-50%) of canopy, and only one age class present

Debris - Very small quantities of debris present

01. Aquatic Habitat**Condition:**

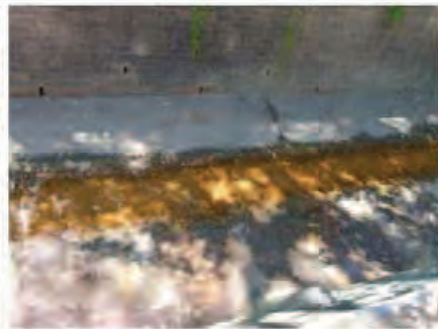
Degraded

Restoration**Potential:**

Low

Fish Habitat:

Class 4, Unlikely

**Hydrology** - Large creek; urban/bush catchment**Physical form** - Steep concrete/brick channel**Water quality** - Very clear; urban runoff**Habitat variability** - Homogenous concrete channel 3m wide; 100% run; no woody debris**Aquatic flora** - Absent

Site: Reach 02, Devlins Creek (downstream of M2)

Location: -33.7617347482, 151.072258984

Rail structure and works: Bored tunnel; surface works; groundwater discharge to creek

RCMS Category: 1

Stream Order: 3

Riparian connectivity value: High

Summary:

Devlins Creek is a large tributary of Lane Cove River that dissects Beecroft, Cheltenham and North Epping. It connects several bushland reserves with Lane Cove National Park. Devlins Creek and the surrounding reserves have a long history of bush regeneration and recreation. The most recent impacts to the creek are due to the construction and more recent upgrade of the M2 Motorway, which traverses Reach 02 and follows its right bank. The riparian zone is in moderate condition and has high potential for restoration. The aquatic habitat is in good condition and also has high potential for restoration. The proposed rail alignment at this reach will be a bored tunnel. Potential impacts to the creek's water-holding capacity may occur if the tunnelling creates small rock fractures causing water leaching. Any cracks formed within the stream beds due to tunnelling would be expected to eventually fill with fine material (alluvium) once the tunnel lining is installed, and no long term impacts to the stream surface flows are anticipated. A construction staging area is proposed for the bushland to the west of Cheltenham Oval and does not encroach into the riparian buffer zone (**Tile 02**). Groundwater will not be discharged from this site. Other construction impacts may include weeds, erosion and sedimentation of the creek and riparian zone (due to minor surface runoff).

02. Riparian Habitat

Condition:

Moderate

Restoration

Potential:

High

Connectivity Value:

High



Spatial Integrity - Width reduced by up to 1/3 and/or some breaks in continuity

Nativeness - One or more strata dominated by exotic species, 'high threat' species present

Structural Integrity - Cover within one stratum up to 50% lower or higher than natural

Age Structure - Reduced cover (75-50%) of canopy, and only one age class present

Debris - Quantities and/or cover 50% higher or lower than normal

02: Aquatic Habitat**Condition:**

Good

Restoration**Potential:**

High

Fish Habitat:

Class 2, Moderate



Hydrology - Large creek; urban/bush catchment

Physical form - Mostly natural banks except where M2 lies directly on right bank; culvert upstream; bank slope 30-70°; 40% undercut

Water quality - Moderate clarity; urban/bush runoff

Habitat variability - Variable pools, runs and riffles; width 1-8m; variable substrate; woody debris rare

Aquatic flora - One native species present but rare

Site: Reach 03, Tributary to Devlins Creek (Chilworth/Beecroft Reserve)

Location: -33.7550249846, 151.062544106

Rail structure and works: Bored tunnel

RCMS Category: 1

Stream Order: 1

Riparian connectivity value: High

Summary:

This small tributary of Devlins Creek runs through Chilworth and Beecroft Reserves. The riparian zone is intact and well protected with a forested surrounding. Nearby residential blocks may occasionally put pressure on the creek through weeds, sediment and water quality. The creek is a steep series of narrow rocky ledges with intermittent flows during rain events only. The aquatic habitat is in good condition (albeit dry at the time of survey). The proposed rail alignment at this reach will be a bored tunnel (**Tile 03**). The tunnel will have no surface impacts on Reach 03. Potential impacts to the creek's water-holding capacity may occur if the tunnelling creates small rock fractures causing water leaching. However, due to the steepness and ephemeral nature of the creek, water flows would be fast and intermittent. At best, instream micro-topography may create small rock pools valuable to frogs and some aquatic insects. Cracks would be expected to eventually fill with fine material (alluvium) once the tunnel lining is installed, and no long term impacts to the stream surface flows are anticipated.

03. Riparian Habitat

Condition:

Near intact

Restoration

Potential:

Very High

Connectivity Value:

High



Spatial Integrity - No or little evidence of broadscale loss of native vegetation

Nativeness - Vegetation predominantly native, few weeds and no 'high threat' species

Structural Integrity - Cover within one stratum up to 50% lower or higher than natural

Age Structure - Reduced cover (75-50%) of canopy, and/or only two age classes present

Debris - Some evidence of unnatural loss of debris

03. Aquatic Habitat**Condition:**

Moderate

Restoration**Potential:**

Moderate

Fish Habitat:

Class 3, Minimal



Hydrology - Large Medium size intermittent creek; urban catchment

Physical form - Steep incised toe of banks; banks 30-70°; 25% undercut; culvert downstream

Water quality - Moderate clarity; urban/reserve runoff

Habitat variability - Variable pools and riffles; width 0.5-2.5m; shallow water; rocky substrate; woody debris rare

Aquatic flora - Absent

Site: Reach 04, Devlins Creek (Fearnley Park)

Location: -33.7506573034, 151.056007661

Rail structure and works: Bored tunnel

RCMS Category: 1

Stream Order: 2

Riparian connectivity value: High

Summary:

This reach forms the upper catchment of Devlins Creek in Fearnley Park. Upstream is a narrow riparian corridor surrounded closely by residential houses. Downstream is Pennant Hills Golf Course with a stabilised rocky channel and scattered Eucalypt habitat. Both the riparian zone and aquatic habitat are in moderate condition with urban pressures evident, especially weed invasion and some undercutting of banks due to fast flowing events. The rock and cobble substrate indicated that water flows swiftly during heavy rains, which is common in dense urban catchments. Aquatic flora did not occur, likely due to the steep banks and dense canopy shading the narrow channel. The value of this reach is likely important for frogs, reptiles and birds, especially as the corridor links urban bushland upstream and larger forest patches downstream. The riparian habitat has high restoration potential due to the adjacent reserve. However, the aquatic habitat has only moderate restoration potential due to the narrow channel, steep banks and sporadic fast flows.

The proposed rail alignment at this reach will be a bored tunnel (**Tile 04**). The tunnel will have no surface impacts on Reach 04. Potential impacts to the creek's water-holding capacity may occur if the tunnelling creates small rock fractures causing water leaching. Even though the creek would flow fast during heavy rain, the deep permanent pools would be at risk of draining if fissures occur. This would decrease the aquatic value to fauna dependant on permanent water, especially frogs. Any cracks formed within the stream beds due to tunnelling would be expected to eventually fill with fine material (alluvium) once the tunnel lining is installed, and no long term impacts to the stream surface flows are anticipated.

04. Riparian Habitat

Condition:

Moderate

Restoration

Potential:

High

Connectivity Value:

High



Spatial Integrity - Width reduced by up to 1/3 and/or some breaks in continuity

Nativeness - Exotic species present but not dominating any strata, 'high threat' species rare

Structural Integrity - Cover within one stratum up to 50% lower or higher than natural

Age Structure - Reduced cover (75-50%) of canopy, and/or only two age classes present

Debris - Some evidence of unnatural loss of debris

04. Aquatic Habitat

Condition:

Moderate

Restoration

Potential:

Moderate

Fish Habitat:

Class 3, Minimal



Hydrology - Medium size intermittent creek; urban catchment

Physical form - Steep incised toe of banks; banks 30-70°; 25% undercut; culvert downstream

Water quality - Moderate clarity; urban/reserve runoff

Habitat variability - Variable pools and riffles; width 0.5-2.5m; shallow water; rocky substrate; woody debris rare

Aquatic flora - Absent

Site: Reach 05, Pyas Creek (upstream of Roberts Road)

Location: -33.735043, 151.032714

Rail structure and works: Bored tunnel; surface works; water discharge to creek; Cherrybrook Station

RCMS Category: 3

Stream Order: 1

Riparian connectivity value: Moderate

Summary:

This reach upstream of Roberts Road is divided into an open-canopy narrow channel, a small woodland creek and numerous drainage depressions eroded through dense bushland. Downstream of the road the creek is piped for nearly a kilometre. The lower portion of the reach is highly degraded with dense weed cover and a narrow incised channel. Slashing of vegetation occurs close to the right bank. This area provides little aquatic and riparian value, although has moderate potential for restoration. The upper portion of the reach is in relatively better condition within a small woodland reserve. Habitat here is improved and variable compared to the lower portion. Drainage depressions within the surrounding bushland are straight and incised, indicating they have been intentionally dug as part of the surrounding residential development. Dense bushland helps slow the flow of overland water, thus preventing significant erosion downstream. The intersection of all drainage depressions with the creek occurs upstream of a small culvert (vehicle access track) and forms a small weedy swamp, with numerous frogs.

05. Riparian Habitat

Condition:

Degraded

Restoration

Potential:

Moderate

Connectivity Value:

Moderate



Spatial Integrity - About 50% of the native vegetation remains, either in strips or patches

Nativeness - One or more strata dominated by exotic species, 'high threat' species present

Structural Integrity - One stratum missing or extra, cover within remaining strata 50% lower or higher than natural

Age Structure - Reduced cover (<50%) of canopy, and only one age class present

Debris - Very small quantities of debris present

05. Aquatic Habitat

Condition:
Degraded-Moderate

**Restoration
Potential:**
Moderate

Fish Habitat:
Class 4, Unlikely



Hydrology - Very small creek with overland drainage paths; urban catchment

Physical form - Bank slope <30°; 10% undercut; downstream piped

Water quality - Moderate clarity; urban/reserve runoff

Habitat variability - Variable edge habitat; width 0.1-1.5m; very shallow; 90% run; occasional pools; woody debris rare

Aquatic flora - One exotic species present but rare

Site: Reach 06, Excelsior Creek (upstream of Highs Road)

Location: -33.734476, 151.027112

Rail structure and works: Bored tunnel

RCMS Category: 3

Stream Order: 1

Riparian connectivity value: Moderate

Summary:

This reach is a minor headwater gully with no aquatic habitat and limited riparian value. Regular slashing of the grass in and around the reach has prevented any understorey growth (besides lawn). Large *Eucalyptus* trees provide the most valuable terrestrial habitat, however these trees are not dependant on any waterway. The proposed rail alignment at this reach will be a bored tunnel (**Tile 06**). The tunnel will have no surface impacts on Reach 06. Potential impacts such as substrate cracking will not impact the reach as no aquatic habitat exists.

06. Riparian Habitat

Condition:

Degraded

Restoration

Potential:

Low

Connectivity Value:

Moderate



Spatial Integrity - About 50% of the native vegetation remains, either in strips or patches

Nativeness - One or more strata dominated by exotic species, 'high threat' species present

Structural Integrity - More than one stratum completely altered (lost or <10% remaining)

Age Structure - Reduced cover (75-50%) of canopy, and only one age class present

Debris - Very small quantities of debris present

06. Aquatic Habitat**Condition:**

Degraded

Restoration**Potential:**

Low

Fish Habitat:

Class 4, Unlikely



Hydrology - Small headwater drainage line; urban catchment

Physical form - Depression drainage gully with no defined channel in upper reach; gentle banks stabilised by lawn; no erosion

Water quality - No water; urban runoff

Habitat variability - No aquatic habitat

Aquatic flora - Absent

Site: Reach 07, Cattai Creek (upstream of Sorrowbund Road)

Location: -33.726947, 150.983424

Rail structure and works: Bored tunnel; surface works; water discharge to creek; Hills Centre Station

RCMS Category: 1

Stream Order: 2

Riparian connectivity value: High

Summary:

Cattai Creek is a large tributary of the Hawkesbury River. The location of Reach 07 is nearly at the headwaters of its catchment. The riparian zone is in moderate condition, with surrounding pressures from urban/semi-industrial land uses. The aquatic habitats were variable but condition was overall degraded-moderate. The rock and cobble substrate indicated that water flows swiftly during heavy rains, common in dense urban catchments. Aquatic flora did not occur, likely due to the steep banks and dense canopy shading the narrow channel. The value of this reach is likely important for frogs, reptiles and birds, especially as the corridor links urban bushland upstream and larger forest patches downstream. Although weeds dominate the riparian zone, it has high potential for restoration, especially due to its width and isolation from public access.

The proposed rail alignment will be a bored tunnel passing beneath Cattai Creek (**Tile 10**). The adjacent Hills Centre Station will be a cut and cover construction. Potential impacts to the creek's water-holding capacity may occur if the tunnel creates small rock fractures causing water leaching. Any cracks formed within the stream beds due to tunnelling would be expected to eventually fill with fine material (alluvium) once the tunnel lining is installed, and no long term impacts to the stream surface flows are anticipated. Tunnel construction operations may discharge groundwater into Cattai Creek at a rate of 1,728,000 L per day. Recommendations to mitigate impacts of water discharge during construction and operation are provided in **Sections 5.3** and **5.4**.

The alignment and construction footprint of the railway, station and car park may encroach the 50 m buffer zone from the top of bank therefore the risk of indirect impacts to the existing stream habitats are increased. Disturbances can be reduced by using sediment fences, off-stream settling ponds for runoff/discharge, and minimal night works involving excessive noise and large floodlights (a possible disruption to nocturnal birds, bats and mammals foraging in the riparian corridor). Post construction, or once cover is in place over the cut, revegetation and soil stabilisation works will be necessary to prevent surface erosion and sedimentation of the creek.

Other indirect impacts from the car park include pollution of water runoff (litter and motor vehicle oils), increased runoff velocity (risk of erosion) and spread of weeds (especially around fringes of the footprint). Installation of gross pollutant traps and construction of settling ponds (velocity control) will help control pollution and erosion. Construction of a series of macrophyte swamps between the footprint and the creek would improve frog habitat and help filter pollutants from the water.

07. Riparian Habitat

Condition:
Moderate

**Restoration
Potential:**
High

Connectivity Value:
High



Spatial Integrity - About 50% of the native vegetation remains, either in strips or patches

Nativeness - Most strata dominated by exotic species, 'high threat' species abundant

Structural Integrity - More than one stratum completely altered (lost or <10% remaining)

Age Structure - Reduced cover (75-50%) of canopy, and only one age class present

Debris - Very small quantities of debris present

07. Aquatic Habitat

Condition:
Degraded-Moderate

**Restoration
Potential:**
High

Fish Habitat:
Class 3, Minimal



Hydrology - Large creek; urban catchment

Physical form - Steep banks >70°; culverts upstream and downstream; 70% undercut

Water quality - Clear; urban runoff

Habitat variability - Variable riffles, runs and pools; gravel and rock substrate; up to 1m depth; 2-10m wide; woody debris rare

Aquatic flora - Absent

Site: Reach 08, Tributary to Cattai Creek (Anella Avenue)

Location: -33.727576, 150.981463

Rail structure and works: Bored tunnel

RCMS Category: 3

Stream Order: 1

Riparian connectivity value: Low

Summary:

This small tributary of Cattai Creek is a unique refuge albeit in a heavily modified landscape. Both upstream and downstream reaches are piped underground. The remaining central patch is surrounded by development but fenced from public access. This provides a small but isolated patch of dense riparian habitat. Access to the site was not possible, but vantage points from the neighbouring land provided sufficient views of the variable rocky aquatic habitat, suitable for frogs and reptiles. The riparian vegetation has a dense canopy with a weedy understorey, suitable for an array of birds.

The proposed rail alignment at this reach will be a bored tunnel (**Tile 10**). The tunnel will have no surface impacts on Reach 08. Potential impacts to the creek's water-holding capacity may occur if the tunnelling creates small rock fractures causing water leaching. Any permanent pools would be at risk of draining if fissures occur. This would decrease the aquatic value to fauna dependant on permanent water, especially frogs. Any cracks formed within the stream beds due to tunnelling would be expected to eventually fill with fine material (alluvium) once the tunnel lining is installed, and no long term impacts to the stream surface flows are anticipated.

08. Riparian Habitat

Condition:

Moderate

Restoration

Potential:

Moderate

Connectivity Value:

Low



Spatial Integrity - About 50% of the native vegetation remains, either in strips or patches

Nativeness - One or more strata dominated by exotic species, 'high threat' species present

Structural Integrity - One stratum missing or extra, cover within remaining strata 50% lower or higher than natural

Age Structure - Reduced cover (75-50%) of canopy, and/or only two age classes present

Debris - Natural quantities and cover present

08. Aquatic Habitat**Condition:**

Degraded

Restoration**Potential:**

Moderate

Fish Habitat:

Class 3, Minimal



Hydrology - Small creek with piped upper and lower reaches; urban catchment

Physical form - Natural stable banks; no erosion; bank slope 30-70°; piped upstream and downstream;

Water quality - Clear; some surface pollution; urban runoff

Habitat variability - Variable pools and riffles; width 0.5-2.5m; shallow water; rocky substrate; woody debris rare; groundcover invasion in narrow channel sections

Aquatic flora - Absent

Site: Reach 09, Lake of Strangers Creek (Norwest Boulevard)

Location: -33.732284, 150.965151

Rail structure and works: Bored tunnel

RCMS Category: 3

Stream Order: 1

Riparian connectivity value: Low

Summary:

This reach is greatly modified from its original form. Upstream of Norwest Boulevard the creek is piped beneath/adjacent to small landscaped ponds. Downstream of the road is a large artificial lake with some fringing reeds and riparian revegetation.

The proposed rail alignment at this reach will be a bored tunnel (**Tile 12**). The tunnel will have no surface impacts on Reach 09. Potential impacts such as substrate fracturing from vibrations may compromise the water-holding capability of the lake and result in impacts on habitat viability. Groundwater will not be discharged from this site.

09. Riparian Habitat

Condition:

Moderate

Restoration

Potential:

Moderate

Connectivity Value:

Low



Spatial Integrity - About 50% of the native vegetation remains, either in strips or patches

Nativeness - Vegetation predominantly native, few weeds and no 'high threat' species

Structural Integrity - Cover within one stratum up to 50% lower or higher than natural

Age Structure - Reduced cover (75-50%) of canopy, and only one age class present

Debris - Some evidence of unnatural loss of debris

09. Aquatic Habitat**Condition:**

Degraded

Restoration**Potential:**

Moderate

Fish Habitat:

Class 2, Moderate



Hydrology - Artificial lake with upper reaches piped; urban catchment

Physical form - Banks gentle and stabilised by rock armour; creek upstream of lake is piped under landscaped ponds and urban land

Water quality - Water moderately turbid; urban runoff

Habitat variability - Large open water lake; rock armour banks; fringing reeds common; some shading and root overhang from riparian trees

Aquatic flora - One native species common

Site: Reach 10, Tributary to Strangers Creek (Edgewater Drive)

Location: -33.736703, 150.956241

Rail structure and works: Bored tunnel

RCMS Category: 3

Stream Order: 1

Riparian connectivity value: Moderate

Summary:

This reach is greatly modified from its original form. Upstream of Norwest Boulevard the creek is piped beneath the suburb. Downstream of the road is a series of tiered artificial ponds with some fringing reeds and riparian revegetation. The stream bed is lined with concrete.

The proposed rail alignment at this reach will be a bored tunnel (**Tile 13**). The tunnel will have no surface impacts on Reach 10. Potential impacts such as concrete fracturing from vibrations may compromise the water-holding capability of the creek and result in impacts on habitat viability. Groundwater will not be discharged from this site.

10. Riparian Habitat

Condition:

Moderate

Restoration

Potential:

Moderate

Connectivity Value:

Moderate



Spatial Integrity - About 50% of the native vegetation remains, either in strips or patches

Nativeness - Vegetation predominantly native, few weeds and no 'high threat' species

Structural Integrity - Cover within one stratum up to 50% lower or higher than natural

Age Structure - Reduced cover (75-50%) of canopy, and only one age class present

Debris - Some evidence of unnatural loss of debris

10. Aquatic Habitat**Condition:**

Moderate

Restoration**Potential:**

Moderate

Fish Habitat:

Class 3, Minimal



Hydrology - Artificial tiered ponds; urban catchment

Physical form - Gentle banks with concrete edge lining; no erosion; piped upstream

Water quality - Clear; urban runoff

Habitat variability - Variable reed and rock habitat; some shading from riparian trees; mostly shallow concrete pools

Aquatic flora - Four native species common

Site: Reach 11, Elizabeth Macarthur Creek (Norwest Boulevard to Celebration Drive)

Location: -33.733065, 150.948547

Rail structure and works: Bored tunnel; open cut; Bella Vista Station

RCMS Category: 1

Stream Order: 2

Riparian connectivity value: High

Summary:

This reach comprises of upstream and downstream portions of a rehabilitated stream channel centred by a large artificial lake. Both types have well-established reeds, shrubs and trees and form the headwaters of Elizabeth Macarthur Creek.

The proposed rail alignment at this reach will be a bored tunnel, raising to open cut and entering Bella Vista Station (**Tiles 13 and 14**). The tunnel will have no surface impacts on Reach 11. Potential impacts such as concrete fracturing from vibrations may compromise the water-holding capability of the creek and result in impacts on habitat viability. Any cracks formed within the stream beds due to tunnelling would be expected to eventually fill with fine material (alluvium) once the tunnel lining is installed, and no long term impacts to the stream surface flows are anticipated. Groundwater will not be discharged from this site.

11. Riparian Habitat

Condition:

Moderate

Restoration

Potential:

Very High

Connectivity Value:

High



Spatial Integrity - About 50% of the native vegetation remains, either in strips or patches

Nativeness - Exotic species present but not dominating any strata, 'high threat' species rare

Structural Integrity - One stratum missing or extra, cover within remaining strata 50% lower or higher than natural

Age Structure - Reduced cover (<50%) of canopy, and only one age class present

Debris - Very small quantities of debris present

11. Aquatic Habitat**Condition:**

Moderate

Restoration**Potential:**

Moderate

Fish Habitat:

Class 3, Minimal



Hydrology - Small creek with central lake; urban catchment

Physical form - Rehabilitated rocky channel with artificial lake; several culverts; gentle stable banks <30°

Water quality - Moderate clarity; urban runoff

Habitat variability - Variable shallow rocky channels 1-2m wide to large open water deep lake; woody debris absent

Aquatic flora - One native species common

Site: Reach 12, Elizabeth Macarthur Creek (Celebration Drive to Balmoral Road)

Location: -33.726799, 150.944562

Rail structure and works: Open cut; support site

RCMS Category: 1

Stream Order: 2

Riparian connectivity value: High

Summary:

This reach of Elizabeth Macarthur Creek has a mostly degraded riparian zone, with clearing up to the bank and weed invasion common. However, small patches of good riparian vegetation do occur. With good management this reach has very high potential for riparian restoration. Even in its mostly degraded state it is still of value as it contributes to a long green corridor that will eventually be constricted by development. Numerous small dams scatter the reach, which break the hydrological connectivity for fish movement. The aquatic habitat is in moderate condition and restoration potential instream is moderate.

The proposed rail alignment at this reach will be open cut construction running adjacent to Old Windsor Road (**Tile 14**). A construction plant (manufacture of precast concrete tunnel lining and viaduct platforms) is proposed for the area near Elizabeth Macarthur Creek. This construction footprint is within the 50 m buffer zone from the top of bank, therefore the plant increases the risk of impacts to riparian and aquatic habitats. Impacts during construction can be controlled by adequate sediment fences, off-stream settling ponds for runoff/discharge, and minimal night works involving excessive noise and large floodlights (a possible disruption to nocturnal birds, bats and mammals foraging in the riparian corridor). Post construction, revegetation and soil stabilisation works will be necessary to prevent surface erosion and sedimentation of the creek.

12. Riparian Habitat

Condition:

Degraded

Restoration

Potential:

Very High

Connectivity Value:

High



Spatial Integrity - Only small patches of well-separated native vegetation remain

Nativeness - One or more strata dominated by exotic species, 'high threat' species present

Structural Integrity - More than one stratum completely altered (lost or <10% remaining)

Age Structure - Reduced cover (75-50%) of canopy, and only one age class present

Debris - Very small quantities of debris present

12. Aquatic Habitat

Condition:

Moderate

Restoration

Potential:

Moderate

Fish Habitat:

Class 3, Minimal



Hydrology - Small creek with two instream dams; urban/rural catchment

Physical form - Banks mostly stable, slope 30-70°; 10% undercut; culverts upstream and downstream

Water quality - Turbid water; urban/rural runoff

Habitat variability - Variable riffles, runs and pools; mostly clay substrate; 0-5-10m wide; variable depths and edge habitat; woody debris rare

Aquatic flora - Three native species common

Site: Reach 13, Elizabeth Macarthur Creek (Balmoral Road to Burns Road)

Location: -33.721711, 150.942901

Rail structure and works: Open cut; embankment; viaduct; service road

RCMS Category: 1

Stream Order: 2

Riparian connectivity value: High

Summary:

This reach of Elizabeth Macarthur Creek has a mostly degraded riparian zone, with clearing up to the bank and weed invasion common. With good management this reach has very high potential for riparian restoration. Even in its mostly degraded state it is still of value as it contributes to a long corridor that will eventually be constricted by development. Numerous weedy swamps scatter the reach, which breaks the hydrological connectivity for fish movement. The aquatic habitat is also degraded and restoration potential instream is moderate.

The proposed rail alignment at this reach will be partly open cut and partly elevated viaduct, connected by a short embankment (**Tiles 14-15**). A construction road will be created adjacent to the viaduct section. A small area of the construction footprint is within the 50 m buffer zone from the top of bank, therefore it increases the risk of impacts to riparian and aquatic habitats. Disturbances can be reduced by using sediment fences, off-stream settling ponds for runoff/discharge, and minimal night works involving excessive noise and large floodlights (a possible disruption to nocturnal birds, bats and mammals foraging in the riparian corridor). Post construction, revegetation and soil stabilisation works will be necessary to prevent surface erosion and sedimentation of the creek.

Other indirect impacts include pollution of water runoff (litter and motor vehicle oils), increased runoff velocity (risk of erosion) and spread of weeds (especially around fringes of footprint). Installation of gross pollutant traps and construction of settling ponds (velocity control) will help control pollution and erosion. Construction of a series of macrophyte swamps between the footprint and the creek would improve frog habitat and help filter pollutants from the water.

13. Riparian Habitat

Condition:

Degraded

Restoration

Potential:

Very High

Connectivity Value:

High



Spatial Integrity - Only small patches of well-separated native vegetation remain

Nativeness - Few native species remaining, cover dominated by exotic species

Structural Integrity - More than one stratum completely altered (lost or <10% remaining)

Age Structure - Canopy mostly absent

Debris - Debris mostly absent or completely dominating the sites, with little or no living vegetation

13. Aquatic Habitat

Condition:

Degraded

Restoration

Potential:

Moderate

Fish Habitat:

Class 3, Minimal



Hydrology - Small creek with swamp and straighten channel mix; urban/rural catchment

Physical form - Banks mostly stable, slope 30-70°; culverts upstream and downstream

Water quality - Moderate clarity; urban/rural runoff

Habitat variability - Mix of straight narrow channels and wide dense macrophyte swamps; woody debris rare

Aquatic flora - One native species abundant

Site: Reach 14, Elizabeth Macarthur Creek (Burns Road to Samantha Riley Drive)

Location: -33.714995, 150.938061

Rail structure and works: Viaduct; service road; Kellyville Station

RCMS Category: 1

Stream Order: 2

Riparian connectivity value: High

Summary:

This reach of Elizabeth Macarthur Creek is in mostly moderate condition. The riparian zone is generally uncleared, but with a weedy understorey common. With good management this reach has very high potential for riparian restoration. This reach is of great value as it contributes to a long corridor that will eventually be constricted by development. In the southern portion of the reach several small dams and swamps break the hydrological connectivity for fish movement. Restoration potential for instream habitat is high, due to its mostly unmodified channel and stable banks.

The proposed rail alignment at this reach will be an elevated viaduct adjacent to Old Windsor Road (**Tiles 15-16**). A construction road will be created adjacent to the viaduct. Kellyville Station will be located near the north of this reach, and may include a car park. A small area of the construction footprint is within the 50 m buffer zone from the top of bank, therefore it increases the risk of impacts to riparian and aquatic habitats. Disturbances can be reduced by using sediment fences, off-stream settling ponds for runoff/discharge, and minimal night works involving excessive noise and large floodlights (a possible disruption to nocturnal birds, bats and mammals foraging in the riparian corridor). Post construction, revegetation and soil stabilisation works will be necessary to prevent surface erosion and sedimentation of the creek.

Other indirect impacts include pollution of water runoff (litter and motor vehicle oils), increased runoff velocity (risk of erosion) and spread of weeds (especially around fringes of footprint). Installation of gross pollutant traps and construction of settling ponds (velocity control) will help control pollution and erosion. Construction of a series of macrophyte swamps between the footprint and the creek would improve frog habitat and help filter pollutants from the water.

14. Riparian Habitat

Condition:

Moderate

Restoration

Potential:

Very High

Connectivity Value:

High



Spatial Integrity - About 50% of the native vegetation remains, either in strips or patches

Nativeness - One or more strata dominated by exotic species, 'high threat' species present

Structural Integrity - One stratum missing or extra, cover within remaining strata 50% lower or higher than natural

Age Structure - Reduced cover (75-50%) of canopy, and/or only two age classes present

Debris - Quantities and/or cover 50% higher or lower than normal

14. Aquatic Habitat

Condition:

Moderate

Restoration

Potential:

High

Fish Habitat:

Class 3, Minimal



Hydrology - Medium size creek with two instream dams; urban/rural catchment

Physical form - Variable bank slope <30-70°; 20% undercut, 5% slumped; culverts upstream and downstream

Water quality - Turbid water; urban/rural runoff

Habitat variability - Long continuous narrow channel with one macrophyte swamp and artificial open water pool; homogenous clay substrate; woody debris rare

Aquatic flora - One native species occasional

Site: Reach 15, Elizabeth Macarthur Creek (Samantha Filley Drive to Windsor Road)

Location: -33.708214, 150.932521

Rail structure and works: Viaduct; service road

RCMS Category: 1

Stream Order: 3

Riparian connectivity value: High

Summary:

This reach of Elizabeth Macarthur Creek varies in condition, with a degraded riparian zone to the south and a moderate riparian zone to the north. Clearing and continued slashing to the bank is common. Weeds are abundant, except under areas with dense canopy cover. With good management this reach has very high potential for riparian restoration. Even in its partly degraded state it is still of value as it contributes to the long corridor, however this will eventually be constricted by development. Aquatic habitat is in moderate condition and restoration potential instream is high, especially if coinciding with riparian restoration.

The proposed rail alignment at this reach will be an elevated viaduct running along the floodplain on the left bank (**Tile 16**). The elevated viaduct will enter the 50 m buffer zone from the top of bank and cross the channel twice, therefore it increases the risk of impacts to riparian and aquatic habitats. A construction road will also be created adjacent to the viaduct. Impacts during construction can be controlled by adequate sediment fences (downslope of cleared areas during construction), and minimal night works involving excessive noise and large floodlights (a possible disruption to nocturnal birds, bats and mammals foraging in the riparian corridor).

Special attention should be paid to the northern-most area where a large wetland exists west of the creek. Care should be taken to prevent surface erosion and sedimentation of the wetland from construction activities. Due to the elevated nature of the viaduct, the rail-channel crossings will not impede on the riparian and aquatic connectivity values of the reach. However, the loss of some trees at these crossings should be compensated for by restoring the southern section of the reach to improve the greater riparian corridor. Footings should not be placed within the channel and spaced as far away from the banks as practical. Post construction of the viaduct footings revegetation and soil stabilisation works will be necessary to prevent surface erosion and sedimentation of the creek.

15. Riparian Habitat

Condition:
Degraded-Moderate

**Restoration
Potential:**
Very High

Connectivity Value:
High



Spatial Integrity - Only small patches of well-separated native vegetation remain

Nativeness - One or more strata dominated by exotic species, 'high threat' species present

Structural Integrity - One stratum missing or extra, cover within remaining strata 50% lower or higher than natural

Age Structure - Reduced cover (<50%) of canopy, and only one age class present

Debris - Very small quantities of debris present

15. Aquatic Habitat

Condition:
Moderate

**Restoration
Potential:**
High

Fish Habitat:
Class 3, Minimal



Hydrology - Medium size creek with two dams and several piped tributaries; urban/rural catchment

Physical form - Variable bank slope 30-90°; 70% undercut, 10% slumped; culverts upstream and downstream; numerous inflowing pipes to eroded pools

Water quality - Moderate clarity; urban/rural runoff

Habitat variability - Long continuous channel 1-10m wide with occasional pools and riffles near culvert inlets; mix of shaded and exposed water; mostly clay substrate; poor bank habitat; woody debris occasional

Aquatic flora - Four native species occasional

Site: Reach 16, Caddies Creek (downstream Windsor Road)

Location: -33.703167, 150.932334

Rail structure and works: Viaduct; service road; support site

RCMS Category: 1

Stream Order: 3

Riparian connectivity value: High

Summary:

This reach of Caddies Creek is in moderate condition. The left bank is highly disturbed in parts due to the adjacent land use. The right bank is relatively intact with a good cover of riparian trees and adjacent woodland. Understorey weeds are prevalent. With good management this reach has very high potential for riparian restoration. The reach is of great value as it contributes to a long green corridor that will eventually be constricted by development. The aquatic habitat is substantially vaster compared to that upstream in Elizabeth Macarthur Creek. Large carp were observed swimming here. The aquatic habitat is in moderate condition and restoration potential instream is high.

The proposed rail alignment at this reach will be an elevated viaduct adjacent to Windsor Road (**Tile 17**). A construction road will be created adjacent to the viaduct and a support site (material storage and offices) will be located between Windsor Road and Caddies Creek. The footprint of the support site is within the 50 m buffer zone from the top of bank, which increases the risk of impacts to riparian and aquatic habitats. The proposed support site appears to include most of the left bank and some of the channel. The proximity of the footprint to the stream is inappropriate and any material storage and facilities should be set outside the riparian buffer. Disturbances can be reduced by recognising a buffer zone, using sediment fences, off-stream settling ponds for runoff/discharge, and minimal night works involving excessive noise and large floodlights (a possible disruption to nocturnal birds, bats and mammals foraging in the riparian corridor). Post construction, revegetation and soil stabilisation works will be necessary to prevent surface erosion and sedimentation of the creek.

16. Riparian Habitat

Condition:

Moderate

Restoration Potential:

High

Connectivity Value:

High



Spatial Integrity - About 50% of the native vegetation remains, either in strips or patches

Nativeness - One or more strata dominated by exotic species, 'high threat' species present

Structural Integrity - More than one stratum completely altered (lost or <10% remaining)

Age Structure - Reduced cover (<50%) of canopy, and only one age class present

Debris - Very small quantities of debris present



Hydrology - Medium size creek; urban/rural catchment

Physical form - Steep banks >70°; 40% undercut; culvert upstream

Water quality - Turbid still water; urban/rural runoff

Habitat variability - Long continuous channel 0.5-8m wide; up to 1m deep; good overhanging trees; homogenous clay substrate; carp observed

Aquatic flora - One native species present but rare

Site: Reach 17, Tributary to Caddies Creek (opposite Ettamogah Pub)

Location: -33.699623, 150.929662

Rail structure and works: Viaduct; service road

RCMS Category: 2

Stream Order: 1

Riparian connectivity value: Moderate

Summary:

This small tributary to Caddies Creek is in degraded-moderate condition. The sections that receive inflows from three culverts beneath Windsor Road are highly degraded, with no riparian vegetation and dense *Typha* and Blackberry stands within the channel. Further downstream, the riparian zone is in moderate condition with occasional weeds and some regeneration. Despite its condition, the reach has high potential for riparian restoration, especially if providing a wider vegetation corridor. The connectivity value of the riparian zone is important from a downstream perspective (links to The Outlook Nature Reserve). However from an upstream perspective, Windsor Road creates a significant break in riparian connectivity to the engineered upper reaches of this creek. Overall in Reach 17, the aquatic habitat is in degraded-moderate condition, with only small patches of valuable instream habitat. Restoration potential instream is low-moderate, with greater potential downstream.

The proposed rail alignment at this reach is an elevated viaduct with one crossing over the upper extent of the reach (**Tile 18**). Therefore, the alignment will enter the 30 m riparian buffer zone. This crossing will dissect the three channels inflowing from culverts beneath Windsor Road. Here, the reach is highly degraded and due to the close proximity of Windsor Road and the existing culverts upstream, potential impacts from this crossing would be indistinguishable from that already present. However, mitigation measures to prevent disturbance downstream during construction are still warranted. This includes: avoiding viaduct footings instream, as this may change the hydrology and increase bank scouring; installation of erosion and sediment control fences during construction; minimal night works involving excessive noise and large floodlights (a possible disruption to nocturnal birds, bats and mammals foraging in the riparian corridor); and revegetation or stabilisation of disturbed areas post construction. Weed control within the footprint will reduce transportation of propagules downstream.

17. Riparian Habitat

Condition:
Degraded- Moderate

**Restoration
Potential:**
High

Connectivity Value:
Moderate



Spatial Integrity - Only small patches of well-separated native vegetation remain

Nativeness - Most strata dominated by exotic species, 'high threat' species abundant

Structural Integrity - More than one stratum completely altered (lost or <10% remaining)

Age Structure - Reduced cover (<50%) of canopy, and only one age class present

Debris - Very small quantities of debris present

17. Aquatic Habitat

Condition:

Degraded-Moderate

Restoration

Potential:

Low-Moderate

Fish Habitat:

Class 3, Minimal



Hydrology - Small headwater creek; urban catchment

Physical form - Steep banks >70°; 25% undercut; 10% slumped; culverts upstream

Water quality - Clear; urban runoff

Habitat variability - Mix of wide shallow swamp and narrow creek; occasional pools; channel with good riparian cover; clay and gravel substrate; woody debris occasional

Aquatic flora - Two native species common

Site: Reach 18, Tributary to Caddies Creek (White Hart Drive)

Location: -33.693607, 150.925896

Rail structure and works: Viaduct; service road; Rouse Hill Station

RCMS Category: 3

Stream Order: 1

Riparian connectivity value: Low

Summary:

This small tributary to Caddies Creek has a riparian zone in moderate condition and appears to be establishing well after restoration works. The reach has high potential for continued riparian restoration, especially if providing a wider vegetation corridor on the right bank. The connectivity value of the riparian zone is moderate as it provides a link to larger woodland habitats downstream. Upstream of this reach is a culvert beneath Windsor Road and then becomes heavily cleared with little to no riparian vegetation. The aquatic habitat in Reach 18 is engineered and includes curved channels and gentle steps stabilised by riprap. Generally the aquatic habitat is in degraded-moderate condition, with only small patches of valuable instream habitat, especially for frogs. Restoration potential instream is low-moderate.

The proposed rail alignment at this reach is an elevated viaduct with one crossing over the upper extent of the reach into the proposed Rouse Hill Station (**Tile 18**). Therefore, the alignment will enter the 10 m riparian buffer. This crossing will occur through a small basin immediately downstream of the culverts under Windsor Road. Due to the existing disturbance from the culverts and the close proximity to Windsor Road, potential impacts from this crossing would be minor. However, mitigation measures to prevent disturbance downstream during construction are still warranted. This includes: avoiding viaduct footings instream, as this may change the hydrology and increase bank scouring; installation of erosion and sediment control fences during construction; minimal night works involving excessive noise and large floodlights (a possible disruption to nocturnal birds, bats and mammals foraging in the riparian corridor); and revegetation or stabilisation of disturbed areas post construction. Weed control within the footprint will reduce transportation of propagules downstream.

18. Riparian Habitat

Condition:
Moderate

**Restoration
Potential:**
High

Connectivity Value:
Low



Spatial Integrity - About 50% of the native vegetation remains, either in strips or patches

Nativeness - One or more strata dominated by exotic species, 'high threat' species present

Structural Integrity - More than one stratum completely altered (lost or <10% remaining)

Age Structure - Reduced cover (75-50%) of canopy, and only one age class present

Debris - Quantities and/or cover 50% higher or lower than normal

18. Aquatic Habitat	
Condition: Degraded-Moderate	
Restoration Potential: Low-Moderate	
Fish Habitat: Class 4, Unlikely	

Hydrology - Small headwater creek; urban catchment

Physical form - Gentle stabilised banks; some creek restoration; culvert upstream

Water quality - Moderate clarity; urban runoff

Habitat variability - Mix of shallow channels and small swamps; 0.5-3m wide; clay and gravel substrate; woody debris absent

Aquatic flora - Two native species abundant

Site: Reach 19, Second Ponds Creek (downstream of Schofields Road)

Location: -33.690937, 150.909934

Rail structure and works: 250 m long viaduct bridge

RCMS Category: 1

Stream Order: 2

Riparian connectivity value: High

Summary:

This reach of Second Ponds Creek was assessed by ELA (2010) as part of the Area 20 Biodiversity Assessment. Eight reaches were assessed for hydrologic change, fringing vegetation condition, physical form, water quality and aquatic habitat. Half of the reaches were classed as degraded. The others were classed as being in moderate condition. The proposed rail alignment at this reach is a 250 m long elevated bridge similar to the viaduct design, with one creek crossing (**Tile 19**). The exact location of the crossing was not assessed as part of this study or by ELA (2010) due to access restrictions. However, ELA (2010) assessed the reaches immediately upstream and downstream of the proposed crossing and adjacent footprint. Both reaches were classed as degraded. After reviewing aerial photographs of this site, we conclude that Reach 19 is in no better condition than these adjacent reaches. Despite its current ecological condition, Second Ponds Creek is an important riparian corridor and its value will increase as development encroaches in the future. Therefore, the proposed crossing structure should recognise this significance and be designed accordingly to minimise penetration into the 50 m buffer zone from top of bank. It is recommended that bridge/viaduct footings are not placed within the channel or the bank slope as this may change the hydrology and increase bank scouring.

Other mitigation measures to prevent disturbance to the creek during construction include installation of erosion and sediment control fences; minimal night works involving excessive noise and large floodlights (a possible disruption to nocturnal birds, bats and mammals foraging in the riparian corridor); and revegetation or stabilisation of disturbed areas post construction. Weed control within the footprint will reduce transportation of propagules downstream.

19. Riparian Habitat

Condition:

Degraded

Restoration

Potential:

Very High

Connectivity Value:

High



Spatial Integrity - About 50% of the native vegetation remains, either in strips or patches

Nativeness - High density of weeds on ground and within other strata. *Cardiospermum grandiflorum*

(Balloon Vine) prolific and causing significant damage to canopy and prevention of future recruitment

Structural Integrity - One stratum missing or extra, cover within remaining strata 50% lower or higher than natural

Age Structure - Some recruitment outside of weedy areas.

Debris - Not assessed

19. Aquatic Habitat

Condition:

Degraded

Restoration

Potential:

Moderate

Fish Habitat:

Class 3, Minimal



Hydrology - Medium size creek broken by numerous instream dams; urban/rural catchment

Physical form - Moderate bank stability; relatively homogenous structure within reach

Water quality - Not assessed

Habitat variability - Large wood and snags present though some of these used to change flow regime

Aquatic flora - Occasional aquatic macrophytes

Site: Reach 20, First Ponds Creek (downstream of Schofields Road)

Location: -33.695534, 150.894175

Rail structure and works: Embankment; Tallawong Stabling

RCMS Category: 1

Stream Order: 2

Riparian connectivity value: High

Summary:

This reach of First Ponds Creek (and a small tributary) is outside of the study area but has been included because the proposed Tallawong Stabling Facility is upslope of the creek and may cause indirect impacts during construction (**Tile 20**). Potential impacts could arise unless appropriate erosion control and sediment fences are used during construction. Revegetation and/or soil stabilisation works will be necessary post stabling construction to prevent surface erosion and sedimentation of the creek.

20. Riparian Habitat

Condition:

Degraded

Restoration

Potential:

Very High

Connectivity Value:

High



Spatial Integrity - Only small patches of well-separated native vegetation remain

Nativeness - Most strata dominated by exotic species, 'high threat' species abundant

Structural Integrity - More than one stratum completely altered (lost or <10% remaining)

Age Structure - Reduced cover (75-50%) of canopy, and only one age class present

Debris - Very small quantities of debris present

20. Aquatic Habitat**Condition:**

Degraded

Restoration**Potential:**

Moderate

Fish Habitat:

Class 3, Minimal



Hydrology - Small creek; rural catchment

Physical form - Gentle banks stabilised by weeds; little erosion; culvert under road

Water quality - Not flowing

Habitat variability - Homogenous dense reeds and weedy edges; occasional narrow channel with riparian shading

Aquatic flora - One native species abundant

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