

5. MASTERPLANNING PRINCIPLES

The following principles were identified to guide to masterplan's preparation. Not all could be applied with equal weight along the full length of Farmers Creek – given inherent variations in the nature and attributes of the public lands that comprise the creek corridor. However these principles articulate the overall framework that guided masterplan decision-making.

- Confine the masterplan's extent to public lands, including re-establishing the public land estate where adjacent land uses have encroached upon it.
- Ensure that proposed measures deliver both an increase in public access to and enjoyment of Farmers Creek and its tributaries and improvements in the creek corridors' environmental values, water quality performance, and scenic quality.
- Control, and where practical remove, weeds and other introduced plants along Farmers Creek and its tributaries to improve the system's environmental and biodiversity values and enhance its recreational and visual appeal.
- Restore natural riparian vegetation communities along appropriate sections of Farmers Creek and its tributaries.
- Improve the continuity and connectivity of native vegetation along Farmers Creek.
- Identify measures to improve the quality of water entering, and in, Farmers Creek.
- Identify opportunities for applying water sensitive urban design principles, and sustainable and sensitive stormwater management.
- Avoid exacerbating the flood risks along Farmers Creek.
- Provide for greater community access to and connectivity along Farmers Creek, and encourage increased enjoyment, appreciation and understanding of this urban waterway asset.
- Include measures or opportunities to promote community support for, and engagement or active involvement in, the creek's improvement.
- Recognise the different settings, landscape character and usage patterns evident along the creek corridor – and maintain or reinforce these where appropriate to ensure that a variety of settings and experiences continue to be offered to users.
- Activate the creek corridor by identifying a shared path alignment that follows Farmers Creek as closely as practically possible.
- Identify a shared path alignment that is able to accommodate, or has the potential to be upgraded to, a sealed path with a minimum design width of at least 2.4 metres.
- Build on the existing path network (shared paths, footpaths and other links) within and adjacent to the creek corridor.
- Identify assets within and adjacent to the creek corridor (such as plantings, toilets, recreation facilities) to ensure the preferred path alignment maximises access to these assets. Make optimal use of the creek's existing scenic assets and attractive settings along the path's alignment to enhance user experiences.
- Select a path alignment that links locations of interest or activity centres, and services likely pedestrian and cyclist traffic generators.

- Identify a shared path alignment that can be quickly established in the first instance to provide continuity of access along the creek corridor within a reasonable budget, but is also suitable for a staged development programme of upgrading and extension.
- Provide for user safety, and identify hazard points where additional infrastructure is required to provide safe access.
- Activate and enhance areas of open space alongside the creek corridor.
- Link the creek corridor open space and shared path to Lithgow's wider path and open space network wherever possible.
- Consider the current condition of the creek and ensure that creek health is not compromised by the proposed shared path alignment or other planned measures.
- Consider the proximity of adjacent development and potential privacy conflicts between path and open space users along the public land corridor and existing adjoining property owners.
- Pair path development and open space improvements along specific sections of the creek with accompanying measures to enhance the environmental value and water quality outcomes in that area.
- Identify locations for advance environmental works and amenity enhancement measures ahead of the path's construction to improve biodiversity, creek health and amenity.

6. FARMERS CREEK MASTERPLAN

6.1 A Vision for Farmers Creek

This masterplan envisions Farmers Creek as a green corridor of publicly accessible land through Lithgow's northern suburbs.

It will feature a high standard path, suitable for multiple uses, meandering along the creekside through a mixture of developed parks and playing fields as well as attractive semi-natural landscape settings and restored natural riparian vegetation communities. Connections to the urban pathway network and low-key facilities dot the path, which will also link activity centres and heritage or other attractions in and around the town area. The path and its surrounding green spaces will be conveniently accessible for leisure, recreation and fitness activities for locals and visitors alike.

Weed control, revegetation using native species and improvements to stormwater management undertaken as part of the corridor's improvements will deliver biodiversity and water quality benefits and also offer opportunities for outdoor education and interpretation.

The "new" Farmers Creek will become a valued, enjoyed and well managed asset of which the Lithgow community will be justifiably proud.



6.2 Masterplanning Approach

In broad terms the overall masterplanning approach adopted is one of:

- incremental development – initially building on existing assets and then progressively extending a managed high-quality public open space system and shared path network, resulting over time in a "green

corridor" (variously as restored natural bushland or managed plantings/landscapes using native species), public open spaces and shared path "backbone" gradually accessing more of Farmers Creek from Stage 1 to Stage 2 and culminating in Stage 3 with continuous or connected native vegetation and (potentially) access to almost the entire urban creek corridor;

- supporting these recreational, amenity and biodiversity improvements by “advance” environmental restoration and enhancement measures in those sections of the creek corridor planned for future open space and path improvements – to both improve the environmental quality of these areas and provide attractive settings for future open space and recreational improvements;
- enhancing the natural and semi-natural attributes, and water quality management measures along the entire creek corridor;
- targeting early open space, shared path, amenity, vegetation and biodiversity enhancements in the more “visible” central sections of the creek corridor – to demonstrate the project’s benefits to the Lithgow community and engender support for the project’s continued roll-out; and
- generally progressing from downstream to upstream in terms of expanding and upgrading the open space system and shared path network, while initially focusing weed control and revegetation efforts in the creek’s upstream segments and major tributaries.

Within this overall masterplanning approach there are a number of more specific masterplan “drivers” that have influenced the identification, staging and priority of the masterplan’s components – as described for each stage in Sections 6.4 (Stage 1), 6.5 (Stage 2) and 6.6 (Stage 3) below.

The legend for the following detailed individual masterplans – in Sections 6.4 (Stage 1), 6.5 (Stage 2) and 6.6 (Stage 3) – is provided in Figure 16.

6.2.1 Proposed Staging

Enhancement of the Farmers Creek corridor has been planned as a staged process – with most initiatives or actions requiring sequential and co-ordinated implementation, while some could potentially be undertaken as stand-alone projects.

For the purposes of this masterplan the following three stages, and associated implementation periods, have been identified:

- Stage 1 – 1 to 4 years;
- Stage 2 – 5 to 10 years; and
- Stage 3 – 11 years and beyond.

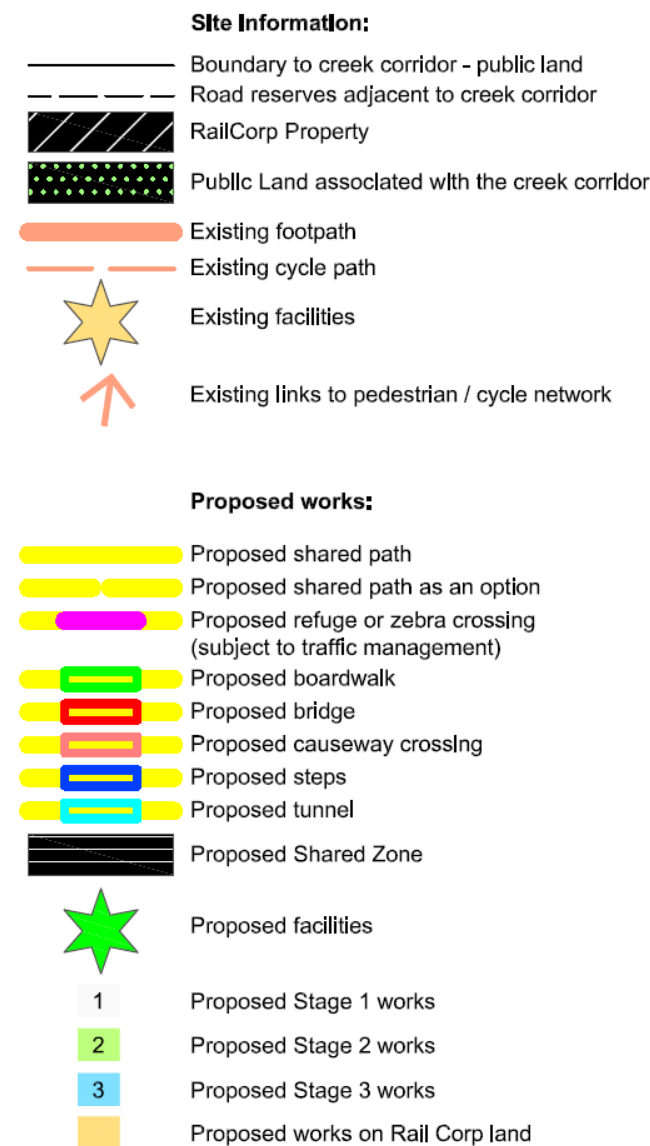


Figure 16 Masterplans legend

These should be considered very indicative, and interpreted as a planning framework only. The actual timing of masterplan actions will very much depend on Council's budget cycles and competing priorities, levels of community support for the project, possible complimentary or related works, supplementary funding possibilities, and many other factors.

6.3 Key Masterplan Components

6.3.1 Shared Path Standards

The *Austroads Guide to Road Design - Part 6A: Pedestrian and Cyclist Paths* 2009 acknowledges that the width of shared paths can "have a significant bearing on the level of convenience and conflict between users and potentially on path safety" and is also an "important factor given construction costs and operational considerations".

The Austroads Guide gives the following guidance regarding shared path widths – "local access paths" have a desirable minimum width of 2.5 metres with a range of 2.5 to 3.0 metres, and for "recreational paths" a desirable minimum width is 3.5 metres with a range of 3.0 to 4.0 metres. However the Guide also notes that lower minimum widths may be adopted under certain circumstances (such as lower cyclist volumes or lower "operational" speeds). The preferred minimum width recommended for shared paths by state roads agencies is frequently 2.5 metres – for example the *Queensland Road Planning and Design Manual* 2015 recommends this width for "recreational and regional commuter paths". Many park management agencies and local councils have also adopted 2.2 to 2.5 metres as the minimum preferred width for shared paths for maintenance and operational reasons, acknowledging that maintenance vehicles can also effectively operate on 2.4 to 2.5 metre wide paths.

Within the Lithgow area most of the existing paths signposted for shared use (walkers and cyclists) are typically 1.8 to 2.2 metres wide. The *Lithgow Open Space and Recreation Needs Study* 2011 identified 2 metres as the minimum width for "walk/cycle" trails as part of the town's "pedestrian

pathway access network". The *Lithgow Bike Plan* 1998 recommended "shared pedestrian/cycle paths of a preferred minimum width of 2.5 metres with a reservation to allow for landscaping where appropriate".

Balancing user convenience and safety, appearance, maintenance practicalities and construction cost the masterplan has applied a minimum shared path width of 2.4 metres for alignment selection and order of cost estimation purposes.

However it is recommended that further assessments of existing and projected/potential user numbers, and the probable mix of usage types, are

undertaken before finalising a preferred minimum width for all, or sections of, the proposed Farmers Creek shared path. The expected volume of mobility scooter (or wheelchair) usage of the path is likely to be a significant factor when considering minimum path widths. A greater "design width" for the path would alter the order of cost



estimates but would have few, if any, implications for the indicative alignments included in the individual masterplans.



The proposed shared path is envisaged as a reinforced concrete path along the greater majority of its length – as consistent with the type and standard of Council's recent path works along the creek corridor. Concrete paths offer greater durability and a long effective life (and a relatively simple construction method compared with other surface seals).



Construction as a compacted path (using crushed sandstone or decomposed granite, contained by timber or recycled plastic edge

strips) is also proposed along sections of the creek. This is as an interim stage in the path's development, pending growth in usage levels (as in Planning Units FC9-South, FC9-North and FC10-Northwest), or where this less formalised/developed path style is more in keeping with the surrounding landscape setting (as in Planning Unit FC2).



Bitumen (asphaltic concrete) has not been costed as a path construction material, but may offer a 20 to 30% cost saving compared with concrete construction (and offer greater flexibility which may be an advantage in potential subsidence zones). However these paths would have a shorter life span and higher maintenance costs, and are

especially susceptible to edge degradation and surface failure (due to seal break-up, potholing, root intrusion, etc.).

6.3.2 Overall Approach to Landscape and Vegetation Management, Bush Regeneration and Amenity Plantings

The masterplan's overall approach to landscape or vegetation management – principally amenity plantings, the character of open spaces, and native riparian or bushland restoration and management – along Farmers Creek and its tributaries is as follows.



Upstream of the urban boundary, in Planning Unit FC1, it is envisaged that the creek corridor will be retained in its existing, predominantly natural, character – as a bushland creek in a largely natural setting.

Within the “eastern upstream environmental zone” it is proposed to aim, ultimately, for the restoration of more or less continuous native riparian vegetation along the narrow band of

public land that makes up the creek corridor. This would result in a ribbon of native vegetation, dominated by riparian species extending from the urban edge in the east downstream to Burton Street – within Planning Units FC2, FC3, FC4 and FC5. A more or less continuous band of native vegetation along this section of Farmers Creek will offer a fauna, and flora, link into (and in places through) the town's eastern urban area. However the moist nature of this riparian environment will act to minimise potential fire risks within, and the potential for fire spread



along, this narrow corridor (which is largely confined by adjacent residences). This approach is also envisaged for those public lands along State Mine Creek (Planning Unit SMC2), and the upper reaches of Vale of Clywdd Creek (Planning Unit VoCC2).

Planning Unit FC6 and the eastern end of Planning Unit FC7-East – from Burton Street downstream to the start of the large stormwater canal – is proposed as a transition zone in terms of vegetation management. The upstream bushland restoration treatments merging with, and gradually giving way to, the more managed landscapes and amenity plantings of the downstream central sections of Farmers Creek – as described further below. Establishing a reasonably continuous or connected corridor of native vegetation through this area is seen as important to connect the (future) vegetated creekline with the bushland hillslope to the north of the Montague Street dog park enabling and enhancing potential fauna links.

Vegetation management within the Lake Pillans Wetlands and Blast Furnace Park (Planning Unit VoCC3) will be as guided by Council's current grounds/vegetation management regimes, and existing plans, for these sites.

In the central sections of Farmers Creek the surrounding urban landscape “opens up” and the creek becomes far more visible as it flows beside roads or extensive areas of playing fields. This section of creek aligns with the “central urban recreation and open space zone”, and runs from Burton Street downstream to the Geordie Street Causeway (Planning Units FC6, FC7 and FC8 – Farmers Creek's more developed open space and



channelised sections). Here the creek corridor is envisaged as variously lined or dotted with bands or “islands” of native plantings – as already in place at Saywell Street Park and, more informally, around the margin of Glanmire Oval. These planted areas would mostly be dominated by trees and lower understorey species – to avoid markedly changing the appearance or character of the town’s major open spaces and for safety/security concerns (observing Crime Prevention through Environmental Design [CPTED] principles). More complex or varied plantings could occur where practicable.

Using “islands” or “bands” of planted areas will permit management of the creek corridor (where space allows) by machine mounted mowers, which is Council’s preferred approach and allows for efficiencies in operations/maintenance. The discontinuous nature of these additional landscape or amenity plantings will also minimise the risk of the creek corridor acting as a channel for wildfire to enter or spread through the urban area under high fire risk scenarios. However, these “islands” of plantings will serve as “stepping stones” for the movement of wildlife as well as offering habitat for smaller urban-adapted species. This habitat connectivity would be enhanced if the Council owned (contaminated land) block on the corner of Sandford Avenue and Coalbrook Street is revegetated, in whole or part, to connect the creek corridor to the bushland hillslope to the north-



west. Despite its appearance of being a less natural landscape, and the focus on creekside and amenity plantings (rather than full bushland/habitat restoration), weed control will still be a priority in these reaches. This includes the progressive control/removal of Poplars and Pines and the general

shift towards a landscape, albeit a managed one, dominated by native species.

Undertaking weed control, revegetation and amenity planting works in these more visible central sections of Farmers Creek early in the masterplan’s implementation would have the additional benefit of helping establish the project’s profile and promote community awareness. This will be very valuable in engendering community support for the project and encouraging involvement in its progressive roll-out.

Downstream of the Geordie Street Causeway (Planning Units FC9) Farmers Creek is again envisaged as being returned to a corridor of more or less continuous native riparian vegetation. Given the existing less vegetated nature of these sections, and their downstream location, this may be a longer term undertaking. Strategic gaps in the tree and shrub storey layers here may be warranted to retain views to the escarpments and timbered slopes to the north and north-east, and to assist in fire management (although again the mesic nature of the riparian corridor will minimise the degree of fire risk).

6.3.3 Weed Control and Bush Regeneration / Revegetation

Weed control and native vegetation regeneration/revegetation within the Farmers Creek corridor and its major tributaries, particularly State Mine Creek, are essential environmental works – and will also significantly support enhancing the creek corridor’s recreational and aesthetic values.

The masterplan proposes significantly expanding and escalating Council’s current programme of weed control and native species regeneration/revegetation along Farmers Creek and its tributaries. As described in Section 6.3.2 above, these efforts will be focused on restoring native riparian communities in the following areas:

- upstream from Burton Street to the town’s eastern edge – Planning Units FC5, FC4, FC3 and FC2;
- from Burton Street downstream to the start of the large stormwater canal (as a transition zone and mix of restored bushland and

landscape/amenity plantings) – Planning Unit FC6 and the eastern end of Planning Unit FC7-East;

- public lands along State Mine Creek – in Planning Unit SMC2;
- the upper reaches of Vale of Clywdd Creek – in Planning Unit VoCC2; and
- downstream from the Georgie Street Causeway to the limit of public lands (north of Evans Close) – in Planning Unit FC9.



Progressively implementing weed control and riparian vegetation community restoration will significantly improve the native vegetation and biodiversity values of the creek corridor. Removing upstream sources of weeds (in Planning Units FC2, FC3, FC4, FC5, SMC2 and VoCC2) will benefit lower sections of Farmers Creek. Importantly, reinstating natural (or near natural) riparian vegetation will also enhance the creek corridor's visual appeal and provide an attractive setting for the subsequent development and use of the envisaged shared creekside path. However these restoration works are warranted from a biodiversity and environmental values perspective alone, as well as for water quality improvement, in addition to (or regardless of) the additional recreational and aesthetic advantages they will also deliver.

Within these targeted reaches of Farmers Creek and its tributaries (as above) weed control and riparian vegetation community restoration works have been prioritised and co-ordinated with other masterplan components (and Council's current and planned works along the creek corridor) as follows.

Stage 1 weed control and riparian vegetation community restoration works have been prioritised in the following areas.

- Planning Unit FC6 and the eastern end of Planning Unit FC7-East, along Burton Street downstream to the start of the large stormwater canal (with restored bushland merging with, and transitioning to, landscape/amenity plantings). Despite being in the middle sections of Farmers Creek (as opposed to commencing in the upper reaches and working downstream) these works will support Council's planned



weed control and landscape improvement works in this area. Importantly, they will also assist in promoting community awareness and support for enhancing Farmers Creek through such works (and demonstrable positive results) in this highly visible section of the creek. These works will provide an attractive setting for the shared path and other recreational facilities proposed for this reach in Stage 1 (and beyond).

- Planning Unit SMC2, along the public lands on State Mine Creek, to consolidate and build-on Council's past and current weed control efforts on this creek. These works will help remove a major source of weed propagules for downstream sections of Farmers Creek (however collaboration with private landholders in this planning unit, and upstream on State Mine Creek, will be required to effectively minimise this tributary's role as a weed source for Farmers Creek).

Stage 2 works are proposed in Planning Units FC2, FC3, FC4, FC5 and VoCC2 in conjunction with, or preferably in advance of, the development of a shared path, recreation facilities and amenity or other plantings.



Weed control and riparian vegetation community restoration works are the only masterplan actions proposed in Planning Unit VoCC2. These measures will consolidate and build-on Council's past weeding (particularly Willow control) and planting efforts in this

area. Despite being a moderately to heavily weed infested reach, environmental works in this planning unit have been allocated to Stage 2 in recognition of the Lake Pillans Wetlands' function in limiting weed propagule spread downstream into Farmers Creek.

Considering their downstream location, as well as the limited suite of recreational facilities proposed and smaller residential catchment, weed control and riparian vegetation community restoration works in Planning Unit FC9 (downstream from the Geordie Street Causeway to the limit of public lands) have been allocated to Stage 3 of the masterplan.

No riparian vegetation community restoration works have been identified for Planning Units FC7 (downstream of the start of the large stormwater canal) or FC8. Only landscape enhancement and amenity plantings are proposed in these areas. Similarly no riparian vegetation community restoration works are proposed for Planning Unit VoCC3, where Council's current management of the Lake Pillans Wetlands and Blast Furnace Park would continue.

However weed control measures are still required in these planning units, and along Farmers Creek and its tributaries generally – including, but not limited to:

- the staged removal of Poplars and Pines (particularly in Planning Units FC7, FC8 and FC9) commencing from the upper catchments and working downstream;
- the staged removal of Honey Locust trees (*Gleditzia* species) (particularly in Planning Units FC3, FC4 and SMC2) again commencing from the upper catchments and working downstream;
- the on-going staged removal of Willows wherever occurring (and particularly in Planning Units VoCC2 and SMC2); and



- removal of state weeds of significance, noxious weeds and environmental weeds – particularly targeting species already identified by Council as environmental issues.

Liaison and collaboration with neighbouring landholders will be required to support, or ensure complete coverage, of weed control works on some creek sections – notably Planning Units FC1, FC2, FC4, FC9-North, FC10 (none of which is Council land) and SMC2.

In undertaking weed control, as well as for general grounds and plantings maintenance, Council should consider the current independent advice regarding the use of “Glyphosate” before developing maintenance programs that heavily rely on the use of this herbicide.

6.3.4 Proposed Plantings – Typical Treatments

A palette of the main landscape or amenity plantings envisaged are identified in the accompanying cross-sections, showing typical proposed treatments suggested. These primarily apply to the central sections of Farmers Creek where additional plantings are proposed to enhance the visual and recreational appeal of these reaches (as discussed in Section 6.3.2 above) particularly along the shared path's route, as well as to soften or screen channelised creek sections plus contribute to biodiversity values and connectivity. The cross-sections identify the location (e.g. large canal, small stormwater canal, or road edge) and the configuration or style of plantings proposed. Cross-sections are also provided for narrower creek sections, typically in the upstream “eastern upstream environmental zone” to show the relationship between rear fencelines, plantings and the positioning of a shared path or boardwalk.

For landscape or amenity plantings it is recommended that the selection of species has regard to:

- the original endemic riparian vegetation of the creek, that occurred prior to past/historic clearing and removal;
- the amenity role the planting may play (e.g. winter solar access and summer shade, which may necessitate exotic species being selected in some instances);
- potential for species to become weeds – such species are to be avoided;

- environmental and microclimatic conditions;
- expected level of ongoing maintenance;
- Crime Prevention through Environmental Design (CPTED) issues – avoid planting that allows concealment;
- habit and growth of trees as they mature – avoiding trees with aggressive and invasive root systems; and
- ability to manage and control potential weed invasion by other species

Figure 17 shows a “stylised typical” treatment for creek plantings – with a tree layer over groundcovers/vines and low shrub cover on wider creekbanks/slopes that offer a greater planting area, and native grasses (and sedges) in those situations where space is limited.



As a general approach it is recommended that, at a minimum, a “filter strip” of planting be located immediately adjacent to the creek where possible to ensure that stormwater drains and filters through this planting prior to entry into the creek waters (see Section 6.3.5 for further discussion). The filter strip

would essentially contain native grasses, both dry and wetland species, to accommodate fluctuating levels of the creek (in natural situations) and varied/extreme weather conditions.

Typical cross-sections for landscape or amenity plantings in particular situations commonly encountered along the “central urban recreation and open space zone” of Farmers Creek include the following.

- Small stormwater canal adjacent to open space or sports fields (see Figure 18) – such as north and west of Marjorie Jackson Oval in Planning Unit FC7-East, Glanmire Oval in Planning Unit FC7-West, and south of Geordie Street in Planning Unit FC8-West.

It is recommended that existing mature trees, where possible, be retained. Understorey weed species, however, should be removed as soon as possible and replaced with indigenous riparian species (if weed removal is delayed or staged on-going control of suckering or

regrowth should occur to avoid expanding the number of problem specimens), and introduced trees progressively replaced with native trees over time. A shared path if/where developed should be offset from the roots of retained mature trees, unless this encroaches into the outfields of sports grounds (where it may be necessary to provide a ground level boardwalk over the root zones – such as proposed north



of Glanmire Oval in Planning Unit FC7-West). Again provide a filter strip of planting between the path and the edge of the canal to manage stormwater runoff (due to the absence of in-stream or stream bank vegetation). Avoid leaving turfed areas between the path and the creek vegetation, to

avoid encroachment of exotic species such as Kikuyu. As an adjunct, where required or already planned, stormwater management and flood mitigation works should be undertaken preferably in as natural a style as possible (avoiding large, creek-width, concrete canals to reduce visual and physical impacts and minimise the loss of green space and environmental values – see Section 6.3.5).

- Large stormwater canal adjacent to an open space or sports fields (see Figure 19) – such as north of Marjorie Jackson Oval in Planning Unit FC7-East and in Planning Unit FC8-East.

As space permits, it is proposed that large trees be planted at regular intervals to create an “avenue”. Each tree should be contained in a large mulched area (say 5 metres by 5 metres) of low plantings, such as native grasses and low shrubs. A mid-storey planting layer is not proposed so as to retain clear visibility under the trees. A filter strip of planting should be planted between the shared path and the edge of the canal to manage stormwater runoff (due to the absence of in-stream or stream bank vegetation). In any future constructed stormwater canals, where possible sufficient room should be left to enable a shared path to be offset at least 1 metre from the canal edge to ensure that a densely planted filter strip can be provided. The filter planting would not only contribute to water quality and creek health but also to a site’s amenity and micro-habitat values.

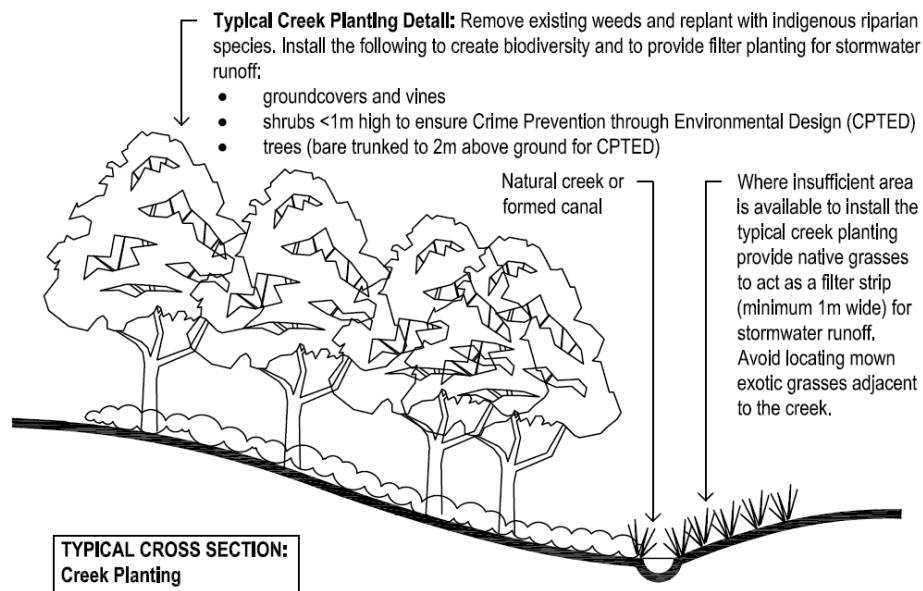


Figure 17 Typical creek planting treatment

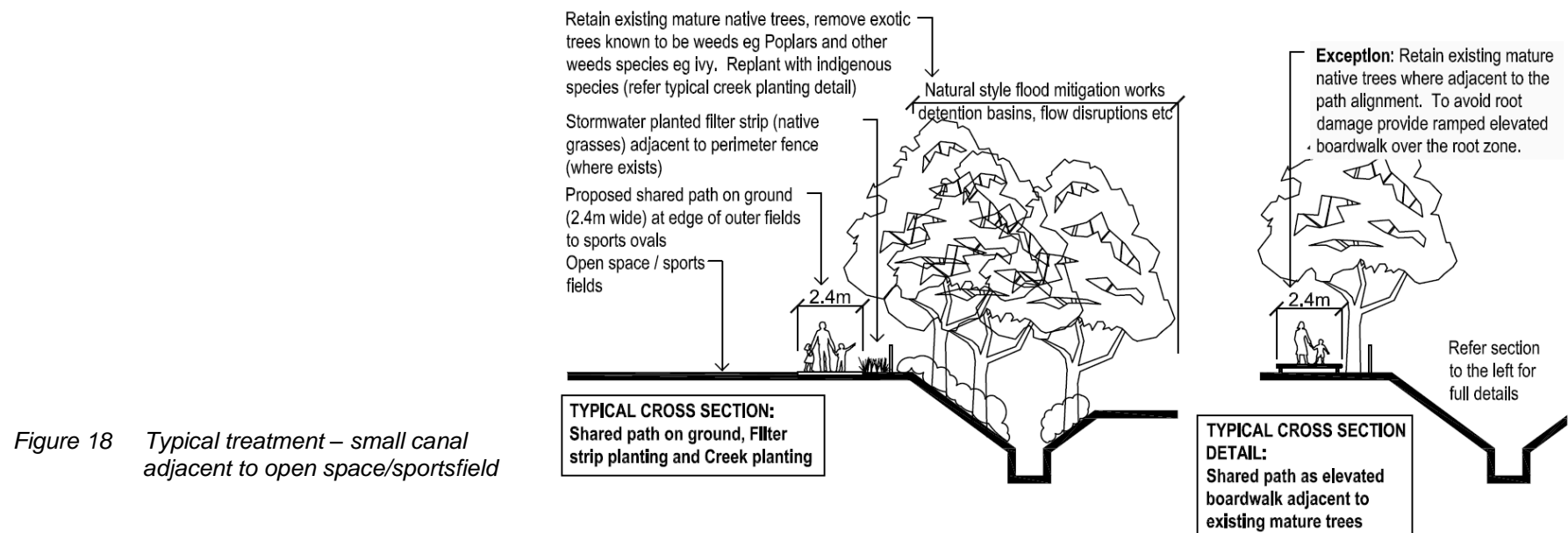


Figure 18 Typical treatment – small canal adjacent to open space/sportsfield

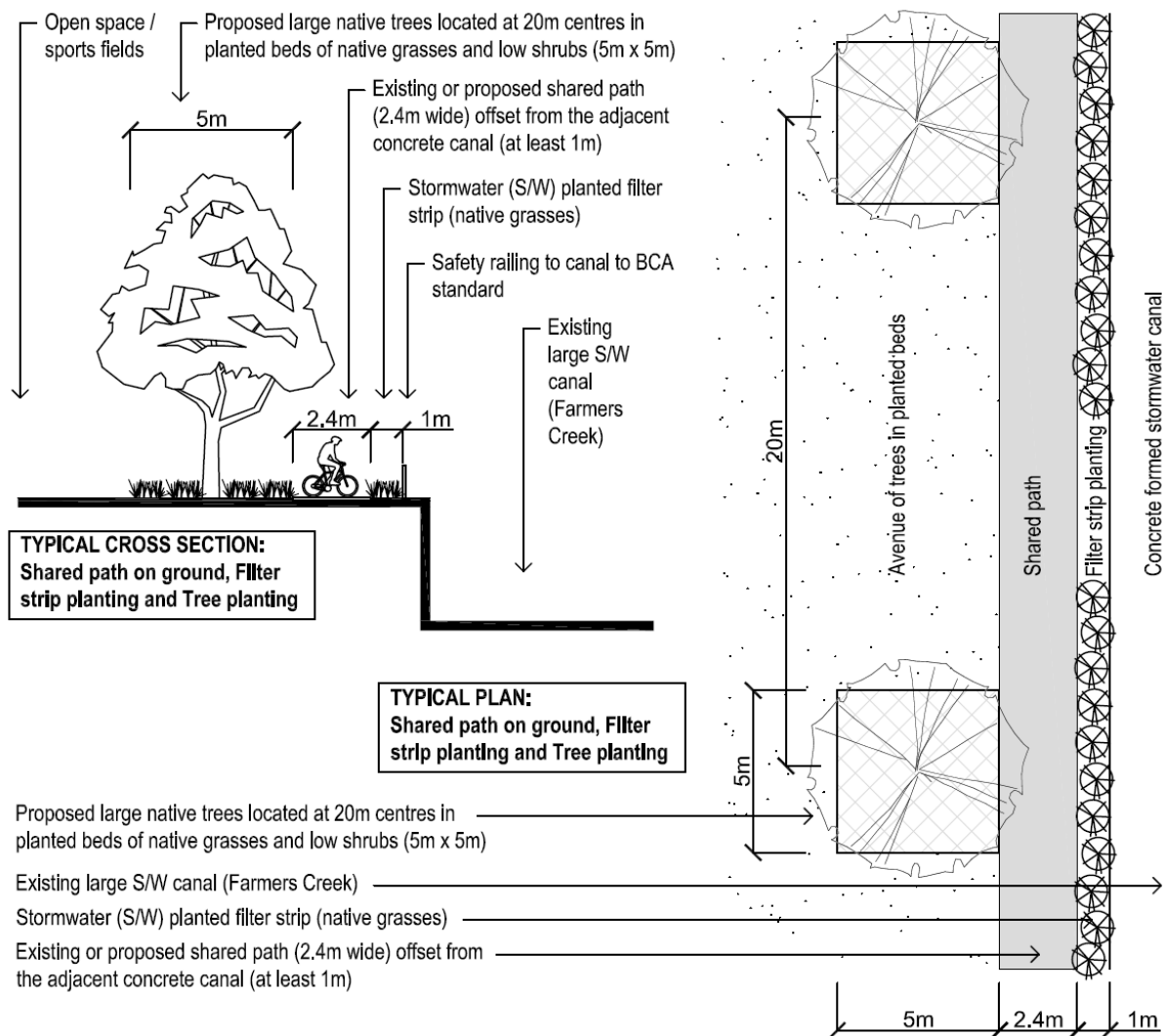


Figure 19 Typical treatment – large canal adjacent to open space/sportsfield

- Wide road reserves or passive open space areas along the creek corridor offer greater flexibility in the size and location of planted areas, alignment of a shared path or siting of recreational facilities. In these locations – such as south of Geordie Street in Planning Unit FC8-West, parts of Planning Unit FC7 around Marjorie Jackson Oval, and through Saywell Street Park in Planning Unit 5 – planting bands/islands can be more extensive, a shared path can be aligned to meander through and around these plantings (and/or located under any overhead wires [if possible] to better accommodate trees plantings either side) (see



Figure 20). Islands of plantings could be located between the road pavement and the proposed shared path where possible. Trees should be grouped into mulched areas (allowing for better outcomes for plantings) to avoid single trees in grass (which would create increased maintenance

issues). Avoid planting trees under overhead wires. As elsewhere remove weed species from the creek vegetation and replace with native riparian plantings.

- Where the proposed shared path is adjacent to an un-kerbed road (such as along the south-east side of Macauley Street in Planning Unit FC6) locate a strip of densely planted native grasses with bollards between the path and the road pavement (see Figure 21). Provide a filter strip of planting between the path and the creek vegetation – avoid leaving thin strips of exotic mown grasses to minimise mowing maintenance and reduce invasion by exotic grass species. Undertake weed removal and control of creek vegetation, and replant with native riparian species.
- Where the existing, or proposed, shared path is an extension of the road pavement (notably beside Sandford Avenue in Planning Unit FC7-East) locate guard rails or crash barriers and trees with substantial tree guards to ensure the safety of path users and to improve user amenity (see Figure 22). A vehicle safety barrier (such as an Armco railing) could be employed along the road-path boundary if warranted. Provide a filter strip of planting between the path and the creek vegetation –

avoid leaving thin strips of exotic mown grasses to minimise mowing maintenance and reduce invasion by exotic grass species. Undertake weed removal and control of creek vegetation, and replant with native riparian species.

The following two typical cross-sections apply to narrower creek sections, where plantings and a shared path or boardwalk have to be realised within a very limited “useable” creek corridor.

- In a narrow creek corridor where a level area is available – such as upstream of Burton Street in Planning Unit FC5 and parts of Planning Unit FC3 – offset the proposed shared path from the adjacent rear boundary fences, allowing sufficient space to plant hedge species against rear boundaries (see Figure 23). Provide at least a filter strip of planting, avoiding thin strips of exotic mown grasses, adjacent to the creek. Remove weed



species and replant with indigenous riparian species.

- In a narrow creek corridor where limited to no level area is available – such as several sections of Planning Units FC4 and FC4, and isolated/smaller lengths in Planning Units FC2 and FC3 – develop an elevated boardwalk with a safety rail creek side (to BCA standard) where required by height/slope (see Figure 24). Undertake weed control and removal within the creek corridor and replanting of riparian native species. Avoid retaining or planting exotic grass species.

6.3.5 Water Quality Improvement and Water Sensitive Urban Design (WSUD) Measures

Water Sensitive Urban Design (WSUD) aims to integrate stormwater management systems into the urban landscape, design and development processes, and land management practices. It is aimed at delivering stormwater quality improvements, water savings and efficiencies, reduced

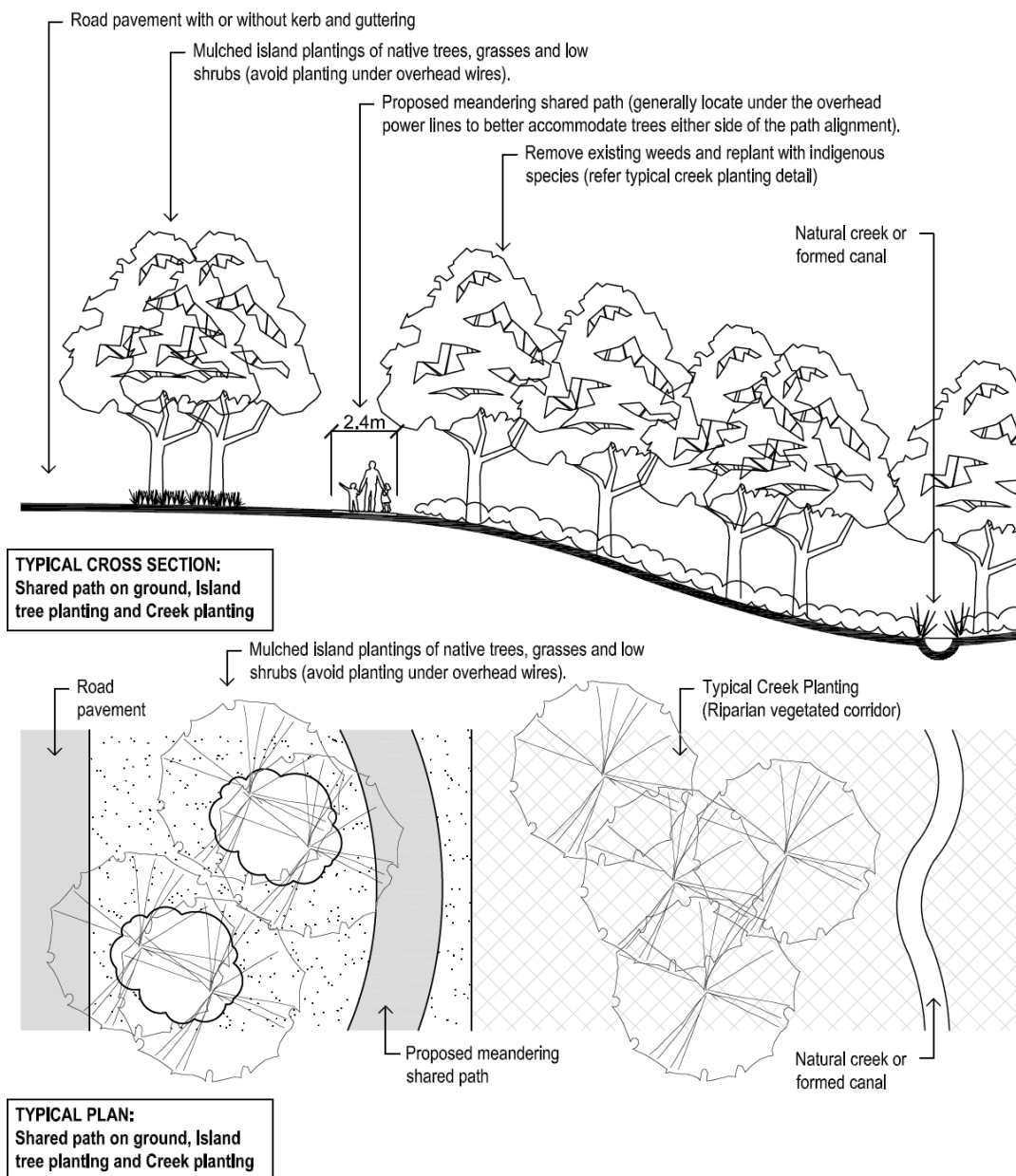


Figure 20 Typical treatment – wide road reserve or nature strip

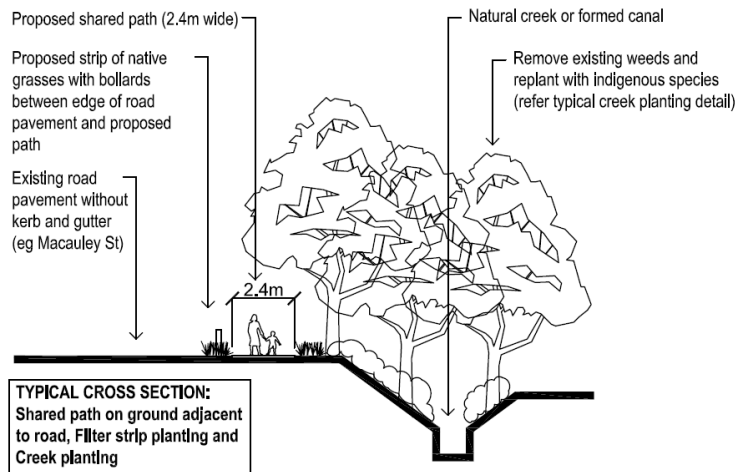


Figure 21 Typical treatment – adjacent un-kerbed road

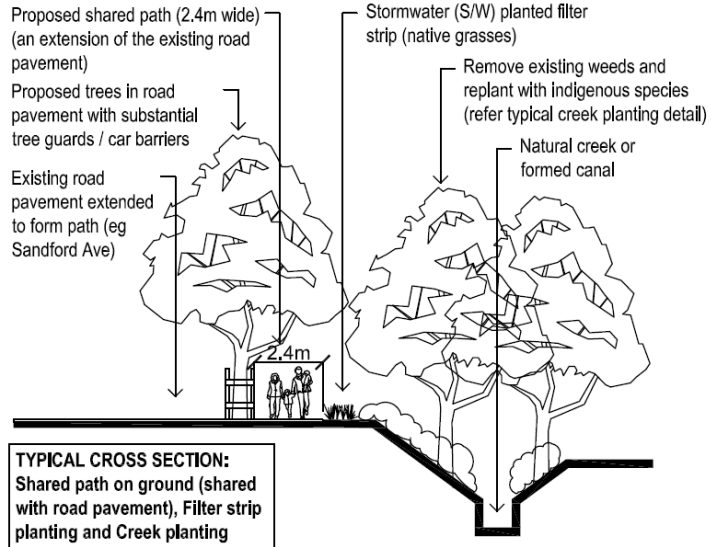


Figure 22 Typical treatment – extension of roadway

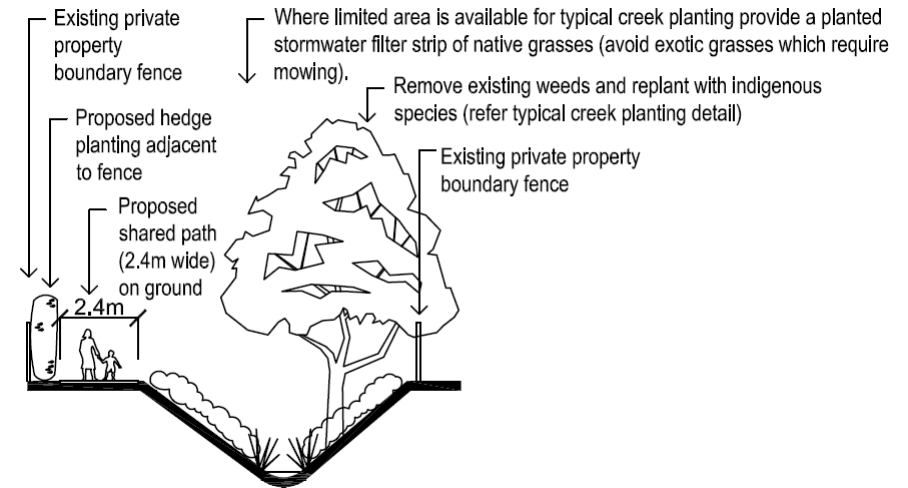


Figure 23 Typical treatment – narrow creek corridor (with level bench)

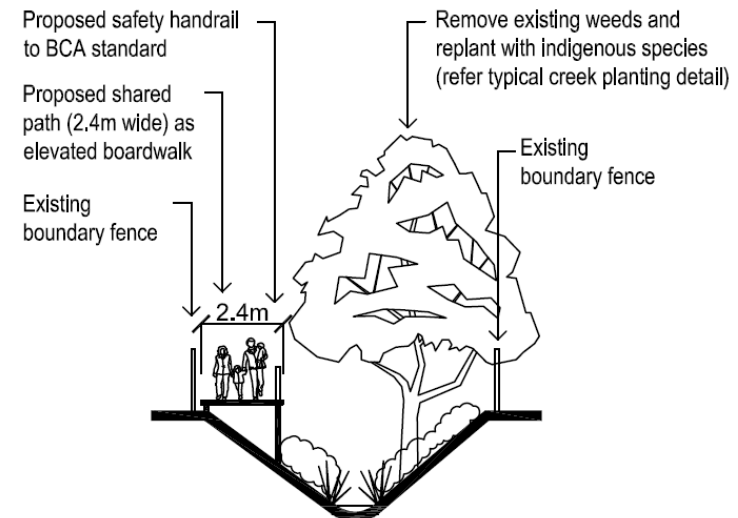


Figure 24 Typical treatment – narrow creek corridor (with little or no level area)

environmental degradation, and improved aesthetic outcomes. Ideally WSUD is applied on a broad scale, such as a sub-catchment or whole-stream level, and early in the planning and land development process. However existing urban areas can be “retrofitted” to achieve improved WSUD and water quality outcomes.

Due to its “bottom” valley location, Farmers Creek offers limited opportunities for applying WSUD principles. Liaison and collaboration with neighbouring landholders will also be required to support water quality improvement measures on some creek sections – notably Planning Units FC1, FC2, FC4, FC9-North and FC10.

A number of approaches have been proposed to realise improved water quality in the urban sections of Farmers Creek and downstream.

Filtering Creekside Vegetation

The most common and widely applied direct WSUD measure proposed in the masterplan is to install a “filter strip”, of native grasses and/or sedges where suitable, between the proposed shared path and the creekbank or channel. This is to ensure that stormwater drains and “filters” through this band of planting prior to entry into the creek waters. Filtering stormwater in this way allows silt and other debris to be removed from surface waters draining into the creek, and thus assists in improving creek health.



This measure would be focused on those creek sections where vegetation (or revegetation potential) of the creekbanks and/or channel is limited due to channelisation, and especially where the existing or proposed shared path is close to the canal edge – as shown in Figures 18, 19, 21 and 22. This is mainly Planning Units FC7-East, FC7-West, FC8-East and FC8-West. As shown in Table 4 a total of 2,545 metres of the creekbank (along Farmers Creek only) will be treated with filter strip planting over all proposed stages – made up of 1,740 metres in Stage 1, 230 metres in Stage 2 and 575 metres in Stage 3.

Table 4 Proposed Filter Strip Plantings

Planning Unit	Approximate Length of Creekside Filter Strip Plantings (metres) *			
	Stage 1	Stage 2	Stage 3	TOTALS
FC1				0
FC2			30 ¹	30
FC3				0
FC4				0
FC5	55	25	35	115
VoCC3 North & South	Managed wetland setting (and parkland away from creek channel)			0
VoCC2				0
FC6				0
SMC2				0
FC7 East ²	525	40	70	635
FC7 West	325	165	115	605
FC8 East	520	0	190	710
FC8 West	315	0	135	450
FC9 South				0
FC9 North				0
FC10 south east & north-west	No Council managed lands along creek corridor			0
ENTIRE PROJECT TOTAL	1,740	230	575	2,545

Key:

Existing vegetated (usually weedy) creek corridor
Weed control and native species riparian plantings / revegetation of creek corridor
Bushland setting

Notes:

* Cumulative lengths

¹.... Creekside at picnic area at north end of shared path

² Includes length of weed control and native riparian plantings / revegetation downstream (west) of Tank St to start of existing large stormwater canal

Elsewhere the existing creekside vegetation (typically weed infested in most parts) and the subsequent proposed native species riparian plantings and revegetation of the creek corridor (after weed control measures) will act to



filter local surface waters, or stormwater running off a path surface, before entering the creek channel – and so negate the need for specific/additional filter strip plantings. These more “passive” WSUD measures will be the case in most other planning units – as also identified in Table 4 (and shown on Figures 17 and 20). In these areas

a continuous planted edge of un-slashed native grasses could be provided to the creekbank, where there is none currently (“pulling back” mown exotic grasses, as necessary, in areas that are now mown/managed open space), to also provide a stormwater filter strip upslope of more dense native riparian plantings. However where the un-slashed native grasses strip is wider than 3 metres a mown grass edge, between the shared path and the residual grass strip, should be considered if practical to allow for regular mowing. Such a grass edge will help to avoid potential issues arising with exotic gasses invading the native species and developing as a weed issue.

Stormwater Quality Improvement Devices

As noted in Section 2.4, at present there are no stormwater quality improvement devices (SQIDS) on the Lithgow stormwater network – this includes those pipes and channels discharging directly into Farmers Creek. Priority locations for the installation of SQIDS – such as gross pollutant traps, gully pit baskets/nets, trash racks, sediment or stilling ponds, biofiltration ponds, etc. – have been identified as Planning Units FC6, FC7-



West, FC8-East and FC8-West. A more site-specific assessment will be required to determine the type of SQID suited to each discharge point, and priority points to target with available funding.

Off-line Detention Basins and Constructed Wetlands

The Lake Pillans Wetlands, on the lower reaches of Vale of Clywdd Creek, is a good example of a constructed wetland (and an on-line flow storage and detention area).

Off-line constructed wetlands are located away from a waterway’s main channel – typically on creek flats, flood terraces and other areas subject to periodic inundation. Comprising one or more shallow constructed ponds, usually densely-planted, they offer a “natural” method to remove pollutants



Source: landscapesolutions.com

from stormwater or creek flows. This is achieved by three processes – physical, biological and chemical uptake, and pollutant transformation. Shallow ponds densely planted with aquatic plants, such as macrophytes, are the heart of this system and work to remove fine particles and dissolved pollutants. Constructed wetlands can also

retain or slow small to medium flows, but generally are not suited to managing large flows (under these conditions a high flow bypass system is required to direct/avoid larger flows and prevent damage to the plantings or the integrity of the system). Wetlands also require inlet protection, to catch sediment and gross pollutants that would otherwise block or infill the system. Wetlands can also have biodiversity, visual or amenity, and recreation values – as demonstrated by the Lake Pillans Wetlands.

Dry detention basins – off-line on larger waterways, but also on-line along ephemeral or stormwater drainages – are intended to temporarily detain and store stormwater or diverted flows for a period of time before allowing this storage to slowly discharge. This detention and slow release is mainly intended to reduce flow peaks and flood potential, but can also remove pollutants by allowing solids or particulates to settle out of the ponded waters. Dry detention basins typically include inlet protection, to catch sediment and gross pollutants, as well as a detention mechanism (often an



earth bund) and delayed outflow feature. They are usually turfed (to assist sediment capture and for erosion protection), and can also serve open space and recreation use when dry. Dry detention basins can also be planted with native grasses and shrubs tolerant of short periods of inundation to improve

their sediment/pollutant capture functions, as well as enhancing their biodiversity and visual/amenity values (but limiting open space and recreation potential).

Both off-line constructed wetlands and detention basins require careful siting and design to perform effectively, fit the hydrological characteristics of a waterway, and not exacerbate flood risks.

Opportunities for off-line constructed wetlands and detention basins are severely constrained by the limited and usually narrow area of public land available along Farmers Creek (and its tributaries). The incised character of the creek in most areas, with limited flood terrace development, also makes relative levels for diverting flows from the channel into off-line water quality features challenging in many locations. Flood performance requirements also severely constrain opportunities for in-stream detention measures (notably no such features were identified for Farmers Creek in Council's *Lithgow Flood Study Review, 2015*).

Nevertheless potential sites for off-line constructed wetlands or off-line/diversion detention basins (vegetated) occur in the following planning units (as shown on Figures 58, 61, 62 and 63). All proposed sites would require hydraulic performance and flood risk impact assessments and engineering feasibility investigations, as well as detailed designs, if likely to proceed.

- Planning Unit FC6 – two potential sites on the lower broad creekflats on the south side of the creek, opposite Guy Street and the (existing) Guy-Macauley Streets intersection. A wetland opposite the Guy Street open space would also enhance the visual and recreational appeal of this area.

- Planning Unit FC7-East – potential (small) site on the creekflat on the north side of the creek, west of the existing dog park and south of Sandford Ave. A wetland would also enhance the visual and recreational (and possible educational/interpretive) appeal of the shared path in this area.

- Planning Unit FC7-East – two potential sites on the creekflats on the south side of the creek, inside the sweeping bend opposite Sandford Avenue. Wetlands would enhance the visual and recreational appeal of these areas.



- Planning Unit FC7-West – potential (small) site on the narrow creekflat on the north side of the creek Farmers Creek, south of Coalbrook Street.

A large potential site for a constructed wetland or vegetated flood detention basin is found in Planning Unit FC5, on an area of Crown land abutting the creek's northern bank (situated on a flood terrace opposite the north end of Saywell Street). Being Crown land development of a basin or wetland on this site would require approval, or concurrence, from the Department of Industry (Lands).

Improving Water Quality, and Habitat, Outcomes on Engineered or Constructed Creek Channels

The investigation of possible measures to improve water quality and enhance the habitat value of those existing sections of large stormwater canal along Farmers Creek (in Planning Units FC7-East, FC7-West and FC8-East) is also warranted. Potential measures to investigate – where they can be realised with minimal detriment to hydraulic and flood mitigation performance, can be adequately maintained, pose minimal health or amenity risks (such as mosquito breeding or odours), and are sufficiently cost-effective – include such treatments as:

- embedded rock bars or riffles set into the base of concrete canals;

- staggered/offset concrete block riffles and mini bulkheads across the bottom of a canal, with possible stone/block beds, to retain/slow smaller flows and create areas of micro-habitat;
- retrofitting or replacing sections of vertical wall with layback or sloped stone/block revetments, allowing for vegetation to be planted (or to self-seed) between the blocks (where space permits such sloped stone walls could also include small perched wetlands– as has been recently done by Sydney Water on sections of the Cooks River Canal);
- modifying vertical concrete block walls into a stepped or irregular cross-section; or
- stepping or terracing sections existing side walls to create rock armoured and/or planted benches.



Plans are also under consideration to extend the existing large stormwater canal east of Albert Street upstream around the west side of Glanmire Oval (Planning Unit FC7-West). Rather than simply extending/replicating the adjacent large concrete block canal Council has the opportunity to consider alternative design approaches. These should aim to balance hydraulic and environmental (chiefly water quality and habitat issues) performance, as well as aesthetic outcomes, for replacement of the current narrow concrete canal in this area. In view of the number of existing mature native (and other) trees along this section of the creek, which provide a scenic backdrop

to Glanmire Oval, a type of flood mitigation and stormwater management design that protects or incorporates these features warrants serious consideration. Alternative treatments to evaluate, among others, include:

- large grassed swales (with or without a low-flow pipe system beneath);
- large grassed swales with top-of-bank and overbank tree/shrub plantings;
- large grassed swales with a rock-lined vegetated central canal and bank/overbank tree plantings;
- rock-lined swales or trapezoid channels;
- channels with rock armoured and planted sloped banks;
- vegetated detention basins “staggered” along the creek corridor (and possible off-line detention ponds); or
- semi-natural channel designs.



Examples of all the above treatments can be found, operating successfully, in a number of large urban development areas in metropolitan Sydney – such as measures employed by Sydney Water across their “trunk drainage lands” in the Rouse Hill area.

Turf Management

In view of the multiple playing fields adjacent to the middle reaches of Farmers Creek, Council should also endeavour to manage fertiliser and turf management on these expansive grassed areas to minimise impacts on water quality (nutrient loads, weed spread, etc.) in Farmers Creek. These playing fields also offer the opportunity for Council to investigate options for large scale stormwater harvesting and re-use schemes (including underground tanks or water storage beds) where relative levels and other design factors permit and such measures are cost-effective.

6.3.6 Interpretive and Educational Measures

An enhanced Farmers Creek corridor, and the proposed shared path specifically, will connect and provide access to a number of other features of interest with interpretive and/or educational potential – particularly historic heritage attractions. However all such major features of interest – apart from the Lake Pillans Wetlands and Blast Furnace Complex (and the Bowenfels Rail viaducts, which are not in Council ownership) – are not located within the public lands of the creek corridor. The Lake Pillans Wetlands and Blast Furnace Complex already have on-site interpretive panels. The Blast Furnace Complex is also part of the wider “Furnace Fire and Forge Heritage Trail”, and improved interpretation is planned for this attraction.

While a more-accessible, connected and attractive Farmers Creek corridor may link these surrounding features, their presentation/interpretation (for those that are publicly accessible) would be more appropriate – and far more effective – if undertaken on-site, rather than “remotely” from a distance on the creek or shared path.

Consequently interpretive and educational opportunities within an enhanced Farmers Creek corridor would be more focused on generic themes and



messages, mainly dealing with environmental elements – such as “bringing back the bush”, the habitat value of the creek and creekbank vegetation, environmental issues associated with Farmers Creek and urban waterways generally, micro-habitats, flora and fauna features of interest (where these are readily visible or are likely to be seen by

most visitors), the value of urban green space and natural areas, improving water quality, Council’s environmental management efforts, flood management, being a “good bush neighbour”, the history and past character of Farmers Creek, historical “then and now” images of certain sections of the creek showing changes through time, and so on.

Interpreting Aboriginal cultural heritage values of the creek and its environment would require consultation with Aboriginal knowledge-holders.

An enhanced Farmers Creek corridor would also offer numerous educational opportunities for local schools and others. Zig Zag Public School has already constructed informal steps to access the adjacent creekbed, presumably to support for educational uses and outdoor classes. To encourage, and take full advantage of the creek’s education potential appropriate curriculum materials, matched to suitable creek locations, could be developed for use by surrounding schools.

6.3.7 Community Involvement

An enhanced Farmers Creek corridor will enable surrounding residents and the wider the Lithgow community to access, enjoy and reconnect with the creek corridor as a leisure, recreation and environmental asset. This in turn can be expected to generate a degree of community support for these works and the creek’s continuing visual, recreational and environmental improvement – as well as possibly fostering increased appreciation and understanding of the creek and its importance. Implementation of the masterplan would also presents a significant community education opportunity.

This greater engagement and appreciation has the potential to be converted into increased community action and involvement in the creek’s rehabilitation and improvement – such as through local bushcare groups, waterwatch groups or programmes, schools groups, community planting or clean-up days, and similar volunteer programmes or events. However it

also needs to be acknowledged that such involvement needs to be directed or managed by Council to ensure that it coincides with the masterplans’ directions, and that these community programmes and activities/events do require Council resources to organise and run.



Source: Pittwater Council