Scrubby Creek

RECOVERY PLAN

29-08-2019 • Final Report

Document Register

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Document Structure

RECOVERY PLAN REPORT

PART ONE

CATCHMENT ANALYSIS & UNDERSTANDING

PART TWO

About the Project

Scrubby Creek is a mix of natural and constructed waterway channels and waterbodies which receive flows from a highly developed catchment. Scrubby Creek connects with Slacks Creek in Meadowbrook, which continues to flow into the Logan River. The creek generally lies within parklands and conservation zones, and has a mostly intact riparian zone, which is in good condition. Highways and other infrastructure cross the catchment, disconnecting people from the waterway, and inhibiting fish movement along the waterway. Through this project, Council and the community seek to enhance the natural environment to support and improve the connections to and along the waterway corridor, and improve the health of the waterway so it can be used by all to enjoy.

The waterways that dissect Logan, including Scrubby Creek, have integral economic, environmental and social values, and are an important component of the cityscape, contributing to the character, liveability and lifestyle of the region. The importance and value of waterways to the community has become increasingly evident. Social research undertaken as part of the 2010 Queensland Growth Summit indicated that the health of local waterways across South East Queensland was a fundamental element to consider for the growing region. The local community in Logan echoes this, with outcomes of 'Logan Listens: Residents surveys' (2018) and the '2011 Logan Waterways Summit' highlighting the importance of Logan's waterways, and the desire for investment and protection.

'Logan's Rivers and Wetlands Recovery Plan 2014-2024' represents a significant policy and engagement approach for the recovery of Logan's rivers, streams, and wetlands, which is based on local collaboration, community engagement, whole of system understanding, and a common vision and goals. The Slacks Creek Recovery Plan completed in 2013 was a key deliverable of Logan's Rivers and Wetland Recovery Plan, demonstrating the value of taking a collaborative approach to urban creek renewal.

The Scrubby Creek Recovery Plan is the second urban creek renewal initiative which follows the approach taken for the award-winning Slacks Creek Recovery Plan. It is also supported by the local community, with respondents to a survey undertaken as part of this project strongly agreeing that rejuvenating Scrubby Creek could benefit the economy, as well as the local community (see Appendix A).

This report presents a long-term vision for the Scrubby Creek Catchment, and is designed to aid Council develop a clear and agreed trajectory for the catchment's enhancement based on total water cycle principles. It presents a range of initiatives, with the power to transform the catchment and strengthen community connections to and along the waterway by addressing:

- Waterway Health (including water quality, habitat, water conveyance, and flooding)
- Ecological Corridors (aquatic and terrestrial connections)
- Community Connections (community use and understanding)

More specifically, the initiatives seek to achieve the following project outcomes:

- Enhance the health of the creek and its wetlands by improving water quality and the extent and condition of riparian vegetation
- Improve the amenity of the waterway and its value to the local community by providing connected, shaded, healthy, and safe public spaces
- Restore the ecological connections along the waterway for fish and other animals
- Efficiently manage and use the diversity of water resources across the catchment.

The initiatives presented in this report are based on a strong understanding of the catchment condition and future pressures, but are currently ideas only, designed to inspire discussion about what is possible. Each initiative, therefore, requires further investigation and consultation before Council can drive the project forward.

Change can come from local, small initiatives, as well as large scale integration of solutions which can catalyse major change. This report presents a full range of individual possibilities, as well as showcasing how these initiatives can be achieved through five example interventions at sites across the catchment:

1. Connected habitats - Parklands where there is opportunity to enhance terrestrial and aquatic fauna habitat and movement opportunities
2. Connecting communities - Parkland which is an important asset to the local community and provides opportunities to connect with the creek
3. Improved waterway health - Concrete channel which can be retrofitted to improve ecological condition and amenity
4. Room for water - Floodplain areas which are regularly inundated and provide important flood storage that needs to be preserved
5. Multifunctional corridors - Existing wetlands and waterways in new development zones which require protection and enhancement

These concepts should be used as a starting point in the implementation process. Visualisations and indicative costings have been provided to enable community consultation on future possibilities.

PROJECT APPROACH

A combination of desktop reviews, site inspections, catchment modelling, fish and water quality sampling, community survey, and stakeholder meetings and workshops were used to build an understanding of the catchment, develop a vision, and identify initiatives across the catchment.

The vision and initiatives presented in this report will be tested and refined through further Council and community consultation. This continued stakeholder engagement will ensure that future actions across the Scrubby Creek Catchment reflect the community's aspirations, and provides an appropriate implementation plan for Council to achieve the agreed vision.

LOGAN'S WATERWAYS SUMMIT 2011

LOGAN RIVERS & WETLANDS RECOVERY PLAN 2014-2024

SLACKS CREEK CATCHMENT FUTURES STUDY 2013

SCRUBBY CREEK RECOVERY PLAN

Desktop Assessment

- GIS mapping review
- Report reviews
- Flood review
- One-on-one meetings with key Council staff

Site Investigations

- Water quality monitoring
- Fish assessment
- Field investigations of key sites to verify desktop assessment and identify initiatives

Condition Assessment

- Water quality and water balance modelling
- Thematic mapping and identification of existing and future pressures
- Survey to understand community perception of catchment
- Draft condition assessment summary report

Opportunities and Prioritisation

- Draft vision developed
- Documentation and prioritisation of draft catchment-wide initiatives
- Council workshop to present draft vision and list of draft initiatives for review and input

THIS REPORT

Scrubby Creek Recovery Plan

- Summary of catchment condition
- Vision for the catchment
- Initiatives and locations to achieve the vision
- Delivering the vision

Future Vision

> ***Scrubby Creek will be a valued corridor of connected habitats for people, plants, and animals.***

Logan City Council is committed to ensure the future transformation of Scrubby Creek is based on a holistic strategy which aims to achieve environmental, social, and economic outcomes. This transformation is guided by a number of existing key visions and strategies including Logan's City Vision which is:

"Innovative, Dynamic, City Of The Future"

Imagine a well-planned sustainable city that has local and global reach, where resources are used responsibly, and where connections between people and places are convenient. The City of Logan is a place with a rich history and diversity interwoven into the fabric of our neighbourhoods. A place where people and business are adaptable and where potential is realised.

Key priorities for Logan are set in the Corporate Plan 2017-2022 and include:

- Quality lifestyles
- Conveniently connected
- Economic transformation
- Image and identity
- Green and renewable

The Logan Rivers and Wetlands Recovery Plan 2014-2024 strategic outcomes are:

- Strengthening community connection
- Sustaining productive waterways
- Enhancing waterway health and resilience

These are supported by strategic objectives and actions which include supporting waterway based amenity, recreation and tourism (SO2.2), undertake waterway and catchment restoration (SO3.1), and ensuring multiple benefits of waterways are protected and enhanced through Council's strategic planning.

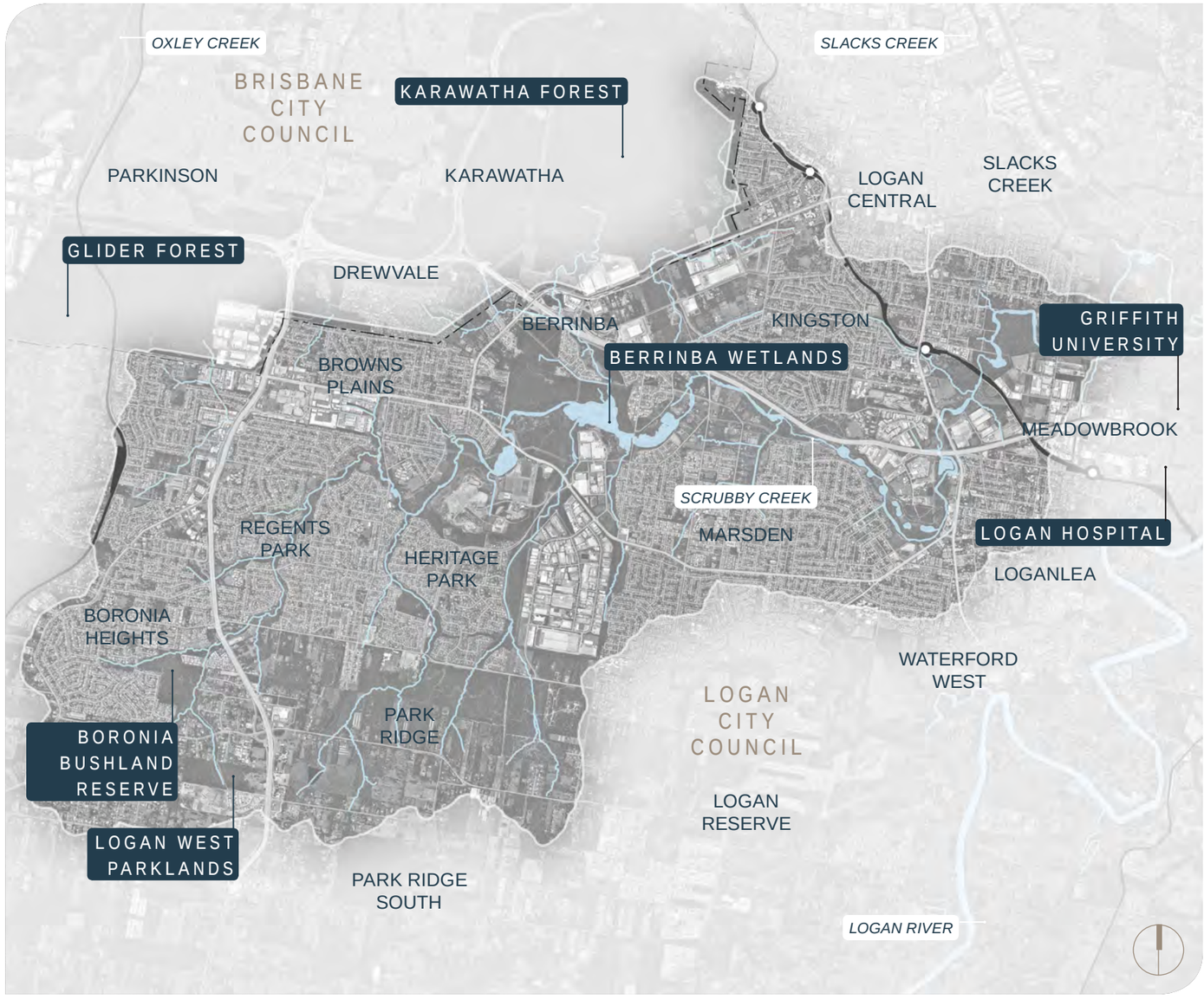


Figure 1: Scrubby Creek study area location within the Logan City Council Local Government Area

Scrubby Creek sits within the Logan River catchment (Figure 1). The Logan River Vision process has engaged with the local community to build a vision for the future catchment and river. Key ideas and values which were shared through this visioning process focused on:

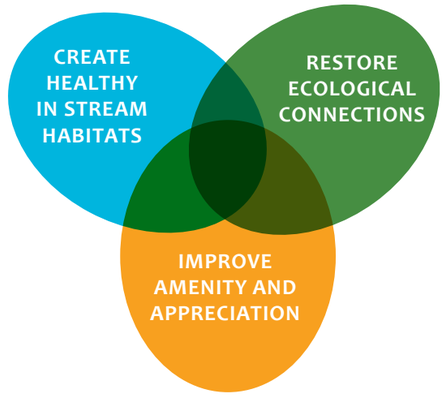
- Water quality
- Fishing
- Accessibility
- Parks and pathways

The future transformation of Scrubby Creek therefore aims to:

- Improve water quality and waterway health
- Improve habitat and ecological connectivity for native terrestrial and aquatic fauna
- Provide ecological and community connections
- Provide safe opportunities for the community to access the waterway
- Protect and enhance existing environmental values
- Improve amenity and city image
- Incorporate total water cycle management initiatives to improve sustainability outcomes in developed area

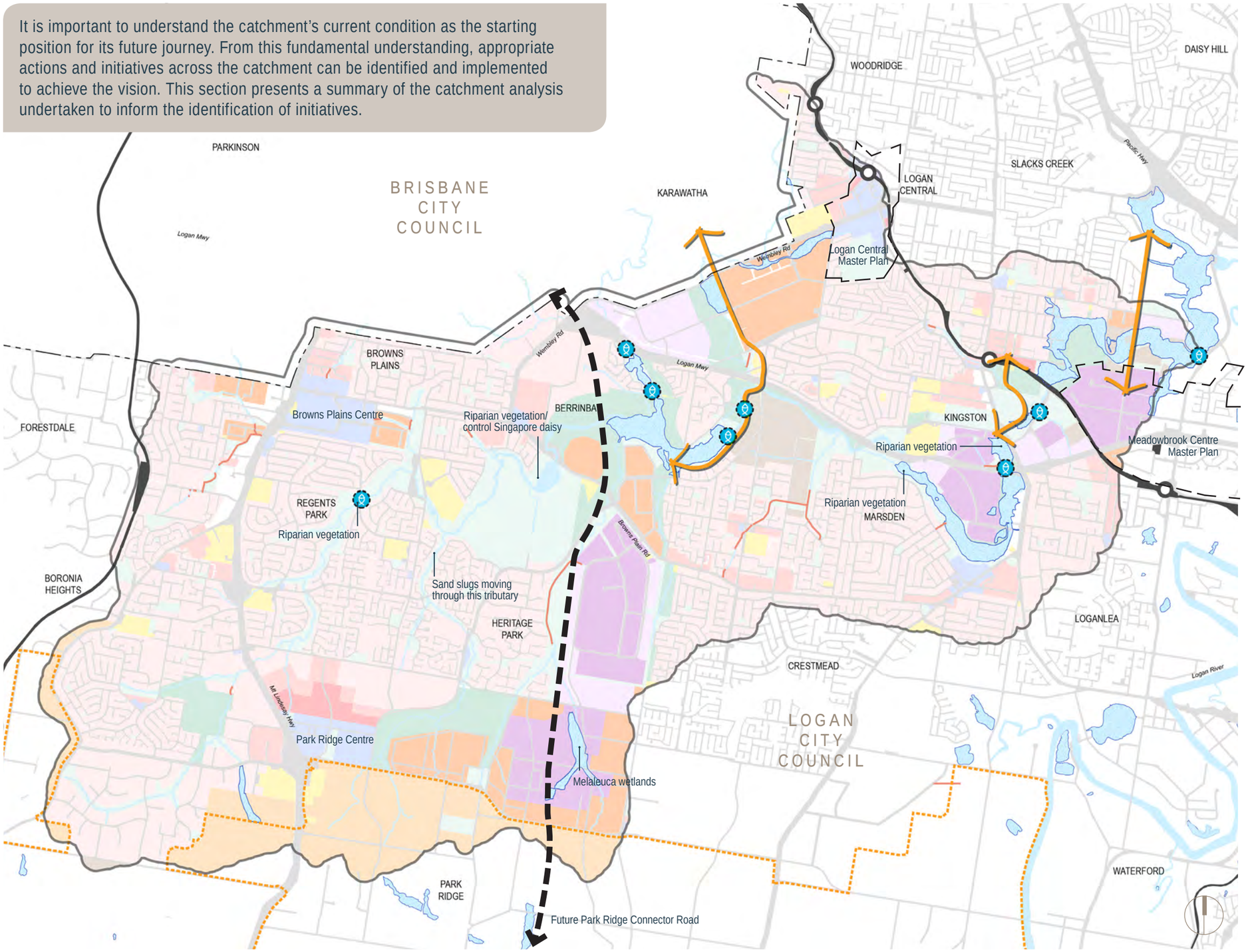
This can be distilled into 3 key objectives which the Scrubby Creek Recovery Plan aims to achieve:

- Create healthy in-stream habitats
- Restore ecological connections
- Improve amenity and appreciation



Where Are We Now

It is important to understand the catchment's current condition as the starting position for its future journey. From this fundamental understanding, appropriate actions and initiatives across the catchment can be identified and implemented to achieve the vision. This section presents a summary of the catchment analysis undertaken to inform the identification of initiatives.



LOCATION AND CHARACTER

The Scrubby Creek catchment ('catchment') covers over 57 km² and drains from Park Ridge and Regents Park, through Browns Plains, Heritage Park, Berrinba, Marsden, and Loganlea before entering Slacks Creek at Meadowbrook. The catchment is mostly located in the Logan City Council area, with some tributaries to the north located within Brisbane City Council.

The catchment is highly urbanized, with a mix of land uses including residential, industrial, commercial, open space, rural residential, and conservation. The waterway corridor primarily falls within the open space network. There are a number of main roads including the Logan Motorway and the Mount Lindsay Highway which dissect the catchment.

The waterway corridor is generally characterised by natural channels and wetlands, as well as constructed open waterbodies and sections of concrete and grass lined channels. The Berrinba wetlands are remnants from past sand mining activities, and are located in the heart of the catchment, providing a key destination for the community for recreation, despite being located in an industrial area.

LEGEND

- Scrubby Creek Catchment Boundary
- Waterway Centreline
- Concrete Culverts
- Wetlands
- High Priority Fish Barriers
- Centre
- Community Facilities
- Emerging Community
- Future Urban Area
- Recreation and Open Space
- Environmental Management and Conservation
- Rural Residential
- Low Density Residential
- Low-Medium Density Residential
- Medium Density Residential
- Low Impact Industry
- Medium Impact Industry
- Mixed Use
- Master Plan Area Boundary
- Council Area Boundary
- Future Park Ridge Connector Road
- Train Line and Stations
- Key Missing Links in Pedestrian and Cycle Network

CATCHMENT PLANNING AND DEVELOPMENT

The population of the Scrubby Creek catchment is predicted to grow by 25% (almost 21,000 people) by 2041. The majority of the Scrubby Creek catchment is already developed, but there are small pockets of infill development likely to occur, as well as the major conversion of existing rural residential land into residential, industrial and commercial in the Park Ridge area. There is also the future Park Ridge connector road easement, dissecting the catchment through Park Ridge, Heritage Park, and Berrinba.

The Logan Central and Meadowbrook centres are on the northern and southern catchment boundaries respectively. Both of these centres have current master plans which will guide redevelopment in these locations.

For more information on the land use and planning assessment, refer to Appendix B.

ECOLOGICAL CONDITION AND FISH PASSAGE

Desktop reviews and site inspections by aquatic ecologists were undertaken to determine the ecological condition of the waterway. This included a detailed assessment of fish assemblages, habitat, and passage.

The majority of the Scrubby Creek riparian corridor is vegetated, providing links between conservation areas including Boronia Bushland Reserve, Rosia Road and Slacks Creek Conservation Park. The vegetated waterway corridor also helps to connect regional landscapes, including Greenbank, Karawatha Forest and Daisy Hill. The condition of the riparian corridor can be improved through weed management and increased canopy cover at some locations. Terrestrial fauna movement will also need to be provided at the many road crossings across the waterway to ensure it can act as an ecological corridor both locally and regionally.

The waterway channel form is varied between concrete and grassed channels, large waterbodies, natural channels, and wetlands. The banks are relatively stable, and there are some sand slugs moving through the catchment as a result of past land use impacts. There are also a number of natural wetlands, including Melaleuca forest wetlands in the Park Ridge development area.

An assessment of the fish assemblages along the waterway identified both native and pest fish species in the catchment. Native fish numbers were much higher than pest fish in the two most downstream sampling sites in the catchment. As sampling continued up the catchment, fewer natives were observed compared to pests, with no native species identified at the furthest upstream site. The native fish observed in the upstream sites were large in size, indicating that juveniles are not able to reach these upstream sites. It is likely this trend was driven primarily by the number of barriers to fish passage along the waterway.

For more information on the ecological condition and fish passage and assemblage assessments, refer to appendix C and D respectively.

WATER QUALITY

Desktop, catchment stormwater pollutant modelling, water balance modelling and flood analyses were undertaken to provide an understanding of the water quality and hydrology of the Scrubby Creek catchment. In addition, field based water quality sampling and laboratory analysis was undertaken at 12 locations along the waterway.

This provided a snapshot of the water quality conditions across the Scrubby Creek catchment. This assessment showed that in general the water quality of Scrubby Creek met the relevant water quality objectives listed in the Environmental Protection (Water) Policy 2009 – Logan River Environmental Values and Water Quality, Australian and New Zealand Environment and Conservation Council (ANZECC) water quality guidelines and the NHMRC Guidelines for Managing Risks in Recreational Water for metals, bacteria and in-situ physiology and chemistry parameters.

The stormwater pollutant modelling identified that there will be an increase in pollutant loads of approximately 13% in future, due to new urban development. These catchment changes will mostly occur in the Park Ridge area. The modelling also identified that the key contributors of pollutants across the catchment are roads, commercial centres, and industry.

For more information on the water quality and catchment stormwater modelling, refer to Appendix E.

WATER BALANCE AND FLOODING

The water balance modelling highlighted that the majority of water used across the catchment is for residential purposes. The future increase in water use will also be driven predominantly by new residential and mixed use developments, especially in the Park Ridge area. This modelling also highlighted that there is significant volumes of stormwater and wastewater available in the catchment which could be captured, treated and re-used for non-potable demands.

A flooding assessment was undertaken using existing flood modelling results for the catchment. This assessment identified that the upstream catchment flows are generally contained within the main waterway channel. Downstream of Browns Plains Road, the nature of the creek changes, and the waterway and floodplain become more engaged as the magnitude of flooding increases. This engagement of the floodplain can begin in regular small events (i.e. one exccedence per year (1EY)) and in some locations results in the flooding of properties. There are also a number of important floodplain storage areas across the catchment where velocities remain low in large flood events.

For more information on the water balance modelling and flood assessment refer to Appendix F.

COMMUNITY CONNECTIONS

There are a number of main transport corridors across the catchment which create significant barriers to pedestrian and cyclist connectivity. As a result, existing parks within the catchment appear somewhat disconnected and do not read as part of the larger ‘Scrubby Creek’ corridor, while the pedestrian and cycle networks lack legibility and a clear identity.

Key challenges to creating a connected, safe network include land uses which turn their back to the waterway, limited access due to transport infrastructure, and public safety issues associated with limited passive surveillance and lack of lighting. Despite this, Scrubby Creek contains high landscape and ecological values which should be protected, and allows adequate provision of public open space and active transport corridors which provide legible, safe and shaded connections.

For more information on community connections analyses, refer to Appendix G.

Achieving the Vision

To work towards achieving the vision, an “Activate, Beautify, Cleanse” approach has been identified as an effective way to transition degraded urban waterways into valued assets.

Scrubby Creek is an urban waterway which has been impacted by past land uses – resulting in channelisation, excavation, and impoundment in some areas. The development of the catchment, including the removal of riparian vegetation, channelisation and the increase of stormwater velocities and pollutants, has led to a decline in its health and biodiversity and has reduced its value to the local community. While parklands are located along the majority of waterway, public interaction with Scrubby Creek is limited.

The Scrubby Creek Futures project therefore aims to re-engage the community with the waterway, and drive improvements in environmental health and social connection through an Activate, Beautify and Cleanse (A.B.C) approach. This approach was originally successfully applied in Singapore, and then tailored for use in the Slacks Creek Catchment Futures Study to harness the full potential of this urban waterway as an environmental and community asset.

The A.B.C approach aims to turn degraded urban waterways into city assets, which create places for residents, workers, and visitors to enjoy by providing environmental enhancement and beautification of the waterways.

Logan City and its residents stand to gain many benefits by taking the A.B.C approach including:

- Improved city image as a clean and sustainable city
- Improved recreational amenity and opportunity
- Improved environmental and public health outcomes
- Improved economic activity by attracting visitors to enjoy Logan’s natural environment
- Shared funding of projects by identifying a wide range of project types that deliver multiple benefits

ACTIVATE

to make Scrubby Creek safe and accessible to the community

BEAUTIFY

to enhance activation, amenity and legibility of the creek corridor and improve connections

CLEANSE

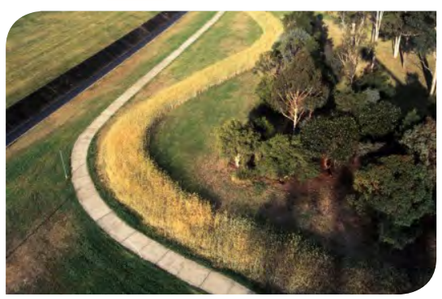
to improve waterway health, fish passage, protect downstream environments and support human activities on the waterway

The A.B.C approach does not provide a temporal transition for the catchment, but rather identifies a range of initiatives that can be developed and delivered in an integrated manner to improve the value of urban waterways. The delivery of projects using this framework will respond to the current condition and reflect the future aspirations in a practical and meaningful way. Projects therefore may deliver one or more of the A.B.C. principles.

EXISTING CONDITIONS

Concrete Channels

ACTIVATE



Access + Artwork

BEAUTIFY

Regional Parkland

CLEANSE

Stormwater Treatment

Degraded Edges

Formalised Access

Shade + Weed Suppression

Riparian Zone Revegetation

Disconnected Habitats

Signage + Access

Revegetation + Woody Debris

Restocking + Fish Barrier Removal

Delivering the Vision

This project has started to identify a range of initiatives that could be delivered across the catchment to kick-start the transformation process.

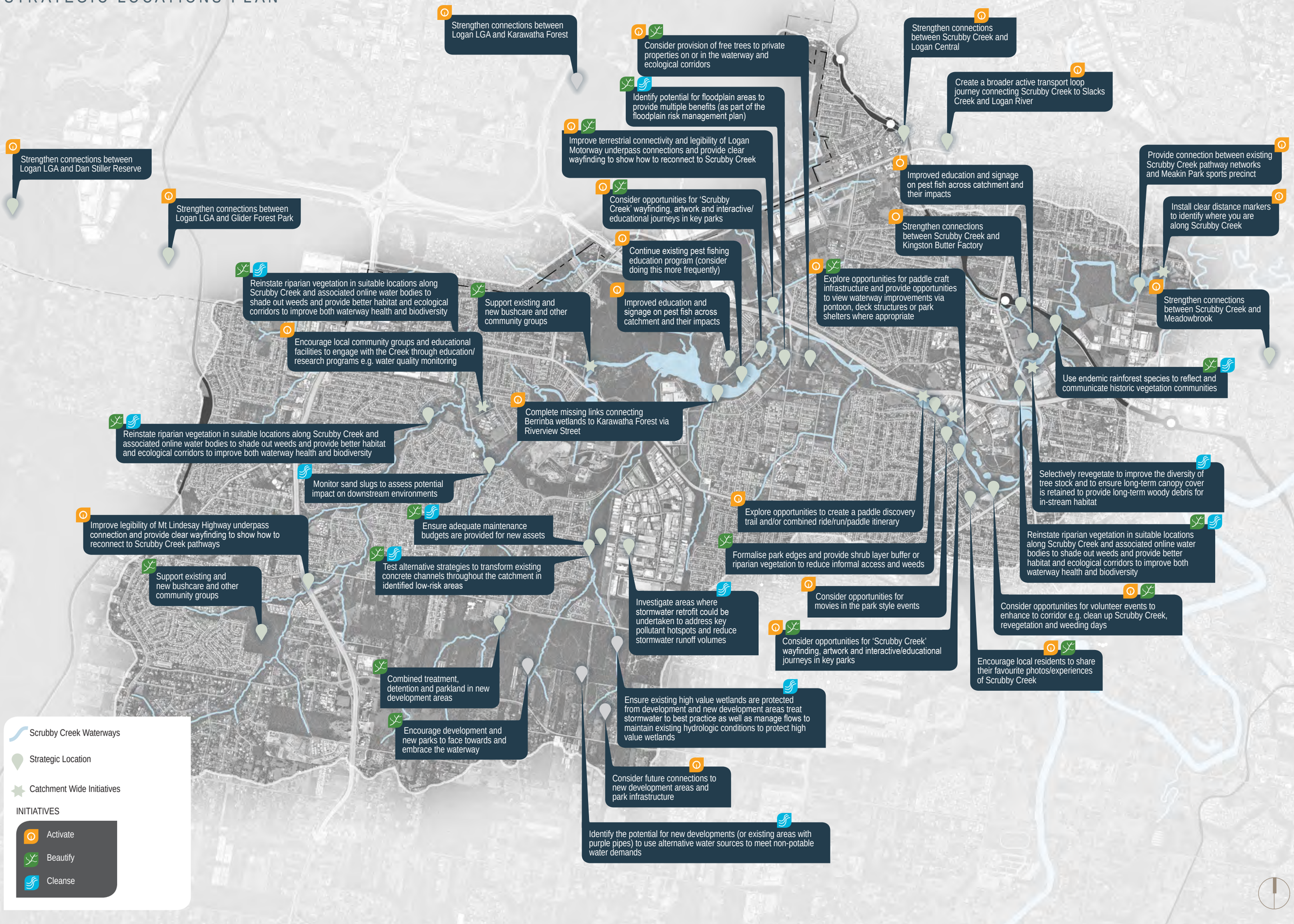
The following table presents an initial list of initiatives which have been identified by the project team and through stakeholder consultation. It identifies how these initiatives deliver outcomes across the A.B.C framework. It also identifies which initiatives are applicable across the whole catchment and those which are best suited to specific site conditions. A supporting map is used to identify potential locations for these initiatives, but this should not limit the application of these projects to other suitable sites across the catchment.

This table will be used by Council as a flexible implementation tool which will allow initiatives to be added and reprioritised as feedback from the community is received, and in response to new ideas and funding opportunities.

LIST OF SCRUBBY CREEK INITIATIVES

ACTIVATE Improve safety and accessibility to the community	BEAUTIFY Enhance activation, amenity, legibility and connections	CLEANSE Improve waterway health and fish passage	STRATEGIC LOCATIONS
Update relevant sections of the Planning Scheme to support outcomes of the Scrubby Creek Recovery Plan (Strategic Framework, PSPs etc)			Catchment wide
Support existing and new bushcare and other community groups			Catchment wide
Development of new parks to embrace and include the waterway			New development areas
Combined treatment, detention and parkland in new development areas			New development areas
	Reinstate riparian vegetation in suitable locations along Scrubby Creek and associated online water bodies to shade out weeds and provide better habitat and ecological corridors to improve both waterway health and biodiversity		Along whole waterway
	Use endemic rainforest species to reflect and communicate historic vegetation communities		Lower catchment corridor
	Test alternative strategies to transform existing concrete channels throughout the catchment in identified low-risk areas		Parks with concrete channels
	Identify potential for floodplain storage areas to provide multiple benefits (as part of the floodplain risk management plan)		Floodplains
	Improve terrestrial connectivity across the catchment		Major transport crossings
	Ensure adequate maintenance budgets are provided for new assets		Catchment wide
Consider provision of free trees to private properties on or in the waterway and ecological corridors			Private land along waterway or in ecological corridors
Consider opportunities for volunteer events to enhance the corridor e.g. clean up Scrubby Creek, revegetation and weeding days			Parks along waterways
Provide opportunities to enhance views and access the creek improvements via pontoon, deck structures or park shelters where appropriate			Parks along waterways
Gather and communicate indigenous history of the catchment through signage etc			Catchment wide
Consider opportunities for ‘Scrubby Creek’ wayfinding, artwork and interactive/educational journeys in key parks			Parks and pathways
Encourage local residents to share their favourite photos/experiences of Scrubby Creek			Catchment wide
Encourage development to face the waterway			New development
		Selectively revegetate to improve the diversity of tree stock and to ensure long-term canopy cover is retained to provide long-term woody debris for in-stream habitat	Along waterway
		Remove/rehabilitate fish barriers from downstream to upstream to improve fish passage and overall aquatic ecosystem health	Starting from bottom of the catchment
		Protect existing high value wetlands from development	New development areas
		Ensure new development areas treat stormwater to best practice as well as manage flows to maintain existing hydrologic conditions to protect high value wetlands and tributaries	New development areas
		Restock endangered Mary River cod and Australian bass to pool habitats to improve the recreational fishing experience and reduce the threats posed by pest fish (via predation and competition)	Gould Adams Park, Demeio Park
		Monitor success of fish improvement strategies with the potential to include community tracking and reporting	Gould Adams Park, Demeio Park
		Investigate areas where stormwater retrofit could be undertaken to address key pollutant hotspots and minimise catchment stormwater flows entering the creek	Commercial centres, industry, roads
		Incorporate and progress to a risk based land use planning approach to flooding	Catchment wide
		Addition of complex large woody debris (snags/log jams) in key locations to improve fish habitat	Start from bottom of catchment with a focus on water bodies
		Monitor sand slugs to assess potential impact on downstream environments	Upstream of Berrinba wetlands
		Identify the potential for new developments (or existing areas with purple pipes like South West 1) to use alternative water sources to meet non-potable water demands	New development areas
		Investigate opportunities to improve water quality	Waller Park, Heritage Park, between Wembley Road & Logan Motorway
		Identify key flood conveyance and flood storage areas to ensure these are preserved	Catchment wide
Continue existing pest fishing education program (consider doing this more frequently)			Demeio Park
Encourage local community groups and educational facilities to engage with the Creek through education/research programs e.g. water quality monitoring			Schools, Friends of Berrinba wetlands
Consider future connections to new development areas and park infrastructure			New parks and new park infrastructure
Strengthen connections between Logan LGA and the adjacent Karawatha Ecological Corridor and other large recreational assets within BCC			Karawatha Forest, Glider Forest Park and Dan Stiller Reserve
Strengthen connections between Scrubby Creek and key centres and destinations			Logan Central, Meadowbrook, Kingston Butter Factory
Create a broader active transport loop journey connecting Scrubby Creek to Slacks Creek and Logan River			Loop from Logan Central, through Meadowbrook, out to Riverdale Park and up along Slacks Creek
Install clear distance markers to identify where you are along Scrubby Creek			Catchment wide
Explore opportunities for paddle craft infrastructure e.g. formal access points			Catchment wide
Improved education and signage across catchment on pest fish and their impacts			Catchment wide
Explore opportunities to create a paddle discovery trail and/or combined ride/run/paddle itinerary			JJ Smith Park
Consider opportunities for movies in the park style events			Neighbourhood or district parks
Provide connections between existing pathway networks and key open space areas			From Berrinba wetlands up to Karawatha Forest via Riverview street & Logan Motorway, from Meakin Road to the Meakin Park sports precinct
Improve legibility of underpass connections (currently an identified CPTED issue) and provide clear wayfinding to show how to reconnect to the Scrubby Creek pathways			Mount Lindesay Highway underpass, Logan Motorway (near Karawatha Forest)
Prepare a signage plan, including a palette of different signs/markers to be implemented in various circumstances along the length of the creek			Catchment wide
	Formalise park edges and provide shrub layer buffer or formal edge to riparian vegetation to reduce informal access where appropriate and reduce weedy, unmaintained edges		All parks
	Provide additional shade trees/clusters of endemic vegetation along pathways to enhance shade provision with a desired goal of 50% shade cover over paths		Neighbourhood and district parks

STRATEGIC LOCATIONS PLAN



TYPICAL APPLICATIONS AND COSTS

The following table provides a high level assessment of the initiatives which can be used to inform prioritsiation of projects by identifying how the different initiatives achieve the Scrubby Creek objectives, the typical budget and potential partners required to deliver the project.

INITIATIVES	PERFORMANCE AGAINST OBJECTIVES			COST TO DELIVER	POTENTIAL PARTNERS
	Improved Amenity and Appreciation	Restored Ecological Connections	Healthy In Stream Habitats		
Update relevant sections of the Planning Scheme to support outcomes of the Scrubby Creek Recovery Plan (Strategic Framework, PSPs etc)	High	High	High	Low	State Government / community
Support existing and new bushcare and other community groups	High	High	High	Low	Community
Development of new parks to embrace and include the waterway	High	Med	Med	Low	Developers
Combined treatment, detention and parkland in new development areas	Med	Med	High	Low	Developers
Reinstate riparian vegetation in suitable locations along Scrubby Creek and associated online water bodies to shade out weeds and provide better habitat and ecological corridors to improve both waterway health and biodiversity	Med	High	High	Med	Community / private landholders
Use endemic rainforest species to reflect and communicate historic vegetation communities	High	High	Med	Low	
Test alternative strategies to transform existing concrete channels throughout the catchment in identified low-risk areas	High	High	Med	Med/High	Community
Identify potential for floodplain storage areas to provide multiple benefits (as part of the floodplain risk management plan)	Med	High	High	Low	State Government / community
Improve terrestrial connectivity across the catchment	Med	High	Med	Med	State Government
Ensure adequate maintenance budgets are provided for new assets	Med	Med	Med	Low/Med	
Consider provision of free trees to private properties on or in the waterway and ecological corridors	High	High	High	Low/Med	Community
Consider opportunities for volunteer events to enhance the corridor e.g. clean up Scrubby Creek, revegetation and weeding days	High	Med	Med	Low	Community / schools
Provide opportunities to enhance views and access the creek improvements via pontoon, deck structures or park shelters where appropriate	High	Med	Med	Med/High	
Gather and communicate indigenous history of the catchment through signage etc	High	Low	Low	Low	Community
Consider opportunities for 'Scrubby Creek' wayfinding, artwork and interactive/educational journeys in key parks	High	Low	Low	Low	Community / schools
Encourage local residents to share their favourite photos/experiences of Scrubby Creek	High	Low	Low	Low	Community
Encourage development to face the waterway	High	Low	Low	Low	Developers
Selectively revegetate to improve the diversity of tree stock and to ensure long-term canopy cover is retained to provide long-term woody debris for in-stream habitat	Med	High	High	Medium	Community / private landholders
Remove/rehabilitate fish barriers from downstream to upstream to improve fish passage and overall aquatic ecosystem health	Med	High	High	Med/High	State Government
Protect existing high value wetlands from development	Med	High	High	Low	Developers
Ensure new development areas treat stormwater to best practice as well as manage flows to maintain existing hydrologic conditions to protect high value wetlands and tributaries	Med	High	High	Low	Developers
Restock endangered Mary River cod and Australian bass to pool habitats to improve the recreational fishing experience and reduce the threats posed by pest fish (via predation and competition)	Med	Med	High	Med	
Monitor success of fish improvement strategies with the potential to include community tracking and reporting	Med	Med	High	Low	Community
Investigate areas where stormwater retrofit could be undertaken to address key pollutant hotspots and minimise catchment stormwater flows entering the creek	Med	Med	High	Med/High	
Incorporate and progress to a risk based land use planning approach to flooding	Med	Med	High	Low	
Addition of complex large woody debris (snags/log jams) in key locations to improve fish habitat	Low	Med	High	Low/Med	
Monitor sand slugs to assess potential impact on downstream environments	Low	Med	High	Low	
Identify the potential for new developments (or existing areas with purple pipes like South West 1) to use alternative water sources to meet non-potable water demands	Low	Low	High	Med	Developers / Logan Water
Investigate opportunities to improve water quality	Med	Low	High	Low	Logan Water
Identify key flood conveyance and flood storage areas to ensure these are preserved	Low	Med	High	Med	
Continue existing pest fishing education program (consider doing this more frequently)	High	Low	High	Low	Community / schools
Encourage local community groups and educational facilities to engage with the Creek through education/research programs e.g. water quality monitoring	High	Med	Med	Low	Community groups / schools

INITIATIVES	PERFORMANCE AGAINST OBJECTIVES			COST TO DELIVER	POTENTIAL PARTNERS
	Improved Amenity and Appreciation	Restored Ecological Connections	Healthy In Stream Habitats		
Consider future connections to new development areas and park infrastructure	High	Med	Med	Low	Developers
Strengthen connections between Logan LGA and the adjacent Karawatha Ecological Corridor and other large recreational assets within BCC	High	Med	Low	Med	Brisbane City Council
Strengthen connections between Scrubby Creek and key centres and destinations	High	Med	Low	Med	Developers
Create a broader active transport loop journey connecting Scrubby Creek to Slacks Creek and Logan River	High	Med	Low	Med/High	State Government
Install clear distance markers to identify where you are along Scrubby Creek	High	Low	Low	Low	
Explore opportunities for paddle craft infrastructure e.g. formal access points	High	Low	Low	Med/High	
Improved education and signage across catchment on pest fish and their impacts	High	Low	Low	Low	Community
Explore opportunities to create a paddle discovery trail and/or combined ride/run/paddle itinerary	High	Low	Low	Low	Community
Consider opportunities for movies in the park style events	High	Low	Low	Low	Community
Provide connections between existing pathway networks and key open space areas	High	Low	Low	Med/High	Developers
Improve legibility of underpass connections (currently an identified CPTED issue) and provide clear wayfinding to show how to reconnect to the Scrubby Creek pathways	High	Low	Low	Low	State Government / police
Prepare a signage plan, including a palette of different signs/markers to be implemented in various circumstances along the length of the creek	High	Low	Low	Low	
Formalise park edges and provide shrub layer buffer or formal edge to riparian vegetation to reduce informal access where appropriate and reduce weedy, unmaintained edges	Med	High	Med	Med	Community
Provide additional shade trees/clusters of endemic vegetation along pathways to enhance shade provision with a desired goal of 50% shade cover over paths	Med	Med	Med	Med	Community

Project Objectives Criteria	Rating
No/limited contribution towards objective	Low
Reasonable contribution towards objective	Med
Significant contribution towards objective	High

Costs Criteria	Rating
Council input into project could be < $10,000	Low
Council input into project could be between $10,000 - $100,000	Med
Council input into project could be > $100,000	High

Opportunities for Change

There are 5 key typical scenarios across the Scrubby Creek catchment which present opportunities to integrate a number of initiatives to drive the future catchment transformation.

Connected Habitats

Parkland with waterbody that has the potential to connect fish and people to regional locations

Connecting Communities

Parkland which is an important asset to the local community and provides opportunities to connect with the creek

Improved Waterway Health

Concrete channel which can be retrofitted to improve ecological condition and amenity

Room for Water

Floodplain areas which are regularly inundated and provide important storage for flows that need to be preserved

Multifunctional Corridors

Existing wetlands and waterways in new development zones which require protection and enhancement

Five key locations have been selected to demonstrate how these typologies could be applied across the catchment:

1. Gould Adams Park – connected habitats
2. JJ Smith Park – connecting communities
3. Hawthorne Park – improved waterway health
4. Marsden rural residential precinct – room for water
5. Park Ridge structure plan area – multifunctional corridors

High level concepts and visualisations have been developed to communicate potential initiatives at these locations. These solutions can be adapted and refined to suit many other similar locations across the catchment. The final locations and designs should be decided in partnership with project stakeholders and the broader community.

DEMONSTRATION AREAS

ROOM FOR WATER

MARSDEN RURAL RESIDENTIAL PRECINCT

CONNECTED HABITATS

GOULD ADAMS PARK

CONNECTING COMMUNITIES

JJ SMITH PARK

IMPROVED WATERWAY HEALTH

HAWTHORNE PARK

MULTIFUNCTIONAL CORRIDORS

PARK RIDGE STRUCTURE PLAN AREA

CONNECTED HABITATS

Parkland with waterbody that has the potential to connect fish and people to regional locations.

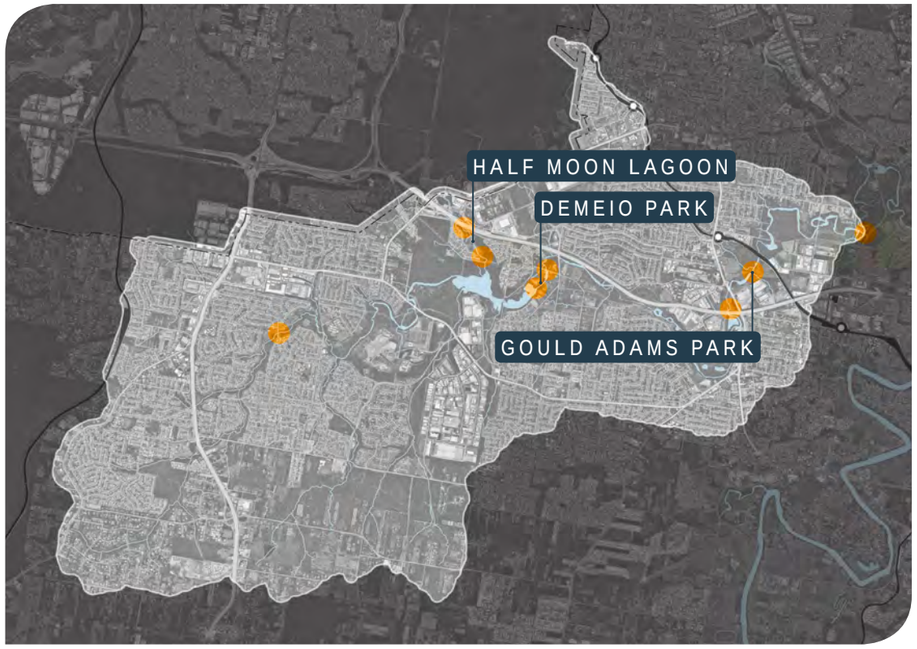
There are a number of locations along Scrubby Creek where the waterway has been modified to create large open water bodies. Many of these water bodies are located adjacent to a parkland, and have a weir structure which maintains the water level.

These water bodies provide good opportunities to reconnect fish passage and allow the community to understand more about native fish populations and how waterway rehabilitation efforts can help to improve the number and diversity of native fish species. Removal of fish barriers from the bottom of the catchment up to Demeio Park would maximise available habitat and movement opportunities for native fish.

Possible initiatives:

- Removal / rehabilitation of fish barriers – investigate if the current weir structure is required and, if not, plan for its removal. If this structure is required, then an appropriately designed fishway should be retro-fitted to the existing structure
- Addition of complex woody structures – the addition of complex large woody debris (e.g. tree stumps with intact root balls and branches) creates in-stream habitat for fish.
- Fish stocking – stocking of endangered Mary River Cod and Australian Bass to the water bodies will increase the number of large native predators, and will improve community awareness.
- Improve knowledge of pest fish species – signage, media campaigns, and pest fishing events can improve community understanding of the impacts of pest fish.
- Formalised access points – these can include signage and suitable bins to encourage people fishing to appropriately remove rubbish (especially fishing line) and disposal of pest species.
- Terrestrial habitat improvements – this location is an important ecological corridor and provides habitat for koalas and Swift Parrots. Therefore, the planting of additional trees will improve habitat and connectivity, as well as provide additional sources of large woody debris.

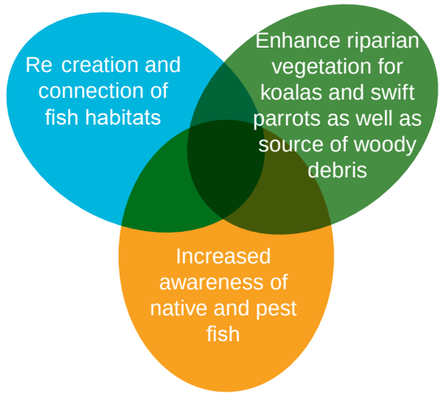
Note that these initiatives could be delivered at other similar parkland locations across the catchment with waterbodies where habitat and connectivity (fish, koalas etc.) is a priority (e.g. Demeio).



Scrubby Creek study area showing high priority fish barriers (orange circle) and other similar park locations

DEMONSTRATION AREA: GOULD ADAMS PARK

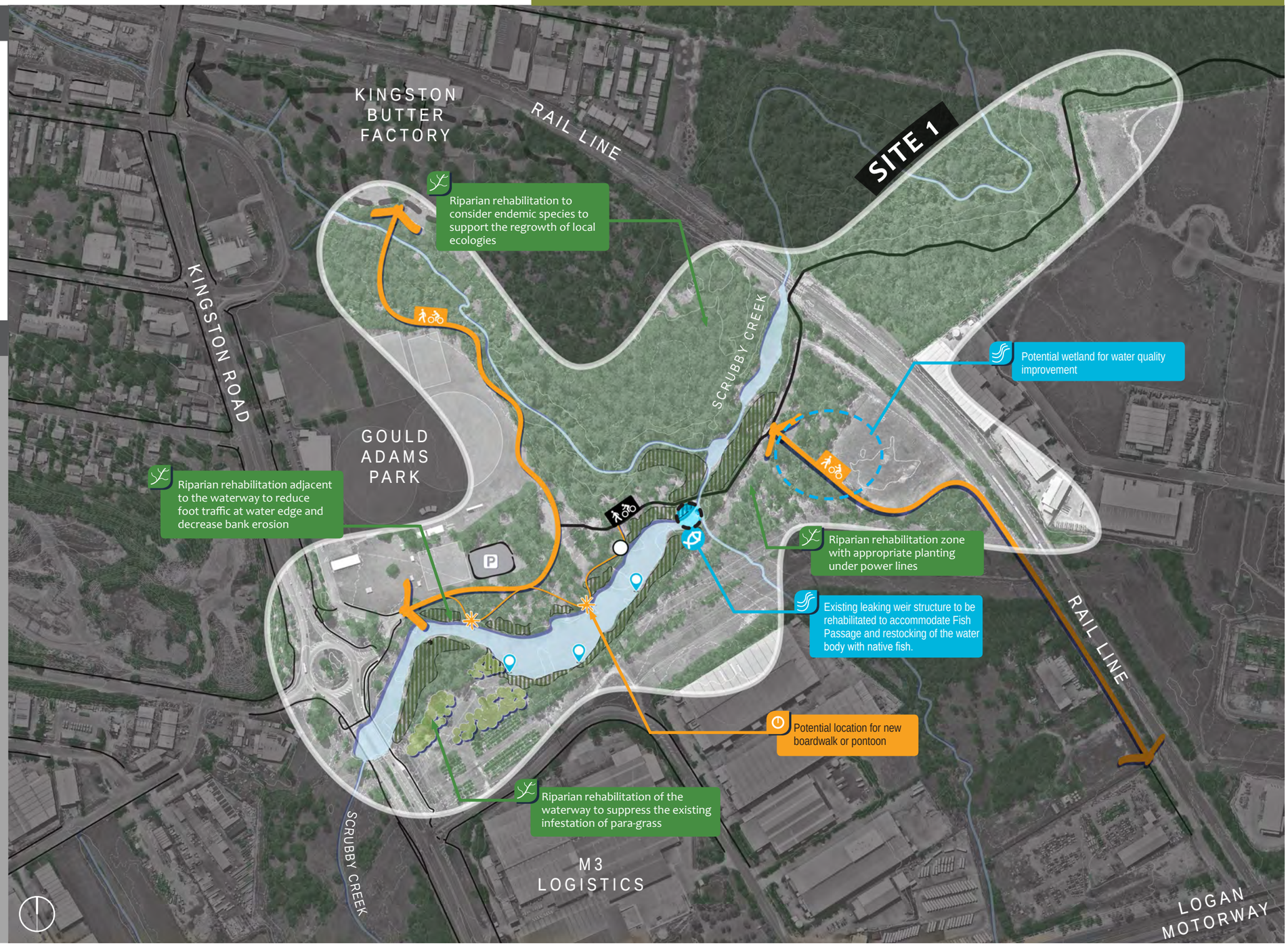
KEY LOCATION OBJECTIVES



LEGEND

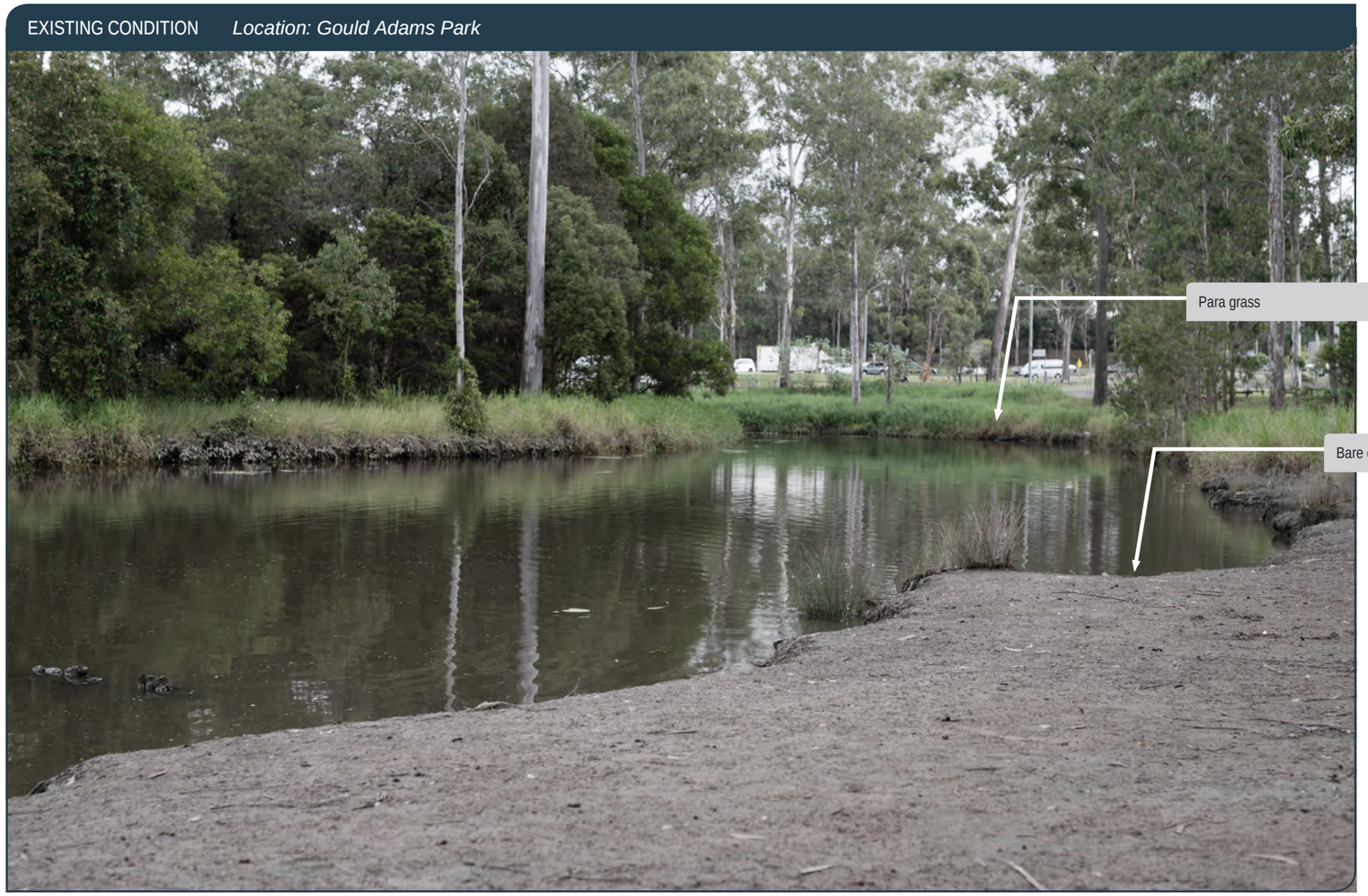
- Activate
- Beautify
- Cleanse
- Fish passage rehabilitation. Refer Appendix D for details
- Fish habitat / large woody debris. Final location and quantity of natural structure and type to be determined.
- Existing creek access (Decking, Pontoon) to be retained
- Proposed creek access. Consider boardwalk pontoon structures with appropriate interpretive signage
- Proposed pedestrian & cycle link
- Future pedestrian & cycle link
- Existing pedestrian & cycle path
- Existing vegetation to be retained and protected
- Proposed riparian planting including tree cover where appropriate
- Proposed riparian under storey planting under existing tree canopy to maintain views
- Car parking (consider permeable paving if road pavement is to be improved so as to retain existing vegetation)

SCALE 1:5000 @ A3



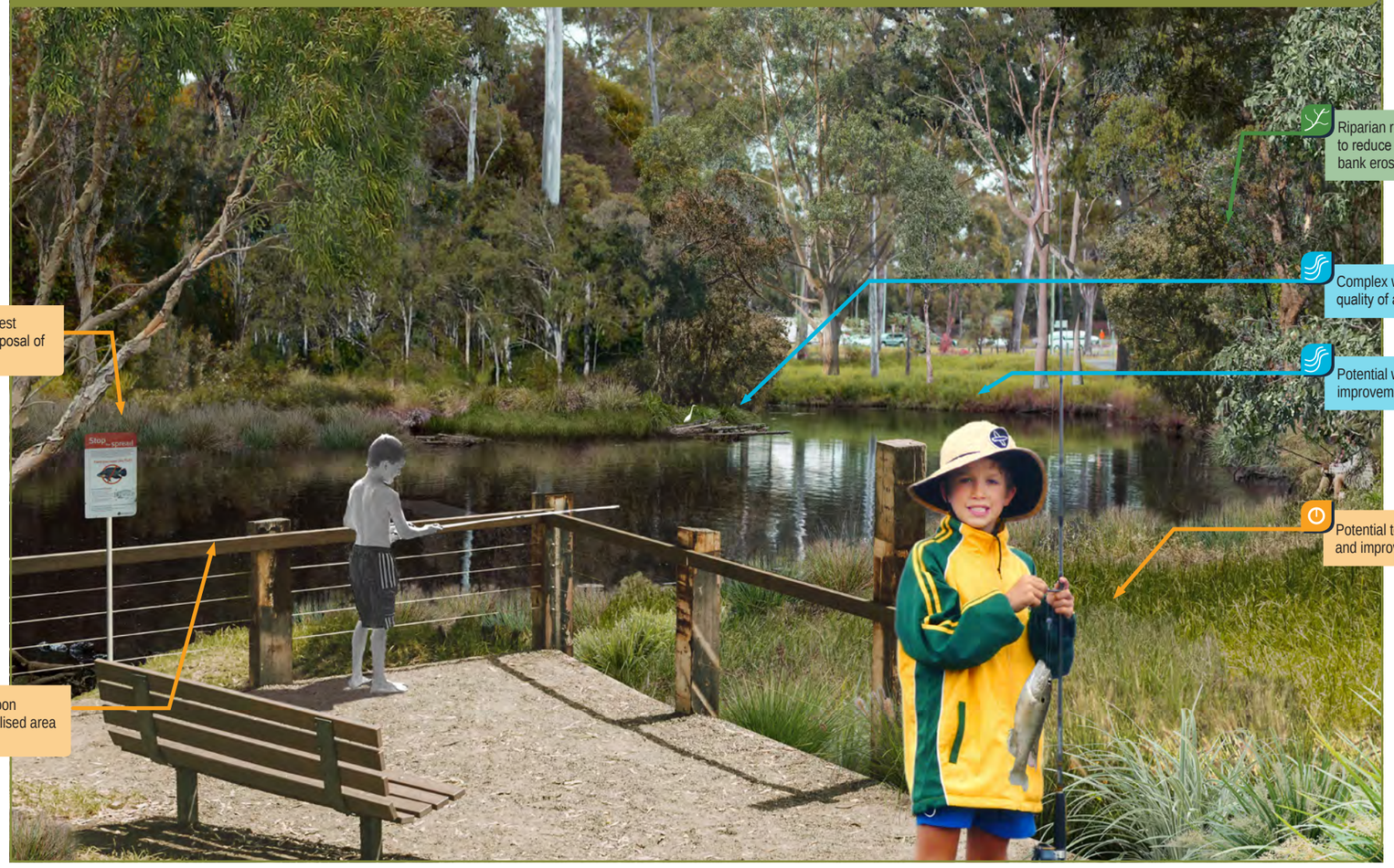
EXISTING CONDITION

EXISTING CONDITION *Location: Gould Adams Park*



FUTURE ASPIRATION

FUTURE VISION



Bins and signage to be provided on pest versus native fish and appropriate disposal of waste etc.

Riparian rehabilitation adjacent to the waterway to reduce foot traffic at water edge, decrease bank erosion and shade out weeds

Complex woody debris added to improve the quality of aquatic habitat and fish stocking

Potential wetland edges for water quality improvement

Potential to provide active community access and improve amenity of edges

Potential boardwalk/pontoon structure to provide formalised area for fishing etc.

CONNECTING COMMUNITIES

Parkland which is an important asset to the local community and provides opportunities to connect with the creek.

There are a number of parklands adjacent to the waterway which are used frequently by the local community for a range of recreational activities, including walking, picnicking etc. The waterway in many of these locations is not easily accessible and there is limited signage to identify it as Scrubby Creek.

These areas provide a good opportunity to connect the local community with the waterway, and to improve their understanding of the Scrubby Creek catchment.

Possible initiatives:

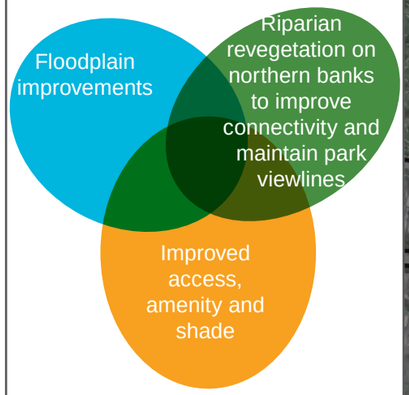
- Enhanced riparian vegetation – riparian revegetation is important as the parkland sits within the ecological corridor; however, revegetation should be prioritized on the far bank to act as a buffer between industry and the waterway, and to maintain view lines on the park side of the waterway. Weed control of bankside para grass ensures native riparian vegetation is provided with a competitive edge in establishing along the waterbody
- Improved edges – formalization of edge between mown parkland and vegetated edges of waterway to reduce weeds, delineate maintenance zones, and to identify dedicated access points
- Improved views and access – maintain view lines of the waterway provision of key areas where the community can access the waterway.

Note that these initiatives could be delivered at other similar parkland locations across the catchment where riparian vegetation is important but needs to be balanced with parkland requirements.

Scrubby Creek study area showing potential locations of similar parklands

DEMONSTRATION AREA: JJ SMITH PARK

KEY LOCATION OBJECTIVES



LEGEND

- Activate
- Beautify
- Cleanse
- Potential for large woody debris to be added to waterbodies to improve fish habitat
- Proposed creek access. Consider boardwalk pontoon structures with appropriate interpretive signage
- Proposed pedestrian & cycle link
- Existing pedestrian & cycle path
- Existing vegetation to be retained and protected
- Proposed riparian planting including tree cover where appropriate
- Proposed riparian under storey planting under existing tree canopy to maintain views
- Car parking (Existing to remain)

SCALE 1:5000 @ A3

Riparian rehabilitation zone with appropriate planting under power lines

TO BEGA PARK & KINGSTON COLLEGE

SCRUBBY CREEK

M6 LOGAN MOTORWAY

SITE 2

Potential restocking of the water body with native fish.

Focus riparian revegetation on far bank to improve terrestrial connectivity and act as buffer between industry and waterway

Formalise edges between park and riparian zone to reduce foot traffic at water edge and address weedy edges

Revegetation in areas to provide shade for pedestrians and maintain view lines

Potential location for new boardwalk or pontoon

Potential community events and rebranding of park to improve understanding that the waterbodies are Scrubby Creek

Consider minor earthworks remodeling to increase floodplain engagement and infiltration

Formalise edges between park and riparian zone to reduce foot traffic at water edge and address weedy edges

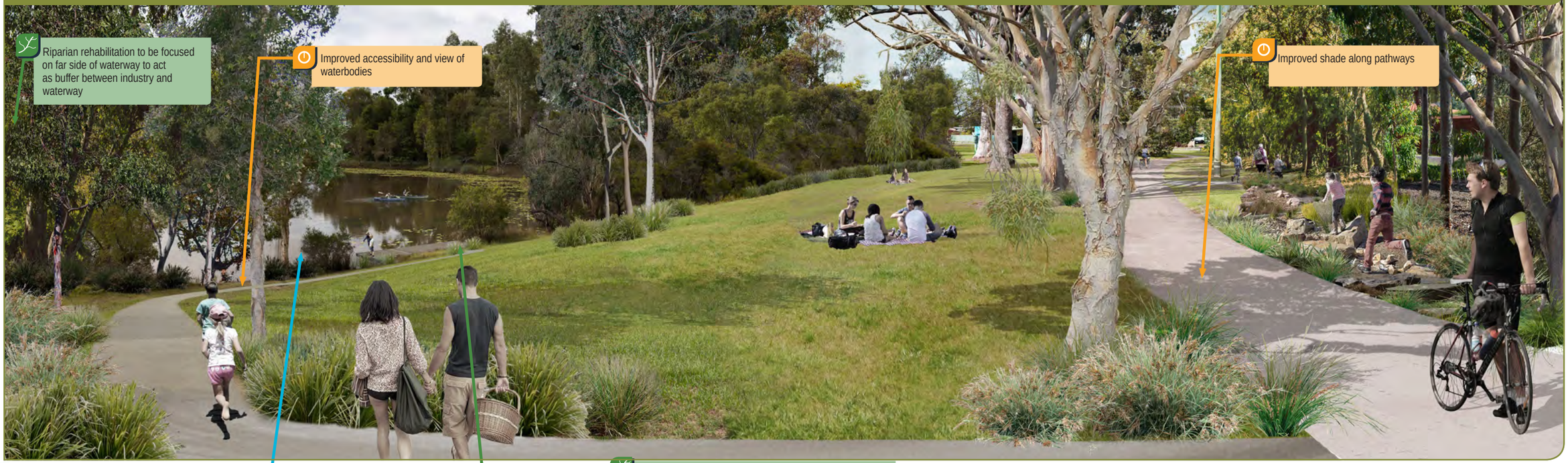
Riparian rehabilitation zone within flood plain is to include flood appropriate species

EXISTING CONDITION

EXISTING CONDITION *Location: JJ Smith Park*

FUTURE ASPIRATION

FUTURE VISION



IMPROVED WATERWAY HEALTH

Concrete channel which can be retrofitted to improve ecological condition and amenity.

There are a number of concrete channels throughout the catchment, including sections of concrete channels which have natural channels upstream and downstream. Some of these constructed channels are also located within broad parklands.

These areas provide a good opportunity to recreate natural channel features. This could range from small initiatives to large scale natural channel design.

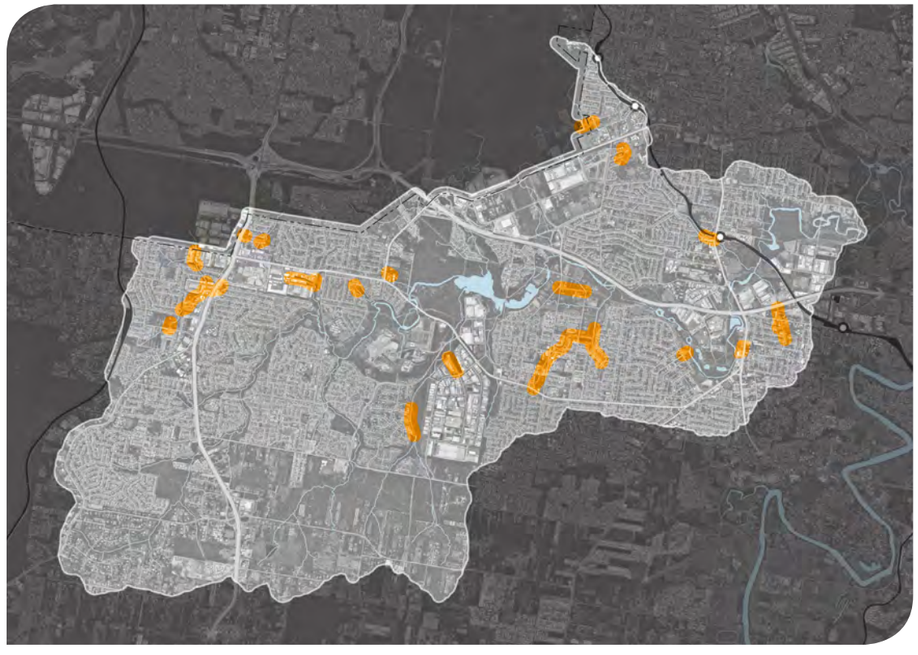
Possible initiatives:

- Demonstration and testing – test a range of possible natural channel solutions to understand cost and benefit. This testing could occur in low flood risk areas. Solutions could range from removal of small sections of concrete and pocket revegetation to full removal of the concrete and natural channel reinstatement.
- Improved connectivity – areas which connect existing natural waterway channels and are located in ecological corridors should also be identified as priority locations.
- Community involvement – the local community could be included in the design of these channels as well as the revegetation and on-going maintenance.

Note that these rehabilitation techniques could be applied at other concrete channels across the catchment (subject to flood risk assessments).

EXISTING CONDITION

EXISTING CONDITION Hawthorne Park



Location of concrete channels within the Scrubby Creek study area

FUTURE ASPIRATION

EXISTING CONDITION

Small and shallow concrete channel which sits within a wide open space corridor.

OUTCOME SCENARIO A

STEP ONE:

Demolish existing concrete channel, utilising broken concrete as channel bed

DESIGNED OUTCOME:

Concrete provides opportunities for riparian planting to be reestablished within the drainage channel

OUTCOME SCENARIO B

STEP ONE:

Remove whole section of concrete lined drainage channel

DESIGNED OUTCOME:

New natural channel design outcome created

ROOM FOR WATER

Floodplain areas which are regularly inundated and provide important storage of flows that needs to be preserved.

There are floodplain areas along Scrubby Creek which are still well connected to the waterway and are regularly inundated. These areas provide important storage zones and regulate flood levels downstream as well as filter water, store carbon and other important ecological processes.

It is important to preserve these floodplain zones and ensure that the land uses are compatible with the regular inundation.

Possible initiatives:

- Preserve storage and provide room for water – preserve existing movement and storage of water in these areas.
- Improve current practices – work with private landholders to ensure land use practices are suitable and reduce the risk to water quality impacts during inundation events (e.g. ensure fertilisers are kept out of the flood range).
- Protect and enhance function – look for opportunities to enhance connection between the waterway and the floodplain and revegetate the floodplain area to improve water filtering and carbon sequestration.
- Identify opportunities for naturalisation where suitable – identify opportunities for acquisition and concrete channel replacement to allow for revegetation and naturalization of floodplain and waterways.
- Passive recreation opportunities – identify opportunities for the creation of ‘Scrubby Commons’ providing a range of informal and passive natural recreation opportunities.
- Identify suitable land uses – suitable land uses in floodplains can include rural residential (with resilient housing design and low risk land use practices), parklands, etc.

Note that these floodplain management techniques should be applied to similar floodplain zones across the catchment.

The following activities and land uses are deemed incompatible and are to be avoided in order to ensure the existing floodplain function is maintained:

- Avoid conversion of existing rural land uses to more impermeable landuses including residential, industrial and commercial.
- Avoid cut and fill to accommodate development
- Avoid high risk landuses which may generate pollutant loads

FUTURE ASPIRATION

COMPATIBLE USES AND OPPORTUNITIES

Note: The following images are indicative only and are examples of potential land uses /activities that allow floodplain storage to be maintained. These possible land uses encourage infiltration and generally mimic a natural hydrology.

LOCAL PARK

NATURE BASED RECREATION

FLOOD PLAIN WETLANDS

RURAL RESIDENTIAL

DRIVING RANGE

PERMACULTURE

MULTIFUNCTIONAL CORRIDORS

Existing wetlands and waterways in new development zones which require protection and enhancement.

There are a number of new development areas in the Scrubby Creek catchment, including greenfield and infill development. These areas provide an opportunity to ensure development embraces the waterway and that corridors can be developed that provide multiple benefits, including protection of existing wetlands, stormwater treatment and detention, habitat and recreation.

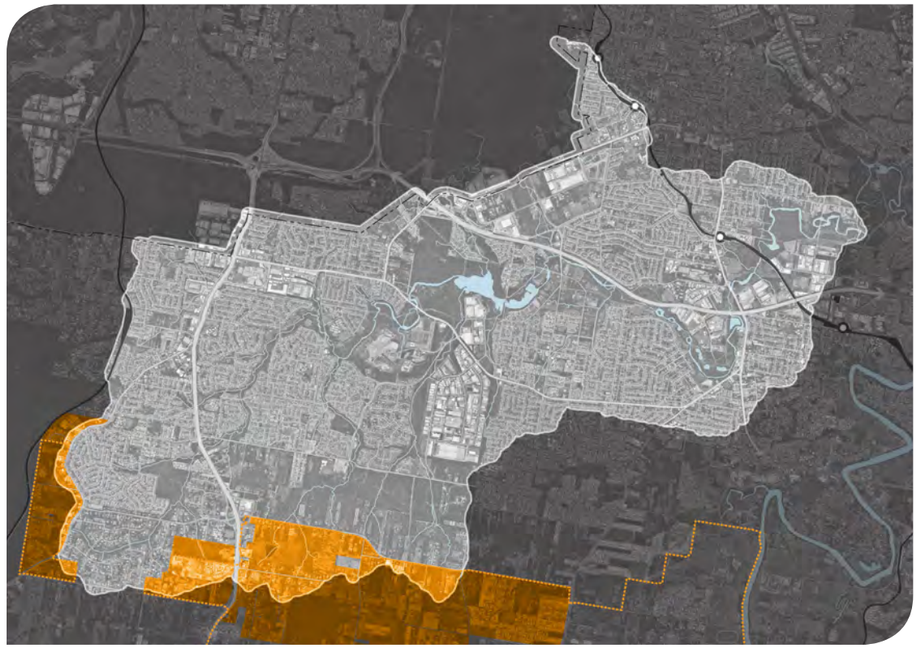
Potential initiatives

- Protect existing waterways and wetlands – Council's planning scheme requires the protection of wetlands and waterways from new development. This include buffers, water quality treatment and the maintenance of natural hydrology which is critical to protect sensitive Melaleuca wetlands and natural tributaries which exist in the catchment. Therefore it is important that these requirements are achieved for new development upstream and adjacent to these sensitive wetland areas.
- Embrace the waterway – new development and parks to face and embrace the proximity to the waterway corridor and allow for passive surveillance.
- Multiple-use corridors – design new linear corridors to provide stormwater treatment, detention, habitat, pathways and recreation where possible.
- Alternative water use – identify opportunities for new development to use alternative water supplies where possible such as rainwater harvesting, stormwater harvesting or recycled water.
- Ecological corridors – enhance waterway and terrestrial connectivity and habitat, especially in areas which connect existing habitat and conservation areas.

Note that these solutions should be applied to similar development areas next to wetlands and waterways across the catchment.

EXISTING CONDITION

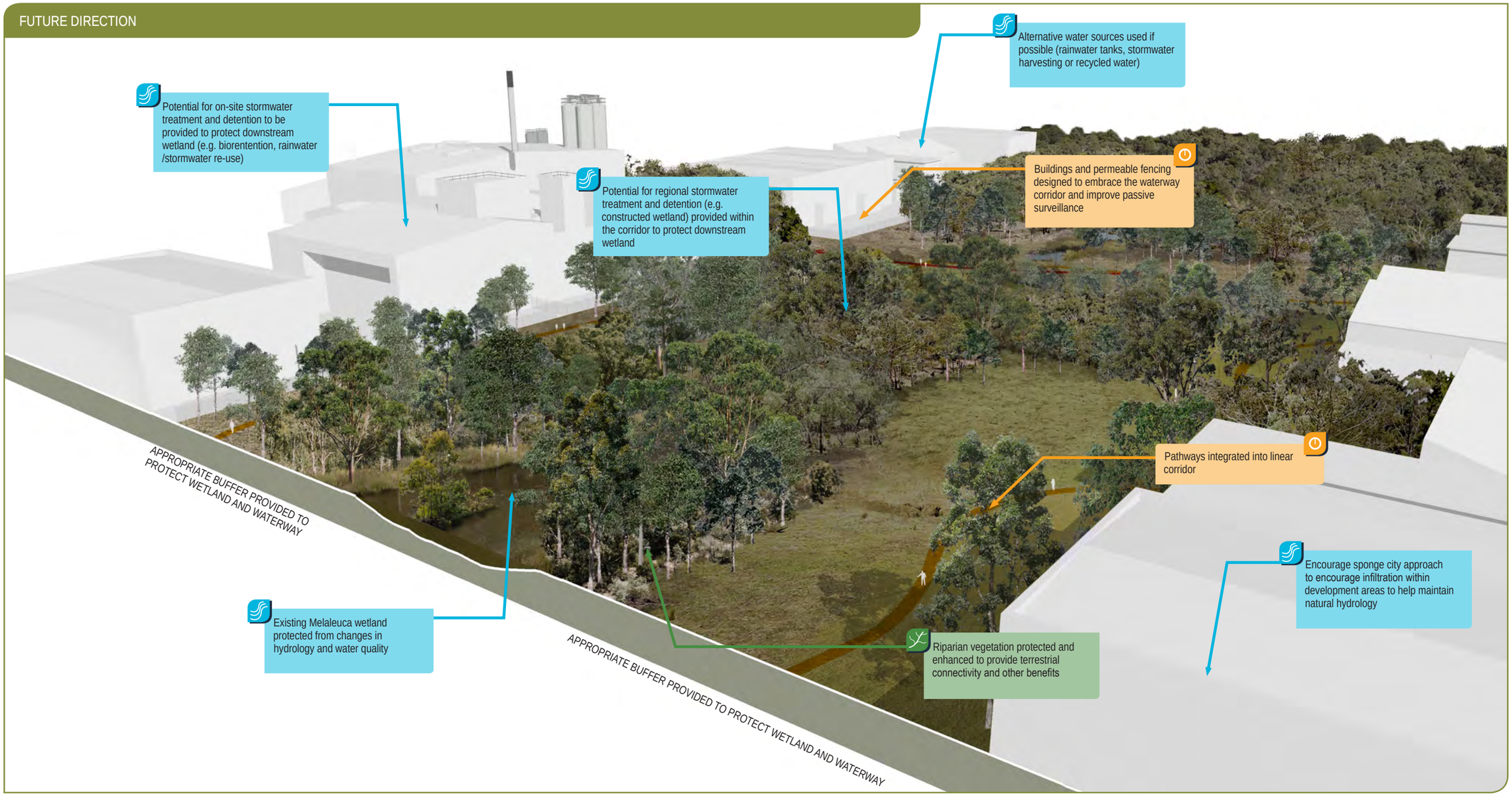
EXISTING CONDITION - Park Ridge wetland



Location of future urban areas and emerging communities within the Scrubby Creek study area

FUTURE ASPIRATION

FUTURE DIRECTION



Next Steps

The Scrubby Creek Recovery Plan is a significant ongoing project which will have extensive, long-term community involvement.

The Scrubby Creek Recovery Plan is a holistic plan which presents initiatives across planning, environment, waterways, parks and recreation, water management, active transport and flooding to present an integrated approach to catchment transformation. It bridges Council departments, stakeholders and the community and requires the support and involvement of all to realise its full potential.

Council is keen to continue to engage with the broader community to build a better understanding of the opportunities for improvement for Scrubby Creek. Together we will be able to transform Scrubby Creek into a valued corridor of *connected habitats for people, plants and animals.*

CATCHMENT ANALYSIS & UNDERSTANDING

PART TWO

Appendix A - Council & Community Engagement

Appendix B - Catchment Land Use

Appendix C - Ecological Condition

Appendix D - Fish Passage and Assemblage

Appendix E - Catchment Modelling and Water Quality Management

Appendix F - Water Balance and Flooding

Appendix G - Community Connections

Appendix A

COUNCIL & COMMUNITY ENGAGEMENT

This strategy has been developed with input from both Council and the community using meetings, workshops and surveys to gather input.

COUNCIL ENGAGEMENT

Council stakeholder engagement was undertaken with representatives across different Council branches using a mix of group workshops and one-on-one meetings. The timing and purpose of these engagement activities were as follows:

1. Inception meeting, 6th February – to provide an overview of the purpose, structure and scope of the Scrubby Creek Recovery Plan
2. One-on-one meetings, 21st Feb and 27th Feb – to gain an understanding of the catchment issues and opportunities based on Council staff knowledge and planned activities
3. Council workshop, 1st May – to present catchment condition summary and refine and prioritise opportunities across the catchment.

The outcomes of these meetings and workshops have been incorporated into the materials presented in the Scrubby Creek Recovery Plan document.

Table 1 – Iniatives in the Scrubby Creek Recovery Plan developed based on Council engagement outcomes

INITIATIVES
Install clear distance markers to identify where you are along Scrubby Creek
Explore opportunities for paddle craft infrastructure e.g. formal access points
Improved education and signage across catchment on pest fish and their impacts
Explore opportunities to create a paddle discovery trail and/or combined ride/run/paddle itinerary
Consider opportunities for movies in the park style events
Continue existing pest fishing education program (consider doing this more frequently)
Provide connections between existing pathway networks and key open space areas
Strengthen connections between Logan LGA and the adjacent Karawatha Ecological Corridor and other large recreational assets within BCC
Encourage local community groups and educational facilities to engage with the Creek through education/research programs e.g. water quality monitoring
Improve legibility of underpass connections (currently an identified CPTED issue) and provide clear wayfinding to show how to reconnect to the Scrubby Creek pathways
Consider future connections to new development areas and park infrastructure
Strengthen connections between Scrubby Creek and key centres and destinations
Create a broader active transport loop journey connecting Scrubby Creek to Slacks Creek and Logan River
Gather and communicate indigenous history of the catchment through signage etc
Consider opportunities for ‘Scrubby Creek’ wayfinding, artwork and interactive/educational journeys in key parks
Consider opportunities for volunteer events to enhance the corridor e.g. clean up Scrubby Creek, revegetation and weeding days
Provide opportunities to enhance views and access the creek improvements via pontoon, deck structures or park shelters where appropriate
Encourage local residents to share their favourite photos/experiences of Scrubby Creek
Consider provision of free trees to private properties on or in the waterway and ecological corridors
Update relevant sections of the Planning Scheme to support outcomes of the Scrubby Creek Recovery Plan (Strategic Framework, PSPs etc)
Combined treatment, detention and parkland in new development areas
Encourage development to face the waterway
Development of new parks to embrace and include the waterway
Support existing and new bushcare and other community groups

INITIATIVES
Formalise park edges and provide shrub layer buffer or formal edge to riparian vegetation to reduce informal access where appropriate and reduce weedy, unmaintained edges
Provide additional shade trees/clusters of endemic vegetation along pathways to enhance shade provision with a desired goal of 50% shade cover over paths
Reinstate riparian vegetation in suitable locations along Scrubby Creek and associated online water bodies to shade out weeds and provide better habitat and ecological corridors to improve both waterway health and biodiversity
Ensure adequate maintenance budgets are provided for new assets
Use endemic rainforest species to reflect and communicate historic vegetation communities
Test alternative strategies to transform existing concrete channels throughout the catchment in identified low-risk areas
Identify potential for floodplain storage areas to provide multiple benefits (as part of the floodplain risk management plan)
Selectively revegetate to improve the diversity of tree stock and to ensure long-term canopy cover is retained to provide long-term woody debris for in-stream habitat
Remove/rehabilitate fish barriers from downstream to upstream to improve fish passage and overall aquatic ecosystem health
Restock endangered Mary River cod and Australian bass to pool habitats to improve recreational fishing experience and reduce the threats posed by pest fish (via predation and competition)
Monitor success of fish improvement strategies with the potential to include community tracking and reporting
Addition of complex large woody debris (snags/log jams) in key locations to improve fish habitat
Monitor sand slugs to assess potential impact on downstream environments
Protect existing high value wetlands from development
Ensure new development areas treat stormwater to best practice as well as manage flows to maintain existing hydrologic conditions to protect high value wetlands and tributaries
Identify the potential for new developments (or existing areas with purple pipes like South West 1) to use alternative water sources to meet non-potable water demands
Investigate areas where stormwater retrofit could be undertaken to address key pollutant hotspots and minimise catchment stormwater flows entering the creek
Investigate cause of water quality hotspots
Incorporate and progress to a risk based land use planning approach to flooding
Identify key flooding conveyance and storage areas to ensure these are preserved

COMMUNITY SURVEY

Council ran a community survey of local resident via its web based 'have your Say' page in order to understand current community perceptions of the creek and future expectations. This survey had 27 respondents, 26 who lived in the Logan area. The survey responses show support for the development of this plan and the recovery of Scrubby Creek for the community, the environment and the economy.

Results

Understanding of current condition and values

Respondents recognized the importance of Scrubby Creek for Logan's history and has habitat for native flora and fauna. And while the respondents recognized there are recreational, lifestyle and liveability values along Scrubby Creek, the water quality is assumed to be poor and the area is not currently used regularly for recreational purposes (Figure 1).

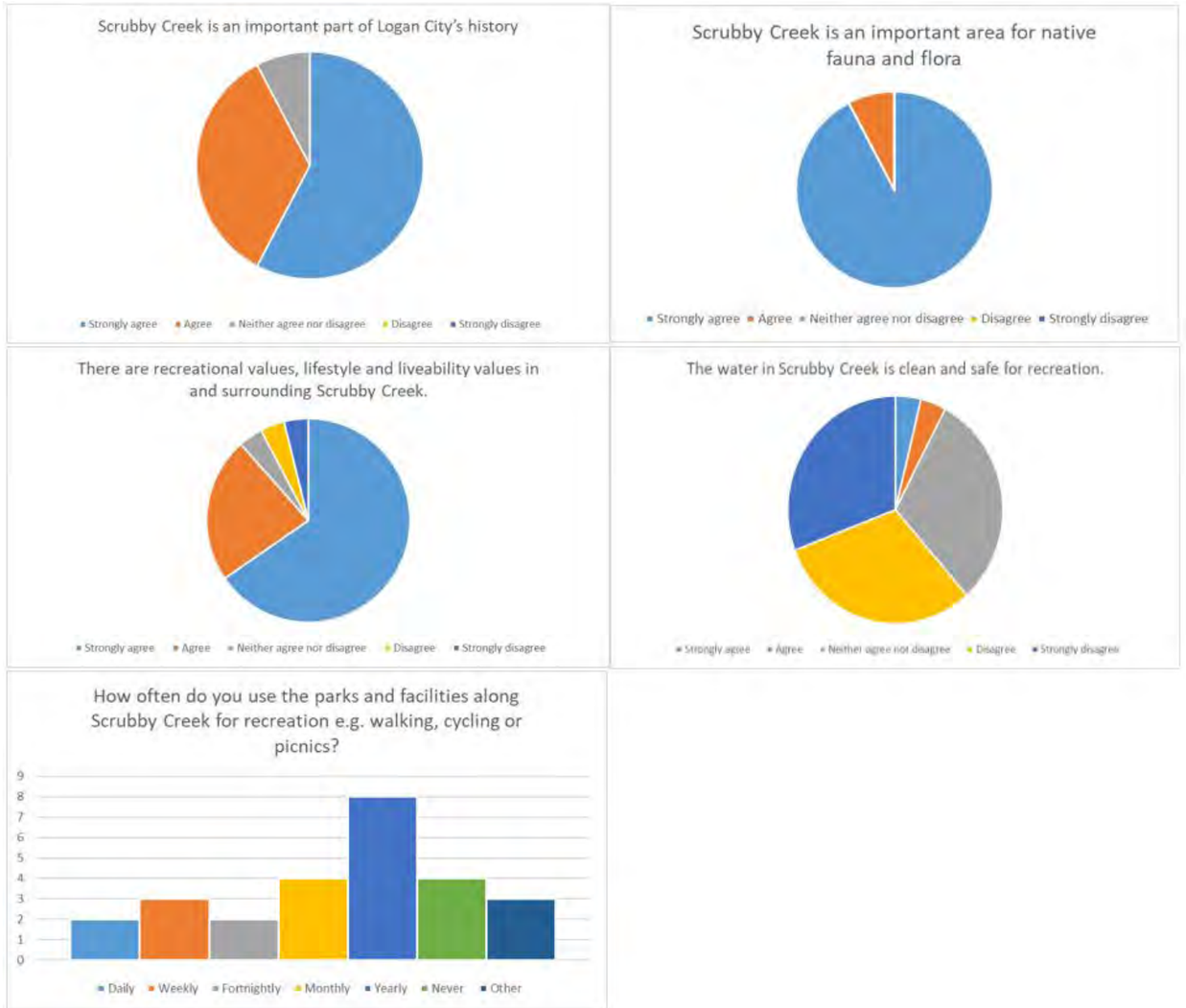


Figure 1 – Community survey results showing understanding of current condition and values of Scrubby Creek

Priority outcomes for Scrubby Creek's Recovery

Respondents identified improving water quality as a priority for the catchment recovery and would also like to see the waterway rehabilitated as close to natural as possible (Figure 3). There was also general agreement that there should also be some investment to improve its recreational values and that Scrubby Creek should be a key destination for locals and visitors.

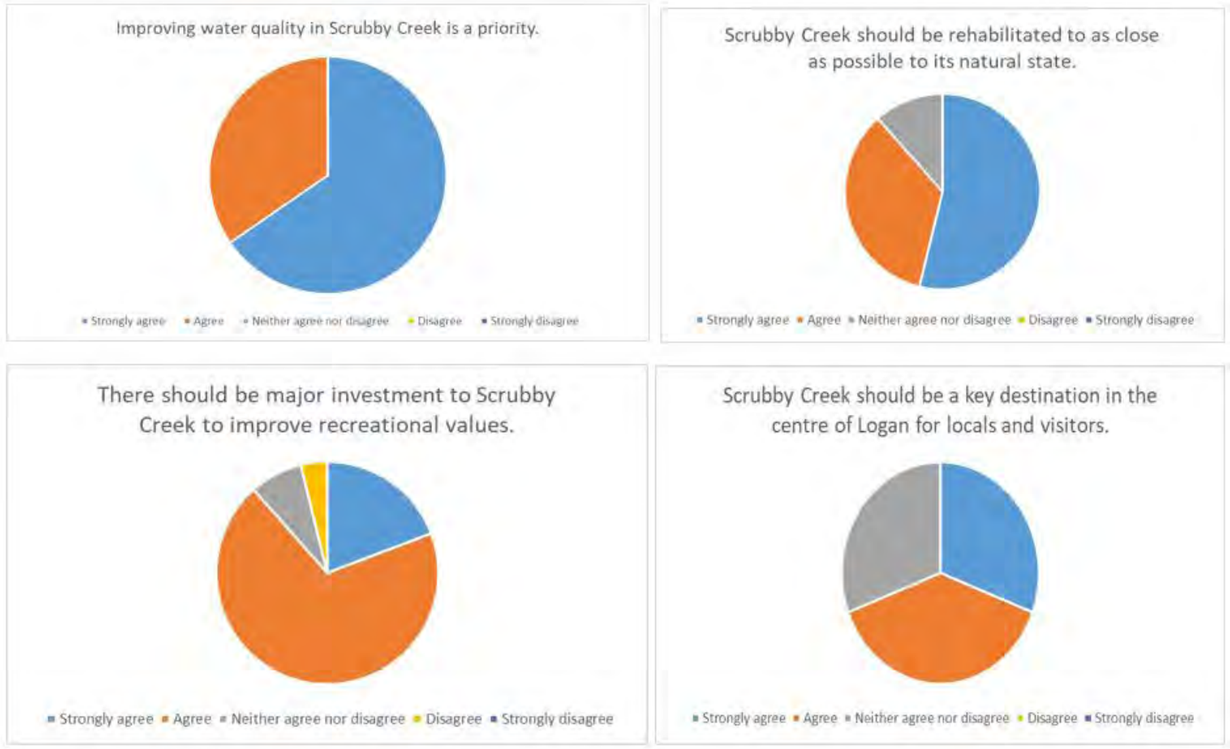


Figure 3 – Community survey results showing priority investment areas

Importance of the Scrubby Creek Recovery Plan

Respondents strongly agreed that rejuvenating Scrubby Creek would benefit the economy and could also be beneficial to the local community (Figure 4).

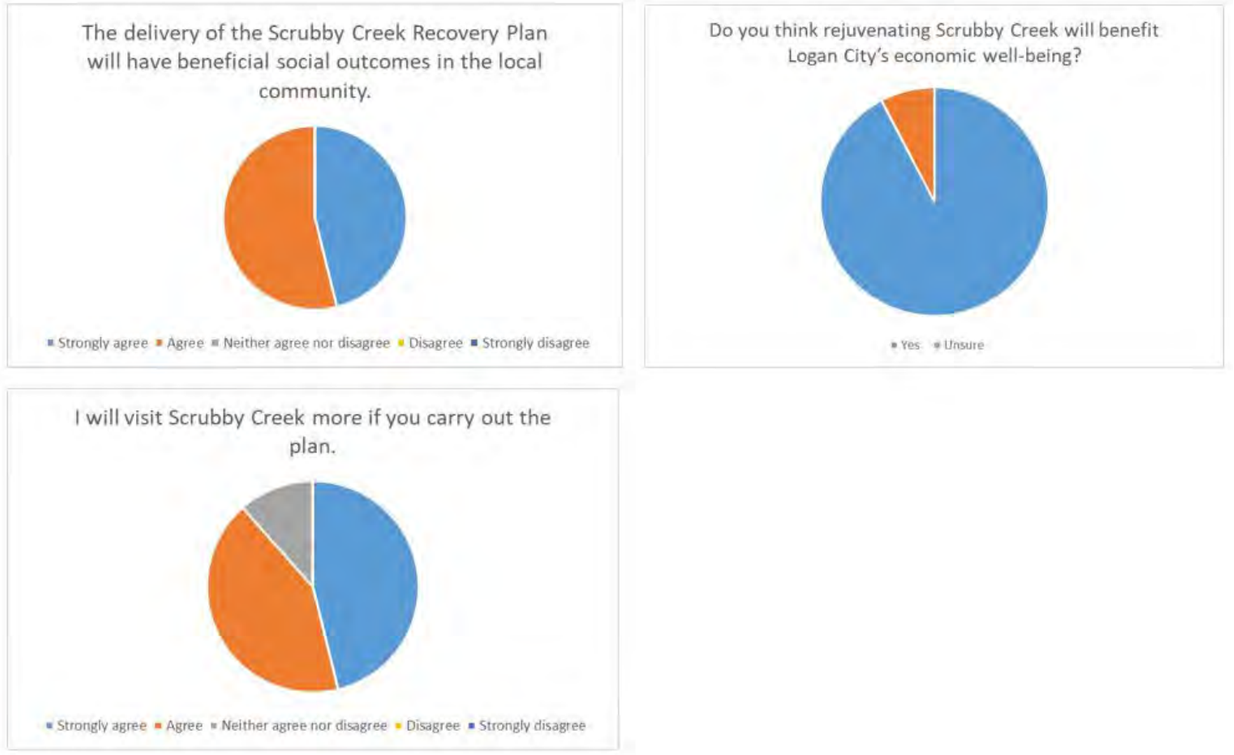


Figure 4 – Community survey results showing support for the Scrubby Creek Recovery Plan

Appendix B

CATCHMENT LAND USE

EXISTING LAND USE

The Scrubby Creek catchment caters for a broad suit of land uses including residential, industrial, commercial, open space, rural residential and conservation. The open space network comprises of a web of tributaries that intertwine through low density residential land from the west and south-west of the catchment into the Berrinba Wetlands located in the heart of the Scrubby Creek catchment. The wetlands drain through Demeio Park and JJ Smith Recreational Corridor through to Gould Adams Park and Meakin Road Scrubby Creek Park prior to forming a confluence with Slacks Creek. Commercial, retail and industrial development are predominately located along major transportation routes which dissect the catchment; namely Mt Lindsey Highway, Logan Motorway, Browns Plains Road, Wembley Road and Kingston Road. The major industrial areas are located in Berrinba, Kingston, Park Ridge and Meadowbrook and four main commercial centres are located in Browns Plains, Logan Central and Park Ridge. The catchment waterways are predominately in land zoned as 'Environmental Management and Conservation' and 'Recreation and Open Space' which fall within the responsibilities of Logan City Council.

FUTURE LAND USE

The population of Logan City is anticipated to grow by more than 272,200 by 2041, with almost 21,000 people moving into the Scrubby Creek catchment. The majority of the Scrubby Creek catchment is already developed, but there are small pockets of infill development likely to occur as well as the major conversion of existing rural residential land into residential, industrial and commercial in the Park Ridge area. There is also a large road corridor dissecting the catchment through Berrinba for the future Park Ridge connector road. This section aims to summarise the changes in land use for major centres located within the Scrubby Creek catchment based on a review of the South East Queensland Regional Plan 2017 – ShapingSEQ and Council planning documents.

Logan Central

Logan Central is listed as a major regional activity centre in ShapingSEQ and is recognized as a 'great place' in South East Queensland for its focus on urban quality by contributing towards a more socially cohesive and economically successful region. Logan City Council's Logan Centre Master Plan (2014) extends from the western boundary of Woodridge State High School, north to Orchid Street, south to include Logan Gardens and east along Wembley Road to Kingston Road including Logan Central Plaza. Sections of this fall within the north eastern boundary of the Scrubby Creek catchment.

Both ShapingSEQ and Council's Logan Central Master Plan recognize Logan Central as the administration and cultural heart of Logan City, creating a place where the city's multicultural community can come together to learn, do business, celebrate and socialize.

The Master Plan aims to support the growth of the centre through encouragement of higher densities in accordance with maximum heights and to facilitate the growth of niche retailing and markets to provide an alternative shopping experience. The Town Centre core is intended to function as the business hub of Logan Centre and the mixed use zone at Berrinba as well as the pedestrian focal point and heart of the centre, with links to the nearby train station, Wembley Road and the Logan Gardens and Civic Centre parklands.

Figure 1 – Scrubby Creek planned land uses, key centtres and future Park Ridge Connector Road

Meadowbrook

Meadowbrook is identified in ShapingSEQ17 and Council's Meadowbrook Master Plan (2016) recognises the area as a knowledge and technology precinct which encompasses the Logan Hospital and the Logan campuses for Griffith university and TAFE QLD. The master plan area is surrounded by open space areas along Scrubby Creek and Slacks Creek which are subject to inundation. These natural areas are recognized as important health spaces and places which provide important recreational, restorative, social and ecological functions which should be preserved and strengthened in the design of streets and parks. A section of the Meadowbrook Master Plan area (Precinct 8) is located in the south eastern boundary of the Scrubby Creek catchment. This precinct contains a number of small to large-sized light industrial lots which benefit from good access to the Logan and M1 Pacific motorways

"Meadowbrook is a vibrant and diverse centre for preventative health and wellbeing, a centre where healthy streets and healthy places emerge to create an active and social community"- Meadowbrook Master Plan vision.

Browns Plains

The Browns Plains centre is located in the north western corner of the Scrubby Creek catchment and is recognised in ShapingSEQ as a major economic area. It contains Grand Plaza and other key retail and specialised centre landuses. There are no Council plans for this area at present.

Park Ridge

The Park Ridge area is currently mostly large rural residential blocks but is identified in ShapingSEQ as a major enterprise and industrial area. Council adopted a Structure Plan for this area in 2011 which identifies a mix of lands uses including residential, mixed industry business area, commercial and industrial green space networks are also located alongside a number of Scrubby Creek tributaries which drain north from the southern boundary of the catchment towards Berrinba wetlands. The aim of this plan is to guide the development of the area to "achieve an integrated, well planned, well serviced urban community and employment area defined by an extensive environment, parks and waterways network". It is anticipated that the northern section of the structure plan area (located between Park Ridge Road and Green Road) will be developed in the next 15 years. A General Planning Layout has been developed for this section and was endorsed by Council in 2014. This identifies the existing tributaries of Scrubby Creek and how these fall within the proposed future development. A number of these tributaries are located within an environmental conservation corridor which will provide important habitat links between conservation areas within and beyond the Scrubby Creek catchment. Council Planning Scheme (Waterway and wetland overlay (OM-13)) identifies several mapped wetlands which are located within the development footprint which should be protected from urban development impacts, including ensuring development achieve near natural hydrology' as per section 3.3.2 of the Planning Scheme Policy 3 – Environmental Management.

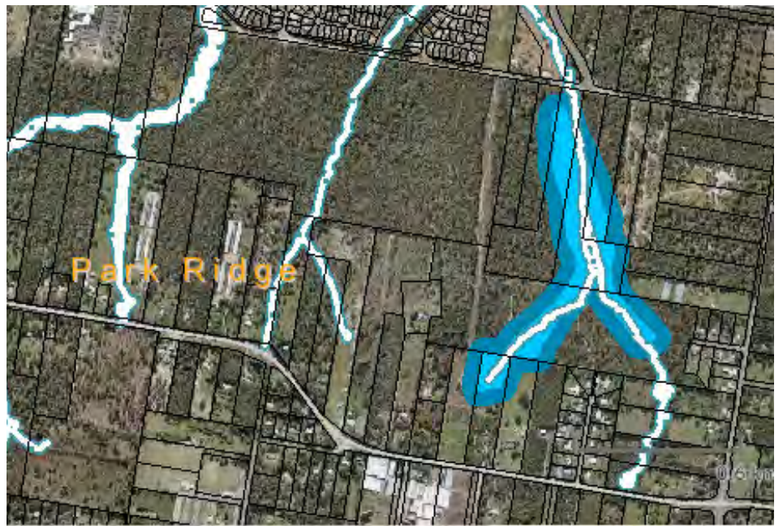


Figure 2 – Comparison of waterway (white) and wetland (blue) mapping (top map) and Park Ridge General Planning Layout (bottom plan)

Appendix C

ECOLOGICAL CONDITION

Scrubby Creek, along with Quinzeh, Chambers, Slacks and Undullah Creek, are the largest of 61 creeks in Logan City that flow into the Logan River. Establishing the ecological condition of Scrubby Creek provides insight into how the creek has been impacted by development, the urban hydrological cycle and other anthropological contributions. The condition of the creek has been determined by E2Designlab using several methods:

- Desktop review of Council reports, supporting information, aerial imagery and GIS mapping
- Water quality data analysis to provide a snapshot of waterway health (refer attachment D)
- Site inspections of priority locations identified to resemble the catchment challenges holistically

The ecological condition assessment highlighted that the Scrubby Creek Catchment is highly developed and that the waterway has been modified in the past with the creation of a number of large permanent water bodies which are remnants of past activities focused on activities such as sand mining and flood detention. Despite these impacts, the waterway corridor sits within a relatively intact riparian corridor and is mostly located within Council owned land.

SIGNIFICANT VEGETATION AND HABITAT VALUES

While there is the potential for the riparian corridor from Berrinba wetlands and downstream to contain Angle-Stemmed Myrtle (*Gossia gonoclada* - Endangered – NCA 1992; EPBC 1999), there have been no known natural occurrences. There are a number of Gossia that have been planted in Logan Gardens Park and the Parks Depot in Marsden. A lone recorded occurrence of Swamp Tea Tree (*Melaleuca irbyana*) (Endangered – NCA 1992; Critically Endangered – EPBC 1999) was also mapped in the Meadowbrook area but this endangered tree is more commonly found around Jimboomba and Waterford West areas which are outside of the Scrubby Creek catchment. The majority of the vegetation mapped within the natural areas across the catchment is a mosaic distribution of least concern, of concern (threatened) and key pockets of endangered remnant vegetation; Park Ridge, the Berrinba Wetlands and Gould Adams Park (12.9-10.12, 12.5.3a, 12.5.3d, 12.11.27).

A review of Council's biodiversity database identified that there have been a number of koala (vulnerable, EPBC Act) sightings across the catchment, with the majority of these being reported north of Berrinba and in the Southern end of the catchment. Another vulnerable species in the catchment is the grey-headed flying fox which are located along the waterway around Regents Park.

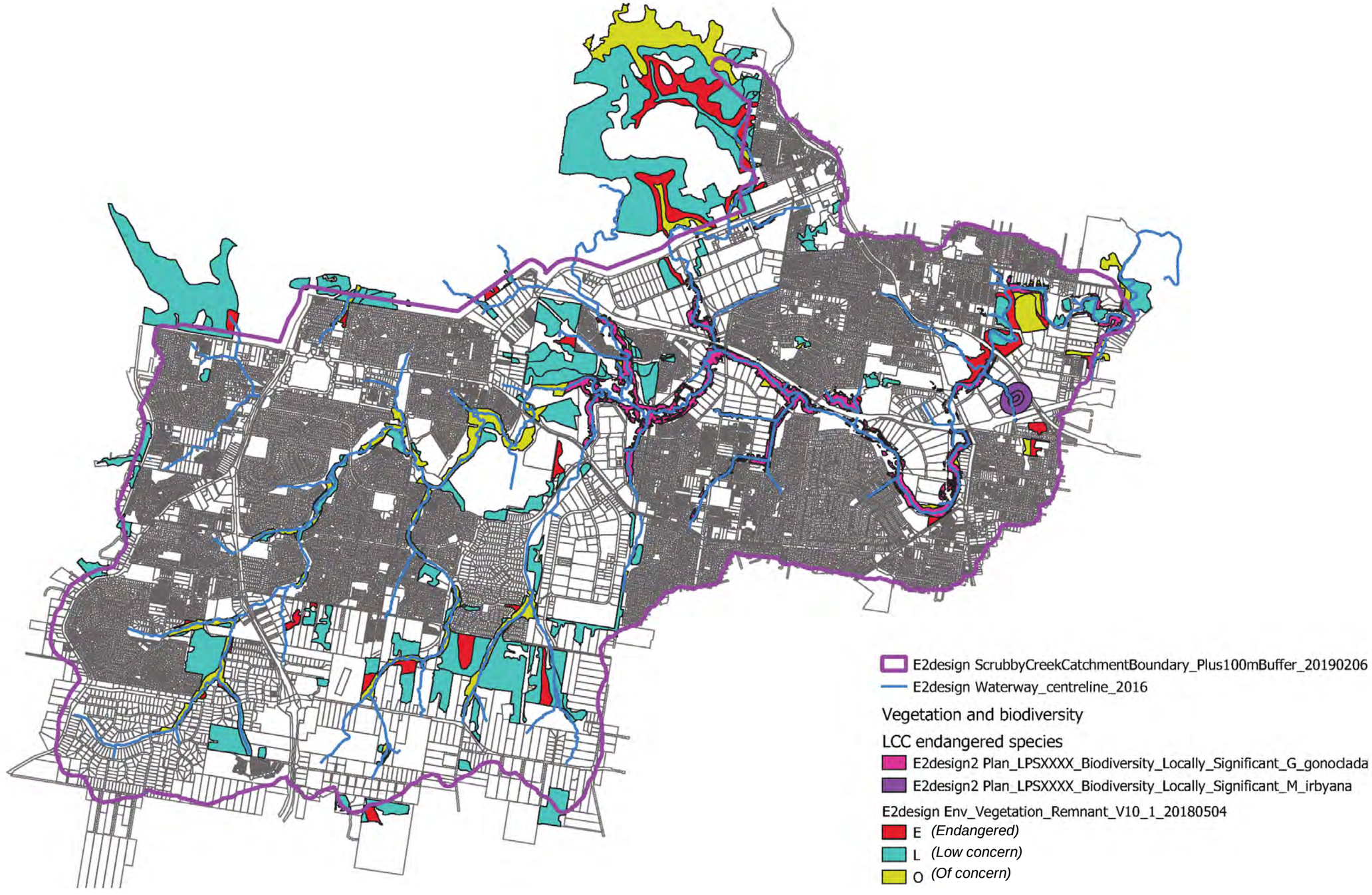


Figure 1 – Vegetation mapping across the Scrubby Creek catchment

ECOLOGICAL CONNECTIVITY

The majority of the Scrubby Creek waterways are highly vegetated, providing a connected vegetated corridor from the upper catchment to the confluence with Slacks Creek. These waterways are mapped as Biodiversity Corridors in the LCC Planning Scheme and provide important links between larger habitat areas including Boronia Bushland reserve in the upper catchment, Rosia Road conservation which sits south of the catchment through to Berrinba wetlands and then down to the Slacks Creek Environmental Park. The waterways also connect to the broader Flinders Karawatha Forest environmental corridor which sits around the catchment along the western and northern boundaries. The intact continuous riparian corridor therefore presents an important regional link between Greenbank, Karawatha Forest and across to Daisy Hill to the east.

The waterways mostly sit within Council owned Recreation and Open Space or Environmental Management and Conservation land which means that this riparian corridor is unlikely to be impacted directly by land development in the future. Major ecological breaks exist due to the Logan Motorway, Mount Lindesay Highway, Browns Plains Road, Wembley Road and historic land clearing for agricultural and industrial purposes. There is also another major transport corridor planned in the catchment for the future Park Ridge Connector Road.

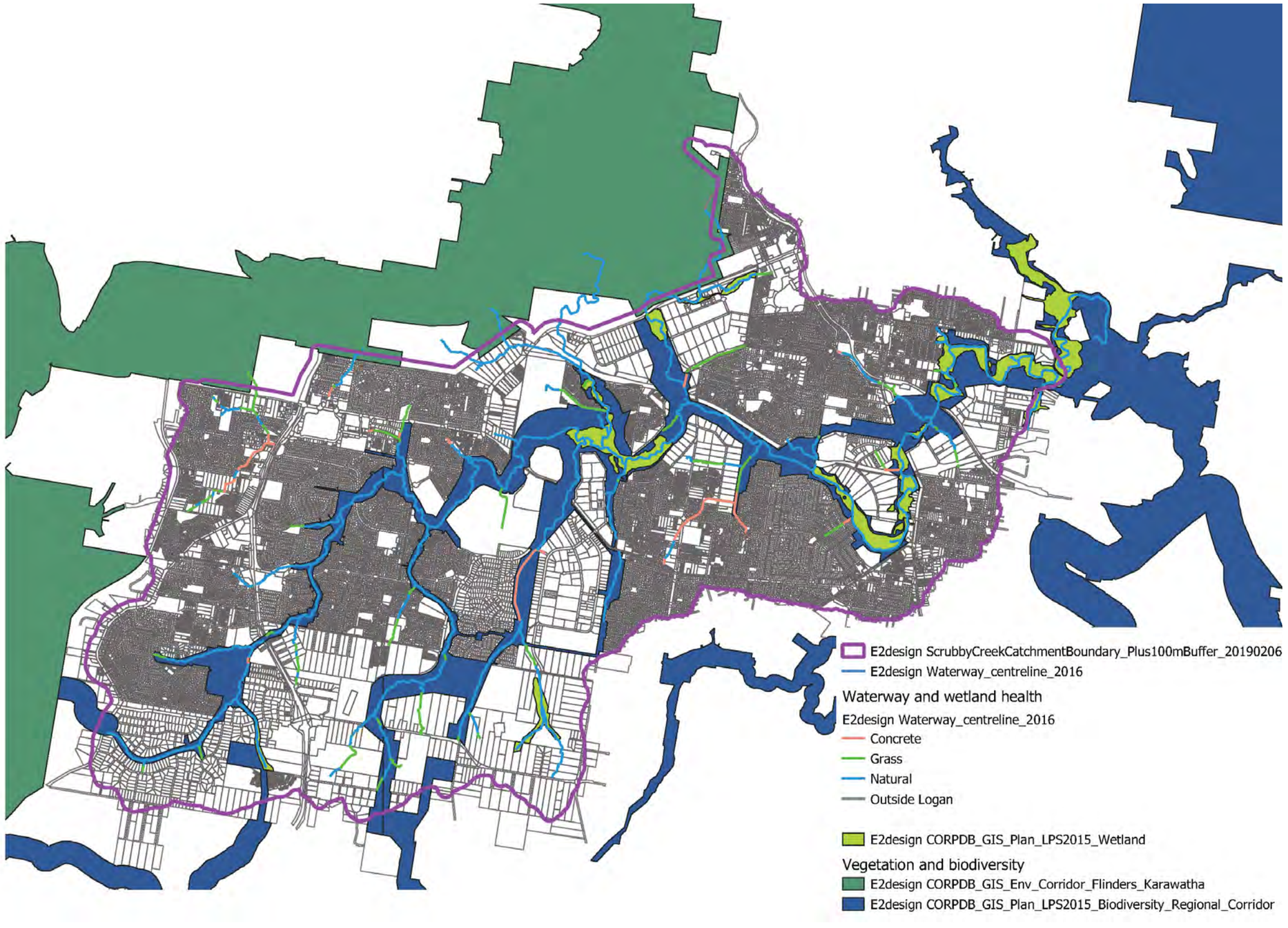


Figure 2 – Mapping of ecological corridors, wetlands and waterway type across the Scrubby Creek catchment

WATERWAY CONDITION

Scrubby Creek catchment comprises an array of freshwater waterbodies, wetlands, waterways and tributaries that convey water from the upper-most catchment to the confluence with Slacks Creek. There are a number of wetlands mapped across the catchment including the waterbodies in Berrinba and JJ Smith Parks. There is also a Melaleuca wetland which is located in the planned development area for Park Ridge which appears to be in good condition (see Plate 1).

The waterway channels are dominated by turbid water and sandy/silty substrates with some sand slugs appearing to move through the catchment as a result of past landuse impacts. A large sand slug is present in the tributary entering Scrubby Creek just upstream of the active landfill, which is then entering the main scrubby Creek channel and moving into the Berrinba wetlands. There is a continuous riparian zone which has stabilized the banks throughout the majority of the catchment and contributes woody debris, creating in-stream habitat and ecological value for macroinvertebrates and fish. A fish survey has been undertaken as part of the study and the outcomes of this are presented in Appendix D.

Due to the highly urbanized nature of the catchment, the waterways mostly receive piped flows and are dissected by culverts and road crossings. Some waterways have also been transformed to grassed or concrete channels (refer Figure 2). These channels have reduced habitat complexity and provide limited habitat and ecological value. There is also anthropogenic litter found throughout the waterway (shopping trolleys, car parts, large conduits etc.).

The urbanization of the catchment has also increased the overall area of % impervious, resulting in an increase in runoff velocities, increase in localized albedo, and a reduction in groundwater recharge. This increase in the frequency, velocities and volume of stormwater flows entering the waterway can result in bed and bank erosion, transport of nutrient and sediments and the loss of biota. Research has identified that as little as 2-5% directly connected impervious (DCI) area in a catchment can result in significantly degraded waterways (Walsh et al. 2005). The Scrubby Creek Catchment as an average 46% cover of impervious surfaces. Directly connected impervious area mapping has not been undertaken but it can be reasonably assumed that of these impervious surfaces, 80% will be directly connected to the waterway by hydraulically efficient drainage infrastructure (e.g. stormwater pipes and concrete channels). Thus, the DCI of the Scrubby Creek Catchment is likely to be around 36% which is well beyond the 5% DCI threshold and is likely to be impacted (see Figure 4).

Plate 1 – Existing wetland in the Park Ridge development area

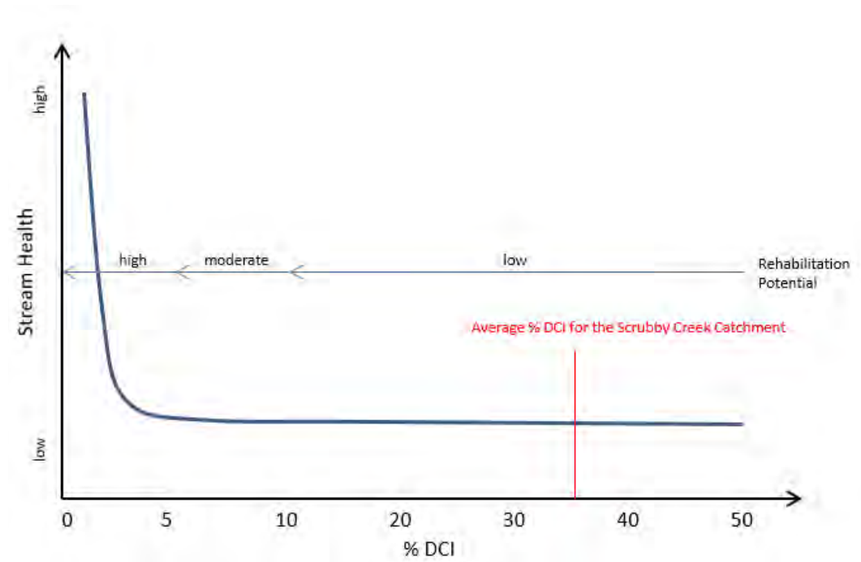


Figure 3 - Illustrative graph depicting the impacts of urbanisation on stream health and the likely positioning of the Scrubby Creek catchment (adapted from Walsh et al., 2005).

SUMMARY AND RECOMMENDATIONS

In identifying waterway management initiatives for the Scrubby Creek catchment it is first important to establish suitable and achievable end-points based on the current condition of the waterway and catchment. Restoration, rehabilitation and remediation represent three theoretical trajectories for waterway management as shown in Figure 5 (Rutherfurd et al. 2000). "Rehabilitation" and "restoration" define waterway management objectives directed at returning degraded waterways back to their predevelopment condition. "Remediation" represents management objectives of establishing a new ecosystem state to accommodate altered catchment hydrology and water quality characteristics. This is the suitable trajectory for Scrubby Creek given the extent of urbanization which has occurred in the catchment and the associated hydrologic changes. Table 1 summarises the key management actions for the waterway based on its current condition and likely trajectory.

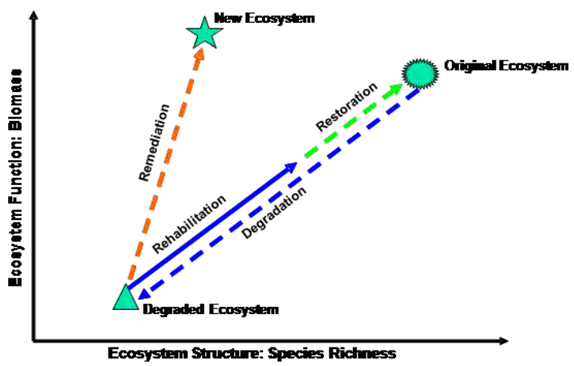


Figure 4 - A theoretical construct of trajectories for waterway rehabilitation and remediation (Adapted from Rutherfurd et al., 2000)

Table 1 – Key waterway condition management actions for Scrubby Creek

Theme	Current Condition	Management Actions	Intended outcome
Hydrology	Significantly modified due to urbanization of the majority of the catchment and it is not possible to return it to the natural state. Main waterway channel has adapted to new hydrologic conditions. However there are areas in Parkridge that have not yet been developed and flow management can be undertaken here to protect downstream environments.	› Hydrology management applied to new development in the Park Ridge area to ensure frequent flows are managed to protect existing Melaleuca wetlands.	Protection of intact wetlands in the upper tributaries in Park Ridge which have not yet been impacted by changes in hydrology. No real change to the main channel hydrology.
Water Quality	Physio-chemical variations and nutrient concentrations outside desirable levels (refer to Appendix D). Litter observed at some sites.	› Undertake investigations to understand water quality issues and appropriate management actions. › Focus on litter for increased visual amenity and benefits downstream.	Improved water quality.
Natural Geomorphic Integrity	Predominately a natural waterway that is dominated by sandy/ silty reaches connecting large permanent water bodies. There are sand slugs moving through the catchment above Berrinba wetlands. A number of concrete and grassed channels are also present with limited habitat values.	› Monitor sand movement through the waterway and its potential impact on habitats in Berrinba wetlands etc.	Protect existing areas of high habitat value from smothering from sand.
Riparian Corridors and Connectivity	Continuous riparian corridor which contains trees and weedy understory. Numerous barriers to fauna and fish movement across the catchment.	› Weed management by providing trees and shade which will also enhancement habitat values and improve waterway condition. › Address key barriers to fauna and fish movement.	Improved riparian corridor condition and connectivity across the catchment.
In-Stream Habitat	Some woody debris across the catchment but limited complexity in channel morphology and waterbodies requires additional habitat complexity.	› Improve in-stream habitat for fish in waterbodies and channels by planting more trees and introducing complex woody debris (e.g. large trees with intact root balls into waterbodies and waterways).	Improved habitat to support native fish and other instream fauna.

REFERENCES

Rutherfurd, I.D., Jerie, K. and Marsh, N. (2000) A Rehabilitation Manual for Australian Streams – Volume 1 and 2, Land and Water Resources and Development Corporation and Cooperative Research Centre for Catchment Hydrology.

Walsh, C.J., Fletcher, T.D., and Ladson, A.R. (2005) Stream restoration in urban catchments through re-designing stormwater systems: looking to the catchment to save the stream. Journal of the North American Benthological Society, 24, 690-705.

Walsh, C.J; Roy, A.H., Feminella, J.W., Cottingham, P.D., Groffman, P.M. and Morgan, R.P. (2005) The urban stream syndrome: current knowledge and the search for a cure. Journal of the North American Benthological Society 24(3):706–723

Figure 5 – Scrubby Creek corridor acts as a key connector between Greenbank, Karawatha Forest and Daisy Hill and would benefit from riparian vegetation in key locations as well as the protection of wetlands from smothering and changes in hydrology.

Appendix D

FISH PASSAGE AND ASSEMBLAGE

LITERATURE REVIEW

A literature and data review was conducted by Catchment Solutions into the fish communities surveyed historically throughout Scrubby Creek, and the broader Logan-Albert catchment. The species list collated data from a range of sources including Catchment Solutions existing data, published literature and online searches. This list was then refined based on Catchment Solutions existing knowledge of the habitat type and stream morphology throughout the Scrubby Creek sub-catchment to generate an 'Expected Species' list. From this list, a more explicit understanding can be attained on the species likely to be encountered during field surveys. Furthermore, species expected to be encountered which are not, may act as important indicator species throughout the on-going catchment recovery project. The future presence of such species may be useful in indicating successful project recovery outcomes.

FIELD SURVEYS

Fish community sampling was conducted at eight sites throughout Scrubby Creek between Sunday March 3rd and Tuesday March 5th 2019. All sites were surveyed using electrofishing techniques. The seven lower sites were surveyed using the boat electrofisher and one headwater site via the backpack electrofishing unit (due to site constraints). Boat electrofishing was conducted from a 3.7m vessel ('Electrolyte') operating a Smith-Root 2.5GPP electrofisher unit, equipped with a single boom arm, a six-dropper anode array and a hull cathode. Settings were adjusted based on electrical conductivity of the water on site to maximise the efficiency and safety of electrofishing operations. A master and single dip-netter were employed during all sampling activities on *Electrolyte.*

Sampling was conducted at various depths and encompassed all available in-stream habitats within the waterbody. Power-on time was recorded to standardize results by Catch Per Unit Effort (CPUE); number of fish per minute of electrofishing 'power on'. Fish positively identified during electrofishing operations but not netted were also recorded and contributed towards abundance and assemblage data.

Backpack electrofishing was conducted at the most upstream site, where boat access was not achievable due to the shallow and narrow nature of the site. The backpack unit utilised was a Smith-Root Model-LR24 backpack electrofisher operating a 300-500 volt pulsed-DC current and a standard pulse setting (1ms). An operator and single dip-netter were employed during backpacking operations. Sampling protocol involved a series of 'shots' that consisted of altering power-on and power-off periods encompassing all in-stream habitat types present within the site. Power-on time was recorded to standardize results by Catch Per Unit Effort (CPUE). During electrofishing operations, the observation of uncaptured, positively identified fish were also recorded and included in abundance records.

All fish captured during electrofishing sampling were identified to species level, counted and measured to the nearest millimetre (fork length of forked-tail species, total length for all other species). If large numbers of a species were captured during a single event, a random subset of 20 individuals were measured, with the remaining fish counted and contributing to abundance data only. After processing, all native fish were released within the reach or waterbody they were captured from. Pest fish species were euthanised as per Biosecurity Queensland legislation and ANZCCART procedures, and disposed of in an appropriate manner.

Figure 1 – Fish survey locations

RESULTS AND DISCUSSION

Expected vs observed species

Table 1 compares the species observed against the expected species list which identified 34 native species which would likely occur throughout the Scrubby Creek catchment under ideal conditions (no pest fish present). In total, only 16 native fish species were captured across the eight sites in addition to six invasive pest fish species (Table 1).

The species with the greatest distribution were the Long-finned eel (*A. reinhardtii*) and the introduced Mosquitofish (*G. holbrooki*) which were both present at all eight sites. This was closely followed by Sea mullet (*M. cephalus*) and introduced Carp (*C. carpio*) and Tilapia (*O. mossambicus*) which were each surveyed from seven sites. Conversely, five species were surveyed from only two sites, including the Fork-tailed catfish (*A. graeffei*), Estuary perchlet (*A. marianus*), Yellowfin bream (*A. australis*), Bullrout (*N. robusta*) and the introduced Goldfish (*C. auratus*). Finally, one species, the Shortfin eel (*A. australis*), was only surveyed from a single site. See Figure 2 for field images of species caught during the baseline fish community assessments.

Five species of small, native fish including Crimson-spotted rainbowfish (*M. duboulayi*), Marjorie's and Unspecked hardyheads (*C. marjoriae* and *C. fulvus*), Pacific blue-eye (*P. signifer*) and Australian smelt (*R. semoni*) were not observed throughout the surveys. It is likely that these five species have been displaced by the proliferation of small pest fish species Mosquitofish (*G. holbrooki*), Swordtail (*X. helleri*) and Platy (*X. maculatus*) which play a similar role in the trophic ecology (Allen et al. 2002). The ability of these pest species to thrive in sub-optimal conditions would likely offer them an advantage to succeed and outcompete the native species (Harris 2013). Furthermore, these pest species have been known to show aggression towards small native species, which causes significant stress and injury.

Eel-tailed catfish (*T. tandanus*) were another species expected to occur throughout the system however were not observed. Eel-tailed catfish are a large-bodied, demersal, potamodromous species which are a good indicator of stream health. This species requires good water quality, habitat condition and flowing water conditions to provide suitable nesting sites and complete their life-cycle. The absence of this species is likely attributable to water infrastructure development such as weirs and road causeways which have directly reduced the amount of suitable habitat for eel-tail catfish while also creating conditions that favour the proliferation of pest fish species. Barriers throughout the system significantly disrupt the natural river continuum, which in south-east Queensland is generally comprised of pool-run-riffle stream morphology. In-stream barriers of the Scrubby Creek catchment impede this continuum through capturing and diminishing natural stream flows. This results in a series of large, artificial weir pools as opposed to natural, meandering pool-run-riffle habitat conditions which are favored by the species (along with all other native species). Eel-tailed catfish are also likely heavily out-competed for resources from larger pest species such as Tilapia (*O. mossambicus*), Carp (*C. carpio)* and Goldfish (*C. auratus*).

Table 1 – Expected vs observed species list for the Scrubby Creek catchment

Migration Classification	Common name	Species	Site							
			1	2	3	4	5	6	7	8
Insufficient data: Do not appear to adhere to life-history strategies affiliated with definitive habitat requirements.	Fork-tailed catfish	*Arius graeffei*		x	x					
	Snub-nosed garfish	*Arrhamphus sclerolepis*								
Marine vagrant: Species which will enter freshwater habitats for periods of time through natural dispersal, however are not obliged to do so biologically.	Estuary perchlet	*Ambassis marianus*	x	x						
	Yellowfin bream	*Acanthopagrus australis*	x	x						
Diadromous: True migratory species which require access between freshwater and estuarine habitats to complete their life-cycle and/or maintain species distribution.	Australian bass	*Percalates novemaculeata*				x	x	x	x	
	Bullrout	*Notesthes robusta*	x				x			
	Common silver-biddy	*Gerres subfasciatus*								
	Cox's gudgeon	*Gobiomorphus coxii*								
	Empire gudgeon	*Hypseleotris compressa*	x	x	x	x	x	x		
	Freshwater mullet	*Trachystoma petardi*	x			x		x		
	Jungle perch	*Kuhlia rupestris*								
	Long-finned eel	*Anguilla reinhardtii*	x	x	x	x	x	x	x	x
	Shortfin eel	*Anguilla australis*						x		
	Eel species*	*Anguilla sp.*		x						
	Sea mullet	*Mugil cephalus*	x	x	x	x	x	x	x	
	Speckled goby	*Redigobius bikolanus*								
	Striped gudgeon	*Gobiomorphus australis*	x		x	x	x	x	x	
	Tarpon	*Megalops cyprinoides*								
Potamodromous: Species which exist exclusively within freshwater habitats, and can complete their entire life-cycle within these environments	Agassizi's glassfish	*Ambassis agassizii*			x	x	x	x	x	
	Australian smelt	*Retropinna semoni*								
	Bony bream	*Nematalosa erebi*	x	x	x	x	x	x		
	Crimson-tipped gudgeon	*Butis butis*								
	Crimson-spotted rainbowfish	*Melanotaenia duboulayi*								
	Dwarf flathead gudgeon	*Philypnodon macrostomus*								
	Eel-tailed catfish	*Tandanus tandanus*								
	Firetail gudgeon	*Hypseleotris galii*			x	x	x	x	x	x
	Flathead gudgeon	*Philypnodon grandiceps*		x	x	x	x			
	Unspecked hardyhead	*Craterocephalus fulvus*								
	Marjorie's hardyhead	*Craterocephalus marjoriae*								
	Mouth almighty	*Glossamia aprion*								
	Ornate rainbowfish	*Rhadinocentrus ornatus*								
	Pacific blue-eye	*Pseudomugil signifer*								
	Purple-spotted gudgeon	*Mogurnda adspersa*								
	Spangled perch	*Leiopotherapon unicolor*								
	Western carp gudgeon	*Hypseleotris klunzingeri*			x	x		x	x	
	TOTAL NATIVES = 34		9	9	10	11	10	11	7	2
Pest Fish: Introduced fish species to Australia. All are potamodromous and exist wholly within freshwater habitats.	Carp	*Cyprinus carpio*	x	x	x	x	x	x	x	
	Goldfish	*Carassius auratus*			x				x	
	Guppy	*Poecilia reticulata*								
	Mosquitofish	*Gambusia holbrooki*	x	x	x	x	x	x	x	x
	Oriental weatherloach	*Misgurnus anguillicaudatus*								
	Platy	*Xiphophorus maculatus*		x	x	x	x	x		x
	Swordtail	*Xiphophorus helleri*			x	x	x	x		x
	Tilapia	*Oreochromis mossambicus*	x	x	x	x	x	x	x	
	TOTAL FISH SPECIES = 42		12	13	16	16	15	16	11	5

*Juvenile eels, too small to be identified in the field to species level. At ~100mm they lack defining features and pigmentation to correctly identify. These individuals are expected to be either juvenile Long-finned eel (A. reinhardtii) or Shortfin eel (A. australis), and thus were not added to species counts.

Figure 2 – Photos of sampled fish - Top left to bottom right; a) Estuary perchlet (A. marianus), b) Yellowfin bream (A. australis), c) Striped gudgeon (G. australis), d) native fish including three juvenile Sea mullet (M. cephalus), two mature Empire gudgeon (H. compressa), a mature Striped gudgeon and two mature Firetail gudgeon (H. galii), e) Freshwater mullet (T. petardi), f) Firetail gudgeon (H. galii), g) pest fish including one juvenile Tilapia (O. mossambicus), one Swordtail (X helleri), one Mosquitofish (G. holbrooki) and six Platy (X. maculatus), h) Carp (C. carpio), i) Australian bass (P. novemauleata), j) Bullrout (N. robusta), k) adult Tilapia and l) pest fish including two Goldfish (C. auratus) four juvenile Tilapia, two Mosquitofish and two Platy.

Relationships Between Native Fish and Pest Fish Abundances

Of the native species which were observed, many were detected in relatively low abundances, with often ≤3 individuals observed at a site. Diversity and abundances of pest fish species were relatively high throughout Scrubby Creek with the six pest fish species making up 58.31% (n=2344) of the total catch (n=4020) for all 8 sites in the sub-catchment. Figure 3 below shows the pooled relative abundance (fish per minute) of native fish versus pest fish for each of the eight sites. This figure shows that native fish abundances were much higher than pest fish abundances at the lowest 2 sites in the catchment. Moving further up the system, sites 3, 4 and 5 showed similar relative abundances of native and pest fish while the uppermost three sites had much higher abundances of pest fish than native fish.

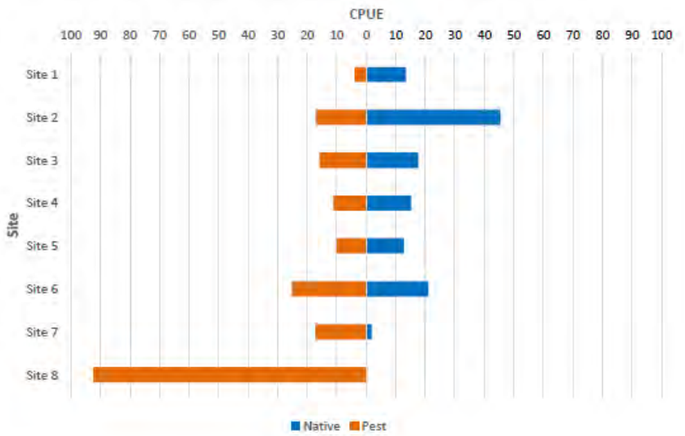


Figure 3 – Pooled relative abundance expressed as catch per unit effort (fish per minute) of all native fish versus all pest fish for each site.

Figure 4 presents the observed trend of increasing pest fish abundances coinciding with decreasing native fish abundances from the most downstream site (Site 1) to the most upstream site (Site 8).

It is likely this trend was driven primarily by fish passage barriers and degraded habitat conditions (Arthington and Mackenzie 1997). Fish passage barriers are physically impeding the movements of native community species and providing lentic conditions which facilitate the proliferation of pest species. Native fish which are managing to access upstream habitats, are then becoming vulnerable through a lack of appropriate complex habitat structure in the artificial 'weir pool' type habitats created by the barriers. The sub-optimal habitat conditions do not impact the success of pest species which are extremely tolerant of a range of environmental conditions (Harris 2013).

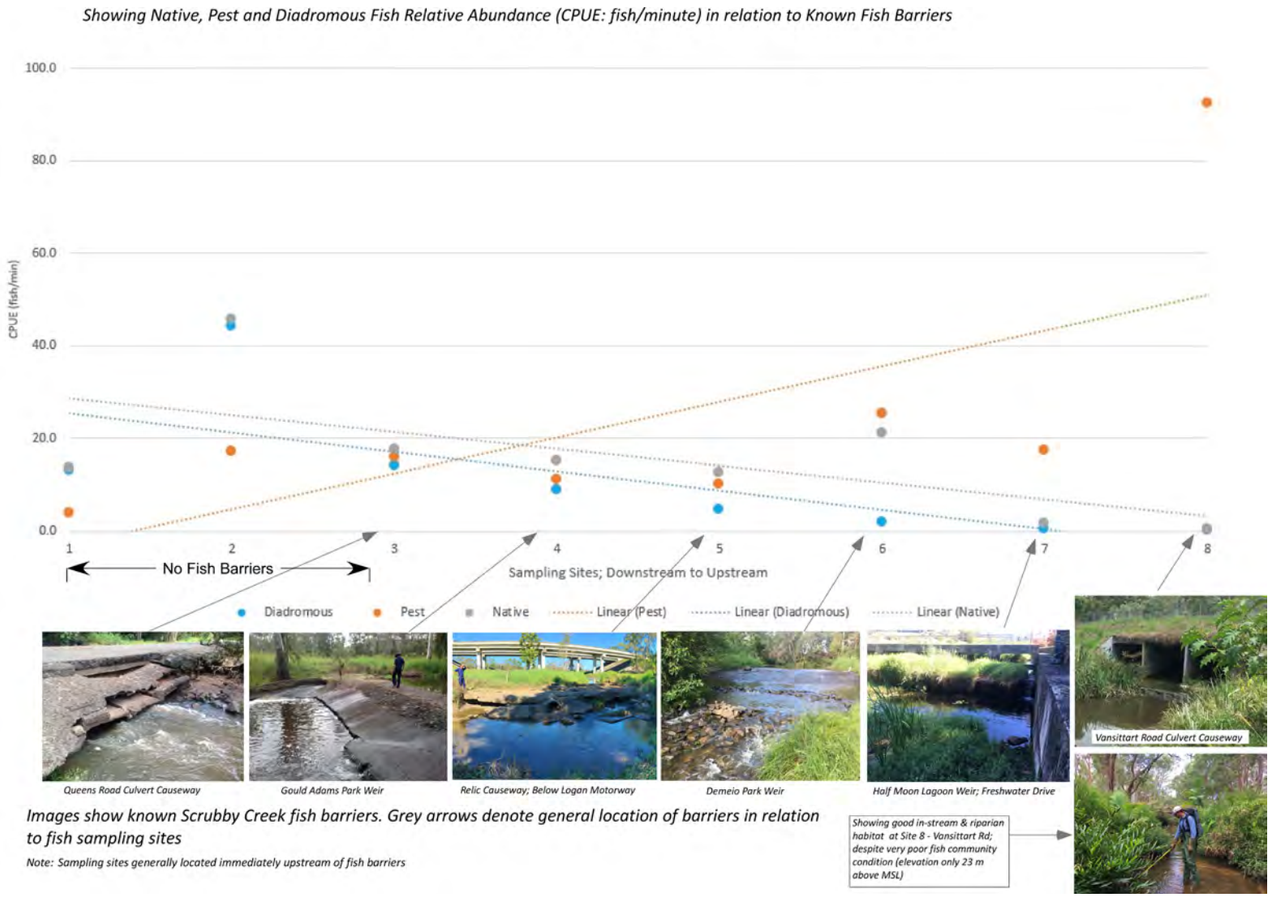


Figure 4 - Pooled relative abundance expressed as catch per unit effort (fish per minute) of all native, diadromous and pest fish for each site, with trendlines showing decrease in native abundances coinciding with increases in pest fish abundances moving longitudinally upstream. Arrows show location of fish barriers, which were generally located downstream of each sampling site.

Indicator species

Two species, Empire gudgeon (*H. compressa*) and Sea mullet (*M. cephalus*), were chosen as indicators of barrier impacts due to their highly-mobile, diadromous life-history strategies and their suitable abundances recorded at a number of the sites. Figure 5 below shows the relative abundance (fish/min) of both species at each site and highlights that the distributions of these fish (which would generally be expected to occur right throughout the catchment), showed gradual declines in abundances resulting from inaccessibility and unsuitable habitat condition. The most downstream site (Site 1), showed generally low relative abundances of both species. Whilst Site 1 was the lowest site in the catchment, with unrestricted fish passage to the site (as fish migrate upstream to these reaches from the estuary), habitat condition at the site was likely driving the low abundances recorded. The site reach was extremely narrow (<2m), shallow (<.5m), turbid and devoid of complex in-stream and riparian habitat. At Site 2, relative abundances of both species were good, with slightly higher numbers of Empire gudgeon than Sea mullet. This is the generally expected trend, with Empire gudgeons a smaller-bodied species which occur generally in higher abundances than Sea mullet. Moving upstream from Site 3 to Site 6, abundances of both species dramatically declined. Following this, only a single Sea mullet was caught at Site 7. The steady decline in abundances of these two species from lower sites to upper sites provides a visual representation of the impacts fish passage barriers have on the longitudinal distributions of diadromous fish.

To further investigate the potential impacts barriers may be having on fish assemblages, the median body sizes (mm) of both indicator species were examined for each site. Figure 6 below shows the median body size of Empire gudgeon (left) and Sea mullet (right) at each of the sites. It was found that despite the decrease in relative abundances moving upstream for both species, the median body size increased moving further up the catchment. This finding demonstrates that the juveniles of diadromous species which undertake the greatest upstream migrations, and are required to reach suitable freshwater habitats to settle in, are potentially not reaching sites higher in the catchment. The increasing median body size shows that only larger-bodied (stronger swimmers) individuals are able to ascend the barriers, or alternatively, have made it to these habitats in low numbers during barrier drown out events and settled out as juveniles; hence the lower abundances and larger body sizes.

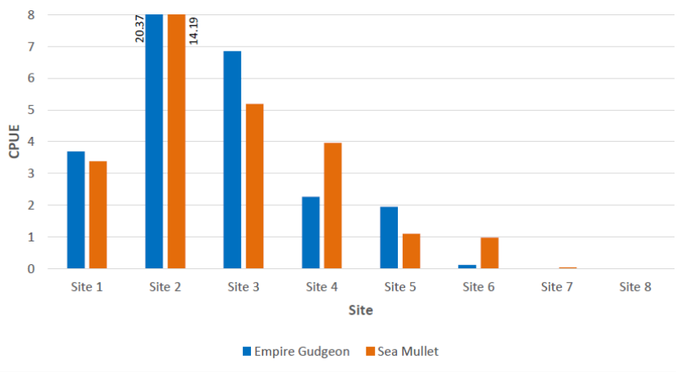
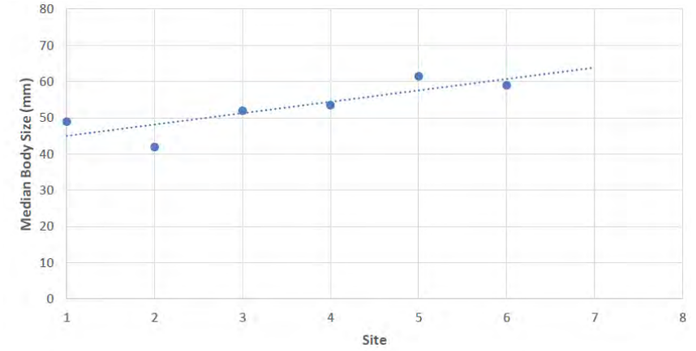


Figure 5 - Relative abundance expressed as catch per unit effort (fish per minute) of chosen indicator species Empire gudgeon (H. compressa) and Sea mullet (M. cephalus) at each site.

This is further supported by findings from investigations of the body size distributions of a further two species, Freshwater mullet (*T. petardi*) and Australian bass (*P. novemaculeata*) (Figure 7). Both of these species are large, catadromous species which live and mature in freshwater habitats however make annual downstream migrations to estuarine habitats to spawn. Like Empire gudgeon and Sea mullet, both species are particularly vulnerable to fish passage barriers with the juveniles of both species required to migrate up to hundreds of kilometres upstream to suitable freshwater nursery habitats. Figure 7 shows the body lengths (mm) of four Freshwater mullet (top) and 16 Australian bass (bottom) surveyed. Aside from a single sub-adult Freshwater mullet, only large mature Freshwater mullet and Australian bass were recorded, highlighting recruitment failure of both species. This is likely due to connectivity issues throughout the catchment and sub-optimal habitat condition in accessible reaches. .



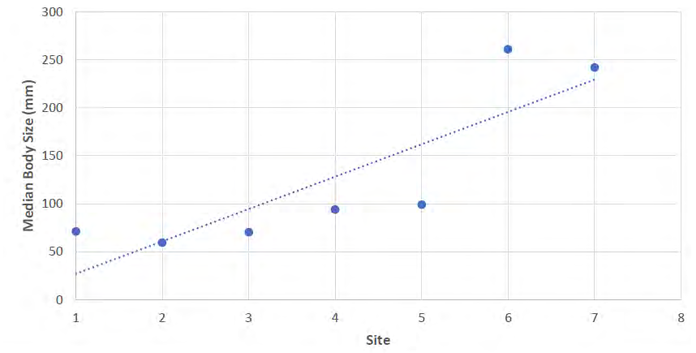


Figure 6 - Median body size (mm) of all Empire gudgeon (H. compressa) (top) and all Sea mullet (M. cephalus) (bottom) measured at each site

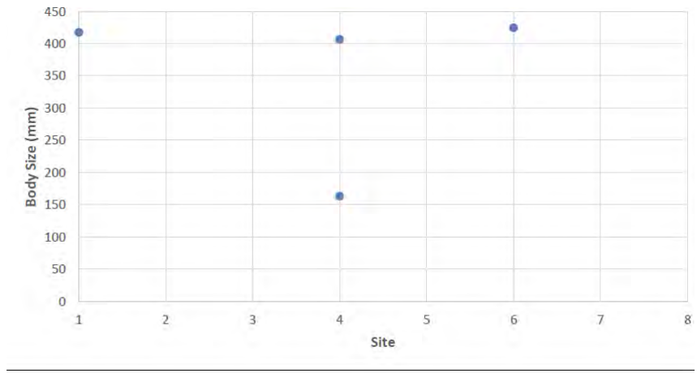


Figure 7 - Body sizes (mm) of four Freshwater mullet (top) and 16 Australian bass (bottom) measured during fish community assessments.

Barrier prioritisation assessment

Fish passage barriers have the potential to severely impact native fish communities and overall aquatic eco-system health in a number of ways, including:

- Impeding obligatory upstream migrations of diadromous fish species which require access between estuarine and freshwater habitats at specific developmental stages to complete their life-cycle,
- Decreasing fisheries resource output through reducing the numbers of fish important to commercial and recreational fisheries i.e. Sea mullet, Freshwater mullet and Australian Bass,
- Prevent or impede the free movement of freshwater fish populations. This movement may be necessary for fish to locate suitable spawning sites, breeding partners; acquire food resources and maintain genetic diversity,
- Creating lentic conditions which facilitate the proliferation of pest fish species such as Carp, Tilapia and Mosquitofish, and
- Drown-out previously good fish habitat comprising pool, run and riffle sequences and replace with poor habitat conditions e.g. lentic weir pool habitats

Moore et al., (2018) completed a fish barrier prioritisation project throughout the Greater Brisbane region including the Scrubby Creek Catchment. This fish barrier assessment process utilised aerial imagery to identify 13,629 potential barriers to fish passage in the project region and 251 within the Scrubby Creek catchment. Note: All barriers are defined as ‘potential’ barriers until they have been validated in the field as ‘actual’ barriers.

Potential barriers identified in this process were initially prioritised using river network analysis tools in ArcMap (GIS). Barrier assessment was based on five geo-spatial questions relating to the barrier’s position in the catchment, type and amount of available upstream habitat, stream hierarchy (Strahler stream order and gradient), proportion of intensive land use (e.g. cropping/ grazing) and number of barriers downstream. Further details regarding fish barrier assessment methodology can be found in Moore et al. (2018). Potential barrier data from this project was used during on-site barrier assessments along Scrubby Creek. Six sites were field assessed during this process with two additional fish barriers validated on the main channel of Scrubby Creek. Data from this updated fish barrier assessment has been added to the data collected by Moore et al. 2018 to produce the following priority ranked fish barrier list for the Scrubby Creek catchment (Figure 8). Additional information on these priority fish barriers can be found in “Scrubby Creek Fisheries Options Summary Report” (McCann and Moore 2019).

Recommendations

A number of key recommendations were determined based on conclusions of the assessments which identified that overall the current fish community assemblages are in a poor state:

1. Improvements to catchment connectivity through remediation of high priority fish barriers. It is recommended that fish barriers are remediated in priority order (See ‘High Priority Fish Barriers’ on Figure 8 for remediation order). If possible, redundant barriers should be completely removed. However, if the barrier exists for a purpose, then an appropriately designed fishway should be constructed. It is recommended that a Fish Passage Option Assessment is undertaken for each fish barrier site requiring fish passage remediation.
2. Rehabilitate in-stream habitat through the addition of large woody debris (i.e. snags and log-jams). Native fish, particularly important socioeconomic species such as Australian bass require structurally complex habitat to reside in. It is recommended that targeted in-stream habitat improvements occur in conjunction with the removal of fish barriers. The benefits of re-snagging would be enhanced at locations with public access. This would improve recreational fishing opportunity and increase the likelihood of the community having optimised fishing experiences, while also immersing themselves in the natural environment. It is recommended that a detailed in-stream habitat assessment is undertaken to determine the best locations for rehabilitation actions. From the current study, it was evident that the following sites would benefit from re-snagging:
   - Gould Adams Park weir pool
   - Demeio Park weir pool
   - The Lakes, Marsden (upstream Logan Motorway)

3. Re-stock endangered Mary River cod and Australian bass into weir pool habitats. Fish surveys showed that these habitats contain few apex predator species, largely due to fish barriers preventing access. The lack of predation and competition may be increasing pest fish populations at these sites. Recreational fishing is already very popular at some of these locations as was observed during the fish surveys. However, community members participating in recreational fishing had very little to target other than pest fish species such as Carp and Tilapia. Introducing native, recreationally valuable species will assist in raising community awareness regarding the detrimental impacts of pest fish species on waterway health. Key fish re-stocking locations include
   - Gould Adams Park weir pool
   - Demeio Park weir pool
   - The Lakes, Marsden (upstream Logan Motorway)
4. Raise the profile of pest fish species throughout the catchment to inform the community of common pest fish species in the area and their associated impacts. Awareness could be raised through social media campaigns, signage, or potentially through continued use of pest fish fishing days for the community. Re-stocking as per Recommendation 3 could occur in conjunction with community pest fish fishing days. Recreational fishing is often popular for people with culturally diverse backgrounds, and may present opportunities for LCC to engage with the local community.

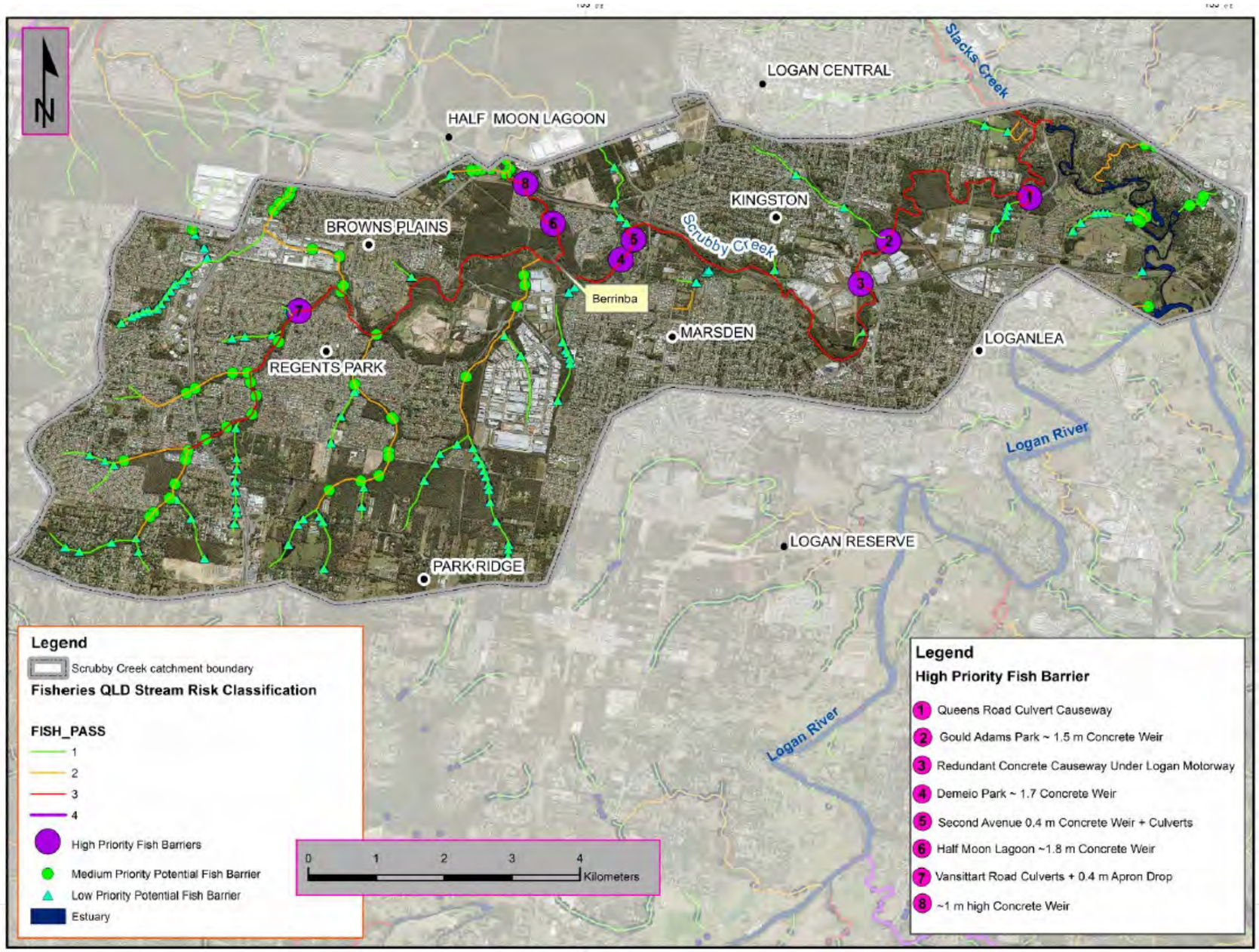


Figure 8 - Map identifying the top eight priority fish passage barrier remediation sites following the updated barrier prioritisation. Medium and low priority potential fish barriers throughout the Scrubby Creek catchment are also indicated.

Appendix E

CATCHMENT MODELLING & WATER QUALITY MANAGEMENT

The water quality for Scrubby Creek had been assessed by E2Designlab through a combination of monitoring and catchment modelling. A 'snapshot' of water quality monitoring had been undertaken to provide a high-level understanding of the conditions within the catchment, thus highlighting the waterway compliance level against objectives. The sites were selected to give a good understanding of the water quality along the waterway and to pick up any likely pollutant hotspots such as active landfills, sewer overflow locations, industrial and major shopping centres. As a separate exercise, modelling was undertaken for the catchment to develop an array of thematic maps which illustrate the current and future modelled pollutant generation according to land type, again to better understand water quality issues throughout the catchment.

WATER QUALITY MONITORING

Water quality samples were collected on the 7th of March 2019 from 13 scheduled sites along the Scrubby Creek catchment waterways. This was at the end of a dry period with only 64.6mm of rainfall falling in the previous month with a highest daily rainfall of 14.6mm.

Monitoring included the use of an in-situ measurement of water quality using a ProDSS multiparameter probe at each site. Water quality samples were planned to occur at 13 sites across the catchment as listed below. However there was no water found at the confluence site and therefore only 12 sites were sampled. Note site numbering is based on sequence that they were sampled

- Site 1: Scrubby Creek/Slacks Creek confluence (Soccer Drive) – not sampled
- Site 2: Queens Road – downstream section of main Scrubby Creek channel (note: this was below a known sewer overflow area)
- Site 3: Gould Adams Park – main Scrubby Creek channel (Battle Street)
- Site 4: JJ Smith Park Lakes - main Scrubby Creek Upper channel (Princess Street)
- Site 5: Berrinba - Unnamed Tributary (Wayne Goss Drive)
- Site 6: Campden Park – main Scrubby Creek channel (Campden Street)
- Site 7: Park Ridge catchment - Unnamed Tributary (St James Circuit)
- Site 8: Regents Park catchment – main Scrubby Creek channel (Vansittart Road)
- Site 9: Grand Plaza catchment - Unnamed Tributary (Waller Road)
- Site 10: St James Park – main Scrubby Creek channel (St James Circuit)
- Site 11: Demio Park – main Scrubby Creek channel (Demeio Road)
- Site 12: Karawatha catchment - Unnamed Tributary (Third Avenue)
- Site 13: Half Moon Lagoon - Tributary (Freshwater Drive)

In-situ measurements and water sample collection, storage, transportation and laboratory analysis were undertaken according to standards defined in the Monitoring and Sampling Manual (DERM, 2009). Water quality samples were assessed by a laboratory accredited by the National Association of Testing Authorities (NATA). The parameters that were assessed are listed below in Table 1.

In-situ and laboratory analyzed water quality results were assessed against accepted water quality objectives (WQOs) listed in the Environmental Protection (Water) Policy 2009 – Logan River Environmental Values and Water Quality (Department of Environmental and Resource Management (DERM), 2010), as well as the Australian and New Zealand Environment and Conservation Council (ANZECC) water quality guidelines and the NHMRC Guidelines for Managing Risks in Recreational Water.

Table 1 – Water quality parameters sampled for Scrubby Creek

In situ sampling results using ProDSS multiparameter probe	Laboratory Analysis
Physiology and chemistry: - Water Temperature (°C) - Conductivity (C µS/cm) - Salinity (SPC µS/cm) - pH (-) - Dissolved Oxygen (%) - Dissolved Oxygen (mg/L) - Oxidation Reduction Potential (ORP mV) - Turbidity (mg/L)	- Total Suspended Solids (mg/L) - 20 Dissolved metals (mg/L): Aluminium, Arsenic, Beryllium, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Nickel, Selenium, Silver, Strontium, Vanadium, Zinc, Boron, Iron, Mercury and Reactive Silica - 8 Nutrients (mg/L): Ammonia as N, Nitrite as N, Nitrate as N, Nitrite plus Nitrate as N (NOx), Total Kjeldahl Nitrogen as N, Total Nitrogen as N, Total Phosphorus as P and Reactive Phosphorus as P - Chlorophyll a (mg/m³) - Bacteria: Faecal Coliforms (CFU/100mL), Escherichia coli (CFU/100mL), Enterococci (CFU/100mL)

RESULTS

Figure 1 presents the summary of these results for each of the sites using coloured boxes for physiology and chemical parameters (PC), dissolved metals (MT), nutrients (NT) and bacteria (BA).

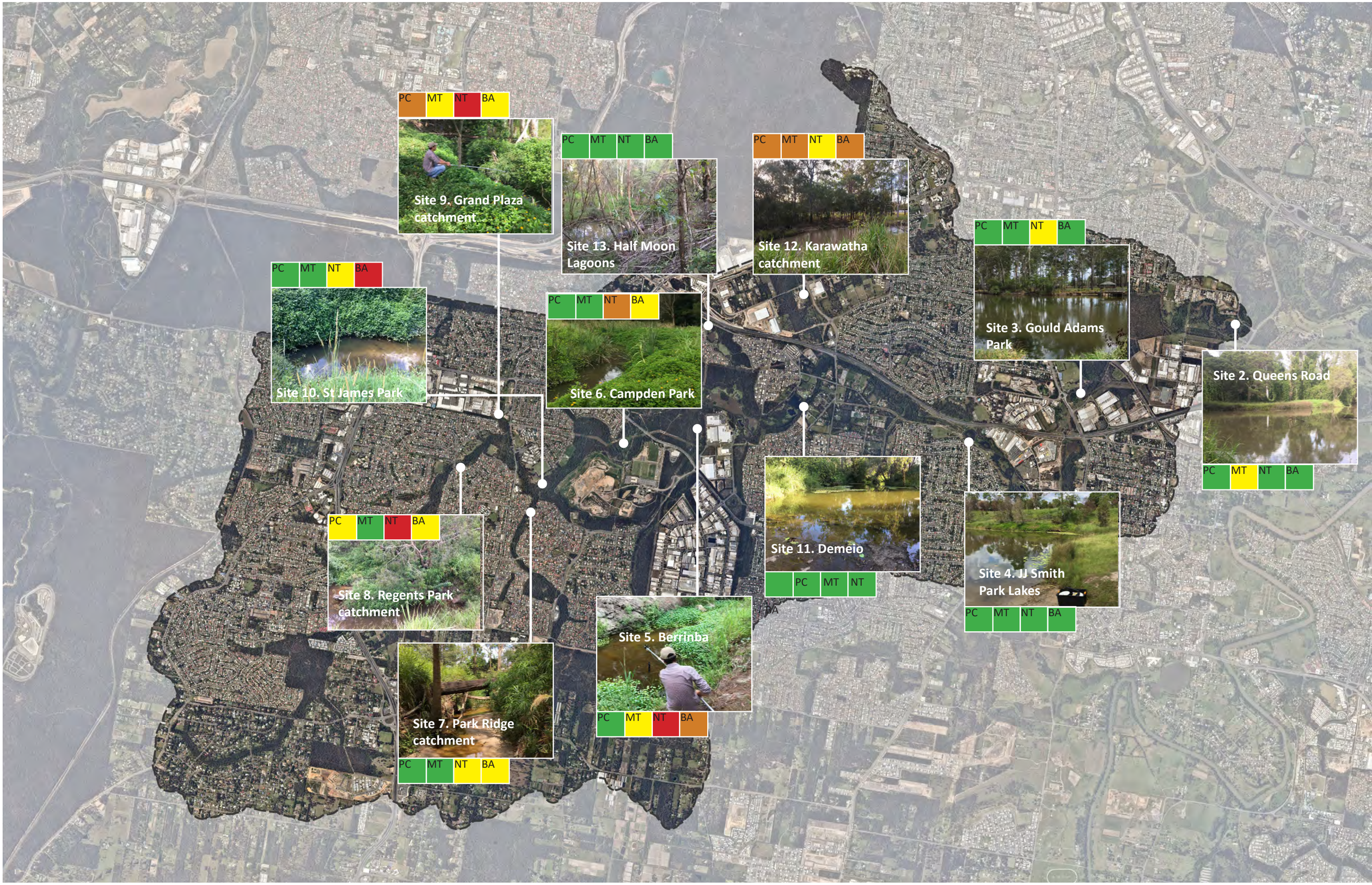


Figure 1 - Map summarising the water quality results for physiology and chemical parameters (PC), dissolved metals (MT), nutrients (NT) and bacteria (BA) at each sampling location

WATER QUALITY MODELLING

Method

The catchment was modelled using the eWater MUSIC Model and methods outlined in the MUSIC Modelling Guidelines (Water by Design, 2010). A 10-year 6 minute rainfall dataset (1990-1999) from the Shailer Park station was selected to best represent the catchment. The main land uses were modelled with relevant % impervious, run-off and pollutant export parameters (Table 2). These land use classifications were based on land use planning GIS data supplied by Logan City Council for the future land use scenario. The current land use scenario was developed using this mapping data as a base which was then refined based on a review of current aerial photography to reclassify land uses based on what is currently there. Unit models were used in MUSIC to generate the pollutant loads and flows per hectare. These were then multiplied by the total land use to generate the total pollutant loads and flows for the current and future scenarios. Using GIS software, an array of thematic maps were also produced to illustrate the changes in pollutant loads generated from existing conditions to future projections.

Table 2 - MUSIC modelling parameters used for Scrubby Creek (as defined by the MUSIC Modelling Guidelines (Water by Design, 2010)

Land use classification	% Imperviousness	Runoff-off parameter (Table 3.7)	Pollutant export parameter (Table 3.8 and 3.9)
Road Reserve	70	Urban residential	Urban residential - road
Special Purpose	65	Urban residential	Urban residential - road
Low Impact Industry	90	Commercial and industry	Industrial
Mixed Use	90	Commercial and industry	Industrial
Medium Impact Industry	90	Commercial and industry	Industrial
Medium Density Residential	85	Urban residential	Urban residential
Low-Medium Density Residential	65	Urban residential	Urban residential
Emerging Communities	65	Urban residential	Urban residential
Low Density Residential	55	Urban residential	Urban residential
Rural Residential	20	Rural residential	Rural residential
Centre	90	Commercial and industry	Commercial
Specialised Centre	90	Commercial and industry	Commercial
Environmental Management & Conservation	0	Forested	Forest
Recreation and Open Space	15	Urban residential	Urban residential
Vacant	15	Urban residential	Urban residential
Community Facilities	50	Urban residential	Urban residential

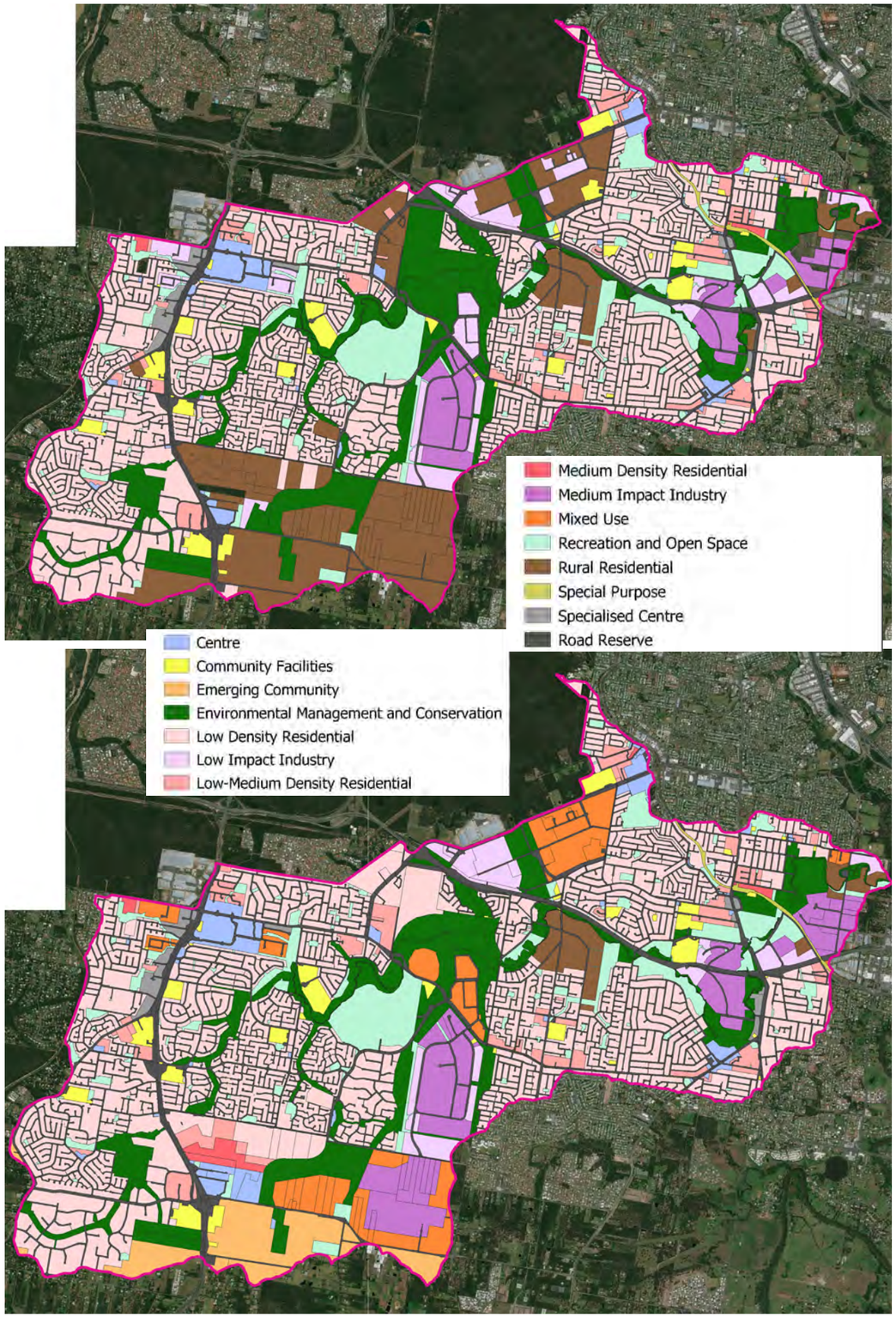


Figure 2 - Current (top) and future (bottom) land use classification

Results

Table 3 presents the total pollutant loads and flows for the current and future land use scenarios for Scrubby Creek as modelling in MUSIC. This shows that the future increase in pollutants is only likely to be up to 13% due to the current urbanized nature of the catchment.

Figures 3-5 show the current pollutant volumes for TSS, TP and TN across the catchment. These highlight that roads are key contributors of TSS and TP across the catchment while centres and industrial areas are key contributors of TP and TN. Figures 6-8 present where the pollutant loads will increase with the future land use changes. These highlight the areas in the catchment which will generate more pollutants in the future due to the conversion of vegetated land into developed areas, especially in the Park Ridge area where there will be large redevelopment occurring.

Table 3 - MUSIC modelling results for current and future land use scenarios

Land use classification	Current					Future				
	Flow (ML/y)	TSS (kg/y)	TP (kg/y)	TN (kg/y)	GP (kg/y)	Flow (ML/y)	TSS (kg/y)	TP (kg/y)	TN (kg/y)	GP (kg/y)
Road Reserve	970	206026	541	3099	22466	1282	272388	716	4097	Centre
Special Purpose	860	197893	388	1787	23805	819	188344	369	1701	22656
Low Impact Industry	1	137	0	1	16	1567	360830	692	3244	41429
Mixed Use	1182	108385	106	1149	0	1063	97502	95	1034	0
Medium Impact Industry	12682	2869057	5702	26521	346227	13565	3068716	6099	28367	370322
Medium Density Residential	1999	277018	743	4661	46316	1388	192297	515	3235	32151
Low-Medium Density Residential	1086	250076	480	2248	28713	1448	333313	639	2997	38270
Emerging Communities	84	19654	37	176	2068	339	79152	148	710	8330
Low Density Residential	2026	280782	753	4724	46946	3364	466262	1250	7845	77957
Rural Residential	11	1536	4	26	257	3148	436301	1170	7341	72948
Centre	1226	272581	546	2610	29112	1235	274581	550	2629	29326
Specialised Centre	7047	2756882	4558	14905	183026	7051	2758513	4560	14914	183134
Environmental Management & Conservation	3973	1386121	1368	10479	77587	463	161607	159	1222	9046
Recreation and Open Space	91	36477	60	188	2395	91	36477	60	188	2395
Vacant	362	76888	202	1156	8384	399	84888	223	1277	9257
Community Facilities	117	26111	52	250	2789	0	0	0	0	0
TOTAL	33717	8765622	15538	73981	820106	37223	8811172	17245	80799	926922
					% increase	10.40%	0.52%	10.99%	9.22%	13.02%

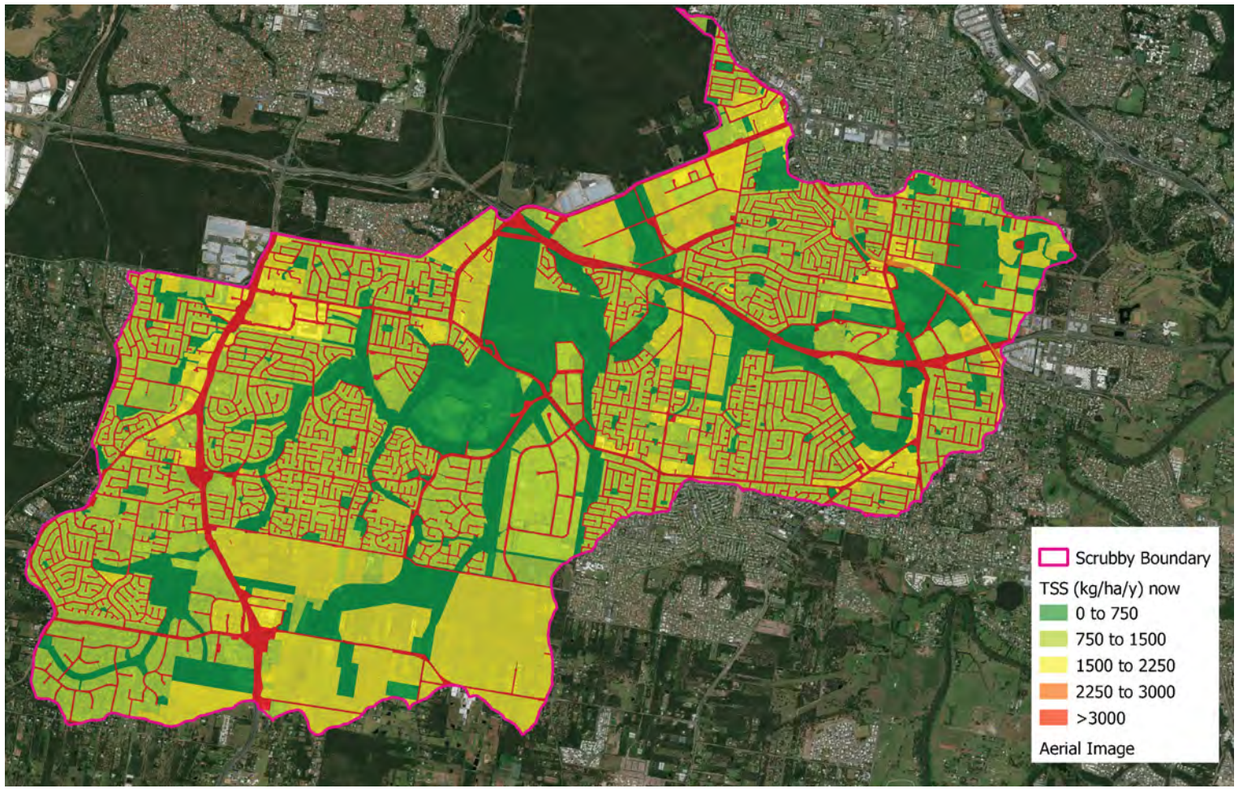


Figure 3 – Current TSS pollutant loads (kg/ha/yr) based on MUSIC model results

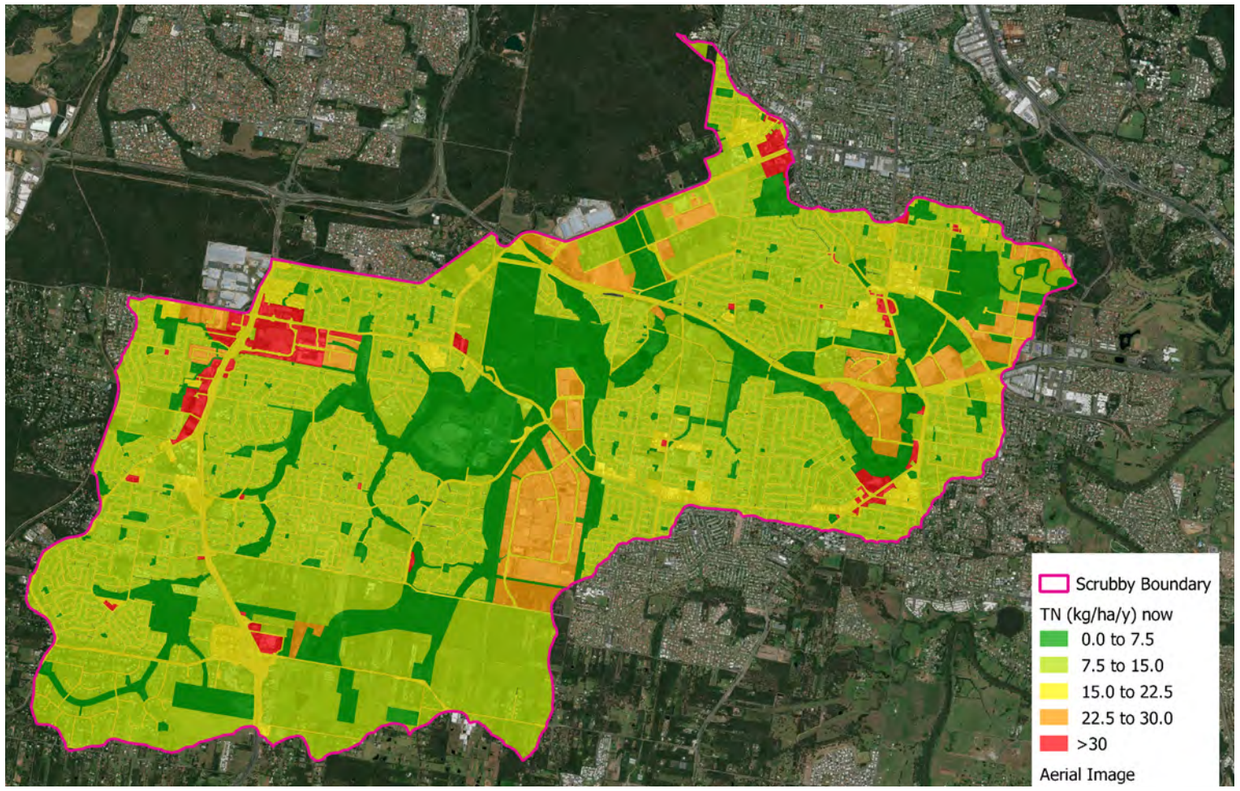


Figure 4 – Current TN pollutant loads (kg/ha/yr) based on MUSIC model results

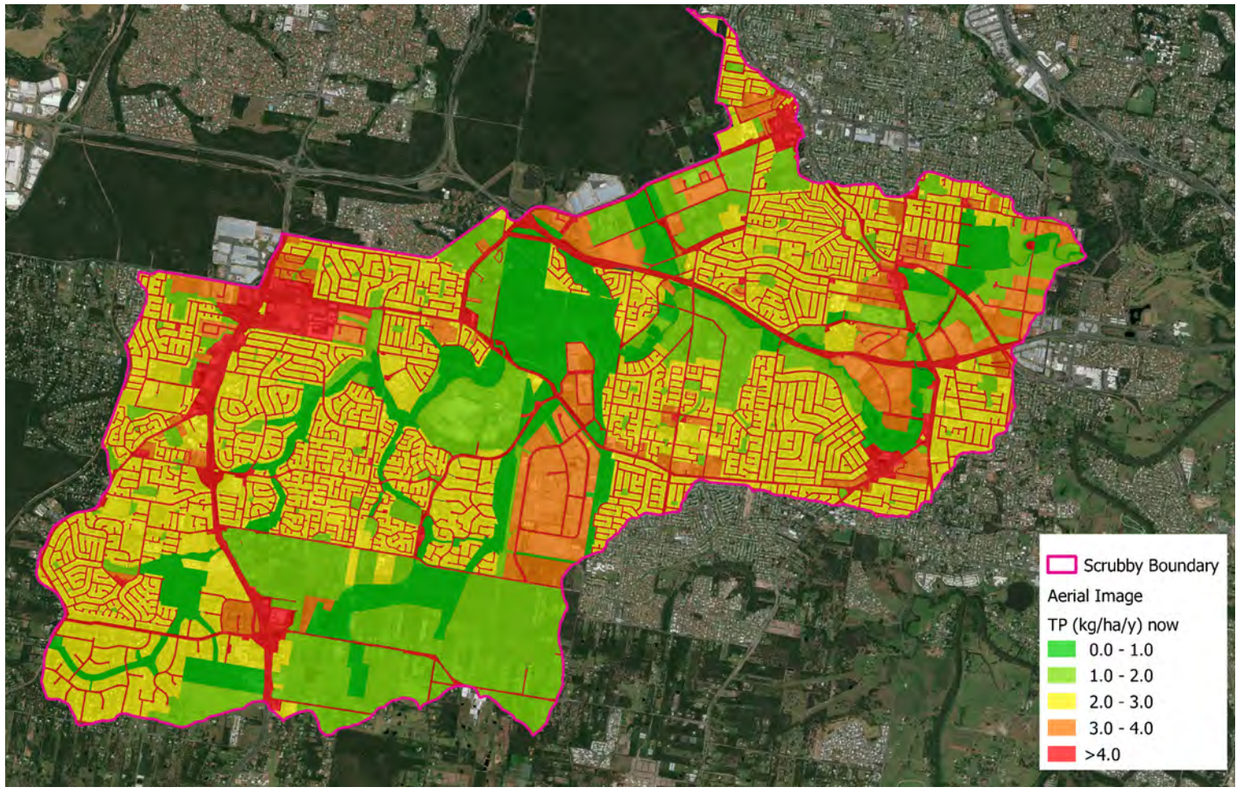


Figure 5 – Current TP pollutant loads (kg/ha/yr) based on MUSIC model results

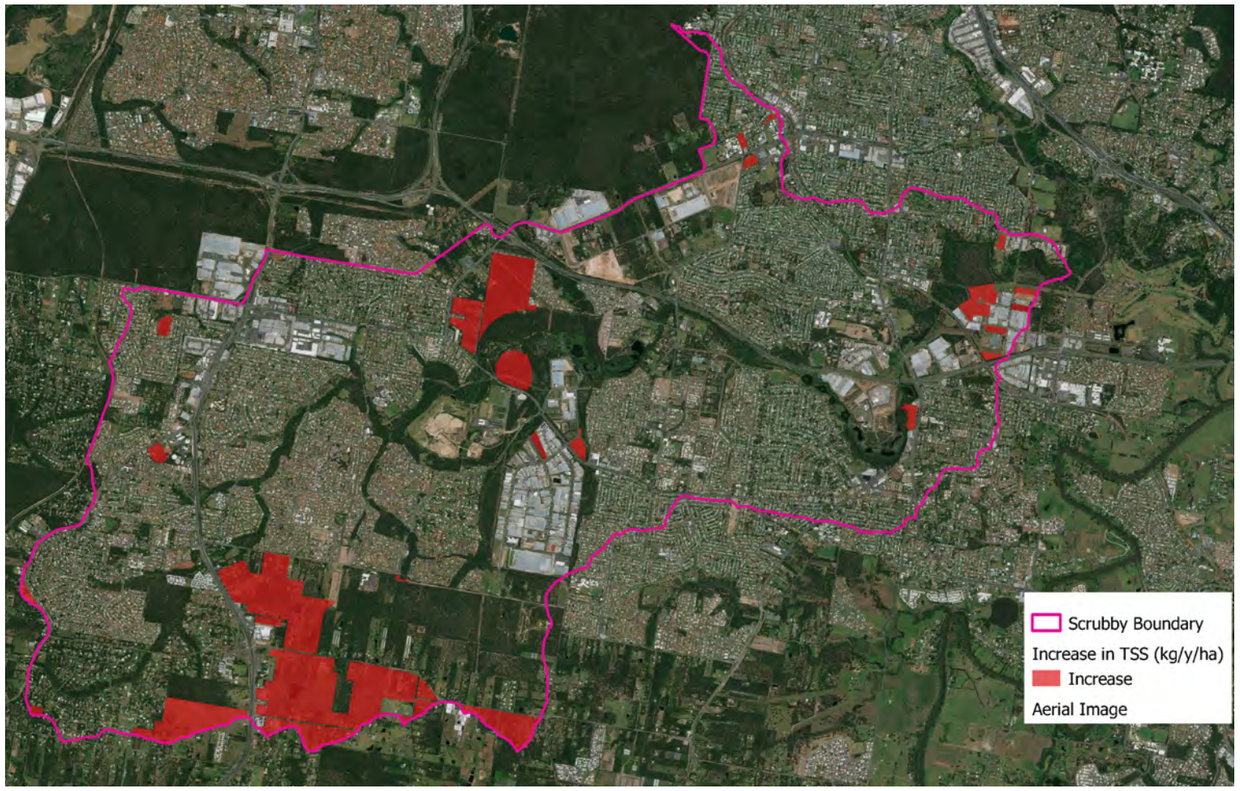


Figure 6 – Modelling increase in TSS pollutant loads (kg/ha/yr)

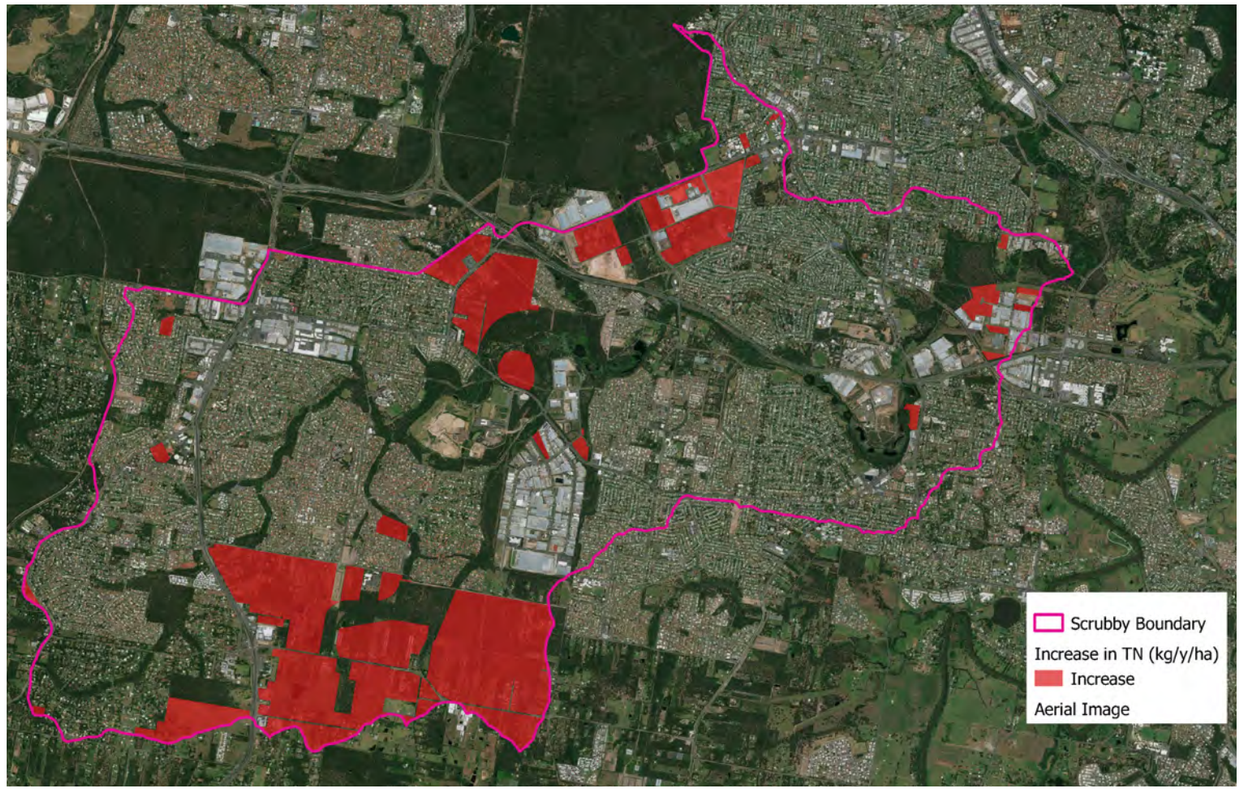


Figure 7 – Modelling increase in TN pollutant loads (kg/ha/yr)

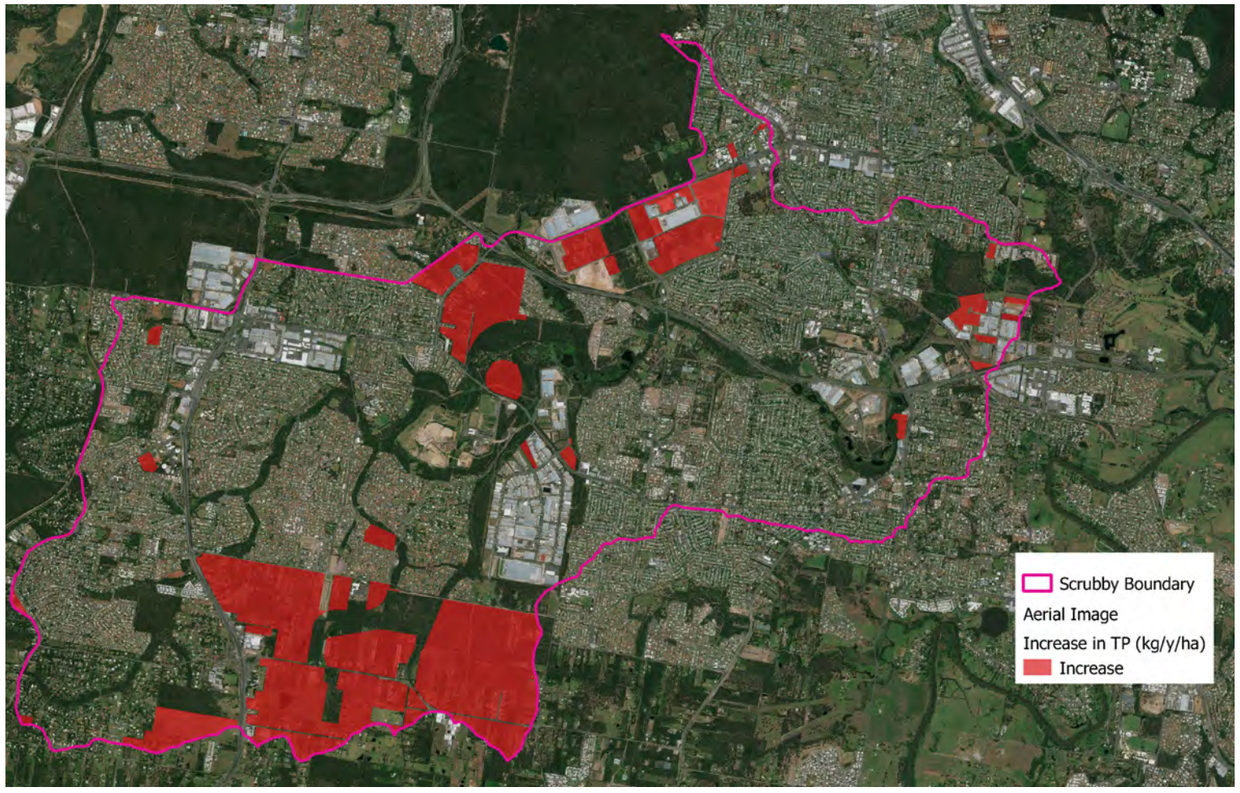


Figure 8 – Modelling increase in TP pollutant loads (kg/ha/yr)

RECOMMENDATIONS

Based on the water quality monitoring and modelling undertaken across the Scrubby Creek catchment, the following recommendations have been made to improve the water quality of Scrubby Creek:

- Investigate potential leachate entering the waterway from the old landfill at Waller Park (Site 9)
- Investigate potential cross connection of sewer and stormwater at Heritage Park (Site 10 - high bacterial water quality results)
- Investigate water quality issues in tributary at Berrinba between Wembley Road ad Logan Motorway for metals and turbidity
- Investigate high nitrogen levels in tributary entering Berrinba wetlands (site 5)
- Ensure new developments provide best practice stormwater treatment to reduce the volumes of sediment and nutrients entering the waterway in the future
- Investigate opportunities to retrofit stormwater treatment devices in hotspot areas near industry, commercial centres and roads where possible

Appendix F

WATER BALANCE MODELLING AND FLOOD ASSESSMENT

The movement of water through the Scrubby Creek catchment has been assessed through a combination of water balance modelling to identify the total volumes of stormwater, potable water and wastewater moving through the catchment as well as a review of the flooding conditions across the catchment.

WATER BALANCE MODELLING

Methods

Existing and future projected water demands, both potable and non-potable, have been determined by E2Designlab using existing water use data as provided by Logan Water Alliance for the catchment. These were provided as total water use for different land use categories which were re-assigned for this project to reflect the land use planning used in the MUSIC modelling for this project (refer Appendix E). General return to sewer rates were also supplied for each land use type which were used to calculate the wastewater generation for each land use type (Table 1). A unit rate for water demand was calculated based on the existing total area of each land use which was then used to calculate the future water demands based on the future land use areas. The rate of water demand was assumed to remain unchanged for each land type from existing to future scenarios. The return to sewer rates were then applied to these to understand the generation of wastewater. Stormwater flows were generated in a MUSIC model for the catchment for current and future scenarios (as described in Appendix D).

Water demand for each land type was subsequently calculated by multiplying the total gross floor areas (GFAs) or the population counts with the respective rate of water demand.. Water demand results were presenting according to land type. Total water demand results were compared to the total stormwater flow and the volume of water returned to sewer.

Results

Table 2 and Figure 1 present the water demand results for existing and future land use scenarios. This analysis highlights that the majority of water use in the catchment is for residential purposes and there will be over 30% increase in water use and wastewater generation in the future land use scenario. The main increase in water demand is due to an increase in residential and mixed use land uses in the future land use scenario. The majority of this change is occurring in the Park Ridge area (Figure 2).

Table 1 – Water demand data and return to sewer rates provided by Logan Water Alliance and refined land use categories for use in this project showing existing and future area (ha)

Water demand land use	Existing water demand (kL/d)	Return to Sewer (%)	Refined land use categories	Existing land use area (ha)	Future land use area (ha)
Residential_Detached	10,365	70%	low density residential	1967	2104
Residential_Attached	1,234	90%	low-medium density residential	149	199
Residential_Other	84	90%	medium density residential	9	38
Other_Beds	1	90%	community facilities	143	136
Community	169	90%			
Education	339	80%			
Health	238	80%			
Retail	622	90%	centre	99	131
Commercial	39	90%			
Showroom	66	90%	specialised centre	37	41
Industry_Light	1,247	80%	industry (low impact + medium impact)	413	487
Industry_Heavy	0	80%			
Nursery	6	-	rural residential	842	98
Other_Rural	12	0%			
Outdoor_Sport_R	87	60%	recreation and open space	394	397
Not_Serviced	53	-	vacant	38	0

Table 2 – Existing and future water demands for different land use classifications

Land use classification	Current		Future	
	Water use (kL/d)	Wastewater generation (kL/d)	Water use (kL/d)	Wastewater generation (kL/d)
Centre	661	595	874	787
Community Facilities	747	598	711	569
Emerging Community	0	0	1780	1602
Industry	1248	998	1473	1178
Low Density Residential	10365	7255	11086	7760
Low-Medium Density Residential	1234	1110	1644	1480
Medium Density Residential	84	75	337	303
Mixed Use	0	0	1964	1572
Recreation and Open Space	87	79	88	79
Rural Residential	18	0	2	0
Specialised Centre	66	59	72	65
Vacant	53	0	0	0
TOTAL	14,561	10,769	19,425	14,909

Figure 3 presents the total water demand against the water available across the catchment as potential alternative water sources (wastewater and stormwater) for the current and future scenarios. This highlights that in both scenarios there is an excess of stormwater + wastewater across the catchment which could be captured, treated and re-used to supply non-potable water demands.

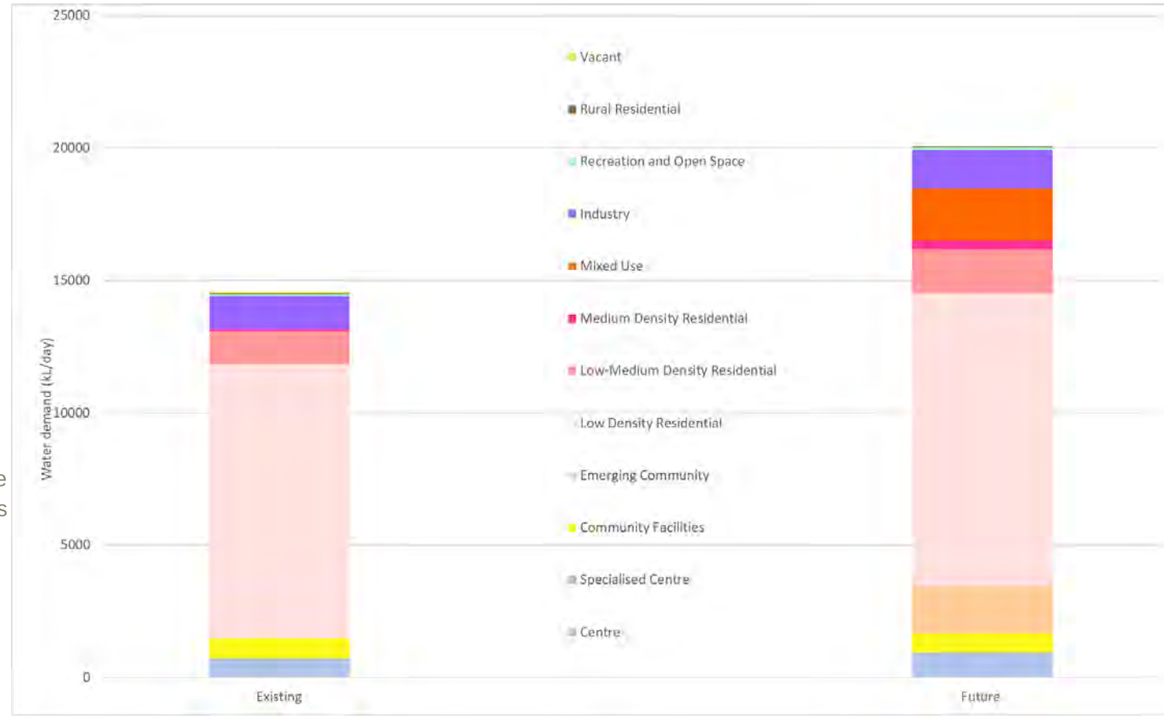


Figure 1 – Existing and future water demands for different land use classifications

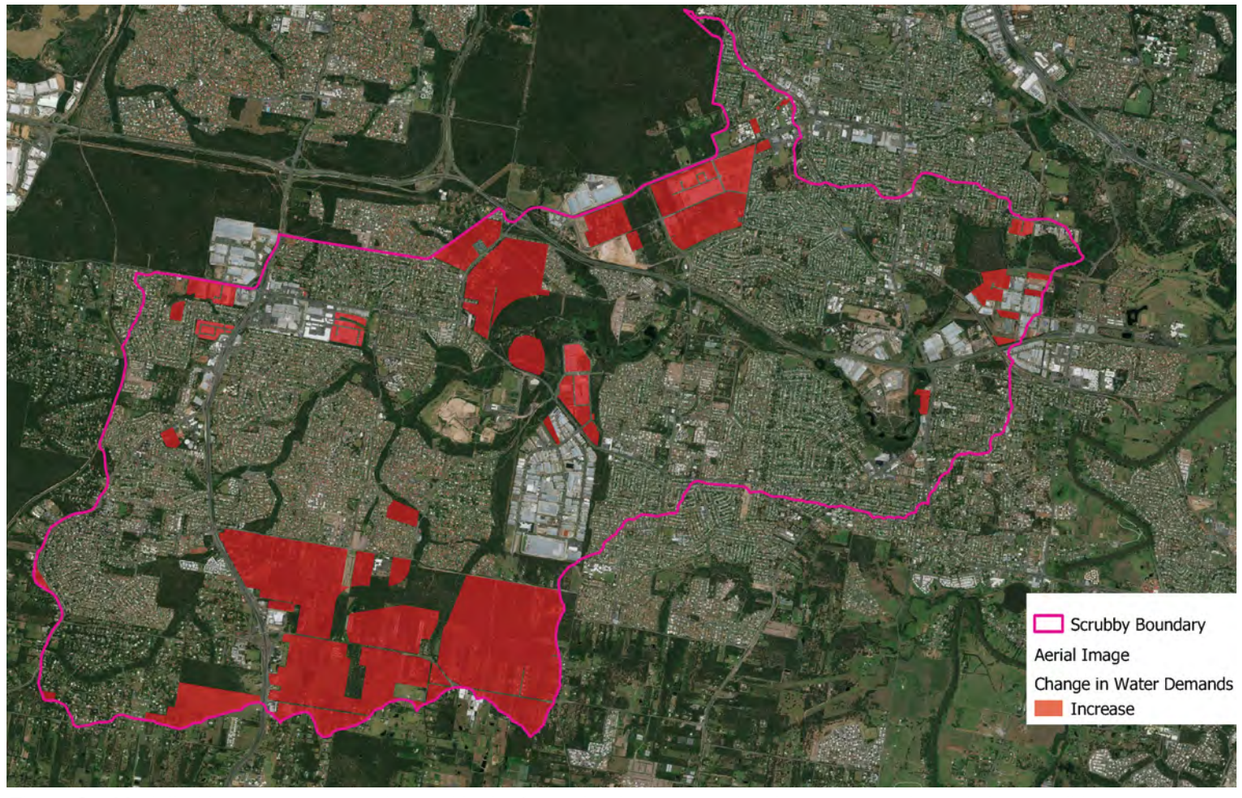


Figure 2 – Modelled increase in water demand in the future land use scenario when compared to existing conditions

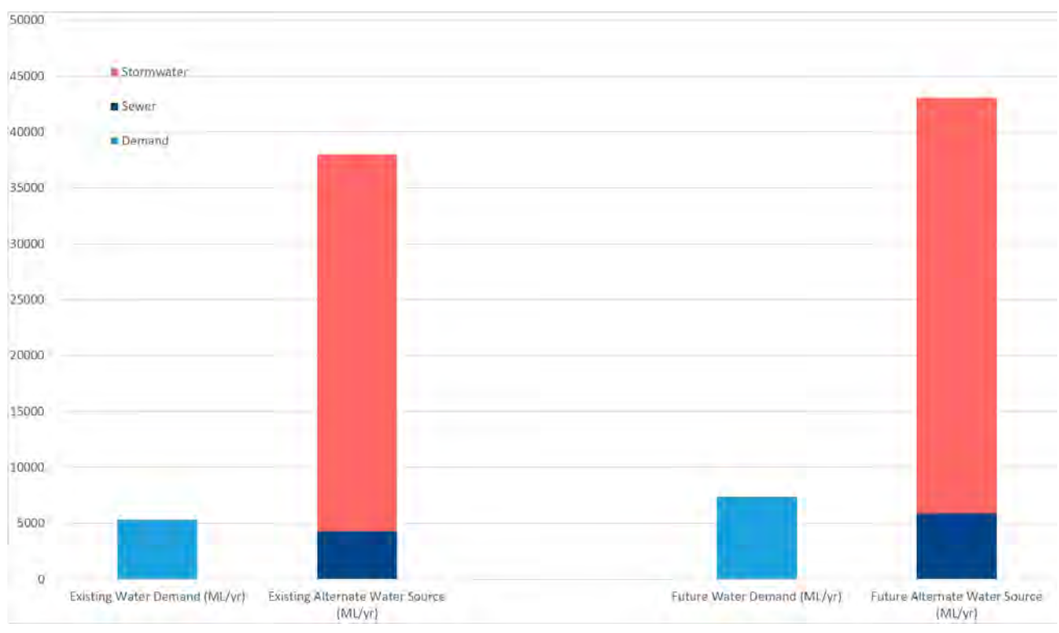


Figure 3 – Total water demands compared to alternative water sources (wastewater and stormwater) for existing and future land use scenarios

FLOODING

Method and available data

Existing flood model results were supplied from the WRM Water Scrubby Creek Flood Study and were reviewed by Synergy Solutions for this project. No flood report was available however depth, level and velocity results from the 50% Annual Exceedance Probability (AEP) to the 0.05% AEP were made available for assessment. Inspection of the results indicates a 5.0m grid sizing for the hydraulic model which provides sufficient detail on the main Scrubby Creek corridor. Whilst sub catchment delineation of hydraulic detail may not be fine enough for urban tributaries, this level of detail is satisfactory for the Scrubby Creek investigation.

Catchment wide assessment

Scrubby Creek is a highly urbanised catchment and settlement has historically built close to the banks of Scrubby Creek which introduces risk during major flood events.

The catchment upstream of Browns Plains Road is generally contained within the main waterway of Scrubby Creek and flood extents are similar across a wide range of AEP's (Figure 4). Depths and velocities obviously increase as magnitude increases however flood extents are generally minimised. There are exceptions to this, within sub catchments where overland flooding occurs at higher magnitude events and pipe networks, culvert and bridge capacity are exceeded. A particularly good example of this is the Grand Plaza shopping centre where it would appear this section of tributary has been built over.

Figure 4 – 50% AEP (Velocity) vs 1% AEP (Depth) mapping for Scrubby Creek upstream (top) and downstream 9bottom) of Browns Plains Road

Downstream of Browns Plains Road, the nature of the creek changes and the waterway and floodplains become more engaged as the flooding magnitude increases (Figure 4). Traditionally a lot of these areas would have acted as natural floodplain storage, however risk is introduced as historically these areas have also been built upon. In and around the Berrinba wetlands is a good example of where the creek can widen significantly during flooding and introducing new broader flood paths.

In the area of Second, Third Avenue etc (a rural residential area) there are significant differences between flooding magnitudes. The floodplain begins to engage early during minor events and is significantly inundated in major events (1% AEP). The floodplain engages via backwater but also new preferential flowpaths across the area. Velocities remain quite low indicating a major floodplain storage area which floods rural residential properties in this area. Velocities remain largely small (below 1m/s) even in the 0.1%AEP event reconfirming a major storage area. Another area of significant floodplain storage and urban inundation is surrounding the Chambers Flat Road Park. Historical development on the floodplain results in many houses being inundated during the 1% AEP event.

Further downstream between the Pacific Highway and Logan Motorway (and discharge to Slacks Creek) is another area of significant floodplain inundation and indication of major floodplain storage areas. Fortunately, it appears this area has not been historically developed as intensively as upstream areas and there is sufficient room for the creek here even during the 0.2% AEP event without causing major flooding.

Priority Site Investigation Areas – Summary and Recommendations

Whilst this section focusses on flood modelling and flood risk management considerations, an integrated floodplain management approach is considered contemporary and valuable for this project. In that regard, considerations of flood mitigation potential through created floodplain storage, conversion of land use and complimentary waterway health and flooding outcomes will be considered and heavily prioritized.

In addition to this, a key outcome of this commentary is to highlight and introduce opportunity through future overlapping strategies such as the Scrubby Creek Flood Risk Management Plan.

Priority Site Area 1 – Gould Adams Park

The Gould Adams Park site in its entirety is generally an area of floodplain engagement and storage when the sports field is inundated. The sporting field begins to heavily inundate during the 10% AEP event and fully inundates during the 1% AEP event. In general, the channel of the creek bed is quite extensive in the area but only provides capacity for up to the 50% AEP event.

Velocities within the creek are generally quite high (up to 2 m/s) and reduce to low velocities (0.3m/s) across the floodplain indicating this area of floodplain storage.

Priority Site Area 2 – JJ Smith Park

This section of Scrubby Creek is quite complex in its flooding characteristics. Towards the north western end of the park, there is a section that appears to have been modified substantially historically. The highway to the north and sports field to the south have had significant fill placed in the floodplain. This restricts the floodplain and thus dramatically increases velocities (up to 3m/s during the 1% AEP event and as high as 2.5m/s in the 10% AEP event). As floodplain break out does not occur until after the 10% AEP event, frequent flooding with elevated stream power exists through this section which has the potential to cause erosion.

The next section of the park is a heavily modified chain of ponds and parkland. In general the floodplain is encouraged to interact at lower flooding levels compared to the northern section which reduces velocities. A combination of reducing creek grade, heavier vegetation and a significant bend in the river also reduces velocities and thus properties along this section begin to inundate above the 10% AEP event. Velocities remain low and this urban area can still be considered as flood storage.

The final section of the park (around the bend of Scrubby Creek, near the Marsden Library) is a complex section of branched arms of the creek which generally begin to interact across the joint floodplain above the 50% AEP event. As above this area is a major flood storage area of Scrubby Creek, inundating a large urban area above the 10% AEP event

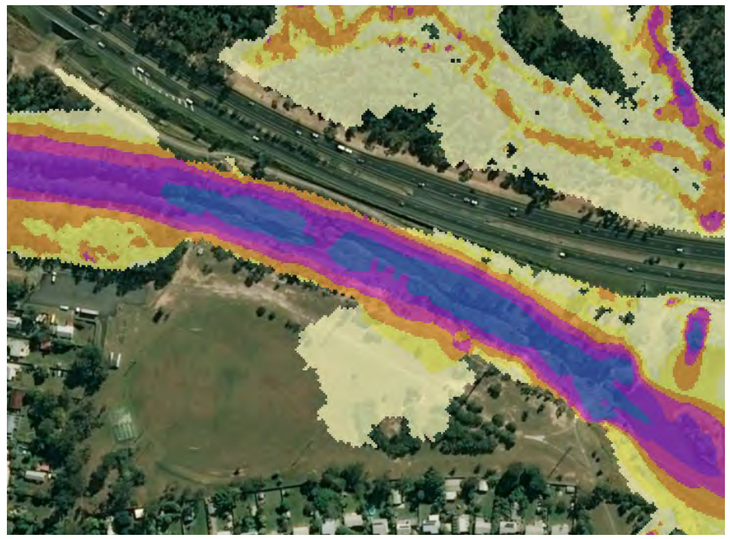


Figure 5 – 10% AEP velocity in waterway upstream of JJ Smith Park

Figure 6 - 50% AEP (Velocity) vs 1% AEP (Depth) downstream of JJ Smith Park

Priority Site Area 3 – Rural Residential Area

This area of flooding is quite unusual in its characteristics considering the urban population within the site. In general the flooding characteristics display classic natural phenomena where channel capacity is exceeded readily and the floodplain engages rapidly. Additional comments regarding this area include:

- The channel capacity of the creek is very small and is exceeded below the 50% AEP event. Another indication of this is the relatively small differences between 50% AEP and 1% AEP event velocities in the creek. Flood flow through this area is controlled via the floodplain.
- This area represents the largest area of floodplain engagement/storage through the study area and the floodplain is significantly engaged beyond the 50% AEP event. Velocities and depths through the floodplain remain low. This area could be considered a critical location for floodplain storage/ mitigation.
- Significant flooding occurs early for the entire area of rural housing and will/should be a major focus point for the upcoming Scrubby Creek Flood Risk Management Strategy.

Figure 7 - 50% AEP (Velocity) vs 1% AEP (Depth) in rural residential area

Priority Site Area 4 – Hawthorn Park

This area is fairly constrained with limited floodplain engagement categorised by a potentially filled floodplain on the extents of the creek. There is little distinguishing the 50% AEP and 1% AEP events in regards to extent, although property does begin to inundate during the larger events. Because of the constrained nature (and limited floodplain engagement), velocities increase fairly substantially between the 50% AEP and 1% AEP events (50-70% more in some cases).

Velocities are also increased locally within the small artificial channel (concrete in some cases).

The existing concrete channel in general provides very limited conveyance during major flooding (conveyance is primarily within the more broader channel). The channel in general was most likely installed for a historical perception of “nuisance” and shallow creek grades in urban areas.

In general, it would be expected that removal of the concrete channel will not increase flooding substantially however this will need to be carefully managed and detailed modelling will need to occur to test the sensitivity of the concrete channel, any modifications in the larger creek channel and any required upstream storage introduced for mitigation. There are some houses affected by the 1% AEP event extent line and it is also possible that adjacent storage can be introduced at these “pinch points” through creek meandering (and consequentially excavation) to mitigate the impact.

A combined integrated water approach to investigating both flooding and waterway health analysis is recommended. In addition to this, a regional view of the area (including upstream development areas) may introduce opportunity for additional flood storage and assist with balancing out waterway works.

Any proposed works should also consider the impact of planned upstream development on naturalising this section of concrete channel. It is very unlikely that volumes will be unable to be mitigated and frequency of lower storm events will significantly increase. In considering the flooding impacts, a eco-hydrodynamic assessment (both hydrological and hydraulic) could be considered to ensure selected channel properties and vegetation are able to cope with future impacts

SUMMARY AND RECOMMENDATIONS

There is a significant amount of water moving through the Scrubby Creek catchment which can result in flooding impacts in some sections but also provides an opportunity to capture, treat and re-use this water for non-potable uses in the catchment.

From a flooding point of view, a holistic approach to the integration of floodplain management and waterway health is an important concept to understand. Floodplain management incorporates many elements including risk-based land use planning, emergency management, building guidance and flood mitigation outcomes. Contemporary floodplain management is also sensitive to receiving areas and the environment and where possible utilising flooding as an opportunity to integrate into waterway health elements and reduce built infrastructure (levees, dams, channels etc). It is therefore recommended that the solutions developed provide both waterway health and flooding outcomes through encouraging floodplain re-engagement, revegetation and reducing the impact of urbanisation. A key area for this will be the Park Ridge area to ensure that the future development can utlise alternative water sources where possible and manage the urban excess flows in a way which protects both downstream homes and infrastructure from flooding, but also the waterways from scour and changes in hydrology.

Appendix G

COMMUNITY CONNECTIONS

An assessment of the catchment was undertaken by Lat27 to understand the community connection across and through the catchment. This assessment identified that the urban catchment of Scrubby Creek is dominated by residential and industrial land uses and traversed by the Beenleigh Rail Line as well as several large road arterials including the Mount Lindesay Highway, Logan Motorway, Pacific Highway, Kingston Road and Browns Plains Road. These transport corridors favour the use of motor vehicles and create significant barriers to pedestrian and cyclist connectivity throughout the catchment.

As a result, existing parks within the catchment appear somewhat disconnected and do not read as part of the larger 'Scrubby Creek' corridor, while the pedestrian and cycle network lacks legibility and a clear identity.

Key challenges to creating a connected, safe network include:

- Industrial land uses that offer limited public access and turn their backs on the waterway, typically providing areas of very low casual surveillance where undesirable activities (e.g. motor cycle riding) occur.
- Convoluted residential pockets that turn their backs on the waterway, creating a compressed corridor with limited casual surveillance.
- Residential areas that 'borrow' from the creek corridor, where it acts as an extension of their backyard and creates a sense of private ownership over public land.
- Rural residential areas that lack legibility and provide limited public access to the creek corridor.
- Linear rail and road corridors and creek crossings, which reduce passive surveillance of the creek network and create large areas of adjacent road corridors with limited access points.
- Areas of significant remnant vegetation, including areas with high/dense weed and shrub layers that reduce visibility and opportunities for passive surveillance, impacting both public safety (including the perception of public safety).
- Limited opportunities to engage with the waterway.
- Lack of adequate lighting along pathways.
- Limited connections between existing parks, playgrounds and community facilities which encourage patronage and casual surveillance.

SUMMARY AND RECOMMENDATIONS

Despite its history of urbanisation, Scrubby Creek is a corridor of high environmental value and is part of a regional biodiversity corridor. Areas identified as having high landscape and environmental values should not be negatively impacted by plans to improve access and connections. Future development within the catchment (e.g. Park Ridge) should ensure the protection of these areas and ensure the adequate provision of public open space along key waterway and active transport corridors to provide legible, safe and shaded connections.

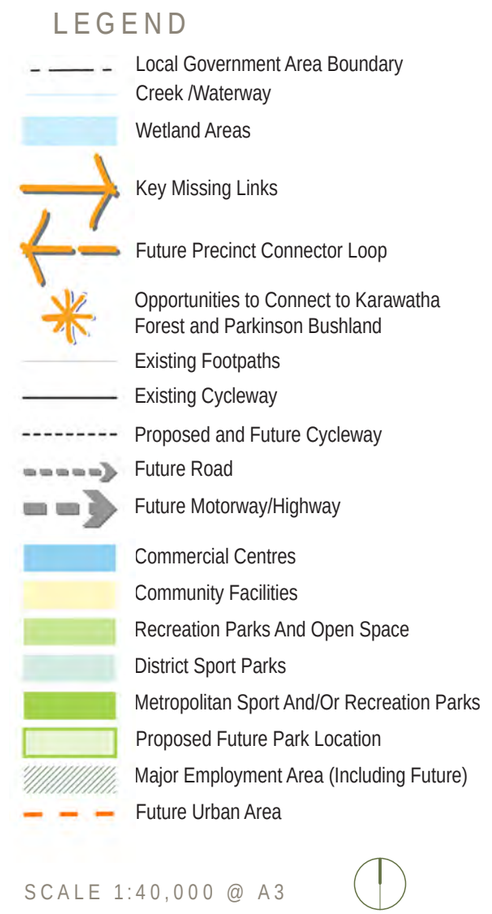
Key identified missing links/opportunities (Refer Figure 1)

1. Strengthen connections between Scrubby Creek and Grand Plaza.
2. Complete the missing link from the Logan Motorway (at Third Ave) to Riverview Park (Riverview Street).
3. Provide a connection between Karawatha Forest and the Logan Motorway.
4. Create a legible and safe connection between the Kingston Butter Factory and Gould Adams Park.
5. Complete missing link along Meakin Road to connect the existing cycle network along Scrubby Creek to the Meakin Park sports precinct.
6. Create a loop journey connecting Logan Central to the Knowledge Precinct and Logan River (including Griffith University, Logan Hospital and Riverside Park).

Safety in design principles should also be considered as part of any works to balance environmental habitat requirements with community access. To do this, the acceptable balance (or minimum requirements) between densely vegetated areas and perceived or real pedestrian safety through publicly accessible parts of the Scrubby Creek corridor should be identified. This may include but not be limited to:

- Minimum sight line distances
- Help point installation
- Clear wayfinding and identification of nearest streets etc.
- Appropriate pavement and low vegetation widths within the corridor to provide visibility and maintenance access.
- Identify alternative 'safer' night-time routes on cycleway/pathway wayfinding and signage.
- Identify alternative 'safer' circulation route in heavy rain or flooding events.

Figure 1 - Summary of community connections across Scrubby Creek



COMMUNITY CONNECTIONS