Oxley Creek Condition Assessment

Condition indicators represent the key elements of a complex environmental system that can be measured to quantify its ecological health, quality and condition.

Nine condition indicators have been identified to represent a different aspect of ecological health, quality and condition of the Oxley Creek corridor and its catchment. Individually, the condition indicators provide an insight into a singular aspect of the natural environment and a strategic basis for assigning targeted restoration goals, objectives and actions.

Environmental stresses that directly impact the health of the waterway corridor and catchment can be identified and often quantified for each of the condition indicators. The best available data gathered forms an environmental baseline to track changes specific to each indicator over time. Where available, condition indicator assessments use established legislative or best practice quality parameters, standards and objectives.

While each of the indicators have been classified individually, it is acknowledged that there are a number of inter-dependencies between indicators. For example, elements of aquatic life and habitat health cannot be entirely separated from water quality, and the condition of wildlife and habitat, is to some extent, reliant on the condition of vegetation cover.

Condition indicators

Social value

Communities that use and value their local waterways naturally desire to protect and care for them. Raising awareness of the ecological value of local waterways and the challenges they face can increase public interest, encourage businesses and households to reconsider impactful behaviours and foster community stewardship.

Social value can also be increased by improving access to waterways for recreational pursuits such as walking, cycling, paddling, bird watching and accessing interpretive information. These activities build physical and psychological connections between the community and the place. Positive experiences generated through these activities can be enhanced when there is support infrastructure in place such as pathways, way finding and interpretive signage, viewing points and picnicking areas.

Vegetation cover

Vegetation provides food, habitat and movement corridors for wildlife as well as providing cool shady places for people to use and enjoy the natural environment. Vegetation also reduces erosion and sediment loss by holding the soil together and slowing down water flow velocity. The condition and extent of vegetation cover, including vegetation composition, canopy coverage and connectivity, will support biodiversity, wildlife habitat and movement, as well as human comfort.

Riparian vegetation corridor

Riparian corridors provide important habitat and food for terrestrial and aquatic fauna. They also provide wildlife movement corridors. Riparian vegetation provides bank stability and shade over waterways, improving conditions for aquatic life and habitats, as well as water quality within the waterway.

The condition and extent of riparian vegetation along waterway corridors is important in ensuring a connected, self-sustaining and resilient vegetated corridor that supports both terrestrial and aquatic ecosystems.

Wildlife and habitat

Providing adequate wildlife habitat and movement corridors is essential for terrestrial wildlife. Established and connected native vegetation cover, with minimal fauna movement barriers, allows wildlife to easily move between water, food and breeding locations.

Water quality

Good water quality is essential in providing a waterway system that facilitates stable aquatic biological/biochemical processes, thereby supporting diverse and species-rich aquatic ecosystems, as well as opportunities for safe water-based human recreation. Improving natural processes that reduce the speed and volume of stormwater entering waterways can reduce the introduction of sediment, pollutants and nutrients.

Hydrology

Maintaining adequate water flow, at a sustainable flow rate, is vital to support aquatic ecosystems, provide flood resilience and optimise water storage and absorption capacity. Improving natural processes that reduce the speed and volume of stormwater entering waterways can reduce sediment uptake as well as the ingress of pollutants and nutrients.

Erosion and sediment

Stream bank erosion is a natural process, however, land use changes resulting in land clearing, altered channel form and flooding can often accelerate erosion which affects the stability of the waterway corridor, influencing the extent and quality of habitat. When soil in the catchment erodes, sediment washes into streams, creeks and ultimately, Moreton Bay. Increased sediment volumes entering waterways can negatively impact on waterway health, contributing to poor water quality and increased pollution levels.

Reducing areas of erosion and sediment run-off by stabilising channel banks can assist in improving the health of the waterway, as well as the connected environments downstream.

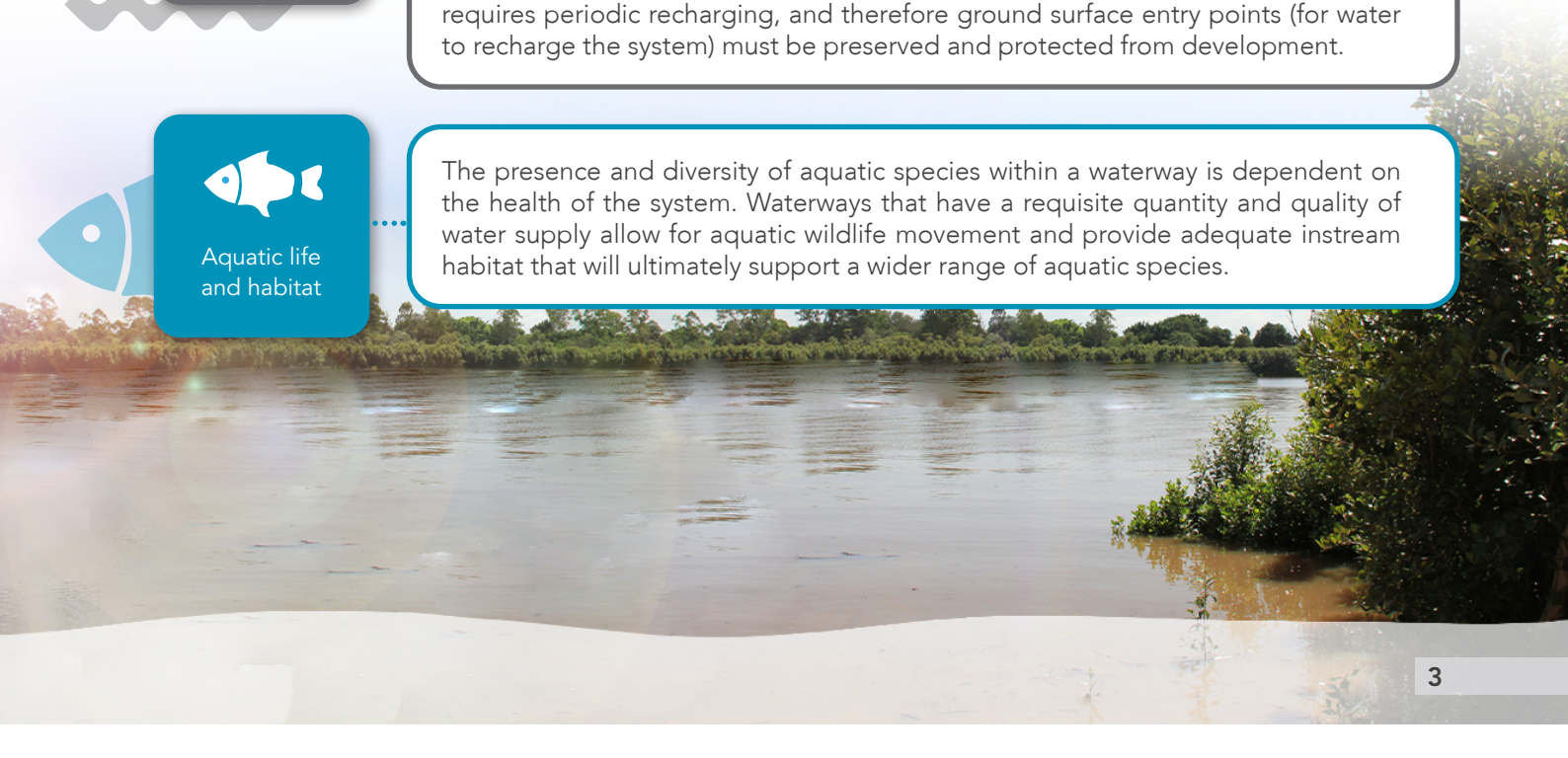
Groundwater availability

A healthy groundwater network provides a constant water supply to waterways and waterbodies and supports a range of important groundwater dependent ecosystems, including wetland systems.

In order to maintain a healthy groundwater network it must be protected from pollutants and contaminates entering the system. The groundwater network also requires periodic recharging, and therefore ground surface entry points (for water to recharge the system) must be preserved and protected from development.

Aquatic life and habitat

The presence and diversity of aquatic species within a waterway is dependent on the health of the system. Waterways that have a requisite quantity and quality of water supply allow for aquatic wildlife movement and provide adequate instream habitat that will ultimately support a wider range of aquatic species.



Social value

Waterway corridors provide opportunities for exercise, recreation and connections with nature, as well as providing public spaces to socialise and interact with others.

When people value a place, they are more likely to care for and protect it, and therefore understanding how communities perceive and value their local waterways gives an insight into how likely they are to use and look after them. The way that communities value their waterways has been found to be directly related to the perception of waterway cleanliness, health and utility.

Status

Transforming the Oxley Creek corridor into a vast environmental and recreational destination also contributes to Brisbane's economic growth. As tourism and economic assets, Moreton Bay, the Brisbane River and local waterways inject more than $2.5 billion into the economy each year.

Locals already enjoy walking and cycling alongside sections of the creek and its tributaries, as well as relaxing, picnicking and playing sport in the catchment's many greenspaces. The lower reach of Oxley Creek is a popular kayaking and canoeing destination. However, in recent decades, poor water quality as a result of high bacterial levels, has restricted some recreational activities such as swimming.

Surveys undertaken in 2017 by Council show that residents value local creeks primarily for the active and passive recreation opportunities these creek corridors provide. Walking, running, exercising, picnicking, playing and simply enjoying nature are key creek-side activities, with walking along local creeks being the most popular activity.

The surveys also identified two key issues keeping people from interacting with their local creek: concerns about water quality – generally due to the presence of rubbish and lack of water clarity; and the lack of access to the creek for recreational purposes.

In 2019, Healthy Land and Water and the Queensland University of Technology surveyed South East Queensland residents about how they use and value the region's waterways. They found that, of survey participants who resided within the Lower Brisbane Catchment (which takes into account the Oxley Creek catchment), only 5.2% have visited Oxley Creek, and 75% of these participants visited Oxley Creek less than once a month.

Public bushland, parks and reserves along waterways within the Oxley Creek catchment in Brisbane generally afford limited access to the creek. The access points that do exist are often not well distinguished or signed. In addition, adjacent private land along Oxley Creek provides limited opportunities for connected and accessible stretches of waterway frontage for public use.

The community's ability to participate in water-based recreation is directly affected by the number of available public pontoons, boat ramps and jetties. Currently, access is limited to four launch points in the lower reaches of Oxley Creek, north of the Ipswich Motorway.

Community-based environmental stewardship is widespread within the Oxley Creek catchment. There are currently 43 active community-delivered bushland restoration sites covering 272 hectares within the Oxley Creek catchment. Oxley Creek Catchment Association (OCCA), a not-for-profit organisation that provides leadership and guidance on catchment issues, has restored 100 hectares, while Habitat Brisbane, Council's community bushcare volunteer program, has 13 bushcare groups restoring the remaining 37 hectares of natural habitat.

The Oxley Creek corridor has a range of unique places, environments, histories and stories. Opportunities to gain a deeper understanding of these unique aspects of the creek corridor are currently limited.

Current catchment condition: Based on a limited sample size, 5.2% of survey participants have visited Oxley Creek, with 75% having visited Oxley Creek less than once a month.

Social value

Legend

- Council public parks and reserves
- Existing Council pontoons and boat ramps
- Habitat Brisbane Bushcare Group sites (assisted by OCCA Creek Care Program)
- OCCA clean-up site
- OCCA CreekWatch
- OCCA on-ground restoration site
- Council environmental offset site

Sources:

Kantar Public, Waterways Recreation Report, 2017.

QUT and Healthy Land and Water, South East Queensland Catchments: Waterway Engagement 2019 Research Report, 2019.

TNS and Council, Open Spaces and Waterways Qualitative Research Report, 2016.

Council Parks and Reserves mapping layer.

Council Community Conservation Partnerships Program mapping layer.

OCCA Annual report 2018

Vegetation cover

Brisbane's bushlands, wetlands, parks and mosaic of backyard gardens, tree-lined streets, plant-filled balconies, living walls and green roofs are part of an urban forest. The total extent of Brisbane's urban forest includes all native and non-native vegetation found on both public and private land within urban areas.

Brisbane's urban forest has the following significant economic, environmental and social benefits.

- **Economic benefits – Reducing energy costs for air conditioner usage from increased shading and evapotranspiration, increasing property values associated with attractive leafy streetscapes, decreasing health costs through improved physical and mental wellness, marketing the city image, avoiding costs of infrastructure damage and renewal (e.g. increased road pavement life) due to lower temperatures, and reducing wind speeds and consequent wind damage to property.**
- **Environmental benefits – Providing food resources and habitat for wildlife, holding stormwater within their canopies thereby reducing stormwater flows and nutrient loads in waterways, reducing air pollution by filtering airborne particulates, producing oxygen, and storing and sequestering carbon.**
- **Social benefits – Providing shade to cool our city and mitigate urban heat island effects, reducing heat-related illness, providing a sense of place and creation of local identity, creating attractive landscapes with colour and beauty, encouraging outdoor activity and walkable neighbourhoods, improving social cohesion, reconnecting people with nature and reducing people's exposure to sun and UV radiation.**

Status

Brisbane's native vegetation is a key component of the urban forest and is collectively called 'natural habitat'. Natural habitat includes all of Brisbane's different vegetation communities in all forms of maturity and condition. This acknowledges that immature or poor condition vegetation communities can, if managed sympathetically, mature into remnant vegetation over time. In Brisbane there are 81 native vegetation communities that make up the natural habitat, ranging from eucalypt woodlands and dry rainforests to wetlands, riparian vegetation and mangrove forests. These native vegetation communities naturally occur in Brisbane and were present before modern settlement. Natural habitat comprises of about 8.7% of the total urban forest within the Oxley Creek catchment. Brisbane's natural habitat is important in supporting the wide-ranging biodiversity across the city. Even natural habitat that is in a poor condition, or is immature, can still support some level of biodiversity.

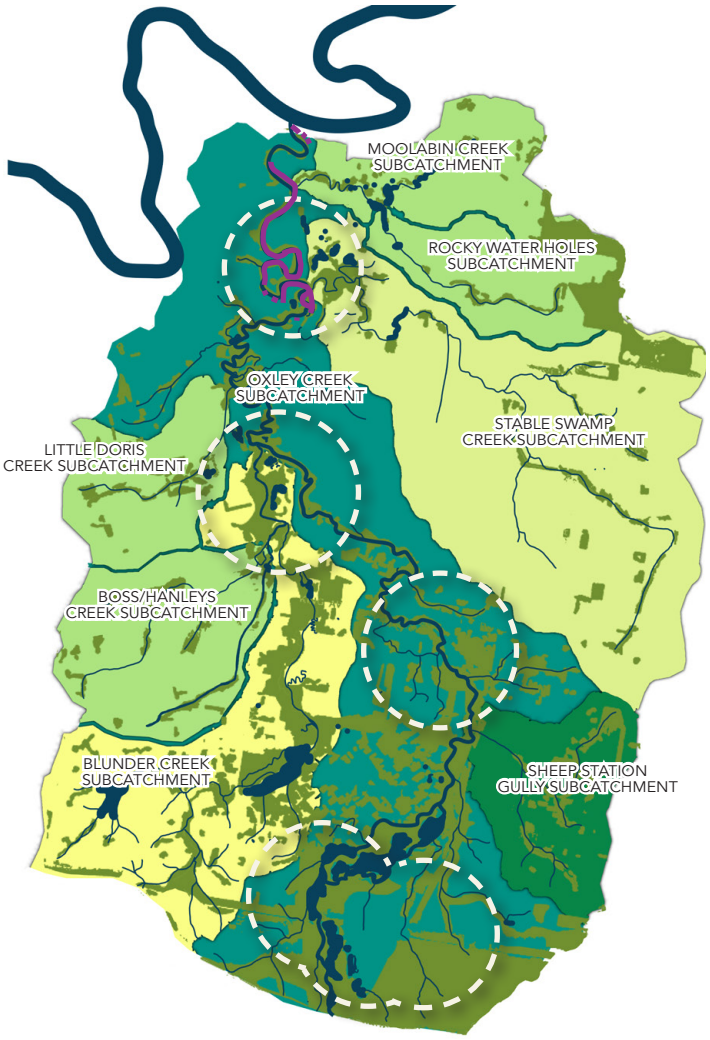
Urban forest covers about 41% of the Oxley Creek catchment within the Brisbane LGA. Sizable native bushland areas remain in Larapinta and Parkinson, where the middle and upper catchment meet. However, natural habitat is also preserved along the corridors of Oxley Creek and its tributaries. The catchment hosts 38 native vegetation communities including mangrove shrubland within Oxley Creek's lower reaches, vine forests in the mid-reaches, and melaleuca and casuarina forests in the middle and upper reaches.

Eucalypt forest and grassland communities surround catchment waterways on more elevated sites. These different vegetation types provide a rich biodiverse system that supports a range of habitats. Invasive weed species are one of the key threats to the health and condition of existing natural habitat within the catchment and corridor.

Mangroves found in the tidal reaches of the Brisbane River and its surrounding creeks act as nurseries for fish and crustaceans as well as habitat for invertebrates, bats and birds. They are also highly effective carbon sinks. Mangroves naturally occur along tributaries in the catchment's lower estuarine reaches, extending from the mouth of Oxley Creek to Rocklea. The mangrove canopy covers approximately half of the estuarine creeks and tributaries. Aerial imagery indicates that since 1946 there has been reduction in mangrove extent, particularly within Moolabin and Stable Swamp Creeks. The likely causes of this include vegetation removal for flood management purposes, urbanisation and industrial activities, channel alteration as well as significant flood events, including the 2011 flood, which had a significant detrimental impact on mangroves in tidal areas along the Brisbane River.

Loss of vegetation cover, as a result of continued land clearing for urban development, is an ongoing pressure within the Oxley Creek catchment, particularly within the emerging residential suburbs of Willawong, Pallara and Heathwood.

Current catchment condition: Urban forest coverage of 41%, with natural habitat cover accounting for 8.7% (unknown quality).



Total vegetation cover

Legend

- 70-79% vegetation cover
- 60-69% vegetation cover
- 50-59% vegetation cover
- 40-49% vegetation cover
- 30-39% vegetation cover
- Natural habitat cover 2019
- Key habitat areas
- Mangrove cover

*total vegetation cover includes trees, shrubs and grass.

Sources:

Council Impervious Surfaces mapping layer, 2014.

Council Natural Habitat Cover mapping layer, 2019.

ArcGis Lower Brisbane Catchment Story, Mangrove Forest mapping layer, 2020.

Note: Brisbane's natural habitat condition is assessed using a slightly modified version of the Queensland Government's BioCondition methodology. This considers the features on site that are important for sustaining wildlife.

Riparian vegetation corridor

Riparian vegetation is the transition zone between aquatic and terrestrial environments. The plants that flourish along the water's edge, on the banks and creek margins, perform vital environmental functions. Riparian vegetation shades the water, keeping its temperature cooler and more uniform, it filters nutrients and sediment from overland flows, stabilises banks and offers habitat for terrestrial and aquatic fauna.

Sandy soil catchments, like Oxley Creek's, require wide vegetated riparian zones to stabilise the waterway during flood events. When connected along the length of the waterway, these stretches of riparian vegetation become primary wildlife corridors, providing direct access to food and water sources.

Status

Riparian coverage is the percentage of both native and non-native vegetation cover within the riparian zone*. The average riparian coverage across the Oxley Creek catchment within the Brisbane LGA is roughly 56%. The remaining riparian coverage within the corridor is fractured and disconnected due to land clearing, development, roads and bridges.

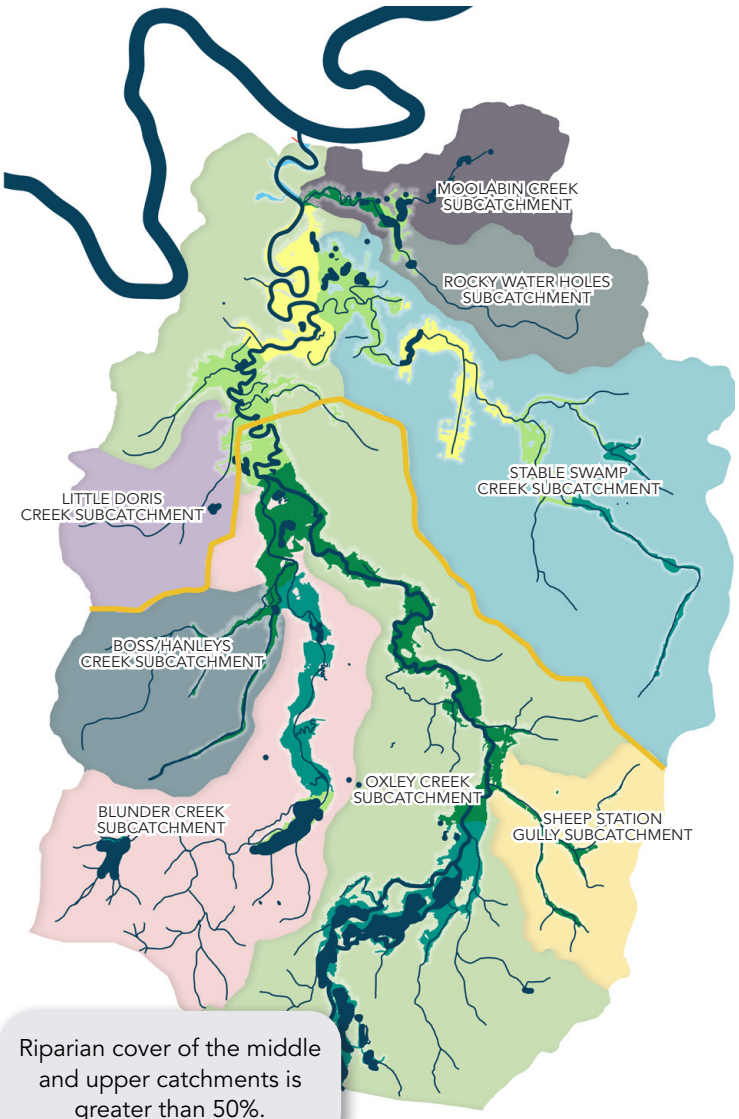
The Boss Creek and Hanleys Creek subcatchments contain more than 60% riparian coverage, however, like Stable Swamp Creek and Sheep Station Gully subcatchments, there are long reaches with limited riparian vegetation where land has been cleared or the creek channel has been modified. The lower reaches of Oxley Creek's main channel have less than 50% riparian vegetation cover. The Blunder Creek subcatchment has the most extensive and intact riparian vegetation cover. Although the extent of riparian vegetation cover is known, further data is required about its condition and quality across the catchment.

Small remnant areas of endangered vegetation communities remain in the vicinity of Oxley Creek Common, including vine forest and palustrine wetlands. These communities once fringed the Brisbane River and many of the middle reaches of the western tributaries of the Brisbane River. There are four other endangered riparian vegetation communities within the Oxley Creek catchment that support rare and threatened plant species such as *Gossia gonoclada*.

Widening the vegetated footprint of these riparian corridors, removing weed species and increasing the diversity of native species will support the health and resilience of the waterways.

*This assessment is based on both estuarine and freshwater areas within the one in five-year flood zone.

Current catchment condition: 56% riparian vegetation coverage (unknown quality).



Riparian cover of the middle and upper catchments is greater than 50%.

Riparian vegetation

Legend

- Lower and middle catchment
- 70-79% vegetation cover
- 60-69% vegetation cover
- 50-59% vegetation cover
- 40-49% vegetation cover

Sources:

Council 5yARI mapping layer.

Council Impervious surfaces mapping.

Riparian cover of the lower catchment and lower reaches of Oxley Creek's main channel is less than 50%.

Wildlife and habitat

Ecological corridors are vital for terrestrial wildlife movement and habitat. Connected vegetation provides wildlife with a range of routes to access water, food, habitat and breeding areas.

Roads generally pose the greatest safety threat to fauna moving along waterway and bushland corridors, while gaps in vegetation and fences around parks, sports fields, homes and businesses are also impediments to movement. Connecting existing vegetation corridors provides the best means to support wildlife movement. However, constructed outcomes such as rope bridges, culvert underpasses and land bridges are increasingly being used to overcome obstacles where natural solutions are not possible. Generally, well connected vegetation communities that are in good health, with fewer weeds and invasive species, can support greater populations of native terrestrial wildlife.

Status

The Oxley Creek corridor and its tributaries provide a range of habitat areas for terrestrial wildlife. Key locations include Oxley Creek Common, Warril Parkland, Glider Forest Reserve, Archerfield Wetlands, and the waterholes between Learoyd Road and the Logan Motorway. These parks, reserves and riparian edges also act as stepping stones for terrestrial wildlife to reach larger habitat areas beyond the catchment. The Stable Swamp Creek and Rocky Water Holes corridors provide routes east to Toohey Forest, one of Brisbane's largest urban forest areas. However, both creek systems are heavily fragmented with poor vegetation cover. Oxley and Blunder creeks, both identified as regional ecological corridors, provide connections south into the Flinders (Greenbank) Karawatha Corridor.

The area of the Oxley Creek corridor, extending south from the Ipswich Motorway at Oxley and connecting into the Flinders (Greenbank) Karawatha Corridor at Larapinta, is identified by Queensland Government as a Statewide Koala Priority Area. Remnant vegetation within this section of the Oxley Creek corridor has been mapped by the Queensland Government as koala habitat with opportunities for future koala habitat restoration.

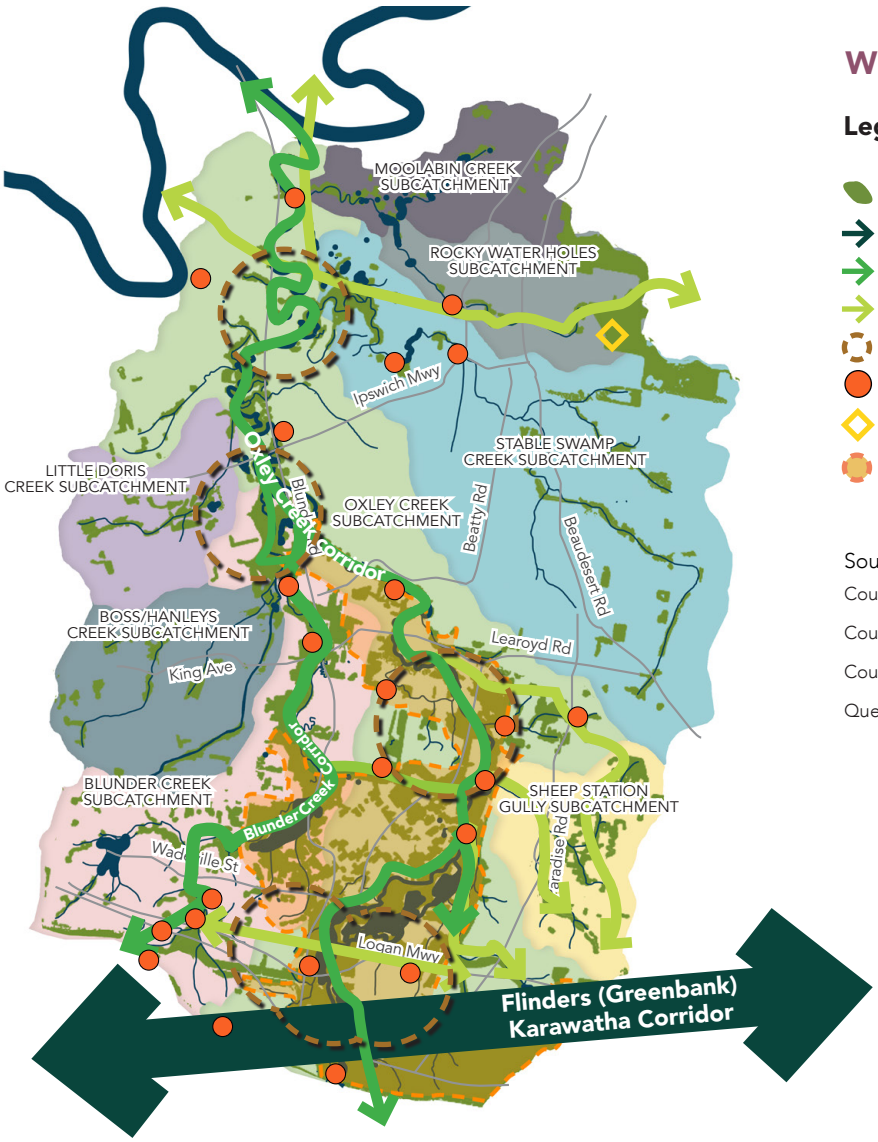
Glider Forest Reserve and Warril Parkland, situated in the southern-most section of the Brisbane LGA, host a number of glider species, including the squirrel, sugar and greater gliders. Local community organisations, such as Oxley Creek Catchment Association, have been proactively installing nesting boxes within these two locations to supplement a lack of natural refuges.

Several major barriers restrict terrestrial wildlife movement across the catchment's network of aquatic and terrestrial corridors. Paradise Road, Johnson Road, Gooderham Road, Learoyd Road, King Avenue and Bowhill Road are all wildlife strike hotspots, particularly for kangaroos, wallabies and koalas. These hotspots tend to be busy roads near bushland or creeks that form part of movement corridors.

Artificial wildlife-friendly crossing and passage solutions can be employed at wildlife and vehicle movement corridor hotspots to reduce conflicts. For example two rope bridges extend over Paradise Road, Larapinta, providing safer opportunities for fauna to cross between Glider Forest Reserve and Warril Parkland. Glider poles and a culvert passage have been provided near the intersection of Johnson and Stapylton roads, Heathwood, to provide a connection between the Heathwood bushlands and the Greenbank Military Reserve.

Council's continued monitoring of wildlife strikes will identify further locations where fauna crossings should be considered.

Current catchment condition: Natural habitat cover accounting for 8.7% of catchment. Several major barriers to terrestrial wildlife movement.



Wildlife and habitat

Legend

- Naturalhabitat cover 2019
- Ecological corridor - state
- Ecological corridor - regional
- Ecological corridor - local
- Key habitat areas
- Terrestrial widlife barriers/hotspots
- Toohey Forest
- Koala priority area

Sources:

Council wildlife movement solutions mapping.

Council ecological corridors mapping.

Council remnant vegetation mapping.

Queensland Government Koala plan mapping.

Water quality

Water quality is influenced by a range of factors within a catchment such as current and historical land use, levels of new development, urban runoff, droughts and floods. Sediment within waterways acts as both a source of and a reservoir for contaminants as well as influencing surface water appearance.

Measuring the physical, chemical and biological properties of water and sediment gives an indication of its suitability for drinking, recreation and ecological processes. Parameters that are commonly measured include temperature, acidity, water clarity (turbidity) and dissolved oxygen concentrations, as well as levels of bacteria, pesticides, herbicides, heavy metals and other contaminants. Each parameter reveals something different about the health of a waterway.

Status

Council monitors recreational waterways across Brisbane on a monthly basis to determine the risks to human health caused by microbial contamination. The Oxley Creek Transformation project has expanded monitoring activities within the lower catchment of Oxley Creek with the introduction of three additional monitoring sites.

Water quality within the highly urbanised lower catchment of Oxley Creek is generally poor. This is due to a combination of significant urban development within the catchment, the abundance of industrial land uses within the creek corridor, and a legacy of unregulated waste filling within areas of past sand mining operations.

In contrast, the water quality in the upper catchment is relatively good as the creek is less exposed to runoff from intense development and multiple land use types.

While there is an abundance of surface water quality data for the Oxley Creek catchment, data is typically restricted to the main channel and larger tributaries. Smaller tributaries, or those that are highly urbanised such as Little Doris Creek and Hanleys Creek, have little to no data.

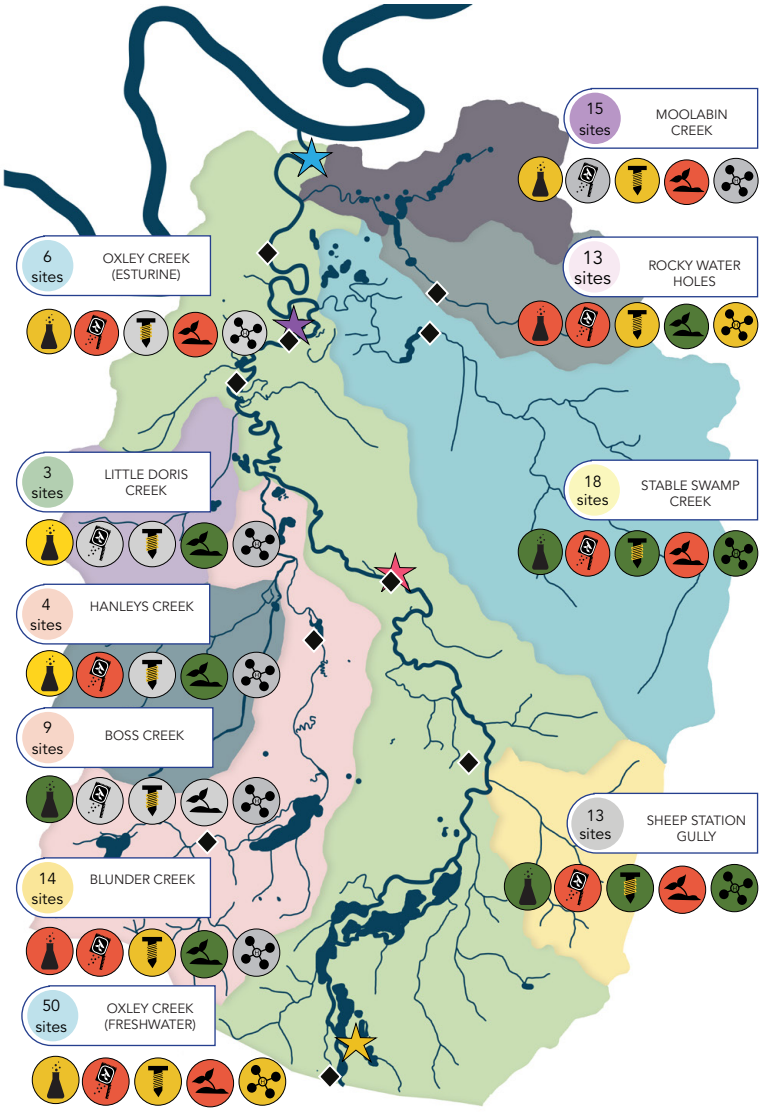
The available catchment water quality data has been compared to the guideline values in the following policy documents.

- *Queensland Government Environmental Protection (Water) Policy 2009* – Schedule 1 Oxley Creek Environmental Values and Water Quality Objectives, published July 2010.
- *Australian & New Zealand Guidelines for Fresh and Marine Water Quality 2018.*

This comparative assessment has identified the following catchment-wide issues:

- Low percentage saturation of dissolved oxygen which aquatic species require to survive, with subcatchments generally well below the water quality objectives, excluding Stable Swamp Creek and Boss Creek.
- High concentrations of nutrients with high concentrations of nitrogen, which can cause algal blooms. These algal blooms can negatively impact on aquatic species in a number of ways, including reducing the amount of available dissolved oxygen.
- Average turbidity that is mostly compliant with water quality objectives during non-flood times, with the exception of Boss Creek, Little Doris Creek and Oxley Creek's main channel. Turbidity is caused by suspended material, including sediment that prohibits sunlight penetrating the water, which can stunt aquatic plant growth.
- With the limited sediment quality data available, the following observations were noted:
  - Lead and zinc were recorded above sediment quality guidelines in the Moolabin, Oxley and Stable Swamp Creek subcatchments.
  - Nickel and mercury were identified as above sediment quality guidelines within the Oxley Creek subcatchment.
  - Nutrients were within normal ranges across all subcatchments.
- Total petroleum hydrocarbons have been recorded above sediment quality guidelines within the wetlands at Warril Parkland and Hanleys Creek, and below guidelines along Oxley Creek, Blunder Creek and Sheep Station Gully.
- At sediment sampling locations along Oxley Creek, including Warril Parkland, pesticide and herbicide results have been lower than laboratory limits of reporting.

Current catchment condition: Catchment-wide water quality issues identified, with data gaps limiting a comprehensive assessment to be able to benchmark against relevant water quality guidelines and objectives.



Samples may not be reflective of general waterway condition. Periods of high rainfall can skew sampling results by increasing stormwater runoff into local creeks, resulting in greater quantities of sediment and nutrients entering waterways.

Water quality

Legend

- Physico-chemical (e.g. pH, turbidity and electrical conductivity, dissolved oxygen).
- Nutrients (e.g. ammonia, total nitrogen and total phosphorous).
- Metals and metalloids (e.g. chromium, copper, lead, zinc).
- Biological (e.g. Enterocci and E.coli).
- Hydrocarbons
- 13 sites — Number of sites analysed for water quality data.
- EHMP monitoring sites.

Health risks

- Low: parameters are lower than or within WQOs at all sites, or exceed WQOs at less than 20% of sites.
- Moderate: Up to 50% of parameters exceed WQOs at multiple sites.
- High: Majority of parameters exceed WQOs at multiple sites.
- Not enough data available.

Recreational water monitoring sites:

- Tennyson pontoon
- Cliveden Avenue
- Beatty Road
- Warril Parkland

Sources:

Council Monitoring Data (SAS Labs).

SEQ Catchment maps - ArcGIS - EHMP monitoring site.

Hydrology

Flowing water within waterways is a key attribute of a healthy waterway. It allows aquatic species to move freely between habitats, reinvigorates and oxygenates water, tops up underground water aquifers and reduces algal and weed growth. Some fish species even require specific flows to trigger reproductive cycles. Instream gauges are used to measure the speed and volume of water flows to assess waterway health.

As a result of population growth and development, many waterways, primarily within more urban areas, have been straightened and piped underground or modified into concrete-lined channels to control flooding. The broader consequences of these changes include negative downstream impacts to water quality, channel stability, underground aquifers and flooding. Modifying channels not only alters the hydrology of waterway systems, but also prevents movement of aquatic species, including native fish that must migrate to breed. Some fish move between fresh and salt water to feed and breed, making access from local waterways to the Brisbane River vital.

Status

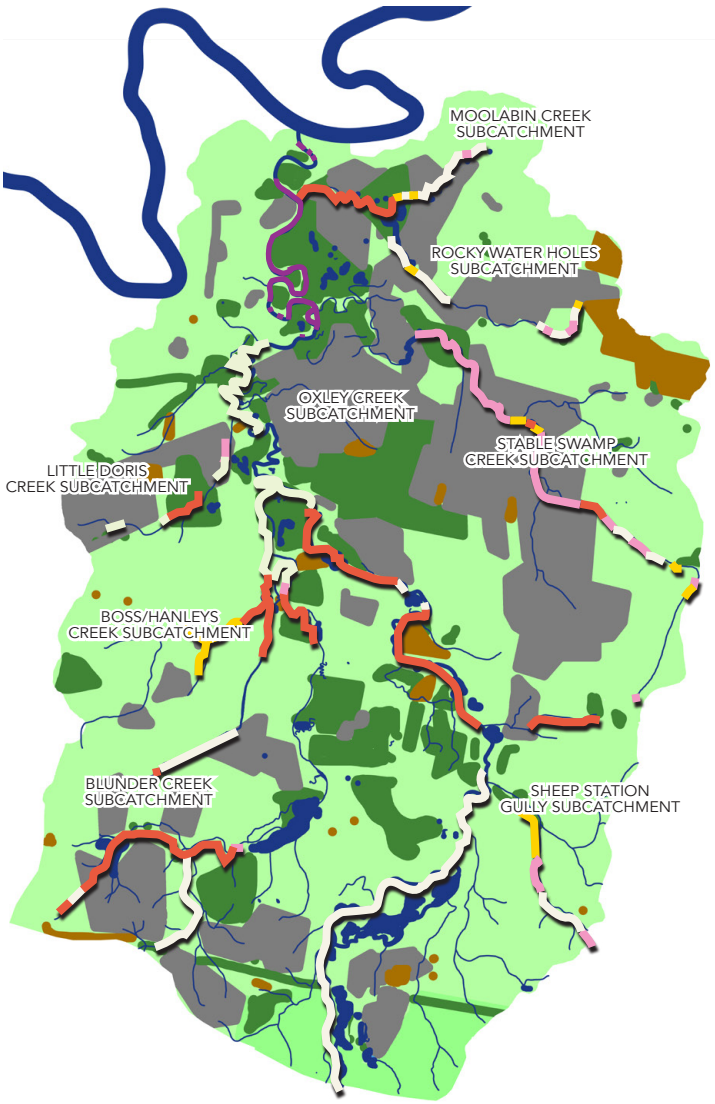
Oxley Creek and its tributaries are made up of both modified and natural waterway segments. More than three kilometres of waterways in the Brisbane LGA are concrete-lined with more than 50% of these lined channels located within the Boss/Hanleys Creek and Sheep Station Gully subcatchments. Naturalising concrete-lined waterways would improve the hydrological behaviour of these tributaries, and in turn, that of Oxley Creek.

Impervious surfaces, such as concrete, prevent rainwater soaking into the natural ground, increasing the volume and velocity of surface runoff entering the waterway and altering the catchment's natural hydrology. These surfaces also prevent groundwater from infiltrating and saturating the soil profile and recharging aquifers. In general, the more impervious areas there are within a catchment, the worse its ecological health. High levels of imperviousness are usually accompanied by poor water quality, weed growth, channel erosion and reduced wildlife presence. Impervious surfaces account for approximately 33% of the middle and lower Oxley Creek catchment areas.

Past and current land use activities, such as vegetation clearing, landfill, channelisation and urbanisation, also impact on the creek function. Cleared riparian vegetation, reduced wetland and groundwater absorption areas as well as constrained natural floodplain corridors, can result in more frequent and intense flooding. This is as a result of increased water volumes and velocities, generated by runoff from impervious urban surfaces, entering a modified waterway corridor with limited natural elements to slow and absorb the water. Furthermore, increased water volumes and velocities also result in increased levels of nutrients, debris and sediment loads within the waterway. The lower catchment is more prone to flooding during high rainfall events, which is often amplified due to the tidal nature of the waterway.

Stream height gauges measure the height of flow and rainfall, typically to assess human safety relating to flooding, whereas streamflow gauges measure the low flows (also called environmental flows). Streamflow gauges are an important tool to measure parameters that are critical for the presence of aquatic species such as flow velocity, flow peaks and duration of flow. While there are eleven stream height gauges located along waterways within the catchment, there is only one streamflow gauge along Oxley Creek, located in New Beith in Logan. Base and low flows are therefore currently not monitored in any waterway within the lower or middle catchment areas.

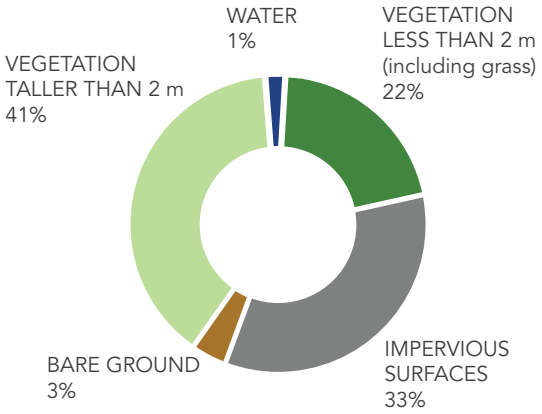
Current catchment condition: Impervious surfaces account for approximately 33% of the middle and lower Oxley Creek Catchment. One streamflow gauge within catchment providing limited environmental flow data.



Channel types and surfaces

Legend

- Natural channel
- Modified channel - unlined/partly unlined
- Modified channel - fully lined
- Unclassified
- Bare ground
- Impervious surfaces
- Shrub or other vegetation shorter than 2 m including grass
- Vegetation taller than 2 m
- Water
- Mangrove cover



Sources:

ArcGis Lower Brisbane Catchment Story, Mangrove Forest mapping layer, 2020.

Council Impervious surfaces mapping.

Council Waterway Asset Condition Assessments.

Erosion and sediment

Some sediment is important to a healthy creek. Creeks naturally erode as the bed and banks continually adjust to different water flows over time. However, vegetation clearing and urbanisation can greatly increase sediment loads entering the waterway above natural levels.

Large volumes of sediment limits aquatic plant growth, prevents fish from breathing effectively and negatively impacts on habitat and food sources for fish and other wildlife. Nutrients, heavy metals and other contaminants attach to sediment particles and can be transported along the waterway, contributing to poor surface and groundwater quality. Sediment that normally settles on creek beds can be resuspended during rain and flood events, increasing the sediment load and, in turn, increasing pollution levels within the waterways.

Status

Local soil types and modifications to creek channels make the Oxley Creek catchment susceptible to erosion. Much of the soil within the elevated areas of the catchment is dispersive, which is highly vulnerable to erosion, particularly during heavy rainfall events. More than 90% of the sediment load in Oxley Creek is sourced from channel erosion.

Natural waterway channels across the catchment have also been modified through channel deepening and widening works associated with historic sand mining, resulting in bank erosion and instability. Vegetation clearance has also undermined the stability of channel banks and led to increased sediment in creeks via runoff-generated erosion. Ongoing urban development has the potential to further alter flows into the creek and exacerbate waterway instability.

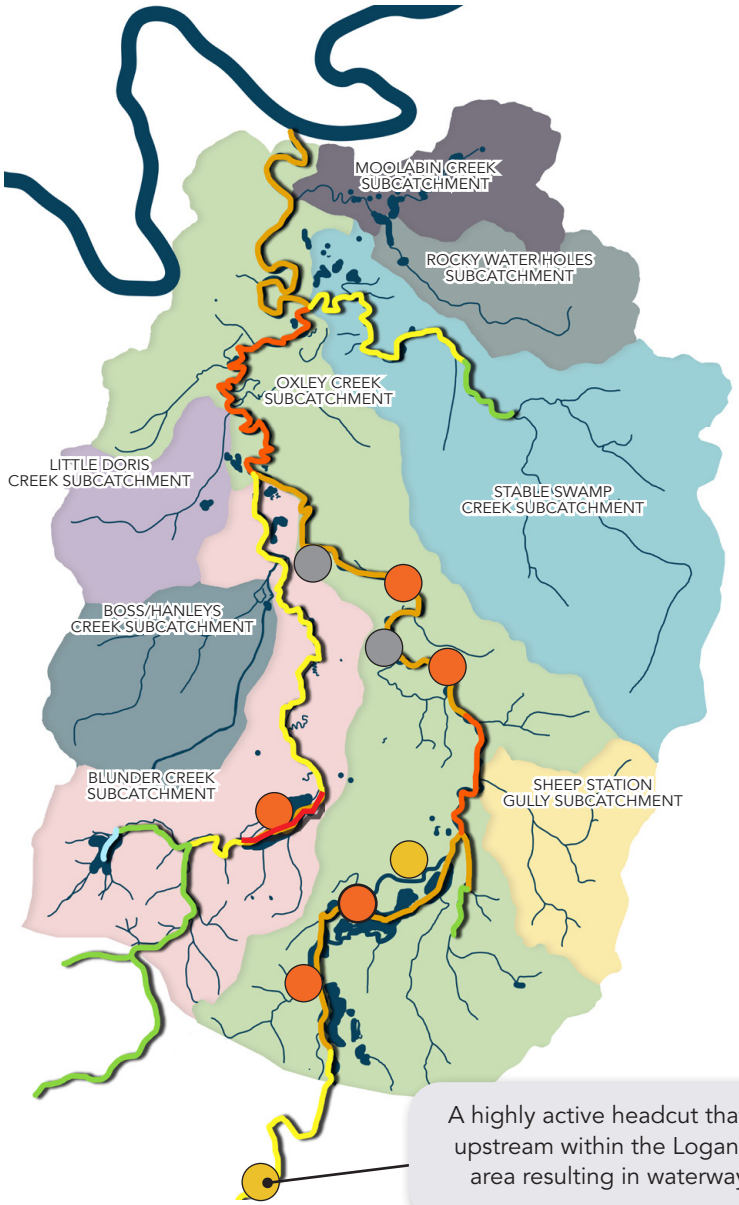
A headcut is channel erosion within a waterway that migrates upstream from a point of disturbance. Headcut erosion increases waterway width, lowers the channel bed depth, steepens the banks and disconnects the waterway from the floodplain. Headcut migration is typically triggered by flood events. Where a waterway corridor space is limited, headcuts can undermine built infrastructure such as roads and bridges that are located adjacent to the waterway. In less urbanised, more sand-based creeks, this type of erosion is a natural process and, over time, vegetation will re-establish and the waterway will eventually stabilise.

There are two active headcuts within the Oxley Creek corridor, one located upstream of Johnson Road, Larapinta, and the other near Brookbent Road, Pallara. These areas are identified as stretches with characteristics that are highly prone and vulnerable to erosion, which could be caused by catalysts such as flash flooding or loss of vegetation.

The sediment generated by the Oxley Creek catchment eventually washes into Moreton Bay, negatively impacting sea grasses and coral, which many aquatic species rely on either as a primary source of food or as a part of the food chain.

Further information is required across the catchment on erosion sources and the extent to which this occurs in order to identify areas at greatest risk of further expansion.

Current catchment condition: Multiple sites of extreme erosion along Oxley Creek, with two active headcuts located upstream of Johnson Road, Larapinta and near Brookbent Road, Pallara.



A highly active headcut that is migrating upstream within the Logan City Council area resulting in waterway instability.

Erosion and sediment

Legend

- Floodplain disturbance areas
- Unstable banks from sand extraction
- Active headcut locations
- Dam
- Low channel erosion risk
- Moderate channel erosion risk
- High channel erosion risk
- Very high channel erosion risk

Sources:

SEQ Catchments ARCgis maps - Erosion - channel erosion risk mapping layer.

Groundwater availability

Groundwater is the water that collects below ground in the spaces in between soil, sand and rock. Geological formations able to collect groundwater are known as aquifers. There are various types of geological formations that generate aquifers, such as water-bearing porous rock, rock fissures or unconsolidated materials, such as sand and gravel. Aquifers are also able to transmit groundwater long distances through their networks of porous geological material. Water moves at different speeds through aquifers depending on their composition. They are replenished through the process of rainwater seeping through permeable surface soils into the aquifer.

Groundwater plays an important role in the hydrological functioning of waterways. Where groundwater aquifers connect with creeks, waterholes and wetlands, they provide continuous water flow into the waterway network, which is important during dry periods. During wetter periods, water percolates through the surface layers of soil collecting in the aquifers, reducing surface water velocities and flooding. Groundwater is vital for the survival of aquatic ecosystems and provides essential habitat for numerous terrestrial flora and fauna, as well as unique subterranean species.

Status

Oxley Creek's lower and middle catchment areas host 47 permanent waterholes, with most located along Blunder and Oxley Creeks. Two permanent waterholes located in Blunder Creek and Oxley Creek are currently monitored and provide an indication of groundwater flows. Aquatic plants present in both waterholes indicate they retain water all year round. Sediments around the edge of the Blunder Creek waterhole suggests it is directly topped up by groundwater flows, while the Oxley Creek waterhole is fed by a small wetland upstream.

Groundwater dependent ecosystems (GDEs) are ecosystems that rely on groundwater for some or all of their water requirements. Because GDEs are connected to the groundwater table during both wet and dry periods, they provide important habitat for flora and fauna that rely on groundwater for survival. GDEs also provide ecological corridor networks and assist in mitigating floods, reducing soil erosion, reducing sediment and nutrient loss, and helping to absorb nutrients and pollutants. Many of the wetlands, aquifers, creek corridors and terrestrial vegetation communities within the Oxley Creek catchment are mapped as GDEs.

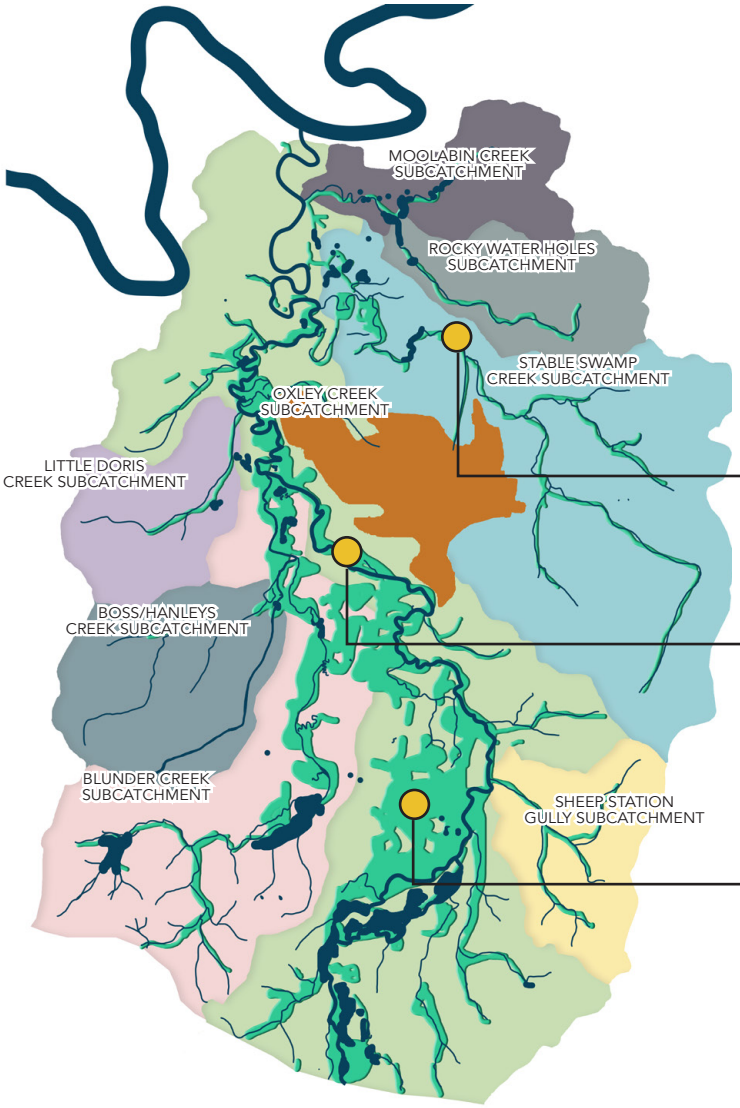
There are three main aquifer systems that lie beneath the Oxley Creek catchment area. These aquifers occur at different depths, with the deepest aquifer being a relatively permanent source of water that has historically been investigated as a supplementary water supply for Brisbane during dry times.

Past and present land uses within the catchment have contributed to the degradation of groundwater quality. Pollutants and contaminants from industrial and residential urban development, or leaching contaminants from landfill sites, can readily sink through the permeable surfaces into the groundwater system and contaminate the water supply. Remediating areas of contaminated land along waterway corridors may also assist in preventing contaminants leaching into the groundwater system.

Limited data is available on the quality and flow of groundwater within the Oxley Creek catchment, however, frequent groundwater monitoring is undertaken at the closed landfill site at Willawong. Limited sampling has also been undertaken at Rocky Water Holes and within the Oxley Creek subcatchment.

Areas of fractured sedimentary rock and alluvium, as well as actual aquifer recharge areas, provide for groundwater recharge within the catchment. In order to protect and maintain healthy groundwater function and the ecosystems that depend on them, these recharge areas require permeable surfaces to be able to absorb surface water into the ground. Wetlands, creeks, waterholes and the floodplains that surround them therefore require the highest level of protection from development, to protect the quantity of water entering and recharging these systems. The primary aquifer recharge area within the Oxley Creek catchment is located in the suburb of Archerfield and includes the Archerfield Airport site.

Current catchment condition: Limited understanding of groundwater function across the catchment. Approximately 67% of catchment has permeable surfacing with approximately 1052 ha of the catchment comprising wetlands to allow recharge of groundwater systems.



Groundwater System

Legend

- Existing groundwater monitoring areas
- Groundwater dependent ecosystems (GDEs)
- Aquifer recharge area

Groundwater rated generally good but high concentrations of nutrients, nickel and zinc.

High concentrations of nutrients and metals, presence of petroleum hydrocarbons.

High concentrations of nutrients, occasional presence of petroleum hydrocarbons but other parameters at low levels compared to surface water quality guidelines.

Sources:

Brisbane Lower Catchment story - aquifer recharge area.

Queensland Government wetlands map - ground dependent ecosystems.

Aquatic life and habitat

Waterways, wetlands and other permanent waterbodies provide essential habitat for aquatic life. Waterbodies that retain water for extended dry periods are particularly valuable ecological assets, enabling aquatic species to survive drought and return to the waterway once flows return. Healthier, more diverse aquatic communities are typically found in locations that have a range of terrestrial and instream habitat features, such as a natural riparian zone, waterway shade, instream aquatic plants, submerged and creek bank woody debris and leaf litter. Connectivity along the waterway is also important, allowing movement of aquatic species to source food, breed and expand communities. Common barriers to aquatic species movement include dams, steep drops and concrete-lined channels.

Status

Council currently undertakes annual monitoring at Oxley Creek to identify changes in aquatic habitat and fish species abundance. Aquatic habitat is assessed against five indicators – bank stability, channel substrate, vegetation cover, scouring and deposition. The aquatic habitat within Oxley Creek is currently rated as moderate. However, existing data is insufficient to extrapolate across the full catchment as monitoring mostly occurs in Oxley Creek and the major tributaries, rather than smaller waterways.

Native fish species recorded across lower and middle catchment areas include western carp, firetail, empire, dwarf flathead, flathead gudgeon, eel-tailed catfish, bullrout, bony bream, rainbow fish, longfinned and shortfinned eels, hardyhead, Australian smelt, and glass fish. Diversity of fish species is highest in the two main channels, Oxley Creek and Blunder Creek, while other tributaries are less diverse. There are significant differences in the fish communities found across the monitoring sites, with many fish species only found in one or two subcatchments. Few species have been found across the entire lower and middle catchment, which is likely due to the catchment's large size and highly variable condition of each subcatchment. However, this also suggests that fish barriers within creeks are preventing aquatic movement within subcatchments and to the Oxley Creek main channel. Waterways fragmented by concrete-lined channels are particularly vulnerable to upstream species decline as increased velocities within the concrete sections are often too strong for aquatic species to swim upstream.

Council monitors the presence of targeted species, such as platypus, using environmental DNA techniques. To date, platypus have not been recorded at the sample sites, however, there is anecdotal evidence that suggests they inhabit locations within the upper catchment. Freshwater turtles are known to occur throughout the catchment, but the species present, and their distribution, is unknown.

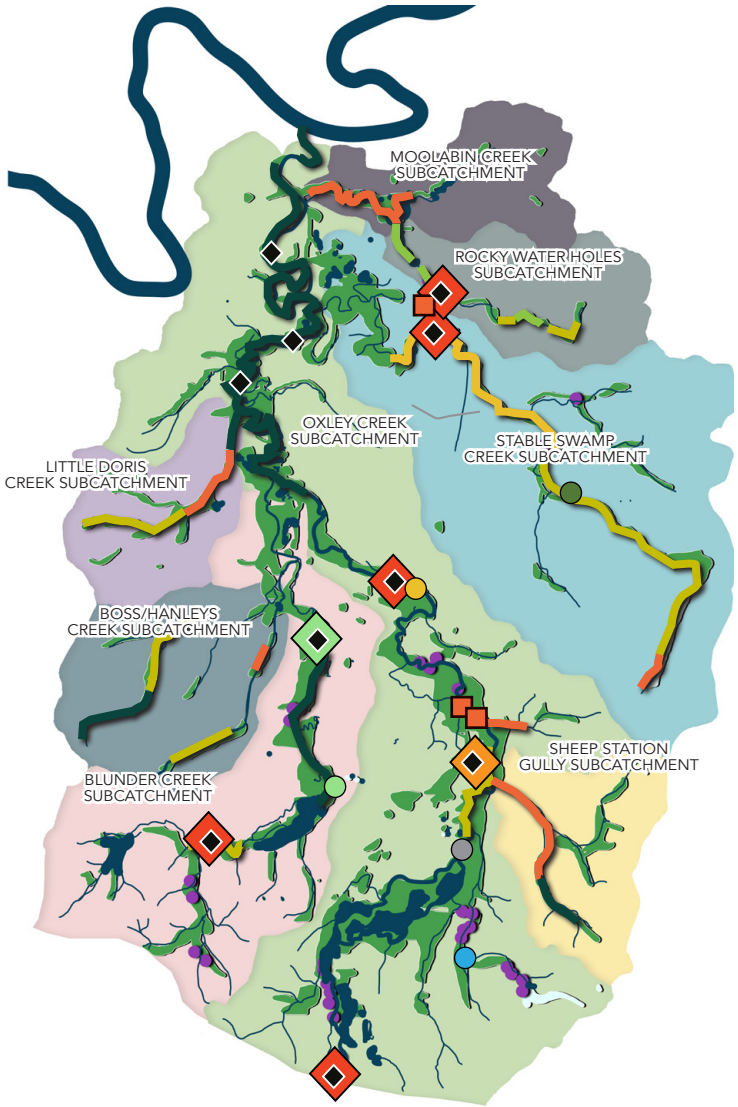
Declared pest species including eastern gambusia, swordtails, platys, tilapia and European carp are abundant across the lower catchment as they tend to thrive in highly disturbed waterways.

Aquatic macroinvertebrates are small animals that live for all, or a part of their lives, in water. The types and presence of macroinvertebrates in waterways are good indicators of waterway health. The macroinvertebrate index is rated mostly poor within the lower catchment, with the exception of the Blunder Creek monitoring site at King Avenue, Durack, which received a rating of 'excellent' in 2020.

More than 100 potential fish barriers have been identified within Oxley Creek's middle and lower catchment areas, indicating that the catchment's waterways are fragmented and restrict the ability for aquatic species to travel up and down the channel during stages of their life cycle. Three barriers identified within the middle and lower catchment are considered to be major impediments to movement during all creek flow conditions. One of these barriers is located in Rocky Water Holes near the intersection of Sherwood and Fairfield roads, Rocklea. The other two are located along Sheep Station Gully near Paradise Road. A study undertaken to identify the top 50 fish barriers across greater Brisbane identified another barrier located within the Oxley Creek catchment at Archerfield Wetlands. Further field assessment will be required before priority can be assigned to fish barrier remediation works.

Council rates the connectivity condition of local waterways by assessing the suitability of instream habitat and existing fish barrier mapping. The rating system uses a scoring system of 1 (excellent) to 5 (very poor). Waterway connectivity varies along watercourses within each Oxley Creek subcatchment. In the most recent assessment undertaken in 2017, Blunder Creek rated best overall at 1.3, while Stable Swamp Creek rated the poorest at 3.6. On average the whole catchment was rated at 2.9.

Current catchment condition: Instream habitat rated as moderate, with limited monitoring and data available across the catchment. Waterway connectivity rated as average, with multiple known major barriers to wildlife and fish movement.



Aquatic life and habitat

Legend

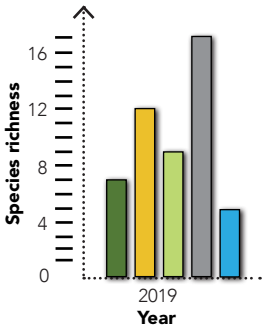
- Excellent waterway connectivity
- Good waterway connectivity
- Average waterway connectivity
- Poor waterway connectivity
- Very poor waterway connectivity
- Major fish barriers
- Wetlands
- Permanent waterholes
- Ecosystem Health Monitoring Program (EHMP) monitoring sites

2020 Macroinvertabrate Index (EHMP freshwater sites)

- Excellent
- Fair
- Very poor

Council's annual monitoring sites

OX01 OXN2 OXN4
OXN1 OXN3



Sources:

Council wetlands 2013 mapping.

Waterway Asset Management Plan - Connectivity Rating.

Council Waterhole Database.

Local Waterway Health Assessment Program Fish Barrier Assessment.

SEQ Catchment maps - ArcGIS - EHMP monitoring sites.

SEQ Catchment maps - ArcGIS - 2020 Macroinvertabrates.

State of the catchment summary

Catchments are complex systems which have a number of elements that rely on and influence one another. Changes to one part of the catchment can have multiple impacts on the condition and functioning of the catchment system in other areas.

The condition of the Oxley Creek catchment within the Brisbane LGA varies across its subcatchments. Some of the condition ratings are based on limited data and may change as more data is acquired.

A summary of the state of the catchment is described below and illustrated on the adjacent map.

- Limited data available as to the value the community places on the waterways, however where data was available, research showed that 5.2% of survey participants had visited Oxley Creek, with 75% of participants visiting Oxley Creek less than once a month.
- Forty-three active community restoration sites have been developed within the catchment with fourteen community based groups working on restoring these sites.
- Access to and along Oxley Creek and its tributaries for recreation is limited.

- Urban forest covers approximately 41% of the catchment within the Brisbane LGA, with most of the cover located within the Oxley Creek subcatchment, primarily within the middle catchment where there are larger areas of intact bushland.
- Natural habitat comprises about 8.7% of the total urban forest and is preserved primarily along the corridors of Oxley Creek and its tributaries.

- Average riparian coverage across the Oxley Creek catchment within the Brisbane LGA is 56% and is for the most part fractured and disconnected. The quality of this vegetation is unknown.
- Blunder Creek subcatchment comprises the most extensive and intact riparian vegetation.
- Small remnant areas of endangered vegetation communities remain around the Oxley Creek Common.

- Paradise Road, Gooderham Road, Learoyd Road, King Avenue and Bowhill Road are wildlife strike hotspots and can form major barriers to wildlife movement.

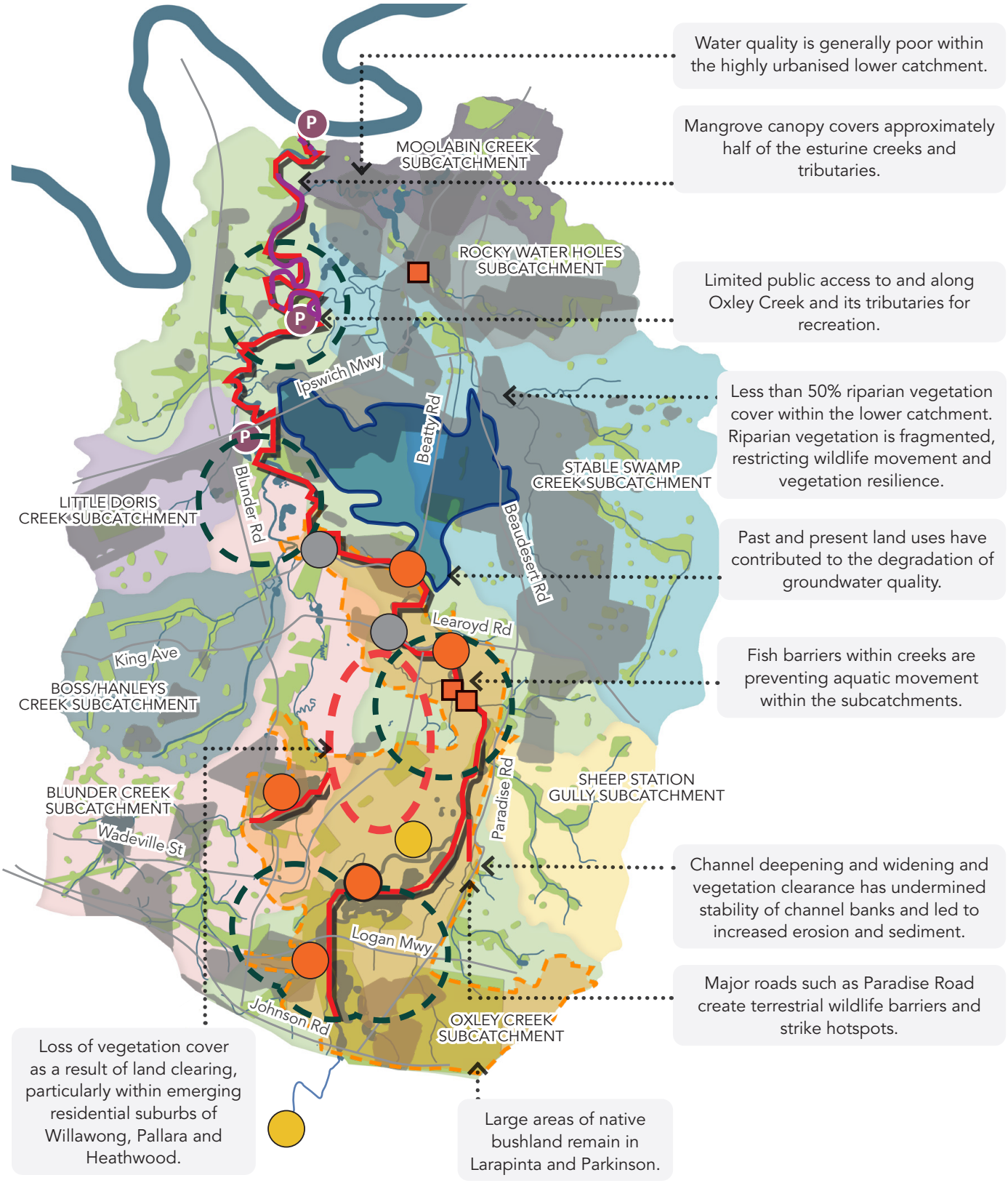
- Limited availble water quality data exists to be able to provide an overall benchmark against relevant water quality parameters, however water quality within the highly urbanised lower catchment is generally poor.
- Adjoining land uses, generally and during floods, contribute to poor water quality.

- Impervious surfaces account for approximately 33% of the middle and lower Oxley Creek catchment.
- Limited environmental flow data is available.

- Three kilometres of waterways are concrete-lined with more than 50% of these lined channels located within Boss and Hanleys Creeks and Sheep Station Gully.
- More than 90% of the sediment load in Oxley Creek is sourced from channel erosion.
- There are two active headcuts within the Oxley Creek corridor, located upstream of Johnson Road in the upper catchment and near Brookbent Road in the middle catchment.

- There is limited understanding of groundwater function across the catchment.
- Approximately 1052 hectares of the Brisbane LGA Oxley Creek catchment comprises wetlands.

- Aquatic habitat is rated as moderate within the Oxley Creek subcatchment. Limited available data exists for other subcatchments.
- Diversity of fish is highest in Oxley Creek and Blunder Creek.
- The macro invertebrate index is rated mostly poor within the lower catchment.
- Waterway connectivity is rated as average with more than 100 potential fish barriers identified within the middle and lower Oxley Creek catchments. Three of the barriers are considered to be major impediments to aquatic species movement.



Legend

- Council public parks and reserves
- Existing Council pontoons and boat ramps
- Key wildlife habitat areas
- Koala priority area
- High to very high channel erosion risk
- Floodplain disturbance areas
- Unstable banks from sand extraction
- Active headcut locations
- Impervious areas
- Groundwater recharge area
- Major fish barriers

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