Coomera River Catchment
Study Guide
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What is a catchment?

A catchment is an area of land that collects water because of gravity and the natural lay of the landscape. Rain and run-off water within a catchment will eventually flow to the lowest point through creeks, rivers and storm water systems. This could be a river, creek, lake, dam, or the sea. A catchment also includes groundwater, storm water, wastewater, and water-related infrastructure as well as rivers, creeks, lakes and dams. Natural and human systems like rivers, bush land, farms, dams, homes, plants, animals and people can co-exist in a catchment.

Healthy catchments provide:
- a source of clean drinking water
- areas for recreational opportunities
- habitat for plants and animals
- water for stock and irrigation
- industry and agribusiness opportunities.

The challenge of catchment management is to cater for many uses while ensuring the waterway and surrounding land can sustain good water quality to support a diversity of plants and animals.
Gold Coast catchments

The population for the Gold Coast is 510,000. By 2011 this number is expected to grow to between 552,000 and 557,000, and within 50 years the current population is expected to double. This population lives within five main catchment areas.

- Pimpama River catchment
- Coomera River catchment
- Broadwater Creeks catchment
- Nerang River catchment
- Tallebudgera and Currumbin Creeks catchment

These main catchment areas contain many smaller sub-catchments that have creeks at their centres. These smaller sub-catchments include waterways such as Loders Creek and Mudgeeraba Creek.

The main catchment areas are influenced by the same broad land uses but the pressures on each area are slightly different. Some catchments contain large areas of agricultural land, while others are influenced more by the pressures of urbanisation.

All of the Gold Coast catchments will be affected by population growth in the region. The Gold Coast City Council is planning development with care to ensure the natural beauty of the coast is maintained and enhanced. Management of Gold Coast waterways, however, will require all community members to ensure their actions have minimal impacts on waterway health.


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2 Make your water mark! - Watersaver education program; Middle and secondary school kit; Gold Coast City Council; 2008
The Coomera River catchment

The Coomera River catchment is on the northern end of the Gold Coast. It is bordered by the Pimpama catchment to the north, South Stradbroke catchment to the east and the Nerang catchment to the south.

The catchment has a total area of 489km² and a stream network length of 928km. The upper reaches of the river begin on the Lamington plateau in Lamington National Park. This area is relatively undisturbed and provides a perfect environment for the start of this waterway. The mid-reaches flow through rural areas in the valley between the Beechmont and Darlington Ranges, to Upper Coomera. At this stage the river is small and the tributaries consist of shallow water with occasional deep pools. In the lower catchment, the river spreads wide as it flows along the floodplains of Coomera, Oxenford, Helensvale and Coombabah. The river flows into southern Moreton Bay at Paradise Point.

The Coomera River catchment area is approximately 50km south of Brisbane and 20km north of Surfers Paradise on the Pacific Highway. The M1 Motorway and train link between Brisbane and the Gold Coast have made the region an increasingly popular place to live. As a result there has been considerable urban development in the area in the past 10 years. This development has placed pressure on the natural environment. These trends mean the area of the Coomera catchment is set to be the next major growth corridor on the Gold Coast.

The catchment lies within two local government area boundaries; Gold Coast City Council and the Scenic Rim Council. These two councils have been working together to ensure the health of the catchment is maintained and improved.

Figure 1.0 – General overview of a catchment area

Nine named tributaries feed directly into the Coomera River:
- Coombabah Creek
- Saltwater Creek
- Yaun Creek
- Brygon Creek
- Baker Creek
- Oaky Creek
- Wongawallan Creek
- Guanaba Creek
- Clagiraba Creek

Land use within the catchment is diverse and is divided into:
- native bush - 48.9 per cent
- grazing land - 22.4 per cent
- urban land - 11.6 per cent
- extractive industries, light industry and a Land Warfare Centre Training Area used by the Australian military, accounts for the remaining 17.1 per cent.
Looking at Coomera catchment – cross sections

The Coomera River and associated tributaries flow from Lamington National Park into the ocean at Paradise Point. Throughout this journey the waterway passes through a number of different environments.

**Upper Catchment – relatively undisturbed**

![Fig. 1.1 Upper catchment of Coomera River](image)

The very upper catchment of Coomera River is characterised by well wooded banks and good in-stream cover and structure. The water quality is very good in this region as it is within the protection of Lamington National Park.

**Upper catchment – cleared for grazing and acreage living**

![Figure 1.2 Downstream of Upper catchment](image)

Downstream from Lamington National Park is the township of Beechmont. Here land has been cleared for dairy farming and rural living. Soil surface is generally covered with exotic grasses. Some riparian vegetation remains however clearing of the banks may have led to erosion and invasion of weed species. Water quality may be influenced by excess nutrient levels or stock accessing the water.
Lower freshwater – cleared for urban development

![Diagram of a river with urban development in the background](image_url)

**Fig. 1.3 Lower freshwater reaches of Coomera River**

Urban development has been extensive in the lower freshwater reach of the Coomera River. Clearing of riparian zones has led to sediment and nutrients entering the waterway. Much of the remaining bank vegetation is non-native species. Stormwater has an increasing impact on the water quality, contributing a range of inputs that affect waterway health.

Salt fresh mixing zone – extent of the tidal influence

![Diagram of tidal mixing zones](image_url)

**Fig. 1.4 Small rock barrage**

The intrusion of salt water into Coomera River is limited by a small rock barrage located at the end of Old Tamborine Road at Oxenford. This barrage, along with causeways upstream may prevent the movement of fish and other aquatic species.
Upper estuary – increasing urbanisation and canal estates

Fig. 1.5 Lower reaches of the Coomera River catchment

The estuarine reaches of the Coomera River and associated tributaries (for example: Coombabah Creek) have been extensively modified. The introduction of canal estates has led to massive loss of bank and riparian vegetation. Significant modifications have occurred to the waterways structure. The impact of stormwater and other overland flows is increasing, with greater areas of hard paved materials and other drainage modifications. The water quality is reduced by the impacts of road, household and light industrial land-use.
At the mouth of the Coomera River (particularly the south branch) many modifications have occurred. Rock training and retaining walls have been added to the banks to eliminate erosion from tidal and boat movements. Impacts on the water quality arise from a range of sources including recreational uses, visual amenity, dredging, stormwater, urban development, stream modification and tidal flow. Stream-side vegetation is protected on Coomera Island and further upstream by Coombabah Lakelands.
History

The waterway was originally named the River Arrowsmith by Robert Dixon, a government surveyor. However, Thomas Mitchell, the Surveyor General, overruled this replacing it with an Aboriginal name. There are two theories as to where the name Coomera originated. Some believe that Coomera came from Kumera Kumera, an aboriginal word for a native species of wattle. Others believe that Kumera referred to blood or vein and that this meant the flowing river which provides life for the surrounding catchment area.

By 1865 the Coomera River was an important waterway for timber-getters working in the Hinterland. The timber-getters were after the prized cedar wood. The wood was tied into rafts and floated down the rivers to meet the ocean going sailing ships.

The first settlements occurred in Upper Coomera and these settlers were primarily farmers and timber-getters. A ferry service was established downstream and this became known as Ferry Township or Lower Coomera, to distinguish from the original settlement site at Upper Coomera. The first Coomera Bridge was opened in 1930 and until this point the main link for the coast road had been the ferry. Lower Coomera was located on the South Coast Rail line which helped to establish a permanent township at this site.

Early families grew small crops such as melons and potatoes. There was a cream dairy at Lower Coomera and cattle were grazed along the river and on Coomera Island. Crabbing and fishing were a popular pastime and also an occupation for many who lived along the Coomera River. The crabs and fish were transported by boat and sold to the Queensland Fish Board in the Broadwater.

The lower catchment was heavily modified in the mid 80’s when Sanctuary Cove was developed. Since this time there have been a number of canal based residential developments which have modified water flows.

The southern end of the catchment encompasses the suburbs of Helensvale, Gaven, Pacific Pines and Coombabah. Helensvale was the first of the Gold Coast’s master planned suburbs and was developed in the 1980’s. Prior to this time the area was bushland. Helensvale borders Coombabah Lake to the east and is characterised by parkland throughout.

Coombabah is a quiet suburb that borders the Coomera River and the tidal wetlands of Coombabah Lakelands. Fishing and boating were the main attractions of Coombabah in the past, with many people setting up fibro fishing shacks in the area 40 to 50 years ago. Fishing and boating continues to be a popular pastime for locals in the area. Coombabah Creek, Saltwater Creek and Coombabah Lake have areas of protected fish habitat and are recognised as some of the most important fish nursery areas of South East Queensland.

Pacific Pines, originally an estate of Gaven, is now the largest master planned suburb on the Gold Coast. It was developed in 1993 and currently has a population of 10,000 residents. Pacific Pines has over 68 hectares of open space and parklands - making it a very attractive place for families to live.

Historical and Pre-Historic use of the Coomera River

The name ‘coomera’ is clearly an Aboriginal name. However, its native meaning is debated by linguists. Some say it's the name of a fern, a wattle and even blood. A case can be made for the so-called white mulberry, a local shrub found in the upper reaches of the streams in the Coomera Valley. Its Aboriginal name is ‘kumuru-kumuru’, also recorded in the late 1880’s as ‘coomeroo-coomeroo’ by the early botanist, J.H. Maiden. Evidence remains even today that the local Aboriginal people, the Kombumerri, used the Coomera River for thousands of years. It was widely used also by early settlers and even more so by today’s Gold Coast population.

One of the earliest recorded uses of the river by non-Aboriginal people occurred in the 1850’s (as far as is known) by an Englishman by the name of the Rev. Henry Stobart. In an extant letter, he speaks of the natives growing fat on the fruit of what he called the “Coomera Tree”. Its name is unknown apart from this reference but there is speculation that a species of Macadamia is likely, given its very high fat content and seasonal availability in large numbers.

European settlers were quick to recognise the farming potential of the rich alluvial plains of the river. The riverine scrubs were soon cleared and crops such as sugar cane and even arrowroot were planted. Dairying also became one of the major activities along the Coomera River.

Navigable rivers were treated very much like highways by the native peoples who used bark canoes to travel around, particularly where certain conditions such as large mangrove forests, swamps and deepwater crossings made travel by land fraught with difficulty. Early records point to the natives leaving canoes in strategic places for later use by either themselves, other tribal members and family friends.

As with most rivers near the coast, the Coomera River’s estuarine (saltwater) stretches were abundant with all manner of fish, crustacean and shellfish life. Evidence of native use of these resources can still be seen today in the estuarine middens on the river’s banks. Middens are essentially mounds of discarded shellfish, fish and animal bone, and even misplaced stone artefacts. The estuarine mangroves were a source of much of these marine resources, especially shellfish and crustaceans such as crabs.

The riparian areas of the Coomera River and its tributaries in pre-European times were bordered by suburbs that contained abundant wildlife such as wallabies, bandicoots, possums, carpet snakes, goannas and birds. These animals were certainly exploited by the natives. Excavated hinterland campsites have revealed bones that have been identified as most of those (and others) mentioned above. These sites were usually located close to the river and its tributaries for easy access to fresh water.

Additionally, these suburbs contained a wide range of flora that provided the Aborigines with food (fruits, nuts, roots and tubers), as well as material for camp utensils (dilly bags, coolamons, digging sticks) and weapons such as spears, nulas and boomerangs. Growing close to the freshwater streams were a range of trees, including shrubs and vines that could be used as fish poisons. All of these mentioned above, together with medicinal plants were available in the Coomera suburbs. Even the flowering of some riparian plant species was helpful to the natives by signalling the best time to hunt certain animals, including freshwater tortoises, eels and fish. All plants, used for whatever reason by the Kombumerri, are known today as ‘economic plant species’.

Evidence of stone (lithic) scatters from tool-making activity at campsites also points to the presence of the local natives around the Coomera River. Much of the material for stone implements was sourced from Wongawallan where outcrops of stone suitable for artefacts are located. Having canoed their way up the Coomera to a strategic point, the natives could make a relatively short walk to the stone quarries. Stone artefacts manufactured from the lithic material from these quarries include sharp instruments such as knives, scrapers and axes.

To make ground-edged axes, the Kombumerri would locate suitably shaped, hand-sized stone such as basalt from the shallower parts of the river and its tributaries. They would then abrade the stone to its desired shape on suitable grindstone material such as sandstone, usually located near a stream.

Clearly, the Coomera River, as with most coastal streams, was of considerable economic benefit to the Aborigines of this area.

Conservation reserves within the Coomera catchment

There are three conservation reserves within the Coomera catchment:
- Clagiraba Conservation Reserve
- Coombabah Lakelands Conservation Area and Parkwood Reserves
- Tamborine-Guanaba Conservation Reserves

Many of the areas within these reserves have been purchased by the council under the Open Space Preservation Levy Acquisition Program for nature conservation.

Clagiraba Conservation Reserve
The Clagiraba Conservation Reserve is a series of reserves that stretch from the Lower Beechmont plateau to Mt Nathan. It comprises the Clagiraba Conservation Area, Mount Nathan Reserve, Clagiraba Reserve, Freeman Family Park, Oval Drive Parklands, Parkway Drive Reserve, Lakeview Downs Reserve and Coolbunbin Creek Reserve. These reserves provide a habitat link between Canungra and the Coombabah Lakelands of Moreton Bay. They also provide wildlife corridors linking the Hinze Dam, Tamborine Plateau, Canungra Forest and the Nerang State Forest. This reserve is also important for a number of reasons:
- It contains at least 12 threatened plants including the endangered native jasmine and the rare bush cassia.
- It supports populations of at least nine threatened animals including the endangered cascade tree frog and glossy black cockatoo.
- The reserve provides a large area of bushland with good connectivity and habitat diversity that supports an abundance of fauna species including possums, gliders, birds, reptiles and small mammals.
- The area provides opportunities for bushwalking, picnicking and nature appreciation.

Coombabah Lakelands Conservation Area and Parkwood Reserves
These reserves protect more than 1,290 hectares of wetland, eucalypt forest, salt marsh and mangrove swamp habitats and combined, are the largest coastal mainland conservation area on the Gold Coast. The area includes Lake Coombabah and the mid and lower reaches of Coombabah Creek. The areas within these reserves are significant for the following reasons:
- Eleven threatened fauna species, including the powerful owl and the square-tailed kite, are known to live in the area.
- The Cabbage Palm and Tall Broom Heath are just two of the 14 species of significant plants that are present
There are 11 distinct regional ecosystems.

One of the largest koala populations on the Gold Coast lives within the Coombabah Lakelands conservation area.

A large flying fox camp with between 3,500-15,000 individuals is at Helensvale. The grey-headed flying-fox (a vulnerable species) and the black flying-fox are the permanent populations. The migratory little red flying-fox also lives in the area between October and April.

Lake Coombabah and the conservation area are world heritage listed wetlands covered by an international agreement, the Ramsar Convention for Wetlands (1971). To find out more about the Ramsar Convention visit www.ramsar.org.

Lake Coombabah is part of the Moreton Bay Marine Park and is a protected Fish Habitat Area. An increase in urban development in this area in the past 10 years has significantly altered the surrounding area. It's had an impact on the quality of the water entering the stormwater system and the overall health of the Coombabah Lake. Landholders must minimise their contribution to stormwater pollution. Ideas on how to do this can be found on Council's website. www.goldcoast.qld.gov.au/t_standard2.aspx?pid=141

Tamborine-Guanaba Conservation Reserves
These reserves provide a link of continuous habitats along the eastern escarpment of Mount Tamborine including Tamborine National Park, Guanaba Indigenous Protected Area and Mount Tamborine.

These reserves are significant for the following reasons.

- They link fragmented sections of Tamborine National Park.
- The reserves protect the headwaters of Running Creek and the downstream Coomera catchment.
- They provide habitat for fauna, including the Albert's lyrebird, the glossy black cockatoo and a number of threatened frog species.
- The areas contain significant flora habitat including the spiny gardenia and long-leaved tuckeroo.
Current influences on catchment health and water quality

The health of all Gold Coast catchments is influenced by a range of issues. The issues which have a negative impact on a waterway and water quality are called pressures and the main pressures on Gold Coast waterways are:

- waterway modification
- urbanisation and industrialisation of catchment areas
- riparian vegetation loss
- general vegetation loss
- stormwater quality and movements
- stream and water flow barriers (Hinze Dam, for example)
- impact of weed species
- impacts from introduced animals
- erosion and sedimentation
- point source pollution
- diffuse source pollution
- increased nutrient levels.

All catchments on the coast are subject to these pressures to some degree. The Gold Coast City Council has catchment management strategies in place to reduce the influence of these pressures on the region’s waterways.

In this guide three issues will be discussed in detail, particularly in relation to their impact on the Coomera catchment. These issues are:

- urbanisation and development pressures
- riparian vegetation loss
- stormwater quality and movements.
Urbanisation and development pressures

Coomera catchment is one of Australia's fastest growing residential areas. It is expected to grow from approximately 15,000 people to 120,000 by 2056. As a result, there is pressure on the water resources of Coomera River in terms of the physical availability of water and its quality.

The lower freshwater and estuarine sections of the river have been the most significantly-effected by urban development. Grazing areas and floodplain have been replaced with housing estates, shopping centres and light industry. Canal estates have altered the movement of water in the lower estuarine section. There has also been an increase in boat traffic in the past 15 years because of the popularity of the Gold Coast Marine Precinct, and marinas associated with Sanctuary Cove, Hope Island, Coomera Waters, River Links and Paradise Point. The increased traffic, coupled with the loss of riparian vegetation, has led to bank erosion in areas of the estuarine reach.

As development increases, so too does the area of land covered by hard surfaces like roads, pathways and buildings. This infrastructure reduces the amount of water soaking into the ground and increases the water flowing into stormwater systems. Many small tributaries have been modified with the use of pipes or concrete drainage channels.

New estates in the area have to meet water-sensitive urban design (WSUD) guidelines to reduce these pressures. The guidelines include the use of erosion and sediment control devices, bio-retention systems, constructed wetlands and vegetated swales. These initiatives help reduce flow velocities, increase absorption of water into the soil and remove excess nutrients from the stormwater. They also minimise the impact of urban stormwater on the receiving environment. To find out more about WSUD, visit the 'Water by Design’ pages on the Healthy Waterways Website www.healthywaterways.org/wbd_project_overview.html.

The lower reaches of the catchment on the eastern side of the M1, until recently, were floodplain. Development has taken place only in the past 30 years. The presence of this floodplain allowed water travelling down the catchment to be retained for nutrients, and sediment to settle out of the water. The urbanisation of the area has reduced the available floodplain and in some places, artificial wetlands have been constructed to replicate the natural process. Coombabah Lakelands receives a large amount of the stormwater. As the water is retained in the wetlands, sediments and nutrients settle out of the water (for more information on the process visit www.healthywaterways.org/wbd_project_overview.html). Over time this could lead to a build-up of these materials in the waterway. Although a study conducted by the Coastal CRC in 2006 revealed the lakelands are relatively healthy. The area is, however, vulnerable to changes that occur in the catchment.

What is Council doing to minimise urban development pressures?

The Gold Coast City Council has developed the ‘Gold Coast Planning Scheme – Our Living City’ document. This document has a greater focus on ecological sustainability than previous planning schemes. New research and policy initiatives have been developed and used in the planning scheme. A recent nature conservation strategy highlighted the Gold Coast as Australia’s most biologically diverse city. The strategy suggested ways to achieve the long-term protection and management of significant biological resources.

Catchment Management Plans have been developed for each of the catchments on the Gold Coast. These plans involve an assessment of water quality and riparian vegetation conditions; outline the status of the ecological health and diversity of biological communities in the waterway; and provide guidelines for stormwater management plans. The plans help council to manage the catchment in the most appropriate way to ensure ecological sustainability in the area.

The development of the northern wastewater strategy provides an integrated approach to the collection, treatment and re-use of water in the Albert Growth Corridor within which the Coomera catchment lies.

The Pimpama Coomera Waterfuture Master Plan has been developed to deliver sustainable water and wastewater services to this growing area. At the moment, all water delivered to homes is drinking-quality and is used for all purposes, from toilet flushing to consumption. The master plan aims to reduce demand for drinking-quality water in homes by up to 84% using strategies like supplying A+ recycled water for toilet flushing and external use, and implementing water sensitive urban design strategies.

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6 Our Living City; Gold Coast Planning Scheme; Gold Coast City Council; amended January 2007
To find out more about the Gold Coast City Council’s plans to minimise development pressure, access the ‘Our Living City; Gold Coast Planning Scheme’ document www.goldcoast.qld.gov.au/gcplanningscheme_new/. For more on the Pimpama Coomera Catchment Management Plan visit www.goldcoast.qld.gov.au/t_gcw.asp?PID=5885

What can residents do to improve their catchment?
Protecting the environment is everyone’s business and individuals in the community can have an enormous impact on the health of the catchment. Here are some of the things you can do to improve the health of the catchment in your area.

- Keep stormwater clean. For more ideas, visit the stormwater quality and movements section of this document or visit www.goldcoast.qld.gov.au/t_standard2.aspx?pid=141
- Fill your garden with native plants. This will attract native fauna to our gardens and reduce the transfer of weed species throughout our environment.
- Mulch gardens to reduce topsoil run-off, keep soil wet and reduce evaporation.
- Correctly dispose of rubbish, animal wastes, pesticides and herbicides.
- Educate others about the importance of maintaining a healthy catchment.

Riparian vegetation

Riparian (stream-side) vegetation is the plant life along the edges of a waterway and includes both aquatic and terrestrial species in this zone. This area of vegetation hosts an abundant and diverse range of flora and fauna and often forms micro-climates which can provide ideal environments for species with specific habitat requirements. In-stream the vegetation protects juvenile fish and crustaceans. Out of stream vegetation provides shade and acts as a buffer against biological factors like temperature variability and excess light penetration. Riparian vegetation plays an important role in preserving the health of a waterway.

- Riparian vegetation provides shade over the water, reducing large fluctuations in water temperature.
- It provides habitat.
- The root systems of vegetation on stream banks help to bind soils, reducing erosion.
- Vegetation provides an in-stream nutrient source.
- Plant life reduces stream velocity which, in turn, reduces the amount of sediment transported in the water during times of flood.
- Plants play a part in maintaining water quality by physically and chemically cleaning the water.
- Ground cover, including leaf litter, reduces erosion caused from raindrop impact.

Riparian vegetation loss

There has been a significant loss of vegetation in the catchment as a result of grazing, extractive industries and urban development. Of most concern is the loss of riparian vegetation. This loss can be attributed to a number of factors.

- It has been removed to increase the amount of land available for development or to improve water views.
- Dredging in upstream and estuarine areas has depleted vegetation.
- As livestock grazing areas are extended, natural vegetation is removed.
- The loss of riparian vegetation affects water quality in the following ways.
- Increased sediment in the water decreases bank stability and erosion.
- Sedimentation of the waterway leads to pooling in times of low flow. This can lead to fragmentation of species; and waters may become stagnant (no oxygen). Stagnant waters can lead to loss of in-stream fauna.
- Aquatic plants and algae can grow excessively when there is not enough shade along waterways because water temperatures rise when there is too much light. This affects nutrient processing in the waterway and changes the balance of plant life.
- Nutrient loads in the water increase too much when there is too much direct stock access and stormwater runoff and, when there is no nutrient uptake by vegetation.
- Cleared waterways leave soil open for weed species to colonise and out-compete native species. This leads to reduced biodiversity in the area.
Riparian vegetation rehabilitation
Rehabilitating riparian zones requires planning and care and cannot be done by simply planting a few trees. Care must be taken to establish the appropriate species of native vegetation; to maintain the area through ongoing weed control; and to monitor for signs of vandalism and tree removal. Gold Coast City Council is continually assessing riparian zones and undertaking works to restore and preserve these areas.

Maintenance and rehabilitation of riparian zones increase:
- biological diversity
- bank stability
- water quality (through reduced temperatures and nutrient loads)
- aesthetic values of the area.

There are many ways to improve the health of the riparian zone. Firstly, it is important to maintain the local native vegetation whilst controlling weed species. People living along waterways are encouraged to plant species native to the area, and remove any exotics. Seek advice on the best way to remove particular weed species as some methods are more effective than others. It is essential to think of weed removal and native re-planting as a long term process because newly-planted natives need time to establish and become viable. For more information on weeds see www.goldcoastcity.com.au.weeds.

Another way of protecting riparian vegetation is to erect fences around riparian zones to prevent access by stock. Stock graze on, and trample riparian vegetation which decreases bank stability and can increase erosion.

Boat owners and jet skiers can also play a part. By reducing their speed in waterways, they can minimise boat wash and the resulting impact that the water movement has on the riparian zone. The regular movement of large amounts of water at speed can collapse banks into the waterway, taking with it the riparian vegetation.

It is essential to protect and re-establish riparian vegetation within our waterways. This zone is vital to maintaining water quality and to ensuring a continuing abundance and diversity of aquatic species.

Figure 1.8 – A well established riparian zone
Stormwater quality and movement

Stormwater is rainwater and anything that is carried along with it. In urban areas stormwater runs from roofs and hard surfaces (pavements, roads), flowing into gutters and the drainage system. In many areas of the catchment, all stormwater is directed into the stormwater system. It is usually not treated.

In new developments water sensitive urban design (WSUD) guidelines have been used. WSUD aims to reduce the speed at which water is removed from an area to increase water retention and promote water soaking into the ground. Allowing water to soak into the ground promotes filtering of nutrients from the water, settling of sediments and reduces the amount of excess, unnatural water entering the waterway at once.

WSUD guidelines include the use of erosion and sediment control devices like barrier fencing, stormwater drain barriers/covering, and mulching or using artificial covering when establishing new garden beds. The guidelines also recommend the use of bio-retention systems, constructed wetlands and vegetated swales.

These devices minimise the impact of urban stormwater on the receiving environment. To find out more about WSUD, visit the ‘Water by Design’ pages on the Healthy Waterways Website www.healthywaterways.org/wbd_project_overview.html.

Figure 1.9 – Drainage channel that promotes retention of water and slowing of water speed.

Figure 1.10 & 1.11 – Stormwater quality improvement devices reduce erosion on development sites by removing coarse sediment like sand and some silt.

Figure 1.12 – Sediment ponds allow fine sediment particles like clay and silt to settle out of the water.
What is transported with stormwater?
Stormwater carries with it materials which can degrade the waterways. These include:

- nutrients from fertilisers, garden waste (leaves and grass clippings and animal waste)
- sediment from garden beds and housing development sites
- detergents and oils
- litter
- terrestrial and aquatic weeds.

One of the main issues associated with stormwater is the transfer of litter throughout the environment. Litter looks unsightly. It can also strangle and choke fish, birds and other marine life, and smother and kill young plants. Litter gets blown or washed into the stormwater system after it is thrown on the ground, tossed from car windows, or has overflowed from bins.

Gold Coast City Council has a public education campaign and litter enforcement strategy to combat littering. The community can play a large role in keeping our stormwater clean. Here are some ideas.

- Always dispose of rubbish correctly; put a rubbish bag in the car or take rubbish home if there is no bin nearby.
- Dispose of all chemicals, oils, pesticides and herbicides correctly. Take them to a transfer station for correct disposal.
- Pick up animal droppings.
- Wash cars or boats on the lawn so detergents don’t run directly into the stormwater system.
- Sweep driveways and paths instead of hosing.
- Compost garden waste and apply as a soil conditioner to the garden rather than using chemical fertilisers.
- Never dispose of garden waste in the stormwater system.
Current catchment health

There has been a high level of urban growth in the Coomera catchment in the lower freshwater and estuarine sections. This growth has had a negative effect on the health of the catchment and care is being taken to reduce future impacts of growth on water quality.

Upper freshwater section
The water quality in the upper freshwater reach varies and is dependent on the surrounding land's primary use. Within Lamington National Park water quality is very high. The waterway then flows through properties that have been cleared for grazing. This has had an impact on the level of riparian vegetation and bank erosion. This affects water quality and, as a consequence, nutrient levels are high in this section.

The waterway then travels through the Land Warfare Centre where there is a high level of riparian vegetation and very limited outside influences on the water quality.

Lower freshwater section
Land use in the lower freshwater section also has a large impact on water quality. The waterway meanders through rural properties where riparian vegetation has been degraded through clearing. In other parts, land surrounding the water is continually being rehabilitated.

As the river and tributaries join and continue their journey to the ocean, there is increased pressure due to:
- water being removed for commercial use by nurseries, aquaculture companies and for pasture irrigation
- housing developments
- extractive industries
- road crossings and causeways affecting fish movement.
Small dams on properties can lead to the transfer of nutrients and weed species down the catchment. When there is high rainfall these dams may overflow into the river and tributaries, affecting water quality.

Increased sediment and nutrient levels, low macro-invertebrate diversity and degraded riparian vegetation affect water quality in this section.

Estuarine section
The estuarine section of the Coomera River has been heavily impacted by urban development, but is still considered to be relatively healthy. Land along the estuarine section of the Coomera River was floodplain until about 30 years ago. Now, it is residential land and includes several canal estates. In 2006 the Ecosystem Health Monitoring Program (EHMP), (which conducts comprehensive marine, estuarine and freshwater monitoring and research) gave the estuarine section of the Coomera River a health rating of A-. In 2007 this rating has dropped to B.

The health rating is based on ecosystem health indicators including water studies of the levels of nitrogen, chlorophyll, turbidity, phosphorous and dissolved oxygen. The biological health ratings include a riparian vegetation assessment. Water quality in this section of waterway is influenced by run-off, tidal exchange, dredging and modification of water channels. Other factors include recreational use of the waterway and loss of riparian vegetation, particularly mangrove communities.

Figure 1.13 – Catchment health is impacted by urban development in the lower freshwater section
The estuarine health of the Coomera River is good but it was noted that the riparian habitat throughout the estuary, particularly on the southern banks, have been heavily compromised. The health of this area is influenced by commercial boat building activities, marine infrastructure developments and canal estates. These activities can have significant negative, long term influences on the health of the waterway if they are not monitored carefully.

The ability of this area to ‘flush’ as a result of tidal movement plays a large part in determining nutrient levels. Tidal flushing has been, and continues to be, influenced by developments and infrastructure change along the estuarine section of the catchment. High nutrient levels have negative impacts on the health of both the waterway and the riparian zone. If this section of the river is to remain healthy, as determined by EHMP, nutrient levels must be monitored closely and residents need to reduce or stop doing things which cause nutrients to flow into the river. Refer to the stormwater quality and movement section of this guide for tips on how to reduce nutrient levels.

For more information on the EHMP program, and to see what the catchment’s latest environmental rating is, visit www.ehmp.org/pimpamacoomera_rivers_catchment_and_estuary.html.

**Catchment groups**

There are two catchment groups working to improve the health of the local creeks and waterways within the Coomera catchment:

- Coombabah Catchment Management
- Coomera River Catchment Group

To find out more about these groups or to become involved, contact Gold Coast City Catchment Management on 5581 6722.

As well as these catchment groups, traditional owners and Green Corps groups have been working for the past seven years in the Guanaba Indigenous Protected Area within the Coomera. In this time the area has undergone many changes. Riparian vegetation has been re-established and water quality has been continually measured to see how successful the revegetation work has been.

A number of schools in the area have also been involved in tree planting and water quality monitoring activities. In this way, students develop a connection with their surrounding environment and protect it for the future.

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8 Environmental Inventory of the Coomera River Catchment and its Tributaries, September 2005, WBM Oceania Australia, Pg 2
Areas of significance within the catchment

Coombabah Wetlands
The Coombabah Wetlands and Parkwood Reserves cover about 1300 hectares and are adjacent to more than 800 hectares of state-managed reserves, wetlands and waterways. The wetlands extend from Lake Coombabah to the Broadwater and southern Moreton Bay. They incorporate salt marsh, eucalypt forests and mangrove habitats. These wetlands have 11 distinct ecosystems which are home to many threatened species of flora and fauna. The wetlands are highly valued for its:
- flora and fauna habitat and diversity
- contribution to ecological health of the environments
- role as nursery grounds for young crustaceans and fish
- role in flood mitigation.

Further to this, the biodiversity of the Coombabah Wetlands is such that it has been identified as ecologically significant on a regional, national and international scale. One such recognition was made at the Ramsar Convention for Wetlands in Iran where the Coombabah Wetlands received world heritage listing because of its international significance to migratory bird species.

The Coombabah Wetlands have also been classified as important sites in the Japan Australia Migratory Bird and China Australia Migratory Bird Agreements. JAMBA and CAMBA are international agreements between Australia, Japan and China. These agreements recognise the importance of the certain areas to endangered species of migratory birds and aim to protect these vital habitats. The lake is also a Fish Habitat Area and is used for various recreational activities.

Lamington National Park
Lamington National Park is part of the MacPherson Ranges and was declared a national park in 1915. It covers an area of approximately 20,000 hectares and is the beginning of the Coomera catchment. The earliest inhabitants of the park were the Yugembeh, an Aboriginal kinship group who called the mountains Woonoongoora, and considered them to be sacred and spiritual. By 1870 the first Europeans had moved into the area. They were timber-getters who were interested in the red cedar. Agriculture followed and soon the lower rainforest areas had been destroyed.

The national park has spectacular scenery, lush rainforests and is now a UNESCO World Heritage listed national park because of its ecological importance. Lamington is home to numerous species of rare flora and fauna, some of which are found nowhere else in the world.

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9, 13 Gold Coast City Council Website; http://www.goldcoast.qld.gov.au/attachment/communityconsultation/Coombabah_feedback.pdf; accessed 24/9/08
The importance of water testing

Water testing provides students with hands-on experiences. It allows them to get involved with, and to physically interact with the environment. Their involvement builds the students’ capacity to make informed inferences based on the results that they discover. Students can be involved in two different types of water testing: physical water testing and macro-invertebrate testing. The water testing gives students a sense of stewardship and responsibility for the health of the local waterways and catchments. Becoming involved in water testing will help students in many ways.

- An appreciation grows of the importance of local waterways and their interconnections within the catchment.
- Students may identify issues in the catchment they want to address and research further.
- Students will identify natural and modified features of the catchment that help explain the results of their monitoring activities.

Demand for waterway health information has increased on a regional and local level. The increased interest relates to the need for more informed planning and decision-making for regional natural resource management.

Students can contribute to this data collection by being involved in water testing. The data is compiled by Waterwatch and used to provide a historical overview of changes in the water quality. If an anomaly is detected the Gold Coast City Council is informed, and staff investigate the cause. The data also helps to assess whether efforts to control pollution and restore waterway health are working. Anyone can access water monitoring results via the Gold Coast Waterwatch website, http://www.goldcoastwaterwatch.org/

The testing outlined in this guide seeks to address questions on the environmental health of a waterway. None of the test approaches, as described in the guide, are designed to answer questions like, “Can you drink this water?”

Water testing safely

Issues of safety, environmental protection and consideration for others must be addressed before any field testing is done.

Safety guide

- Never test alone.
- Always choose a test site that provides safe access to the water.
- Carry drinking water, hat and mobile phone in case of an emergency.
- Be aware of areas that may flood without warning.
- Limit entering the water to less than knee depth and always wear appropriate footwear.
- Be aware of test chemicals and take appropriate precautions when handling these chemicals.
- Be observant and aware of hidden objects or hazards and dangers including holes, snakes or electric fences.

Environmental guide

- Always dispose of used test chemicals and samples responsibly (bring suitable waste containers).
- Do not litter.
- Avoid damaging verge, bank-side and in-stream vegetation and structures.
- Return macro-invertebrate samples to the water as quickly as possible to limit harm, injury or death to these creatures.
- Minimise the number of students collecting macro-invertebrate samples to minimise trampling of riparian vegetation.

Courtesy considerations

- Do not enter private property without permission.
- Do not climb, stretch or move fences.
- Leave all gates as you find them.

Stormwater safety

It is critical to understand the dangers of stormwater drains if teachers and students are to stay safe. The Gold Coast City Council has developed a comprehensive stormwater safety awareness campaign - www.goldcoastcity.com.au/m8s4life. The speed and depth of stormwater is deceptive and care should be taken whether you are five or 50-years-old. Stormwater levels can rise extremely quickly and people can be sucked into drains in seconds.

Some things to remember when testing are:

- never test alone
- do not test during storms
- if testing during periods of high flow DO NOT do so near stormwater drains

If you feel unsafe or unsure about an area for any reason, DO NOT test there. It will be safer to test somewhere else and if it isn’t then do not test that area at all.
Macro-invertebrates

Macro-invertebrates are very useful as biological indicators of water quality and the environmental health of a waterway. These creatures play a central role in the food chain of waterways. In most cases they live in the water for more than a year and cannot escape the impacts of pollution. Some are tolerant of poor water quality while others are very sensitive and require high water quality. This said, the presence or absence of particular macro-invertebrates can help determine waterway and habitat health.

Food chain
Macro-invertebrates fill each of the levels within the food chain in aquatic environments.

![Macro-invertebrates food chain](Fig. 1.14)
Life cycle
Macro-invertebrates are divided into a range of species and family groupings, as well as representing many stages of lifecycle development for creatures. For example, caddis fly larvae may be considered the third stage in a four-stage life cycle for the creature.

![Life cycle of a caddis fly](image)

Each of these life cycle stages require specific environmental conditions and have specific tolerances. As a result, some creatures have a very narrow range of environmental conditions in which they will survive and thrive. The range of environmental conditions in which an organism can thrive will be determined by its sensitivity to changes in water quality.

Creatures that require very narrow ranges of environmental conditions are generally considered to be very sensitive to changes in water quality, while creatures that survive a wide range of water quality conditions are considered to be tolerant of most changes. These differences provide a measure of water quality based on the types and numbers of creatures observed in the water.

Macro-invertebrates are ideal as indicators as they can be seen by the naked eye, are very diverse, fill most ecological niches and cannot limit exposure to water quality issues (fish, for example, can escape some water quality problems).
Factors affecting macro-invertebrates

There are various factors which influence the abundance and diversity of macro-invertebrates in a waterway. These have been summarised in the table below.

<table>
<thead>
<tr>
<th>TYPE OF FACTOR</th>
<th>Physical habitat</th>
<th>Waterway chemistry</th>
<th>Biological factors</th>
<th>Human influences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>riffles, edges, pools</td>
<td>pH</td>
<td>food availability</td>
<td>suspended solids</td>
</tr>
<tr>
<td></td>
<td>flow and velocity of water</td>
<td>dissolved oxygen</td>
<td>life cycle of water bugs</td>
<td>presence or absence of riparian vegetation</td>
</tr>
<tr>
<td></td>
<td>substrate type</td>
<td>nutrients (nitrogen &amp; phosphorus)</td>
<td>seasons</td>
<td>removal of debris</td>
</tr>
<tr>
<td></td>
<td>presence or absence of aquatic plants</td>
<td>salinity</td>
<td></td>
<td>built barriers</td>
</tr>
<tr>
<td></td>
<td>temperature</td>
<td></td>
<td></td>
<td>run-off</td>
</tr>
<tr>
<td></td>
<td>water depth</td>
<td></td>
<td></td>
<td>sewage and industrial discharge</td>
</tr>
</tbody>
</table>

Macro-invertebrate sampling

Macro-invertebrate sampling can be done without specialist equipment. A pool scoop, large tray (white is best), ice cube tray, plastic spoon and a magnifying glass are all the materials needed.

Water bugs live in a variety of habitats within a waterway. When sampling, it is best to do so at a variety of in-stream habitats; samples should be taken from a combination of areas such as rocky bottoms, areas of steep banks, areas with in-stream vegetation and areas with emergent vegetation.

These areas should be sampled by sweeping a net upstream, gently touching and disturbing the banks, bottom and vegetation with the edge of the scoop (taking care not to cause erosion of the bank or remove riparian vegetation). The creek or stream should be sampled for two minutes or a length of 10m of scooping. It is advisable, however, to take several sweeps within this time or length period to collect the bugs in smaller lots. Too many organisms will spill back in the water if a large sample is taken.

Once collected, the sample net should be emptied onto a large tray. From here, the live bugs are sorted into smaller trays, (ice cube containers) with spoons or paintbrushes. (Don’t use tweezers. They will crush the delicate creatures). More detailed identification can be done in the smaller trays.

Identifying the macro-invertebrates

Use the images in the ‘Water Bug Guide’ in the resources section for more information, or contact the Gold Coast City Council Catchment Management Unit (5581 6722) for detailed bug identification materials. Macro-invertebrates can also be identified with online identification guide at www.mdfrc.org.au/bugguide/display.asp?type=1&class=19.
Very sensitive macro-invertebrates

Stone Fly Nymph
Sensitivity Rating 10
Note: two tails and two pairs of wing pads

Sensitive macro-invertebrates

Riffle Beetle
Sensitivity Rating 8
Adults less than 4mm black or dark brown, larvae (grubs) less than 5mm and torpedo shape

Caddis fly Larvae
Sensitivity Rating 8
Three pairs of legs below head, builds/ collects homes from sticks, sand, leaves

Mayfly Nymph
Sensitivity Rating 8
Three tails, short antennae and lateral gills on abdomen

Medium tolerance macro-invertebrates

Damselfly Nymph
Sensitivity Rating 4
Three leaf like tails, short antennae, large eyes - hunters

Water Mite
Sensitivity Rating 6
Small, pinhead to 4mm, with four pairs of legs. Usually red or blue but sometimes bright green in colour

Dragon Fly Larvae
Sensitivity Rating 4
Up to 75mm but more commonly 30mm; short round body and no leaf-like tail. Large eyes – they are hunters and closely related to damselflies

Water Strider
Sensitivity Rating 4
Commonly seen on water’s surface. Dark coloured body. Around 8mm in length with long slender legs

Fresh Water Shrimp
Sensitivity Rating 4
Commonly 20 to 30mm and are translucent (see through), easily identifiable as they jump around in the water sample
Tolerant macro-invertebrates

Diving Beetle
Sensitivity Rating 3
Adults vary in size between 3 and 35mm. Hard, oval shaped bodies, will dive up and down in water. Larvae can grow up to 55mm; they have two thin ‘tails’ and large mouth parts.

Back Swimmer
Sensitivity Rating 2
Can grow up to 11mm and have large eyes which cover most of the head. Have an elongated body with pointed abdomen.

Very tolerant macro-invertebrates

Freshwater Worm
Sensitivity Rating 1
Usually red or brown but may also be green, cream, tan or black. Worms move by stretching and pulling their body through their surroundings. Can grow up to 30mm in length.
Using the information

There are many ways to interpret information about the types and numbers of macro-invertebrates collected. These methods range from the scientific SIGNAL index which uses species richness measures and tolerance ratings, to simple tolerance rankings. At the core of any of the interpretation techniques is the rule that the greater the diversity of creatures observed, the more likely the health of the waterway is high.

The second assumption is that few or no very sensitive creatures will be found in low water quality waterways. Whilst remembering these two basic assumptions, it can be said simply, that the presence of creatures of high sensitivity indicates higher water quality.

Simple tolerance method

<table>
<thead>
<tr>
<th>DOMINANT GROUP 2</th>
<th>Very Tolerant</th>
<th>Tolerant</th>
<th>Medium</th>
<th>Sensitive</th>
<th>Very Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOMINANT GROUP 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Tolerant</td>
<td>degraded</td>
<td>degraded - poor</td>
<td>poor</td>
<td>medium</td>
<td>good - medium</td>
</tr>
<tr>
<td>Tolerant</td>
<td>degraded - poor</td>
<td>poor</td>
<td>poor</td>
<td>good - medium</td>
<td>good</td>
</tr>
<tr>
<td>Medium</td>
<td>poor</td>
<td>poor</td>
<td>medium</td>
<td>medium - good</td>
<td>good</td>
</tr>
<tr>
<td>Sensitive</td>
<td>medium</td>
<td>medium</td>
<td>good</td>
<td>good</td>
<td>excellent</td>
</tr>
</tbody>
</table>

An understanding of the causes of lowered water quality can also be developed from the types of bugs observed. The table below indicates some of these connections.

<table>
<thead>
<tr>
<th>You find...</th>
<th>... it suggests</th>
</tr>
</thead>
<tbody>
<tr>
<td>little variety of organism types, with large numbers of each type identified</td>
<td>water overly enriched with selective pollutants such as organic matter</td>
</tr>
<tr>
<td>only one or two organisms in large numbers</td>
<td>severe organic pollution</td>
</tr>
<tr>
<td>a variety of organisms, but only a few of each or no organisms but the stream appears clean</td>
<td>stream may have undergone flooding or scouring</td>
</tr>
<tr>
<td>no animals</td>
<td>toxic pollution</td>
</tr>
</tbody>
</table>
Sensitivity rating method – stream invertebrate grade number – average level (SiGNAL)

Using this monitoring tool, each of the macro-invertebrates is given a sensitivity rating. These can be used to give an estimate of water quality. Use the following steps to calculate the health of the waterway.

1. List all of the macro-invertebrates and their sensitivity ratings.
2. Add up these sensitivity ratings.
3. Divide this number by the number of different species found. This gives you the sensitivity rating of your waterway.
4. Use this number and the table below to determine the health of your waterway.

<table>
<thead>
<tr>
<th>&gt;6</th>
<th>healthy</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-6</td>
<td>mildly polluted</td>
</tr>
<tr>
<td>4-5</td>
<td>moderately polluted</td>
</tr>
<tr>
<td>&lt;4</td>
<td>severely polluted</td>
</tr>
</tbody>
</table>

Example:
Found – Shrimp (sensitivity rating - 4), Snail (2), Dragonfly larvae (4), Water mite (6)
Total = 16
16 / 4 (number of species found) = SiGNAL score of 4 indicating a moderately polluted waterway.
**Habitat survey**

The health of the habitat surrounding a waterway has a direct relationship to the water quality. When surrounding habitats are poor, it is generally true that water quality is also poor. The role of the surrounding habitat in maintaining water quality is very important. These areas filter inflow run-off, support a diversity of life, and provide physical protection from large changes in temperature, or from significant erosion or sedimentation.

**Conducting a habitat survey**

A habitat survey involves observing and documenting the vegetation and physical condition of the waterway and surrounding environments. Ideally, the survey is conducted over a 100m length of the waterway on both banks, (for example: 50m upstream and 50m downstream from test site). However, this may not always be possible. Make sure to note the length of the survey area, remembering the longer the survey area, the more accurate the result.

**Five habitat indicators are observed in the survey:**

1. Bank vegetation
2. Verge vegetation
3. In-stream cover
4. Bank erosion and stability
5. Riffles, pools and bends (in-stream diversity).

To conduct a habitat survey read the descriptions provided in the following table and decide which best describes the waterway being assessed. Record details on the stream habitat record (refer to the data collection section). Total the ratings for each of the indicators and use the rating table to interpret the results.

---

Fig. 1.16 Habitat Survey
Assessing habitats

<table>
<thead>
<tr>
<th>Bank vegetation</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>FAIR</th>
<th>POOR</th>
<th>VERY POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(10) Mainly undisturbed native vegetation. No signs of alteration.</td>
<td>(8) Mainly native vegetation. Little disturbance or no signs of recent site disturbance</td>
<td>(6) Medium cover, mixed native/ introduced. Or one side cleared, the other undisturbed.</td>
<td>(4) Introduced ground cover, little native under or over-storey, predominantly introduced vegetation.</td>
<td>(2) Introduced ground cover with lots of bare ground, occasional tree. Also includes sites with concrete lined channels.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Verge vegetation</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>FAIR</th>
<th>POOR</th>
<th>VERY POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(10) Mainly undisturbed native vegetation on both sides of the stream. Verge more than 30m.</td>
<td>(8) Well-vegetated wide verge corridor. Mainly undisturbed native vegetation on both sides of stream; some introduced or reduced cover of native vegetation</td>
<td>(6) Wide corridor of mixed native and exotics, or one side cleared and other wide corridor of native vegetation.</td>
<td>(4) Very narrow corridor of native or introduced vegetation.</td>
<td>(2) Bare cover or introduced cover such as pasture land.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>In-stream cover</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>FAIR</th>
<th>POOR</th>
<th>VERY POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(10) Abundant cover. Frequent snags, logs or boulders with extensive areas of in-stream, aquatic vegetation and overhanging bank.</td>
<td>(8) A good cover of snags, logs or boulders, with considerable areas of in-stream and overhanging vegetation</td>
<td>(6) Some snags or boulders present and/or occasional areas of in-stream or overhanging vegetation</td>
<td>(4) Only slight cover. The stream is largely cleared, with occasional snags and very little in-stream vegetation. Generally no overhanging vegetation</td>
<td>(2) No cover, no snags, boulders submerged or overhanging vegetation. No undercut banks. Site may have rock or concrete lining.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bank erosion and stability</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>FAIR</th>
<th>POOR</th>
<th>VERY POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(5) Stable: no erosion/ sedimentation evident. No undercutting of banks, usually gentle bank slopes, lower banks covered with root mat grasses, reeds or shrubs</td>
<td>(4) Only spot erosion occurring, little undercutting of bank, good vegetation cover, usually gentle bank slopes, no significant change to bank structure</td>
<td>(3) Localised erosion evident. A relatively good vegetation cover. No continuous damage to bank structure or vegetation</td>
<td>(2) Significant active erosion evident especially during high flows. Unstable, excessive areas of bare banks, little vegetation cover.</td>
<td>(1) Extensive or almost continuous erosion. Over 50% of banks have some form of erosion: very unstable with little vegetation cover</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Riffles, pools and bends (flowing water only)</th>
<th>EXCELLENT</th>
<th>GOOD</th>
<th>FAIR</th>
<th>POOR</th>
<th>VERY POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>(5) Wide variety of habitats. Riffles and pools present of varying depths, bends present.</td>
<td>(4) Good variety of habitats - e.g. riffles and pools or bends and pools. Variation in depth of riffle and pool</td>
<td>(3) Some variety of habitat - e.g. occasional riffle or bend. Some variation in depth</td>
<td>(2) Only slight variety of habitat. All riffle or pool with only slight variation in depth.</td>
<td>(1) Uniform habitat. Straight stream, all shallow riffle or pool of uniform depth e.g. channelled stream or irrigation channel.</td>
<td></td>
</tr>
</tbody>
</table>
Physical and chemical tests

A range of physical and chemical tests can be done to assess water quality.

The most common tests for field activities include:
- dissolved oxygen
- temperature
- pH
- salinity
- turbidity
- flow
- nutrients (phosphates).

To correctly interpret results, several things must be taken into consideration, including the nature of the water being tested and the question/s you are trying to answer. It also helps to know whether the results are considered acceptable for the waterway. In order to find this out, it is recommended that students or teachers refer to either the Environmental Protection (Water) Policy 1997: Coomera River Environmental Values and Water Quality Objectives – Basin No. 146 produced March 2007 or the Queensland Water Quality Guidelines 2006 to obtain recommended levels. Results can then be compared with those expected for a healthy waterway in the catchment.

For detailed information on interpreting results for the tests above, see the Queensland Community Waterway Monitoring Manual.

It is important to note that results of these physio-chemical tests are not intended to be used independently. It is essential that judgement on the health of the waterway is not based on one or two of the above tests, but that the results of all tests are assessed as a whole to accurately rate water quality. The results of one test may be meaningless without those of another. Therefore, complete all of the physio-chemical tests before arriving at conclusions.
**Dissolved oxygen**

*Dissolved oxygen* is a measure of the amount of oxygen in the water. It may be expressed as milligrams per litre (mg/L) or percent saturation (% sat). It is an essential direct measure of the ability of the waterway to sustain life. If dissolved oxygen levels are too low, aquatic organisms cannot breathe (through the process of respiration). Alternately, very high dissolved oxygen levels may be as a result of large amounts of algae and aquatic plants. Levels of DO in waterways can be affected by various factors like:

- the rate that oxygen can enter the water
- the rate at which the oxygen is used
- photosynthesis by plants and algae
- time of day and season
- salinity levels
- water depth.

Oxygen enters the waterway through two main processes.

- Absorption through the water surface (enhanced by waterfalls and rapids).
- Photosynthesis of water plants and algae during the day.

Two processes remove oxygen from the water.

- Oxygen escaping through the water surface (bubbles).
- Respiration of plants and animals in the waterway (24hrs per day).

Healthy levels of dissolved oxygen in the water occur when there is a balance between the processes introducing oxygen and those removing it.

Dissolved oxygen can be measured by using the following methods: titration, colorimetry or a DO meter (electrode).

For more information on monitoring methods, see the Queensland Community Waterway Monitoring Manual.

For specific recommended DO levels for your area of catchment, refer to the Environmental Protection (Water) Policy 1997: Coomera River Environmental Values and Water Quality Objectives – Basin No. 146, Produced March 2007.

**Oxygen Variations Over 24 Hours**

![Graph showing oxygen variations over 24 hours]
**Temperature**

Temperature is a measure of one of the physical properties of water. It shows how hot or cold a substance is, and is normally measured in degrees Celsius (°C). The temperature of the water affects the level of oxygen that can be dissolved in the water (the warmer the water the less oxygen it can hold). Temperature also affects the metabolic rate of organisms living in the waterway. As a result of the increased speed of chemical reactions, some plants, algae, and other organisms grow at faster rates in warmer waters. As a result, high temperatures can lead to algal blooms or other eutrophic events.

Changing air temperature is not the only thing which alters water temperature. Other factors include:

- changes to vegetation cover
- runoff from roadways and other urban environments (which are generally warmer)
- stormwater runoff
- changes in the turbidity of the water column
- type, depth and flow of waterway
- groundwater inflows
- water discharges
- water depth.

Temperature can be determined by using an expansion-contraction thermometer or a digital temperature probe.

For more information on monitoring methods see the Queensland Community Waterway Monitoring Manual.

For specific recommended temperature levels for your area of catchment, refer to the Environmental Protection (Water) Policy 1997: Coomera River Environmental Values and Water Quality Objectives – Basin No. 146, Produced March 2007.

**pH**

pH is a chemical measure of the waters acidity. pH is measured on a scale of 0-14, with 0 being highly acidic and 14 strongly alkaline. Both extremes of the pH scale are corrosive and harmful to aquatic life. Most freshwater creatures prefer pH to be in the range of 6.5 to 8.0.

The pH of a waterway can be influenced by industrial runoff, fertilizer runoff and significant organic loads. However, the most significant human impact on the pH of a waterway is the result of disturbance to potential and actual acid sulphate soils (for more information on acid sulphate soils in the Coomera catchment contact Gold Coast City Council catchment management unit 5581 6722).

pH can be affected by factors like:

- respiration and photosynthesis
- buffering capacity of waterway
- variations in vegetation and salinity
- human disturbance to waterway.

pH can be determined by using one of the following methods and devices: pH meter, colorimetry, pH test strips or titration.

For more information on monitoring methods, see the Queensland Community Waterway Monitoring Manual.

For specific recommended pH levels for your area of catchment, refer to the Environmental Protection (Water) Policy 1997: Coomera River Environmental Values and Water Quality Objectives – Basin No. 146, Produced March 2007.
**Turbidity**

Turbidity refers to the clarity of the water. It is a measure of how cloudy the water is, and is generally recorded in nephelometric turbidity units (NTU). As turbidity increases less light is able to penetrate the water column, reducing the amount of light available to green plants for photosynthesis. Increases in turbidity may be seasonal or associated with rainfall events. These are natural and ecosystems are equipped to cope with such variations. Changes in the turbidity beyond the normal range (either in severity or duration) will affect ecological systems. Possible effects on ecological systems include:

- reduction of light required for photosynthesis
- increased water temperatures due to the suspended sediments being heated by the sunlight and warming the water
- smothering of bottom-dwelling or anchored plants and organisms
- clogging of gills or feeding apparatus for small organisms (which occurs if sediments are contaminated with agricultural chemicals).

Actions that may lead to increased turbidity include:

- clearing of stabilising vegetation on slopes and waterway banks, leading to erosion events
- modification of the waterway to increase flow rates, resulting in increased bank erosion and less settlement of sediments
- cattle or other disturbance to the waterway bed or base
- discharges into the waterway and stormwater runoff
- fauna stirring up bottom sediments
- algal growth.

Turbidity can be determined by using a turbidity meter (or nephelometer) or turbidity tube.

For more information on monitoring methods, see the Queensland Community Waterway Monitoring Manual.

For specific recommended turbidity levels for your area of catchment, refer to the Environmental Protection (Water) Policy 1997: Coomera River Environmental Values and Water Quality Objectives – Basin No. 146, Produced March 2007.

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**Salinity**

Salinity, (electrical conductivity or total dissolved solids), measures the amount of ions or salts in the water. It is usually expressed in micro siemens per centimetre (µS/cm). In its simplest form, salinity defines fresh and salt water. However, as an environmental measure of water quality, the outcome is more specific. Aquatic animals and plants can only tolerate small changes in salinity as the concentration of salts in the water affects the ability of cells to control hydration and chemical exchange. Each organism has a specific and limited range of salinity in which it can survive and thrive.

Changes in salinity in the waterway are most commonly the result of tidal or sea water influences. However a number of other circumstances will affect the salinity of the waterway. They are:

- fertiliser and industrial discharges (generally increases salinity)
- removal of vegetation and associated rises in the water table (generally increases salinity)
- water discharges from irrigation, industry, groundwater and run-off
- rainfall and evaporation
- geology and land use of surrounding land.

Salinity can be determined by using a conductivity meter.

For more information on monitoring methods, see the Queensland Community Waterway Monitoring Manual.

For specific recommended salinity levels for your area of catchment, refer to the Environmental Protection (Water) Policy 1997: Coomera River Environmental Values and Water Quality Objectives – Basin No. 146, Produced March 2007.
**Flow** is a measure of the volume and speed of water movement in a waterway. In tidal areas flow is determined by regular tidal cycles. In non-tidal areas the flow rate is affected by the physical structure of the waterway and the amount of inputs to the catchment (either by rainfall or through seepage and movement in the soil). The upper freshwater reaches of Gold Coast waterways are classified as ephemeral; that is, they have periods of flow and periods of no-flow, as opposed to perennial waterways which have continuously flowing waters. As a result, flow rates are variable, and the aquatic systems have developed and adapted to these conditions.

Problems for the ecology of the waterway arise when the flow rates are artificially impacted. The primary purpose of the stormwater system is to control overland flow. One side-effect from some stormwater drainage is an impact on the flow rates of the natural waterways.

As well as stormwater runoff, other factors affecting flow can include:
- weather patterns
- human disturbances (building dams, altering of catchment shape, water extraction)
- absence or presence of vegetation
- condition of vegetation (natural or cleared)
- size and slope of the catchment.

Flow can be determined by using the float method or the heat rod method.

For more information on monitoring methods, see the Queensland Community Waterway Monitoring Manual.

**For specific recommended flow rates for your area of catchment, refer to the Environmental Protection (Water) Policy 1997: Coomera River Environmental Values and Water Quality Objectives – Basin No. 146, Produced March 2007.**

**Nutrients** are the essential building blocks of life. Commonly investigated nutrients are phosphorous and nitrogen. These elements occur in a variety of forms in aquatic environments; some water-soluble, some inert and some gaseous. Many of these forms are difficult to measure in the field. As a result, field testing should be limited to examination for soluble forms of the elements as they are the simplest to extract and most likely to be used in the nutrient cycle. Of the soluble forms of these nutrients, phosphates are the most accessible and reliable to test in the field.

Elevated nutrient levels can trigger excessive plant and/or algae growth and is a key contributor to the major environmental issues of algal blooms and eutrophication. Other key contributors include sunlight and temperature. If all three factors are high and environmental conditions favourable, algal blooms are likely to occur.

Sources of excess nutrients include:
- fertiliser runoff
- degradation of organic matter in waterways (including garden waste dumped in drains or gutters)
- inflow of sediments and topsoil
- sediments associated with stormwater runoff
- detergents and some other chemicals.

Other factors affecting nutrient levels may include:
- soil and rock types
- vegetation
- organic decomposition in the waterway
- presence of animal waste
- climatic factors
- flow rate and water depth.

Nutrient levels can be determined by using colorimetry.

For more information on monitoring methods, see the Queensland Community Waterway Monitoring Manual.

**For specific recommended nutrient levels for your area of catchment, refer to the Environmental Protection (Water) Policy 1997: Coomera River Environmental Values and Water Quality Objectives – Basin No. 146, Produced March 2007.**
Activity/data collection sheets

Water sample collection spot overview
Stream habitat record
Macro-invertebrates data sheet
Physio-chemical data collection

Note: The following sheets have been produced to use directly or as a suggested guide to incorporate into your catchment tour. All sheets are fully reproducible and may be altered at your convenience.
Water sample collection spot overview

Date: [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] Monitor: 

Tributary name: Nearest suburb: 

GPS reference: 
Latitude: [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] degrees [ ] minutes [ ] seconds [ ]
Longitude: [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] degrees [ ] minutes [ ] seconds [ ]
Elevation: 
Other (e.g. – UBD reference): 

Permission required to access site? [ ] Yes [ ] No
Details: 

Access Instructions: 

Sketch: Show site location on water body, access points, land marks, survey boundaries and access path

Observations: (e.g. – smell, colour, water level, flow rate)

Reasons for choosing site:
Types of monitoring at site:

- Physical / Chemical
- Biological
- Stream condition and habitat

Type of water body:

- River
- Lake / Dam
- Creek / Stream
- Pond
- Drain
- Irrigation channel
- Other

Potential nearby pollution sources:

- Tip
- Dirt road / Track
- Quarry
- STP
- Culvert
- Aquaculture
- Development
- Stock access
- Drain
- Other

Evidence of water pollution:

- Oil
- Litter
- Algal growth
- Froth
- Odour
- Other

Waterway bed:

- Mud
- Sand
- Rock
- Gravel
- Boulders
- Concrete
- Not visible
- Other

Fauna observed:

- Fish
- Lizards
- Frogs
- Snakes
- Birds
- Spiders
- Macro-invertebrates
- Others

Evidence of environmental disturbance:

- Dead fauna
- Dead flora
- Vandalism
- Weeds
- Feral animals
- None
- Other

Changes to site:

- Natural changes (e.g. – due to flood, fire, drought, pest invasion)
- Artificial changes (e.g. – due to tree clearing, road construction, development)
- None

Description of changes:

Do changes pose a health and safety risk when mentoring site? Yes No

Vegetation cover:

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-stream</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bank</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Out of stream</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Macro-Invertebrate Recording

<table>
<thead>
<tr>
<th>Name</th>
<th>Sensitivity</th>
<th>Tick</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caddis fly Larvae</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Mayfly Nymph</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Stonefly Nymph</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Riffle Beetle</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Riffle Beetle Larvae</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Water Mite</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Long Jawed Spider</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Whirligig Beetle</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Whirligig Beetle Larvae</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Water Flea</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Water Strider</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Water Measurer</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Damselfly Larvae</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Dragonfly Larvae</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Freshwater Yabby</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Freshwater Shrimp/Prawn</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Seed Shrimp</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Water Scorpion</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
### Species richness test

<table>
<thead>
<tr>
<th>Number of bugs</th>
<th>Signal index</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B&gt;9</td>
<td>&gt;4.5</td>
<td>Good</td>
</tr>
<tr>
<td>3≤B&lt;9</td>
<td>3.5≤S&lt;4.5</td>
<td>Moderate</td>
</tr>
<tr>
<td>B&lt;3</td>
<td>S&lt;3.5</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

### Signal index test

<table>
<thead>
<tr>
<th>Signal score</th>
<th>Environmental rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;6</td>
<td>Good</td>
</tr>
<tr>
<td>5≤S&lt;6</td>
<td>Good Mildly polluted</td>
</tr>
<tr>
<td>4≤S&lt;5</td>
<td>Moderately Polluted</td>
</tr>
<tr>
<td>S&lt;4</td>
<td>Degraded</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sum of sensitivities</th>
<th>Total number of bugs</th>
<th>Signal index score</th>
<th>(A divided by B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>S</td>
<td></td>
</tr>
</tbody>
</table>
Stream habitat record

Location:  

Person(s) conducting survey/test:  

Date of survey/test:  

Easting:  

Time of survey/test:  

Northing:  

Length of stream examined:  

Stream habitat rating

Circle your stream's rating for each factor in the table below

<table>
<thead>
<tr>
<th>Rating</th>
<th>Bank vegetation</th>
<th>Verge vegetation</th>
<th>In-stream cover</th>
<th>Bank erosion and stability</th>
<th>Riffles, pools and bends</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>(10)</td>
<td>(10)</td>
<td>(10)</td>
<td>(5)</td>
<td>(5)</td>
</tr>
<tr>
<td>Good</td>
<td>(8)</td>
<td>(8)</td>
<td>(8)</td>
<td>(4)</td>
<td>(4)</td>
</tr>
<tr>
<td>Fair</td>
<td>(6)</td>
<td>(6)</td>
<td>(6)</td>
<td>(3)</td>
<td>(3)</td>
</tr>
<tr>
<td>Poor</td>
<td>(4)</td>
<td>(4)</td>
<td>(4)</td>
<td>(2)</td>
<td>(2)</td>
</tr>
<tr>
<td>Very Poor</td>
<td>(2)</td>
<td>(2)</td>
<td>(2)</td>
<td>(1)</td>
<td>(1)</td>
</tr>
</tbody>
</table>

Add up all the ratings to calculate a total score

<table>
<thead>
<tr>
<th>Rating</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>36-40</td>
</tr>
<tr>
<td>Good</td>
<td>29-35</td>
</tr>
<tr>
<td>Fair</td>
<td>20-28</td>
</tr>
<tr>
<td>Poor</td>
<td>12-19</td>
</tr>
<tr>
<td>Very poor</td>
<td>8-11</td>
</tr>
</tbody>
</table>

Total score:  

Stream habitat rating:  

Interpreting and analysing the results

Excellent  
Site in natural or virtually natural condition: excellent habitat condition

Good  
Some alteration from natural state: good habitat conditions

Fair  
Significant alterations from the natural state, but still offering moderate habitat; stable.

Poor  
Significant alterations from the natural state, with reduced habitat value; may have erosion or sedimentation problems.

Very poor  
Very degraded, often with severe erosion or sedimentation problems.

Conclusions from findings
Physio-chemical data collection

Site name: [ ]
Date of survey/test: [ ]
Time of the day: [ ]
Weather: [ ]

Site description (List the human activities that would effect the water quality at this site)

Site sketch (include human activities surrounding the creek)

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolved oxygen</td>
<td>mg/L</td>
<td>%sat</td>
</tr>
<tr>
<td>Temperature</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>pH units</td>
<td></td>
</tr>
<tr>
<td>Turbidity</td>
<td>NTU</td>
<td></td>
</tr>
<tr>
<td>Phosphates</td>
<td>mg/l</td>
<td></td>
</tr>
<tr>
<td>Salinity/electrical conductivity</td>
<td>us/cm</td>
<td></td>
</tr>
</tbody>
</table>
Vegetation identification

Use the key and the site sketch outline to assess the level of vegetation cover. Further details can be found in the habitat assessment section of the guide.

### Vegetation identification key

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree</td>
<td>More than 2m high</td>
<td>Tree</td>
<td>More than 2m high</td>
</tr>
<tr>
<td></td>
<td>Has only one stem</td>
<td></td>
<td>Has only one stem</td>
</tr>
<tr>
<td></td>
<td>Native to the area</td>
<td></td>
<td>Native to the area</td>
</tr>
<tr>
<td>Woody shrub</td>
<td>Less than 2m high</td>
<td>Woody shrub</td>
<td>Less than 2m high</td>
</tr>
<tr>
<td></td>
<td>One or more stems</td>
<td></td>
<td>One or more stems</td>
</tr>
<tr>
<td></td>
<td>Native to the area</td>
<td></td>
<td>Native to the area</td>
</tr>
<tr>
<td>Herb (grass)</td>
<td>Not woody</td>
<td>Herb (grass)</td>
<td>Not woody</td>
</tr>
<tr>
<td></td>
<td>More than one stem</td>
<td></td>
<td>More than one stem</td>
</tr>
<tr>
<td></td>
<td>Short</td>
<td></td>
<td>Short</td>
</tr>
<tr>
<td>Sedges &amp; rushes</td>
<td>Herbaceous</td>
<td>Sedges &amp; rushes</td>
<td>Herbaceous</td>
</tr>
<tr>
<td></td>
<td>Tufted perennial</td>
<td></td>
<td>Tufted perennial</td>
</tr>
</tbody>
</table>

### Native

<table>
<thead>
<tr>
<th>Submerged/ floating leaf</th>
<th>Exotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free floating</td>
<td></td>
</tr>
<tr>
<td>Broad leaf emergents</td>
<td></td>
</tr>
<tr>
<td>Narrow leaf emergents</td>
<td></td>
</tr>
</tbody>
</table>

### Exotic

Note – Emergent plants usually grow at the waters edge or in shallow water. Most of the plant is above water. These include common plants such as rushes and some grasses.
Unit of work

Our catchment

Introduction
This unit of work introduces students to the concept of a catchment and the pressures on catchment health. It explores the diversity of land use within the Coomera catchment and investigates how land use has changed over time. It also invites students to assess human impacts on the catchment and increase their capacity to positively influence these impacts.

Key concepts
The key concepts considered in this unit of work include:
- What is a catchment?
- Land use - past and present
- Human impacts on water quality
- What must be considered when managing a catchment?

Unit overview

<table>
<thead>
<tr>
<th>LEARNING PHASE</th>
<th>PRESENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engage</td>
<td>Catching up on what is happening. What is a catchment? Land use investigation.</td>
</tr>
<tr>
<td>Explore</td>
<td>From the mountains to the sea. Catchment game (explore activities that occur within a catchment and gain an understanding of their impacts on water quality).</td>
</tr>
<tr>
<td>Explain</td>
<td>Just state the facts. Develop information fact sheet - focus on a land use/activity (for example: the importance of riparian vegetation or stormwater management)</td>
</tr>
<tr>
<td>Elaborate</td>
<td>Catchment tour (water testing, biological sampling, observations, and plant identification)</td>
</tr>
<tr>
<td>Evaluate</td>
<td>Management plan: examine a section of the catchment, look at and identify fauna/flora species, examine vegetation types and consider weed management issues.</td>
</tr>
</tbody>
</table>

Linking locally
Invite the Catchment Management Unit on 5581 6722 to assist you during your catchment tour. The Catchment Management Unit can provide local knowledge, monitoring equipment and analysis of results.
Visit the Gold Coast Waterwatch website (www.goldcoastwaterwatch.org) to discover more about the Coomera Catchment and water monitoring data that has been collected in the past.
Invite a Gold Coast City Council Officer, 5581 6722, to your school to explain how the catchment is being managed to ensure it does not become degraded.

Taking action
Gold Coast City Council encourages schools to investigate the environment and learn more about the catchment in which they live. Gold Coast City Council aims to get the community involved in ongoing water monitoring and protection of waterways by organising catchment tours and other activities.
Water monitoring equipment is available to schools for students to do regular monitoring of a waterway in or near their school. Monitoring results are fed back into a database that is accessible by council and the community. This information allows council to identify anomalies and conduct further testing if required. To become
involved in regular waterway monitoring contact council’s Catchment Management Unit 5581 6722.

Schools can work to enhance the local catchment by participating in regular litter collection to reduce the amount of litter entering our waterways through the stormwater system. Students can also participate in tree planting activities which encourage local fauna to return to an area. Tree planting activities in riparian zones directly benefits the waterway by stabilising the waterway’s banks, thus reducing erosion and providing food and shelter for local fauna species.

Essential learning

<table>
<thead>
<tr>
<th>ESSENTIAL LEARNING FOR THIS UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Knowledge and understanding</strong></td>
</tr>
<tr>
<td>Key Learning Area (KLA) Science</td>
</tr>
<tr>
<td>Students know and understand:</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**At the end of Year 5**
- Science relates to students’ own experiences and activities in the community.
- Science can help to make sustainable natural, social and built environments and may influence personal human activities.

**By the end of Year 5**
- Evaluate information and evidence to support data gathered from activities and investigations.
- Draw conclusions that are supported by evidence, reproducible data and established scientific concepts.
- Reflect on learning’s to identify new understandings and future applications.

**At the end of Year 7**
- Science impacts on people, their environment and their communities.
- Scientific knowledge can help to make sustainable natural, social and built environments on a local through to global level.

**By the end of Year 7**
- Draw conclusions that summarise and explain patterns in data and are supported by experimental evidence and scientific concepts.
- Communicate scientific ideas, data and evidence, using scientific terminology suited to the context and purpose.
- Identify, apply and justify safe practice.

**At the end of Year 9**
- Issues are influenced by the application of scientific knowledge.
- Immediate and long-term consequences of human activity can be predicted by considering past and present events.
- Based on science, students can make responsible and informed decisions about real-world

**By the end of Year 9**
- Research and analyse data, information and evidence.
- Evaluate data, information and evidence to identify connections, construct arguments and link results to theory.
## ESSENTIAL LEARNING FOR THIS UNIT

<table>
<thead>
<tr>
<th>Knowledge and understanding</th>
<th>Ways of working</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key Learning Area (KLA) SOSE</strong></td>
<td><strong>Students are able to:</strong></td>
</tr>
<tr>
<td><strong>Students know and understand:</strong></td>
<td></td>
</tr>
<tr>
<td>▪ Human-environment relationships.</td>
<td>▪ Predict the impact of changes on environments by comparing evidence.</td>
</tr>
<tr>
<td>▪ Students are able to:</td>
<td>▪ Participate in geographical enquiries to evaluate impact on ecosystems in different global locations.</td>
</tr>
<tr>
<td>▪ Use criteria and geographical skills to develop conclusions about the management of a place.</td>
<td></td>
</tr>
<tr>
<td>▪ Predict the impact of changes on environments by comparing evidence.</td>
<td></td>
</tr>
<tr>
<td>▪ Participate in geographical enquiries to evaluate impact on ecosystems in different global locations.</td>
<td></td>
</tr>
</tbody>
</table>

### At the end of Year 5
- Environments are defined and changed by interactions between people and places.
- Interactions between people and places affect the physical features of the land, biodiversity, water and atmosphere.
- Sustainability of local natural, social and built environments can be influenced by positive and negative attitudes and behaviours.

### By the end of Year 5
- Draw and justify conclusions based on information and evidence.
- Pose and refine questions for investigations.

### At the end of Year 7
- Environments are defined by physical characteristics and process, and are connected to human activities and decisions about resource management.
- Sustainability requires a balance between using, conserving and protecting environments, and involves decisions about how resources are used and managed.
- Distribution maps, climate zone maps and weather maps have specific features to convey information, including latitude, longitude, eight compass points, scale and distance, a legend and shading and/or symbols.

### By the end of Year 7
- Identify issues and, use and create focus questions.
- Collect and analyse information and evidence from primary and secondary sources.
- Draw conclusions and make decisions based on information and evidence by identifying patterns and connections.
- Communicate descriptions, decisions and conclusions, using different text types for specific purposes and the conventions of research-based text.
- Reflect on learning, apply new understandings and identify future applications.

### At the end of Year 9
- Environments are defined by spatial patterns, human and physical interactions, and sustainable practices can balance human activity and environmental practices.
- Interrelationships between human activity and environments result in particular patterns of land and resource use, and can cause environmental problems.
- Governments and communities need to balance economic, social, political and environmental factors through sustainable development, consumption and production.
- Maps, including topographic, political and thematic maps are developed with particular features, including scale, contour lines and human-created boundaries, and use the specific skills of observing, visualising, estimating, sketching and measuring.

### By the end of Year 9
- Identify a research focus from broad topics and write focus questions and sub-questions.
- Research and analyse data, information and evidence from primary and secondary sources.
- Draw conclusions and make decisions supported by interpretations of data, information and evidence.
- Communicate descriptions, decisions and conclusions, using different text types for specific purposes and the conventions of research-based text.
- Reflect on learning, apply new understandings and justify future applications.
Engage

Lesson one: catching up on what is happening

Lesson overview
Using photographs and maps students will be introduced to the concept of what a catchment is. Additionally students will be provided with an insight into the diversity of land uses within the Coomera catchment and how land use has changed over the past 10 to 15 years.

Lesson objectives
Students should be able to:
- explain the term ‘catchment’
- identify land uses through visual aids
- compare maps from past and present and make conclusions.

Equipment
For the class
- Colour land use map (Resource 1) (may be electronic and/or hard copy)
- Aerial photographs of Coomera catchment (Resource 2)
- Gold Coast catchment map (Resource 3)
- ‘Everyone lives in a catchment area’ poster (Resource 4)
For the student
- Concept map black line master (BLM) (Resource 5)

Preparation
Ensure there is access to a Smart board or similar to project map images. Teacher can refer to the information provided in the study guide to gain background knowledge (specifically on the Coomera catchment).

Lesson steps
1. Introduce lesson by posing the question ‘What is a catchment?’
2. Students examine the Waterwatch Poster ‘Everyone lives in a catchment area’ and complete the Concept Map BLM.
3. To provide context, discuss the different catchments on the Gold Coast referring to the Gold Coast catchment map
4. Pose the questions:-
   - Which catchment do we live in?
   - What catchment is our school in?
   - What do we do in our catchment that may positively or negatively affect it?
5. Using the Land Use Map, have students identify, locate and highlight different land uses, suburbs or townships and places of interest within the Coomera catchment. This activity provides students with an appreciation and awareness of the enormity of the Coomera catchment.
6. Once students have had an opportunity to explore the Land Use Map, discuss how this land use may have changed in the past 50, 20 and 10 years.
7. Show students the aerial photographs from 1994 and 1999. Compare photographs to identify similarities and differences.
8. Discuss how the different land uses in the area impact upon the catchment. For example:
   - What impacts occur as a result of unfenced creeks in rural areas?
   - What role do mangroves play in the catchment?
   - What happens when mangroves are removed?
   - What waste products are washed into the stormwater system in urban areas?
9. Set up an area in the classroom for students to display their work and to be actively engaged in independent learning opportunities.
**Suggested follow-up activities**

- As a class project or an extension activity, participate in the Catchment Detox game (www.catchmentdetox.net.au). This is an online game by ABC Science that allows students to manage a whole catchment. The aim of the game is to manage a catchment so that it is environmentally and economically thriving. The game provides students with an opportunity to experience some of the difficulties involved in managing a catchment.

- Compare Coomera catchment to another Gold Coast catchment (for example, Currumbin Creek catchment).


- Using the ‘Which Side of the River’, poster, students analyse and make conclusions with reference to the Coomera Catchment.

**Suggested resources**

Map of the Coomera catchment.

‘Which side of the river?’ poster.

‘Everyone lives in a catchment area’ poster.

Gold Coast City Council www.goldcoast.qld.gov.au

Healthy Waterways www.healthywaterways.org

Gold Coast Waterwatch www.goldcoastwaterwatch.org/coomera.htm

SEQ Catchments www.seqcatchments.com.au

Waterwatch www.waterwatch.org.au


**Curriculum links**

- SOSE
  - Science
Explore
Lesson two: from the mountains to the sea

Lesson overview
This lesson provides students with a hands-on, visual representation of the impacts of certain land uses and activities that occur within the Coomera catchment.

Lesson objectives
Students should be able to:
- identify activities that occur within the Coomera catchment and their associated impacts
- reflect on the negatives and positives associated with the activity
- provide solutions to minimise the impacts from the activities.

Equipment
For the class
- Catchment game materials and procedure as outlined at the end of this lesson overview.
- Map of the Coomera catchment
- ‘Everyone lives in a catchment area’ poster (Resource 4)
- ‘The Effects of pollution on a waterway’ handout (Resource 6)
For the student
- Problem/solution BLM (Resource 7)

Preparation
Teacher to refer to background information provided in the Coomera study guide. The teacher will need to organise catchment game materials as required.

Lesson steps
1. Using the Coomera catchment map, revise and discuss the concept of a catchment.
2. Briefly discuss the water cycle within the catchment. This discussion will need to include concepts such as precipitation, stormwater, evaporation, and transpiration.
3. Outline the Catchment Game activity to students, providing students with their characters.
4. Read the Coomera catchment story.
5. At the conclusion of the story, allow students time to reflect on the polluted water body. Have students participate in a Think, Pair, Share activity.
   - Think about the activity in which they have just been involved.
   - Pair with a friend and discuss their observations.
   - Share these thoughts with others either verbally or in a written form.
6. Through an open discussion, highlight a number of impacts that occurred during the catchment game activity. Discuss possible alternative actions that would lead to either prevention or minimisation of the negative impacts on the catchment.
7. After examining ‘The effects of pollution on a waterway’ handout. (Resource 6), have students complete a Problem/Solution BLM (Resource7).
Suggested follow-up activities

- Participate in the Catchment Detox game (www.catchmentdetox.net.au). This ABC Science online game provides students with a chance to manage a catchment area.
- Visit a nearby water body to explore and identify activities that may affect the water quality. Alternatively, have students locate a water body near where they live and complete observations.
- Have students make a poster or postcard based on the Healthy Waterways ‘What you can do’ poster (http://www.healthywaterways.org/litter_what_u_can_do.html) focussing on what they can do to minimise waterway pollution.
- Invite a quest speaker to your class to discuss ways in which development sites minimise run off.
- If the school is near a water body, have the students identify activities and possible impacts that influence the health of the waterway. The students could then educate other year levels through role plays, posters, assembly presentations, write a story book or create an article for the school newsletter or website.

Suggested resources

Gold Coast Water’s ‘Our Watercycle’ poster Gold City Council www.goldcoast.qld.gov.au Healthy Waterways www.healthywaterways.org
Gold Coast Waterwatch www.goldcoastwaterwatch.org/coomera.htm
SEQ Catchments www.seqcatchments.com.au
Waterwatch www.waterwatch.org.au
Ecosystems Health Monitoring Program www.ehmp.org/what_is_ecosystem_health.html and www.ehmp.org/pimpamacoomera_rivers_catchment_and_estuary.html

Curriculum links

SOSE
Science
**The Coomera River Story**

My story starts high up in the hills in Lamington National Park on the Lamington Plateau where my tiny creek is formed.

As the rain begins drizzling down, the water from one of my tiny rock pools spills over and I start my journey.

Hmm, smell that BBQ sizzling away. It’s David. He’s celebrating his 11th birthday with his family at Binna Burra in the Lamington National Park. As I go rushing past a gust of wind picks up a balloon, and some of David’s streamers fall into my creek. Unfortunately, no-one has noticed and the balloon and streamers join me on my journey.

Rushing down the hill I go, and just as the rainforest ends I see Jenny’s farm. Oh, that’s different. Jenny and her dad must have pulled out some of the lovely trees near my banks to let the grass grow for their cows. Don’t they realise that soil is washing down off the banks and into my water, making me all muddy?

There’s Madeline and her dog Boogie. Whoops! Boogie is going to the toilet and Madeline has forgotten Boogie’s pooper scooper. That mess is going to end up in my water when it rains next. Yuck.

My river is getting a little wider now, and at the bottom of the hill I run through a new housing development in Upper Coomera. It’s great to see so many people from the neighbourhood swimming in me on the weekends but I wonder if they realise what they’re swimming in. You see, anything that goes down the stormwater drain goes straight into me.

Jane and her mother are out washing the car. Great day for it but they are washing the car in the driveway. All that detergent is going straight down the drain and into me. If they washed the car on the lawn, it wouldn’t be such a mess.

Jane’s neighbour, Carlo is out mowing his lawn. I wonder if he is going to put those grass clippings in the compost bin? Carlo, what are you doing? He’s tipping it straight into the gutter. That’s going to end up in me.

I love rushing past Yoshii’s house. His garden looks gorgeous. I wonder how he does it? Wait. What’s Yoshii putting on his garden? Doesn’t he know all that fertiliser will just get washed off his beautiful garden and end up in my river? It will make the animals, plants and me quite sick.

Yoshii should ask Carlo to start a compost bin. Compost bins are a better, natural fertiliser for gardens.

There’s Yoshii’s best friend, Joshua. He has just moved into a house on one of the canal estates. He loves going for a swim in me. You see, Joshua’s old place use to have a pool but his new house doesn’t. Joshua and his father usually take all of their old pool chemicals back to the pool shop to get rid of them properly.

Oh no, Josh’s dad is tipping them down the drain today. He thinks that no-one is looking but I am and I don’t want those chemicals in my water. It creates a strange smell and some of the fish that live in me get really sick.

As I run around the next bend I go past a new shopping centre. Its car park is close to my banks. Looks like Ben has just finished some shopping and is loading his groceries into the car. A gust of wind has blown a plastic bag out of Ben’s hands and into the air. Quick! Catch it Ben, before it’s too late! Ben chases the bag but it has landed in my water and is joining me on my journey.

On the other side of the car park, Nick is painting a new sign. Looks great Nick…..watch out for that bucket of paint! That paint is coming straight for me. Ahh!!! I’m all red. (cough, cough)

I’m starting to change shape as I rush past many new canal estates; I think I will have some interesting adventures in them. Around the bend I go, rushing and winding over the rocks and through the trees. Just past the clearing, I can see Sara in the school playground.

Sara is a fantastic basketball player. Oh look, she’s
practising her shots now. Hang on, that’s not a ball. Sara’s using her lunch wrap and shooting it into the bin. What a great idea. Oops! There’s the bell. Quick Sara, you don’t want to be late for class! Hey, what about that last shot? She’s missed the bin.

An Ibis has picked up Sara’s litter. Wonder what he’s going to do with it? Ew! He’s dropped it into my water.

I don’t feel so well. All of this stuff is making me sick.

I am nearly at the end of my journey; just a bit further now. There’s the Walton family out having a BBQ at Paradise Point. Brittany is playing with a Frisbee with her sister. Gee Brittany, that was quite a throw and it’s heading straight for your mum. Brittany yelled out to her mum to catch the Frisbee. Her mum caught the Frisbee but dropped her cigarette butt in the process. That’s going to wash into my water too.

Along the shore, Brittany’s brother, Toby was looking for bugs. Ouch! That’s gotta hurt. Toby slipped and smashed the bottle he was carrying. Good to see he’s picking up the pieces but he’s forgetting about the bits that have fallen into me.

Whoosh! There goes Kacey on her jet ski. What’s that stuff coming out of the back? Is that oil? (cough, cough) All that black greasy mess coming from Kacey’s engine is washing straight into me.

I have nearly finished my journey now and I have almost made it to the ocean. This is Kyle’s favourite fishing spot, just within eyesight of South Stradbroke Island. When he was here last, he got his line caught on some rocks and couldn’t free it, so he cut the line and left it. Oh no there’s a turtle caught up in Kyle’s old fishing line. Kyle is going to feel just terrible when he sees this.

As I flow out into the Broadwater there are locals and tourists swimming, water skiing, fishing and playing in my water. I use to love being a crystal clear creek, growing into a river and now flowing out into the sea but I just wish people would take better care of me.

### Materials required for catchment game activity

<table>
<thead>
<tr>
<th>NAME</th>
<th>CANISTER CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>David</td>
<td>balloon and streamers</td>
</tr>
<tr>
<td>Jenny</td>
<td>half canister of soil</td>
</tr>
<tr>
<td>Madeline</td>
<td>dynamic lifter (dog poo)</td>
</tr>
<tr>
<td>Jane</td>
<td>detergent mixed with water</td>
</tr>
<tr>
<td>Carlo</td>
<td>grass clippings</td>
</tr>
<tr>
<td>Yoshii</td>
<td>three teaspoons of baking soda</td>
</tr>
<tr>
<td>Joshua</td>
<td>vinegar</td>
</tr>
<tr>
<td>Ben</td>
<td>plastic shopping bag cut up into small pieces</td>
</tr>
<tr>
<td>Nick</td>
<td>few drops of red food colouring in half-full canister</td>
</tr>
<tr>
<td>Sara</td>
<td>small piece of plastic cling wrap</td>
</tr>
<tr>
<td>Brittany</td>
<td>butts made from foam, polystyrene or similar (do not use real butts due to the health and safety issues)</td>
</tr>
<tr>
<td>Toby</td>
<td>chopped up hard pieces of clear plastic</td>
</tr>
<tr>
<td>Kacey</td>
<td>water and browning essence (few drops)</td>
</tr>
<tr>
<td>Kyle</td>
<td>fishing line</td>
</tr>
</tbody>
</table>

You will also need a clear container or bowl filled with water.

**Process** — Fill film canisters or small containers with the ingredients as listed and label the containers appropriately (you may need two sets so all of your class is involved). Give a canister to each student. Read the story and when the name on the canister is mentioned in the story, the student comes forward to empty the canister into the bowl.

When emptying the ‘polluted’ water pour it through a sieve to remove the non-biodegradable materials.
Explain

Lesson three: just state the facts

Lesson overview
This lesson aims to consolidate the ability to identify issues within the Coomera catchment with the need to educate Coomera catchment residents about preventative measures regarding catchment issues.

Lesson objectives
Students should be able to:
- identify an activity or land use relevant to the Coomera catchment
- research information about an identified activity or land use
- produce an information fact sheet regarding the identified activity or land use.

Equipment
For the class
- Examples of information facts sheets (e.g. GCCC Riparian Vegetation and Stormwater)

For the student
- Hot list of relevant websites (Resource 8)
- Middle school – information fact sheet BLM (Resource 9)

Preparation
Teacher to refer to background information provided in study guide.

Lesson steps
1. As a class, brainstorm a list of activities and/or land uses within the Coomera catchment.
2. Students are to choose an activity or land use and research it. Middle school students can use the information fact sheet BLM (Resource 9) to help scaffold their research.
3. Upon completion of research and information gathering, students compile a fact sheet that will provide information to explain the activity and ways to minimise its affects on the waterways. The target audience can be local residents, businesses, schools or community group such as the local pony club.
4. Information fact sheet could be created in hard copy or online as a portable document (PDF).
**Suggested follow up activities**

- Participate in the Catchment Detox game (www.catchmentdetox.net.au), an online ABC Science game that enables students to manage a catchment.
- Invite a guest speaker from the Coomera Catchment Group to your class.
- Students could design a postcard that can be delivered to residents informing them of issues within the catchment.
- Students design a poster based on the ‘Everyone lives in a catchment area’ poster.

**Suggested resources**

- The Effects of Pollution on a Waterway – (Resource 6)
- Gold Coast City Council [www.goldcoast.qld.gov.au](http://www.goldcoast.qld.gov.au)
- Healthy Waterways [www.healthywaterways.org](http://www.healthywaterways.org)
- Gold Coast Waterwatch [www.goldcoastwaterwatch.org.coomera.htm](http://www.goldcoastwaterwatch.org.coomera.htm)
- Ecosystems Health Monitoring Program [www.ehmp.org/what_is_ecosystem_health.html](http://www.ehmp.org/what_is_ecosystem_health.html) and [www.ehmp.org/pimpama_coomera_rivers_catchment_and_estuary.html](http://www.ehmp.org/pimpama_coomera_rivers_catchment_and_estuary.html).

**Curriculum links**

- SOSE
- Science
Elaborate

Lesson four: catchment tour

Lesson overview
Students visit sites along the Coomera River and its tributaries and use various recording methods to collect data and information that gives them an understanding of the health of the waterway.

Lesson objectives
Students should be able to:
- make conclusions about the health of the waterway using observational data collection methods
- draw a detailed sketch of the study site
- identify pollutants, pollutant pathways and other environmental threats evident at the site.

Equipment
For the class
- Water monitoring equipment
- First aid kit
For the student
- Clipboard
- Writing material
- Sun protection

Preparation
(Refer to the catchment tour section in this guide for more information).
- Identify suitable excursion locations. Aim to visit at least three sites during the day. Ensure at least one of these is a freshwater site.
- Teacher will need to complete site assessment as per Education Queensland requirements.
- Teacher to refer to background information provided in the study guide.
Lesson steps
1. Conduct tour
2. Reflect on monitoring experiences and results at each site.

Suggested follow up activities
- Access Google and Google Earth maps to collect further information on the field study site.
- Participate in a comparative study between the Coomera catchment and theCurrumbin catchment.
- In addition to the Catchment Tour or as an alternative to a full catchment tour, water quality testing could be conducted near a body of water close to the school grounds.

Suggested resources
Gold City Council www.goldcoast.qld.gov.au
Healthy Waterways www.healthywaterways.org
Gold Coast Waterwatch www.goldcoastwaterwatch.org/coomera.htm
SEQ Catchments www.seqcatchments.com.au
Waterwatch www.waterwatch.org.au
Ecosystems Health Monitoring Program www.ehmp.org/what_is_ecosystem_health.html and www.ehmp.org/pimpama_coomera_rivers_catchment_and_estuary.html

Curriculum Links
SOSE
Science
Note: Gold Coast City Council can provide water monitoring equipment and personnel to accompany you on the catchment tour. Contact 5581 6722 for more details.
Lesson five: managing our catchment

Lesson overview
Students produce a catchment management plan relevant to the Coomera catchment.

Lesson objectives
Students should be able to:
- identify an area that requires management
- research and collate data/information
- provide a clear format of issues and management strategies.

Equipment
For the class
- Examples of existing catchment management plans
- The effects of pollution on a waterway handout (Resource 6)
For the student
- Developing a Catchment Management Plan framework (Resource 10)
- Issue ideas list (Resource 11)

Preparation
Teacher to refer to background information provided in study guide and the Environmental Inventory of the Coomera River and all its tributaries (Catchment Management Plan for the Coomera River – provided on CD). Provide a list of possible management issues to students.

Lesson steps
1. Ask the following questions and discuss them as a class.
   - What is a catchment management plan?
   - Why do we need them?
2. Provide students with example catchment management plans Highlight formats, information to be included, and topics.
3. Provide students with the ‘issue ideas list’ (Resource 11) to provide direction.
4. To scaffold the development of the catchment management plan, provide students with Resource 10, Catchment Management Plan framework.
5. Students will be required to research, collate and develop strategies for managing the Coomera catchment. The ‘Effects of pollution on a waterway’ handout (Resource 6) can assist students in this research.
Suggested follow up activities

- Students produce an Environmental Impact Statement (EIS) based on a real life scenario within the Coomera catchment or a fictional scenario.
- Students produce a report card based on the Ecosystems Health Monitoring Program.
- The students could develop a Catchment Management Plan that is specific to the school.

Suggested resources
Gold Coast City Council www.goldcoast.qld.gov.au
Healthy Waterways www.healthywaterways.org
Gold Coast Waterwatch www.goldcoastwaterwatch.org/coomera.htm
SEQ Catchments www.seqcatchments.com.au
Waterwatch www.waterwatch.org.au
Ecosystems Health Monitoring Program www.ehmp.org/what_is_ecosystem_health.html and www.ehmp.org/pimpamacoomera_rivers_catchment_and_estuary.html

Curriculum Links
SOSE
Science
Learning activity booklet: Year 3
Learning activity booklet: Year 3

For the teacher -

Lesson overview:

Using field resources and site investigations, students will learn about what a catchment is and what catchment they live in. They will revise the meaning of non-living and living things in the context of non-living and living things that comprise a catchment.

Lesson objectives

Students should be able to:

- describe what a ‘catchment’ is
- identify some features of a healthy catchment/ identify some human activities that may affect the health of the catchment
- identify living and non-living things that may be found in the catchment area.

Equipment

For the class

- Gold Coast catchment map (Resource 3)
- ‘Everyone lives in a catchment area’ poster (Resource 4)

For the student

- Scissors
- Glue or sticky tape
- Coloured pencils
- HB pencil or pen to write with

Preparation

Teacher can refer to the information provided in the study guide to gain background knowledge (specifically on the Coomera catchment). Teacher may need to work closely with students so they can understand the questions.

Curriculum links

Science
For the students –

Activity Booklet

Part 1: What is a catchment?

1. After looking at the ‘everyone lives in a catchment area’ poster, write down in your own words what you think a ‘catchment’ is:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

2. Have a look at the gold coast catchment map and write down what catchment area you live in:

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

3. Have another look at the Gold Coast catchments map and name two catchments that are nearby to your catchment area:

__________________________________________________________________________
__________________________________________________________________________
4. What are some things in a healthy catchment? (Talk about it with your teacher and classmates and write down answers as you go!).

- 
- 
- 
- 
- 

5. What are some human activities that might make the catchment polluted or unhealthy?

- 
- 
-
6. In the space provided below, draw an ideal picture of the catchment you live in. You can do this by pretending you are a bird flying over the top and draw what you see. You can draw houses, farms, forests, ocean and upper parts of the waterway (you can use the ‘everyone lives in a catchment area’ poster as a guide):

Part 2: Living and non-living features of a catchment.

1. Place the words living, plants, non-living and cement in their right place in the sentence below:

   _______ things are things that are alive or were once alive, such as people, ______

   and animals. Things that have never been alive are called ________ things. These include things like rocks, ______, drains and roads.
2. Write down some living and non-living things of the catchment using the ‘everyone lives in a catchment area’ poster as a guide:
3. Now, complete the **cut and paste** activity to group the words and pictures into living and non-living things. Once you have cut out the shapes on the last page of the activity booklet, paste them into the correct side of the table below.

<table>
<thead>
<tr>
<th>LIVING</th>
<th>NON-LIVING</th>
</tr>
</thead>
</table>

**Cut and paste** these living and non-living pictures into their right place in the table provided in **Part 2** of the activity booklet. If you have time you can colour in the black and white ones!
Learning activity booklet: Year 4
Learning activity booklet: Year 4

For the teacher -

Lesson overview:

Using field guides and site investigations, students will learn the difference between aquatic and terrestrial environments and identify what sort of plants and animals might live in each environment. Students will investigate the life-cycle of an insect that spends time in both aquatic and terrestrial environments throughout its life-cycle. Students will explore how relationships between plants and animals are linked through the food chain.

Lesson objectives

Students should be able to:

- describe some differences between ‘aquatic’ and ‘terrestrial’ environments
- identify aquatic and terrestrial stages of the caddisfly lifecycle
- understand how plants and animals in aquatic and terrestrial environments are connected through food webs

Equipment

For the class

- Field guides (e.g. plants of greater Brisbane, wildlife of greater Brisbane, Mangroves to Mountains)
- ‘Life cycle of a caddisfly’ poster (Resource 12)
- ‘Everyone lives in a catchment area’ poster (Resource 4)
- ‘Gold Coast catchment’ map (Resource 3)

For the student

- Writing materials

Preparation

Teacher can refer to the information provided in the study guide to gain background knowledge (specifically on the Coomera catchment). Review what a catchment is with the class using the ‘everybody lives in a catchment area’ poster. Part 1, question four will require a site visit to a waterway. This may be within the school grounds or nearby area. If a site visit is not possible, you may use internet resources to assist students with their observations and answers.

Curriculum links

Science
For the students –

Part one – Your catchment area

1. Look at the Gold Coast catchment map and write down what catchment area you live in

__________________________________________________________________________

2. Have another look at the Gold Coast catchment map and write down the names of two surrounding catchment areas

3. Now have a look at the ‘everyone lives in a catchment area’ poster and write down some of the things that make up a catchment:

Part two - Aquatic and terrestrial environments

1. Catchments are made up of aquatic and terrestrial environments. Write the words forests, deserts, land, terrestrial, aquatic, ponds, oceans, saltwater, freshwater and lower in their correct place in the sentences below:

Environments that are on the _____ are known as ________ environments. They include

mountaintops, ________, grasslands, houses and ________. Watery environments are known as ________ environments. They may be _________ aquatic environments, such as seas,
estuaries or salt lakes, or freshwater aquatic environments, which include lakes, 
creeks and springs.

Saltwater environments are usually found in the _____ parts of the catchment, whereas __________ environments are found in the upper parts of the catchment.

2. Have a look at the ‘everybody lives in a catchment’ poster and see if you can think of any other types of terrestrial environments?

3. Can you think of any other types of aquatic environments?
4. Make some observations about the aquatic and terrestrial environments in and around a selected waterway by exploring the table below and writing your best response:

<table>
<thead>
<tr>
<th></th>
<th>AQUATIC</th>
<th>TERRESTRIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can you see any plants in this environment?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Where are they growing?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there any animals you can see?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How are they moving around?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you think there is a lot of oxygen available in this environment?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you think a lot of light can get in to this environment?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much space is available?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Part two - aquatic and terrestrial life stages of the caddisfly

The caddisfly is a type of macroinvertebrate. Macroinvertebrates can be defined by two things: firstly they are small animals but still large enough to be seen with the eye and secondly, they are invertebrates meaning they have no backbone but instead have a strong outer covering or exoskeleton to protect them. There are four stages to the caddisfly’s lifecycle. It spends part of its lifecycle underwater in an aquatic environment, and part of its lifecycle in a terrestrial environment. Can you label the different life stages of the caddisfly larvae in the diagram below? HINT: The four stages are eggs, larvae, pupa and adult!

Now that you have labelled the life stages of the caddisfly larvae, can you identify which of the life stages are spent underwater in the aquatic environment and which life stage is spent in a terrestrial environment? Draw a line from the word ‘aquatic’ to the life stages that are spent in this type of environment. Do the same for the word ‘terrestrial’. It may be helpful to your field guides and look at the different features of the caddisfly to get your answer!
Part 3 - Aquatic and terrestrial food chains

Living things in terrestrial and aquatic environments, depend on each other for survival. Now that you have gained an understanding of some difference between aquatic and terrestrial environments, we will explore how plants and animals in aquatic and terrestrial environments are connected through food chains.

So what is a food chain?

A food chain is a picture that shows who eats who! First, there are the producers, which include plants that produce their own energy from the sun. They get eaten by the primary consumers, also known as herbivores. Some herbivores might get eaten by carnivores who are at the top of the food chain.

1. Have a look at the diagram below which shows the structure of a food chain. To the left of the diagram are some terrestrial plants and animals. To the right are some plants and animals that are aquatic. Draw a line from each picture to one of the boxes, to show where they sit in the food chain. One of these has been done for you:
2. What might happen if there weren’t any aquatic plants in the waterways of the catchment you live in?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

3. What might happen if there were no terrestrial plants or trees on the land in the catchment you live in?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

4. What are some human activities that might affect the health of aquatic and terrestrial environments in your catchment area?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

5. What can you do to help your catchment stay healthy and prevent it from becoming polluted?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
6. What can people do to make sure the water stays nice and healthy in aquatic environments?

__________________________________________________________

__________________________________________________________

__________________________________________________________
Learning activity booklet: Year 5
Learning activity booklet: Year 5

For the teacher -

Lesson overview:
Through class discussions lead by the teacher, students will gain a broad understanding of what is meant by adaptations of plants and animals. This will enable them to compare aquatic plants and animals to terrestrial plants and animals by identifying some of their adaptations to different environments using field resources and site investigations. Students will gain a broad understanding of ecosystems within a catchment how plants and animals in aquatic and terrestrial environments are connected through food webs.

Lesson objectives
Students should be able to:
- explain the term ‘adaptations’.
- identify some differences between aquatic and terrestrial plants within their catchment area based on structural and functional adaptations.
- identify some differences between aquatic and terrestrial animals within their catchment area based on structural and functional adaptations.
- describe the term ‘ecosystem’.
- understand how plants and animals in aquatic and terrestrial environments are connected through food webs.

Equipment

For the class
- field guides (e.g. plants of greater Brisbane, wildlife of greater Brisbane...)
- Gold Coast catchment map (Resource 3)
- ‘everyone lives in a catchment area’ poster (Resource 4)

For the student
- scissors
- glue or sticky tape
- coloured pencils
- HB pencil or pen to write with

Preparation
Teacher can refer to the information provided in the study guide to gain background knowledge (specifically on the Coomera catchment). Review what a catchment is with the class using the “everybody lives in a catchment area” poster. A site visit to a local waterway may be useful for developing an understanding of the differences between aquatic and terrestrial environments and the different adaptations of plants and animals. This may be within the school grounds or nearby area. If a site visit is not possible, you may use internet resources to assist students with their observations and answers.
Definitions:

Adaptations:

May be structural or functional changes that occur in a plant or animal that help them to survive in their environment.

Ecosystem:

An ecosystem is a group of plants, animals and other things that live, feed, reproduce and interact together in the same area. Three main groups of living things that make up a food chain within an ecosystem are producers (plants and things that make energy from the sun), primary consumers (things that eat plants, the vegetarians) and secondary consumers (the carnivores – they eat the primary consumers!).

Curriculum links

Science
For the students –

Part one – Your catchment area

4. Look at the Gold Coast catchment map and write down what catchment area you live in

5. Have another look at the Gold Coast catchment map and write down the names of two surrounding catchment areas

6. Now have a look at the ‘everyone lives in a catchment area’ poster and write down some of the things that make up a catchment:

   -
   -
   -
   -
   -
   -
Part two - Aquatic and terrestrial animals

1. Animals that live within a catchment area may be mostly aquatic or terrestrial. Write the words terrestrial, aquatic, ducks, fish, dolphins, frogs and carpet python in their correct place in the sentences below:

   Animals that live mostly on the land are known as _________ animals.

   Some types of terrestrial animals include cats, dogs and some reptiles, including the ________________! __________ animals spend most or all of their lives in water, including _____, turtles, eels, sharks and __________. Some types of animals will send some of their time in an aquatic environment and the rest of their time in the surrounding terrestrial environment, such as eastern water dragons, ______ and water birds like _______ and spoonbills.

2. Can you think of any other aquatic and terrestrial animals that live in your catchment area? Have a look at your surroundings and see if you can observe any animals and decide if you think they are aquatic or terrestrial. Write down your answers in the table below:

<table>
<thead>
<tr>
<th>AQUATIC ANIMALS</th>
<th>TERRESTRIAL ANIMALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Different types of animals will often have different adaptations to their environment based on whether they are aquatic or terrestrial. Adaptations may be small changes that happen over a long time to help an animal survive in its environment. These might be changes in the way an animal looks, moves, eats, breathes or reproduces. An adaptation may also be a change that happens over a short period of time to help an animal survive, for example the burrowing frog adapts to different seasons by sleeping underground in the dry season and being active in the wet season to look for food and find a mate!

Choose one animal from an aquatic environment and one from a terrestrial environment in your catchment area and fill out the table below based on your observations. You may use a field guide to help with your answers.

<table>
<thead>
<tr>
<th>TYPE OF ANIMAL</th>
<th>AQUATIC ANIMALS</th>
<th>TERRESTRIAL ANIMALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the name of this animal?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin texture (what does its skin feel like?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of skin covering (does it have fur, feathers, scales, or something else...)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How does it breathe? (does it have lungs or gills, does it breathe through its mouth or skin?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What colour is it?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How does it move?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What does it eat?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does it have a backbone?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How does it reproduce? (does it lay eggs or have live babies?)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Part three - Aquatic and terrestrial plants

1. Plants that are found within a catchment area may be mostly aquatic or terrestrial. Write the words terrestrial, aquatic, waterlilies, seaweed, trees and eucalypt in their correct place in the sentences below:

Plants that grow mostly on the land are known as _________ plants. Some types of terrestrial plants include plants that are found in the garden, like rose bushes and plants that are also found in the forest, like acacias, banksias and __________, which koalas love to eat! __________ plants are mostly found growing in watery environments, like ponds, creeks, rivers and the ocean. Aquatic plants may be free floating, like duckweed, or anchored to the bottom like _________ and ________, or amphibious (like a frog!), meaning they can survive on land or in the water.

2. Can you think of any other types of aquatic and terrestrial plants that are found in your catchment area? Have a look at your surroundings and see if you can see any plants and decide if you think they are aquatic or terrestrial. Write down your answers in the table below:

<table>
<thead>
<tr>
<th>AQUATIC PLANTS</th>
<th>TERRESTRIAL PLANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Different types of plants may also have different adaptations to their environment based on whether they are aquatic or terrestrial. Choose one plant from an aquatic environment and one from a terrestrial environment in your catchment area and fill out the table below based on your observations. You may use a field guide to help with your answers.

<table>
<thead>
<tr>
<th>TYPE OF PLANT</th>
<th>AQUATIC PLANT</th>
<th>TERRESTRIAL PLANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the name of this plant?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaf texture (what do the leaves feel like?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of trunk covering (does it have bark, or does it have a smooth trunk? Maybe it has both?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What colour is it?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How does it reproduce? (does it have flowers, or seeds as in a pine cone or grass?)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Part four - Aquatic and terrestrial food chains

Living things in terrestrial and aquatic environments, depend on each other for survival. Now that you have gained an understanding of some difference between aquatic and terrestrial environments, we will explore how plants and animals in aquatic and terrestrial environments are connected through food chains.

What is a food chain?

A food chain is a picture that shows who eats who! First, there are the producers, which include plants that produce their own energy from the sun. They get eaten by the primary consumers, also known as herbivores. Some herbivores might get eaten by the secondary consumers, also known as carnivores, which are at the top of the food chain.

7. Have a look at the diagram on the next page which shows the structure of a food chain. To the left of the diagram are some terrestrial plants and animals. To the right are some plants and animals that are aquatic. Draw a line from each picture to one of the boxes, to show where they sit in the food chain and write an ‘A’ next to the things that are AQUATIC and a ‘T’ next to things that are TERRESTRIAL. It might help to discuss this with your class mates. One of these has been done for you:

REMEMBER: TERRESTRIAL = ‘T’ AND AQUATIC = ‘A’
SECONDARY CONSUMERS
e.g. carnivores (meat eaters)

PRIMARY CONSUMERS
e.g. Herbivores (plant eaters)

PRODUCERS
e.g. plants

- Mushroom
- Carnivorous Ant
- Dragonfly
- Eagle
- Koala
- Yabbie
- Parrot
- Reeds
- Gum tree
- Freshwater shrimp
- Vegetarian fish
- Caddisfly larvae
- Aquatic plant
- Banksia tree
- Turtle
- Dolphin
8. What might happen if there were no aquatic plants in the waterways of the catchment you live in?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

9. List three things that might happen if all of the terrestrial plants and trees were removed from the land in your catchment area?

- 
- 
- 

10. Do you think any of the aquatic plants or animals could live without the others? Why or why not?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
11. Do you think any of the terrestrial plants and animals could live without the others? Why or why not?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

12. List some human activities that might affect the health of the plants and animals in your catchment area

- 

- 

- 

- 

-
Learning activity booklet: Year 6
Learning activity booklet: Year 6

For the teacher -

Lesson overview:

Students will review what a catchment is and what catchment they live in. Using field resources and site investigations, students will carry out scientific investigations of living and non-living things in the catchment in order to gain an understanding about how the physical conditions of the catchment affect the survival of living things. This will be achieved through physio-chemical and biological sampling of a selected water body, which may be within the school grounds or nearby location.

Lesson objectives

Students should be able to:

- explain the term ‘catchment’ and have knowledge of which catchment area they live in
- recognise physio-chemical testing as being a measure of the non-living component of water quality
- name some physio-chemical tests that are done to assess water quality
- identify biological sampling as being a measure of the living component of water quality
- understand that different types of macroinvertebrates are found in different waterways and this may be influenced by pollution levels
- identify some features of a healthy catchment/ identify some human activities that may affect the health of the catchment

Equipment

For the class

- Gold Coast catchment map (Resource 3)
- ‘everyone lives in a catchment area’ poster (Resource 4)
- one or two copies of the ‘Coomera River Study Guide’
- ‘macro-invertebrate Recording’ activity/data collection sheets provided in the study guide
- macroinvertebrate sampling equipment and identification charts as suggested in study guide (pp.28)
- equipment as prescribed in study guide for physical and chemical tests for dissolved oxygen, temperature, pH, electrical conductivity, turbidity, flow and nutrients

For the student

- HB pencil or pen to write with
- hat, sunscreen, water

Preparation

Teacher can refer to the information provided in the study guide to gain background knowledge on the Coomera catchment and water testing, specifically macro-invertebrates and physio-chemical testing. The teacher may wish to arrange for a Gold Coast Waterwatch Officer to meet the class on site and facilitate the sampling. This service is free of charge within Gold Coast City Council area and may be useful if the school does not have the required equipment.

Curriculum links

Science
For the students –

Part one – Your catchment area

1. Look at the Gold Coast catchment map and write down what catchment area you live in

________________________________________________________________________________________

2. Have another look at the Gold Coast catchment map and write down the names of two surrounding catchment areas

3. Now have a look at the ‘everyone lives in a catchment area’ poster and write down some of the things that make up a catchment:

   •

   •

   •

   •

   •

   •
Part two – Physio-chemical sampling

1. Fill in the missing words in the following by having a look at the section on water testing in the Coomera River Study Guide. Your missing words are temperature, dissolved oxygen and chemical.

Physio-chemical properties of water include the physical non-living elements that we can see or touch, including turbidity, flow and ___________, as well as the __________ properties of water, which include electrical conductivity, ________________ and nutrients.

2. Draw a line from the physio-chemical property on the left, to the correct definition on the right. Have a look at the section on water testing in the Coomera River Study Guide:

<table>
<thead>
<tr>
<th>Property</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbidity</td>
<td>Measures the water’s ability to conduct electricity, which changes depending on the amount of salt in the water (salinity). Used to identify whether the water is salty or fresh.</td>
</tr>
<tr>
<td>Temperature</td>
<td>Measures the amount of oxygen in the water</td>
</tr>
<tr>
<td>Flow</td>
<td>A measure of the acidity of the waterway</td>
</tr>
<tr>
<td>Electrical Conductivity</td>
<td>Refers to clarity or clearness of the water</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>Indicates the volume of water moving through the waterway</td>
</tr>
<tr>
<td>Nutrients</td>
<td>Shows how hot or cold the water is</td>
</tr>
<tr>
<td>pH</td>
<td>Help plants to grow. One form of these is called phosphates.  There may be excessive plant growth if too much is in the waterway</td>
</tr>
</tbody>
</table>
3. By testing the physio-chemical properties of water, it is possible to identify if the waterway is healthy. If the value is outside its ideal range something may need to be done to improve the health of the waterway. Write your results for the physio-chemical testing in the table below and indicate if it is within the ideal range by CIRCLING YES or NO in the correct column.

<table>
<thead>
<tr>
<th>PHYSIO-CHEMICAL PROPERTY</th>
<th>TEST RESULT</th>
<th>IDEAL RANGE*</th>
<th>IS YOUR RESULT WITHIN THE IDEAL RANGE?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Low-mid catchment</td>
<td>Upper catchment</td>
</tr>
<tr>
<td>Turbidity</td>
<td>NTU</td>
<td>&lt;50 NTU</td>
<td>&lt;25 NTU</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>mg/L</td>
<td>8-12</td>
<td>8-12</td>
</tr>
<tr>
<td>Nutrients</td>
<td>mg/L</td>
<td>&lt;0.05</td>
<td>&lt;0.03</td>
</tr>
<tr>
<td>pH</td>
<td>pH Units</td>
<td>6.5-8.0</td>
<td>6.5-8.2</td>
</tr>
</tbody>
</table>

*Based on 2009 Queensland Water Quality Guidelines.

** Freshwater lakes generally fall below this range, often below 5 mg/l. This result is natural and does not indicate poor water quality.

4. Were any of your physio-chemical test results outside the ideal range? What might this indicate about the waterway?

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

Coomera River Catchment Study Guide 99
List two ways that nutrients (like phosphates) can end up in the waterway:

- 
- 

5. What can you do to make sure your waterway stays healthy?

_______________________________________________________________________

_______________________________________________________________________

Part three – biological sampling (macroinvertebrates)

This part of the activity booklet can be completed AFTER you have carried out the macroinvertebrate sampling and recorded your results in a macroinvertebrate record sheet. By this time you should have a bit of an understanding about what a macroinvertebrate is and how sensitive they are to pollution based on their sensitivity rating from 1-10.

“A BRIEF REVIEW” - Macroinvertebrates can be defined by two things: firstly they are small animals but still large enough to be seen with the eye and secondly, they are invertebrates meaning they have no backbone but instead have a strong outer covering or exoskeleton to protect them.

1. What was the highest sensitivity rating you recorded? What type of macroinvertebrate was it?

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________
2. What was the lowest sensitivity score? What type of macroinvertebrate was it?

_______________________________________________________

_______________________________________________________

_______________________________________________________

3. In the space below, sketch one of the macroinvertebrates you found. Don’t forget to write down what type of bug it is and its sensitivity score:
4. What are some physio-chemical properties that might affect the health of macroinvertebrates in the waterway?

________________________________________________________

________________________________________________________

________________________________________________________

________________________________________________________

5. Can you think of some things that might cause a waterway to become polluted?

________________________________________________________

________________________________________________________

________________________________________________________

________________________________________________________

6. Who or what can be responsible for activities that can make the waterway polluted?

________________________________________________________

________________________________________________________

________________________________________________________

________________________________________________________
Learning activity booklet: Year 7
Learning activity booklet: Year 7

For the teacher -

Lesson overview:
Students will review what a catchment is and what catchment they live in. Using field resources and site investigations, students will learn to carry out scientific investigations of living things in the catchment by sampling macroinvertebrates in a selected water body. Students will investigate classification of species by comparing different macroinvertebrates from their sample. Students will explore interactions between species through food webs and how human activities can impact on these interactions. Macroinvertebrate sampling may be conducted at a water body within the school grounds or nearby location.

Lesson objectives
Students should be able to:
- explain the term ‘catchment’ and have knowledge of which catchment area they live in
- describe macroinvertebrate sampling method for carrying out macroinvertebrate sampling in a waterway
- understand that living things are classified into different groups
- identify some characteristics that are used to classify different species
- understand how different living things are connected through food webs
- understand that different types of living things are found in different waterways and this may be influenced by human activity

Equipment

For the class
- Gold Coast catchment map (Resource 3)
- ‘everyone lives in a catchment area’ poster (Resource 4)
- one or two copies of the ‘Coomera River Study Guide’
- ‘macro-invertebrate Recording’ activity/data collection sheets provided in the study guide
- macroinvertebrate sampling equipment and identification charts as suggested in study guide (pp.28)

For the student
- HB pencil or pen to write with
- hat, sunscreen, water

Preparation
Teacher can refer to the information provided in the study guide to gain background knowledge on the Coomera catchment and water testing, specifically macro-invertebrates testing and information on the food chain. The teacher may wish to arrange for a Gold Coast Waterwatch Officer to meet the class on site and facilitate the sampling. This service is free of charge within Gold Coast City Council area and may be useful if the school does not have access to the required equipment.

Curriculum links
Science
For the students –

Part one – Your catchment area: A review

1. Look at the Gold Coast catchment map and write down what catchment area you live in

________________________________________________________________

2. Have another look at the Gold Coast catchment map and write down the names of two surrounding catchment areas:

   ■

   ■

3. Now have a look at the ‘everyone lives in a catchment area’ poster and write down some of the things that make up a catchment:

   ■

   ■

   ■

   ■
Part two – classification of macroinvertebrates

This part of the activity booklet can be completed AFTER you have carried out the macroinvertebrate sampling and recorded your results in a macroinvertebrate record sheet. By this time you should have a bit of an understanding about what a macroinvertebrate is and how sensitive they are to pollution based on their sensitivity rating from 1-10.

‘A brief review’ - Macroinvertebrates can be defined by two things: firstly they are small animals but still large enough to be seen with the eye and secondly, they are invertebrates meaning they have no backbone but instead have a strong outer covering or exoskeleton to protect them.

1. Write down in your own words what a macroinvertebrate is, providing an example of one that you found:

_______________________________________________________________________
_______________________________________________________________________

2. A characteristic is a feature or quality that belongs to a specific type of living thing. Write down some characteristics of one of the macroinvertebrates you found in the waterway in the table below.

<table>
<thead>
<tr>
<th>What is the common name of the waterbug?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does it have legs?</td>
</tr>
<tr>
<td>If yes, how many legs does it have?</td>
</tr>
<tr>
<td>Does it have wings?</td>
</tr>
<tr>
<td>If yes, how many pairs of wings does it have?</td>
</tr>
<tr>
<td>Can you see any mouth parts?</td>
</tr>
<tr>
<td>What do the mouth parts look like?</td>
</tr>
<tr>
<td>What does it eat? (e.g. is it a carnivore or a herbivore or something else?)</td>
</tr>
</tbody>
</table>
3. What are some common features that make your macroinvertebrate an insect (or other)? e.g. how many legs does it have?

3. Another way to classify macroinvertebrates is to use their sensitivity rating. In the space below, draw a diagram to group the macroinvertebrates in your sample based on their sensitivity rating. Use your creativity to create your drawing.
4. The pictures below represent some of the different classes of living things that may be found in your catchment area. Draw an arrow from the living thing to the correct group name below:

- **Birds**
  - Vegetarian fish
  - Parrot

- **Plants**
  - Eucalyptus tree

- **Macroinvertebrates**
  - Yabbie
  - Aquatic plant

- **Reptiles**
  - Carnivorous fish

- **Mammals**
  - Koala

- **Other vertebrates**
  - Omnivorous turtle
  - Aquatic plant
Part three – food webs

Living things depend on each other for survival. One way in which they are connected is through food webs. A food web is a diagram that shows how plants and animals are connected and who eats who! First, there are the **producers**, which include plants that produce their own energy from the sun. They get eaten by the primary consumers, also known as **herbivores**. Some species eat both plants and other animals. They are known as **omnivores**. Some herbivores might get eaten by **carnivores**, also known as secondary consumers, who are at the top of the food chain.

1. Have a look at the pictures from the previous activity. You will notice they are labelled. Write the name of the living things in their correct place in the food web below. **NOTE: Not all of the species above will fit into the food web below**, it’s up to you to work out which is the best fit:
2. What might happen to animals at the top of the food web if the plants are removed from the environment?

___________________________________________________________

___________________________________________________________

___________________________________________________________

___________________________________________________________

3. What are some things that might impact on the survival of plants and animals?

___________________________________________________________

___________________________________________________________

___________________________________________________________

___________________________________________________________

4. Do you think any of the animals in the food web could survive without the other? Why or why not?

___________________________________________________________

___________________________________________________________

___________________________________________________________

___________________________________________________________
5. What are some things you can do to protect food webs from becoming disturbed in your catchment area?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Learning activity booklet: Year 8
Learning activity booklet: Year 8

For the teacher -

Lesson overview:

Using field resources and site investigations, students will revise what a catchment is and what catchment they live in. They will explore the five living kingdoms and the classification of living things. Students will also investigate the classification of macroinvertebrates and adaptations for survival in the catchment, as well as how living and non-living things are connected by exploring how physio-chemical properties can affect survival of macroinvertebrates.

Lesson objectives

Students should be able to:

- explain the term ‘catchment’
- identify the five living kingdoms and understand that living things are classified according to different characteristics
- identify some adaptations of a chosen macroinvertebrate
- understand how the health of the waterways in the catchment can impact on the survival of macroinvertebrates and other living things

Equipment

For the class

- Gold Coast catchment map (Resource 3)
- ‘everyone lives in a catchment area’ poster (Resource 4)
- copies of the ‘Coomera River Study Guide’
- ‘macro-invertebrate Recording’ activity/data collection sheets provided in the study guide
- macroinvertebrate sampling equipment and identification charts as suggested in study guide (pp.28)
- equipment as prescribed in study guide for physical and chemical tests for dissolved oxygen, temperature, pH, electrical conductivity, turbidity, flow and nutrients

For the student

- HB pencil or pen to write with

Preparation

Teacher can refer to the information provided in the study guide to gain background knowledge on the Coomera catchment and water testing, specifically macroinvertebrates and physio-chemical testing. Activities in part three and part four of the activity booklet can only be completed once students have undertaken macroinvertebrate or physio-chemical sampling. The teacher may wish to arrange for a Gold Coast Waterwatch Officer to meet the class on site and facilitate the sampling. This service is free of charge within Gold Coast City Council area and may be useful if the teacher does not have access to the required equipment or background knowledge.

Curriculum links

Science
Part one – Your catchment area: A review

4. Look at the Gold Coast catchment map and write down what catchment area you live in:

__________________________________________________________________________

5. Have another look at the Gold Coast catchment map and write down the names of two surrounding catchment areas:

   -
   -

6. Now have a look at the ‘everyone lives in a catchment area’ poster and write down some of the things that make up a catchment:

   -
   -

   -
   -
Part two – Living Kingdoms

All living things on the planet belong to one of five living kingdoms depending on their different characteristics. These characteristics include things like if they are single celled or multicellular and also how they get nutrients. There are five kingdoms in total, including **plants, animals fungi, protista** and **monera**. The three kingdoms you are most familiar with are likely to be plants, animals and fungi.

1. Investigate the five kingdoms of living things and complete the activity below by drawing an arrow from the kingdom on the left to the correct response:

**Animals**

- Mostly single-celled, cell wall may or may not be present. Has nucleus. Tiny. Gets nutrients from photosynthesis or absorption of other organisms.

**Fungi**


**Plants**


**Monera**

- Multicellular, cell wall present. Nucleus and organelles present. Most get nutrients from decaying matter. Size ranges from microscopic to macroscopic.

**Protista**

- Single celled, cell wall present but no nucleus. Tiny. Absorb nutrients through cell wall.
2. **ALL** of the five kingdoms are represented by the different living things in your catchment area. Can you think of an example of each of the 5 kingdoms that is found within your catchment area? You may need to do some research online or use your study guide.

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Your example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants</td>
<td></td>
</tr>
<tr>
<td>Animals</td>
<td></td>
</tr>
<tr>
<td>Fungi</td>
<td></td>
</tr>
<tr>
<td>Protista</td>
<td></td>
</tr>
<tr>
<td>Monera</td>
<td></td>
</tr>
</tbody>
</table>

3. Place the words provided into the sentences below: **key, classification, characteristics, species** and **scientific**:

   Living things are placed into different kingdoms based on their ______________, which means grouping of ________ based on similar _____________. These characteristics may be used to form a dichotomous ___________, which can be used by scientists to identify living things down to a species level. The genus and species name of a living thing is also known as its ______ name. However, as we get closer to the species name, we need more information about our organism.
4. After living things are classified into their kingdom, they are further divided into seven different groups based on their characteristics and similarities. Investigate the classification of living things in order to complete the words scramble below. The first one has been done for you:

MOKNIGD = kingdom

hpylmu =

lsasc =

eodrr =

ailmyf =

ngeus =

cspeesi =

Part three – Classification of macroinvertebrates

This part of the activity booklet can be completed AFTER you have carried out the macroinvertebrate sampling and recorded your results in a macroinvertebrate record sheet. By this time you should have a bit of an understanding of what a macroinvertebrate is and how sensitive they are to pollution.

1. Write down in your own words what a macroinvertebrate is, providing an example of one that you found:

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________
2. Macroinvertebrates are from the phylum ‘Arthropoda’, which includes crustaceans, insects and spiders. Some of the organisms you caught may be from a different phylum, such as freshwater snails, which belong to the phylum ‘Gastropoda’. Choose one of the organisms that you found in the waterway and do some class research to fill in the table below. HINT: Try starting with the common name of the species in your data record sheet and go backwards from there:

<table>
<thead>
<tr>
<th>Example</th>
<th>Your macroinvertebrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kingdom</td>
<td>Animalia</td>
</tr>
<tr>
<td>Phylum</td>
<td>Arthropoda</td>
</tr>
<tr>
<td>Class</td>
<td>Insecta</td>
</tr>
<tr>
<td>Order</td>
<td>Odonata</td>
</tr>
<tr>
<td>Common Name</td>
<td>Dragonfly</td>
</tr>
</tbody>
</table>

3. Have a look at the results you recorded for the macroinvertebrate sampling. Are they all ‘insects’, from the class insecta, or did you find other classes of macroinvertebrates? If yes, what were they?

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
4. Choose one of the macroinvertebrates you collected and do some research to describe the features that make it living (remember MRS GREN – how does it Move, Respire, Sense, Grow, Reproduce, Excrete waste and gain Nutrition?)

<table>
<thead>
<tr>
<th>How does it...</th>
<th>Your macroinvertebrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move</td>
<td></td>
</tr>
<tr>
<td>Respire</td>
<td></td>
</tr>
<tr>
<td>Sense things</td>
<td></td>
</tr>
<tr>
<td>Grow</td>
<td></td>
</tr>
<tr>
<td>Reproduce</td>
<td></td>
</tr>
<tr>
<td>Excrete waste</td>
<td></td>
</tr>
<tr>
<td>Nutrition</td>
<td></td>
</tr>
</tbody>
</table>

5. Have a look at your insect or find a picture and describe some of the adaptations of your macroinvertebrate that helps it to survive in the area.

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

6. What are some features of your catchment area that make it possible for your macroinvertebrate to survive?

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
7. Can you think of any environmental impacts that might make it difficult for your macroinvertebrate to survive? (give an example of an impact and how it would affect your macroinvertebrate).

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

8. Does your macroinvertebrate need other living things to help it to survive? If so, what are these things and how do they help them survive?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

9. What are some things that people do in a catchment that are good for the waterway? Why are these good for the waterway?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Part four – A bigger picture of catchment health

Investigating living things like macroinvertebrates is a great way of investigating how healthy a waterway is. You can get a bigger picture of the health of your catchment area by also looking at the non-living things. This part of the activity booklet can be completed AFTER you have carried out the physio-chemical sampling and recorded your results in a physio-chemical data record sheet. By this time you should have a bit of an understanding about the different types of tests and why you are doing them.

1. Why might it be important to carry out physio-chemical testing of water in your catchment area?

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

2. Can you think of some things that might indicate the water is polluted?

■

■

■

3. What impact might there be on the living things if a waterway in your catchment area became polluted?

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

_______________________________________________________________________
1. Would it just be the macroinvertebrates that were affected? What are some other living things that might be affected by pollution?

2. What are some human activities that might cause your catchment area to become polluted?

3. Did you see any signs of pollution when you were carrying out the physio-chemical sampling? If so, what were they?

4. Were there any other signs of human disturbance like tree clearing or changes to the waterway? How might this affect the health of the catchment and its living things?
Learning activity booklet: Year 9
Learning activity booklet: Year 9

For the teacher -

Lesson overview:

Using field resources and site investigations, students will review what a catchment is and then identify management issues for a selected study area within their catchment. Management issues are explored with reference to the data collected for habitat assessment, physio-chemical testing and macroinvertebrate sampling at the site. Students will identify appropriate management actions to improve the health of their study area.

Lesson objectives

Students should be able to:

- explain the term ‘catchment’
- recognise signs of human disturbance in a catchment area
- use scientific results to draw conclusions about the health of the study area
- identify some management actions that can improve the health of the waterway and overall biodiversity

Equipment

For the class

- Gold Coast catchment map (Resource 3)
- ‘everyone lives in a catchment area’ poster (Resource 4)
- data record sheets with results for habitat stream rating, macroinvertebrate sampling and physio-chemical properties of water

For the student

- HB pencil or pen to write with

Preparation

This activity booklet will require the students to have undertaken the habitat assessment, macroinvertebrate sampling and physio-chemical testing at the chosen study site. The teacher may wish to arrange for a Gold Coast Waterwatch Officer to meet the class on site and facilitate the sampling. This service is free of charge within Gold Coast City Council area and may be useful if the school does not have the required equipment. The teacher can refer to the information provided in the study guide to gain background knowledge on the Coomera catchment and water testing, specifically macro-invertebrates and physio-chemical testing.

Curriculum links

Science
For the students –

Part one – Your catchment area

4. Look at the Gold Coast catchment map and write down what catchment area you live in:

________________________________________________________________________

5. Have another look at the Gold Coast catchment map and write down the names of two surrounding catchment areas

- 
- 

6. Now have a look at the ‘everyone lives in a catchment area’ poster and write down some features of a catchment:

- 
- 
- 
- 
-
Part two – Your study area

To complete the remainder of this activity booklet, you will be required to carry out an assessment of your study area in order to design a management plan for the area, which is ideally situated along an waterway within your catchment area. The activity booklet may be completed AFTER you have carried out sampling for macro-invertebrates, physio-chemical properties and conducted a habitat assessment as per the guidelines provided in the Coomera River Study Guide.

1. Draw an aerial picture of your ENTIRE catchment area and indicate the location of your study area within the catchment.

2. Describe your study area. What are some of the main features of your study area? You can use the results of your habitat assessment as a guide.

________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
3. Draw a mud map of your study area, labelling the major features or areas of interest. This might include where drain pipes enter the waterway, vegetation, man-made features or signs of disturbance.
4. Are there any signs of human disturbance in your study area? This may be manmade features, weed invasion or signs of human activity. If so, what are they?

- 
- 
- 
- 

5. Record all the different types of terrestrial and aquatic plants and animals that you observe during your visit to the study site by tallying up the number you see in the table below. Write down the common name of the plant or animal if you know what it is.

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees</td>
<td></td>
</tr>
<tr>
<td>Shrubs/grasses/vines</td>
<td></td>
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<tr>
<td>Aquatic plants</td>
<td></td>
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<tr>
<td>Insects</td>
<td></td>
</tr>
<tr>
<td>Birds</td>
<td></td>
</tr>
<tr>
<td>Reptiles/amphibians</td>
<td></td>
</tr>
<tr>
<td>Mammals</td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td></td>
</tr>
<tr>
<td>Algae/bacteria</td>
<td></td>
</tr>
</tbody>
</table>
6. What are some things that might affect the biodiversity of your study area? HINT:

**Biodiversity** means the number of different types of living things (including plants, animals, fungus and even bacteria).

_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

7. Have a look at your habitat assessment results. What was the total score for your habitat stream rating? _________. Why do you think you got this score? e.g. Is the site degraded or in natural condition?

_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

8. Have a look at your macroinvertebrate sampling results. What was the signal index score? This can be calculated using the information at the bottom of your macroinvertebrate record sheet. Why do you think you got this score? Is it a good result?

_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
9. Have a look at your physio-chemical results. Are these results acceptable? Why or why not?


Part three – Your Management Actions

1. Have a look back at the signs of human disturbance you wrote down in part 1. Are there any management actions that could help to fix these problems or reduce their impact on the health of the catchment? Write them down in the table below.

<table>
<thead>
<tr>
<th>Type of disturbance</th>
<th>Management action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

130 Coomera River Catchment Study Guide
2. What are some ways in which you could increase the biodiversity of your study area and the greater catchment area?

- 
- 
- 
- 
- 

3. What are some management actions that could improve the habitat stream rating? Think about how you could reduce some impacts of human disturbance, such as weeds and erosion due to tree clearing.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

4. What are two things that could improve the signal index score for macroinvertebrates? (NOTE: the signal score represents how many different species you got AND the number of each species)

- 
-
5. Have a look at the table below and write down some management actions that could improve the physio-chemical properties of the waterway if it was polluted?

| How could you increase the amount of dissolved oxygen in the waterway? |  
| How could you prevent or reduce the amount of phosphates entering the waterway? |  
| How could you improve the ability for sunlight to penetrate the water, to help aquatic plants grow? |  
| How could you prevent pollutants such as petrol and oil from entering the waterway? |  

6. Streambank erosion often occurs during rainfall events. Are there any signs of erosion in your study area? Write down some ways that you could manage erosion in your study area.

7. Perhaps there are already man-made features in place to manage erosion? If so, write down two of these measures and how they reduce or prevent erosion:
Learning activity booklet: Year 10
Learning activity booklet: Year 10

For the teacher -

Lesson overview:

Using field resources and site investigations, students will learn about what a catchment is and what catchment they live in. They will use collected data, field observations and desktop research to develop a catchment management plan for a chosen area within the Coomera River Catchment.

Lesson objectives

Students should be able to:

- identify different catchment areas using the Gold Coast catchment map
- identify human activities and natural processes that occur within the Coomera River Catchment
- identify management issues, develop a plan of management and identify desired outcomes

Equipment

For the class

- Gold Coast catchment map (Resource 3)
- ‘everyone lives in a catchment area’ poster (Resource 4)
- one or two copies of the ‘Coomera River Study Guide’
- ‘macro-invertebrate Recording’ activity/data collection sheets provided in the study guide
- macroinvertebrate sampling equipment and identification charts as suggested in study guide (pp.28)
- equipment as prescribed in study guide for physical and chemical tests for dissolved oxygen, temperature, pH, electrical conductivity, turbidity, flow and nutrients

For the student

- HB pencil or pen to write with
- hat, sunscreen, water
- access to internet and resources

Preparation

Teacher can refer to the information provided in the study guide to gain background knowledge on the Coomera catchment and water testing, specifically macro-invertebrates and physio-chemical testing. The teacher may wish to arrange for a Gold Coast Waterwatch Officer to meet the class on site and facilitate the sampling. This service is free of charge within Gold Coast City Council area and may be useful if the school does not have the required equipment.

The task will involve a one or two day field trip to a chosen location/s within the Coomera River catchment. Following this, students should be allowed four weeks to compile and submit their management plan, this may include in-class time and homework.

Curriculum links

Science
For the students –

Your task is to produce a management plan for a chosen area within the Coomera River catchment. In order to do this you will collect field data for your chosen study area, including physio-chemical properties, macroinvertebrates, site sketches and habitat assessment. Other observations should be noted, including the presence of weeds and any plants and animals you can identify, both terrestrial (land dwelling) and aquatic (lives in water). You will also need to do some desktop research to find some background information on the Coomera River catchment, and mapping that indicates where your study site is. Using the information collected, you can identify some of the potential management issues for your chosen area. The overall aim of your management plan is to enhance the water quality and protect or increase biodiversity in the area.

Your plan should address one of the management issues you identify during your site visit. Some suggestions are provided below:

1) *Invasion of weeds in the Coomera River catchment area.* Your management plan will focus on management of weeds within your study area/catchment. This will include identification of weed infested areas, potential issues and proposed management actions and desired outcomes.

2) *Erosion in the Coomera River catchment area.* Your management plan will focus on management of erosion in your chosen study area. This will include identification of current erosion issues and identifying any man-made attempts to reduce erosion. Your plan will also identify how you aim to manage the erosion, for example restore creek banks and riparian vegetation.

3) *Agriculture in the Coomera River catchment area.* Your management plan will focus on ways to improve agricultural practices in your study area. This will include identifying current issues with agricultural practices in the area and identifying any man-made attempts to reduce these impacts. Your plan should identify what farmers can do to reduce the impacts of grazing animals or crops on the waterway, for example preventing hooved animals from accessing the waterway or preventing fertilisers from entering the waterway during a rainfall event.
The management plan:

- Talk with your teacher about the preferred format for submission of your report. Ideally it will be presented in word (.doc, .docx) format. Ensure that your document is saved regularly and it is a good idea to keep a backup or second copy in case something happens.
- Include a map of the catchment highlighting the study area, as well as your mud map and any photographs you may have taken that are relevant to your plan.
- Attach copies of any data you have collected and referred to in your report.
- Word limit is 800-1000 words, not including data and images.
- You may be able to submit a draft copy of your report, which is a good way to find out if you are on the right track!

Example report structure, word count and content criteria:

- **Title page.** Include your name, due date, teacher, subject and the title of your report (name of management plan).
- **Table of contents.** Don’t forget to include page numbers!
- **List of tables.** Include table number and page number.
  
  - **List of figures.** Include figure number and page number.
  
  - **Introduction** (50-100 words). Provide some background information on the Coomera River catchment area, such as existing land uses and environmental issues. Describe your study location and include an aerial photograph of the study site. Identify what will be discussed in your management plan, including the management issue, what is currently being done about it, what do you plan to do about it, and what are the desired outcomes of your plan.
  
  - **Methodology** (50-100 words). What methods did you use to collect your data (i.e. how did you identify the management issue?). Why did you use these methods? This may have been field observations, site sketches, photographs, internet research, habitat assessment, macroinvertebrates and physiochemical testing.
  
  - **Findings** (200-300 words). Use sub-headings to discuss your findings in terms of the management issue you have chosen to address, for example:
    
    - Existing land uses in your study area (e.g. recreation, agriculture, etc).
    - Extent of issue and site observations (e.g. How much of the bank has been eroded? How much of the area is covered by weeds? You may refer to your habitat assessment).
    - Discussion of field data
- **Management actions** (200-300 words). Discuss what you propose to do to manage the issue and identify desired outcomes. Draw a table with the advantages and disadvantages of your proposed management plan.

- **Conclusion** (50-100 words). Why did you choose this type of management action? Sum up the advantages of your management proposal.

- **References**. List any websites, books, or other resources you used to get information for you report. You should include at least two references in your report.

- **Appendix**. Attach any additional data to the back of your report as an appendix.
Caddisfly life-cycle
Resources

**Resource 1** – Land use maps

**Resource 2** – Aerial photos of Coomera catchment

**Resource 3** – Gold Coast catchment map

**Resource 4** – Everyone lives in a catchment area poster

**Resource 5** – Concept map black line master

**Resource 6** – Effects of pollution on a waterway

**Resource 7** – Problem/solution black line master

**Resource 8** – Hot list of websites

**Resource 9** – Information fact sheet black line master

**Resource 10** – Developing a catchment management plan

**Resource 11** – Issues ideas list

**Resource 12** – Caddisfly Lifecycle
Coomera Catchment Study Guide

STUDY AREA

LEGEND

Coomera Catchment Land Use

- Conservation
- Managed Forest Plantations
- Natural Bush Grazing
- Broadacre Agriculture
- Intensive Agriculture
- Rural Residential Suburban
- Dense Urban
- Water

Catchment Land Use (2002)
Resource 2

Inset

Area of interest
Coomera River Catchment

1994 Aerial Photography: Gold Coast City Council

©Gold Coast City Council 2008 or ©The State of Queensland (Department of Natural Resources and Water) 2008

No warranty given in relation to the data (including accuracy, reliability, completeness or suitability) and no liability accepted (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws. External contributors to data listed at www.nrw.qld.gov.au/products or www.goldcoast.qld.gov.au
LEGEND

- LOGAN RIVER (Part)+Sandy Creek
- ALBERT RIVER
- Sub-Catchment of Logan River
- SOUTH MORETON BAY+Behms Ck
- PIMPAMA RIVER
- COOMERA RIVER
- BROADWATER +Biggera, Loders, Runaway Bay
- NERANG RIVER
- PACIFIC BEACHES +Burleigh, Flat Rk & Coolangatta
- TALLEBUDGERA CREEK
- CURRUMBIN CREEK
- TWEED RIVER (Part)
EVERYONE LIVES IN A CATCHMENT AREA

1. Poorly drained land can lead to increased water storage and flooding, as well as decreased yields and farm income.

2. Overgrazing and overgrazing of pastures can lead to soil compaction and reduced water infiltration into the soil, leading to increased flooding and decreased yields and farm income.

3. Cultivation and overgrazing on steep slopes can lead to soil erosion and create massive scars in the landscape.

4. Cultivation down the slope is more efficient for agriculture, but can lead to soil erosion and reduced yields and farm income.

5. Trees along stream banks or on farms can help prevent stream bank erosion.

6. Poorly managed farm land which promotes soil siltation can lead to decreased yields and farm income.

7. Overclearing of forests on steep slopes can lead to increased soil erosion and create massive scars in the landscape.

8. Contour cultivation and a system of contour planting can help maintain high quality soil and reduce erosion.

9. Treatment of industrial and domestic wastes can harm the environment by lowering water quality and making the environment unsuitable for human and aquatic life.

10. Sediments washed down from eroded catchments can block the river mouth and other parts of the stream, preventing navigation and increasing the risk of flooding.

11. Carefully sited public facilities and a well managed beach can provide a pleasant and stable environment for human activities.

12. A clear bay provides a pleasant environment for human activities and encourages the growth of sea grass to maintain a healthy reef community.

13. Higher than naturally occurring levels of nitrogen and phosphorus from sewage, oil and anecdote can disrupt the reef ecosystems, decrease fish stocks, and decrease the growth of sea grass.
**Concept map**

What do we do in our catchment?

Do these things have an impact on the quality of the water or surrounding environment?

What can we do to reduce these impacts?
# The effects of pollution on a waterway

<table>
<thead>
<tr>
<th>POLLUTANT</th>
<th>PROBLEMS</th>
<th>SOLUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertiliser</td>
<td>Algal blooms</td>
<td>Don’t use excessive amounts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use solid fertilisers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use compost or mulch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Don’t apply on wet or windy days</td>
</tr>
<tr>
<td>Manure and septic tank</td>
<td>Algal blooms</td>
<td>Pick up dog droppings</td>
</tr>
<tr>
<td>discharge</td>
<td>Bacteria</td>
<td>Fence off rivers from livestock</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pump water to drinking troughs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintain septic tanks</td>
</tr>
<tr>
<td>Introduced species of</td>
<td>Seeds can be distributed by water, wind or</td>
<td>Remove introduced species and replace with native species</td>
</tr>
<tr>
<td>vegetation</td>
<td>animals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Can out-compete native vegetation</td>
<td></td>
</tr>
<tr>
<td>Oil and petrol</td>
<td>Poisons flora and fauna</td>
<td>Ensure motor vehicles and watercraft are serviced regularly</td>
</tr>
<tr>
<td></td>
<td>Forms a film on the water surface</td>
<td>Place drip trays under cars</td>
</tr>
<tr>
<td></td>
<td>which impacts on aquatic macro-invertebrates</td>
<td></td>
</tr>
<tr>
<td>Pesticides and insecticides</td>
<td>Kills flora and fauna</td>
<td>Don’t use excessive amounts</td>
</tr>
<tr>
<td></td>
<td>Water becomes unsuitable for drinking or</td>
<td>Use products that biodegrade</td>
</tr>
<tr>
<td></td>
<td>recreation</td>
<td>Don’t apply on wet or windy days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use alternative biological controls</td>
</tr>
<tr>
<td>Salt</td>
<td>Freshwater flora and fauna are not adapted to</td>
<td>Reduce irrigation drainage by watering more efficiently (late at night or early in the morning)</td>
</tr>
<tr>
<td></td>
<td>high levels of salt</td>
<td>Salt interception schemes</td>
</tr>
<tr>
<td></td>
<td>Water may become unsuitable for drinking or</td>
<td>Increase the amount of deep-root vegetation</td>
</tr>
<tr>
<td></td>
<td>farming</td>
<td></td>
</tr>
<tr>
<td>Detergent</td>
<td>Makes water harder</td>
<td>Use low or no phosphate detergents and car wash products</td>
</tr>
<tr>
<td></td>
<td>Contains phosphate, a nutrient which</td>
<td>Don’t wash cars or machinery on driveways or roads where the run-off can enter the stormwater system</td>
</tr>
<tr>
<td></td>
<td>can cause algal blooms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strips the protective coating from the skin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of frogs and fish</td>
<td></td>
</tr>
</tbody>
</table>

149 Coomera River Catchment Study Guide
<table>
<thead>
<tr>
<th>POLLUTANT</th>
<th>PROBLEMS</th>
<th>SOLUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litter</td>
<td>Clogs up the waterway, increasing the risk of flooding</td>
<td>Dispose of responsibly and thoughtfully</td>
</tr>
<tr>
<td></td>
<td>Stagnation</td>
<td>Reduce, reuse and recycle</td>
</tr>
<tr>
<td></td>
<td>Wildlife can mistake it for food</td>
<td>Organise clean-up days</td>
</tr>
<tr>
<td></td>
<td>Bacteria</td>
<td>Install trash racks</td>
</tr>
<tr>
<td></td>
<td>Unsightly</td>
<td></td>
</tr>
<tr>
<td>Lawn clippings and leaves</td>
<td>Use up oxygen as they decompose</td>
<td>Compost and mulch green waste</td>
</tr>
<tr>
<td></td>
<td>Increase nutrient levels in water causing algal blooms</td>
<td></td>
</tr>
<tr>
<td>Dirt, sand and gravel run off</td>
<td>Siltation of waterway reducing flow and increasing flooding</td>
<td>Maintain or increase riparian vegetation on stream bank</td>
</tr>
<tr>
<td></td>
<td>Prevents sunlight from reaching the water plants, reducing their ability</td>
<td>Use sediment control devices</td>
</tr>
<tr>
<td></td>
<td>to photosynthesize</td>
<td>Sweep dirt on to garden and not onto the road</td>
</tr>
<tr>
<td></td>
<td>Reduces water visibility (water life unable to see predators or find food)</td>
<td>Use a dust pan</td>
</tr>
<tr>
<td></td>
<td>Can clog the gills of fish and aquatic macro-invertebrates</td>
<td>Cover trailers with tarpaulins</td>
</tr>
<tr>
<td></td>
<td>Can contain seeds of weeds</td>
<td></td>
</tr>
<tr>
<td>Fishing line and hooks</td>
<td>Kills and injures birds, fish and other aquatic animals</td>
<td>Fish responsibly</td>
</tr>
<tr>
<td></td>
<td>Poisonous to wildlife and humans</td>
<td>Clean up after yourself</td>
</tr>
<tr>
<td>Toxic chemicals</td>
<td>Water becomes unsuitable for drinking and recreation</td>
<td>Prevent run-off from factories entering the storm water system</td>
</tr>
<tr>
<td></td>
<td>Kills aquatic plants and animals</td>
<td>Build drainage storage tanks which can be emptied professionally</td>
</tr>
<tr>
<td>Rubber from motor vehicle</td>
<td>Releases chemicals into the water</td>
<td>Drive safely to avoid skidding</td>
</tr>
<tr>
<td>tyres</td>
<td>Wildlife can mistake it for food</td>
<td>Replace old tyres and don’t leave strips of shredded tyre on the road</td>
</tr>
</tbody>
</table>

Note: GCCC have developed factsheets on many catchment issues including: Algal Blooms, Stormwater Pollution and Riparian Environments. For more information contact GCCC’s Catchment Management Unit of (07) 5581 6722.

Riverland Waterwatch: The River Murray Story; Teacher Resource Pack
Is there a problem? Let’s find a solution.

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. Untreated factory effluent entering the waterway</td>
<td>Treat effluent and control the rate of flow into the waterway</td>
</tr>
<tr>
<td>River bank destabilisation/erosion</td>
<td>Maintain or replace vegetation in riparian zone</td>
</tr>
</tbody>
</table>

Hot list

- Gold Coast City Council  
- Healthy Waterways  
  [www.healthywaterways.org](http://www.healthywaterways.org)
- SEQ Catchments  
- Department of Environment, Water, Heritage and the Arts  
- Waterwatch Australia  
- EPA/QNWs  
Getting started… information fact sheet

What is the issue?

Who is responsible?

My issue is

Where is it occurring?

Why is it an issue?

When is it occurring?

Benefits

Threats
Catchment management plans

Catchment management plans (CMPs) are developed to address water quality and ecosystem health for waterways throughout the Gold Coast. Scientists research and gather data on the state of a waterway and its associated catchment. Community consultation is undertaken as part of these studies to determine environmental values (EVs) for the waterway. Once these EVs are established, water quality objectives (WQOs) can be formulated. Information from the study is also used to help with future water quality monitoring and management.

Objectives of studies may differ between waterways, but include:
- providing a current status report on the ecological health and diversity of biological communities in the waterway
- undertaking an assessment of water quality conditions
- assessing the status and extent of riparian vegetation along the waterway
- developing guidelines for a stormwater management plan.

Catchment management plan framework

1. Describe the current health of the catchment using data from a range of sources, including observational and water testing,
2. Who is managing the catchment, helping, volunteering, and what is being done?
3. List the current issues that impact on the catchment.
4. Explore the networks of cause and effect that shape ecosystem dynamics in the catchment.
5. Identify the main issues which will be addressed in this management plan.
6. Who should be involved in managing these issues?
7. Prepare an action plan that includes a timeframe for the implementation of strategies to achieve the main goals for this catchment.

Catchment management issues

- Management of a section of the catchment (for example: from Upper Coomera to Helensvale; the Coombabah Wetlands)
- Management of a species of fauna or flora (for example: an endangered/threatened or vulnerable species)
- Management of vegetation types (like mangroves or wetlands)
- Management of conservation areas
- Management of riparian vegetation
- Management of grazing or farming lands
- Management of stormwater
- Management of erosion
<table>
<thead>
<tr>
<th>Issue 4</th>
<th>Short and long term effects</th>
<th>Management actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue 3</td>
<td>Short and long term effects</td>
<td>Management actions</td>
</tr>
<tr>
<td>Issue 2</td>
<td>Short and long term effects</td>
<td>Management actions</td>
</tr>
<tr>
<td>Issue 1</td>
<td>Short and long term effects</td>
<td>Management actions</td>
</tr>
</tbody>
</table>

Management plan for Coomera River Catchment Study Guide 154
Catchment tour

Conducting a catchment tour is a fantastic way for students to see and examine the environment. It provides context to what they have been learning in class.

A number of sites in the catchment have been investigated and reviewed. The sites offer a range of land-use and water quality experiences allowing you to tailor the tour according to your topic of study. A site description and activities that can be conducted at this site are contained within the following table. Also listed below are things you may need to consider before embarking on your tour.

A council representative can assist you during the tour. Water quality monitoring equipment can be provided at no cost to the school. Contact the Gold Coast City Council Catchment Management Unit on 5581 6722 for more information. You are responsible for the sites selected but the council representative may be able to offer suggestions.

When selecting sites it is best to stick to the one water body. For example, stay in and around Clagiraba Creek rather than jumping between this creek and Coombabah Creek. This will provide continuity for students.

The recommended activities have been chosen to suit the conditions at each of the sites. These conditions cannot be guaranteed and a site assessment is recommended before starting a tour.

Locations are listed in order from the top of the catchment to the bottom. You will not be able to visit all of the locations listed in the one day. Choose which sites will best suit the students’ classroom-based work.

It can be tricky to map the tour and get right the approximate times to travel to and between sites. Try planning your trip with Google maps (Tip – add 15 minutes to each estimated trip time to allow for the bus).

**Catchment tour: example one**

<table>
<thead>
<tr>
<th>Leave School</th>
<th>9.00</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First stop</strong> - Sharp Park, Canungra</td>
<td>10.00 – 10.45 10.45 – 11.10 – food and toilet break</td>
</tr>
<tr>
<td><strong>Second stop</strong> - Capone Court Maudsland</td>
<td>11.50 – 12.30</td>
</tr>
<tr>
<td><strong>Third stop</strong> - The Coomera River Weir, Old Tamborine Road, Oxenford</td>
<td>1.00 – 1.30</td>
</tr>
<tr>
<td><strong>Fourth stop</strong> - Phil Hill Environmental Park, Paradise Point</td>
<td>2.00 – 2.30 – food and toilet break</td>
</tr>
<tr>
<td><strong>Return to school</strong></td>
<td>3.00</td>
</tr>
</tbody>
</table>

**Catchment tour: example two**

<table>
<thead>
<tr>
<th>Leave School</th>
<th>9.00</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First stop</strong> - Little Clagiraba Reserve Clagiraba Rd, Clagiraba</td>
<td>9.45 – 10.30</td>
</tr>
<tr>
<td><strong>Second stop</strong> - Capone Court Maudsland</td>
<td>11.00 – 11.45 11.45 – 12.00 – Food break</td>
</tr>
<tr>
<td><strong>Third Stop</strong> - John Siganto Park, Gawler Place, Upper Coomera</td>
<td>12.25 – 1.00 – Toilet Break</td>
</tr>
<tr>
<td><strong>Fourth stop</strong> - The Coomera River Weir, Old Tamborine Road, Oxenford</td>
<td>1.15 – 1.45 – Food break</td>
</tr>
<tr>
<td><strong>Fifth stop</strong> - Phil Hill Environmental Park, Paradise Point</td>
<td>2.15 – 2.30</td>
</tr>
<tr>
<td><strong>Return to school</strong></td>
<td>3.00</td>
</tr>
<tr>
<td>Site Location</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| **Sharp Park, Canungra**      | This site is in the upper reaches of the catchment on Coomera River. The river runs adjacent to the park which is also a camp ground. This site allows for assessment of an isolated area where there is some disturbance to the creek because the area is a camp ground. Students will see native and introduced vegetation at this site. Students should take care when accessing the water so they don’t disturb the riparian vegetation. Surrounding land use includes farming and acreage properties. There are toilets and a shelter shed at this site. | - Physio-chemical testing  
- Macro-invertebrate testing  
- Vegetation assessment | 1 hour 25 mins (including 20- min food break) |
| **Little Clagiraba Reserve**  | This site is in the mid reaches of the catchment on Clagiraba Creek. The creek runs adjacent to the reserve with parking. There are no toilets at this site. This site allows for assessment of an isolated area with minimal disturbance to the creek. Students will see native and introduced vegetation at this site. Students will also be able to view a high level of riparian vegetation. Students should take care when accessing the water so as not to disturb riparian vegetation. It is suggested that only a limited number of students (not the whole class) access the water to gather water samples. Surrounding land uses includes acreage properties and small hobby farms; a winery; wholesale nurseries; aquaculture and forest reserve. Note – this site is a popular weekend picnicking spot and there may be litter on-site when you arrive. | - Physio-chemical testing  
- Vegetation assessment  
- Vegetation identification | Between 1 hour 15 mins and 1 hour 25 mins |
| Capone Court, Maudsland | This site is an off creek dam that acts as a stormwater collection basin for the surrounding housing estate. After periods of heavy rain this water would overflow into the nearest creek (not named; leads directly into the Coomera River). This is a highly modified water body with limited riparian vegetation. Surrounding land use includes small acreage lots (less than two acres) and large acreage lots (greater than two acres). There is safe access to the water however care should still be taken. There are no toilets or other facilities at this site. | | Physio-chemical testing  
Macro-invertebrate assessment  
Vegetation assessment | Between 1 hour and 1 hour 25 mins |
| --- | --- | --- | --- | --- |
| John Siganto Park, Gawler Place, Upper Coomera | This is a salt water environment that is highly modified. The Coomera River Weir is located upstream of this site and can be seen from the northern area of the park. Surrounding land use includes extraction, small acreage lots and urban development. There is no riparian vegetation at the testing site. Water access is via a boat ramp. This site has toilets and a shelter shed. | | Physio-chemical testing  
Vegetation assessment  
Discussion about the affects of human impacts on the water body. | 1 hour 15 mins (including lunch break) |
<table>
<thead>
<tr>
<th>Site</th>
<th>Description</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalina Way Upper Coomera</td>
<td>This site is on Yaun Creek and although there is no water access at this site it is an opportunity for students to see revegetation of a riparian zone in progress. It also allows students to see and identify saltmarsh vegetation.</td>
<td>30 mins</td>
</tr>
<tr>
<td>Coombabah Conservation Area, Gold Coast Highway, Coombabah</td>
<td>This site is a good one for students who are studying mangroves to take a closer look at this vegetation type. The Lakelands has a high ecological significance and is a world heritage listed wetland covered by an international agreement, the Ramsar Convention for wetlands (1971). The mangrove boardwalk is 500m from the car park on a graded path that has interpretative signage along its length. There are no toilets at this site and bus parking is best on the entry road.</td>
<td>1 hour 15 mins</td>
</tr>
</tbody>
</table>
Phil Hill Environmental park—Jabiru Island
Oxley Drive Paradise Point

This site is in the lower reaches of the estuarine portion of the River. It is a great location to conclude (or begin the tour). Situated at the junction of Coombabah Creek and Saltwater Creek, immediately prior to joining with the south branch of the Coomera River. Although there is limited riparian vegetation and this is a highly modified site, it does provide an opportunity to talk about land use in the surrounding area. There are toilets and a shelter shed at this site.

- Physio-chemical testing
- Vegetation assessment
- Discussion about the affects of human impacts on the water body.

1 hour 15 mins
(including food break)
<table>
<thead>
<tr>
<th>Glossary</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrage</td>
<td>A small in-stream structure designed to limit and modify water flow, generally for the purpose of capturing water for future use</td>
</tr>
<tr>
<td>Carnivore</td>
<td>A flesh-eating animal</td>
</tr>
<tr>
<td>Catchment</td>
<td>A catchment is an area or basin of land bounded by natural high features such as hills or mountains from which all run-off water flows to a low point like a stream, river or the sea</td>
</tr>
<tr>
<td>Catchment – lower</td>
<td>The area of the catchment where the water leaves the catchment – the lower catchment refers to least distance upstream from outfall point</td>
</tr>
<tr>
<td>Catchment – upper</td>
<td>The area of the catchment in the hills and foot hills – the upper catchment refers to most distance upstream from outfall point</td>
</tr>
<tr>
<td>Detritivore</td>
<td>Organisms that feed on waste and other organic debris formed by the decomposition of plants and animals</td>
</tr>
<tr>
<td>Dissolved oxygen</td>
<td>The amount of oxygen dissolved in the water. It is essential for respiration of living creatures</td>
</tr>
<tr>
<td>Ephemeral</td>
<td>Watercourses that do not have surface water flow all year round (dry creek beds, episodic or temporary streams)</td>
</tr>
<tr>
<td>Estuary</td>
<td>The area where ocean and river processes meet and mix – exact definitions are highly variable and technical</td>
</tr>
<tr>
<td>Eutrophic</td>
<td>Having waters rich in nutrients that promote a proliferation of plant life, especially algae, which reduces the dissolved oxygen content and often causes the extinction of other organisms</td>
</tr>
<tr>
<td>Herbivore</td>
<td>An animal that feeds mainly on plants</td>
</tr>
</tbody>
</table>
| Macro-invertebrates | Macro – visual to the naked eye  
Invertebrates – creatures without an internal backbone                                                                                     |
| Nutrient         | The essential components to growth and life                                                                                               |
| Omnivore         | An animal that feeds on both animal and vegetable substances                                                                               |
pH
Chemical property of the water (or soil) describing its acidity or alkalinity

Photosynthesis
Biological process whereby green plants use sunlight as an energy source to convert carbon dioxide (CO\textsubscript{2}) into sugars (energy) and oxygen

\[
6\text{CO}_2 + 12\text{H}_2\text{O} + \text{sunlight} = \text{C}_6\text{H}_12\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2
\]

... carbon dioxide + water + sunlight = glucose + water + oxygen

Respiration
Biological process describing breathing – respiration uses oxygen and generates carbon dioxide. Plants and animals respire 24hrs a day

Riffles
Shallow areas in waterways where rocks, pebbles, cobbles or boulders disrupt the surface flow of water – smaller than rapids

Riparian
The vegetation on the side of the waterway, generally considered to be an area up to 30m on each side of the waterway.

Salinity
Refers to the level of salt in the waterway – ocean water has high salinity, drinking water has low salinity

Stormwater
The waters collected through a drainage system (either piped or open) with the purpose of moving built-up waters away from infrastructure and housing quickly

Turbidity
The measure of water cloudiness or ability to allow light to pass

Urban
Areas of residential, commercial development – built-up areas

Verge vegetation
The vegetation on the direct bank-side or other in-stream structures

Weir
A small in stream structure designed to limit and modify water flow, generally for separating saline and fresh waters
References

Books and publications

Environmental Protection Agency, (2007), Environmental Protection (Water) Policy 1997: Coomera River Environmental Values and Water Quality Objective – Basin No. 146 including all tributaries of the Coomera River, Report, Australia

Gold Coast City Council, (2006), Environmental Weeds of the Gold Coast, Booklet, Australia

Gold Coast City Council, (2008), Protecting Riparian Environments, Fact Sheet, Australia

Gold Coast Water, (2008), Make Your Water Mark! Watersaver Education Program: Middle and Secondary School Kit, Resource Book, Australia,

Gold Coast Waterwatch (2003), Currumbin Creek Catchment Study Guide, Booklet, Australia

Gold Coast Waterwatch (2006), Water Bug Guide, Booklet, Australia


WMB Oceanics Australia, (2005), Environmental Inventory of the Coomera River Catchment and Its Tributaries, CD Rom, Australia

Websites


Equipment
Testing equipment can be borrowed from Gold Coast City Council’s Catchment Management Unit. This testing equipment would allow you to conduct all tests listed in this resource. For more information, phone 5581 6722. Equipment and assistance can also be provided by Jacobs Well Environmental Education Centre or Numinbah Valley Environmental Education Centre.

Useful websites
Gold Coast City Council
www.goldcoast.qld.gov.au

Gold Coast Waterwatch
www.goldcoastwaterwatch.org

Centre for Coastal Management
www.gu.edu.au/centre/gccm/

Healthy Waterways
www.healthywaterways.org

Waterwatch Queensland
www.qld.waterwatch.org.au

Waterwatch Australia
www.waterwatch.org.au

Waterwatch Victoria
www.vic.waterwatch.org.au

Waterwatch South Australia
www.sa.waterwatch.org.au

GECKO
www.gecko.org.au

Ecosystem Health Monitoring Program
www.ehmp.org

Catchment Detox Game
www.catchmentdetox.net.au

Australian and New Zealand Guidelines for Fresh and Marine Water

Coomera River Catchment Group

Pimpama/Coomera Rivers Catchment and Estuary
www.ehmp.org/pimpamacoomera_rivers_catchment_and_estuary.html

Queensland Water Quality Guidelines 2006

Murray Darling Freshwater Research Centre
www.mdfrl.org.au/bugguide/display.asp?type=1&class=19