Gateway Upgrade Project

# 12. Surface Water Quality

12

Return to Contents Page

# 12. Surface Water Quality

## 12.1 Introduction

**TOR Requirements: Existing Environment**

A description should be given of the watercourses in the area affected by the Project with an outline of the significance of these waters to the river/creek catchment system in which they occur. Details provided should include a description of water quality in major watercourses and wetlands.

An assessment is required of existing water quality in surface waters and wetlands likely to be affected by the Project. The assessment should provide the basis for a long-term monitoring program, with sampling stations located upstream and downstream of the Project.

The water quality should be described, including seasonal variations or variations with flow, where applicable. A relevant range of physical, chemical and biological parameters should be measured to gauge the environmental harm on any affected watercourse or wetland system.

The environmental values of the waterways of the affected area should be described in terms of:

- values identified in the Environmental Protection (Water) Policy;
- sustainability, including quality; and
- any Water Resource Plans, Land and Water Management Plans (including the Brisbane River Management Plan and other local authority stream management initiatives) relevant to the affected catchment.

**TOR Requirements: Potential Impacts**

This section is to define the potential impacts of the project on the water environment, to outline strategies for protecting water resource environmental values, how nominated quantitative standards and indicators may be achieved, and how the achievement of the objectives may be monitored, audited and managed.

The EIS should describe the possible environmental harm caused by the proposed works to environmental values for water as expressed in the Environmental Protection (Water) Policy.

Water management to address surface and groundwater quality, quantity, drainage patterns and sediment movements should be outlined. Key water management strategy objectives include:

- Maintenance of sufficient quantity and quality of surface waters to protect existing beneficial downstream uses of those waters (including maintenance of in-stream biota and downstream wetlands including the Moreton Bay Ramsar wetland);
- Protection of important local groundwater aquifers;
- Measures proposed to avoid or minimise afflux resulting from changes to drainage patterns;
- The potential environmental harm to the flow and the quality of surface waters from all phases of the project should be discussed, with particular reference to their suitability for the current and potential downstream uses, including the requirements of any affected riparian area, the Ramsar wetland, estuary, littoral zone and any marine and in-stream biological uses. The impacts of surface water flow on existing and proposed infrastructure should be considered. Reference should be made to the Environmental Protection (Water) Policy, *Water Act 2000* and the Australian and New Zealand Environment and Conservation Council (ANZECC) 2000 guidelines; and
- Options for mitigation and the effectiveness of mitigation measures should be discussed with particular reference to sediment, acidity, salinity and other emissions of a hazardous or toxic nature to human health, flora or fauna.

A water quality impact assessment has been undertaken to provide information on the existing baseline environment and an assessment of the potential impacts on water quality associated with the development during construction and operation of the proposed GUP. Mitigation and management measures have been recommended were appropriate to minimise the identified potential impacts.

## 12.2 Methodology

### *12.2.1 General Methodology*

To assess the potential surface water quality impacts of the GUP the following approach was adopted:

- Identification of the existing water quality environment utilising:
  - existing data from EPA, BAC and other sources;
  - additional sampling at selected locations within Bulimba Creek, Kedron Brook Floodway and Cannery Creek;
  - downstream values of the Brisbane River, Moreton Bay and Ramsar Wetlands;
- Assess impacts of GUP on the water quality of the potentially affected watercourses that are located nearby or in the direct route of the GUP;
- Mitigation measures were recommended to ensure that any potential impacts to water quality from the GUP are minimised.

### *12.2.2 Water Quality Sampling*

Water quality sampling was undertaken in Bulimba Creek (three sites) by Connell Wagner on 26 March and 20 May 2004 and in Kedron Brook Floodway (two sites) and in Cannery Creek (one site) on 16 April and 20 May 2004 (refer Figures 12.1a to 12.1d).

Samples BC1 and BC2 were taken in Bulimba Creek where it intersects with Wecker and Meadowlands Roads upstream of GUP. BC3 is located downstream of the Motorway close to the railway line and Hemmant Recreation Reserve.

KB1 and KB2 are located downstream of the GUP alignment. Both sites were accessed from BAC land. CC1 is located upstream of GUP in Cannery Creek near Nudgee Road. All three sites are estuarine sites.

These sites were chosen to provide a general indication of the water quality of Bulimba Creek Kedron Brook Floodway and Cannery Creek and were subject to access and safety considerations. BC1 is a freshwater site, while BC2 and BC3 are estuarine sites.

Due to the highly variable water quality within the Brisbane River, water quality sampling was not undertaken for the EIS.

In situ sampling was undertaken on the day for pH, temperature and conductivity using a 90FL field lab analyser. Water quality samples were collected in bottles approved and supplied by ALS Environmental. Samples were sent to ALS Environmental laboratory for analysis. Samples were tested for total suspended solids (TSS), total phosphorus (TP), total nitrogen (TN), lead, nickel, zinc, copper, and Total Petroleum Hydrocarbons (TPH).

Table 12.1 illustrates that rainfall 24 hours prior to surface water quality sampling was low.


KEY

- EPA Sampling Locations (one site not shown, west of Mansfield)
- Connell Wagner EIS Sampling Locations
- GUP Corridor

**FIGURE 12.1a**
**Surface Water Quality Sampling Locations**


KEY

- EPA Sampling Locations
- Connell Wagner EIS Sampling Locations
- GUP Corridor

Queensland Government Main Roads

Australian Government Department of Transport and Regional Services

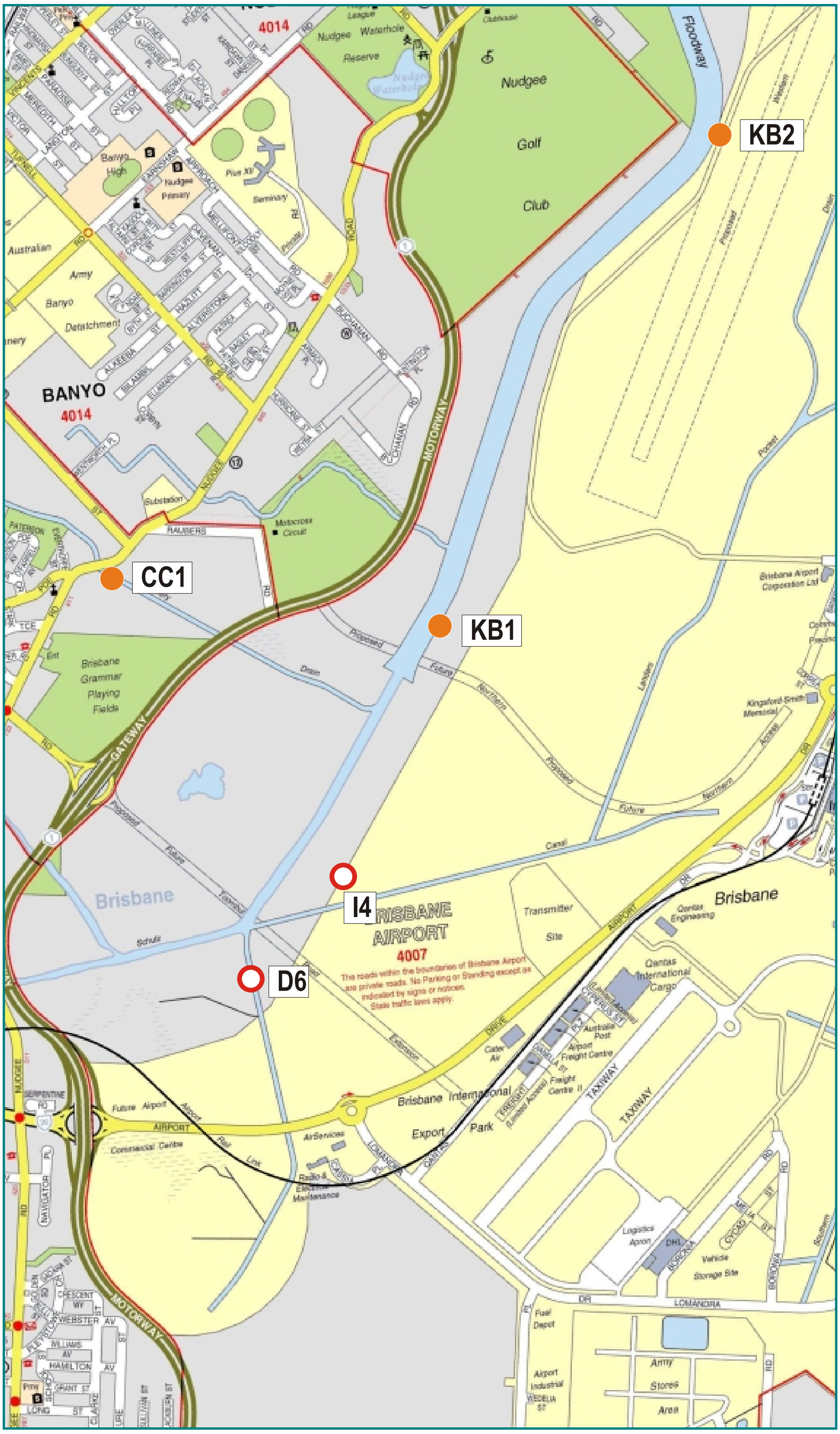
Connell Wagner

**FIGURE 12.1b**
**Surface Water Quality Sampling Locations**


KEY

- EPA Sampling Locations
- GUP Corridor

**FIGURE 12.1c**
**Surface Water Quality Sampling Locations**




KEY

- Connell Wagner EIS Sampling Locations
- BAC Sampling Locations
- GUP Corridor



**FIGURE 12.1d**
**Surface Water Quality Sampling Locations**

**Table 12.1 Summary of Rainfall Prior to Surface Water Quality Sampling**

| Date | Rainfall |
|---|---|
| 26 March | 2.4mm |
| 16 April | 0.8mm |
| 20 May | 0mm |

**Table Note**
Data provided by Bureau of Meteorology Brisbane Aero measuring station.

Aquatic flora and fauna is assessed in Section 17.

## 12.3 Background

Stormwater runoff from urban roads has the potential to impact upon downstream water quality and associated flora and fauna. To determine changes in water quality from the construction and operation of a project, background information needs to be obtained. Monitoring can also assist in the day to day management of a work site and can assist in compliance with legislation or licensing conditions.

Changes in water quality near roads can occur from a variety of sources. An increase in nitrogen and phosphorous may be caused from an increase in garden fertilisers and sediment into waterways. The increase in nutrients can promote algal growth and therefore affecting oxygen levels in the water column affecting aquatic flora and fauna.

Erosion and sedimentation increase suspended solids and therefore could potentially reduce light penetration and affect the growth of flora and fauna. Smothering of organisms also could potentially occur. Hydrocarbons are generally washed from road surfaces and paved areas. Hydrocarbons can be noxious to aquatic flora and fauna and can potentially impact upon the aesthetics of an area. Heavy metals such as copper, lead, zinc, chromium and nickel can be washed from roads and hardstand areas as they are associated with motor vehicles, tyres and rubber. These metals in high doses can be lethal to aquatic flora and fauna.

Vehicles utilising roads and highways have the potential to drop fuel, oil, antifreeze and other chemicals onto the pavement. Metals are released onto the road from the wear of brake linings, clutch plates and tyres. During a rain event these substances are washed into the drains and eventually wash into the creeks and rivers if they are not managed and/or treated along the way. It is important to minimise the amount of contaminants entering waterways and a suitable design of the stormwater system and implementation of mitigation measures during construction and operation, will assist in the removal of contaminants to protect ecological values of the waterways.

## 12.4 Regulatory Framework

### *12.4.1 Environmental Protection (Water) Policy 1997*

In Queensland, the EPP(Water) is the governing piece of legislation in relation to water. The EPP(Water) is subordinate legislation to the *Environmental Protection Act 1994* (EP Act). The objective of the EPP(Water) is to uphold the EP Act objective of protecting "Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ESD)". The EPP(Water) achieves this by:

- Identifying environmental values for Queensland waters;
- Setting water quality guidelines and objectives to enhance or protect environmental values;
- Making consistent and equitable decisions about Queensland waters that promote efficient use of resources and best practice environmental management; and
- Involving the community through consultation and education, and promoting community responsibility.

The policy and legislative framework mentioned above sets the broad goals for design criteria for water quality controls.

### *12.4.2 Airports (Environment Protection) Regulations 1997*

The *Airports (Environment Protection) Regulations 1997* defines water pollution as when water contains a substance or organism that causes, or is reasonably likely to cause, the physical, chemical or biological condition of the water to be adversely affected or has an adverse effect on the beneficial use of the water. Waters contain a polluting substance if:

- The substance is dissolved in waters; or
- Whether or not the substance is capable of uniformly mixing with water. It is:
  - suspended or otherwise dispersed in the waters; or
  - floating on the surface of waters; or
  - deposited on the bed of the waters.

Under the regulations all operators at airport have a general duty to take all reasonable and practicable measures to prevent or minimise pollution. Operators are considered to comply with the regulations if levels of contamination fall within acceptable limits. Accepted limits for water pollution are detailed in Appendix I.

Water quality controls for the GUP will need to be implemented during construction and operation so that water pollution of the nearby waterways is minimised.

### *12.4.3 Water Quality Guidelines*

**Waterways Management Plan**

The *1998 Waterways Management Plan – A Framework for the Management of the Waterways of the Brisbane River and Moreton Bay Catchment* was developed as a framework of the integrated management of Moreton Bay. It is a guide for planning projects and processes linked to waterways. Undertaking water quality sampling, developing stormwater management plans and incorporating water sensitive urban design into new projects are key items outlined in this document in relation to water quality which will be undertaken and incorporated into the GUP where possible.

**ANZECC Water Quality Guidelines**

The Australian and New Zealand Environment and Conservation Council (ANZECC) developed *Guidelines for Fresh and Marine Water Quality 2000* to:

- Protect and manage environmental values supported by water resources;
- Outline the management framework recommended for applying the water quality guidelines to the natural and semi-natural marine and freshwater resources in Australia and New Zealand; and

- Provide advice on designing and implementing water quality monitoring and assessment programs.

The document provides water quality guidelines for a variety of uses such as primary industries, recreational uses, drinking water and industrial water, but for the purposes of the EIS the guidelines for protecting aquatic ecosystems was used. The aquatic ecosystem chapter specifies biological, sediment and water quality guidelines for protecting a range of aquatic ecosystems, both freshwater and marine.

**Brisbane City Council Water Quality Management Guidelines**

BCC has developed Water Quality Management Guidelines to provide an understanding of key issues and required measures to effectively manage water quality impacts associated with development activities. They provide guidance as to what key issues must be addressed during the planning, design, construction and operational phases of a development.

## 12.5 Downstream Waterway Values

Environmental and ecological values downstream of the GUP have been identified in other EIS sections (Sections 16, 17 and 18) and are summarised as:

- Diverse saline and freshwater complex comprising mangrove with saltmarsh fringe in good condition at Bulimba Creek;
- Mangrove lined canal and saltmarsh fringe within Kedron Brook area and on BAC land;
- Downstream values of Moreton Bay and Ramsar site;
- Intrinsic value of the ecosystem;
- Water associated wildlife;
- Human consumption of fish and crustaceans;
- Primary contact recreation in various parts of the water;
- Secondary contact and visual recreation; and
- Cultural heritage.

## 12.6 Mt Gravatt-Capalaba Road to Cleveland Branch Rail Line

### *12.6.1 Background*

This section of the GUP is within the Bulimba Creek catchment which covers a total of 122km$^2$, one of Brisbane's largest catchments. The land uses abutting the creek include residential, rural residential, commercial, industrial, recreational and open space purposes, as well as wetland and remnant bushland areas.

Bulimba Creek is tidal within the lower reaches and flows into the Brisbane River. The Bulimba Creek Catchment Management Plan prepared by BCC outlines the management strategy for the creek and catchment areas.

Construction of the GUP in the vicinity of Bulimba Creek will require works within the Bulimba Creek floodplain in the form of an additional bridge and piers, and road widening works to the existing embankments which traverse the floodplain in this area (refer Section 3 for details).

### *12.6.2 Existing Environment*

Water quality information provided by the EPA indicates that the water quality of Bulimba Creek is generally poor. The data shows that nitrogen and phosphorous levels are generally above the recommended guideline levels. Dissolved oxygen at most monitoring sites was below the recommended guideline level. Mean pH and turbidity levels were consistently within the guidelines. Mean chlorophyll-a levels were above guideline levels at some monitoring sites. Raw data is located in Appendix I.

Elevated lead, nickel, zinc and copper were not detected in any of the samples collected by Connell Wagner in March 2004. Lead and zinc were detected in BC2 in April 2004, exceeding recommended levels, while copper exceeded recommended levels in BC2 and BC3. Total nitrogen was elevated in all of the samples exceeding twice the levels recommended in the ANZECC guidelines and BCC water quality objectives on BC1 and BC2. Total phosphorous was elevated in BC2 and BC3 and exceeded the recommended levels by two and four times, respectively (refer Figures 12.2a to 12.2f). TPH was not detected in any of the samples. pH was within the recommended limits, as was suspended solids. ANZECC Guidelines for aquatic ecosystems levels are indicated in the figures by a red line for freshwaters, green line for marine waters, while the BCC water quality objective is shown as a blue line. Sampling results are included in Appendix I.

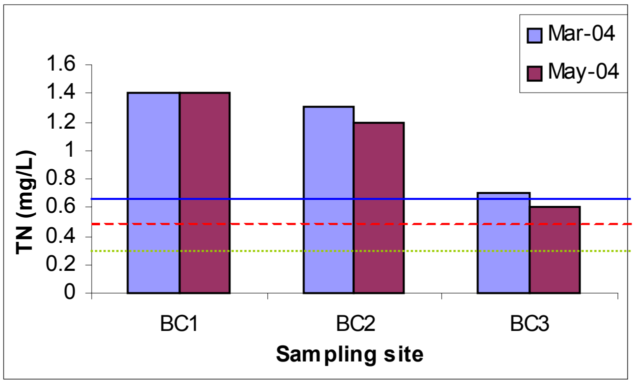



**Figure 12.2a Nitrogen levels within Bulimba Creek (Green line indicates estuarine limits)**

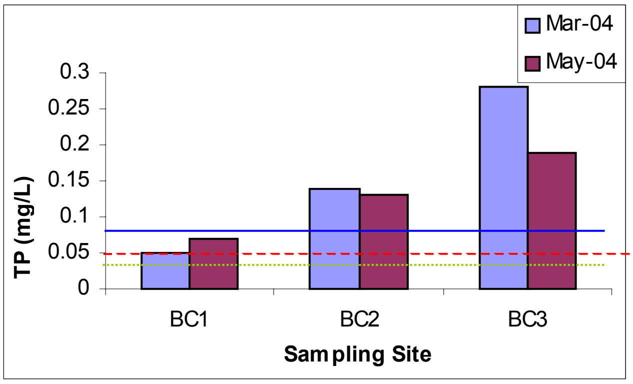



**Figure 12.2b Phosphorous levels within Bulimba Creek (Green line indicates estuarine limits)**

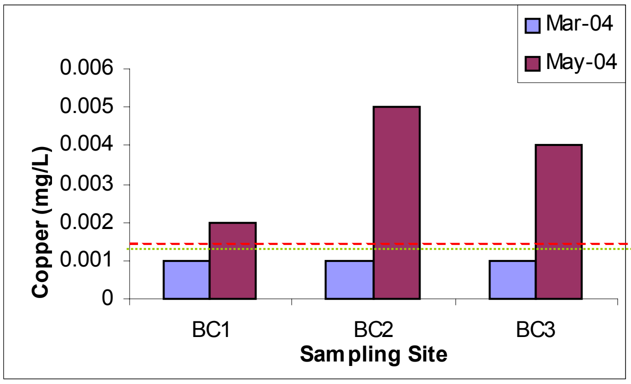



**Figure 12.2c Copper levels within Bulimba Creek**

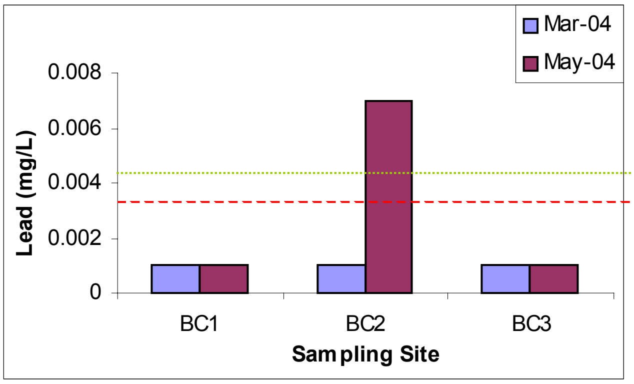



**Figure 12.2d Lead levels within Bulimba Creek**

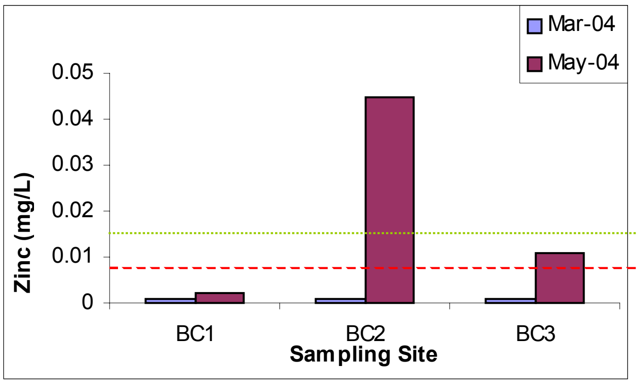



**Figure 12.2e Zinc levels within Bulimba Creek**

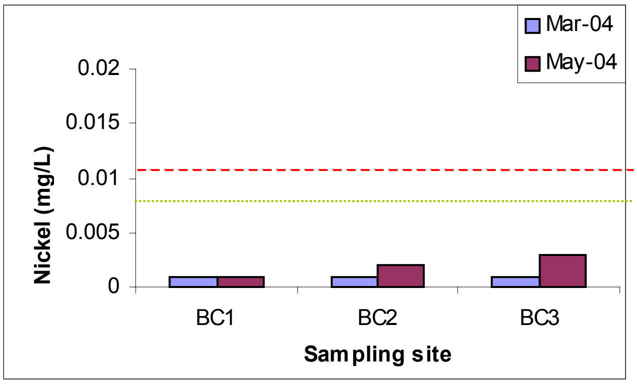



**Figure 12.2f Nickel levels within Bulimba Creek**

Elevated nutrient levels can be attributed to:

- Fertilisers from sports fields, parks adjacent to or upstream from the creek;
- Fertilisers from households and urban stormwater drains;
- Household cleaning products being washed into the creek; and
- Tidal exchange with Brisbane River.

High metal concentrations can be attributed to the increase in development along the creek and associated runoff and erosion. Industry located adjacent to or nearby the creek may contribute to levels found in the samples. Copper and zinc are commonly found in brake linings and tyres and the elevated levels of these could also be attributed to runoff from the Motorway and other roads.

### *12.6.3 Potential Impacts*

Potential impacts on Bulimba Creek for the GUP include both direct and indirect impacts. Direct impacts include excavation and vegetation removal associated with widening existing bridges and constructing new bridges over Bulimba Creek.

The key activities associated with direct potential impacts near Bulimba Creek are:

- Culvert extensions or replacements near drainage areas or near the creek (CH6150, 7200, 9400, 13100 and 14250);
- Large areas of earthworks near drainage lines (CH7100, 11400-12100, 13500 and 14400-14900);
- Widening of existing bridge and construction of new bridge over Bulimba Creek (CH14700-14800); and
- Removal of illegal fill from Bulimba Creek floodplain.

Indirect impacts include sedimentation and erosion, changes to water quality during construction and operation from road runoff and potential pollutants from vehicles. The quality of water leaving the construction site will differ to that experienced during the operational phase of the project, and as such different management measures will be required. There are a number of new culverts being constructed and upgrades to existing culverts that will be occurring within this section of the GUP.

The potential impacts on the natural and created environments caused by contamination of waters include the following:

- Degradation of the quality of runoff discharging to Bulimba Creek, Brisbane River and Moreton Bay;
- Contamination of underlying soils and eventually groundwater;
- Vegetation and fauna utilising surface water environments, including freshwater runoff and estuarine and marine waters; and
- Increased sedimentation and flooding.

**Potential Construction Impacts**

The potential sources of groundwater and/or surface water contamination during GUP construction, which will require appropriate measures to avoid or minimise potential water quality impacts, are as follows:

- Disturbance of acid sulphate soils;
- Sediment from disturbed areas;
- Disturbance of instream sediments in Bulimba Creek;
- Hydrocarbon or chemical leaks and small scale spill from vehicles;
- Hydrocarbons of chemical spills from storage areas;
- Discharges from temporary sewerage and site facilities; and
- Storage and disposal of waste material.

The potential for soil erosion and sedimentation is the main construction related impact. This generally occurs after vegetation removal and/or during excavation and earthworks. Sediment is transported offsite by runoff into the drainage network (often blocking infrastructure), into receiving waters and onto adjacent properties. This can impact upon waterways by increasing turbidity, reducing aesthetics and amenity of an area, changes to water quality due to increased nutrients or pollutants associated with sediment and impacts to flora and fauna due to changes in composition of water quality.

Increased sedimentation from earthworks, hazardous/chemical substances (such as hydrocarbons from oil spills, asphalt prime, solvents, cement slurry and wash waters) and litter are potential pollutants if not managed properly. Eutrophication (the process of excessive nutrient enrichment) of receiving waters often stems from nitrogen, phosphorus and silica bound to the surface of deposited soil particles. This over enrichment of a water body with nutrients can result in excessive growth of organisms and depletion of oxygen within the water column. Consequently, waterbodies with freshly deposited sediments may often undergo a rapid transformation from aquatic plant dominated communities to algal dominated communities resulting in corresponding changes in the aquatic fauna, dependant upon pre existing aquatic flora for food and shelter. Acid drainage (from acid sulphate soils) is a potential impact that can impact upon groundwater and surface water quality.

The following potential impacts are discussed in other sections of the EIS:

- Acid sulphate soils and contaminated soils (refer Section 10);
- Groundwater quality (refer Section 13); and
- Downstream aquatic values (refer Section 17 and Appendix M5).

**Potential Operational Impacts**

The key locations where potential impacts may occur from operation are areas where runoff from the Motorway can enter waterways and drainage lines (including but not limited to CH11900, 13100, 14300, and 14800).

The operational impacts of road runoff tend to be less well documented, though recent studies indicate that road runoff contains elevated levels of sediment, heavy metals, petroleum hydrocarbons, polynuclear aromatic hydrocarbons (PAH) and nutrients (Drapper 2001). Motor vehicles are the predominant source of road runoff pollutants. Secondary contributors include gross pollutants from motor vehicle users and other users within the road catchment, pavement wear, fertilisers, pesticides and atmospheric sources. These potential contaminants result from a combination of the breakdown, spillage and normal operational emission of automotive components such as tyres, clutch and brake linings, hydraulic fluids, automotive fuels or lubricants, particulates from exhaust emissions and materials (eg soils, mud and litter) tracked, carried, washed, blown or thrown from the under body or payload of vehicles. Also present are windblown soils and vegetative matter from roadside plantings and vegetation.

Many of the potential chemical contaminants in road runoff (in particular, metals, some lubricants) become bound or strongly adsorbed to the soil particles. Therefore whilst the quantities of sediment and soil particles lost from developed road surfaces are much smaller than comparable roads undergoing construction, the pollutants exported from the roadway catchment in runoff may be of much higher toxicity to aquatic fauna.

When constructed the Motorway will carry a higher volume of traffic than it does currently and there will be an increased potential for a chemical/fuel spill to occur. A chemical/fuel spill has the potential to cause significant damage to the terrestrial and downstream waterways, and public health. The potential environmental damage from a spill may be long term and, in the case of groundwater, the effects may persist for many years.

The GUP during the operational phase has the potential to effect water quality within the Bulimba Creek and downstream waterways. The identified potential impacts are:

- Decrease in downstream water quality from road runoff resulting in a decrease in downstream waterway values (refer Section 12.5, Section 17 and Appendix M5);
- Localised water temperature changes in Bulimba Creek due to increase shading;
- Contamination of soil, groundwater and surface water from a chemical spill on the Motorway; and
- Poor design of waterway crossing structures can also change flows, which in turn leads to erosion of watercourse bed and banks, delivering sediment downstream, including to Moreton Bay.

To ensure that operational impacts are minimised a ”water quality treatment train” approach should be adopted to reduce the level of contaminants entering waterways (refer Section 12.10.1).

Provided mitigation strategies are developed and following, the potential environmental impacts identified above are likely to be minimal.

## 12.7 Cleveland Branch Rail Line to Pinkenba Rail Line

### *12.7.1 Background*

This section of the GUP crosses the Brisbane River. The Brisbane River catchment covers a total area of 13,500km$^2$ in size and extends from Moreton Bay to the Great Dividing Range. Land use along the river is varied and includes significant areas of urban, cropping, grazing and forested land. The lower reaches of the river near the GUP are mainly urban. This catchment supports a population of over one million which is continuing to rise.

The Brisbane River is the largest and most significant river flowing into Moreton Bay. Previously, the tidal limit was only 16km due to upstream bars and shallows, however, due to continual dredging within the River the tidal limit now extends 85km upstream. Major tributaries of the Brisbane River include Breakfast, Bulimba, Norman and Oxley Creeks. The nutrients and sediment loads within the Brisbane River are higher than other rivers that flow into Moreton Bay. This is likely due to the large volumes of stormwater and sewage that enters the system. The Brisbane River catchment deposits 450,000 tonnes of suspended sediment into Moreton Bay every year (Holland *et al* 2001).

### *12.7.2 Existing Environment*

Water quality information from EPA indicates that the water quality of the Brisbane River is generally of average to poor quality. Total Phosphorous is above recommended levels at all EPA monitoring sites. Total Nitrogen is above recommended levels in upstream locations but is within recommended limits closer to the mouth of the River. Suspended solids were well above the recommended levels upstream of the GUP, however, suspended solids near or downstream of the GUP are below recommended levels. Turbidity and chlorophyll a are within recommended guidelines as is dissolved oxygen levels. Raw data can be located in Appendix I. The tidal flushing at the mouth of Brisbane River is the likely contributor to the improved water quality downstream of GUP.

The Healthy Waterways report for 2002 states that the condition of the Brisbane River is poor. Majority of EPA sampling sites had elevated levels of Total Nitrogen and Total Phosphorous, over twice the recommended objective. Sediment loads were also above the recommended objective. The lower Brisbane catchment is considered in poor condition for water quality and ecosystem health. The freshwater tributaries received an F in the last annual report while the estuarine and marine areas received a D-.

Within the Brisbane River catchment there are a number of sources where nutrients and pollutants can enter the river. These include:

- Fertilisers, chemicals and other contaminants in runoff from households;
- Sewage discharges;
- Industry located on the river;
- Construction located on or adjacent to the river promotes erosion and sedimentation;
- Tidal exchanges with tributaries of the Brisbane River;
- Discharges from wastewater treatment plants;
- Boats and other vessels utilising the River; and
- General pollutants from roads and other anthropogenic sources washed into river via stormwater drains.

The section of the Brisbane River that lies within the GUP has been highly modified from its original condition due to past wharf and port development, heavy industry, light industry, warehousing and wharves, and residential development along the river. There are approximately 11 sewage treatment plants that currently discharge treated effluent into the tidal area of the Brisbane River. There are oil refineries and a fertiliser plant that also discharge into the river and approximately 200,000 tonnes of sediment per year is deposited into the river from uncontrolled residential building sites (Holland *et al* 2001).

Other causes for poor water quality within the Brisbane River include:

- Extensive riparian vegetation clearance;
- Altered flows;
- Introduced plants and animals;
- High nutrient and sediment levels;
- Bacteria levels;
- Heavy metal and toxicant accumulation in sediments from urban creeks; and
- Channelisation of waterways.

### *12.7.3 Potential Impacts*

Direct impacts to the Brisbane River include excavation, vegetation removal and associated impacts from the construction of the new bridge and pilings.

The key location where potential impacts could occur is between CH16500-17900, with piling within the Brisbane River the largest potential risk.

Indirect impacts include sedimentation and erosion, changes to water quality during construction and operation from runoff, and potential pollutants from vehicles. The quality of water leaving the site during the construction phase will differ to that experienced during the operation phase of the GUP, and as such different management measures will be required.

**Potential Construction Related Impacts**

The potential sources of groundwater and/or surface water contamination during GUP construction, which will require appropriate measures to avoid or minimise potential water quality impacts, are as follows:

- Disturbance of acid sulphate soils;
- Sediment from disturbed areas;
- Disturbance of instream sediments in Brisbane River;
- Hydrocarbon or chemical leaks and small scale spill from vehicles;
- Hydrocarbons of chemical spills from storage areas;
- Discharges from temporary sewerage and site facilities; and
- Storage and disposal of waste material.

The main construction related impacts to potentially affect the Brisbane River are erosion and sedimentation and disturbance of river bed sediments during pier construction within the river. These impacts can potentially affect the Brisbane River and associated flora and fauna by increasing turbidity and changing water quality due to increased nutrients or pollutants associated with sediment.

Potential pollutants, including sedimentation from earthworks, hazardous/chemical substances (such as hydrocarbons from oil spills, asphalt prime, solvents, cement slurry and washwaters) and litter, will need to be appropriately managed. The highest risk is associated with the construction of the bridge. The pilings and the bridge construction could directly impact upon the water quality of the river. During the construction phase stringent management and mitigation measures will need to be implemented to ensure minimal impact occurs.

The following potential impacts are discussed in other sections of the EIS:

- Acid sulphate soils and contaminated soils (refer Section 10);
- Decrease in groundwater quality (refer Section 13); and
- Decrease in downstream aquatic values (refer Section 17 and Appendix M5).

**Potential Operation Related Impacts**

The key locations where potential impacts may occur from operation are areas where runoff from the Motorway can enter Brisbane River and tributaries (including but not limited to CH16500-17900).

Potential operational impacts include:

- An increased potential for a chemical/fuel spill to occur;
- An increase in traffic volumes and therefore increased pollutants entering stormwater system;
- Increased nutrients and pollutants entering the Brisbane River impacting on aquatic flora and fauna; and
- Increased erosion and sedimentation due to unsuitable design of waterway crossing structures.

The potential operational impacts from road runoff are provided in Section 12.6.3 and Appendix M4.

The hydraulic connection between the bridge site along the Brisbane River and Moreton Bay, is the primary pathway by which potential water quality impacts might be propagated. The nearest designated Ramsar wetland, with proximity to potential road runoff from the GUP on the south side of the Brisbane River, is along the eastern shore of Fisherman Islands. Because of the comparative distance (approximately 10km from the GUP river crossing), dilutions and prevailing currents involved between the potential sources of generation of road runoff and this designated Ramsar wetland area; it is unlikely that the GUP will have any significant impact to this wetland area.

To ensure that operational impacts are minimised a "water quality treatment train" approach should be adopted to reduce the level of contaminants entering waterways.

The introduction of structures, within the Brisbane River floodplain and channel have the potential to restrict flows, particularly flood flows that can deliver significant amounts of nutrients to shallow, inshore marine ecosystems. Any interruption to these inputs could lead to ecological changes in nearby marine ecosystems, including both intertidal and sub tidal ecosystems in the nearby Ramsar site. Design measures will be adopted with the main bridge crossing the Brisbane River to minimise localised erosion around piers. In this way, changed water flows will not lead to changes in the water regime of affected areas, or in the delivery of flood flows to Moreton Bay and the associated Ramsar wetlands.

## 12.8 Pinkenba Rail Line to Nudgee Road

### *12.8.1 Background*

This section of the GUP crosses Kedron Brook Floodway and is located near Schultz Canal, Cannery Creek and other small unnamed tributaries and canals. The proposed alignment also traverses BAC land which contains a number of small man made canals and drains. These canals drain into Schulz Canal, Landers Pocket Drain and Kedron Brook Floodway prior to entering into Moreton Bay.

Kedron Brook is a natural waterway that extends from the D'Aguilar Ranges. The uppermost sections of Kedron Brook are ephemeral gullies. Cedar Creek joins Kedron Brook at Ferny Grove. The Brook meanders almost permanently through Arana Hills, Mitchelton, Everton Park and Grange urban areas. Kedron Brook Floodway has been made into channels through Lutwyche, Wooloowin and Toombul areas. Downstream from Toombul it is tidal and it has been re-routed to the north so it can drain the Airport site. Kedron Brook enters Bramble Bay within Moreton Bay, to the south of the Boondall wetlands. Bramble Bay extends from the mouth of Brisbane River to north of the Redcliffe Peninsula. Bramble Bay is considered to have poor water quality due to poor flushing within the Bay and has the poorest water quality of all Moreton Bay zones (Healthy Waterways 2004).

Cannery Creek is located north of Northgate. Cannery Creek, formally a chain of waterholes, was constructed as a waterway for drainage purposes. It flows into the Kedron Brook Floodway and is tidally inundated. Mangroves line the channel.

Battery Drain is a constructed drainage channel that transects the GUP south east of the Gateway Motorway Airport Drive interchange. It is approximately 20m wide and "v" shaped and flows from the outlet structure under the Gateway Motorway to the north east. The catchment for this drain extends as far west as the suburb of Ascot, and flows generally through Eagle Farm and Doomben Racecourse prior to discharge in the vicinity of the GUP. This drain appears to have been excavated to divert the flow of Serpentine Creek. Battery Drain is tidally influenced to within approximately 100m of the existing Gateway Motorway.

Most other tributaries in this area are man made channels that have been rock armoured or modified to better conduct flows and to control erosion. Majority of these waterways are tidal, and some are mangrove lined, while a small number are essentially freshwater they are lined with salt tolerant sedges to cope with the tidal inundation when required.

### *12.8.2 Existing Environment*

#### BAC Monitoring

BAC undertake water quality monitoring on a regular basis at two locations near the GUP on airport land. Both of the sampling sites are located within Schultz Canal near where it intersects Kedron Brook Floodway (refer Figure 12.1d). Both of these monitoring sites have been monitored on incoming and outgoing tides. Data was collected from 13 sampling rounds over four years. The averages of these results from this monitoring are shown in the table below.

**Table 12.2 Brisbane Airport Corporation Water Quality Data**

| Site | Temp (°C) | pH (units) | Conductivity (ms/cm) | DO (%) | TN (mg/L) | TP (mg/L) |
|---|---|---|---|---|---|---|
| D6 incoming | 26.32 | 7.29 | 35.11 | 101.39 | 0.15 | 0.05 |
| D6 outgoing | 23.03 | 7.52 | 40.66 | 91.75 | 0.11 | 0.10 |
| I4 incoming | 24.47 | 7.19 | 31.63 | 89.28 | 0.156333 | 0.031833 |
| I4 outgoing | 22.42 | 7.71 | 46.84 | 94.95 | 0.10 | 0.09 |

**EPA Monitoring**

EPA undertake water quality sampling within the Kedron Brook Floodway, however this is upstream of the GUP and has not been assessed in the EIS.

**EIS Monitoring**

Lead was not detected in any of the samples collected by Connell Wagner in April 2004 and although it was detected in May 2004 it was within the guideline levels. There were low levels of nickel in the samples which were within recommended levels in the ANZECC guidelines. Copper exceeded ANZECC recommended levels in all three samples during both sampling rounds. Zinc exceeded recommended levels in April 2004 only. Total Nitrogen exceeded recommended levels Cannery Creek and Total Phosphorous exceeded recommended limits in all samples (refer Figures 12.3a to 12.3f). pH was within recommended limits. ANZECC Guidelines for aquatic ecosystems levels are indicated by a red line for freshwater, green line for marine waters, while the BCC water quality objective is shown as a blue line. Sampling results are located in Appendix I.

Elevated nutrients can be attributed to fertilisers from households, sports fields, golf courses and parks, sewage overflow and runoff from urban properties. Heavy metal concentrations could be attributed to a variety of sources, including historic and existing industry located adjacent to the waterway or other upstream catchment land uses.

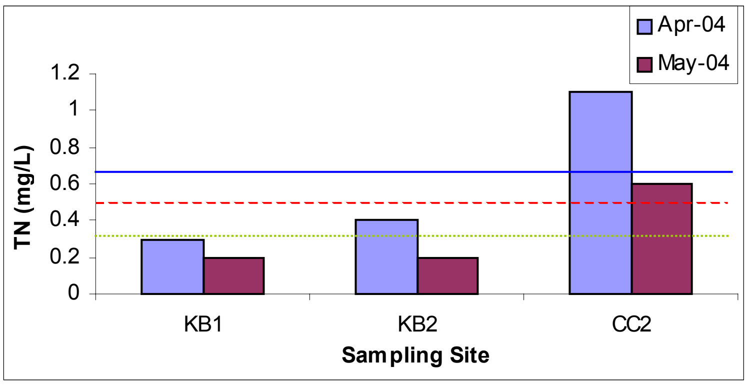



**Figure 12.3a Nitrogen levels within Kedron Brook Floodway and Cannery Creek (Green line indicates estuarine limits)**

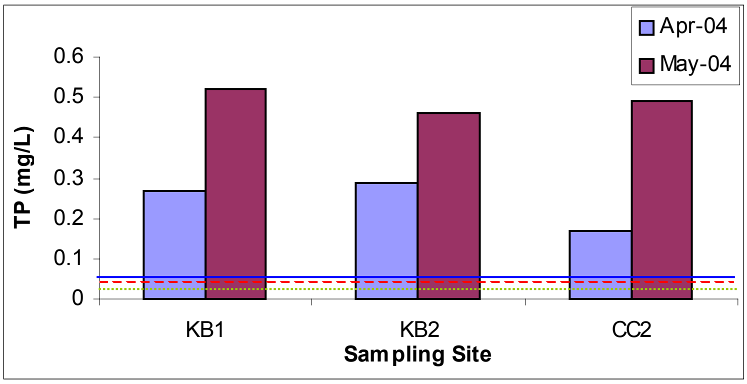



**Figure 12.3b Phosphorous levels within Kedron Brook Floodway and Cannery Creek (Green line indicates estuarine limits)**

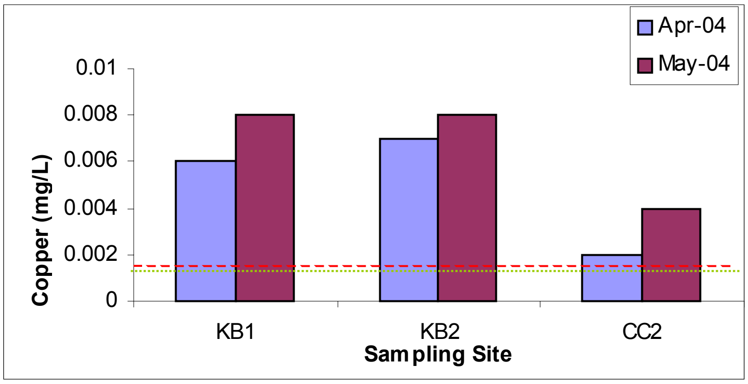



**Figure 12.3c Copper levels within Kedron Brook Floodway and Cannery Creek**

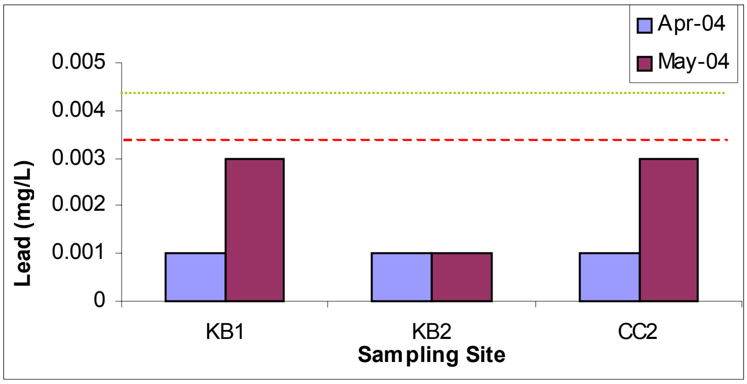



**Figure 12.3d Lead levels within Kedron Brook Floodway and Cannery Creek**

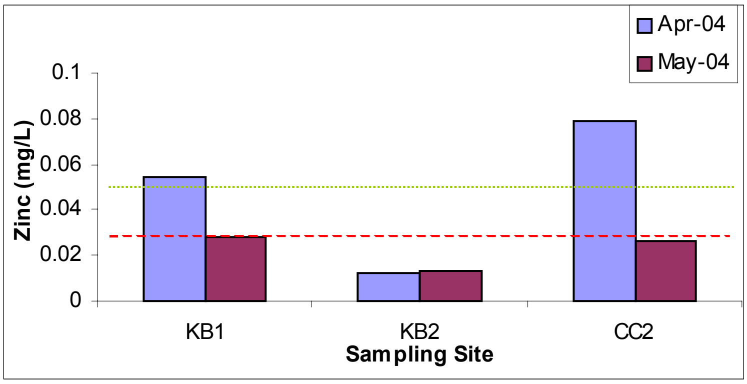



**Figure 12.3e Zinc levels within Kedron Brook Floodway and Cannery Creek**

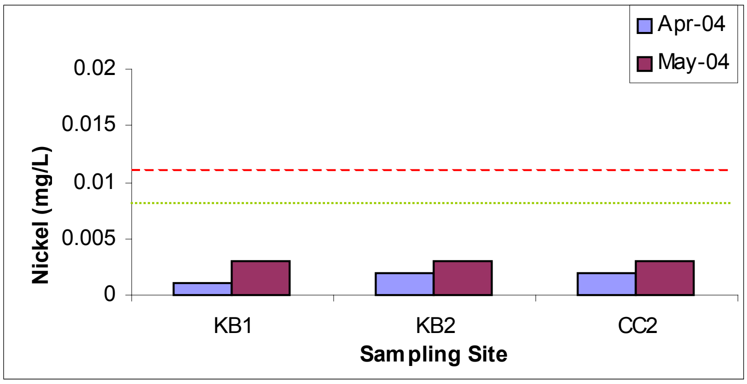



**Figure 12.3f Nickel levels within Kedron Brook Floodway and Cannery Creek**

**Summary of Water Quality**

Based on existing data and data collected for the EIS, the water quality of Kedron Brook Floodway and Cannery Creek is poor. Bramble Bay has poor water quality and tidal flushing would contribute to the high nutrient levels as well as the input from urban sources. The high heavy metal concentrations could be attributed to historic and existing industry located adjacent to the waterways or other upstream catchment land uses. High levels of nutrients and copper levels are the main consistent concerns within Kedron Brook Floodway and Cannery Creek.

### *12.8.3 Potential Impacts*

Direct impacts to Kedron Brook Floodway include vegetation and erosion and sedimentation associated with new bridges, widening bridges and culvert extensions.

The key locations for potential construction and operation related impacts include areas close to creeks and drainage lines:

- Between CH19100-20199 large amounts of earthworks will occur near drainage lines;
- Between CH21800-22400 earthworks and mangrove removal will occur;
- The construction of bridges over Kedron Brook Floodway (CH22900-23200) has the potential to impact upon water quality during earthworks and piling works; and
- The flood mitigation works on the Kedron Brook floodplain.

Indirect impacts include sedimentation and erosion, changes to water quality during construction and operation from road runoff, and potential pollutants from vehicles. The quality of water leaving the site during the construction phase will differ to that experienced during the operation phase of the GUP, and as such different management measures will be required.

The hydraulic connection between Kedron Brook Floodway and Moreton Bay, is the main pathway, after the Brisbane River, by which impacts might be generated.

The potential impacts associated with this section of the GUP are the same as the Cleveland Branch Rail Line to Pinkenba Rail Line section (refer Section 12.7.3).

Within the Kedron Brook Floodway, the road will be raised above the full width of the floodplain on piles, thereby reducing any possible restriction to flood flows in this area.

**Potential Construction Related Impacts**

The potential sources of groundwater and/or surface water contamination during GUP construction, which will require appropriate measures to avoid or minimise potential water quality impacts, are as follows:

- Disturbance of acid sulphate soils;
- Sediment from disturbed areas;
- Disturbance of instream sediments in Kedron Brook Floodway and tributaries;
- Hydrocarbon or chemical leaks and small scale spill from vehicles;
- Hydrocarbons of chemical spills from storage areas;
- Discharges from temporary sewerage and site facilities; and
- Storage and disposal of waste material.

Details of the potential impacts are provided in the Section 12.7.3. Also the following potential impacts are discussed in other sections of the EIS:

- Acid sulphate soils and contaminated soils (refer Section 10);
- Decrease in groundwater quality (refer Section 13); and
- Decrease in downstream aquatic values (refer Section 17 and Appendix M5).

**Potential Operation Related Impacts**

The potential operational impacts from road runoff are provided in Section 12.7.3 and Appendix M4.

The management of stormwater from the pavement in this section is an important issue due to the area being on a floodplain and the potential for runoff and associated contaminants to easily enter waterways.

## 12.9 Summary of Impacts

Overall water quality within the watercourses that could potentially be affected by GUP is poor. There are high levels of nutrients and in some locations high levels of heavy metals. The reasons for this could be attributed to a number of factors, however the potential impact from GUP could contribute to worsen the poor water quality within these systems.

The large quantities of earthworks during construction near drainage lines, creeks and rivers have the potential to increase turbidity and vegetation removal on riverbanks has the potential to promote sedimentation. These activities could potentially supply waterways with nutrients and pollutants attached to sediment, further degrade water quality and impact upon aquatic flora and fauna.

To ensure that potential impacts are minimised, mitigation measures need to be implemented for all phases of GUP as discussed below.

## 12.10 Mitigation Measures

### *12.10.1 Design*

A number of management options exist for the management of road runoff during the operational phase of the GUP. It is important to note that the existing Motorway has minimal formal treatment of road runoff prior to discharge into receiving waters. The potential physical, chemical and biological impacts of this practise is somewhat offset by the natural dilution effects experienced when road runoff enters a receiving environment. The effectiveness of this depends heavily upon the volume of the receiving waters and the volume of contaminants in runoff. While the large water volumes in Brisbane River and Moreton Bay are likely to be sufficient to dilute direct runoff such that no adverse effects are observable, this practice would still contribute to the total pollutant load entering the waterway. More effective treatment measures for road runoff include source reduction (eg emissions from cars) and other roadside management practices (which is outside the scope of this EIS) and stormwater design controls which remove pollutants from runoff prior to discharge into a waterway.

A high level of water quality treatment control is required at areas which represent the highest risk of decreasing water quality and waterway values. These areas are identified by proximity to sensitive receiving environment and the likelihood of contaminants entering waterways. For the GUP, areas requiring a high level treatment control include:

- The new Gateway Bridge (runoff enters Brisbane River and eventually Moreton Bay);
- Pavement runoff discharged into Bulimba Creek and associated mangroves;
- Pavement runoff discharged into Kedron Brook Floodway and associated mangroves;
- Culvert extensions located along route;
- Wynnum Road interchange;
- Port of Brisbane Motorway interchange;
- Lytton Road interchange;
- Old Brisbane Airport site (TCC); and
- Northern airport access interchange; and
- All proposed construction sites.

In principle, it is generally relatively easy to collect and treat runoff from major road projects since they typically have well defined drainage channels and above ground stormwater outlets. As such, runoff can be relatively easily collected and treated prior to final discharge. Therefore road runoff generated should be targeted for treatment prior to discharge to the environment.

The best management practice for treating stormwater is using two or more treatment options in a series. By using a number of stormwater management measures in a sequence, or "treatment train" approach, the overall performance of a water quality treatment system is improved. The optimum treatment train approach utilises primary, secondary and tertiary treatment devices in succession. A primary device removes gross pollutants and coarse sediments, a secondary device removes finer sediments and pollutants while a tertiary device removes extremely fine or soluble material. A variety of stormwater management measures can be incorporated into the design to create a treatment train.

The following design criteria should be applied:

- The quality of runoff from GUP should approach the guidelines shown in the table below where possible.

**Table 12.3 Water Quality Guidelines**

| Water Quality Indicator | Design Guideline Level |
|---|---|
| Total Suspended Solids | <80mg/L |
| Lead | 1-5µg/L (depending on water hardness) |
| Zinc | 5-50µg/L (depending on water hardness) |
| Copper | 2-5µg/L (depending on water hardness) |
| Hydrocarbons | <10mg/L |
| Total Phosphorous | 10-100µg/L |
| Total Nitrogen | 100-750µg/L |
| Cadmium | 0.2-2µg/L (depending on water hardness) |
| Chromium (total) | <10µg/L |
| Nickel | 15-150µg/L (depending on water hardness |
| pH | 6.5-9.0 |

- All permanent water quality treatment control devices must be designed for the adequate control of pollution and sediment and other coarse materials in the 1 year Average Recurrence Interval (ARI) peak flow (minimum), and also designed for the stability of these devices in at least the 20 year ARI peak storm event;

The following stormwater management measures should be incorporated and further developed as part of the detail design of the GUP:

- Grassed/vegetated swales located alongside Motorway and ramps;
- Batter slopes to be grassed/vegetated and rock check dams be installed where appropriate;
- Permanent settlement ponds and detention basins to be constructed if required at key locations along the route;
- Gross pollutant traps to be installed at key locations along the route;
- Planning and development of specific fuelling sites, concrete or bitumen waste containment areas and installation of temporary sediment basins; and
- First flush surface runoff from new bridge decks will not be directly discharged into any roadway below or into any stream or watercourse, but will be diverted to the end of the structure, collected and treated to conform with the requirements of the design water quality objectives in Table 12.3.

### *12.10.2 Construction*

During construction, the management of drainage is the most critical aspect of erosion control. A range of erosion and sediment control devices, including sedimentation basins, should be utilised during the construction phase. During the construction phase of this project, it will be important to implement stringent erosion and sediment control devices in higher risk areas. These areas include but are not limited to all creek crossings and areas with steep slopes (refer to Section 10).

Piling operations present challenges for sediment erosion and control often due to the limited space available for removal and/or containment of excavated materials, particularly where piling is located within or adjoining an existing drainage line or watercourse. In such instances, the following should be implemented:

- Isolation of the working area by temporary fencing, bunding, or sheetpiling to prevent the loss of erodable soils to surrounding receiving waters or drains; and
- Alternative drainage or flow bypass mechanisms such as pipes, culverts or geofabric liners may be temporarily required to divert drainage flows through the workspace whilst preventing or minimising their erosive potential on unvegetated soils surrounding piling operations.

Other mitigation measures that should be implemented during construction include but are not limited to:

- Any dewatering of trenches or excavations should be undertaken to stable ground and in a manner which prevents sediment laden water entering stormwater drains or waterways. The water shall be treated to remove sediment if necessary;
- Liquid discharges from dewatering activities and wick drains should be contained, monitored for pH and selected contaminants and treated if required, prior to discharge.
- The amount of stormwater leaving a site should be minimised through onsite storage and reuse in construction requirements, dust suppression and revegetation;
- Works to be staged to minimise erosion;
- Install cut off and diversion drains prior to significant land disturbance to divert runoff from undisturbed areas into stable drainage lines at non-erosive velocities. Similarly, install cut off or diversions drains to divert runoff around stockpile sites;
- Stockpiles of water pollutants (eg oils, construction materials, fuels etc) should be located so as to minimise the potential for contaminants entering Bulimba Creek, Brisbane River and Kedron Brook Floodway, or any other stormwater or drainage channel;
- An area/s should be designated for the containment of waste concrete materials away from watercourses or drainage lines. A bunded containment area, of earthern materials or similar shall be formed and maintained. Any waste concrete, concrete washings or similar construction materials should be disposed of to the designated bunded area for containment, drying and treatment where required;
- When dry or solidified, the concrete material should be removed from the site for disposal at a licenced waste disposal facility. Alternatively, the dry concrete can be re-used on site for temporary access tracks (as for gravel and rock);
- Chemicals storage and use should be managed as per the chemical storage and handling management plan;
- Notification to the EPA under Section 320 of the *Environmental Protection Act 1994* (duty to notify environmental harm) may also be required;

- A contingency plan for accidental spills of toxic materials should be prepared and all onsite staff made aware of it. Specific runoff control measures for accidental spills of toxic materials should be outlined in the contingency plan;
- Spill containment measures to be incorporated into the Construction EMP and proposed locations of the stockpile and material storage, handling and treatment areas;
- Preparation of spill containment/clean up procedure should incorporate the following principles as a minimum:
  - recording of spill/incident details, including date, time, location, volume/quantity, source, material/contaminant identification, sensitive receptor identification, initial containment/clean up measures implemented, MSDS requirements for spill management etc;
  - communication pathways, requirements and documentation;
  - clean up and disposal/release documentation, including sampling and analysis results and waste tracking documentation; and
  - document control compliance.
- All vehicles and equipment should be checked daily for possible fuel, oil and chemical leaks and should maintain portable spill kits as complete;
- Any chemical or fuel spills should be cleaned up as per the chemical storage and handling management plan. Where it is reasonably believed or expected that the spill has entered a waterway, a water sample shall be collected in the area of the spill and directly downstream and analysed for the parameters outlined below and the chemical or fuel spilt. Water sampling containers shall be held at all times by the project manager for the collection of a sample in the event of a spill;
- Cleaning of equipment and or vehicles used during the road construction should not be undertaken in locations that permit flow of untreated wastewater into any creek or wetland adjacent to the route;
- The use of fertilisers during revegetation works at the site should be the minimum necessary to promote establishment, and shall be incorporated into soils or seeding mixes to minimise the likelihood of fertiliser being carried off site to watercourses;
- The Superintendent should monitor the bureau of meteorology weather forecasts for the area, including prior to non-work periods such as Sundays. Where storms or significant rains are predicted, an inspection of the site including erosion and sediment control devices, should be undertaken and repairs and improvements undertaken as appropriate;
- Where flood rains or floods are predicted to affect the area of the construction site, works will cease and the site should be made safe and as stable as practical. Prior to work closure periods such as Easter, Christmas and other public holidays, works should be stabilised as for preparation for a significant storm event;
- A permit should be obtained from the DNRM&E prior to extraction of water from Bulimba Creek or any other watercourse;
- Should a temporary fill platform be required for pile driving operations, it should aim to achieve the following:
  - protect the watercourse from sedimentation by the use of geofabric and rock protection and using fill material which does not contain fines;
  - protect the opposite bank from diverted water where the platform does not completely cut the stream;
  - ensure that the watercourse can still flow by installing and monitoring appropriate drainage pipes. Temporary drainage shall be designed to ensure erosion of the watercourse bed does not occur;
  - ensure that installation and removal of temporary structure does not cause erosion and sedimentation of the watercourse or chage in channel cross section.

- Revegetation should be done progressively (area by area) so that each area is given a protective ground cover as soon as work is completed for that area. Revegetation shall in accordance with the Landscape Concept Plan (refer Section 22);

#### *12.10.3 Operation*

Environmental impacts and associated controls to contain discharges resulting from emergency situations will be detailed in the EMP (Maintenance).

All runoff water from the structures to be constructed could be collected and treated using combinations of gross pollutant traps, or proprietary oil/water separators, or sediment basins and other properly constructed and/or configured treatment devices such as grassed filter strips, swale drains and bioretention basins. The precise nature of such treatment devices will be a function of locally specific factors such as access to stormwater infrastructure, available space, and maintenance costs.

#### *12.10.4 Water Quality Monitoring*

**Baseline Monitoring**

A baseline surface water quality monitoring program will be conducted by MR for rain event monitoring prior to the commencement of construction activities (refer Section 23 for details).

**Construction**

A water quality monitoring program will need to be implemented during the construction phase to ensure that water quality objectives are met and that potential impacts to water quality are monitored and mitigated during construction. Replicate water samples should be collected from sampling sites upstream and downstream of the construction area. Recommended sites are listed below, however as long as sampling sites are located a reasonable distance upstream and downstream from construction area (ie between 100m-200m) they will be satisfactory.

Samples should be taken on two occasions (minimum 2 week interval) at the sampling sites detailed below prior to commencement of construction to provide additional background data. One occasion should follow a rainfall event where possible. Monitoring will take place fortnightly and during or immediately following storm events equal to or greater than 25mm/hour or as directed by MR.

Recommended monitoring points are as follows:

- Bulimba Creek:
  - One sample 100-200m upstream and one sample 100-200m downstream of CH11900;
  - One sample 100-200m upstream and one sample 100-200m downstream of CH14700, where it crosses Bulimba Creek;
- Kedron Brook Floodway area:
  - One sample 100-200m upstream and one sample 100-200m downstream of CH21000;
  - One sample 100-200m upstream and one sample 100-200m downstream of CH23000, where it crosses Kedron Brook Floodway;

- Brisbane River:
  - One sample 50-100m upstream and one sample 100-200m downstream of the Gateway Bridge on the northside of the river;
  - One sample 50-100m upstream and one sample 100-200m downstream of the Gateway Bridge on the southside of the river;
- Additional monitoring points should be sampled by an appropriately qualified person if visual evidence of site impacts extends beyond these points; and
- If measured levels exceed the recommended water quality guidelines, then the contractor should identify the source of increase and implement strategies to achieve an acceptable downstream water quality.

The following parameters and compliance requirements in Tables 12.3 and 12.4 are provided as the minimum monitoring requirements and shall be monitored at the sites listed above and at any additional locations specified by the Superintendent. Additional parameters may be required to be monitored dependent on site activities and chemical spills.

The following parameters should be monitored insitu during a release from the worksite. Monitoring is required for each non stormwater release (eg dewatering). For stormwater releases monitoring is not required more frequently than once per 48 hour period.

**Table 12.4 Insitu Monitoring Parameters**

| Parameter | Compliance Requirement |
|---|---|
| pH | 6.5 – 9.0 |
| Dissolved Oxygen (DO) | 80 – 110 % saturation |
| Turbidity (NTU) | 6.50 |
| Oils | No visible films or odours. |
| Litter | No visible litter. |

Samples should be collected for analysis of the following parameters during a release from the work site. Monitoring is required for each non stormwater release. For stormwater releases monitoring is not required more frequently than once per 48 hour period (or twice in a 7 day period where rainfall is of a consistent intensity – eg prolonged light rain).

**Table 12.5 Laboratory Analysis Parameters**

| Parameter | Compliance Requirement |
|---|---|
| Total Suspended Solids (TSS) | <10% change between upstream and downstream sampling locations<br>< 80mg/L (for non stormwater releases) |
| Oil and Grease (TPH) | Oil etc not visible as a film on surface of waters<br><10mg/L |
| Nitrogen | Based on background monitoring (stormwater release)<br>500µg/L (freshwater) 300µg/L (marine) (non stormwater |

| Parameter | Compliance Requirement |
|---|---|
| | release) |
| Phosphorus | Based on background monitoring (stormwater release)<br>50µg/L (freshwater) 30µg/L (marine) (non stormwater release) |
| Lead | 0.0034mg/L (fresh) 0.0044mg/L (marine)* |
| Nickel | 0.011mg/L (fresh) 0.007mg/L (marine)* |
| Zinc | 0.008mg/L (fresh) 0.015mg/L (marine)* |
| Copper | 0.0014mg/L (fresh) 0.0013mg/L (marine)* |

**Table Notes:**
Based on ANZECC Water Quality Guidelines for Aquatic Ecosystems (2000) 95% protection values.
* Toxicity depends on water hardness

### 12.11 Conclusions and Recommendations

Current water quality within the waterways downstream of the GUP is considered to be in poor condition. Construction and operational impacts from the GUP will be minimal with the effective implementation of sediment and erosion control devices, especially in high risk areas along the project route, and the implementation of other stringent mitigation measures. Impact on the aquatic receiving environments from stormwater discharges will be minimal due with the implementation of appropriate stormwater treatment devices along the length of the project route.

Direct impact to the water quality during construction will include short term impacts during piling within and adjacent to watercourses. Impacts during operation will be minimised with the implementation of stormwater treatment devices which will reduce the amount of nutrients and pollutants entering waterways.