



Gateway Upgrade Project



23. Environmental Management Plan

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23. Environmental Management Plan

23.1 Introduction

TOR Requirements:

A Draft Environmental Management Plan (EMP) (Planning) should be provided outlining the strategies to be adopted to address identified impacts (as per Section 4 of the TOR). The EMP should conform to an Environmental Management Plan (Planning) as per the Main Roads Road Project Environmental Management Processes Manual.

The purpose of the EMP is to set out the proponents' commitments to environmental management. That is, how environmental values will be protected and enhanced. The EMP is an integral part of the EIS, but should be capable of being read as a stand-alone document without reference to other parts of the EIS (therefore some sections may be duplicated). The EMP should include the following:

- an introduction to the project that includes a detailed project description;
- the project's legislative requirements;
- the mitigation measures for inclusion in the detailed design of the project and for the development of the construction contract documentation, generally provided in tabular format;
- the mitigation strategies for the construction phase, generally provided in tabular format;
- the mitigation strategies for the operational/maintenance phase, generally provided in tabular format;
- any mitigation measures should include performance indicators and outcomes. These are to be measurable criteria against which the implementation of the actions and the level of achievement of the performance objectives will be measured;
- monitoring, auditing and reporting strategies for the construction and operational aspects of the project;
- responsibilities assigned to a relevant person/organisation; and
- the procedure and reporting framework for the identification of non-conformances and the implementation of the subsequent corrective action is to be outlined.

This Preliminary EMP has been prepared for the purpose of addressing the EIS requirements. This EMP will be refined and expanded following the Coordinator-General's decision on the project and during the design phase of the project.

23.1.1 Basis for the Plan

An important requirement of a project of this nature is to prepare an EMP to ensure the environmental safeguards proposed as a result of the planning and environmental assessments associated with the project are enacted in an appropriate and timely fashion.

The potential exists for the degradation of the site and surrounding natural values. This would be likely to occur during the construction and operational stages of this project and has been identified during the course of the environmental studies performed for this project.

Planning and design measures are therefore necessary to ensure that all reasonable measures are taken to protect the environmental values, which may be impacted during construction and operation activities.

23.1.2 Aim of the Plan

The aim or purpose of this EMP is to detail the actions and procedures to be carried out during the implementation phase of the project in order to mitigate adverse and enhance beneficial environmental and social impacts. The environmental studies and consultation conducted as part of the EIS have identified the potential construction and operational impacts of proceeding with the project.

A range of mitigation measures have been identified from the EIS environmental studies to mitigate and manage these potential impacts and need to be implemented during the construction and operational stages of the project.

The EMP addresses the proposed mitigation measures, records environmental commitments and establishes the framework to ensure they are implemented during each stage of the project. In effect, the EMP becomes the key reference document in that it converts the undertakings and recommendations of the environmental studies into a set of actions and commitments to be followed by the designers, constructors and future operators of the proposed GUP.

The EMP will also serve as the benchmark for measuring the effectiveness of environmental protection and management. This can be achieved by specifying the monitoring, reporting and auditing requirements, with nominated responsibilities and timing to ensure the necessary mitigation measures are met. The EMP also makes provision, as appropriate, for unforeseen events by outlining corrective actions which may be implemented in these situations.

23.1.3 Format of the EMP

The EMP is structured as follows:

- Relevant statutory obligations and regulatory framework within which the project will be required to progress (Section 23.2);
- Management structure and general project responsibilities for staff involved in the project (Section 23.3);
- Environmental management strategies for particular environmental aspects (Section 23.4); and
- Subsequent stages of the environmental management process during the detailed design, construction and operational stages of the project (Section 23.5).

To increase the useability of the EMP, it has been prepared as a stand alone document.

23.1.4 MR Environmental Management Approach

In preparing this EMP Main Roads' (MR) environmental management approach was considered.

Main Roads key strategy document is Roads Connecting Queenslanders. This document provides the policy directions that realises MR vision over the next decade and beyond.

The document focuses on four key outcomes for the Queensland road system, which contribute to the government's priorities for the state:

- Safer roads to support safer communities;
- Efficient and effective transport to support industry competitiveness and growth;
- Fair access and amenity to support livable communities; and

- Environmental management to support environmental conservation.

The key to making these outcomes a reality will be MR partnerships and working relationships with communities, federal and state government agencies, local government, industry and the private sector.

23.2 Statutory Obligations

23.2.1 National Strategies and International Conventions

The following national policies provide the guiding principles for the design, construction and operation of the proposed GUP:

- National Ecologically Sustainable Development (ESD) Strategy 1992;
- National Greenhouse Response Strategy 1992; and
- Framework Convention on Climate Change 1994.

Other international conventions and agreements relevant to the GUP include:

- **CAMBA** – Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their environment.
- **JAMBA** – Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their environment.
- **Ramsar Convention on Wetlands** – The Convention on wetlands, signed in Ramsar, Iran, 1971, is an inter-governmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

In addition to the conventions and agreements above, a further two conventions are identified as being indirectly relevant to the GUP. These are:

- **CMS or Bonn Convention** – The Convention on the Conservation of Migratory Species of Wild Animals aim is to conserve terrestrial, marine and avian migratory species throughout their range.

The convention is aimed at restricting harvesting, conserving habitats and controlling other adverse factors. The species covered include marine mammals, sea turtles and sea birds.

- **Convention on Biological Diversity** – is a comprehensive, binding agreement covering the use and conservation of biodiversity.

Regulatory Process

The following legislation is considered relevant to the project:

- *Aboriginal and Torres Strait Island Heritage Protection Act 1986;*
- *Aboriginal Cultural Heritage Act 2003;*
- *Acquisition of Land Act 1967;*

- *Airports Act 1996;*
- *Animal Care and Protection Act 2001;*
- *Building (Flammable and Combustible Liquids) Regulation; and*
- *Coastal Protection and Management Act 1995;*
- *Dangerous Goods Safety Management Act 2001;*
- *Environmental Protection Act 1994;*
- *Environment Protection and Biodiversity Conservation Act 1999;*
- *Fisheries Act 1994;*
- *Health Regulations under the Health Act.*
- *Integrated Planning Act 1997;*
- *Lands Act 1994;*
- *Nature Conservation (Wildlife) Regulation 1994;*
- *Plant Protection (Red Imported Fire Ant) Quarantine Notice 2001;*
- *Queensland Heritage Act 1992;*
- *Soil Conservation Act 1986;*
- *Transport Infrastructure Act 1994;*
- *Transport of Dangerous Goods by Road Act;*
- *Vegetation Management Act 1999;*
- *Water Act 2000; and*
- *Workplace Health and Safety Act 1995.*

A summary of the likely approvals required for the GUP are provided in Table 23.1.

Table 23.1 Summary of Likely State Approvals

Legislation	Administering Authority	Trigger	Project Response	Responsibility (Project Phase)
<i>Coastal Protection and Management Act 1995 and Integrated Planning Act 1997</i>	EPA	Operational work that is tidal works in, on or above land under tidal water. "Land" is defined to include any estate under land and also the subsoil	Development Permit for Operational Works to be obtained	Detail Designer (Detail Design)
<i>Dangerous Goods Safety Management Act 2001</i>	DES	Large dangerous goods location established	Notify the Chief Executive (DES). Emergency Plans and Procedures to be prepared	Construction Contractor (Construction)

Legislation	Administering Authority	Trigger	Project Response	Responsibility (Project Phase)
<i>Environmental Protection Act 1994 and Integrated Planning Act 1997</i>	EPA	ERA 19: Dredging ERA 20: Extracting rock or other material ERA 22: Screening, washing, crushing, grinding, milling, sizing or separating material extracted from the earth ERA 62: Concrete batching Other ERAs as required during construction	Environmental Authority to be obtained	Construction Contractor to obtain Development Permit and Environmental Authority (Prior to Construction)
		Removal of contaminated soil from sites listed on CLR or EMR	Disposal Permit to be obtained	Construction Contractor (Prior to Construction)
<i>Fisheries Act 1994</i>	DPIF	Work in areas causing removal, destruction or damage to marine plants	Permit to be obtained.	MR (Prior to Detailed Design)
<i>Nature Conservation Act 1992</i>	EPA	Taking, using, keeping or interfering with a protected animal or plant	Fauna to be relocated in accordance with Fauna Relocation Plan.	Construction Contractor (Construction)
			Permit to be obtained if protected plants are affected by Project.	Construction Contractor (Prior to clearing)

Table Notes:

- DES = Department of Emergency Services
- DPIF = Department of Primary Industries and Fisheries
- EPA = Environmental Protection Agency
- ERA = Environmentally Relevant Activity
- CLR = Contaminated Land Register
- EMR = Environmental Management Register
- MR = Department of Main Roads

Other key legislative requirements for the GUP are summarised in the table below.

Table 23.2 Other Key Legislative Requirements

Legislation	Administering Authority	Trigger	Project Response	Responsibility (Project Phase)
<i>Animal Care and Protection Act 2001</i>	DPIF	Encounter animals in the course of works/activities	Must not be cruel to an animal (eg cause pain, abuse, confine or transport inappropriately)	Construction Contractor (Construction)
			Fauna Relocation Plan to be implemented	Construction Contractor (Construction)
<i>Environmental Protection (Waste Management) Regulation 2000</i>	EPA	Various triggers relating to waste tracking	Waste management to comply with relevant provisions (refer Section 3.9.3 for further details)	Construction Contractor (Construction)
<i>Land Protection (Pest and Stock Route Management) Act 2002</i>	DNRME	Pests (ie animals or plants) must be controlled	EMP to be implemented during construction and maintenance	Construction Contractor (Construction) Operator (Operation)

Table Notes:

DNRME = Department of Natural Resources, Mines and Energy
DPIF = Department of Primary Industries and Fisheries
EPA = Environmental Protection Agency

Monitoring and Auditing Standards and Guidelines

The following standards apply to monitoring and auditing of performance:

Water and Wastewater

- Water Quality Sampling Manual – For use in Testing for Compliance with the *Environmental Protection Act 1994*. Second Edition (Department of Environment Heritage 1995).
- Standard Methods of the Examination of Water and Wastewater – American Public Health Association (APHA)/Australian Waste Water Association (AWWA).
- AS 2031 Selection of Containers and Preservation of Water Samples for Chemical and Microbiological Analysis.

Soils

- Australian and New Zealand Environment and Conservation Council (ANZECC)/National Health and Medical Research Council (NHMRC) – Guidelines for the Assessment and Management of Contaminated Sites.
- Queensland Government Chemical Laboratory – Guidelines for Soil Sampling.
- Queensland Acid Sulphate Soil Investigation Team (QASSIT) “Sampling and Analysis Procedure for Lowland Acid Sulphate Soils (ASS) in Queensland” dated 1 October 1997.
- “Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland” (Department of Environment 1998).

Air

- AS 3580 Methods of Sampling and Analysis of Ambient Air.

Noise and Vibration

- “Interim Guidelines and Technical Notes for Road Traffic Noise Amelioration” (DMR 1992).
- E1 Environmental Guideline “Noise from Construction, Maintenance and Demolition Sites” (EPA 1989).
- “Noise Measurement Manual” (EPA 1995).
- AS 1055.1 and AS 1055.2 Acoustics – Description and Management of Environmental Noise.
- AS 2187 Explosives – Storage Transport and Use (Explosives Code).
- AS 2436 Guide to Noise Control on Construction, Maintenance and Demolition Sites.
- AS 2659.1 Guide to the Use of Sound Measuring Equipment.
- AS 2659 Sound Level Meters.
- AS 2702 Acoustics – Methods for Measurement of Road Traffic Noise.
- Calculation of Road Traffic Noise (CORTN88) United Kingdom Department of Transport.

Dangerous Goods

- AS 1216 Classification, Hazard Identification and Information Systems for Dangerous Goods.
- AS 1678 Emergency Procedure Guides – Transport.
- AS 1940 Storage and Handling of Flammable and Combustible Liquids.
- AS 2508 Safe Storage and Handling Information Cards for Hazardous Materials.
- AS 2809 Road Tank Vehicles for Dangerous Goods.
- AS 2931 Selection and Use of Emergency Procedure Guides for Transport of Dangerous Goods.

23.2.2 Best Practice

For the purposes of the EMP the term “best practice” refers to the environmental management of an activity (which achieves) an ongoing minimisation of environmental harm of the activities through cost effective measures currently used nationally and internationally for the activity.

23.3 Project Management

The project delivery method for the GUP is not known at this stage. For the purposes of defining responsibilities for this EMP the traditional delivery method roles have been defined. If the project proceeds under a PPP process the EMP implementation responsibilities will be amended to reflect the PPP structure.

23.3.1 Management Structure

The next phase of the project will involve a design, construction and operational phase.

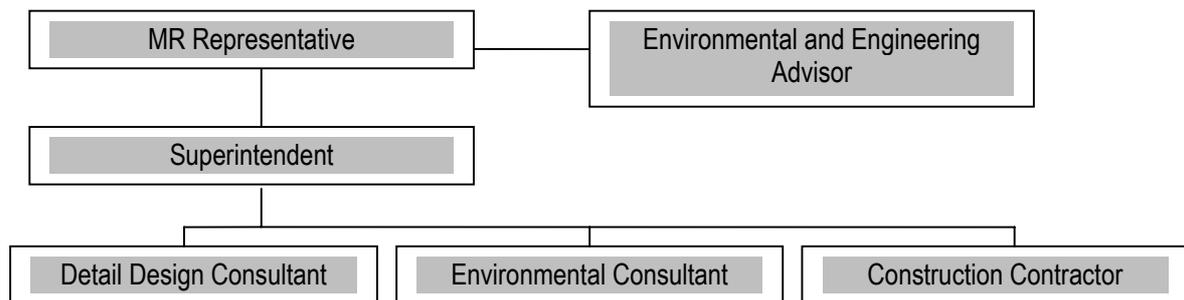
During the detail design and construction stages the overall management will be under the control of the MR Representative. The MR Representative will engage and manage the Detail Design Consultant.

During the construction stage the overall management of the project will be under the control of the MR Representative. The MR Representative will act through the Superintendent, who

directs the Construction Contractor. The Superintendent will act as an interface between the MR Representative and the Construction Contractor to ensure that necessary design and environmental requirements are provided to assist in the adequate completion of the project.

Throughout the EMP the term **Construction Contractor** includes the Contractor's Project Manager, Construction Supervisor (Environmental Officer), Foremen and Sub-contractors and/or Project Staff. The specific responsibility for these tasks will be defined in the EMP (Construction).

The generic management structure for the construction of the GUP is shown below.



Throughout the EMP the term **Operator** includes all staff and subcontractors involved in maintenance activities. The specific responsibilities for these tasks will be defined in the EMP (Maintenance).

An important mechanism for ensuring that MR requirements are met will be the implementation of an appropriate Quality Assurance (QA) system. The Consultants/Contractors (including the Detail Design Consultant, Environmental Consultant, Construction Contractor, Construction Contractor and Subcontractors) will be required to have appropriate current QA certification of systems and operations, as established by independent third party audit. Quality Plans, which are detailed, project specific documents will be prepared by the Contractors to describe fully the organisation and procedures the Contractors would establish in meeting MR requirements. Audits will be needed to monitor conformance to the plans.

Within this mechanism MR will require that the EMP be accorded the status of a "special process" under the Contractors' Quality Plan. This then establishes the EMP as an integral part of the Contractors' onsite operation, making it subject to routine verification procedures which would be set out in detailed inspection and testing plans.

Designating an activity under a contract as a "special process" has a particular meaning in QA terms. It ensures that such processes are accomplished under controlled conditions by qualified personnel using qualified process procedures, documentation and equipment according to specified requirements and established criteria (Australian Standard AS2990-1987, Quality Systems for Engineering and Construction Projects). In effect, this draws special attention to drawing up and implementing the EMP by qualified people with thorough inspection and testing during the process, not simply at the end.

The management structures for design, construction and operation have been chosen to provide a clear chain of authority for the implementation of the EMP during the various stages of the project. From this structure a clear set of responsibilities, accountabilities and authorities have been developed for each party and are summarised below.

The term "Project Staff", is a generic term and includes all persons involved with the design, construction and operation of the GUP (eg MR Representative, Superintendent, Construction Contractor and Operator).

23.3.2 Project Environmental Responsibilities

General Responsibilities of Project Staff

Having regard to Section 36 of the *Environmental Protection Act 1994*, all Project Staff have a general environmental duty (refer Section 23.4). Project Staff must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm.

Section 37 states that if Project Staff, while performing their work, notice that serious or material environmental harm is being caused or threatened by their actions or the actions of someone else, they should then report the matter.

Project Staff will also be required to comply with the following at all times:

- MR Environmental Policy;
- Contractor's environmental policy and EMS;
- Relevant environmental legislation;
- EMP requirements including relevant criteria for design, construction and operation; and
- Training requirements.

The following sections provide the responsibilities and accountabilities of various parties who will have active roles in the environmental management of the GUP. The responsibilities have been divided into the various project stages of design, construction and operation.

Design Environmental Responsibilities

MR Representative

- Approval of the final detailed design of the GUP; and
- Consult with the Environmental Advisor on environmental issues, as required.

Detailed Design Consultant (to be announced)

- Manage all subconsultants and ensure that they are given a copy of the relevant sections of the EMP and are made aware of their environmental responsibilities such that their design reflects the specified environmental requirements;
- Report to the MR Representative on all matters relevant to the project, in particular any nonconformances which are likely to affect the achievement of the environmental objectives of the project;
- Ensure that complete records are maintained of all works performed under the design contract;
- Perform the detailed design of the GUP incorporating all design requirements specified in the EMP;
- Actively engage in training of staff (where required) and others nominated by the Design Manager to ensure appropriate skill transfer; and
- Consult with the Environmental Consultant on environmental issues, as required.

Environmental Consultant (to be announced)

- Prepare Conditions of Contract (Environmental Management) which will outline any specific environmental requirements for the construction phase;
- Review any proposed design variations from the EMP in liaison with the Design Manager; and
- Provide necessary environmental advice to the MR Representative, Design Manager and Detailed Design Consultant, as required.

Construction Environmental Responsibilities

MR Representative

- Approval of EMP (Construction) submitted by the Contractor's Project Manager;
- Ensuring that requirements of the Conditions of Contract (Environmental Management) and approved EMP (Construction) and any revisions are included in contract documentation are implemented;
- Approve any revisions to the EMP (Construction); and
- Overseeing the overall implementation of the project.

Superintendent (to be announced)

- Maintain a master copy of the EMP (Construction) containing a record of the completion of planned actions, monitoring records and reports. supplied by the Contractor's Project Manager;
- Instigating auditing works on behalf of the MR Representative;
- Reporting to the MR Representative if conditions identified cannot be met; and
- Ensuring the Construction Contractor implements environmental protection measures as nominated in the EMP (Construction) and the Conditions of Contract (Environmental Management).

Construction Contractor (to be announced)

- Develop EMP (Construction) in accordance with the Conditions of Contract (Environmental Management) for submission to the MR Representative;
- Obtain all necessary statutory approvals and licences;
- Liaise with the Superintendent to ensure design and construction of work is as required;
- Ensure that conditions of licences/approvals/permits are met;
- Oversee the Construction Supervisor's observance of the approved EMP (Construction) portions of the Project Quality Plan and environmental protection measures as nominated in the EMP (Construction);
- Maintain a record of all training undertaken for all employees, detailing the type and purpose of the training;
- Notify the Superintendent of an environmental incident and maintaining a record of events relating to the environmental incidents;
- Provide copies of the EMP (Construction) to the relevant Project Staff having responsibilities defined in the EMP (Construction); and
- Maintain a master copy of the EMP (Construction) containing a record of the completion of planned actions, monitoring records, reports etc. which are made available during audits.
- Ensure that the Construction Contractor's implementation of environmental protection measures is undertaken as nominated in the approved EMP (Construction);

- Ensure that the Construction Supervisor conducts self assessment of project performance in relation to environmental management issues;
- Ensure that the Construction Supervisor manages corrective actions arising from self-assessments and external audits;
- Ensure that the Construction Supervisor implements onsite monitoring with results included in monthly reports to the Superintendent;
- Ensure that there is adequate and accurate identification and reporting of any non-conformances and any other environmental issues which may arise during construction;
- Ensure that the Construction Supervisor performs actions as directed; and
- Ensure that the implementation of environmental protection measures are undertaken in accordance with the approved EMP (Construction) or as directed by the Construction Contractor or Superintendent.

Environmental Responsibilities during Operation

During operation of the GUP the Operator is likely to nominate an Operation Contractor that will be undertaking the necessary operational environmental management initiatives. The operational environmental management requirements and responsibilities would be included in an EMP (Maintenance).

23.3.3 Training, Awareness and Competence

The Design Manager should ensure that all staff with responsibilities under this EMP have received environmental awareness training. Designers should receive training in relation to:

- the MR Environmental Policy;
- their general environmental duties under the *Environmental Protection Act 1994*;
- the specific environmental objectives and mitigation measures;
- their general responsibilities under the EMP and Output Specification, in relation to the design of the GUP;
- internal and external communication practices; and
- document control.

The Construction Contractor should receive training in relation to:

- the MR Environmental Policy;
- their general environmental duties under the *Environmental Protection Act 1994*;
- the specific environmental objectives and mitigation measures;
- their responsibilities under the EMP (Construction) and Output Specification in relation to implementing mitigation measures, monitoring, reporting and implementing corrective actions;
- their responsibilities in the event of an environmental incident;
- the consequences of not implementing mitigation measures or departure from specified operating conditions;
- internal and external communication practices; and
- document control.

Environmental training for onsite staff could be performed during the site specific safety induction. Any further environmental training should be performed on an ongoing or periodic basis as required.

23.3.4 Communication

Internal Communication

Environmental protection should be achieved through clear and concise internal communications, which will periodically be audited to ensure that the communication structure is performing adequately and all actions are performed and recorded. Auditing should also provide for follow up on any specific or corrective actions raised during previous audits to ensure that they have been acted upon.

The internal communication structure for formal reporting should be detailed in and illustrated on the relevant diagrams within the EMP (Construction).

External Communication

Only those site staff nominated by the Superintendent and the Construction Contractor should be involved in consultation with external bodies on environmental issues.

External communication responsibilities should be detailed in the EMP (Construction).

23.3.5 Documentation

Project documentation including the EMP (Construction) are 'living documents' and will from time to time require amendment. Control of all project documentation for the EMP (Construction), EMP (Maintenance), Project Quality Plans and any other documents or drawings etc, should be performed by the designers, constructors, operators and MR in accordance with the standard Document Control Procedures.

23.3.6 Monitoring Standards

Parties responsible for any baseline, construction and operational stage monitoring should ensure that all monitoring equipment used is regularly calibrated and the results recorded.

All monitoring and sampling undertaken should be in accordance with the relevant agency guidelines or Australian Standards should be used. All analytical testing performed should use National Association of Testing Authorities (NATA) approved procedures or if this is unavailable, performed to the best relevant standard. Provision should be made to permit new technologies or materials to be used so long as standards can be shown to be equal to or exceed current recognised standards.

23.3.7 Non Compliance and Corrective Actions

Non compliance identified by designers, constructors, operators and/or MR identified through monitoring and review, should be handled through corrective action procedures nominated in the Project Quality Plan or EMP. The corrective action procedures should specify methods for recording and reporting of non-conformances and ensuring that corrective actions of sufficient scale are implemented to rectify the problem. The corrective actions procedures should also specify actions to be taken by designers, constructors and operators to ensure that investigations of current environmental practices and control measures are undertaken and a review and modification of current management practices occurs (as appropriate).

23.3.8 Environmental Document Review Procedures

The Design Manager, Detailed Design Consultant and their subconsultants should review the conformance of their Project Quality Plan (PQP) on a monthly basis. Inadequacies should be recorded and reported to their supervisor along with requests for changes to the PQP.

The Construction Contractor should review the conformance of their EMP (Construction) every month, based on environmental performances, non-conformances to date, audit results, necessary changes in construction details, new standards or legislation and any other requirements. The review of the EMP (Construction) should be provided to their supervisor along with requests for changes to the EMP (Construction).

The review procedure during operation of the GUP will be detailed in the EMP (Maintenance).

23.4 Environmental Management Strategies

23.4.1 Structure

The structure of the environmental management strategies that follow are to assist in separate consideration of the relevant environmental issues. It is intended that this format is user-friendly and is amenable to review and amendment. Where appropriate, management strategies for individual sections of the project have been identified. The contents of a typical strategy is described below:

- Commitment or Objective;
- Mitigation Measures (design, construction and operation where relevant); and
- Monitoring (if required).

23.4.2 Land Use

Objective

- Design construction works in order to minimise the need for land resumption and adverse impacts to adjacent land uses.
- Undertake construction activities in a manner which prevents/minimises adverse impacts to adjacent land uses and land use values.

Mitigation Measures

Design

- Private property owners will be compensated for the acquisition of their land through the resumption process.
- The Royal Queensland Golf Course will be compensated for impacts through agreement with MR. Compensation will include consideration for the relocation of all fairways and greens to the west of the GUP corridor and the upgrading of the course to accommodate these changes.
- Directly affected property owners to be compensated for the acquisition of their land.

Construction

- Incorporates principles for protection of the land use values of areas adjacent to the GUP corridor into the development of the EMP (Construction).

23.4.3 Transportation

Objectives

Implement construction management strategies and measures during construction and operation that ensure GUP, the arterial road network and the local street network operate in a safe and efficient manner with minimal delay to road users, cyclists, pedestrians, buses, and Queensland Rail operations.

Specific performance objectives need to be developed for the project. This will ensure that design and construction proceeds with traffic disruption not exceeding expectation. This is likely to involve traffic and transport analysis. Objectives need to identify:

- Minimum number of lanes to be maintained;
- Variation allowed with time (eg peak and off peak requirements);
- Gateway Motorway toll plaza operational requirements;
- Optimal staging configuration; and
- Network performance, including alternative route options.

Mitigation Measures

Design

The Detail Design Consultant should apply the following design concepts:

- Ensure the design developed can be constructed in accordance with the objectives and limitations of the traffic management objectives;
- Utility service relocations are feasible and can be constructed in accordance with traffic management objectives;
- Provide safe provisions for pedestrian and bicycle movements where appropriate;
- Amendments to the local street network including access are consistent with expectations of property owners and other road users;
- Ensure the design can be developed within limitations appropriate to Queensland Rail requirements;
- Ensure the design of pedestrian and cycle pathways and any under/overpasses incorporate adequate safety measures; and
- Adopt maintenance minimisation objectives in development of design detail.

Construction

Construction works should be undertaken under the following set of conditions:

- Limit disruption to arterial roads by staggering the impacts on the various arterial roads involved. This will facilitate traffic redistribution during construction;

- All traffic control, signage and pavement markings to be carried out in accordance with the "Manual of Uniform Traffic Control Devices, Part 3 - Traffic Control for Works on Roads (AS1742.3 - 1985)";
- Comply with the requirements of Queensland Rail for all works over and adjacent to Queensland Rail track and infrastructure. These requirements will include restrictions to the hours of construction activity. These restrictions are necessary to allow continuity in train movements and may severely limit construction progress;
- Maintain two way traffic flow on all roads if at all possible. If closures are required, they are to be carried out during non-peak periods as may be necessary and with approval of the Superintendent. When necessary, arrangements are to be made for property owners directly affected;
- Allow for redirection of bus routes as required by Brisbane Transport;
- Maintain traffic lanes on arterial roads with a 60km/hr design speed including arterial road sidetracks. Requirements may be reduced for off peak periods with approval of the Superintendent;
- Allow for relocation of utility services prior to the commencement of construction wherever possible;
- Provide crash barrier protection to all work areas;
- Make provision for entry and exit of construction traffic remote from arterial road conflict;
- Consult with the community, road users, and property owners regarding all restrictions or changes to traffic arrangements;
- Make provision for all existing pedestrian and bicycle movements adjacent and across the worksite where required;
- Provide advice to emergency services regarding changes to traffic arrangements and site access;
- Establish procedures to coordinate and facilitate responses to traffic incidents including rapid response strategies;
- Limit night work wherever possible. Nightwork will be to the approval of the Superintendent; and
- Evaluate the cost including user costs of all alternative traffic control measures in the selection of measures to be adopted.

Operation

Operator should ensure the following:

- A public awareness campaign is undertaken to educate road users of the new traffic network and operating characteristics.

- Appropriate signage for local access and redirected traffic.
- Develop in consultation with emergency service authorities, a rapid response system to incidents on Gateway Motorway.
- Maintenance crews are to operate in a safe and efficient manner. Operations involving lane closures are to occur in off-peak periods. Traffic control devices to be implemented in accordance with the “Manual of Uniform Traffic Control Devices: Part 3 - Traffic Control Devices for Work on Roads (AS1742.3 - 1985)”.

Monitoring

Construction

The Construction Contractor should monitor the effect of the construction works by monitoring the following:

- Adverse public feedback from road users and affected property owners;
- In cooperation with MR, arterial road performance including signalised intersection performance;
- In consultation with Brisbane Transport, bus performance; and
- Incidents and the response time to clear incidents.

The Superintendent should monitor the Construction Contractor schedule and progress including:

- Timing and extent of traffic closures;
- Local road and access amendments; and
- Provision for pedestrian and cyclists.

Operation

The Operator should monitor:

- Traffic performance including performance of adjacent arterial road network;
- Incidents and response to incidents; and
- Adverse public feedback.

23.4.4 Geotechnical

Mitigation Measures

Design

- Both short and long term batters will need to be assessed for global stability. The batter angles will need to be appraised during detail design based on material strengths and other properties. Detailed investigations will be required to determine these properties. Stability analysis will be required to assess the factor of safety of these slopes;

- Fill embankments during detailed design need to be assessed in terms of both settlements and stability;
- The detailed design of the GUP will need to be carried out in accordance with good engineering practice;
- In terms of geology, the design process will require the input of a comprehensive level of information on the subsurface profile, the strength and reactivity properties of the various materials and groundwater information; and
- A detailed geotechnical investigation will be required to obtain this information. Stability assessments will need to be undertaken and depending on any rock batter heights, this may need to include a rock mechanics study. Foundation design parameters will need to be derived, as will potential settlements of fill embankments and foundations.

Construction

- Bulk earthworks will need to be carried out in a controlled manner. Whilst anticipated earthworking will be dominated by filling (north of the River) and only relatively minor excavations will be required, both operations will need to be carried out under strict control;
- Drainage and overland water flows will need to be carefully controlled so as to not impact of the stability of fill embankments and natural soil slopes. Vegetation should be established as soon as practicable to ensure slope face degradation does not occur; and
- Careful construction practices will be required in the vicinity of any settlement monitoring devices to ensure damage does not occur.

Operation

- An adequate level of maintenance on surface and subsurface drains will be required; and
- Vegetation on soil slopes should be maintained to prevent face degradation.

23.4.5 Soils

Objectives

- Minimise loss of soil from the GUP corridor.
- Soils with the potential to develop acidic properties should be managed in such a way that sulphide oxidation is minimised or prevented. In the event that acid is produced, such acid should be neutralised to prevent or avoid any discharge from the construction site of any acid produced.
- No potentially hazardous contaminants should be allowed to leave the construction site, except in a controlled and EPA approved operation; and
- Site contamination is to be managed to ensure that the effected areas do not present a health or environmental risk.
- The Construction Contractor should give regard to the accepted limits for soil pollution as outlined in the *Airports (Environment Protection) Regulations 1997* for works on airport land.

Mitigation Measures

Design

It is anticipated that there will be a significant area within and adjacent to the GUP corridor that will be cleared and/or disturbed in some manner during the proposed construction activities. Therefore, it will be essential that careful planning and staging of construction activities be undertaken during the design stage of the project in order to ensure that mitigation and control measures are implemented in a proactive and timely manner to prevent/minimise the key potential impacts.

Mitigation measures to be incorporated and further developed during the detail design stage are provided below.

- a) Bank Stability and Erosion
 - Planning of staged construction works is required during detailed design, which should include a detailed schedule of proposed works, which ensure that stabilisation and rehabilitation of disturbed areas is progressive and timely;
 - The detailed construction works schedule is to be developed with due consideration of the timing (seasonal) of activities such as:
 - Vegetation clearing;
 - Site preparation;
 - Soil disturbance;
 - Topsoil stripping; and
 - Soil stockpiling.
 - Seasonal constraints to be considered during the preparation of construction works schedules should include as a minimum the following erosion risk levels:
 - January/February (extreme risk);
 - March/April/May (high risk);
 - June/July (moderate risk);
 - August/September (low risk);
 - October/November (moderate risk); and
 - December (high risk).
 - An erosion risk map should be prepared for each area within the GUP corridor identified as being moderate to extreme erosion risk as an outcome of the completion of the geotechnical investigation based on the development of individual maps for the following factors:
 - Fines hazard;
 - Soil aggregate stability;
 - Topographic factor;
 - Soil cover factor;
 - Flow paths; and
 - Habitat impact factors.These maps should be developed for the purpose of overlaying each other in order to highlight areas of high erosivity, which should be avoided or subject to specific protection during construction activities;
 - Utilise the erosion risk map as a base for the development of a site specific erosion and sediment control plan. Maps should use mapping techniques and standard drawing symbols outlined in BCC Environmental Best Management Practices Manual (1996);

- Temporary and permanent erosion protection measures will be required to be designed for a range of construction activities and sites along the extent of the GUP corridor, which will include as a minimum:
 - Sediment control fences;
 - Sedimentation ponds and basins;
 - Check dams;
 - Cut off drains;
 - Bunding;
 - Vehicle/equipment shakedown areas;
 - Vehicle/equipment washdown areas; and
 - Stormwater and overland flow diversion structures.
- All temporary erosion and sediment control measures should be designed to ensure for non erosive channel or sheet flow for the two year ARI event and for the hydraulic capacity of channels or other control structures (excluding sediment basins and ponds) 10 year ARI time of concentration storm event;
- Permanent soil and water control devices should be designed as per the Concept Design Drawings (Volume 3) and as detailed in Section 12;
- Design of drainage, erosion and sedimentation control devices should be in accordance with BCC Environmental Best Management Practices (1996) and the Institution of Engineers (Qld Div) Erosion and Sediment Control Manual (1996);
- Design of stormwater/overland flow diversion and drainage pathways and structures should be designed/developed with due consideration of the need to minimise erosion, sediment displacement and discharge to the surrounding environment and nearby waterways;
- Sedimentation control devices should be designed to adequately contain runoff from all areas of proposed disturbance including haul roads, access tracks, stockpiles and material storage areas prior to release;
- Chutes and flumes should be designed for progressive lengthening as fill batters are constructed and to discharge water flow to stable areas for sediment collection and treatment;
- The following design criteria should be applied by the designers:
 - The quality of runoff from the Gateway Motorway should approach the guidelines for Total Suspended Solids (TSS) <80mg/L;
 - All permanent water and quality treatment control devices must be designed for the adequate control of pollution and sediment and other coarse material in the one year ARI peak flow (minimum) and also designed for the stability of these devices in at least the 20 year ARI peak storm event;
 - Areas requiring a high level of water quality treatment control should adopt 'best practice' devices to ensure discharges into receiving waters approach the design guideline level for TSS;
 - Other pavement areas should also adopt 'best practice' where possible utilising 'natural' drainage measures rather than hard engineering design solutions; and
 - All drainage works should be stable against erosion. This should be achieved through the selection of channel dimensions, slope and lining, appropriate to individual site sections. All drainage outlets should include level spreaders.

(Source: Institution of Engineers *Manual for Soil Erosion and Sediment Control* 1996).
- Areas suitable for the location of the following activities/areas should be identified during the detailed design stage and should be located a suitable distance from nearby watercourses (minimum of 50m), wetlands/lagoons (minimum 40m) and tidal areas (minimum of 100m):
 - Vehicle shakedown areas;

- Vehicle washdown bays;
- Spoil stockpile and treatment areas;
- Material and topsoil stockpile areas;
- Material storage areas;
- Laydown areas;
- Construction camp areas (for site office and amenities);
- No-go and/or limited access areas; and
- Haul roads and access tracks.
- Design and locate haul roads and access tracks to minimise crossings through wetlands or creek systems;
- Adequately design haul road and access track crossings of areas identified as being sensitive of vulnerable to disturbance and incorporate adequately designed erosion and sediment control measures (ie washdown areas and sediment traps at vehicle exit points from watercourse/wetland crossings and weed infested areas);
- Areas requiring specific erosion protection measures will be identified during the detailed design stage as an outcome from the geotechnical investigation, which will include areas requiring the following:
 - Chemical surface stabilisation;
 - Erosion control mats;
 - Mulching and revegetation;
 - Soil cement; and
 - Surface roughening.
- Fill batters and temporary rock batters in particular sections of the GUP may require face protection measures to be incorporated into their design specifications;
- Bank stability and protection of water quality control measures should consider the following:
 - Incorporate principles for the prevention of bank erosion into the design brief, including avoiding disturbance of riparian areas, progressive topsoiling and revegetation of disturbed areas and rehabilitation of soils associated with riparian areas; and
 - Preparation of management/mitigation strategies and erosion and sediment control management plans should be undertaken based on estimated soil loss rates for areas identified as particularly vulnerable within the corridor and proposed limits to sediment content of runoff.
- Design construction of embankments to ensure that the area of disturbance is minimised to 3m beyond the toe of the batter;
- Design and locate material storage, laydown and soil stockpile/treatment areas to ensure that stormwater and diversion measures divert upslope runoff away from potentially contaminated and/or high sediment load areas and that runoff from these areas is adequately contained for controlled release;
- Design measures adopted for the main bridge crossing of the Brisbane River, Bulimba Creek and Kedron Brook Floodway crossings will be developed to minimise localised erosion around piers;
- Stability of embankments will need to be rigorously assessed with respect to adequate design to ensure erosion protection and slope stability;
- Provision will be made for the Construction Contractor to apply to the EPA under Section 157 of the *Environmental Protection Act 1994* for approval of any emergency release and to comply with conditions attached to any approval;
- In the event that a temporary fill platform is required for pile driving operations during construction, it should be designed and constructed 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 should be designed to ensure erosion of the watercourse bed does not occur; and
- Ensure that installation and removal of temporary structures do not cause erosion and sedimentation of the watercourse or change in channel cross sections.
- The following concepts should be applied in preparing the EMP (Construction) and Erosion and Sediment Control Plan:
 - The Construction Contractor should generally comply with the BCC Environmental Best Management Practices (1996) and Soil Erosion and Sediment Control – Engineering Guidelines for Queensland Construction Sites (Institution of Engineers 1994) for erosion and sediment control;
 - Training in erosion and sediment control for construction personnel;
 - Erosion and sediment controls should be installed prior to any site disturbance. All areas of high erosivity should be cordoned off and all tracks and access roads marked using star pickets, wire and marked with tape; and
 - Erosive potential of runoff on disturbed areas including tracks should be reduced through the installation of check dams, bunds and/or cut off drains across the contour. This should reduce the distance of overland flow and convey water to stable drainage lines at a non erosive velocity.

b) Settlement of Weak Alluvial Material

A construction risk for the GUP is the time to achieve the required settlements. Detailed characterisation of the entire site is required to be completed during the detail design stage in order to adequately assess potential high risk areas, particularly areas associated with the following sites:

- The East-West Arterial Road (Extension of Airport Drive) is known to have experienced significant creep settlement adjacent to the Schultz Canal. This continues to have ongoing maintenance cost; and
- Schultz Canal also cuts across this deviation and this area would need to be targeted in particular for investigation and detailed analysis of options.

During the engineering process, careful attention will need to be given to settlement and stability analysis. Consideration of techniques to control settlements will be required. Such techniques are ground improvements, installation of drainage and use of lightweight fills.

Stability of embankments will also need to be rigorously assessed with respect to adequate design for underlying material to ensure adequate settlement is achieved in a timely manner, slope stability and the prevention/minimisation of settlement creep.

c) Loss of Fertile Topsoil Material

- Develop topsoil management and rehabilitation methods and strategies for each stage of scheduled construction works including stripping, stockpiling, replacement staging activities and suitable storage times to minimise fertility degradation and soil loss;
- Where possible design construction works schedules to incorporate the progressive stripping of topsoil material and site rehabilitation/revegetation in order to minimise stockpiling times and unnecessary broadscale disturbance and exposure of vulnerable subsoils.

- Where possible design scheduled construction activities to incorporate the principles of:
 - Minimal disturbance of insitu soils and natural landforms; and
 - Location of stockpiles, treatment areas, material storage and areas of major disturbance within stable areas that are already highly disturbed/modified.

Acid Sulphate Soils

Design considerations for all proposed works are to incorporate the hierarchy of ASS management principles in line with the Queensland Acid Sulphate Soil Technical Manual Soil Management Guidelines (Version 3.8) (2002) of:

- Avoidance;
- Minimisation of disturbance;
- Neutralisation;
- Hydraulic separation; and
- Strategic reburial.

Mitigation measures to be incorporated into the detail design include:

- Minimisation of disturbance of the natural surface and subsurface drainage regimes, such as retaining/maintaining existing flow pathways and directions for both surface water and groundwater resources and minimising changes to water table levels and tidal influences;
- Design of embankments and other construction activities should incorporate measures to minimise/prevent subsidence, uncontrolled settlement of unconsolidated alluvial material, settlement creep, surface or subsurface heaving or deformation; and
- Planning and staging of proposed construction activities in areas rated as having moderate to extreme risk for ASS material to ensure that disturbance is minimised and rehabilitation/reinstatement is progressive and timely.
- Accurately quantifying the volume of ASS material likely to be disturbed through an Acid Sulphate Soil Investigation, which includes field and laboratory sampling and analysis;
- Design and locate lined and bunded ASS material treatment pads in close proximity to the area of proposed ASS disturbance, but ensure that these areas are located within stable landform areas and a minimum of 100m from a waterway. Potential locations for the management and treatment of ASS are shown Figures 3.1a to 3.1d of the EIS;
- Design runoff control measures specifically for areas of proposed ASS disturbance, stockpiling and treatment so that runoff and overland flow can be adequately captured, contained, treated and monitored prior to release and is completely separate from other drainage control/management systems;
- Identify ASS areas and consider specific management requirements and structures that will be required within and associated with these areas in line with the provisions and requirements of the EMP; and
- Design and locate washdown areas for vehicles and equipment exiting ASS areas.

Contaminated Land

The following are further investigative tasks recommended to be undertaken during the detail design stage of the project to assess the potential for the presence/absence of contaminated land:

- General field observations during geotechnical and acid sulphate soil assessments;

- Assess the need to undertake capping, treatment and/or removal of contaminated soils for areas of known contamination prior to the commencement of construction activities;
- Ensure that a UXO specialist is engaged to be available (on call if required) throughout the duration of the geotechnical investigation site works within areas associated with the TCC site and adjacent areas in the event that material is located that requires identification and/or disarming;
- The Construction Contractor should develop a Site Based Management Plan for the management of areas of known contamination to minimise environmental impacts as a result of disturbance of contaminated soils that is in line with the provisions and recommendations of the EMP (Construction);
- Utilise terrain assessment to identify areas of potential contamination without conducting specific contaminated land specific assessments; and
- A detailed site history is recommended to be completed for each lot identified as being affected by the GUP in order to ascertain the potential level of risk associated the proposed construction activities within the GUP corridor.

The Site Based Management Plan for contaminated land that is developed by the Construction Contractor should be submitted to the Superintendent and may include any or all of the following:

- Outline strategies to address the potential environmental impacts associated with disturbance to any existing contaminated land and possible contamination of land from aspects of the project including waste, reject product and spills at chemical and fuel storage areas;
- Ensure that a UXO specialist is engaged to be available (on call if required) throughout the duration of construction works within areas associated with the TCC site and adjacent areas in the event that material is located that requires identification and/or disarming;
- Development of procedures to be implemented for contamination management in the event that contamination is discovered during construction activities;
- Provide strategies to prevent land contamination (within the meaning of the *Environmental Protection Act 1994*) particularly in areas associated with identified contamination on BAC land (ie area 2A on Figure 10.4d);
- Outline proposed strategies for preventing, recording, containing and remediating any contaminated land should be outlined;
- Use in situ management and treatment measures, where it can be demonstrated that the project related impacts will not result in further mobilisation of contaminants. This may include capping or containment to limit mobilisation of contaminants;
- Removal of identified contaminated material to secure landfill or alternative suitable treatment facility (ie illegal fill material near Bulimba Creek between CH 14500 and CH 15000). The transfer of contaminated soils is required to comply with the *Environmental Protection Act 1994* and EPA waste tracking regulations; and
- Removal and onsite or offsite treatment and remediation (eg bio-remediation suited to organic contaminants). The remediation area should be located and managed to prevent the loss of any contaminated soils to receiving waterways.

Construction

Bank Stability and Erosion

- Implement appropriate sediment and erosion control techniques;
- Install suitably designed shakedown areas and contained washbays;

- Ensure minimal discharge of site runoff and overland flow to waterbodies;
- Minimise disturbed areas, undertake progressive revegetation and install temporary and permanent sediment control devices at targeted locations;
- Avoid disturbing riparian areas and steep banks along waterways;
- Ensure disturbed embankments are topsoiled, grassed and prepared in such a way that promotes the natural regeneration or riparian species;
- Rehabilitate surface soils in the vicinity of the waterway crossings to further stabilise the banks;
- All erosion and sediment control devices should be installed to current best practice for erosion and sediment control prior to the commencement of construction within each stage of the scheduled works and should be maintained on an ongoing basis as required to ensure adequate protection;
- The area of soil disturbed during staged construction works should be minimised to 3m beyond the toe of the batter or cut (ie the clearing line), stockpiling areas, the temporary bridge area and track and areas required for installation of erosion and sediment control measures;
- Soil, mulch and material stockpiles and storage areas should be located a suitable minimum distance from waterways, wetlands/lagoons and tidal areas;
- Stormwater flow from upslope areas should be diverted around stockpiles, material storage areas and other areas of disturbance and storage and water flowing from these areas should be contained, treated and subject to controlled release and other suitable management measures as required;
- Areas where construction or site works have been completed should be progressively stabilised and rehabilitated;
- Permanent soil and water control devices are to be constructed/installed prior to construction and maintained during construction by the Construction Contractor in accordance with the designs specific to each area and stage of works;
- The Construction Contractor should submit a Construction Erosion and Sediment Control Plan developed in accordance with the requirements of the Output Specification and the EMP (Construction) to the Superintendent for endorsement prior to commencing work;
- Early erosion prevention and bank stabilisation work should be in place prior to the commencement of construction activities. This should include adopting appropriate measures for works conducted in watercourses (eg stream bank stabilisation methods);
- Clearly indicate the location of haul roads and access tracks on each site and confine them to the proposed permanent road location, with wetland and watercourse crossings minimised where possible;
- All vehicle exit points from the construction site, watercourse/wetland areas and weed infested areas should have an operational washdown area;
- Install cutoff and diversion drains prior to significant land disturbance to divert runoff from undisturbed areas into stable drainage lines at non erosive velocities;
- Erosion control measures such as chemical surface stabilisation, erosion control mats, mulching, soil cement treatment and surface roughening should be applied by the Construction Contractor to exposed areas as appropriate to limit erosion;
- All vehicles must be washed down in the washdown bay before leaving the site or areas within the site that have a designated washdown area installed (ie weed infested areas);
- Gravel shakedown areas should be used by all vehicles where provided (ie exit/entrance points of the construction site);
- The Construction Contractor should be made aware of identified risk areas for erosion and sediment control and site stability and the various risk based constraints to construction activities (ie seasonal constraints);

- All runoff from disturbed areas including tracks and stockpile areas should pass through sedimentation control devices;
- Chutes and flumes should be progressively lengthened as fill batters are constructed;
- Water flowing from chutes and flumes should be dissipated and directed to stable areas for sediment collection and treatment;
- The amount of stormwater leaving the site should be minimised through on site storage and reuse in construction requirements, dust suppression and revegetation;
- Excess water from the site should not be discharged into stormwater drains, local drainage lines of streams until discharges meet the stated water quality indicators (refer Section 23.4.7); and
- Temporary erosion and sediment control structures should be checked daily, maintained/repared as required and must remain in place until the area they are protecting is stabilised to the satisfaction of the Superintendent.

Recommended monitoring points are as follows:

- Bulimba Creek:
 - Two locations upstream of proposed works;
 - One location downstream of proposed works; and
 - One additional sample downstream of proposed works, between Gateway Motorway and Boundary Street.
- Kedron Brook Floodway area:
 - Two samples downstream of proposed works within Kedron Brook Floodway;
 - One sample upstream of proposed work within Cannery Creek; and
 - One sample upstream of proposed works within Schultz Canal.
- Additional monitoring points should be sampled by an appropriately qualified person if visual evidence of site impacts extends beyond these points.

Settlement of Weak Alluvial Material

Settlement beneath embankment and structures during construction should be monitored to ensure that it complies with the design specifications, particularly in areas identified as having underlying weak alluvial material present within the profile and/or identified as being of moderate to extreme risk as an outcome of the geotechnical investigation.

During the engineering process, careful attention will need to be given to settlement and stability analysis. Consideration of techniques and alternatives to control settlements may be required during construction in the event that estimated settlement characteristics are exceeded. Such techniques may include ground improvements, installation of drainage and use of lightweight fills.

Loss of Fertile Topsoil Material

- Implement topsoil management and rehabilitation methods and strategies for each stage of scheduled construction works including stripping, stockpiling, replacement staging activities and suitable storage times to minimise fertility degradation and soil loss;
- Ensure that progressive stripping of topsoil material and site rehabilitation/revegetation is undertaken in order to minimise stockpiling times and unnecessary broadscale disturbance and exposure of vulnerable subsoils;
- Ensure that scheduled construction activities implement the necessary measures to ensure that:

- Minimal disturbance of insitu soils and natural landforms is achieved during construction; and
- Location of stockpiles, treatment areas, material storage and areas of major disturbance within stable areas that are already highly disturbed/modified.
- Implement management and rehabilitation methods and strategies for each stage of scheduled construction works including stripping, stockpiling, replacement staging activities and suitable storage times to minimise fertility degradation and soil loss; and
- Ensure that progressive stripping of topsoil material and site rehabilitation/revegetation is undertaken in order to minimise stockpiling times and unnecessary broadscale disturbance and exposure of vulnerable subsoils.

Acid Sulphate Soils

- The Construction Contractor should develop a detailed site based management plan for the treatment and management of ASS material throughout construction that incorporates the provisions and recommendations in the EMP and submit it to the Superintendent for approval prior to commencement of disturbance.
- Ensure that site drainage infrastructure within areas identified as being of moderate to extreme risk is installed in accordance with the relevant design specifications;
- Ensure that material excavated from areas identified as being of moderate to high risk with respect to ASS is adequately segregated, stockpiled, contained and treated in accordance with the provisions of the approved EMP (Construction);
- Ensure that ASS treatment and storage areas are constructed prior to the commencement of disturbance of areas likely to or confirmed as containing ASS material and that all drainage control measures are adequately installed;
- Ensure that all leachate and runoff from areas excavated below 5m AHD and ASS treatment and stockpile areas are adequately captured, contained, analysed and treated (if necessary) prior to discharge to the site stormwater systems;
- ASS stockpile and treatment areas are to be checked daily for adequate containment integrity and captured runoff during active periods;
- Drainage control measures associated with ASS management should be checked daily and maintained/repared as required during periods of activity associated with ASS management;
- Ensure that treated ASS material is verified for the effectiveness of neutralisation prior to reuse as ASS free fill material;
- Areas of ASS disturbance should be checked weekly for indications of acid leachate generation until reinstatement of the area has been completed to the satisfaction of the Superintendent; and
- All fill to be used onsite must be ASS free or first evaluated for the presence of ASS. If found it must first be treated in line with the provisions of the Construction Contractor's Site Based Management Plan for ASS.

Contaminated Land

Mitigation measures to be adopted by the Construction Contractor will depend on the nature and level of contamination within areas that are proposed for disturbance during construction. Potential environmental impacts from contaminated soils should be minimised by implementing one or a combination of the strategies below.

- All machinery used on site should be maintained to the specified requirements and should be inspected daily. Any leaks detected should be repaired prior to the use of that machinery on site;

- Provision will be made for the Construction Contractor to apply to EPA under Section 157 of the *Environmental Protection Act 1994* for approval of any emergency release and to comply with conditions attached to any approval;
- The Construction Contractor should give regard to the accepted limits for soil pollution as outlined in the *Airports (Environment Protection) Regulations 1997* for works on airport land.
- All areas designated for the storage of fuels, oils, chemicals or other hazardous liquids should have a compacted base and be surrounded by a bund to contain any spillage in accordance with AS1940. These areas should be covered by a roof structure to minimise the potential for infiltration and contamination of rain water;
- Areas designed for the storage of hazardous materials are to be clearly designated and storage of such materials outside these areas strictly prohibited;
- A manifest detailing the nature, quantity and location of all hazardous materials is to be maintained and regularly updated;
- The Construction Contractor will be required to ensure that dangerous goods are stored on site as far as practicable from residences and water courses and should be responsible for their security;
- If the quantities of chemicals exceed the limits for a minor storage, a licence should be obtained from BCC and the conditions observed. If storage of 10,000 litres of flammable and combustible liquid, then a permit should be obtained;
- The Construction Contractor is to provide the prescribed placarding, hazchem cards and fire extinguishers and should have an emergency response plan in place with a nominated Site Safety Officer;
- The Construction Contractor is to store used oils in the location prescribed for dangerous goods in a banded area pending collection for recycling;
- The Construction Contractor is to render harmless any spills of dangerous goods and arrange for collection and disposal at a local government landfill site, including cleaning materials, absorbents and contaminated soils;
- The Construction Contractor is to arrange for the disposal at a local government landfill site of any waste and surplus dangerous goods and any containers which cannot be recycled;
- At the completion of the construction phase all residual stocks of hazardous materials will be removed from the construction area and returned to an appropriate storage facility or disposed of at a licensed regulated waste facility in accordance with local authority requirements; and
- Any fill introduced on-site should be sourced from an uncontaminated source, or where previously contaminated, have the necessary approval from the EPA. Any fill from an uncontaminated site should have appropriate documentation to confirm the uncontaminated nature of the fill.

Operation

Bank Stability and Erosion

Permanent soil and water control devices installed during and/or after construction should be maintained on an ongoing basis by the Operator during the post construction/operation stage to ensure that long term bank stability and protection against accelerated erosion by wind or water are achieved.

Settlement of Weak Alluvial Material

Settlement beneath embankment and structures during operation should be monitored periodically to ensure that it does not exceed the design specifications. This will be particularly important for areas identified as having underlying weak alluvial material present within the

profile and/or identified as being of moderate to extreme risk as an outcome of the geotechnical investigation, project design and/or construction.

Loss of Fertile Topsoil Material

Maintain rehabilitated/revegetated areas during the post construction and operation stages to ensure that these areas are appropriately stabilised and established. These areas should be maintained as required to prevent the establishment/spread of weeds in accordance with the Landscape Management Plan.

Acid Sulphate Soils

Ongoing monitoring and maintenance may be required for areas of ASS disturbance and permanent structures installed for ASS management and drainage control to ensure that there are no delayed impacts from ASS disturbance during construction resulting from poor condition or deterioration in mitigation controls.

Contaminated Land

Long term periodic monitoring of surface water and groundwater may be required upstream and downstream of areas of known contamination throughout the duration of the operation stage of the project in order to identify mobilisation of contaminants resulting from GUP construction activities.

23.4.6 Hydrology/Hydraulics

Objective

- Achieve a "no worsening" in terms of flooding (ie, existing levels of flood immunity are maintained and are consistent with current requirements) in existing watercourses and culvert locations affected by the GUP.

However, in some circumstances, some worsening may be acceptable. Those circumstances would include increased flood height, volumes or velocity in open space areas without buildings or structures. In all cases, the principal objective should be achieved in areas of existing or future development; and

- Ensure flow rate and volume of site runoff does not cause a significant increase in stream energy in downstream waters such as is likely to cause stream bank or bed erosion.

Mitigation Measures

Design

At Bulimba Creek the recommended works are those detailed in Mitigation Option 2 (refer Appendix H) and include:

- Skewing of the bridge piers to streamline flow patterns and avoid locating one of the piers directly across the creek channel;
- Removal of the illegal fill material as defined in Figure 7b (Appendix H);
- Localised earthworks comprising a total area of 1.16ha as defined in Figure 11 (Appendix H).

At Kedron Brook Floodway the recommended works are those detailed in Mitigation Option 10 (refer Appendix H) and include:

- Pier shapes and spacing as defined in the Concept Design (Volume 3);
- Overbank pier widths reduced to 1.5m; and
- Earthworks to a depth of 0.5m over the area shown in Figure 24 (Appendix H).

The potential impact of possible sea level rise should also be confirmed during the detail design phase of the project.

Full details of the investigative work undertaken for each mitigation option are presented in Appendix H.

Monitoring

Construction

The construction monitoring program should include the following:

- Inspection of existing waterways and culverts prior to the commencement of any construction works to identify existing areas of hydraulic concern and assess previous standards of maintenance and operation. This should be taken into account in the design of alternate drainage paths;
- Provision of rain gauges at appropriate intervals of length over the project site, which should be read at 9:00am each day, during construction, and recorded as the 24 hour rainfall for the previous day as appropriate;
- Inspection of all erosion protection measures and ensure that they are operating satisfactorily and have been constructed in accordance with the Detailed Design Document and relevant guidelines; and
- Inspection of all channels following flooding to assess the level of erosion and scour at entrances along the channels, and determine if remedial works are required.

Operation

The operational monitoring program should include the following:

- Conduct periodic inspections of waterways and culverts to identify any problem areas, for example, hydraulic performance, erosion, weed growth and scour. This is in order to monitor the condition of waterways and culverts and assess requirements for future maintenance; and
- Inspection of any erosion and sediment control devices at regular intervals.

23.4.7 Water Quality

Objective

- To ensure that water quality entering creeks and waterways downstream during and post construction meet with approved guidelines. Where the ambient water quality of existing water bodies does not comply with the guidelines, water quality objectives should reflect historic and seasonal fluctuations and ensure “no worsening” beyond acceptable limits;
- To protect the aesthetic quality of downstream water bodies, waters should be kept free from:
 - Floating debris, oil, grease and other objectionable matter;
 - Substances that produce undesirable colour, odour, taste or foaming; and

- Substances that produce undesirable aquatic life, such as algal blooms, or dense growths of plants or insects.
- The Construction Contractor and Operator should give regard to the accepted limits for water quality as outlined in the *Airports (Environment Protection) Regulations 1997* when developing performance indicators and monitoring parameters for GUP runoff discharged onto airport land.

Mitigation Measures

Design

Design of drainage, erosion and sedimentation control devices shall be in accordance with BCC’s Environmental Best Management Practices (1996) and the Institution of Engineers (Qld Div) Erosion and Sediment Control Manual (1996). Other suitable design manuals include Queensland Urban Drainage Manual (QUDM), and the NSW Department of Housing Soil and Water Management for Urban Development Handbook.

Definitions of the water treatment devices mentioned below have been extracted from the Institution of Engineers Manual for Soil Erosion and Sediment Control (1996).

The following design criteria shall be applied by the designers:

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

Table 23.3 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;

A high level of water quality treatment control is required at areas which represent the highest risk decreasing water quality and waterway values. These areas are covered 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 waterways 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.

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

- 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 23.3;
- A stormwater quality “treatment train” approach is to be adopted where possible;
- 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; and
- Planning and development of specific fuelling sites, concrete or bitumen waste containment areas and installation of temporary sediment basins.

Construction

- All runoff water from the structures to be constructed should 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;
- 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 best management options may involve isolation of the working area by temporary fencing, bunding, or sheetpiling to prevent the loss of erodible soils to surrounding receiving waters or drains. 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;

- 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 should be treated to remove sediment if necessary;
- An area/s should be designated for the containment of waste concrete materials away from watercourses or drainage lines. A bunded containment area, of earthen materials or similar should 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);
- All machinery used on site shall be maintained to the specified requirements and shall be inspected daily. Any leaks detected shall be repaired prior to the use of that machinery on site;
- Provision will be made for the Construction Contractor to apply to EPA under Section 157 of the *Environmental Protection Act 1994* for approval of any emergency release and to comply with conditions attached to any approval;
- All areas designated for the storage of fuels, oils, chemicals or other hazardous liquids shall have a compacted base and be surrounded by a bund to contain any spillage in accordance with AS1940. These areas shall be covered by a roof structure to minimise the potential for infiltration and contamination of rain water;
- Areas designed for the storage of hazardous materials are to be clearly designated and storage of such materials outside these areas strictly prohibited;
- A manifest detailing the nature, quantity and location of all hazardous materials is to be maintained and regularly updated;
- The Construction Contractor will be required to ensure that dangerous goods are stored on site as far as practicable from residences and water courses and shall be responsible for their security;
- If the quantities of chemicals exceed the limits for a minor storage, a licence shall be obtained from Brisbane City Council and the conditions observed. If storage of 10,000 litres of flammable and combustible liquid, then a permit shall be obtained;
- The Construction Contractor is to provide the prescribed placarding, hazchem cards and fire extinguishers and shall have an emergency response plan in place with a nominated Site Safety Officer;
- The Construction Contractor is to store used oils in the location prescribed for dangerous goods in a bunded area pending collection for recycling;
- The Construction Contractor is to render harmless any spills of dangerous goods and arrange for collection and disposal at a local government landfill site, including cleaning materials, absorbents and contaminated soils;
- The Construction Contractor is to arrange for the disposal at a local government landfill site of any waste and surplus dangerous goods and any containers which cannot be recycled;
- At the completion of the construction phase all residual stocks of hazardous materials will be removed from the construction area and returned to an appropriate storage facility or disposed of at a licensed regulated waste facility in accordance with local authority requirements;
- Any fill introduced onsite shall be sourced from an uncontaminated source, or where previously contaminated, have the necessary approval from the EPA. Any fill from an uncontaminated site shall have appropriate documentation to confirm the uncontaminated nature of the fill;

- 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 should 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 should be held at all times by the construction Contractor for the collection of a sample in the event of a spill;
- Notification to the EPA under Section 320 of the *Environmental Protection Act 1994* (duty to notify environmental harm) may also be required;
- The use of fertilisers during revegetation works at the site should be the minimum necessary to promote establishment, and should be incorporated into soils or seeding mixes to minimise the likelihood of fertiliser being carried off site to watercourses;
- The Construction Contractor 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; and
- A permit should be obtained from the DNRM&E prior to extraction of water from any watercourse.

Operation

During operation, water discharges from the project area shall be in accordance with the *Environmental Protection (Water) Policy 1997* and any project approvals received in relation to soil and water management.

The following concepts shall be applied by Operator in the creation of the EMP (Maintenance) for this section:

- Emergency spill contingency plans shall be designed and operational prior to the operation of GUP. These shall incorporate mitigation measures to reduce the possibility of hazardous contaminants spilt on the roadway from reaching Bulimba Creek, Brisbane River, Kedron Brook Floodway and Moreton Bay. All spilt materials shall be collected and removed to a safe area for reuse, treatment or disposal;
- All permanent erosion and sediment controls shall be functional prior to the operation of GUP; and
- The Operator shall be responsible for the maintenance and monitoring of collection and treatment systems for pavement runoff for all sections of the Motorway under their jurisdiction.

Monitoring

Sampling Procedure

Sampling methods, handling and preservation of samples shall be in accordance with the EPA's, *Water Quality Sampling Manual*, 2nd Edition, February 1995. Sample analysis shall be performed by a National Association of Testing Authorities (NATA) certified laboratory.

Turbidity will be measured by appropriate equipment at the centre line at mid-depth of the water at monitoring stations 100 metres upstream and downstream of the works. If the works increase

turbidity upstream, the upstream site will be located above the zone of influence. In the event that the depth of water at such monitoring stations is insufficient for representative monitoring, turbidity will be measured similarly but at mid width and depth at approved locations.

Baseline Monitoring

MR is to coordinate a baseline water quality monitoring program for Bulimba Creek and Kedron Brook Floodway for rain event monitoring prior to the commencement of construction activities. Replicated water samples are to be collected from a sampling site 100m upstream and downstream of proposed construction areas. The monitoring shall be event based and include low and high flow events. In tidal systems, the monitoring should occur midway through an outgoing tide at the same time in each lunar cycle. The monitoring program should be a minimum of 6 months, but preferably 12 months to identify seasonal variations.

The monitoring program will sample for parameters referred to in Table 23.4. Flow and catchment rainfall in the previous 24 hours should also be documented and analysed against the water quality results.

Table 23.4 Water Quality Indicators

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
Total Suspended Solids (TSS)	<10% change between upstream and downstream sampling locations < 80mg/L (for non stormwater releases)
Oil and Grease (TPH)	Oil etc not visible as a film on surface of waters <10mg/L
Nitrogen	Based on background monitoring (stormwater release) 1500µg/L (freshwater) 300µg/L (marine) (non stormwater release)
Phosphorus	Based on background monitoring (stormwater release) 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

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:
 - 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 Table 23.4 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. 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 (or twice in a 7 day period where rainfall is of a consistent intensity – eg prolonged light rain). Additional parameters may be required to be monitored dependent on site activities and chemical spills.

- Inspections of sediment basins shall be carried out weekly and after storm events during the construction stage. Sediment shall be removed as necessary to ensure that at least 60% capacity is available in the sediment basin to contain subsequent storm events.
- The Construction Supervisor or qualified consultant shall perform monitoring within Bulimba Creek, Brisbane River and Kedron Brook Floodway as indicated within Table

23.5. Discharges shall be sampled by the Construction Supervisor and analysed for parameters referred to in Table 23.4.

Table 23.5 Construction Monitoring

Construction Activity	Associated Potential Pollutant	Type of Monitoring Required	Indicator ¹
Earthworks	Sediment	Visual observations to determine adequacy of erosion and sediment control devices	Adopting "best practice" devices and controls
		Water quality sampling prior to off site discharge	TSS Turbidity
Excavating	Acid Sulphate Soils	Water quality sampling prior to off site discharge	pH
		Visual observations	Fish kills Iron staining
		Smell	Rotten egg odour
Use of Construction Machinery	Oils and Fuels	Visual observations	Visible as a film on surface of water
		Water quality sampling within receiving waters	TPH
Piling or Drilling Piles	Sediment	Visual observations to determine adequacy of erosion and sediment control devices	Adopting "best practice" devices and controls
		Water quality sampling prior to off site discharge	TSS Turbidity
Excavating and/or Removal of Contaminated Soil	Chromium, Copper, Zinc and others as identified by contaminated land investigation	Water quality sampling prior to off site discharge	To be determined during detailed design
Storage of Chemicals	Chemical Spill	Visual observations	Visible as a film and/or changes in colour of water surface
		Smell	Dependent on type of chemicals stored
		Water quality and soil sampling	Dependent on type of chemicals stored
Landscaping	Fertilisers	Water quality sampling within receiving waters	Phosphorous Nitrogen

Table Notes:

- Water quality indicator for various water quality parameters are shown in Table 23.4.
- TSS Total Suspended Solids
TPH Total Petroleum Hydrocarbons

- Monitoring should be performed after rainfall events large enough to cause the water quality structures to discharge water.
- Areas being revegetated should be periodically inspected to confirm that vegetation is becoming established.
- The Construction Supervisor shall inspect construction areas and material stockpiles daily to identify potential erosion and water quality issues which need to be addressed.
- The Construction Supervision shall undertake a survey of the channel cross sections in the vicinity of works conducted in watercourses prior to construction activities and post construction within watercourses.

Operation

- Operator should assess the need to conduct operational surface water quality monitoring following construction.
- Operator should regularly inspect the water control structures to ensure that they are functioning as per the design intent. The hydraulic capacity of the structures should be maintained. This may involve regular cleaning to remove trapped sediment and oil and/or greases. The biological integrity of any vegetated water quality control structures such as wetlands, grassed swales etc should be visually inspected at a minimum of once per month to ensure that vegetative communities have established and are self-maintaining, as per the design intent.

Reporting

Documentation for the surface water quality monitoring program shall include details of the monitoring date, time, location, number of type of samples taken and analysis (field and laboratory) results, chain of custody documentation and copies of laboratory analytical reports.

Comments should be made on the compliance or otherwise with the performance criteria, results of investigations and corrective action including modification to management measures, assessment of environmental performance and any other data or observations considered appropriate.

The Construction Contractor shall supply the results of the water quality monitoring sampling to the Superintendent at the end of every month.

All documentation must be able to be audited.

23.4.8 Groundwater

Mitigation Measures

Design

Further assessment to be undertaken during detail design to determine both human and natural receptors that may be influenced by the works. This is needed to confirm users or environments that may be influenced by the activities. The assessment will need to include:

- Conducting a census for potential unregistered groundwater wells located in the area surrounding (up to 250 metres) locations where any dewatering activities may be undertaken; and
- Identifying any sensitive surface water receptors to site groundwater movement.

A detailed groundwater monitoring program should be developed and implemented prior to construction. On this basis, the following outline of works is proposed:

- Installation of groundwater wells at key locations along the GUP where potential impacts may occur, (such as storage and stockpile areas, or where major earthworks are being undertaken) or where local topography and geological conditions dictate. The wells would be sited within the shallow aquifer system as this represents the initial sensitive groundwater receptor. It is anticipated the wells would be between 5 and 10 metres in depth, dependent on terrain and depth to water table;
- Installation of groundwater wells may also be required in areas adjacent to the GUP, in particularly sensitive areas in order to determine local shallow groundwater flow direction. These wells should be surveyed in the appropriate height datum (mAHD); and
- Should significant dewatering works be undertaken, install up to two nested groundwater monitoring wells, sited to monitor changes to groundwater levels and quality in the upper and lower aquifer systems. It is anticipated that the shallow groundwater monitoring well should be between 5m and 10m in depth and the deeper well between 10m and 20m in depth.

Construction

Potential dewatering activities should be carefully managed during the construction works. This may be required in areas where deep excavation is being undertaken. Any dewatering activities should include the following management strategies where significant dewatering is required:

- Ensuring sufficient groundwater monitoring wells are installed prior to the commencement of works and baseline data is acquired;
- Minimal dewatering as necessary to be undertaken;
- Daily monitoring for in situ parameters should be undertaken in installed groundwater monitoring wells. Weekly monitoring of private wells should be undertaken, as permission dictates;
- Receptors to groundwater level changes, including private wells and natural receptors (lagoons or wetlands) are identified;
- Dependent on nearby receptors, an estimation of radius of effect may be required to be undertaken, based on anticipated pumping rates and dewatering requirements;
- Only the minimum required groundwater quantity should be extracted;
- Poor quality discharge water should be treated on site and water quality guidelines achieved prior to discharge;
- Significant degradation in groundwater quality or levels should be noted, in particular should it be determined that receptors are being influenced, alternative water supply arrangements shall be required in the interim recovery period until water levels recover to acceptable levels; and
- Should water quality degrade significantly (ie due to salt water intrusion), longer term alternative water supply arrangements may be required and a longer term monitoring program should be implemented until groundwater quality returns to acceptable level.

Operation

The ongoing management strategies would remain similar to the existing Gateway Motorway management system including:

- Management and upkeep of stormwater and road runoff;
- Management of incidents such as fuel spills through appropriate clean up mechanisms; and

- Upkeep of general services along the Motorway.

Water Quality Monitoring Parameters and Frequency

Baseline monitoring should be undertaken for physical parameters and water quality at all installed monitoring well locations prior to the commencement of works. Groundwater samples should be taken and monitored for the insitu parameters outlined in the table below.

Table 23.6 In situ Monitoring Parameters

Parameter	Compliance Requirement
Water level (mbRL)	NA
pH	6.5 to 9.0
Electrical Conductivity	No significant change
Oils	No visible films or odours

Table Notes:

mbRL Metres below Reference Level

As part of the baseline monitoring, the table below provides the laboratory analyses that should also be undertaken.

Table 23.7 Laboratory Analysis Parameters

Parameter	Compliance Requirement
Total Petroleum Hydrocarbons	<10 mg/l*
Oil and Grease	<20 mg/L (in line with surface water quality)
Polynuclear Aromatic Hydrocarbons (PAHs)	<0.003mg/l**
Nitrogen	No significant increase above baseline levels.
Phosphorus	No significant increase above baseline levels.
Heavy Metals (As, Cd, Cr, Cu, Pb, Ni, Zn)	<relevant ANZECC 2000 water quality guidelines (marine ecosystem, 95% protection)

Table Notes:

* New South Wales EPA (2002) - Experienced based guideline for Service Stations

** NEPC (1999) Groundwater Investigation Guidelines – Marine ecosystems

Monitoring should be undertaken on a regular basis throughout the project, with a frequency of once a month considered appropriate. More frequent monitoring may be required should an environmental incident occur, such as a chemical or oil spill, or after a significant rainfall or flooding.

Construction

Should dewatering activities be undertaken, daily groundwater monitoring for *in situ* parameters (refer Table 23.6) should be undertaken in all installed shallow and deeper system groundwater wells in the vicinity where dewatering activities are undertaken. With permission, groundwater monitoring should also be undertaken in any identified private wells.

23.4.9 Air Quality

Objective

- To minimise the generation of dust and exhaust emissions during the construction of the GUP and to mitigate any air quality impacts; and
- To minimise the emission of air pollutants from the GUP while it is operating and to mitigate any negative air quality impacts.

Mitigation Measures

Design

- Roadway, on ramps and off ramps to minimise steep slopes and maximise traffic speeds within safety and design criteria.

Construction

The Construction Contractor shall ensure that the following actions are performed during construction on an as required basis:

- Dust suppression of haul roads, unsealed roads and work areas using a water truck;
- Damping of stockpiles, primarily using water;
- Provision of adequate water supply for the above activities;
- Use of waste oil for dust suppression shall be prohibited;
- Water pumped from the oxbow lake may be used for dust suppression, providing water does not escape to adjoining properties or waterways;
- Location of stockpiles away from sensitive locations;
- Construction should be timed so that dust generating activities are not carried out during high wind events;
- Limiting the amount of topsoil removal to that required for quarrying, backfill etc;
- Loaded haul trucks travelling to and from the site will be covered or loads will be levelled to avoid spillage;
- Enforcing speed limits for haul trucks along both internal and external roads;
- No pit burning of cleared vegetation;
- Avoid multiple access points during earthwork stages to the existing road networks so that dirt is not tracked onto the roads (particularly following wet weather);
- Carrying out progressive rehabilitation of cleared land;
- Regular maintenance of all construction machinery and vehicles; and
- Direction of exhaust emission of mobile plant away from the ground.

- The Construction Contractor should give regard to the accepted limits for air quality as outlined in the *Airports (Environment Protection) Regulations 1997* for air emissions in the vicinity of airport land.

Monitoring

The Construction Contractor will carry out the following monitoring activities:

- Daily inspection of stockpiles, exposed work areas and construction work practices to ensure dust mitigation measures are being employed;
- Real time monitoring of PM₁₀ and TSP should be carried out to assess the levels of dust generated by construction activities. The monitoring location will be nearby sensitive receptors approved by the Superintendent. Monitoring frequency will need to be increased if dust compliants occur; and
- Formal monthly inspections of stockpiles, exposed work areas and construction work practices with the Superintendent to ensure dust mitigation measures are being employed.

23.4.10 Noise and Vibration

Objective

- Construction noise and vibration impacts to be reduced as far as practicable by appropriate management procedures, including use of low noise equipment and management of construction hours; and
- Operational noise levels to be maintained by appropriate mitigation measures, including appropriate road pavement design and noise barriers.
- The Construction Contractor and Operator should give regard to the guidelines for excessive noise as outlined in the *Airports (Environment Protection) Regulations 1997* when developing performance indicators and monitoring parameters for inclusion in the EMP (Construction) and EMP (Maintenance), respectively.
- Construction noise and vibration impacts to be reduced as far as practicable by appropriate management procedures, including use of low-noise equipment and management of construction hours; and
- Operational noise levels to be maintained by appropriate mitigation measures, including appropriate road pavement design and noise barriers.

Mitigation Measures

Design

The MR “Road Traffic Noise Measurement: Code of Practice January 2000” (Code of Practice) outlines the operational road traffic noise criteria applicable to this project. The Code of Practice provides road traffic noise criteria for proposed roads, road upgrades, existing roads, residential land use developments as well as criteria for other noise sensitive land uses.

Table 23.8 presents relevant noise criteria for this project, from the Code of Practice.

Table 23.8 MR Code of Practice Noise Criteria

Description	Noise Criteria (within 10 years of completion of construction)
<i>Existing Residences</i>	<i>External Noise Level LA10(18hour)</i>
Upgrading Existing Roads (Priority 2)	68 dBA (or greater) and an increase of at least 3 dBA above the pre construction level. Measures for noise attenuation will be considered within the road reserve with the aim of reducing levels to 68 dBA or less
Upgrading Existing Roads (Priority 3)	68 dBA (or greater) and an increase of less than 3 dBA above the pre construction level. Measures for noise attenuation will be considered within the road reserve with the aim of reducing levels to 68 dBA or less
<i>Educational & Health Buildings</i>	<i>Internal Noise Level LA10(1hour)</i>
Upgrading Existing Access – Controlled Roads	55 dBA LA10(1hour) or greater and an increase of less than 3 dBA above the pre construction level Measures for noise attenuation will be considered as part of initial planning and design, with the aim of reducing indoor noise levels to 55 dBA or less
<i>Parks, Outdoor Educational and Recreational Areas</i>	<i>Free Field Noise Level LA10(12hour)</i>
All Roads	63 dBA

Therefore, the applicable criteria needing to be achieved for the GUP design are:

- 68dBA LA10(18hour) for residences;
- 55dBA LA10(1hour) internal for educational and health buildings; and
- 63dBA LA10(12hour) (free field) for parks, outdoor educational and recreational areas.

Actual façade noise reduction measurements should be undertaken during detail design to determine the specific noise reduction for each health and educational building.

Construction

- Work Practice Controls
 - Engines not started before 7:00am where possible and queuing of trucks in front of residential areas prior to the normal 7:00am start time to be avoided wherever possible.
 - Loading and unloading of goods and material away from sensitive areas.
 - The batch plants for the Gateway Bridge duplication are currently located away from residential areas. This approach should be kept in mind if/when other batching plants are proposed.
 - Reversing alarms within construction areas cannot be avoided for safety reasons. Consideration should therefore be given to sourcing “quiet” white-noise alarms whose annoying character diminishes quickly with distance and self adjusting alarms which adjust emission levels to the local background noise level.
 - “Real time” feedback on noise emissions to plant operators. This greatly assists operators to minimise emissions for certain types of plant and equipment.
 - Large rocks to be placed in dump trucks not dropped.

- Where possible, park mobile equipment in 'cut' areas and carry out warm-up in 'cut' the next day to take advantage of shielding.
- Horn signals should be kept at a low volume where feasible.
- Areas to be paved should be as large as possible to reduce the number of passes of the paver.
- Noise on road plats will be controlled by the use of damping material such as soft wood and pin on slopes.

b) Source Noise Controls

- Noise measurements of plant and equipment to maintain/check noise emissions.
- Mobile plant such as excavators, front end loaders and other diesel powered equipment to be fitted with residential class mufflers.
- Minimise the usage of truck exhaust brakes on site.
- Use of compactors rather than vibrating rollers where possible.
- Saw cutting of the road surface by necessity may have to take place in the evening and night. Machines with built in screens will be used. Saw cutting will be conducted as early as is practically allowed by the curing process of the concrete. Where possible, night work will be programmed so that disturbance at any dwelling is limited to two consecutive nights, and six nights in any month.

It is important that residents are pre-warned of night time concrete cutting and the reason for its necessity is explained. This public notification will be in a manner satisfactory to the EPA, in accordance with relevant conditions. The use of built in shrouds is also recommended.

- Bored piling instead of impact pile driving wherever possible. If driven piling is required the only effective noise control is the use of shrouds although the noise attenuation is moderate (possibly up to 10dBA). Bored piles are typically at least 20dBA quieter.
- Where possible, use silenced air compressors on site

c) Community Liaison Controls

- Construction site personnel to be made aware of all community attitudes and complaints.
- Residents be made aware of times and duration they will be affected. Making residents aware of likely future occurrence of noise significantly reduces annoyance and allows people to arrange themselves accordingly.
- 24 hour/day complaints phone number.
- Monitoring of noise and vibration during critical stages, especially at night time.
- Nominated person to receive, log, track and respond to complaints with an appropriate timeframe and to record what actions were taken.

d) Source Noise Control Strategies

- Quietest plant and equipment that can economically undertake the work should be selected wherever possible.
- Regular maintenance of equipment to keep it in good working order.

e) Work Practice Control Strategies

- Construction work to occur wherever possible within the day (7:00am to 6:00pm) period.
- Where possible, avoid the coincidence of plant and equipment working simultaneously close together and near sensitive sites.
- Maintenance work and access points to the alignment to be located as far as possible from sensitive areas wherever feasible.

- Operators of construction equipment to be made aware of potential noise problems and of techniques to minimise noise emission through a continuous process of operator education.
- f) Noise Barrier Control Strategies
 - Where possible, consider the installation of operational (ie permanent works) noise barriers as early as possible to provide additional construction phase noise mitigation.
 - Where possible, use hoarding stockpiles and site sheds/buildings as noise barriers between equipment and sensitive areas.
- g) Community Liaison Strategies
 - Active community consultation and the maintenance of positive relations with residents.
 - Where construction noise levels exceed the recommended criteria or in the event of complaints, a detailed investigation of construction noise will be required.

Performance Criteria for Monitoring

a) Noise

For construction work occurring during normal daytime hours and provided all mechanically powered plant is fitted with appropriate mufflers, specific noise limits are generally not warranted. In this regard it may be noted that the Queensland *Environmental Protection Policy (Noise) 1997* (EPP(Noise)) does not include construction noise or vibration limits (other than those which apply to blasting). Noise impacts are usually minimised by limiting hours of operation and, in particular circumstances, scheduling the noisiest activities to occur at times when they would generate least disruption if possible. This needs to be balanced with traffic management to ensure traffic disruption is minimised.

Where construction noise may affect adjacent residential premises or other residential accommodation (including hotels, motels, serviced units or backpacker accommodation), limitations to the hours of operation as stated below are recommended.

Monday to Friday:

7:00 am to 6:00 pm

Saturday:

7:00 am to 12 noon

b) Blasting

The *EPP(Noise) Environment Protection Amendment Regulation (No 2) 1999* contains the following blast emissions criteria:

“6I Noise from blasting is not unlawful environmental nuisance for an affected building if:

- *the airblast overpressure is no more than 115 dB Linear Peak for 4 out of 5 consecutive blasts; and*

the ground vibration is:

- *for vibrations of more than 35 Hz - no more than 25 m/s ground vibration, peak particle velocity; or*
- *for vibrations of no more than 35 Hz - no more than 10 mm/s ground vibration, peak particle velocity.”*

23.4.11 Applicable Vibration Criteria

Structural Damage Criteria

British Standard 7385:Part 2-1993 “*Evaluation and measurement for vibration in buildings Part 2*” provides criteria against which the likelihood of building damage from ground vibration can be assessed.

Sources of vibration which are considered in the standard include blasting (carried out during mineral extractions or construction excavation), demolition, piling, ground treatments (compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to ensure minimal risk of **cosmetic** damage to commercial and residential buildings are presented numerically in Table 23.9.

Table 23.9 Transient Vibration Guide Values – Minimal Risk of Cosmetic Damage

Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures - Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures - Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

The standard states that the guide values in Table 23.9 relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 23.9 may need to be reduced by up to 50%.

Since the buildings adjacent to the road are residential (refer Table 23.9) and could potentially experience resonance effects, a conservative continuous cosmetic damage criterion of 7.5mm/s at 4Hz increasing to 10mm/s at 15Hz has been adopted for the purposes of this vibration assessment.

Safe Vibration Levels for Common Services

Vibration due to the construction process has the potential to effect services such as buried pipes, electrical and telecommunication cables.

German Standard DIN 4150-3 1999 “*Structural Vibration – Part 3: Effects of vibration on structures*” provides guidance on safe vibration levels for buried pipe work. The levels assume “current technology” as special considerations must be applied for systems associated with older structures such as might occur in the vicinity of heritage listed buildings. Table 15.29 details the DIN 4150-3 limits for short term vibration. The levels apply at the wall of the pipe. For long term vibration the guideline levels presented in Table 23.10 should be halved.

Table 23.10 DIN 4150 Part 3 – Damage to Buried Pipes – Guidelines for Short-term Vibration

Pipe Material	Peak Wall Vibration Velocity
Steel (including welded pipes)	100mm/s
Clay, concrete, reinforced concrete, prestressed concrete, metal with or without flange (other than steel)	80mm/s
Masonry, plastic	50mm/s

Table Notes:

For gas and water supply pipes within 2m of buildings, the levels given in Table 23.9 should be applied. Consideration must also be given to pipe junctions with the building structure as potential significant changes in mechanical loads on the pipe must be considered.

Recommended vibration criteria for electrical cables and telecommunication services such as fibre optic cables range from between 50mm/s and 100mm/s.

It is noted however that although the cables may sustain these vibration levels, the services they are connected to, such as transformers and switch blocks, may not. It is recommended that should such equipment be encountered during the construction process an individual vibration assessment be made.

Human Comfort Criteria

Guidance in relation to assessing potential disturbance from ground-borne vibration is set out in British Standard 6472-1992 “*Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)*”. This standard nominates criteria for various categories of disturbance, the most stringent of which are the levels of building vibration associated with a “*low probability of adverse comment*” from occupants. The applicable levels for daytime activities in residential buildings, offices and workshops for this category are shown in Table 23.11.

Table 23.11 Vibration Levels Corresponding to “Low Probability of Adverse Comment” (1Hz to 80Hz)

Building Type	Peak Floor Vibration (X, Y Horizontal)	Peak Floor Vibration (Z Vertical)
Residential	0.8 mm/s to 1.6 mm/s	0.3 mm/s to 0.6 mm/s
Offices	1.6 mm/s	0.6 mm/s
Workshops	3.2 mm/s	1.2 mm/s

The vibration levels given in Table 23.11 for continuous vibration apply to a 16 hour daytime exposure period.

Vibration Dose Limits

The permissible rms particle velocity levels corresponding to the vibration dose value varies according to the duration of exposure. Table 23.12 shows the range of satisfactory vibration dose values for which various degrees of adverse comment may be expected in residential buildings.

Table 23.12 Vibration Dose Values (m/s^{1.75}) above which Various Degrees of Adverse Comment may be Expected in Residential Buildings

Location	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential buildings 16 hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hour night	0.13	0.26	0.51

Based on the relationship between the vibration levels for residences, offices and workshops, the corresponding daytime vibration dose values are given in Table 23.13 - “*Vibration dose Values above which Various Degree of Adverse Comment Expected in Offices and Workshops*”.

Table 23.13 Vibration Dose Values (m/s) above which Various Degree of Adverse Comment Expected in Offices and Workshops

Location	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Offices 16 hour day	0.4 to 0.8	0.8 to 1.6	1.6 to 3.2
Workshops 16 hour day	0.8 to 1.6	1.6 to 3.2	3.2 to 6.4

Situations exist where motion magnitudes above the dose levels given in BS 6472 can be acceptable, particularly for temporary disturbances and infrequent events of short-term duration. An example is a construction or excavation project.

In certain circumstances, the use of higher magnitudes of acceptability may be considered, for example for projects having social worth or broader community benefits, or in view of the economic or practical feasibility of reducing vibration to the recommended levels. In such cases, best management practices should be employed to reduce levels as far as practical.

Vibration monitoring is recommended for site-specific activities and in any situations where there is some doubt regarding the suitability of the plant or where there is believed to be a risk of exceeding the applicable vibration criteria.

Table 23.14 Safe Working Distances for Vibration Intensive Plant Items

Item	Rating	"Safe" Working Distance to avoid	
		Cosmetic Damage (refer BS 7385)	Human Response (refer BS 6472)
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5m	15 to 20m
	< 100 kN (Typically 2-4 tonnes)	6m	20m
	< 200 kN (Typically 4-6 tonnes)	12m	40m
	< 300 kN (Typically 7-11 tonnes)	25m	100m
	> 300 kN (> 12 tonnes)	25m	100m
Impact Pile Driver		20m to 40m	80m to 120m
Vibratory Pile Driver		5m to 15m	20m to 50m
Pile Boring	(< 800 mm)	2m (nominal)	na
Jack hammer	-	1m (nominal)	Avoid contact with structure

On the basis of the data provided in Table 23.14, vibration buffer zones have been developed for the GUP construction works. These zones are dictated primarily by two activities:

- Bulk earthwork compaction (vibratory roller); and
- Impact pile driving.

Monitoring

Construction

The construction monitoring program should include the following:

- Construction Supervisor should undertake noise monitoring for at least 7 days at key noise sensitive receptors prior to construction commencing;
- Construction Supervisor should regularly review the effectiveness of noise mitigation controls and instruct repair/replacement as necessary;
- Noise monitoring should be carried out at representative dwellings and other noise-sensitive areas close to the works during typical construction activities (ie residential dwellings). The monitoring should comprise a combination of attended, short-term measurements (of typically 15 minutes to one hour duration), and long-term unattended noise measurements;
- The long-term measurements should be carried out with environmental noise loggers recording statistical noise levels (including L_{Amax} (maximum single noise event), L_{A90} , L_{A10} (for an 18 hour period, the arithmetic average of 18 individual L_{10} levels measured between 6:00am and midnight on the day) and L_{Aeq} (for a 24 hour period, means the time average A-weighted noise level, within the meaning given by AS 1055.1) over consecutive 15 minute intervals. Each long-term monitoring station may include a tape recorder or be attended for short periods so that the noise source can be positively identified in the case of a dispute. The number of locations monitored and length of monitoring required at each location should be specified in the EMP (Construction);

- Specific construction activities being undertaken in the proximity of the noise monitoring locations for the duration of the noise monitoring should be recorded. The recording should include the type of activity being undertaken, the start time and the finish time, hours of operation of fixed plant should also be recorded. This should constitute the "Construction Activity Log";
- Ground vibration should be monitored at the closest buildings during any vibration generating activities (eg piledriving), closest to compaction or fill sites;
- Construction Supervisor to ensure that noise and vibration trials are undertaken on plant and equipment to predict emission levels prior to commencing activity on the site to identify procedures to control emissions; and
- A register of complaints concerning excessive construction noise and/or vibration should be set up by the Construction Supervisor and Community Liaison Officer. Any complaints should be investigated within 24 hours if possible, but not longer than 3 days of their receipt. The investigations should include noise and/or vibration measurements at a representative location to the site of the complaint(s) at an appropriate time and over a representative time period.

Operation

The operational monitoring program should include the following:

- Noise monitoring at representative noise sensitive receivers. The monitoring should include L_{10} (18 hr) and L_{eq} (1 hr) be conducted using unattended noise measurements of at least 48 hours duration (using environmental noise loggers) and attended monitoring of at least 1 hour duration (to identify the maximum passby noise levels); and
- The monitoring should be carried out within the first 12 months of operation.

Complaints

Any complaints about construction noise or vibration should be investigated by the Construction Contractor within 24 hours, if possible, but not longer than 3 working days following their receipt. The investigations should record noise and/or vibration measurements at a representative location to the complaint at an appropriate time and over a representative time period, unless the source of the noise causing the complaint is rectified immediately.

Repeat complaints should be recorded as a non compliance.

Vibration Levels (Without Explosive Blasting Activities)

Vibration criteria should apply to excavation and construction works in the vicinity of buildings adjacent to construction activities.

Vibration from construction activities, when measured in the vertical or horizontal axes on a footing of or on any adjacent building at a position closest to the dominant vibration source, should not exceed:

- a. No more than 10% of any 15 minute period —
 - (i) RMS_(1 sec) Velocity 0.4mm/s;
 - (ii) Peak_(1 sec) Velocity 1.6mm/s;
- b. At any time —
 - (i) Peak Velocity 3.0mm/s, unless otherwise approved by the Superintendent.

Construction activities within the vicinity of the Moonie-Brisbane Oil Pipeline and Ampol Oil Pipeline should have a maximum particle velocity above the pipelines of 10mm/s.

Plant equipment and construction vibration which exceeds the levels set out above should be recorded as a non compliance.

Corrective Actions

- The Community Liaison Officer should personally meet with the person making the complaint to resolve issues raised by the complainant; and
- Remove excessively noisy plant from the site and replace with complying plant.

23.4.12 Terrestrial Ecology

Objective

- To minimise the loss of terrestrial and wetland vegetation and habitat;
- Minimise the impact of runoff waters on adjoining wetland areas, watercourses, Bulimba Creek, Kedron Brook Floodway, Brisbane River and Moreton Bay.

Mitigation Measures

To minimise the potential of the GUP on terrestrial ecology values of the area the following mitigation measures should be implemented:

Design

- a) General
 - Except where this compromises safety, retain hollow habitat trees and other large trees within the road reserve. Where these need to be removed salvage the hollow sections and relocate them to trees without hollows adjacent to the Motorway.
 - Except where this compromises safety, retain koala food trees and plant additional koala food trees in the vicinity of Greendale Way. Suitable species include: forest red gum (*Eucalyptus tereticornis*), spotted gum (*Corymbia citriodora* var. *variegata*); pink bloodwood (*C. intermedia*), narrow leaved ironbark (*Eucalyptus crebra*), tallowwood (*E. microcorys*), small fruited grey gum (*E. propinqua*), grey ironbark (*E. siderophloia*), and scribbly gum (*E. racemosa*) (Barnes & Moran 2001).

- Except where this compromises safety, plant large emergent eucalypt (and corymbia) species on either side of the carriageway particularly in the vicinity of Greendale Way to facilitate the movement of squirrel gliders across the carriageway. Monitor research into fauna overpasses and consider their installation across the roadway if their efficacy for this and other arboreal local significant species is proven in future.
- Design measures should be adopted for the new bridge crossing the Brisbane River to minimise localised erosion around piers.
- Supporting piers should stand a sufficient distance from the banks to ensure that existing mangrove communities remain or re-establish beneath or immediately adjacent to the bridge.
- During construction disturbance to mangroves and existing amenity landscaping should be minimised.
- Minimise the loss or disturbance of estuarine or freshwater wetland vegetation.
- Minimise the area of disturbance along the banks of Bulimba Creek, Brisbane River and Kedron Brook Floodway and implement stormwater management plans to minimise the entry of sediment into Bulimba Creek.
- Avoid loss of significant canopy vegetation and works that will lead to enhanced proliferation of weed species and implement a Weed Management Plan.
- Minimise habitat loss for migratory birds especially the Lewin's Rail habitat.
- Drainage design to continue the function of Kedron Brook Floodway and other tidal channels as ecological corridors and low tide feeding areas for waders.
- Retain existing rank grassland/freshwater wetland corridor potential also the eastern edge of Kedron Brook Floodway.
- Bridge designs using minimal footprints could conceivably accommodate this corridor on their approach (from the east) to Kedron Brook Floodway.
- Disturbance to the habitat on the southern side of the Kedron Brook floodplain should be minimised and allowed to regenerate once construction is completed.
- Sufficient distance should be maintained from the active White-bellied sea eagle nest (located outside GUP corridor just off site on BAC land) and the motorway and associated works.
- Bridges over Kedron Brook Floodway should contain a minimum footprint design, and the supporting piers should stand a sufficient distance from the banks to ensure that mangrove communities can survive or establish beneath or immediately adjacent to the bridge. Bridges should run perpendicular to channel direction in order to maintain the shortest possible span within the above constraints. Using a minimal footprint design (eg pylons) would also be advantageous in terms of minimising alteration to stream flows, particularly during flood events.
- Avoid koala habitat.
- Provide road signage warning of koalas.
- Submit property vegetation management plan under VM Act for vegetation clearance on freehold land.
- Implement design principles that avoid disturbance of endangered ecosystems and terrestrial habitat.
- Avoid copses of the endangered REs 12.1.1 and 12.5.2 where they occur in viable remnant stands.
- Design of the deviation and associated infrastructure should incorporate principles to minimise impacts on areas zoned for conservation.

b) Fauna Underpasses

Consider installing fauna underpasses at Wecker Road (CH6100) and the culvert east of Coventry Court (CH7100). These may be dual purpose to accommodate stormwater flows or to facilitate pedestrian/bicycle access. These positions have been chosen for the following reasons:

- To give a good spread of underpasses along this section of the GUP corridor. This gives several underpasses to provide alternate routes to avoid disturbance, predators and to allow for a more natural population distribution (AMBS 1997);
- Because the topography allows them to be installed without altering the vertical profile of the road;
- Because there is medium to high quality habitat on both sides of the GUP corridor in these locations, which is more or less linked to larger areas of habitat beyond; and
- These locations are away from sources of disturbance such as houses that may deter use by fauna from using the underpasses (AMBS 1997).

It is recommended that 3m x 3m box culverts be used. A structure length of 20m or less seems to be optimal (AMBS 2001b) so minimise the length of culvert structures.

c) Fauna Fencing

Consider installing fauna exclusion fencing on both sides of the Motorway between Mt Gravatt-Capalaba Road (CH1500) and Old Cleveland Road (CH9900) for the safety of fauna and road users alike and to funnel fauna towards suggested underpasses at chainages 6100 and 7100 and Greendale Way (CH8800). Exclusion fencing should be located to funnel animals towards underpasses and to prevent them entering the carriageway. The following types are recommended (AMBS 1997):

- Floppy top fences consisting of chain-wire with the top 20cm unsupported and fence posts angled away from the carriageway at the top.
- Chain-wire fencing with a 600mm wide strip of sheet metal or plastic attached to the upper part of the fence. By attaching the sheeting to the non-carriageway side of the fence, animals can still climb the fence from the carriageway side of the fence and escape from the traffic. This is the preferred fence type for excluding koalas. A clear zone with no trees should be maintained for 3 metres either side of the fence to maintain its effectiveness (Main Roads 2000).
- Exclusion fencing may be particularly important in this section of the GUP corridor where there are a number of state and locally significant fauna species adjacent to the GUP corridor. Such species are generally in lower numbers and therefore deaths caused by vehicular collision are more significant when compared with common species. Such fencing needs to be inspected and maintained after construction to ensure its continual effectiveness.
- Landscaping on the verges adjacent to the Motorway should be confined to native trees and shrubs (as appropriate for safety) to deter macropods from grazing close to the Motorway where they are likely to come into collision with motor vehicles.

Construction

- Ensure an animal spotter and catcher is present during the initial clearing to relocate any fauna that is disturbed.

- The patch of large mature eucalypts adjacent to the existing Gateway Bridge should be retained and their root zones protected from vehicular traffic, the storage of materials and the deposition of deleterious materials such as cement.
- During vegetation clearing, an appropriately skilled “spotter and catcher” shall be engaged to visually check for any fauna present in trees or other vegetation. Fauna shall be either persuaded by reasonable means to leave or be captured and relocated in the local environment prior to felling or trimming.
- Site works, such as trenches and culverts, shall be checked each morning and after periods of inactivity, to ensure fauna are not trapped or likely to be harmed by construction activities.
- All native fauna is protected (including snakes) and shall not be intentionally harmed as a result of the works or worker actions.
- During bridge construction disturbance to mangroves should be kept to a minimum. Mangroves have important ecological functions as nursery grounds for fish, biofiltration beds and as providers of organic detritus to marine ecosystems. In the context of Kedron Brook Floodway, they also provide visual barriers for waders feeding at lowtide, helping reduce disturbance from human activities on the banks.
- Flagging tape, barricade webbing or similar highly visible markers shall be used to define the limits of clearing. Clearing in this area shall be restricted to 3m beyond the toe of the batter or cut, excepting areas required for erosion and sediment control.
- Trees with trunks outside the 3m line adjoining the edge of works site shall be trimmed (branch lopping) by sawing rather than felled where branches may interfere with the works or future traffic safety.
- Selective clearing and trimming only shall be undertaken in the area for topsoil and mulch stockpiling. A visual observation of this area should be undertaken prior to clearing and an assessment made by the Construction Contractor regarding the removal of individual trees and shrubs to allow a suitable area for stockpiling.
- Small trees and shrubs shall be removed in preference to large trees in this area and shall be felled to ground level with roots left in the ground. Vegetation to be removed shall be clearly marked by paint or flagging.
- Streetscape vegetation removal shall be limited to the removal of trunks within the works area and trimming of limbs overhanging the work area.
- Streetscape vegetation shall be inspected by the Construction Contractor prior to trimming and a determination of vegetation to be cleared or trimmed shall be made.
- Vegetation to be removed shall be clearly marked with paint or flagging tape prior to clearing.
- Riparian vegetation (vegetation along the edge of Bulimba Creek) removal shall be minimised to the smallest clearance area to undertake the bridge works and install the temporary bridge.
- Where practical, removal shall be limited to pruning branches or where the trunk is felled, leaving the root mass in place.
- A weekly inspection for weeds within and adjoining the works site shall be undertaken by an appropriately skilled officer.
- Where weeds are detected within the work site, the weeds shall be removed or destroyed. Herbicides shall not be used within 20m of the banks of watercourses and drainage lines.
- Revegetation of disturbed soil areas such as batters, inlets and outlets of drainage structures and street landscaping areas, shall be revegetated as soon as practical (but not more than 4 weeks) after completion of earthworks final trim or associated works. Revegetation shall be either through seeding, hydro mulching, or direct planting.
- Revegetation works shall be maintained (watered etc) to ensure establishment.

- During vegetation clearing, an appropriately skilled “spotter and catcher” shall be engaged to visually check for any fauna present in trees or other vegetation. Fauna shall be either persuaded by reasonable means to leave or be captured and relocated in the local environment prior to felling or trimming.
- Site works, such as trenches and culverts, shall be checked each morning and after periods of inactivity, to ensure fauna are not trapped or likely to be harmed by construction activities.
- All native fauna is protected (including snakes) and shall not be intentionally harmed as a result of the works or worker actions.
- Implement revegetation plan to protect remnant vegetation from further degradation

The works are within a Red Imported Fire Ant (RIFA) restricted zone, therefore controls on the movement of materials that may be of risk of transporting RIFA are required. The management actions detailed below reflect the “Red Imported Fire Ant Procedure” of Roads and Drainage Provider Unit.

Table 23.15 Red Imported Fire Ant Management Plan

Investigation Threshold	Strategy	Management Action
Inspection of site for RIFA not undertaken prior to commencement and monthly thereafter.	To inspect the site for the presence of fire ants prior to the start of works and at monthly intervals during the works period.	<i>Prior to commencement of works, a DPIF approved person shall carry out an inspection of the site. This inspection will identify whether the site is visually free or visually infested with RIFA. The inspection of the site shall be repeated every 28 days. The approved inspector will complete the Site Inspection Form (Issued by the DPIF).</i>
Importation to the site of materials capable of transporting fire ants without inspection and clearance.	To only source restricted items (soil, plants etc) which are free of RIFA.	<i>All incoming restricted items (soil, plants etc) must be visually inspected by an DPIF authorised person prior to entry into the site and shall only be sourced from providers outside the restricted area or with a DPIF Approved Risk Management Plan, and be accompanied by a written assurance that the material is Fire Ant free.</i>
No records of imported materials from the restricted area.	To maintain records of any imported materials from the restricted area.	<i>All incoming restricted items must be recorded detailing the nature, quantity and source of materials imported to the site. All records to be held on site by Project Manager.</i>
Importation to the site of materials capable of transporting fire ants without inspection and clearance.	To minimise the risk of RIFA being transported to the site by equipment and machinery.	<i>All equipment and machinery to be visually free of loose soil or other material capable of containing Fire Ants prior to entry on to site.</i>

Investigation Threshold	Strategy	Management Action
Materials being exported from the site without inspection and clearance.	Movement of materials from the site shall not increase the risk of spread of RIFA.	<i>Materials shall only leave the site within 28 days of a site inspection, which finds no visible evidence of RIFA.</i>
Visual evidence of RIFA on site.	Visual evidence or suspicion of RIFA to be reported. Additional management measures to be implemented on detection of RIFA.	<i>In the event that RIFA are detected or reasonable suspicion is held that RIFA are present on the site, the Project Manager shall be immediately notified. The area under suspicion shall be barricaded and works in that area shall cease.</i> The Construction Contractor should notify the Department of Primary Industries. <i>In the event of RIFA being detected on site, additional management measure shall be implemented which are in accordance with Attachment 4 of the Red Imported Fire Ant Risk Management Plan.</i>

Operation

- Implement weed management plan.
- Liaise with the appropriate agency to carry out a long term study of population dynamics and movement patterns of koalas, squirrel gliders, sugar gliders and other significant species with populations on both sides of the GUP corridor to ascertain what effects if any the road is having on local populations.

Monitoring

Construction

During construction clearing, the Construction Contractor should inspect the site to assess compliance with the performance criteria and the EMP (Construction) requirements.

The Construction Contractor should ensure that the area to be cleared is clearly delineated and that impacts on flora are minimised.

Operation

Operator should undertake regular monitoring along the GUP corridor to ensure landscaped areas are being maintained in accordance with the EMP.

23.4.13 Aquatic Biology

Mitigation Measures

Design

- Avoid saltmarsh/mangrove area south of Cannery Creek at Northgate.
- Avoid the loss or disturbance of estuarine or freshwater wetland vegetation.

- Avoid habitat of migratory birds, including areas for feeding and roosting, particularly the wetlands associated with Kedron Brook Floodway and Shultz Canal and the saltmarsh area south of the Cannery Crain at Northgate.
- Design waterway crossings that retain as much as practicable of the natural features of the waterway so as not to unnecessarily cause degradation of sever the waterways.
- Design refinement to occur to minimise the physical disturbance of fringing riparian vegetation and waters where bridge buttresses are placed landward of the riparian zone at the Bulimba Creek crossing (CH14800) and Kedron Brook floodplain (CH21900-22100).
- Bridges to be designed to ensure sufficient light penetration to support marine plants;
- Design elements should seek to maintain existing patterns of flow and bed levels at Bulimba Creek (CH14800);
- Provision is made for the collection and treatment of stormwater runoff.
- Stormwater runoff collection and treatment ponds are designed to minimise the breeding of mosquitoes.
- The number and size of piers are minimised, and their shape produces minimal hydraulic 'interference'.
- Design elements should seek to maintain existing patterns of flow and bed levels within the airport precinct (CH21900 – 22100).

Construction

- Construction activities minimise the loss or disturbance of riparian flora (and in particular 'marine plants'), at the Bulimba Creek crossing (CH 14800), Brisbane River (CH6900), airport land (CH21900-22100) and Kedron Brook floodplain (CH23100-23150).
- Rehabilitation of damaged vegetation communities (particularly 'marine plants') is undertaken where appropriate (refer Section 17.3.7 of EIS).
- Sediments, particularly fine sediments, are prevented from being transported from the construction corridor to waterways. The minimisation of sediment disturbance and subsequent erosion, and the effective adoption of sediment management strategies are likely to be critical.
- Acidified waters are prevented from entering Bulimba Creek, Brisbane River, Kedron Brook Floodway and any wetland and waterway. Where acidified waters accidentally enter a water body, remedial action should be taken to prevent the receiving waters from falling more than 2 pH units below ambient.
- The spillage and subsequent transport of contaminants (including hydrocarbons, heavy metals) from the construction corridor to Bulimba Creek, Brisbane River and Kedron Brook Floodway is prevented. Spill management plans should be developed for the construction phase.
- A mosquito management plan is implemented.
- A comprehensive environmental monitoring program is developed and implemented. Baseline data should be gathered prior to any construction activity.

Operation

- Sediments, particularly fine sediments, are prevented from being transported from the GUP to waterways where possible.
- 'Best practice' surface water quality management is undertaken during operation.
- Runoff from roadways (including bridges) is treated before release to natural waterways.

23.4.14 Social Environment

Mitigation Measures

The following mitigation measures are recommended to manage potential social impacts:

- In approving any new housing estates in Emerging Community Zones, Brisbane City Council should be requested to ensure that appropriate noise mitigation measures are incorporated.
- The proposed installation of noise barriers along the Gateway Motorway which has been progressively implemented from Mount Gravatt-Capalaba Road to Lytton Road should be completed at the earliest opportunity, taking into account the new conditions following the upgrade proposal. The timing of noise barrier installation will be important to residents in the vicinity of the Motorway and certainly in installation timing should be provided.
- Areas of affordable housing should be considered a priority for the implementation of mitigation measures.
- Consideration should be given to the re-establishment of a local park in the vicinity of Percival Park on surplus GUP land following completion of construction. Landscaping other surplus land in this area should also be considered.
- Maintain opportunities to pedestrian and cycle movement under the Kedron Brook Floodway bridge so as not to limit future recreational use of the floodplain.
- Provide certainty to directly affected landowners to enable relocation plans to be prepared in a timely fashion. This will apply particularly to manufacturing industry which has a long lead time for relocation.
- Maintain access to recreation areas, community facilities and businesses during construction using temporary access arrangements, if necessary.
- Avoiding impacts on local and onsite services that may disrupt manufacturing.
- Implementing an effective consultation and communication program during the construction phase. This program to include:
 - regular publication and distribution of information on construction activities, their timing and any temporary arrangements;
 - publication and distribution of information to take into account the needs of local communities, affected landowners, nearby businesses, nearby workers as well as the broader metropolitan community;
 - appointment of Community Liaison Officers (CLO) during the construction period;
 - maintaining a free call information line for the community to access the project delivery team including the CLOs;
 - keeping of a complaints register for recording action taken in response to complaints; and
 - monthly reporting of all consultation and communication activities including issues raised and action taken.

23.4.15 Waste Management

Objectives

To prevent any adverse impacts from wastes generated by the construction and operation of the GUP through the implementation of waste management principles and best practice disposal strategies.

The material from demolished structures should be retained onsite and reused wherever possible to:

- Reduce the amount of waste generated by these new works;
- Reduce the need to remove material from the site and import other material;
- Reduce the need for the use of new products if suitable materials may be reused in their place; and
- Reduce the cost where possible.

Mitigation Measures

Design

The Detailed Design Consultant should take into account all likely waste generators and where possible allow for their reuse in the final design. The main materials likely to be salvaged from the existing infrastructure would be include asphalt, cement treated gravel, concrete, steel and vegetative matter.

The Detail Design Consultant should apply the following concepts for waste minimisation (as appropriate) of the following materials, as a minimum requirement:

- **Asphalt.** The asphalt should, where possible, be reused for recycled asphalt or if it is not of sufficient quality it should be placed into a material suitable to be used as either select fill or embankment material.
- **Gravel.** If testing shows that gravel meets all the required standards, it may be used as a lower sub-base material. If testing shows that it does not reach the required MR standards for pavement material, it should be used as a select fill material or consequently it may be used as an embankment materials.
- **Cement treated gravel.** Cement related pavements would require a level of rehabilitation prior to being used as a fill material. The cement bonds the material into a bound pavement that is relatively thick. Cement treated gravel should be reduced to a useful size (eg < 75mm diameter) prior to use as an embankment materials.
- **Concrete.** Reinforced concrete structures that require removal could be demolished by the use of excavators with rock breakers. These would produce smaller pieces of reinforced concrete that could be treated to remove the excess steel prior to being used as embankment material. This material could be placed in the lowest layers of the embankments. The excess steel would be recycled.
- **Structures to be reused.** Structures such as culverts, poles, cables and other structures to be removed or demolished during construction should be identified at this stage. Structural elements which can possibly be reused on site or used for temporary works should also be identified.
- **Steel.** Any steel removed as part of the new works, such as guard rails, reinforcing steel, or sign posts, would be removed from site and recycled.
- **Vegetative material.** The main vegetative materials would be existing grass, shrubs and trees. Where appropriate the grass would be collected with the topsoil and stockpiled separately as a composted material and used for landscaping. Larger vegetation which needs to be cleared should be mulched. The topsoil and mulched material should be stockpiled separately such that it does not create a nuisance in the form of air borne dust by covering and “wetting down” of the stockpiles as appropriate. Stockpiles should also be maintained to prevent the growth of weeds.
- **Soil.** If not contaminated or an actual or potential acid sulphate material, excess soil removed as a result of construction should be reused in landscaping, embankments or other such design elements of GUP.

The Detail Design Consultant should document all methods and procedures for minimising the generation of waste in the drawings and specification. The procedures should state clearly the anticipated volumes of waste generated and the methods to be used to meet the waste management objectives.

Construction

The Construction Contractor should:

- Apply any waste minimisation and management strategies as nominated in the drawings and specifications;
- Ensure any regulated wastes generated on site are transported and disposed of by an appropriately licenced contractor, as per the provisions of the *Environmental Protection Act 1994*;
- Consider the reuse of stockpiled structural elements for reuse in the construction or for use in temporary works on site. Prior to reuse, the Construction Supervisor should perform an assessment and testing (if required) of these stockpiled structural elements to ensure they meet the required standards and will perform satisfactorily;
- Ensure that there is the adequate provision of correctly signed waste receptacles made available at convenient locations for the disposal of wastes. If practicable, separate receptacles should be provided for wastes which can be source separated, eg steel, paper etc, which will allow easier and more efficient collection and later processing;
- Ensure adequate toilet and ablution facilities are provided for the duration of the contract. Domestic sewage and grey water from these facilities should be retained on-site and collected by a licensed waste disposal contractor at regular periods. Under no circumstances are wastes to be discharged directly into the environment;
- Ensure adequate ground surface area is made for the safe storage of wastes prior to collection;
- Ensure that all wastes on site are suitably contained and prevented from escaping into neighbouring bushland, properties, waterways and that the waste contained does not contaminate soil, surface or ground water or create unpleasant odours for neighbours or workers; and
- Ensure the site is regularly cleaned and waste materials appropriately removed. Material which can be economically recycled, (eg steel, oil etc) should be sent to recyclers. All other waste that cannot be reused on site should be disposed of to a licenced land fill in accordance with Brisbane City Council regulations.

Operation

- Operator should ensure waste and litter is removed and disposal of in accordance with Brisbane City Council regulations.

23.4.16 Landscape and Visual Amenity

Objectives

- To provide a memorable visual experience for road travellers and adjacent land owners, urban design and landscape treatments should be developed to reflect a local and easily identifiable theme at special feature precincts.
- To enhance the visual values of the journey along the Motorway and the adjoining land.
- To promote the use of native Australian vegetation species.

- Through the landscape treatment along the road corridor, contribute of the rehabilitation and enhancement of the environment and in turn act as a catalyst for the general environment improvement of the area.

Design Mitigation Measures

Themes identified in Table 23.16 should be incorporated into the detail design.

Table 23.16 Road User Themes and Level of Visual Significance

Character Precinct	Theme	Level of Visual Significance
Southern Section		
Mt Gravatt – Capalaba Road to Wynnum Road	Forest Lined Motorway	Low
Wynnum Road to Bulimba Creek	Bulimba Creek floodplain	Low
Bulimba Creek to Lytton Road	Industrial	Moderate
Lytton Road to Gateway Bridge	Gateway Approach	High
Northern Section		
Gateway Bridge	Gateway	High
Gateway Bridge to Curtin Road	Gateway Approach	High
Curtin Road to Kingsford Smith Drive/Pinkenba Rail Line	Industrial	Moderate
Pinkenba Rail Line to Airtrain	Industrial	Moderate
Airtrain to Airport Drive	Airport Gateway	High
Airport Drive to Kedron Brook Floodway	Intertidal	Moderate
Kedron Brook Floodway to Nudgee Road	Kedron Brook Floodplain	Moderate

Landscape Mitigation Measures

Landscape treatments need to aim to integrate the GUP into the existing visual environment based on identified themes. To mitigate the identified levels of visual impact listed above, the following themed landscape planting measures summarised below are proposed.

a) General

Proposed plant species are to be native and endemic to the various ecological communities and environmental conditions along the corridor. A strictly native Forest Line Motorway theme is recommended and includes only species that perform in harsh roadside conditions and have a proven track record for minimal ongoing maintenance requirements. No exotic species are to be included.

Specific recommendations for each of the GUP sections are set out below.

b) Mt Gravatt-Capalaba Road to Cleveland Branch Rail Line

- Road interchanges treated with a combination of broad scale massed planting of batters with shrubs and groundcovers with semi advanced feature tree planting to batters;
- Majority of carriageway to be planted with frangible and non frangible native species;
- Acoustic barriers to be planted both sides to screen and minimise visual impacts;

- Planting arrangements and species mix for revegetation beyond clear zones to blend visually with the existing forest edge; and
Plant riparian and swamp species to batters adjacent to the Bulimba Creek floodplain.

The Landscape Concept Plan is shown in Figures 22.4a and 22.4b and includes proposed plant species and landscape treatments.

- c) Cleveland Branch Rail Line to Pinkenba Rail Line
- Majority of carriageway to be planted with frangible and non frangible native species as appropriate for safety;
 - Batters to works undertaken in the Port of Brisbane Motorway interchange and the southern Gateway Approach to be planted with species similar to those installed on recent landscaping. Species located to ensure screening of major batters;
 - Level areas adjacent to the northern Gateway approach planted with large spreading tree species to provide a local feature. Batters planted similarly to southern Gateway approach to minimise visual impact of the Approach batters; and
 - Bikeway planted with ornamental trees to frame the bikeway corridor.
- d) Pinkenba Rail Line to Nudgee Road
- Batters planted with selected mix of trees and shrubs to provide visual screening of batters;
 - Storm water collection ponds planted with suitable aquatic macrophytes to maintain water quality and provide visual amenity ;
 - Storm water swales planted with selected tufting vegetation for visual amenity and to protect from erosion;
 - Medians planted with lineal strips of massed native tufting groundcovers;
 - Areas disturbed adjacent to the Airport interchange revegetated with the same Casuarina species to reinstate pre-existing conditions to minimise risk to aircraft from bird strike. For aesthetics, edges to carriageways, within clear zones are to be planted with massed, lineal plantings of tufting groundcovers;
 - Northern interchange with its riparian theme to have areas outside clear zones massed planted with Melaleuca trees for dominant visual statement. This approach will effectively screen the motorway from the nearby golf course; and
 - For aesthetics, edges to carriageways, within clear zones planted with massed, lineal plantings of tufting groundcovers.

Indicative section details of landscape treatments to the Gateway Bridge approach batters and northern junction with existing Gateway Motorway are provided in Appendix P2.

e) Urban Design Mitigation Measures

Mitigation measures aim to address mainly the visual impacts along the Motorway as viewed by the Motorway road users. However visually significant structures will have mitigation measures to improve aesthetics from external viewers. Where possible, visual integration into the existing landscape will be proposed. To minimise visual impacts, visually recessive colours are proposed for the more visible elements of bridge structures and architectural elements.

f) Urban Design Philosophy

The urban design philosophy of the GUP is to provide uniformity in the appearance of the Gateway Motorway corridor by adopting a consistent overall urban design theme based on:

- Adopting similar urban design treatments as used on the Port of Brisbane Motorway interchange;
- Similarity in design of 'iconic' architectural structures at high profile locations;
- Similar architectural style and materials selection for toll plaza buildings;
- Applying similar design and colour treatments to bridge structures except for the new Gateway Bridge which should be similar in design and colour to the existing bridge;
- Similarity in road lighting colour and pole assembly design; and
- Uniform acoustic barrier design and colour.

Table 23.17 summarises the suggested urban design measures at significant locations. The measures are based on local variations in theme.

Table 23.17 Suggested Urban Design Themes

Location	Theme
South of Port Road	Forest Lined Motorway
Gateway Bridge Approaches	Gateway
Airport Interchange	Intertidal
Airport Drive	Aviation
Northern Interchange	Kedron Brook floodplain

The urban design mitigation measures are summarised in Figures 22.5a to 22.5d and in the "Matrix of Urban Design Treatments" in Appendix P3.

23.5 Environmental Management Process

23.5.1 Preamble

The MR's environmental management process and documentation requirements are summarised in the diagram below.

This EMP has been prepared as a Preliminary EMP and will be finalised prior to the detail design tender phase of the project.

Construction

The Construction Contractor will be responsible for the creation of an EMP (Construction). This document should provide the Construction Contractors' the proposed methods of mitigating any environmental impacts, which may be incurred as a result of their construction activities.

The checklist below provides the methodology, which should be followed by the Construction Contractor to create an EMP (Construction).

- Identify the relevant works;
- Identify which environmental aspects are required to be addressed in the EMP (Construction);
- Refer to the relevant sections ie 'Construction' of the various Environmental Management Strategies (provided in the EMP), which address the environmental

aspects (as identified in step 2) which are required to be included in the EMP (Construction);

- Create the EMP (Construction) in accordance with the requirements of the Environmental Management Strategies (as identified in step 3). Section 23.5.2 provides guidance on the format and content of the EMPs; and
- Submit the EMP (Construction) to the Superintendent, who will then submit the EMP to the MR Representative for approval.

Operation

The nominated Operation Contractor will prepare an EMP (Maintenance). This document should provide the Operator with the proposed method of mitigating any environmental impacts caused by operation of GUP.

The Operator should follow the processes noted above, except that the submission of the EMP for approval should be to the GUP Director.

23.5.2 Content of an EMP

The Construction and Operation EMPs should address the requirements of the relevant environmental management strategies outlined in the EMP in separate sections. The EMPs should provide information under several different headings (which complement those in the environmental management strategies) as outlined below.

- **Overview of Impacts and Existing Situation** – The anticipated construction and/or operational impacts of the projects section as determined in the EIS and final EMP should be detailed.
- **Objectives** – This section should provide the management objectives or environmental commitments to be achieved, as included in the 'objectives' section of the relevant environmental management strategy.
- **Non Compliance** – This section should provide information on the corrective actions to be implemented. The level or extent of corrective actions implemented should reflect the seriousness of the event. The various indicators which should trigger the implementation of corrective actions are provided in the 'corrective actions' section of the relevant environmental management strategy under the subheadings of "minor non-compliance", "major non-compliance" and "environmental issues".
- **Mitigation Measures** – This section should provide details of the actions to be performed on-site. These actions should be developed from the requirements provided in the 'mitigation measures' section of the relevant environmental management strategy.
- **Monitoring** - This section should provide information on the monitoring activities to be performed. The actions included in this section may be sourced from the 'Monitoring' section of the relevant environmental management strategy.

- **Reporting** - This section should provide information on the reporting which will be performed by the Construction Contractor. The details included in this section may be able to be sourced from the 'Reporting' section of the relevant environmental management strategy.
- **Corrective Actions** – This section should outline the action, or the commitment for action, to be implemented when a specified mitigation measures is not met or legislative requirements have been exceeded.

23.5.3 Submission of an EMP (Construction)

The Construction Contractor should submit a EMP (Construction) to the MR Representative for approval at least 3 months prior to construction commencing. The MR Representative should refer the EMP(Construction) to the GUP Environmental Advisor for review.

The MR Representative should liaise with the Superintendent and should subsequently notify the Construction Contractor of the acceptance or otherwise of the EMP within 2 months of it's submittal. Should the EMP not be accepted, the Construction Contractor should submit a revised EMP within 10 working days of the advice of non acceptance.

A Hold Point should occur and no site construction works should proceed until written approval of the amended EMP (Construction), or a section of the EMP (Construction) relevant to a particular construction operation, is received from MR Representative.

The Construction Contractor should be solely responsible for the full and complete implementation of the EMP (Construction). The Construction Contractor should pay all penalties, costs and expenses which may be incurred in respect of offences committed or alleged to be committed under the provisions of the *Environmental Protection Act 1994*.

23.5.4 Auditing

The Construction Contractor should include in the reporting section of the EMP (Construction) the requirement to submit weekly checklist audit reports to the MR Representative.

The Superintendent should audit the Construction Contractor's implementation of their EMP (Construction). The Construction Contractor is responsible for all impacts onsite until completion of the Defects Liability Period. This will be done to ensure that works being undertaken comply with the Contract Documents. The frequency of the audits will depend upon the activities being undertaken but it is envisaged that these audits should be undertaken on a monthly basis. Any changes to this frequency will be authorised by the MR Representative. An audit report would be issued within 2 weeks and distributed to the MR Representative and Construction Contractors and if necessary, to a relevant authority for action as necessary.

Actions to be undertaken by the Superintendent during the audit are likely to include:

- check monitoring program and reporting procedures;
- undertake investigations where necessary;
- review performance standards and criteria against results;
- prepare audit reports over time (with respect to agreed schedule) and submit to the MR Representative; and
- procedures for non compliance and exceedence/investigation/intervention of indicators identification.