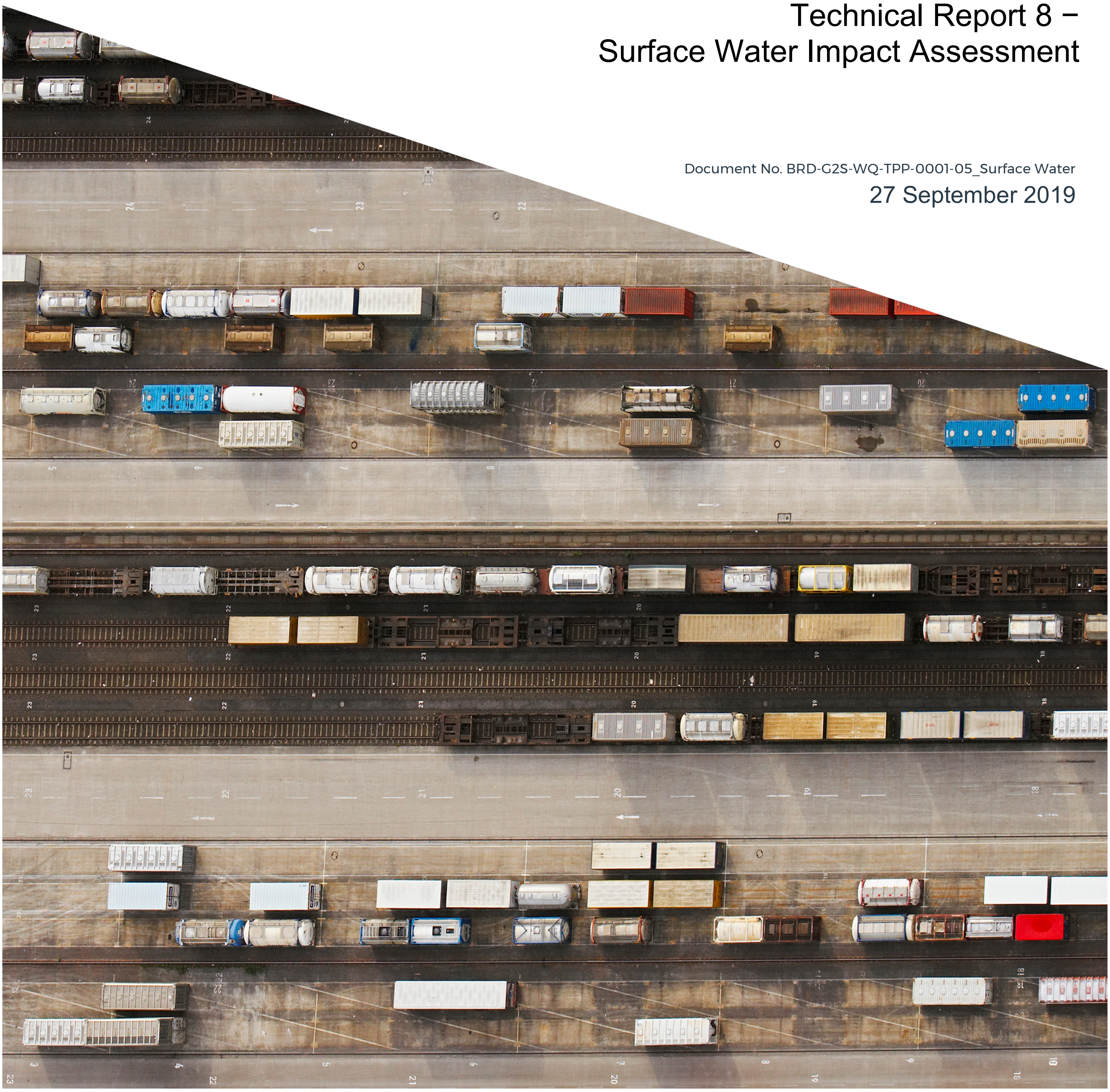
BOTANY RAIL DUPLICATION

TECHNICAL REPORT

Technical Report 8 –
Surface Water Impact Assessment

ARTC

Botany Rail Duplication - Environmental Impact Statement



Technical Report 8 – Surface Water Impact Assessment

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Glossary and abbreviations

Acid sulfate soils	Naturally occurring soils, sediments or organic substrates (e.g. peat) that are formed under waterlogged conditions. These soils contain iron sulfide minerals (predominantly as the mineral pyrite) or their oxidation products. In an undisturbed state below the water table, acid sulfate soils are benign. However, if the soils are drained, excavated or exposed to air by a lowering of the water table, the sulfides react with oxygen to form sulfuric acid.
AHD	Australian height datum
Annual Exceedance Probability (AEP)	An indicator used to describe the frequency of floods. Annual exceedance probability is the probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.
Australia and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000)	A set of guidelines prepared to provide authoritative guidance on the management of water quality in Australia and New Zealand.
Alignment	The geometric layout (e.g. of a road or railway) in plan (horizontal) and elevation (vertical).
ARTC	Australian Rail Track Corporation (the proponent)
Aquifer	A groundwater bearing formation sufficiently permeable to transmit and yield groundwater or water bearing rock.
Ballast	Material such as crushed rock or stone used to provide a foundation for a railway track. Ballast usually provides the bed on which railway sleepers are laid, transmits the load from train movements and restrains the track from movement.
The Blue Book	The Managing Urban Stormwater – Soils and Construction (Landcom, 2004) series of handbooks which provide guidelines, principles and recommended minimum design standards for good management practice for soils and water during construction of projects.
BOM	Bureau of Meteorology
Botany Line	A dedicated freight rail line (operated by ARTC) that forms part of the Metropolitan Freight Network. The line extends from near Marrickville Station to Port Botany.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
construction ancillary facilities	Temporary facilities during construction that include, but are not limited to, construction work areas, sediment basins, temporary water treatment plants, pre-cast yards and material stockpiles, laydown areas, parking, maintenance workshops and offices, and construction compounds.

construction compound	An area used as the base for construction activities, usually for the storage of plant, equipment and materials, and/or construction site offices and worker facilities.
CEMP	construction environmental management plan CEMP
Cess drain	Surface drains located at formation level at the side of tracks, to remove water and to ensure the ballast does not become waterlogged.
Council, the	Bayside Council
detailed design	The stage of design where project elements are design in detail, suitable for construction.
Discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving (e.g. metres per second (m/s)).
Drainage	Natural or artificial means for the interception and removal of surface or subsurface water.
Drawdown	Reduction in the height of the water table caused by changes in the local environment.
Earthworks	All operations involved in loosening, excavating, placing, shaping and compacting soil or rock.
EIS, the	Botany Rail Duplication environmental impact statement
embankment	A raised area of earth or other materials used to carry a rail line in certain areas.
Erosion	A natural process where wind or water detaches a soil particle and provides energy to move the particle.
existing rail corridor	The corridor within which the existing rail infrastructure is located. In the study area, the existing rail corridor is the Botany Line.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
formation	The earthworks/material on which the ballast, sleepers and tracks are laid.
Groundwater	Water that is held in rocks and soil beneath the earth's surface.
Groundwater dependent ecosystem	Refers to communities of plants, animals and other organisms whose extent and life process are dependent on groundwater, such as wetlands and vegetation on coastal sand dunes.
heavy vehicles	A heavy vehicle is classified as a Class 3 vehicle (a two-axle truck) or larger, in accordance with the Austroads Vehicle Classification System.
Hydrology	The study of rainfall and surface water runoff processes.
impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.

LGA	local government area
Metropolitan Freight Network	A network of dedicated railway lines for freight in Sydney, linking NSW's rural and interstate rail networks with Port Botany. The Metropolitan Freight Network is managed by ARTC.
OLS	Obstacle limitation surface
PFAS	Per-and poly-fluoroalkyl substances, which are manufactured chemicals used in products that resist heat, oil, stains and water. There are many types of PFAS, with the best-known examples being perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), which were used in some fire-fighting foams.
Pollutant	Any measured concentration of solid or liquid matter that is not naturally present in the environment.
possession	A period of time during which a rail line is closed to train operations to permit work to be carried out on or near the line.
project site, the	The area that would be directly affected by construction (also known as the construction footprint). It includes the location of operational project infrastructure, the area that would be directly disturbed by the movement of construction plant and machinery, and the location of the storage areas/compounds etc, that would be used to construct that infrastructure.
project, the	The construction and operation of the Botany Rail Duplication
Runoff	The amount of rainfall that ends up as streamflow, also known as rainfall excess.
Secretary's environmental assessment requirements (SEARs)	Requirements and specifications for an environmental assessment prepared by the Secretary of the Department of Planning and Environment under section 115Y of the *Environmental Planning and Assessment Act 1979* (NSW).
Sensitive receivers	Land uses, landscape features and activities that are sensitive to changes in the environment such as water quality and quantity, noise, vibration, air and visual impacts. Sensitive receivers may include aquatic ecosystems, aquaculture areas, residential dwellings, schools and recreation areas.
Soil and Water Management Plan (SWMP)	A plan which describes how to manage obligations and performance with regards to aspects and potential impacts associated with soil and water during construction of the project.
State significant infrastructure	Major transport and services infrastructure considered to have State significance as a result of size, economic value or potential impacts.
study area, the	The study area is defined as the wider area including and surrounding the project site, with the potential to be directly or indirectly affected by the project (e.g. by noise and vibration, visual or traffic impacts). The actual size and extent of the study area varies according to the nature and requirements of each assessment and the relative potential for impacts but which is sufficient to allow for a complete assessment of the proposed project impacts to be undertaken.

Surface water	Water flowing or held in streams, rivers and other wetlands in the landscape.
Trigger Values	Guideline trigger values are concentrations in waterways that, if exceeded, would indicate a potential environmental problem, and so ‘trigger’ a management response, e.g. further investigation and subsequent refinement of the guidelines according to local conditions.
Waterway	Any flowing stream of water, whether natural or artificially regulated (not necessarily permanent).

Executive summary

Australian Rail Track Corporation proposes to construct and operate a new second track typically the existing Botany Line rail corridor between Mascot and Botany, in the Bayside local government area. The Botany Rail Duplication would increase freight rail capacity in and out of Sydney Airport and Port Botany.

The purpose of this report is to assess the potential water quality impacts from constructing and operating the Botany Rail Duplication. This report will be used to inform proposal design, environmental assessment, regulators, stakeholders and community about potential impacts on water quality and to identify recommended mitigation and management measures.

Surface water from the northern 1.4 kilometres of the project site flows to Alexandra Canal via existing drainage network and the Upper Mascot Open Channel. Surface water from the southern 1.6 kilometres of the project site flows to Mill Stream, directly via overland flow or through existing drainage networks.

The Mill Stream catchment is a sub catchment of the Botany Bay catchment, which is part of the Georges River catchment. Alexandra Canal is located within the lower reaches of Cooks River catchment.

The Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) guidelines identify water quality management objectives and trigger values for different potential pollutants based on the environmental values for the catchments. Baseline water quality was found to frequently exceed the water quality criteria for the specific environmental values for both these waterways.

While there is risk of impacts to water quality during construction of the project it is anticipated that implementation of appropriate soil and water construction management measures would minimise potential impacts. Any remaining impacts would be limited to the duration of the construction phase.

Implementation of the recommended mitigation measures during operation will result in a low likelihood of impact to waterways and sensitive receiving environments. A water quality monitoring program is recommended during the construction of the new bridge over Mill Stream to ensure maintenance of water quality values and identify non-conformances for the extent of these works.

1. Introduction

1.1 Overview

1.1.1 Background

Australian Rail Track Corporation (ARTC) proposes to construct and operate a new second track generally within the existing Botany Line rail corridor between Mascot and Botany, in the Bayside local government area (LGA). The Botany Rail Duplication ('the project') would increase freight rail capacity in and out of Sydney Airport and Port Botany. The location of the project is shown in Figure 1.1.

The project is State significant infrastructure in accordance with Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). As State significant infrastructure, the project needs approval from the NSW Minister for Planning and Public Spaces.

This report has been prepared to accompany the Environmental Impact Statement (EIS) to support the application for approval of the project, and address the environmental assessment requirements of the Secretary of the Department of Planning and Environment (the SEARs), issued on 21 December 2018.

1.1.2 Overview of the project

The project would involve (further information on the project is provided in the EIS):

- Track duplication – constructing a new track within the rail corridor for a distance of about three kilometres.
- Track realignment (slewing) and upgrading – moving some sections of track sideways (slewing) and upgrading some sections of track to improve the alignment of both tracks and minimise impacts to adjoining land uses.
- New crossovers – constructing new rail crossovers to maintain and improve access at two locations (totalling four new crossovers).
- Bridge works – constructing new bridge structures at Mill Stream, Southern Cross Drive, O'Riordan Street and Robey Street (adjacent to the existing bridges), and re-constructing the existing bridge structures at Robey Street and O'Riordan Street.
- Embankment/retaining structures – construction of a new embankment and retaining structures adjacent to Qantas Drive between Robey and O'Riordan streets and a new embankment between the Mill Stream and Botany Road bridges.

Ancillary work would include bi-directional signalling upgrades, drainage work and protecting/relocating utilities.

Subject to approval of the project, construction is planned to start at the end of 2020, and is expected to take about three years. Construction is expected to be completed in 2023.

It is anticipated that some features of the project would be constructed while the existing rail line continues to operate. Other features of the project would need to be constructed during programmed weekend rail possession periods when rail services along the line cease to operate.

The project would operate as part of the existing Botany Line and would continue to be managed by ARTC. ARTC is not responsible for the operation of rolling stock. Train services are currently, and would continue to be, provided by a variety of operators. Following the completion of works, the existing functionality of surrounding infrastructure would be restored.

Key features of the project are shown on Figure 1.2.

Figure 1.1 Botany Rail Duplication location

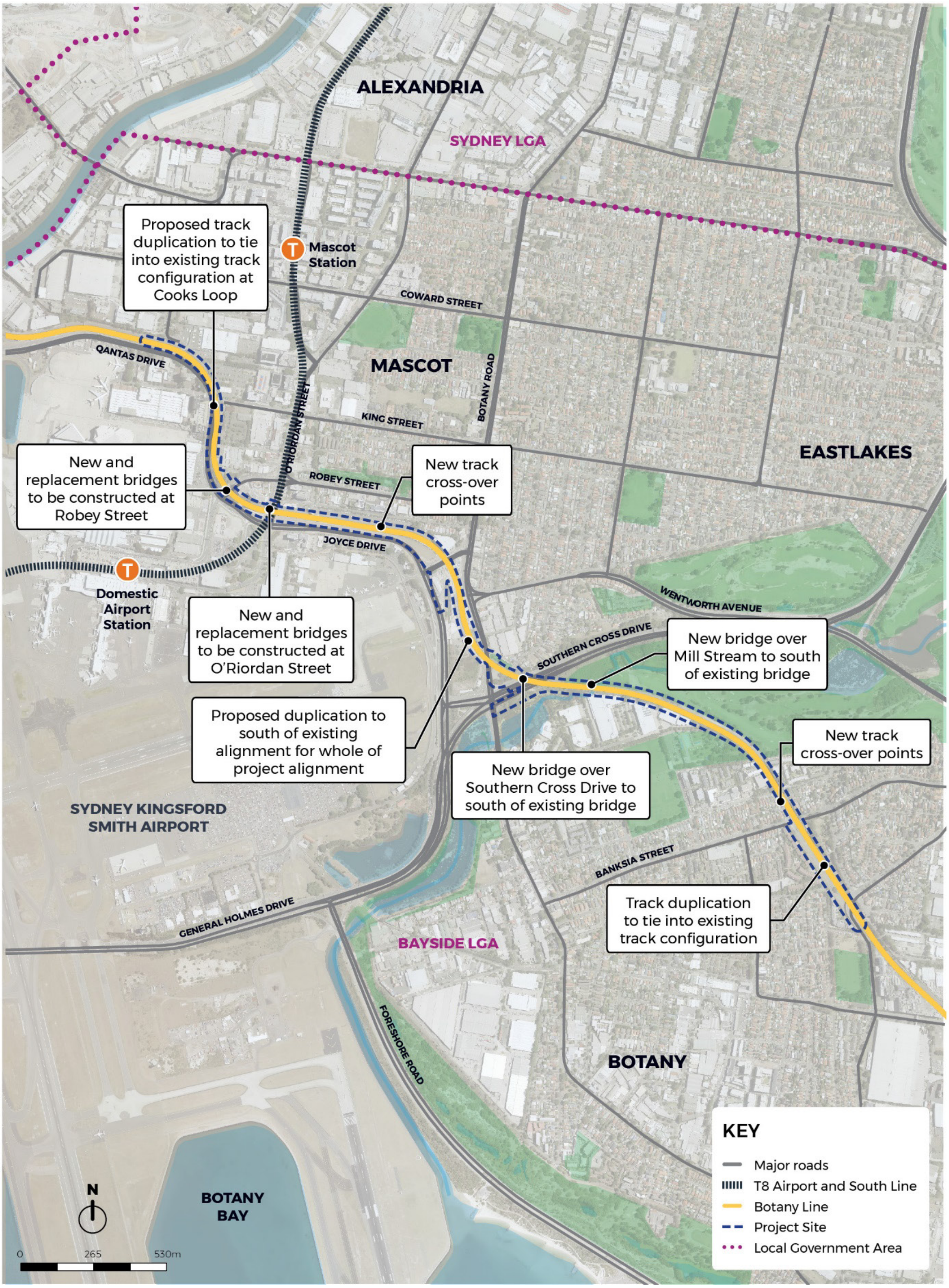


Figure 1.2 Botany Rail Duplication project overview

1.2 Purpose and scope of this report

The purpose of this report is to assess the potential water quality impacts from constructing and operating the project. It will be used to inform project design, environmental assessment, regulators, stakeholders and community about potential impacts on water quality and to identify recommended mitigation and management measures.

The project involves track duplication and re-alignment, and construction of new crossovers and bridges generally within the existing rail corridor, adjacent to mixed industrial and commercial land uses and open space. The potential alteration of catchment conditions as a result of this project, may change surface water flow and quality characteristics around the project site during both project construction and operation.

This report:

- describes the existing catchments and waterways, including their environmental values and relevant regulatory framework
- assesses the impacts of the project on water quality during construction and operation
- recommends measures to mitigate potential adverse impacts during both construction and operation.

1.3 Structure of this report

The structure of the report is as follows:

- Section 1 Introduction – provides an introduction to the report.
- Section 2 Legislative and policy context – describes the legislative and policy context for the assessment, and relevant guidelines.
- Section 3 Methodology – describes the methods and assessment criteria adopted in this report to characterise and assess potential impacts on surface water quality.
- Section 4 Existing environment – describes the existing surface water environment including catchment characteristics, groundwater, climate, water quality conditions and sensitive receptors.
- Section 5 Impact assessment – provides an assessment of environmental impacts associated with water quality.
- Section 6 Management of impacts – details recommended mitigation and management measures to reduce water quality impacts and, where possible, the anticipated effect of nominated mitigation measures on reducing impacts. Includes a proposed monitoring program to assess the emergence of impacts.
- Section 7 Conclusion – overview of the key findings of the report.

2. Legislative and policy context

This section provides a summary of the legislation, strategies and/or guidelines relevant to this investigation.

2.1 Commonwealth legislation

2.1.1 *Airports Act 1996*

Works on Commonwealth-owned land leased to SACL (Sydney Airport land) are subject to the planning and assessment framework prescribed by the *Airports Act 1996* (the Airports Act) and associated regulations.

Section 70 of the Airports Act requires the development of a final master plan for the airport, approved by the Australian Minister for Infrastructure and Transport.

Part 5 of the Act also requires that each airport develop an environment strategy included within its master plan. Sydney Airport and all persons who carry out activities at the airport are obliged to take all reasonable steps to ensure compliance with the environment strategy.

Most of the project site is located within the existing Botany Line corridor, however additional land is required for the establishment of construction compounds. Where these compounds are located on Sydney Airport land, Sydney Airport guidelines and strategy documents as they relate to the project would need to be followed., including the Sydney Airport Masterplan 2039 and associated Sydney Airport Environment Strategy 2019–2024 which are discussed further in Section 2.1.3 and Section 2.1.4, respectively.

2.1.2 Airports (Environment Protection) Regulations 1997

The objective of the Airports (Environmental Protection) Regulations 1997 (the regulations) is to establish a system of regulation for activities at airports that generate or have potential to generate pollution or excessive noise. The regulations impose a general duty to prevent or minimise environmental pollution and have as one of their objects the promotion of improved environmental management practices at Commonwealth-leased airports. The regulations contain detailed provisions setting out:

- definitions, acceptable limits and objectives for air, water and soil pollution, and offensive noise
- general duties to prevent or minimise pollution, preserve significant habitat and cultural areas, and prevent offensive noise
- monitoring and reporting requirements for existing pollution.

Part 2 of the regulations defines pollution in relation to air (including odour), water, soil and offensive noise. Schedule 2 of the regulations provide the acceptable limits of pollutants toxicants. These regulations, in conjunction with other national environment protection measures, provide the system of environmental regulation at Airports.

Part of the project works include a proposed surface water interface with Mill Stream during the construction of a new bridge over Mill Stream. The location of this point, upstream of Commonwealth and Airport land, has the potential to result in downstream changes to water quality. As a result, specific pollutant limits have been considered for the assessment. The limits for marine waters provided in Schedule 2 of the regulation are shown in Appendix A.

2.1.3 Sydney Airport Master Plan 2039

As part of the planning framework established by the Airport Act 1997, airport operators are required to prepare a master plan for the coordinated development of their airport (discussed in Section 2.1.1). The Sydney Airport Master Plan 2039 outlines the strategic direction for Sydney Airport's operations and development over the next 20 years. It acknowledges that the continued growth of Sydney Airport is vital to achieving local, state and national employment, tourism and development objectives. In accordance with the requirements of the Airports Act, the Sydney Airport Master Plan 2039:

- establishes the strategic direction for efficient and economic development at Sydney Airport over the planning period
- provides for the development of additional uses of the Sydney Airport site
- identifies the intended land use zones within Sydney Airport
- reduces potential conflicts between land use of Sydney Airport site and the areas surrounding the airport
- ensures that operations at Sydney Airport are undertaken in accordance with relevant environmental legislation and standards
- establishes a framework for assessing compliance with relevant environmental legislation and standards
- promotes continual improvement of environmental management at Sydney Airport.

The plan acknowledges that various airport activities, including construction, maintenance activities, and hazardous materials storage, have the potential to impact on water quality. As such, Sydney Airport Corporation regularly monitors the adequacy of onsite stormwater management systems by monitoring surface water flows to local waterways, including Mill Stream which intercepts the project site and forms part of the project catchment areas.

2.1.4 Sydney Airport Environment Strategy 2019–2024

The Airports Act 1997 requires that airport operators provide an assessment of the environmental issues associated with implementing the airport master plan and the plan for dealing with those issues. The Sydney Airport Environment Strategy 2019–2024 (the Environment Strategy), which forms part of Master Plan 2039, provides strategic direction for the environmental performance and management of Sydney Airport for the five-year period between 2019 and 2024.

The purpose of the Environment Strategy is to:

- establish a framework for assessing compliance and ensuring that all operations at Sydney Airport are undertaken in accordance with relevant environmental legislation and standards
- promote the continual improvement of environmental management and performance at Sydney Airport and build on the achievements and goals of previous strategies
- realise improvements in environmental sustainability, by minimising the environmental footprint of Sydney Airport and working towards a more efficient and resilient airport.

The following key actions/initiatives in the Environment Strategy are relevant to this study:

- identify water quality improvement projects for waterways surrounding Sydney Airport and proactively seek out partnership opportunities to implement feasible projects
- develop and implement a guideline for introducing water sensitive urban design and rainwater harvesting into new developments within the airport site as appropriate
- incorporate design features in new developments to reduce contaminant loads in stormwater and to align with catchment water quality objectives
- continue to ensure that stormwater quality is considered for the construction and operational phases of development proposals
- continue to implement the initiatives contained in the Sydney Airport Stormwater Quality Management Plan, including continuation of regular stormwater quality sampling
- continue to implement the Sydney Airport Wetlands Management Plan and Wetlands Enhancement Program.

The Environment Strategy identified a continuation, or improvement of stormwater water quality as a key indicator of the success of the above objectives.

As the project site includes the tenancy of airport owned land (identified within the Environmental Strategy) for the purpose of the temporary construction compounds, the project must align with the strategy for the duration of the lease agreements.

2.1.5 *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Australian Department of the Environment and Energy and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as 'matters of national environmental significance' (MNES).

Under the EPBC Act, proposed actions (i.e. activities or projects) with the potential to significantly impact matters protected by the EPBC Act must be referred to the Australian Minister for the Environment to determine whether they are controlled actions, requiring approval from the Minister. The following matters are defined as protected matters by Part 3 of the EPBC Act:

- matters of national environmental significance (MNES), of which there are nine:
  - world heritage properties
  - national heritage places
  - wetlands of international importance (listed under the Ramsar Convention)
  - listed threatened species and ecological communities
  - migratory species protected under international agreements
  - Commonwealth marine areas
  - the Great Barrier Reef Marine Park
  - nuclear actions (including uranium mines)
  - a water resource, in relation to coal seam gas development and large coal mining development
- the environment of Commonwealth land
- the environment in general, if proposed actions are being carried out by an Australian Government agency.

As the project requires the temporary use of airport land (which is Commonwealth land) for the duration of the construction period, the project must consider the requirements of the EPBC Act.

2.2 National strategies

2.2.1 National Water Quality Management Strategy

The National Water Quality Management Strategy (NWQMS) aims to protect the nation's water resources by providing guidance on improving water quality while supporting the businesses, industry, environment and communities that depend on water for their continued development. The main policy objective of the NWQMS is to achieve sustainable use of water resources, by protecting and enhancing their quality, while maintaining economic and social development.

The NWQMS includes water quality guidelines that define desirable ranges and maximum levels for certain parameters (based on scientific evidence and judgement) for specific uses of waters or for protection of specific values. They are generally set at a low level of contamination to offer long-term protection of environmental values. The NWQMS water quality guidelines include the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) and the Australian Drinking Water Guidelines (NHMRC 2011).

The ANZECC (2000) guidelines (refer to Section 2.2.2), are one of the key guideline documents for determining water quality objectives and site-specific trigger values to assess impacts to water quality for the project.

2.2.2 Australian and New Zealand Guidelines for Fresh and Marine Water Quality

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000) were prepared as part of the NWQMS. The guidelines provide a process for developing water quality objectives required to sustain current or likely future environmental values for natural and semi-natural water resources.

The ANZECC (2000) guidelines use a number of terms to refer to levels of assessment for water quality:

- **Water quality guidelines** – A water quality guideline is a numerical concentration limit or narrative statement recommended to support and maintain a designated water use or environmental value.
- **Water quality objectives** – A water quality guideline was defined above as a numerical concentration limit or descriptive statement recommended for the support and maintenance of a designated water use or environmental value. Water quality objectives take this a step further. They are the specific water quality targets agreed between stakeholders, or set by local jurisdictions, that become the indicators of management performance. For this project these objectives were defined by the NSW Water Quality and River Flow Objectives (DECCW, 2006) described in Section 3.4.2.
- **Guideline trigger values** – The ANZECC (2000) guidelines adopt a risk-based approach that is intended to improve the application of guidelines to all Australian and New Zealand aquatic environments. It uses decision frameworks that help users tailor water quality guidelines to local environmental conditions. As such, the old 'single number' triggers (see ANZECC 1992) are regarded as guideline trigger values that can be modified into regional, local or site-specific guidelines.

  Guideline trigger values are concentrations that, if exceeded, would indicate a potential environmental problem, and so 'trigger' a management response.

The ANZECC (2000) guidelines acknowledge that different levels of protection may be appropriate for different water bodies. For aquatic ecosystems, the ANZECC (2000) guidelines provide more detailed guidance on the level of protection to be achieved by the selected water quality guidelines. For aquatic ecosystems, three categories of ecosystem condition are identified:

- high conservation or ecological value systems
- slightly to moderately disturbed systems
- highly disturbed systems.

It should be noted that in 2018, the ANZECC (2000) guidelines were revised to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018). As at May 2019, the default guideline values for various toxicants in ANZG 2018 are the same as the ANZECC (2000) guidelines. For this reason, and because the SEARs refer to the ANZECC (2000) guidelines, this study has adopted the ANZECC (2000) guidelines and analysis methodologies.

The environmental values and water quality guidelines, objectives or guideline trigger values adopted for the project are discussed further in Section 3.4.

2.2.3 PFAS National Environmental Management Plan

The PFAS National Environmental Management Plan (NEMP) (Heads of Environmental Protection Authorities Australia and New Zealand, 2018) provides governments with a consistent, practical, risk-based framework for the environmental regulation of per- and poly-fluoralkylated substances (PFAS) contaminated materials and sites. The PFAS NEMP has been developed as an adaptive plan, able to respond to emerging research and knowledge.

PFAS have been used in applications such as fire-fighting foams, textile treatments for upholstery and clothing, paper products and electroplating. Some PFAS have been globally identified as chemicals of high concern to human health and the environment, particularly due to their persistence and bioaccumulation.

These chemicals have been used for decades and PFAS are found widely in the land and water environments around the world. People are exposed to small amounts of PFOS or PFOA in everyday life through exposure to dust, indoor and outdoor air, food, water and contact with consumer products that contain these chemicals. Food is thought to be the most important source of exposure.

The Heads of EPA of Australia and New Zealand (HEPA) PFAS National Environmental Management Plan 2018 (PFAS NEMP) provides governments with a consistent, practical, risk-based framework for the environmental regulation of PFAS contaminated materials and sites. The PFAS NEMP has been developed as an adaptive plan, able to respond to emerging research and knowledge.

The PFAS NEMP is a reference on the state of knowledge related to the environmental regulation of PFAS. It represents a how-to guide for the investigation and management of PFAS contamination and waste management, including recommended approaches, which will be called upon to inform actions by environmental protection authorities and other regulators.

With respect to assessing site investigation results, health and ecological criteria suitable for generic land uses have been provided in Table 1 to Table 5 of the PFAS NEMP. The criteria for a commercial/industrial land use have been considered for the project. Refer to Section 3.4 for further information about the target water quality values for PFAS for the project.

In NSW, the EPA is leading an investigation program to assess the legacy of PFAS. The EPA is currently investigating PFAS contamination at a number of sites including the Botany Bay area. Specific investigations include the Botany Bay Industrial Park, and Sydney Airport. Investigations at Sydney Airport (near the project site) are currently being managed under the PFAS National Environmental Management Plan, with investigations being undertaken by Airservices Australia.

2.3 State legislation and guidelines

2.3.1 *Environmental Planning and Assessment Act 1979*

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) provides a framework for environmental planning and assessment in NSW. The project is State Significant Infrastructure in accordance with Division 5.2 of the EP&A Act, by operation of *State Environmental Planning Policy (State and Regional Development) 2011 and State Environmental Planning Policy (Infrastructure) 2007*. As State Significant Infrastructure, the project requires the preparation of an environmental assessment and approval from the NSW Minister of Planning and Public Spaces (or their delegate) under Part 5 of the EP&A Act. In accordance with section 5.16 of the EP&A Act, the NSW Planning Secretary must provide environmental assessment requirements to guide the preparation of an environmental assessment (Environmental Impact Statement) for the project.

In accordance with section 5.16 of the EP&A Act, the Secretary's Environmental Assessment Requirement's (SEARs) were issued for the project on 21 December 2018. The SEARs required that the project consider potential impacts to water quality of the local catchments and waterways associated with construction and operation of the project. The SEARs relevant to this assessment are discussed further in Section 2.5.

2.3.2 *Water Management Act 2000*

The NSW *Water Management Act 2000* (WM Act) recognises the need to allocate and provide water for the environmental health of our rivers and groundwater systems, while also providing licence holders with access to water. The main tool the WM Act provides for managing the state's water resources are water sharing plans. The WM Act focuses on protecting, enhancing and restoring water resources and encouraging best practice management and use of water.

In addition, controlled activities carried out in, on or under water front land are regulated by the WM Act, in accordance with the *Guidelines for controlled activities on waterfront land (NSW DPI, 2018).* Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary. In accordance with section 5.23 (1)(g) of the EP&A Act, water use approvals, water management work approval and activity approvals under the WM Act are not required for State significant infrastructure.

Notwithstanding, the intent and objectives of the WM Act have been considered as part of this assessment.

2.3.3 NSW Water Quality and River Flow Objectives

For each catchment in NSW, the NSW Government has endorsed the community's environmental values for water, and identified water quality objectives. These were adopted following extensive consultation with the community in 1998. The NSW Water Quality and River Flow Objectives (DECCW, 2006) are the agreed environmental values and long-term goals for NSW's surface waters and are consistent with the national framework in the ANZECC (2000) guidelines. They set out:

- the community's values and uses for NSW rivers, creeks, estuaries and lakes (i.e. healthy aquatic life, water suitable for recreational activities like swimming and boating, and drinking water)
- a range of water quality indicators to help assess whether the current condition of waterways supports those values and uses.

The catchments affected by the project are Cooks River and Botany Bay (included as sub catchment of Georges River by DECCW). The NSW Water Quality and River Flow Objectives (DECCW, 2006) provide the environmental values and associated water quality objectives for these catchments. These values and objectives are discussed in Section 3.4.

2.3.4 Managing Urban Stormwater – Soils and Construction

The Managing Urban Stormwater – Soils and Construction (Landcom, 2004) series of handbooks are an element of the NSW Government's urban stormwater program specifically applicable to the construction phase of developments. These provide guidance for managing uncontaminated soils in a manner that protects the health, ecology and amenity of urban streams, rivers estuaries and beaches through better management of stormwater quality.

The handbooks were produced to provide guidelines, principles and recommended minimum design standards for good management practice in erosion and sediment control during the construction of roads. Of particular relevance to the project are Volume 1, 4th Edition (Landcom, 2004) and Volume 2D, Main Road Construction (DECC, 2008) (collectively referred to as 'the Blue Book' in this report). The construction mitigation measures proposed in this report are largely based on the guidelines provided in the Blue Book.

For contaminated soils or acid sulfate soils, while the management principles are still relevant, additional site specific management measures, monitoring and treatments, which are not covered in the Blue Book, will be required. An overview is discussed in Section 6. A detailed discussion is in *Technical Report 5 – Contamination Assessment*.

2.4 Local guidelines

2.4.1 Botany Bay and Catchment Water Quality Improvement Plan 2011

The Sydney Metropolitan Catchment Management Authority (SMCMA) has developed the Botany Bay and Catchment Water Quality Improvement Plan. The main objective of the plan was to set targets for pollutant load reductions, of total nitrogen, total phosphorus and suspended sediment, required to protect the condition of Botany Bay, its estuaries and waterways. The targets for large developments are based on those defined for the Growth Centres Commission by DECC (2007) and are recommended as the targets that should be implemented in the Botany Bay catchment.

The target pollutant load reduction can be found in Table 2.1. Achieving these pollutant reduction targets is expected to lead to cleaner waterways and healthier environments in the catchment, and will increase the community's ability to use Botany Bay, and its estuaries and rivers (SMCMA, 2011).

As surface water flow from the project site enters Mill Stream (before entering Botany Bay) these pollution targets would apply to the project. Therefore, where there is potential for the project to increase pollutant loads, water quality treatment devices should be implemented to achieve the pollutant reduction targets in Table 2.1.

Table 2.1 Pollutant reduction targets for Botany Bay catchment (SMCMA, 2011)

Stormwater pollutant	Greenfield/large developments
Gross pollutants	90%
Total suspended solids	85%
Total phosphorus	60%
Total nitrogen	45%

2.5 Secretary's environmental assessment requirements

The SEARs and agency recommendations relevant to surface water quality, together with a reference to where they are addressed in this report, are outlined in Table 2.2.

Table 2.2 SEARs relevant to this assessment

SEAR Requirement	Where addressed in report/EIS
7. Water – Hydrology Long term impacts on surface water and groundwater hydrology (including drawdown, flow rates and volumes) are minimised. The environmental values of nearby, connected and affected water sources, groundwater dependent ecological systems including estuarine and marine water (if applicable) are maintained (where values are achieved) or improved and maintained (where values are not achieved). Sustainable use of water resources	
1. The Proponent must describe (and map) the existing hydrological regime for any surface and groundwater resource (including reliance by users and for ecological purposes) likely to be impacted by the project, including stream orders.	Section 4.1 of this report describes the catchments and current drainage systems within the study area. Figures 3.1 and 3.3 in this report contain maps that show the extent of each catchment and receiving environments from the project. Refer to *Technical Report 6 – Flooding Impact Assessment* for flooding patterns near the project. Refer to *Technical Report 7 – Groundwater Impact Assessment* for further details on the existing groundwater regime.

SEAR Requirement	Where addressed in report/EIS
2. The Proponent must assess (and model if appropriate) the impact of the construction and operation of the project and any ancillary facilities (both built elements and discharges) on surface and groundwater hydrology in accordance with the current guidelines, including:	
a) natural processes within rivers, wetlands, estuaries, marine waters, and floodplains, that affect the health of the fluvial, riparian, estuarine or marine system and landscape health (such as modified discharge volumes, durations and velocities), aquatic connectivity and access to habitat for spawning and refuge.	Sections 5.1 and 5.2 of this report describe the impacts of construction and operation of the project on surface water attributes. *Note, it is proposed that the project would not result in any construction water discharges to local receiving waterways.* Refer to *Technical Report 4 – Biodiversity Development Assessment Report* for impacts of the project on aquatic fauna and habitats. Refer to *Technical Report 6 – Flooding Impact Assessment* for an assessment of the impact the project would have on flooding patterns, including changes in flow velocities and the duration of inundation during a flood event. Refer to *Technical Report 7 – Groundwater Impact Assessment* for an assessment of existing hydrological conditions near the project site.
b) impacts from any permanent and temporary interruption of groundwater flow, including the extent of drawdown, barriers to flows, implications for groundwater dependent surface flows, ecosystems and species, groundwater users and the potential for settlement;	Not addressed in this report. Refer to *Technical Report 4 – Biodiversity Development Assessment Report* for impacts of the project on groundwater dependent ecosystems. Refer to *Technical Report 7 – Groundwater Impact Assessment* for an assessment of the impacts of the project on the existing groundwater regime.
c) minimising the effects of proposed stormwater and wastewater management during construction and operation on natural hydrological attributes (such as volumes, flow rates, management methods and re-use options) and on the conveyance capacity of existing stormwater systems where discharges are proposed through such systems; and	Section 6.2 of this report provides mitigation measures to reduce the construction and operational impacts to surface water attributes. *Note, it is proposed that the project would not result in any construction water discharges to local receiving waterways.* Refer to *Technical Report 6 – Flooding Impact Assessment* for an assessment of the potential impact that the construction of the project would have on flow velocities during a flood event; and impacts that the operation of the project would have on flow velocities, as well as duration of inundation during a flood event.
d) water take (direct or passive) from all surface and groundwater sources with estimates of annual volumes during construction and operation.	Sections 5.1 and 5.2 of this report describe water take from all surface water sources during project construction and operation. Refer to *Technical Report 7 – Groundwater Impact Assessment* for an assessment of water take from groundwater sources.
3. The Proponent must identify any requirements for baseline monitoring of hydrological attributes.	Section 6.2.3 of this report identifies that baseline monitoring of hydrological attributes is not required. Refer to *Technical Report 7 – Groundwater Impact Assessment* for a proposed baseline groundwater monitoring program for the project.

SEAR Requirement	Where addressed in report/EIS
4. The assessment must include details of proposed surface and groundwater monitoring.	Section 6.2.3 of this report provides a proposed surface water monitoring program for the project. Refer to *Technical Report 7 – Groundwater Impact Assessment* for a proposed groundwater monitoring program for the project.
8. Water – Quality The project is designed, constructed and operated to protect the NSW water quality objectives where they are currently being achieved, and contribute towards achievement of the water quality objectives over time where they are currently not being achieved, including downstream of the project to the extent of the project impact including estuarine and marine waters (if applicable)	
1. The Proponent must	
a) describe the background conditions for any surface and groundwater resources likely to be affected by the proposal;	Section 4 of this report describes the existing environment and catchments, including any sensitive receptors likely to be affected by the project. Refer to *Technical Report 7 – Groundwater Impact Assessment* for a summary of exiting groundwater conditions.
b) state the ambient NSW Water Quality Objectives (NSW WQO) and environmental values for the receiving waters relevant to the project, including the indicators and associated trigger values or criteria for the identified environmental values	Section 3.4 of this report describes the assessment criteria that is used to identify water quality objectives and set project trigger values. Refer to *Technical Report 7 – Groundwater Impact Assessment for a* summary relevant water quality objectives and guidelines relevant to the project.
c) identify and estimate the quality and quantity of all pollutants that may be introduced into the water cycle by source and discharge point and describe the nature and degree of impact that any discharge(s) may have on the receiving environment, including consideration of all pollutants that pose a risk of nontrivial harm to human health and the environment;	Sections 5.1 and 5.2 of this report describes the potential pollutants. *Note, it is proposed that the project would not result in any construction water discharges to local receiving waterways.* Refer to *Technical Report 7 – Groundwater Impact Assessment*
d) identify the rainfall event that the water quality protection measures will be designed to cope with;	Section 6.1.1 of this report identifies the construction water quality protection measures designed as per Blue Book guidelines.
e) assess the significance of any identified impacts including consideration of the relevant ambient water quality outcomes;	Sections 5.1 and 5.2 describes the impacts of construction and operation of the project and assesses the significance of these impacts.
f) demonstrate how construction and operation of the project will, to the extent that the project can influence, ensure that;	
– where the NSW WQOs for receiving, waters are currently being met they will continue to be protected; and	Section 4.7.2 of this report includes a summary baseline of water quality data highlighting water quality trigger values exceedances in local receiving environments. Section 6.2.1 and Section 6.2.2 describes the residual water quality impacts from the project with mitigation during construction and operation of the project. Section 6.2 describes mitigation measures to ensure that where water quality objectives are currently being met they will continue to do so.

SEAR Requirement	Where addressed in report/EIS
– where the NSW WQOs are not currently being met, activities will work toward their achievement over time;	Section 4.7.2 of this report includes a summary baseline water quality data highlighting water quality objective exceedances in local receiving environments. Section 6.2.1 and Section 6.2.2 describes the residual water quality impacts from the project with mitigation during construction and operation of the project. Describing the projects limited influence to improve water quality.
– justify, if required, why the WQOs cannot be maintained or achieved over time;	Section 6.2 of this report describes the residual impacts to ambient water quality, highlighting where water quality objectives are not currently being met and why they cannot be achieved over time. Section 6.2.1 and Section 6.2.2 describes the residual water quality impacts from the project with mitigation during construction and operation of the project. Describing the projects limited influence to improve water quality.
– demonstrate that all practical measures to avoid or minimise water pollution and protect human health and the environment from harm are investigated and implemented;	Section 6.2 of this report describes recommended mitigation measures to avoid or minimise water pollution. Refer to *Technical Report 13 – Health Impact Assessment* for a qualitative assessment of health impacts of the project including consideration of contaminated water.
– identify sensitive receiving environments (which may include estuarine and marine waters downstream) and develop a strategy to avoid or minimise impacts on these environments; and	Section 4.6 identify sensitive receiving environments and Section 6.2 of this report recommends appropriate mitigation measures to minimise the impact.
– identify proposed monitoring locations, monitoring frequency and indicators of surface and groundwater quality.	Section 6.2.3 of this report identifies monitoring locations and frequency for surface water quality. Refer to *Technical Report 7 – Groundwater Impact Assessment* for a proposed groundwater monitoring program for the project.
2. The assessment should consider the results of any current water quality studies, as available, for the catchment areas traversed by the proposal	Section 4.7 reviews current and historic water quality studies in the surrounding waterways. Refer to *Technical Report 7 – Groundwater Impact Assessment* for an assessment of relevant groundwater data from previous studies.

3. Methodology

It is important to protect waterways from pollutants (such as dirt or chemicals) that have the potential to enter local waterways as a result of the project.

As poor water quality has a negative impact on the health of our ecosystems, recreational activities and other activities, a national framework (ANZECC 2000) has been set up to guide water quality management. This framework identifies different uses and activities for waterways (e.g. drinking, swimming, crop use) and appropriate water quality values for those uses and activities. It enables water management to be tailored to different waterway environmental conditions and different water uses, so that different waterways and catchments can be protected. Application of the ANZECC framework is used to identify catchment- and waterway-specific water quality management goals for different potential pollutants (trigger values).

To guide water quality management decisions, and to identify when an impact has occurred, the ANZECC framework also identifies methods for measuring and monitoring water quality. These are standard methods adopted across Australia.

For the project, the assessment methodology followed the ANZECC framework and used standard methods for impact assessment including:

- review of existing data on the project site and its catchment to provide an understanding of existing environmental conditions, sensitive areas and constraints
- identification of activities that could result in water quality impacts during construction and operation
- identification of mitigation and management measures that would assist in achieving, or moving towards achieving, the desired water criteria
- recommending an appropriate water quality monitoring strategy.

To identify specific environmental values for waterways in and near the project site, a review of existing environmental conditions, water quality data and current users of the waterways was undertaken. This information was used to identify appropriate criteria (trigger values) for water quality impact upstream and downstream of the project site during operation and construction.

The purpose of this process is to understand the environment, inform project design, inform selection of suitable construction methods and ensure the project operates in a way that will protect the existing water quality environment.

This section describes:

- the study area
- the review of existing information
- the development of assessment criteria
- methods used to assess potential construction phase and operation phase impacts to water quality.

3.1 Study area

The project site identified in this report refers to the area directly disturbed by the construction and operation of the project and includes both temporary and permanent structures and infrastructure.

Water quality impacts have been assessed at two locations which currently receive surface water runoff from the project site:

- Mill Stream
- Alexandra Canal.

Surface water from the southern kilometres of the project site flows to Mill Stream via existing stormwater outlets and drainage networks and overland flow. Surface water from the northern 1.4 kilometres of the project site flows to Alexandra Canal via the Upper Mascot Open Channel and the existing Sydney Airport stormwater drainage network to Northern Pond before flowing to Alexandra Canal.

The project area and key receiving waterways are shown on Figure 3.1.

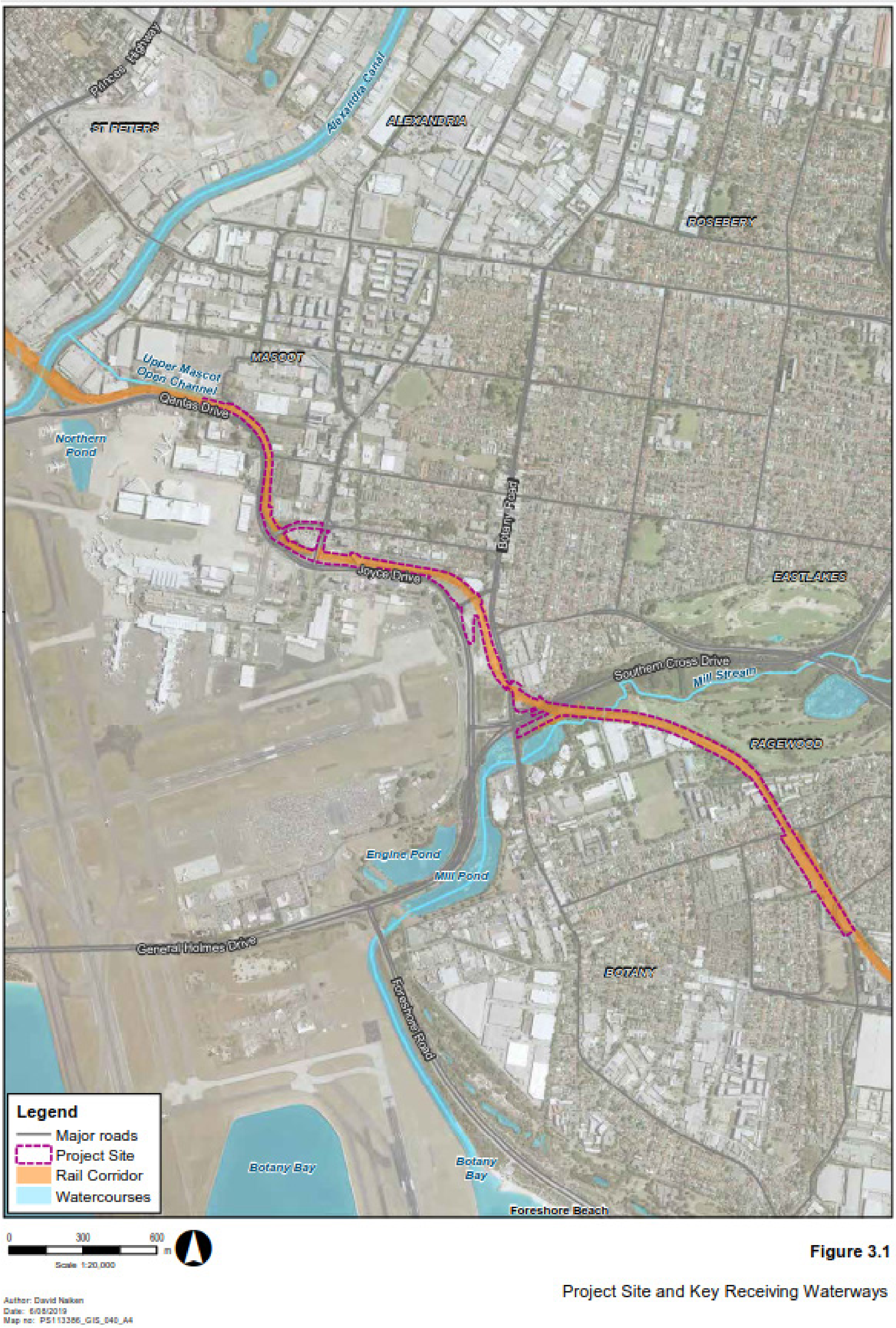


Figure 3.1

Project Site and Key Receiving Waterways

3.2 Review of existing information

Table 3.1 provides a summary of the key documents reviewed to inform an understanding of the existing surface water environment of the project. This included identification of environmental values, water quality objectives and development of site specific water quality objectives where required.

Specific information considered in the assessment included:

- ANZECC (2000) guidelines
- reference design drawings
- previous studies prepared for the alignment and surrounding/connecting projects
- existing hydrology/flooding, surface water quality, and groundwater monitoring data.

Table 3.1 Key data sources

Report reference	Report description	Project data collated
Online rainfall database (Bureau of Meteorology, accessed July 2018).	Database of water, climate, and environmental data.	Historical rainfall data.
WestConnex New M5 – Surface Water Technical Working Paper for EIS (AECOM, 2015).	Surface water assessment for the New M5 WestConnex project.	Surface water quality results and project impact assessment.
Sydney Gateway – Monthly Baseline Surface Water Monitoring data (December 2017- March 2019) (AECOM, 2018-2019).	Excel data of all monitoring data over the entire baseline monitoring period (December 2017 – March 2019).	Surface water monitoring data at numerous locations in Alexandra Canal, Cooks River and Mill Stream.
WestConnex New M5 project construction phase water quality data (Westconnex, 2018).	1 year (August 2016 – July 2017) of construction phase water quality monitoring data.	Water quality monitoring data.

3.2.1 Monthly baseline surface water monitoring

AECOM undertook baseline surface water monitoring at sites within the Alexandra Canal, Cooks River and Mill Stream catchments over a period of 15 months between December 2017 and March 2019. The assessment was undertaken to provide baseline surface water monitoring for the proposed Sydney Gateway project which shares common catchments with the Botany Rail Duplication project.

A total of 11 locations were sampled over 25 sampling events. The locations with most relevance to the Project include:

- SW1–SW4 which are located upstream and downstream respectively of surface water flows into Alexandra Canal from the project site.
- SW9–SW11 which are located upstream and downstream respectively of surface water flows into Mill Stream from the project site.

A total of 17 sampling events were recorded at SW1–SW6, 25 recorded at SW7, SW8, SW10 and SW11, and 13 recorded for SW9. Wet and dry events were combined to provide the average, median, 80 percentile and maximum values shown in Appendix B. Samples that were below the limit of detection were not included in the calculations of the mean, median, 80 percentiles and maximum. The contaminants were assessed against the adopted trigger values. These were determined from the environmental values and water quality objectives in the ANZECC (2000) guidelines. Details of the trigger values are discussed in Section 3.4, and can be found in Appendix A.

In accordance with ANZECC (2000) guidelines, 12 to 24 months of baseline monthly water quality data is ideal to gain a reasonable understanding of baseline conditions. Due to access restrictions, sampling at SW9 (Mill Stream) has been limited, with sampling being undertaken since August 2018.

Location descriptions are included in Table 3.2. Monitoring locations are shown on Figure 3.2.

Table 3.2 Summary and interpretation of Baseline water quality monitoring locations (AECOM, 2018)

Site reference	Water course	Type	Location description	Monitoring purpose (related to project site)
SW1	Alexandra Canal	Tidal	Alexandra Canal – Drainage line flowing from Mascot industrial area into Alexandra Canal	Downstream of industrial area inflow
SW2	Alexandra Canal	Tidal	Alexandra Canal – Upstream of Botany Rail Line Alexandra Canal crossing	Downstream of Project site surface water inflow at Upper Mascot Open Channel
SW3	Alexandra Canal	Tidal	Alexandra Canal – North Pond connection surface water body	Downstream of Project site surface water inflow at Upper Mascot Open Channel
SW4	Alexandra Canal	Tidal	Alexandra Canal – Adjacent Sydney Airport	Downstream of Project site surface water inflow at Upper Mascot Open Channel
SW5	Alexandra Canal	Tidal	Alexandra Canal – Adjacent Sydney Airport and Tempe Reserve	Adjacent Sydney Airport and Tempe Lands
SW6	Alexandra Canal	Tidal	Confluence of Cooks River and Alexandra Canal	Adjacent Sydney Airport
SW7	Cooks River	Tidal	Cooks River – Upstream of confluence of Cooks River and Alexandra Canal	No connection with Project site
SW8	Cooks River	Tidal	Cooks River – Downstream of confluence of Cooks River and Alexandra Canal.	Downstream of Project site surface water inflow at Upper Mascot Open Channel, and Sydney Airport
SW9	Mill Stream	Freshwater	Mill Stream – Adjacent to Eastlakes Golf Course, North (upstream) of Project alignment	Upstream of Project site
SW10	Mill Pond	Freshwater	Mill Pond – South (downstream) of Project Alignment	Downstream of Project site and Sydney Airport
SW11	Mill Pond	Freshwater	Mill Pond – Drainage line parallel to General Holmes Drive flowing into Mill Pond at Southern Cross Drive	Downstream of Project site and Sydney Airport

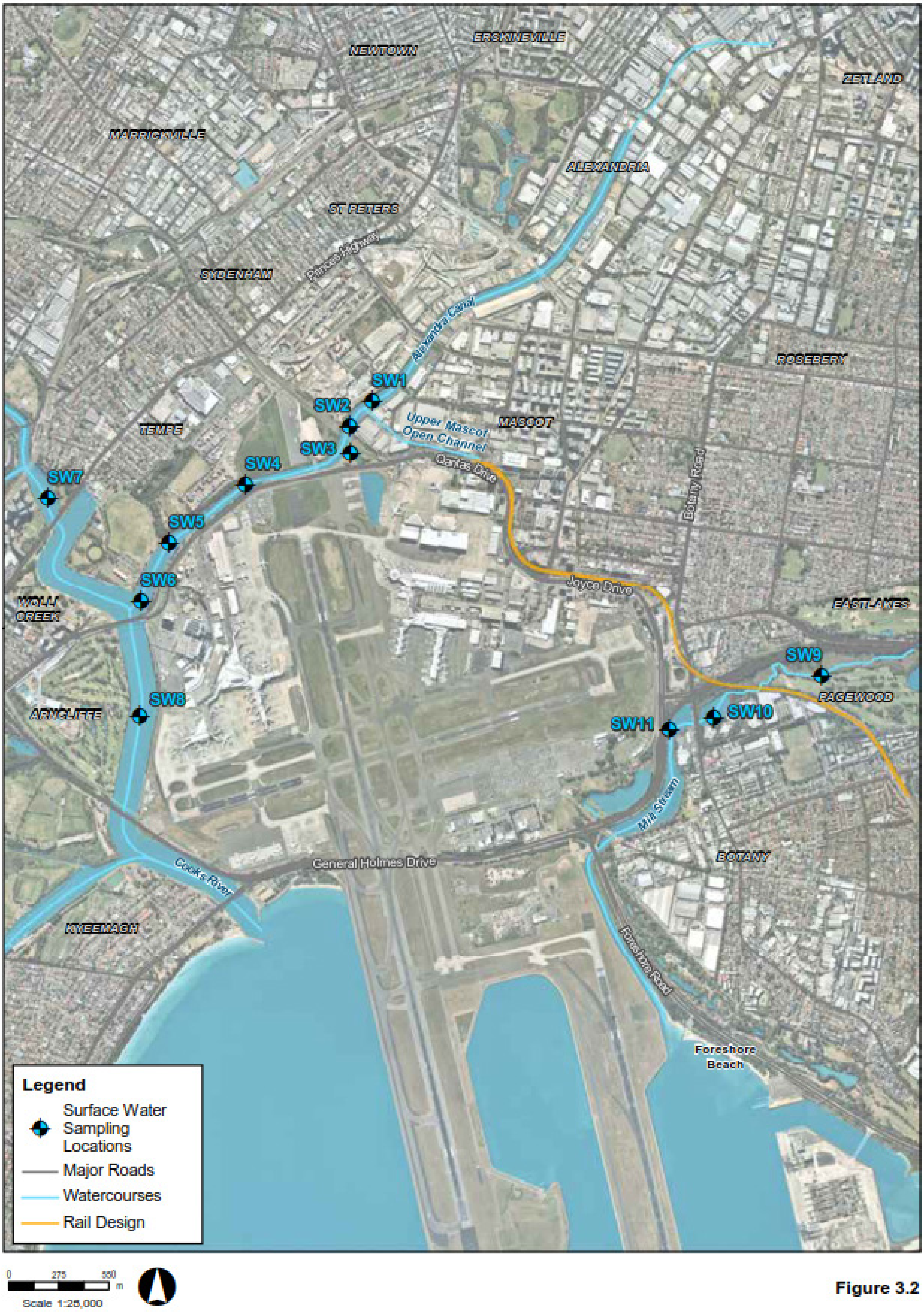


Figure 3.2

Surface Water Monitoring Locations (AECOM 2018-2019)

Author: David Naiken
Date: 1/07/2019
Map no: PS113386_GIS_061_A1

3.3 Assessment of impacts and mitigation effectiveness

The construction phase impact assessment focuses on potential water quality impacts based on the preliminary construction approach outlined in Chapter 7 of the Environmental Impact Statement (EIS). Generic best management practice mitigation measures are then proposed in accordance with the identified potential impacts.

The construction phase impact assessment for this project addresses the following elements:

- Identification of potential water quality impacts during construction, including construction activities that could mobilise sediments into the surface water environment. Controls will be guided by the Blue Book requirements. Further details on this approach are provided in Section 6.1.
- Sydney Airport is known to be impacted by PFAS and other contaminants associated with the historic industrial uses and activities. Overarching construction related impacts associated with the disturbance of contaminated soil, sediment and groundwater are discussed in this report. A detailed review is addressed in the Botany Rail Duplication EIS, *Technical Report 5 – Contamination Assessment*.

The operation phase assessment is qualitative. The operation phase impact assessment for this project addresses the following elements:

- bridge design of the new bridge over Mill Stream
- changes in surface water drainage from the project
- operational activities along the rail corridor.

A qualitative cumulative impact assessment was undertaken, taking into account the project and other major projects in the vicinity of the project site. These impacts are discussed in Section 5.3. Based on these assessments, this report provides recommendations for mitigations measures to be implemented during construction and operation to minimise and manage potential impacts to waterways. These are detailed in Section 6.

3.4 Assessment criteria

3.4.1 Overview

One of the key steps for the project was to identify appropriate water quality assessment criteria. By applying the legislative and policy frameworks described in Section 2, the assessment criteria were developed based on the following guidelines and objectives:

- ANZECC 2000 guidelines national framework for assessing water quality
- NSW Water Quality and River Flow Objectives (DECCW, 2006) for catchments affected by this project (i.e. Botany Bay (Georges River) and Cooks River catchments).

The NSW Water Quality and River Flow Objectives (DECCW, 2006) provide environmental values and associated water quality objectives. ANZECC guidelines and the Airports (Environment Protection) Regulations recommend trigger values for these environmental values. As explained in Section 2.2.2, guideline trigger values are the criteria used for concentrations that, if exceeded, would indicate a potential environmental problem, and so 'trigger' a management response.

There are different trigger values for different environmental values, for example the environmental value of contact recreation has a different pH range trigger value compared to aquatic ecosystems environmental value and corresponding trigger value range because human skin can tolerate a larger pH range than aquatic ecosystems. For this project, where there were multiple environmental values and resulting trigger values, the most stringent trigger value was adopted. These trigger values relate to ambient water conditions, and are appropriate for the assessment of the existing water quality in watercourses close to the project. Contaminants that have trigger values are shown in Appendix A.

Slightly modified trigger values apply for ambient (baseflow) conditions in downstream waterways during construction and operation are described in Section 6.2.3 in the context of ongoing monitoring and investigation. The proposed trigger values for ongoing monitoring are also detailed in Appendix C.

3.4.2 Environmental values

The water quality objectives of a catchment depend on the environmental values within the catchment.

Surface water from the northern 1.4 kilometres of the project site flows to Alexandra Canal (part of the Cooks River catchment) via existing drainage network and the Upper Mascot Open Channel. Surface water from the southern 1.6 kilometres of the project site flows to Mill Stream (part of the Botany Bay catchment, a sub catchment of Georges River) directly via overland flow or through existing drainage networks (Figure 3.3).

Specific values for different catchment types are defined by the NSW Water Quality and River Flow Objectives (DECCW, 2006). Figure 3.3 indicates that the waterways that receive surface water flow from the project are within an estuary type catchment zone. The specific environmental values for this zone are discussed in the following sections.

Cooks River catchment

Surface water flow from the project site will enter Alexandra Canal, a sub catchment of the Cooks River catchment. The following environmental values are defined by NSW Water Quality and River Flow Objectives for the Cooks River estuaries waterways:

- aquatic ecosystems
- visual amenity
- secondary contact recreation
- primary contact recreation
- aquatic food.

The Cooks River is popular for fishing and boating. Currently no fishing is permitted in Alexandra Canal, and only rod and line fishing is permitted in the Cooks River. While the consumption of fish or shellfish caught in the Cooks River is not recommended, the ‘aquatic food’ environmental value is identified because the water quality objective of the catchment is to return the water to this quality in the future. For the same reason, the ‘primary contact recreation’ value is also included, although swimming is not currently recommended.

Alexandra Canal is highly contaminated and currently subject to a remediation order under the *NSW Contaminated Land Management Act* 1997. Historical heavy industrial land uses with the catchment (as discussed in section 4.1.2) has resulted in high levels of contaminants within the bed sediments of the canal. Analysis of the water quality monitoring data (refer to Section 4.7) shows that the aquatic ecosystems in the Alexandra Canal are currently ‘highly disturbed’. Although the goal is to bring these ecosystems back to a less disturbed condition, given the contaminated status of the waterway, the water quality objectives provided in Appendix A are based on the ANZECC (2000) guideline water quality objective for the protection of 80 per cent of species in marine water ecosystems.

Georges River catchment

Surface water flow from the project site will enter Mill Stream which is part of the Georges River catchment. This location is defined within estuary waterways by NSW Water Quality and River Flow Objectives (Figure 3.3). For this reason, the environmental values for estuaries in the Georges River catchment were adopted for these waterways. These are:

- aquatic ecosystems
- visual amenity
- secondary contact recreation
- primary contact recreation
- aquatic food.

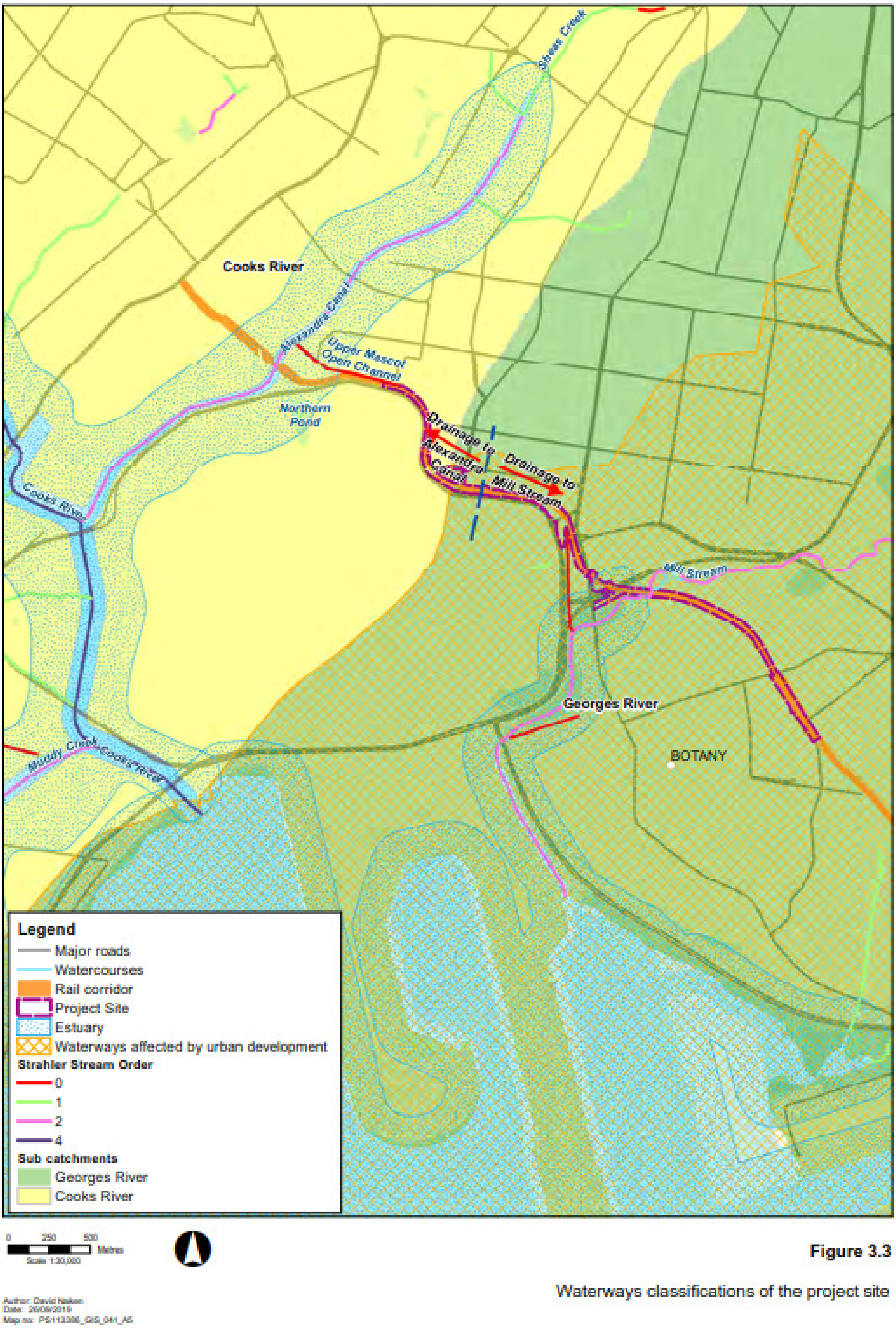


Figure 3.3

Waterways classifications of the project site

For aquatic ecosystems in the Georges River catchment, the assessment adopted water quality objectives for protection of 95 per cent of species in marine water aquatic ecosystems in slightly to moderately disturbed estuary aquatic ecosystems in south-eastern Australia. This is in line with the practice commonly adopted in NSW, as detailed in the using the ANZECC guidelines and Water Quality Objectives in NSW (Department of Environment and Conservation NSW, 2006).

Flow from the project to Mill Stream is upstream of Commonwealth land and Sydney Airport land, therefore the water quality conditions in Mill Stream were assessed using two sets of trigger values:

- limits of accepted contamination specified in Schedule 2 of the Airport (Environmental Protection) Regulations 1997
- ANZECC (2000) guidelines.

These two sets of trigger values contain different pollutant indicators. For those indicators that are common to both, the ANZECC (2000) guidelines trigger values are usually higher for nutrients and lower for toxicants. For some indicators, such as pH, the ANZECC (2000) guidelines provide an absolute range of values while the Airport (Environmental Protection) Regulations 1997 provide a maximum percentage deviation from existing values.

As project works surrounding Mill Stream are upstream of Commonwealth Land, the Airport (Environmental Protection) Regulations 1997 guidelines are appropriate for assessment. However, because Mill Stream flows to NSW waterways (Botany Bay), ANZECC (2000) assessment is useful to understand the impact on NSW waterways. The adopted approach to assess the state of the waterway is to review Mill Stream water quality data against both guidelines. The Airport (Environmental Protection) Regulations 1997 are included in Appendix A to be considered.

3.4.3 Water quality trigger values

Water quality trigger values are the criteria used to identify if there is a potential environmental problem in the waterway. If the water quality concentration is outside the allowable range or value, there is potential risk to an identified environmental value.

Water quality trigger values are applied in three ways:

1. to compare against baseline monitoring data and establish the state of the waterway conditions against the long-term goals. Secondly to determine if site specific values are required for monitoring during construction and operation. The determination of these trigger values is outlined in Section 3.4.4
2. to monitor impact of construction and operation of the project to Mill Stream, trigger values were developed from the findings above (1) and are described in Section 6.2.3. The proposed trigger values for construction and operation monitoring are detailed in Appendix C
3. to monitor point discharge impact to receiving surface waters during construction. Construction discharge is currently not anticipated, but in the event that is required through the construction process, trigger values for this purpose were developed from the findings in (1) and are shown in Appendix C.

3.4.4 Determination of trigger values for existing conditions assessment

There are two types of contaminants classified in ANZECC (2000) for aquatic ecosystem assessments. The method for defining the trigger values is different for each.

- Physical and chemical stressors (section 3.3 of ANZECC (2000)):
  - naturally occurring physical and chemical stressors (e.g. nutrients and pH) can cause serious degradation of aquatic ecosystems when ambient values are too high or too low
  - the trigger values for physical and chemical stressors are based on ANZECC guideline values.

- Toxicants (section 3.4 of ANZECC (2000)):
  - chemical contaminants that have the potential to exert toxic effects at concentrations that might be encountered in the environment
  - the trigger values for toxicants depend on the level of protection required. As discussed in Section 3.4.2, an 80 per cent protection level for species in aquatic ecosystems is proposed for Alexandra Canal. A higher 95 per cent protection level is proposed for species in aquatic ecosystems in Mill Stream
  - for bio accumulative toxicants, based on the precautionary principle, a more stringent 99 per cent level is proposed. Bio accumulative toxicants include PFAS, PCBs, some pesticides, lead, cadmium, mercury, dioxins, furans, benzo(a)pyrene, hexachlorobenzene and chlorobenzenes.

PFAS is not in the list of toxicants in ANZECC (2000). The PFAS NEMP (Heads of Environmental Protection Authorities Australia and New Zealand, 2018), discussed in Section 2.2.3 has been used to provide trigger values for PFAS.

The recommended trigger values for physical and chemical stressors and toxicants for each of the environmental values are provided in Appendix A. These trigger values are recommended for the evaluation of ambient water quality conditions in the existing water environment.

4. Existing environment

This section provides insight into the existing catchments, waterways, rainfall, soil and groundwater conditions of the study area.

4.1 Catchment and waterway overview

Surface water from the northern 1.4 kilometres of the project site flows in a north westerly direction to Alexandra Canal via the existing drainage network and the Upper Mascot Open Channel (refer to Figure 3.3). Alexandra Canal is located within the lower reaches of the Cooks River catchment, which covers an area of approximately 10,000 hectares.

Surface water from the southern 1.6 kilometres of the project site flows to Mill Stream (refer to Figure 3.3), directly via overland flow or through existing drainage networks. The Mill stream catchment is a sub catchment of the Botany Bay catchment which covers an area of about 1,165 square kilometres and contains several other sub catchments.

A description of the catchments and waterways near and in the project site is provided in Section 4.1.1. The location of catchments and waterways is shown on Figure 3.3.

4.1.1 Cooks River catchment

The Cooks River catchment covers an area of around 10,000 hectares in south-eastern Sydney. The Cooks River is 23 square kilometres and flows in a generally easterly direction to Botany Bay at Mascot. The major tributaries are Wolli Creek, Bardwell Creek, Muddy Creek, Alexandra Canal, Sheas Creek, Cup and Saucer Creek, Cox's Creek and Freshwater Creek.

The catchment is home to almost 400,000 people, with 130,000 dwellings and around 20,000 commercial and industrial premises. The catchment is highly urbanised and has a history of intensive land use ranging from residential to heavy industry. The catchment has very little remaining bushland, and a small amount of parkland (SMCMA, 2011*)*.

The Cooks River is one of the most urbanised and degraded river systems in Australia, with stormwater identified as a key contributor to water quality and quantity problems. Present levels of pollutants make it unsafe for swimming, unsuitable for many aquatic species and a health risk for commercial and recreational fishing.

Within the catchment, it is estimated that roughly 89 per cent of stormwater travels through a combination of pit and pipe networks, open concrete channels, metal sheet piled channels and rock armoured channels. Around 71 per cent of the stream reaches in the Cooks River catchment have no vegetation or are used for flood control (SMCMA, 2011*)*.

Several authorities are responsible for the management of the Cooks River and its catchment, including the local councils located within the Cooks River catchment, the Local Land Services Board, the NSW Environment Protection Authority and Sydney Water.

The Cooks River Alliance is a partnership of four local councils formed to help achieve sustainable urban water outcomes in the Cooks River. The Alliance publishes an ecological and waterway score card for the Cooks River Catchment based on sampling and assessment of sites within the catchment. The Cooks River Lower Cooks Estuary and Alexandra Canal received a score of D in the 2015-2016 sampling (no values are available for 2017) (Cooks River Alliance, 2017). A score of D indicates poor ecological condition, with most indicators non-compliant with guidelines and showing significant departure from reference conditions. Additionally, waterways have degraded water quality and poor habitat, reflected by a macroinvertebrate community dominated by pollution tolerant species.

The report card for the Cooks River Lower Cooks Estuary (Cooks River Alliance, 2017) notes frequent non-compliance with guideline values for turbidity and chlorophyll-a. The highest turbidity and chlorophyll-a levels were recorded in March 2017 and the lowest in early January 2017. These results reflected the rainfall during these periods, with falls of 158 millimetres and 232 millimetres recorded in February and March respectively; a significant contrast to the 48 millimetres recorded in January. Heavy rainfall across the catchment results in an influx of sediment laden, nutrient enriched urban stormwater entering the estuary, causing elevated turbidity and excessive algal growth (Cooks River Alliance, 2017).

4.1.2 Alexandra Canal catchment

The Alexandra Canal catchment has an area of about 2,300 hectares. The canal was constructed through dredging and channelisation of a natural watercourse called Sheas Creek. It flows into the Cooks River near the north-western corner of Sydney Airport before it flows into Botany Bay to the west of Sydney Airport.

Alexandra Canal is tidally dominated through its connection to the Cooks River. It is around 3.9 kilometres long and 60 metres at its widest. The tidal influence from the Cooks River extends to the head of the canal.

The canal is owned and operated by Sydney Water, as are the major trunk drainage lines discharging into it. Numerous minor drains in the Alexandra Canal sub-catchment are managed by City of Sydney, Inner West and Bayside Councils.

Dredging and channelisation of Sheas Creek started in 1880s and was mostly complete by 1900. The size and tidal action of the creek resulted in the canal acting as a sediment trap. Major changes in the canal occurred when the airport was expanded over three phases from 1947 to 1970 (Office of Environment and Heritage, 2018).

Runoff into Alexandra Canal was very contaminated in the past from surrounding heavy industry. Contaminants entering via stormwater today come from heavy industry, urban areas and road networks.

The historic industrial land use in the catchment, extensive land reclamation and industries discharging water directly to the canal have been major contributors of pollution to the canal. Older sediments are known to be highly contaminated, and these are overlain by more recent, less contaminated sediments (UoQ, 2002). In 2004, the NSW Environment Protection Authority (EPA) issued a Remediation Order (No 23004) under the NSW *Contaminated Land Management Act 1997* with specific requirements for the sediments in the canal, citing:

“The bed sediments at the site have been found to be contaminated, in such a way as to present a significant risk to harm human health and the environment.”

Disturbing these sediments is therefore highly undesirable as they may be transported into Botany Bay. As a result, where possible, any works in the canal have been minimised to date.

The UoQ (2002) study showed that sediments entering the catchment include a variety of pollutants and toxins at sufficient levels to maintain sediment concentrations above the ANZECC (2000) guidelines levels. Consequently, any attempt to manage the sediment and pollutants in Alexandra Canal cannot succeed without a management program for the whole catchment (UoQ, 2002).

4.1.3 Mill Stream catchment

The Mill Stream catchment extends from Centennial Park in the north, to its outlet into Botany Bay in the south. According to Protecting our Waterways, the catchment covers an area of about 35.9 square kilometres (3,590 hectares). The upper reach of the catchment is located within the Randwick City Council LGA, while the lower reach is located within the Bayside Council LGA.

Engine Pond and Mill Pond are located near the downstream (south-west) end of Mill Stream catchment. Engine Pond acts as a sink for surface water from the surrounding area and is not considered a pristine environment. Mill Pond, Engine Pond and the Mill Stream are collectively known as the Sydney Airport Wetlands and are considered as environmentally significant areas in the Sydney Airport Environment Strategy 2019–2024. They are managed by Sydney Airport Corporation as part of the Botany Wetlands Environmental Management Steering Committee.

4.1.4 Drainage system through the project site

The existing rail corridor contains a number of existing stormwater drainage systems including sub surface box culverts, reinforced concrete pipes and formation level cess drains adjacent to the track to convey overland flows.

The southern portion of the rail corridor drainage (south of Roads and Maritime Service's Airport East project currently under construction) is typically overland flow from the rail corridor. Surface water within the existing rail corridor and upstream catchment flows to Mill Stream via a 1200-millimetre pipe, at (near Mill Stream bridge).

The northern portion (north of the Airport East project currently under construction) of the project site is mostly overland flow that will collate into the existing trunk drainage and flow to Alexandra Canal or Mascot Open Channel (see Figure 3.2). Approximately 500 metres of the existing project site runoff currently flows into the existing Sydney Airport drainage network, into Northern Pond before continuing to Alexandra Canal.

The land around the project site which facilitates the overland flow is typical of a highly urban environment, predominantly disturbed, compact soil with some vegetation.

4.1.5 Water supply

The project site is located in an urbanised area with access to water utility services. This means potable water is likely to be supplied from Sydney Water, and wastewater would be discharged to Sydney Water's sewage system which would not impact the surface water system.

4.2 Rainfall

The nearest climate data recording station to the project site is the Sydney Airport AMO (station number 66037). Rainfall data has been recorded since 1929. June is the wettest month with an average rainfall of 124.5 millimetres. September is the driest month with an average rainfall of 59.7 millimetres (Bureau of Meteorology, 2018). Average rainfall data is shown in Figure 4.1.

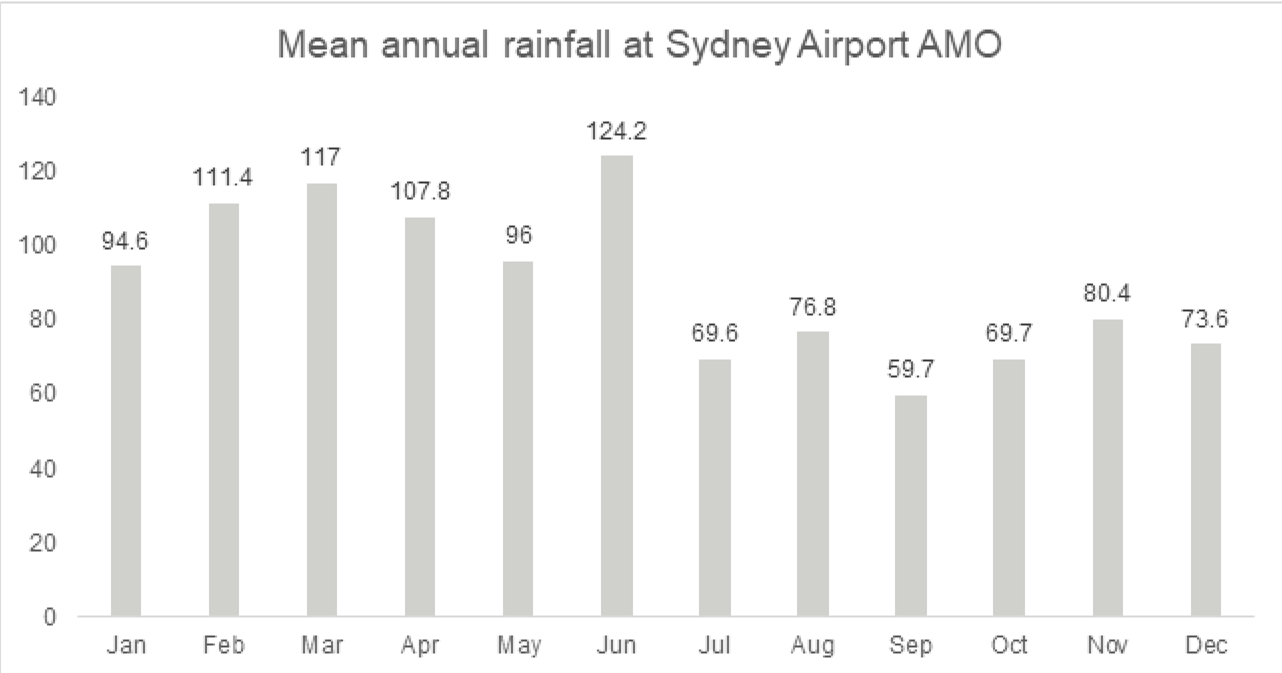


Figure 4.1 Mean annual rainfall for all years of data (BOM, 1929–2018)

4.3 Soil landscapes

According to the 1:100,000 Sydney Region Geological Map (Geological Survey of New South Wales, 1983), the regional geology consists of Triassic Hawkesbury Sandstone and Ashfield Shale overlain by Quaternary sediments (unconsolidated sands with minor peat, silts and clays and hard iron-cemented layers known as waterloo rock). The Quaternary sediments infilled drowned river valleys that were incised into Hawkesbury Sandstone bedrock. These sediments, otherwise known as the Botany Sands, are composed of predominantly unconsolidated to semi-unconsolidated permeable sands. They are interspersed with lenses and layers of peat, peaty sands, silts and clays (low permeability), which become more common at greater depths. Refer to Botany Rail Duplication EIS. *Technical Report 5 – Contamination Assessment*, for further information.

Based on the Soil Landscapes of Sydney (NSW Department for Mines, 2002) (Figure 4.2), the project is straddling along two types of soil landscapes- Aeolian to the east of the rail alignment, and Disturbed Terrain extending across Sydney Airport land to the west, along the Botany wetlands, the lower reaches of the Cooks River and up Alexandra Canal to the north.

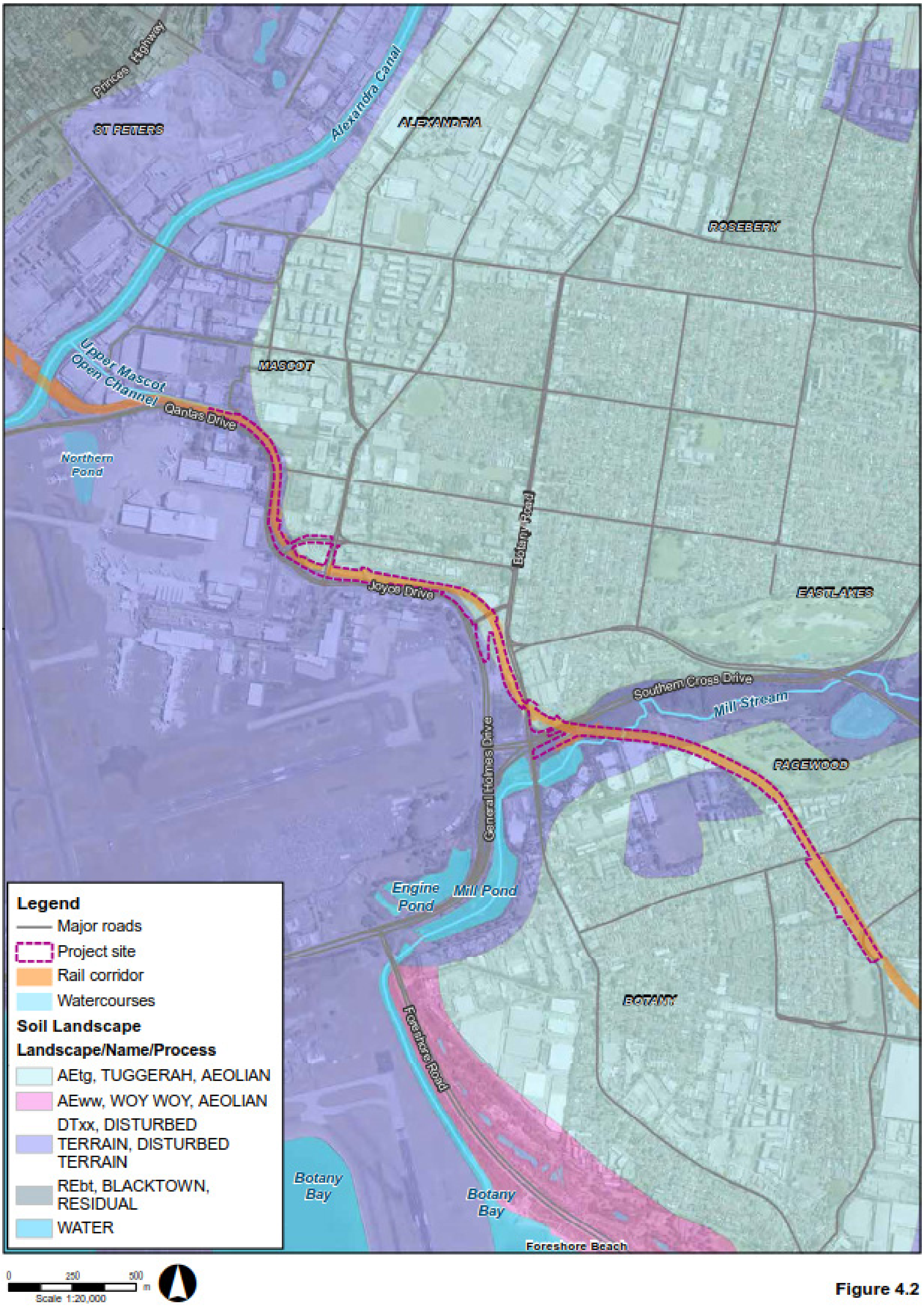


Figure 4.2

Soil classification

Author: David Naiken
Date: 6/08/2019
Map no: PS113386_GIS_042_A2

4.4 Groundwater

There are two main groundwater systems beneath the site: a deep, confined groundwater system associated with the Triassic aged, fractured/porous Hawkesbury Sandstone, and a shallow, unconfined/semi confined system within Quaternary aged marine sands referred to as the Botany Sands Aquifer (Hatley, 2004).

The Botany Sands Aquifer is considered an unconfined, highly permeable aquifer. The flow directions within this aquifer are generally controlled by topography. From the recharge areas located at higher elevations north-east of the Botany basin, groundwater flows south and south-west towards rivers and other tributaries and into Botany Bay. Based on available bore monitoring data, groundwater is about 35 metres AHD near Centennial Park, with elevations gently declining south to the Botany Bay. Flow gradients range from 0.003 to 0.01 (Hatley, 2004).

Further details on the existing groundwater environment are in the Botany Rail Duplication EIS, *Technical Report 7 – Groundwater Impact Assessment*.

4.5 Contamination

The project site and surrounding area has a history of industrial land use, resulting in widespread soil and groundwater contamination issues. An assessment of contamination issues present in the project site and surrounding area is included in the *Botany Rail Duplication EIS, Technical Paper 5 – Contamination Assessment,* and summarised below.

4.5.1 PFAS

Sydney Airport is known to contain sources of PFAS and other contaminants associated with historical and current industrial/commercial uses. Elevated concentrations identified on or near the project site include:

- groundwater in a nearby off-site monitoring well located between the rail corridor and Botany Road (Near Bronti Street) recorded elevated concentrations of PFAS
- a soil sample collected near southern cross drive. Perfluorooctanesulfonic acid (PFOS) a derivative of PFAS, was reported above the laboratory limits of reporting (LOR). Concentrations were below the relevant commercial/industrial land use criteria
- water samples collected from Mill Stream have reported PFOS concentrations above the Heads of the EPAs Australian and New Zealand (HEPA) criteria.

4.5.2 Acid sulfate soils

An area of Class 1 acid sulfate soils has been identified within the project site between Southern Cross Drive bridge and Mill Stream Bridge.

4.5.3 Asbestos

Asbestos has been identified at several locations with anthropogenic material observed within fill material in the southeast portion of the rail corridor, Identified as area of concern (AEC) 1 in the *Botany Rail Duplication EIS – Technical Report 5 – Contamination Assessment*, south of southern cross drive to the southern extent of the project site. Remediation is required in this area to mitigate the risk of exposure to identified asbestos in soil contamination for future users of the rail corridor. Subject to the implementation of appropriate remediation, the site can be made suitable for the project.

No asbestos fibres or asbestos have been identified with soils samples collected in AEC 2, which extends over the north-eastern portion of the project site, north of Southern Cross Drive. However, several Asbestos containing material (AMC) fragments were observed during site inspections on the site surface to the west of the Robey Street Bridge.

4.6 Sensitive receiving environments

There are a number of sensitive receiving environments near the project site including Mill Stream, Mill Pond, Engine Pond, Cooks River and Botany Bay (refer to Figure 3.2).

Botany Bay, which is not considered to be a pristine environment, is used for a range of beneficial purposes including recreational fishing. Recreational fishing is prohibited in the area between the Sydney Airport runways which extend into, but is not prohibited in or around Mill Stream or in the broader Botany Bay area. The NSW Department of Primary Industries (DPI) has prohibited commercial fishing in Botany Bay and Cooks River under the Fisheries Management (General) Regulation 2010).

Cooks River and Botany Bay are both identified as key fish habitats under the *Fisheries Management Act 1994.* Key fish habitats are aquatic habitats that are important for the sustainability of the recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. The Biodiversity Development Assessment Report states that Alexandra Canal does not provide habitat for any threatened fish species known from the locality.

To the east and south-east of the project is Engine Pond. Thick reeds and aquatic vegetation border the majority of the pond. Engine Pond and Mill Stream are designated as Environmentally Significant Areas under a range of registers. As mentioned in Section 4.1.3 these areas are managed by Sydney Airport Corporation as part of the Botany Wetlands Environmental Management Steering Committee and Sydney Airport Environment Strategy 2019-2024. The area around Mill Stream contains vegetation communities of state significance including the Sydney Coastal Freshwater Wetlands and areas identified as Swamp Oak Forrest.

The Botany Bay area provides summer habitat for a number of migratory wading birds that are listed under the EPBC Act, and the ponds may also be used on occasion by these species.

As outlined in the Botany Duplication EIS, *Technical Report 4 – Biodiversity Development Assessment Report*. he overall likelihood of threatened flora and fauna species that are known or predicted to occur within the locality actually being present has been assessed as low, as has the likelihood of future threatened flora recruitment. The report also identifies a number of mature fig trees located near Engine Pond West that provide foraging habitat for *Pteropus poliochepalus* (Grey-headed Flying Fox) which are commonly observed at the airport and listed as vulnerable under both the NSW *Biodiversity Conservation Act 2016* and the EPBC Act.

There is no registered surface water licence for water usage in the Georges River or Cooks River catchment (WaterNSW, 2019).

4.7 Water quality data

The following section outlines available water quality data for receiving environments within the project catchments.

4.7.1 Water quality data from WestConnex New M5 project

Water quality data was collected during construction phase monitoring for the New M5 project. A year (August 2016 – July 2017) of monthly sampling data was supplied (WestConnex, 2018) for analysis for this study.

Monitoring points SW-02, SW-06 and SW-07 for the New M5 WestConnex project were located within the project area of interest. SW02 is downstream of the Upper Mascot Open Channel, SW06 is upstream of the Alexandra Canal on the Cooks River and SW07 is downstream of the Cooks River. Sampling sites are in similar locations (respectively) to monitoring points SW2, SW7 and SW8 which formed the baseline water quality data, collected for the Sydney Gateway Project, and used to assess the baseline for the project (see Figure 3.2 for approximate locations).

Appendix D highlights the 80th percentiles for SW02, SW06 and SW07 for the year of data provided. It is evident that total nitrogen, iron, manganese, zinc and total phosphorus exceed the adopted trigger values for this project (Appendix A) at least 80 per cent of the time (refer to Appendix D for results).

Although the monitoring identified occasional observed parameters above the assigned trigger values, these were not attributed to the New M5 construction works and were determined to be most likely related to external factors (i.e. catchment variability).

4.7.2 Baseline water quality data collected for the Sydney Gateway project

Water quality data was collected for the Sydney Gateway project by AECOM at numerous locations in Alexandra Canal, Cooks River and Mill Stream (refer to Section 3.2.1). Water quality data from AECOM was provided for this study over the sampling period of December 2017 – March 2019. A summary of how the baseline water quality compared to the trigger values in Appendix A is discussed below. Summary tables of this data is provided in Appendix B.

Alexandra Canal and Cooks River

Table B.1, Table B.2 and Table B.3 in Appendix B highlight the mean, median, maximum and 80 percentile values for the key physical properties, nutrients and contaminants of concern. Sampling points SW1 to SW8 are located in Alexandra Canal and Cooks River. A summary of key observations from the water quality at these sampling points is provided below:

- total nitrogen, chloride, sulfate, total dissolved solids, aluminium, iron, manganese, zinc and ammonia mean, median, maximums and 80 percentiles exceed ANZECC (2000) guidelines for all sites, except for median filtered iron at SW8, median and total manganese at SW8, and median filtered manganese at SW6
- phosphorus exceeds ANZECC (2000) guidelines values at all sites, except for medians at SW5, SW6 and SW8
- all Total suspended solids maximums apart SW2, SW1, SW3 and SW7 means and SW1, SW2, SW3 and SW4 80 percentiles exceed ANZECC (2000) guidelines values
- all maximums and 80 percentiles for turbidity exceed ANZECC (2000) guidelines apart from 80 percentiles at SW7 and SW8
- all copper maximums and 80 percentiles exceed ANZECC (2000) guidelines apart from 80 percentiles for SW8
- along Alexandra Canal, the concentrations of the majority of key non-complying contaminants, such as sulfate and metals, increase downstream and peak near SW5 and SW6 before entering Cooks River
  - for nitrogen-related compounds there is a significantly higher ammonia level (more than 10 times the trigger values) between SW1 and SW6. The concentrations peak at SW2 and then diminish further downstream. Total nitrogen also peaks at SW2. The monitoring data suggests that there are ammonia sources between SW1 and SW6. Since this section of Alexandra Canal is next to the former Tempe Tip, this could be the source of the high ammonia levels. Another exception is phosphorus levels, which are higher in the Cooks River than Alexandra Canal.

In summary, sampling points within the Cooks River and Alexandra Canal (SW1 to SW8) frequently exceed ANZECC (2000) guideline values for sulfate, TDS, total suspended solids, chloride, total nitrogen, aluminium, iron, manganese, zinc and ammonia.

Mill Stream

Table B.4 in Appendix B highlights the mean, median, maximum and 80 percentile values for the key physical properties, nutrients and contaminants of concern. Table E.1 in Appendix E compares the same contaminants with the accepted limits of contamination specified in Schedule 2 of the Airports (Environment Protection) Regulations 1997. A summary of key observations at SW9, SW10 and SW11 located in Mill Stream is outlined below:

- total nitrogen, aluminium, iron, manganese, zinc, ammonia and total suspended solids exceed ANZECC (2000) guidelines for all sites
- turbidity exceeds ANZECC (2000) guidelines at all sites except for the median at SW10 and SW9
- all maximum and 80 percentiles phosphorus and average phosphorus at SW10 and SW11, exceed ANZECC (2000) guidelines
- copper at all locations and maximum filtered copper at SW11 exceed ANZECC (2000) guidelines
- all the above contaminants exceed the limits of accepted contamination specified in Schedule 2 of the Airports (Environment Protection) Regulations 1997. Nitrate does not exceed ANZECC (2000) guidelines but does exceed Airports (Environment Protection) Regulations 1997
- concentrations of contaminants are generally higher upstream at SW9 and diminish further downstream.

In summary, sampling points in Mill Stream (SW9 to SW11) frequently exceeded ANZECC (2000) guidelines for total nitrogen, aluminium, iron, manganese, zinc, ammonia and turbidity and the limits of accepted contamination specified in Schedule 2 of the Airports (Environment Protection) Regulations 1997.

PFAS contamination

To assess site investigation results for PFAS, the ecological criteria provided in Table 5 of the PFAS NEMP have been considered. The target water quality objectives detailed in Appendix A are for the protection of 90 per cent of marine water ecosystems for Mill Stream and 80 per cent marine water ecosystems for Alexandra Canal. Adopting a precautionary approach for PFAS in this assessment, a conservative objective of protection of 95 per cent of marine water ecosystems has been adopted for this project.

A summary of key observations is outlined below.

- PFAS compounds, including PFOS and PFOA, were detected in sampling points within the Cooks River, Alexandra Canal and Mill Pond
- PFOS was detected in up-gradient sampling points.

The PFAS level at all sites complied with the NEMP 95% level of protection concentration, except at SW11, where there was an exceedance on 28 March 2018.

5. Impact assessment

This section presents a summary of the predicted construction and operational surface water impacts of the project.

5.1 Impacts during construction

Construction of the project has potential to release the following pollutants to local waterways, if not managed appropriately.

- nitrogen and phosphorus, suspended sediments
- chemicals, oils, grease and petroleum hydrocarbons
- contaminants of concern including Asbestos, PFAS and Acid sulfate soils (refer to Section 4.5).

Table 5.1 describes construction activities which, without mitigation measures, represent potential new sources of water quality pollution in the waterways either directly at Mill Stream, or indirectly to Mill Stream via overland flow or through the existing stormwater network. Water quality impacts to Alexandra Canal could potentially occur through the existing stormwater network. The likelihood of these potential impacts is low with the implementation of appropriate mitigation measures as described in Section 6.

Table 5.1 Construction activities and potential water quality impacts without mitigation

Activity	How impact could occur	Potential water quality impact
Use of water for construction activities including dust suppression and vehicle wash-down.	▪ Increased run-off volumes into the receiving waterways. ▪ Potential for contamination of run-off travelling through site areas. ▪ Increased pollutants from water reuse.	▪ Increased turbidity, lowered dissolved oxygen levels and increased nutrients in water ways. ▪ Increased mobilised sediments in waterways. ▪ Further degradation to aquatic habitat.
Vegetation clearing and earthworks (including site establishment, track formation, clearing of haulage routes, and stockpile areas).	▪ Increased exposed soils resulting in sediment runoff to waterways. ▪ Increased run-off volumes across exposed areas. ▪ Increased pollutant, sediment load or organic matter entering receiving waterways.	▪ Increased turbidity, lowered dissolved oxygen levels and increased nutrients in water ways. ▪ Reduction in channel habitat from sediment transport and deposition. ▪ Potential for increased contaminants in waterways if soil is contaminated.
Increase in impervious surfaces temporarily (such as construction compound, crane pads, access ramps and parking areas).	▪ Increased run-off volumes across exposed areas. ▪ Increased contaminants, sediment load or organic matter entering receiving waterways.	▪ Increased turbidity lowered dissolved oxygen levels and increased nutrients. Potential for increased mobilised contaminants sediments and heavy metals in waterways.
Construction adjacent to Mill Stream, including construction of a new bridge, retaining wall works and drainage works (including associated works such as crane pads, access ramps etc).	▪ Direct disturbance of waterway beds, and banks. ▪ Increased exposure of soils, potentially contaminated soils and increased erosion and localised mobilisation of sediments. ▪ Disturbance of riparian areas. ▪ Increased exposure of soils and increased erosion and localised mobilisation of sediments.	▪ Increased turbidity lowered dissolved oxygen levels and increased nutrients. ▪ Potential for increased disturbed contaminants and bed scouring.

Activity	How impact could occur	Potential water quality impact
Stockpiling of spoil and construction materials (around 35,220 cubic meters of combined fill, structural fill and capping material required for the project) exposing sediment and potentially contaminated materials.	▪ Increased pollutant, sediment load or organic matter entering receiving waterways. ▪ Increased heavy metals entering waterways. ▪ Exposure of soils containing acid sulphides.	▪ Increased turbidity, lowered dissolved oxygen levels and increased nutrients in water ways. ▪ Potential for increased mobilised contaminants sediments and heavy metals in waterways. ▪ Reduction in channel habitat from sediment deposition. ▪ Generation of sulfuric acid and subsequent acidification of waterways.
Inadequate containment of spills or leaks of fuels chemicals from construction plant, equipment and activities.	▪ Release of contaminants, oils, fuels and grease into waterways.	▪ Increased pollutants and contaminants in waterways.
Litter from construction site and activities.	▪ Gross pollutants and litter entering waterways.	▪ Increased pollutants and contaminants in waterways.
Concrete wash out (e.g. concrete track washing).	▪ Concrete washout water produces a highly polluted slurry which is toxic and corrosive which could enter waterways if site management controls are not implemented effectively.	▪ High pH can increase toxicity of other substances in surface water. ▪ Inhabit aquatic ecosystems growth.

5.1.1 Bridge and drainage construction at Mill Stream

Excavation and earthworks activities creates potential risks such as of changes to bed and bank conditions and increased erosion leading to increased volumes of sediment and pollutants entering the watercourse.

The construction methodology includes the installation of a 1350 millimetre pipe outlet to Mill Stream. Due to the pipe being located outside the mean water level, impacts are expected to be minimal.

The proposed bridge works at Mill Stream would involve a new two-span bridge structure to be located to south of the existing bridge. The proposed bridge pier is to be situated on the western bank of Mill Stream and includes the installation of scour protection as necessary. The construction would require the establishment of construction access ramps for piling rigs, and pilling pads, installation of sheet piles, and the construction of abutments, piers, bridge girders and scour protection.

The proposed works have the potential to impact water quality in Mill Stream due to the location adjacent to the waterway, and potential to increase the sediment and pollutant load into the waterway as a result of ground disturbance.

5.1.2 Dewatering of excavations

Excavations and earthworks during construction of bridges, cess drains, ground preparations and around assets have potential to fill with water after rainfall events and will require dewatering. These have potential to increase the pollutant loads if untreated water is discharged into waterways or site erosion and sediment controls are ineffective.

5.1.3 Runoff from other contaminated disturbed areas

Surface water runoff from areas of known contaminated soil (including PFAS and asbestos) that may be exposed during the construction process have the potential to impact sensitive receiving waterways.

5.1.4 Runoff from uncontaminated disturbed areas

For works within uncontaminated areas, there is potential for earthworks and other construction activities to cause erosion and increased sedimentation of the waterways. Application of the mitigation measures outlined in Section 6.2.1, including minimising exposed soil surfaces during construction, would minimise the risk of soil erosion and transport.

5.1.5 Water take

Construction workers would need access to potable water on site, and wastewater would be generated daily. The urban setting of the project means potable water is likely to be supplied from Sydney Water, and wastewater would be discharged to Sydney Water's sewage system. Thus, the construction workers' water use and wastewater disposal on site would not have any meaningful impact on the water quality of Mill Stream and Alexandra Canal.

5.1.6 Residual construction water quality impacts

The above impacts to water quality during construction of the project are short term impacts on receiving waterways. With the implementation of the recommended mitigation measures (refer to Section 6.2.1) and in the context of the overall catchment, these potential impacts are unlikely to have a material impact on ambient water quality within the receiving waterways.

Therefore, the project is unlikely to have an influence on where the water quality trigger values are exceeded during the construction phase.

5.2 Impacts during operation

Table 5.2 outlines operational activities w that may result in an increase to the magnitude and/or frequency of impacts on water quality. Pollutants have the potential to enter Mill Stream via overland flow and the existing and proposed stormwater drainage network. Water quality impacts from the project to Alexandra Canal could potentially occur via existing and proposed stormwater drainage network. The likelihood of these potential impacts is low with appropriate mitigation measures described in Section 6.

Table 5.2 Operation activities and risks without mitigation

Activity	How impact could occur	Potential water quality impact
Formation failure (incidental).	▪ Increased run-off volumes into receiving waterways. ▪ Increased pollutant, sediment load or organic matter entering receiving waterways.	▪ Increased turbidity, lowered dissolved oxygen levels and increased nutrients in water ways. ▪ Increased mobilised sediments in waterways.
Rail accidents (incidental).	▪ Spills or leaks of chemicals, oils and petrols. ▪ Increased pollutant, sediment load or organic matter entering receiving waterways.	▪ Spills of chemicals, oils, fuels and grease into waterways. ▪ Increased pollutants and contaminants in waterways.
Spillages due to blow off or poor wagon sealing or accidental spillages (incidental).	▪ Spills or leaks of chemicals, oils and petrols including total recoverable hydrocarbons (TRH), monocyclic aromatic hydrocarbons (e.g. Benzene, toluene, ethylbenzene and xylene) and heavy metals (arsenic, lead, zinc, cadmium, chromium and iron).	▪ Spills of chemicals, oils, fuels and grease into waterways.
Grease pots/friction modifiers (operational).	▪ Increased pollutants in waterways.	▪ Grease and chemicals in waterways.

The likelihood of impacts in Table 5.2 are low, with the adopted mitigation measures described in Section 6.

5.2.1 Runoff from rail alignment

Impacts to waterways water quality as a result of erosion and sedimentation are anticipated to be minimal from runoff from the rail alignment due to the following:

- Runoff from ballast is typically filtered by the rocks and other material in the ballast. The duplication has low potential to increase contaminants entering the waterways because the runoff from the ballast would be would flow through the rock materials and pollutants would be partially retained.
- The sources for contaminants are currently present from historic industrial and commercial activities adjacent to the project site. Under existing conditions, these contaminants may already be entering waterways from natural surface runoff across the project site. As such and given project relates to construction of a new rail track within the existing corridor, it is not considered that the project would result in any increase of existing contaminants entering waterways during operation.
- There is no meaningful change to the project site catchment areas given the project is generally located within the existing rail corridor, thereby a negligible change in flow is anticipated.

5.2.2 Mill Stream bridge

There are a number of bridges in the project, however only the proposed new bridge over Mill Stream crosses the waterway. Scour and erosion impacts are considered for this bridge only. The current design of the Mill Stream bridge has been developed to avoid the need for structures within mean water flow area of Mill Stream, thereby minimising scour and erosion potential.

5.2.3 Water take

Operation of the project is not expected to consume potable water or to generate wastewater. As such, there is no water take from operation of the project.

5.2.4 Surface water drainage

Approximately 1.6 kilometres of the design rail corridor runoff will flow to Mill Stream either directly via overland flow or through the new or upgraded drainage network. Under the existing conditions, surface water flow was mostly overland flow, however in design the flows are concentrated and discharge to existing trunk drainage or new design drainage. At Mill Stream, there will be a new drainage pipe and headwall that will either replace or supplement the existing 1200 millimetre diameter drainage pipe and headwall. This new headwall outlet will be located outside of Mill Stream mean water level and will have appropriate scour protection incorporated into the design.

Surface water from the northern 1.4 kilometres of the project site flows in a north westerly direction to Alexandra Canal via existing drainage network and the Upper Mascot Open Channel. This is mostly overland flow in the existing pre-development condition, however the design results in a combination of overland flows and more concentrated flows via new cess drains before finally discharging through existing drainage networks.

Approximately 500 metres of the existing rail corridor runoff currently flows into the existing Sydney Airport drainage network, into Northern Pond before final discharge to Alexandra Canal. A portion of the northern rail corridor in both the existing pre-development condition and in the design, will flow into the Upper Mascot Open Channel before discharging into Alexandra Canal.

The overall track drainage system will continue to drain to existing drainage systems surrounding the project with existing final discharge points to remain unaffected.

In summary, there is no substantial change to the existing surface water catchment areas or any significant hydrological behaviour of these catchments due to the project. However there is a slight increase in impervious surface due to duplication of the rail line within the existing corridor and the introduction of new granular formation capping material. The ballast on top act as a pervious layer and will reduce the rate of rainfall runoff. There will be slightly more runoff than the assumed compacted soil surface it replaces. However, the increase in flow is expected to be minimal.

All cess drainage and final outfalls that are installed or modified as part of the project, or areas of confluence will have appropriate scour protection.

5.3 Cumulative impacts

5.3.1 Sydney Gateway Road project

During construction of the Sydney Gateway project there is the potential to impact the Alexandra Canal and Mill Stream waterways through physical impacts such as increasing sedimentation to waterways, increasing turbidity and changing bed conditions. There is also potential to increase contaminants in the waterways if contaminated sediments are disturbed, contaminated groundwater runoff enters the waterways, or existing contaminated sediments in the Alexandra Canal are mobilised into the water column (e.g. through disturbance or increased scour).

Standard construction management and mitigation strategies to minimise sediment disturbance, mobilisation and runoff would be adopted during construction of the project. Where runoff from the project has potential to be contaminated, additional mitigation measures may be required. These construction impacts are short-term and manageable with application of appropriate construction mitigation measures.

During operation, there is potential to impact waterways through:

- greater volume of stormwater discharge from new outlets and new overland flow paths resulting in increased flow velocities, which may increase scouring and mobilisation of contaminated sediments
- increase in sediment and pollution loads in stormwater due to the increase in road surface and vehicular tyre and pavement wear
- contaminated groundwater and leachate entering the road drainage system.

Approximately 500 metres of the project site will connect into drainage networks that will be utilised by the Gateway road project, that will flow to Alexandra Canal. The Botany Rail Duplication project is expected to have a negligible change in flow and water quality conditions from existing and therefore will have not have a meaningful impact on water quality when considered cumulatively with the Gateway road project.

Although each project has the potential to impact water quality, with the application of appropriate mitigation measures to each project, no significant impact is anticipated. Further cumulative impacts from these projects are not predicted.

5.3.2 Other major developments

Airport East upgrades works are currently under construction adjacent to and within the western portion of the project site, between General Holmes Drive, Botany Road and Joyce Road. The key impact to the project is the removal of the General Holmes Drive rail level crossing by constructing a road underpass. There are potential impacts to the water quality of Mill Stream during construction from activities, such as earthworks and excavations. Impacts include the potential for pre-existing contamination of soils including heavy metals and hydrocarbons. The risk to water quality are expected to be managed through implementation of mitigation measures so impacts are not expected (Jacobs, 2015).

Additional major developments constructed within the Cooks River and Georges River catchments may have impacts on flow and water quality in the receiving waterways within the project site. Increases in impervious area during construction and operation of other major projects may contribute to the volume and pollutant loading of surface runoff in the area.

Major developments currently under construction in the vicinity of the project include:

- WestConnex M4-M5 Link and Westconnex New M5
- Sydney Metro South-West
- Airport North upgrades – O'Riordan Street.

Sections of the New M5 and small sections of the M4-M5 Link project will be constructed in the Georges River and Cooks River catchments to the north and west of the project site. Construction measures for the New M5 will include water treatment plants at Arncliffe and Canal Road which would discharge into the Cooks River and Alexandra Canal respectively. The EIS for the New M5 notes that the water discharging from these treatment plants would be of better quality than the current water quality of the receiving environments (AECOM, 2015). The M4-M5 Link would largely be built outside the Cooks River or Georges River catchments; however, a small section of tunnel for this project at the St Peters interchange would drain to the New M5 Arncliffe water treatment plant (AECOM, 2017).

The EIS for the New M5 (AECOM, 2015) concludes that the treatment devices included in the New M5 design would result in fewer pollutants being delivered to Alexandra Canal and the Cooks River. Similarly, the M4-M5 Link EIS (AECOM, 2017a) conclude that the M4-M5 Link would reduce stormwater pollutant loading to receiving waterways and have a neutral or beneficial effect. A full outline of the measures being implemented to mitigate potential water quality impacts is available in the WestConnex approval documents and construction management plans. Proposed mitigation measures should be sufficient so that no impact is expected.

If mitigation requirements are applied consistently across projects, no adverse cumulative surface water impacts are anticipated. As reflected in the approval documents for the WestConnex projects, where there is opportunity to include treatment devices or water treatment plants in the design and construction and operation of the project, the impacts on water quality are expected to be neutral or even beneficial when compared to existing conditions. As such, the residual risk to the environment from the cumulative impacts of the major projects when considered in conjunction with the Botany Rail Duplication are expected to be low.

6. Management of impacts

This section describes the approach and recommended management and mitigation measures for construction and operation of the project.

6.1 Approach

6.1.1 Construction

A soil and water management plan (SWMP) would be prepared as part of the construction environmental management plan (CEMP). The SWMP would comply with the proposal conditions of approval and be in accordance with best on site practice, reflected in the Blue Book. The SWMP would include:

- water quality objectives for the project as outlined in Appendix C for ambient water
- an erosion and sediment control plan that allows for site-specific erosion and sediment controls at all work sites in accordance with the Blue Book and the controls listed in Section 6.2.1. Physical controls may include sediment fences and basins, containment bunds, silt traps, turbidity barriers and diversions, dust suppression and earth compaction around stockpiles and earthworks areas
- sediment and erosion controls would be built for stability in the event of the 10% AEP storm throughout construction as per blue book guidelines. The controls would aim to:
  - divert water from upslope areas around the site
  - reduce erosion from within the site to minimise sediment loading to the receiving waterways
  - intercept runoff and capture sediment from site
  - protect watercourses, drainage lines and drain inlets down-gradient from the site
- procedures detailing appropriate inspection and maintenance of erosion and sediment controls throughout the works to ensure they are operating effectively.

It is noted that there is no sediment storage capacity currently included in the construction phase design. As such all controls would be designed to minimise on site erosion risk and maintain the annual sediment export rate to below 150 m^3 of sediment at each outlet to avoid the need for sediment basins (Landcom, 2004).

While discharge is not currently proposed during construction, in the event that the contractor determines through its construction planning that this may be necessary, a discharge impact assessment would be developed in consultation with DPIE. The discharge impact assessment will determine the mitigation measures which may be required to manage the potential impacts identified and would also detail the monitoring requirements. A discharge management plan would also be developed in consultation with the DPIE and the EPA to detail the relevant mitigation measures and monitoring program specific to the discharge activities proposed.

6.1.2 Operation

Appropriate mitigation measures are identified based on best practice and ARTC operation procedures for the impacts identified in Section 5.2.

6.2 Mitigation measures

6.2.1 Construction

Table 6.1 describes mitigation measures for specific construction activities that present potential water quality risks. Water quality impacts from construction of the proposal are anticipated to be limited and short term. Additionally, it is anticipated that implementation of recommended mitigation measures in Table 6.1 would minimise these impacts further.

Table 6.1 Mitigation measures for construction activities that have potential to impact water quality

Stage	Construction activity	Recommended mitigation measure
Construction	Vegetation clearing and earthworks (including site establishment, track formation, clearing of haulage routes, and stockpile areas) which increases the area of exposed soils	▪ Implementation of soil and water management principles consistent with the *Managing Urban Stormwater – Soils and Construction* handbook. ▪ Minimise the area of exposed soils within the proposal site and protect or stabilise disturbed areas during periods of inactivity to reduce the potential for erosion. ▪ Design batter slope gradients and surface treatments and construction program to minimise erosion risk so the annual sediment export rate is below 150 m^3 at each outlet to avoid the need for sediment basins in accordance with the *Managing urban stormwater – soils and construction* handbook. ▪ Rehabilitate and restore areas disturbed by proposal activities as soon as possible on completion of works in the area to promote surface stability and reduce the potential for erosion. ▪ Where feasible, consider scheduling construction activities to avoid ground disturbance works during periods of heavy or prolonged rainfall. ▪ Where practical, stage vegetation clearing and ground disturbing works sequentially/across the proposal to minimise areas exposed to erosion and sediment risk. ▪ All long-term stockpiles will be stabilised appropriately.
Construction	Establishment of impervious surfaces in areas that were previously pervious (such as construction compounds and crane pads)	▪ Erosion and sediment controls throughout the project site would be inspected and maintained to ensure they are operating effectively.
Construction	Construction works within Mill Stream	▪ Specific measures and procedures for works within waterways, such as the use of silt barriers would be implemented where necessary. ▪ Construction of scour protection along eastern and western banks of Mill Stream. ▪ Construction planning for in-stream works would include procedures for forecasting inclement weather.

Stage	Construction activity	Recommended mitigation measure
Construction	Stockpiling of spoil and construction materials exposing sediment and potentially contaminated materials	Employ stockpile management procedures that include: ▪ segregation of potentially contaminated materials ▪ protection of stockpiles of loose material from erosion due to rain and wind ▪ ensuring all material is immediately removed from the site when practical to do so and at the completion of work ▪ instructing site workers on the need to prevent materials from washing or blowing into the stormwater system.
Construction	ACM contaminated areas	ACM impacted soil would be handled and managed in accordance with the AMP. Areas that are designated as ACM contaminated areas would be clearly fenced off, and infiltration trenches would be installed to allow for potentially contaminated water to be collected and infiltrated back into groundwater rather than discharged to surface water.
Construction	Containment of spills or leaks of fuels chemicals from construction plant, equipment and activities	▪ Establish impervious and bunded areas for the on-site maintenance of construction plant and equipment. ▪ Store all potentially contaminating, contaminated and hazardous substances in secured, bunded and impervious locations. ▪ Regularly inspect construction plant and equipment for leaks and maintain or remove from site as required to prevent soil and surface water contamination. ▪ Ensure that adequately stocked spill kits are immediately on hand and accessible during all refuelling and that all personnel involved in refuelling activities are trained in the use of spill kits. ▪ Clean up any spills of fuels, lubricants, chemicals and other liquids immediately. ▪ Ensure that any potentially contaminated materials are appropriately contained, tested and stored prior to disposal at an appropriately licensed waste facility.
Construction	Litter from construction site and activities	▪ Provision of bins on site for litter. ▪ Transport of all general litter and waste off site to appropriate waste facility.
Construction	Potential for encountering ASS	An ASSMP would be developed in accordance with the ASSMAC (1998) *Acid Sulfate Soils Manual* and included in the SWMP. ASS encountered during construction would be managed in accordance the ASSMP.

Stage	Construction activity	Recommended mitigation measure
Construction	Potential for contaminated groundwater	Adopt construction techniques to avoid groundwater disturbance where practicable. If groundwater is encountered, temporarily store all extracted groundwater to be disposed of offsite in appropriate containers then ensure it is tested for potential contaminants (including PFAS). Options for final disposal of extracted groundwater include: ▪ removal offsite to a water recycling facility if the level of contaminants does not exceed the water acceptance thresholds ▪ discharge to a sewer via a trade waste agreement with Sydney Water ▪ treatment through a groundwater remediation system before being released to surface water (with approval from NSW EPA). For the above options, the analytical testing results would need to demonstrate compliance with the applicable license or discharge criteria.

Residual construction water quality impacts

The proposed surface water management measures aim to minimise short term impacts on receiving waterways. With the implementation of the recommended mitigation measures and in the context of the overall catchment, any potential impacts are unlikely to have a material impact on ambient water quality within the receiving waterways.

Therefore, during construction of the project is unlikely to influence where water quality trigger values are currently being exceeded or not. Where water quality trigger values are exceeded they will continue to exceed and where they are currently being below the trigger value they will remain below the trigger value.

6.2.2 Operation

Table 6.2 describes mitigation measures for potential impacts identified in Table 5.2.

Table 6.2 Mitigation measures for operational activities that have potential to impact water quality

Activity	Mitigation measures
Formation failure	▪ Detailed Design to include design of formation and integrated drainage to prevent failure. ▪ Installation of erosion protection measures at Mill Stream drainage outlets. ▪ Longitudinal drainage has been designed to direct surface water run-off away from the formation. ▪ Undertake regular inspections of formations and complete any repairs promptly.
Drainage infrastructure discharge	▪ Suitably designed scour and erosion control measures would be included in the detailed design where required. The detailed design of Mill Stream bridge would be optimised to minimise upstream or downstream scour effects on the existing watercourse.
Inadequate containment of spills or leaks of fuels chemicals from rolling stock	▪ The existing ARTC Standard Environmental Management Measures would be implemented to manage impacts from maintenance works.
Maintenance activities	▪ The existing ARTC Standard Environmental Management Measures would be implemented to manage litter pollutants, and potential spills and leaks from maintenance activities.

With the implementation of these mitigation measures, no significant impacts to water quality during operation of the project are anticipated.

Residual operational water quality impacts

As detailed in Section 4.7, water quality in Alexandra Canal and Mill Stream frequently exceed many of the trigger values. Residual impacts to ambient water quality as a result of water runoff from the Botany Rail Duplication is unlikely to result in unprecedented further exceedance of these trigger values, particularly with the implementation of the mitigation measures recommended in this assessment.

Water quality trigger values will continue to be exceeded from existing and historical land uses and activities in the area, regardless of operation of the project and the project will have limited influence on the water quality objectives and trigger values. Therefore, where water quality trigger values are currently being exceeded they will continue to exceed and where they are currently being below the trigger value they will remain below the trigger value.

Further, a negligible change in pollutant loading is expected, therefore water quality treatment devices to reduce the pollutant load further are not required.

6.2.3 Surface water quality and quantity monitoring program

Although water quality impacts are not anticipated with implementation of appropriate mitigation measures, there may be unforeseeable impacts, therefore as a precautionary approach and to demonstrate negligible impacts to Mill Stream, a water quality monitoring program is recommended.

The water quality pattern of Alexandra Canal and Mill Stream near the project site is complex and there are existing pollutants sources in both waterways. In the case of trigger values being exceeded, surface water monitoring would need to be able to distinguish local sources of contaminants from contaminants exported from the project during both operation and construction phase.

Existing conditions monitoring

ARTC would obtain monthly surface water quality monitoring data at SW9, SW10 and SW11 (refer to Figure 3.2) to reach a minimum of 12 months and up to 24 months of continuous baseline monitoring. Additional sampling is recommended after a wet weather event (say within 24 hours after rainfall of more than 10 millimetres in 24 hours), up to once a month. Baseline monitoring would cease once construction begins.

Monitoring parameters are recommended to be the same as the baseline assessment:

- In situ measurement of water quality parameters at each location for pH, electrical conductivity (EC), temperature, dissolved oxygen (DO), reduction-oxidation potential (redox) and turbidity. Direction of flow should be noted.
- Laboratory analysis of all water samples for:
  - physical properties: pH, total dissolved solids (TDS), total suspended solids (TSS), turbidity, major anions and cations (calcium, magnesium, potassium, sodium, chloride, sulfate, carbonate and bicarbonate alkalinity, total alkalinity)
  - nutrients: nitrate, nitrite, total nitrogen, ammonia and total phosphorus
  - contaminants of concern: per- and poly-fluoroalkyl substances (PFAS), total recoverable hydrocarbons (TRH), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), total phenols, organochlorine pesticides (OCP), organophosphorus pesticides (OPP), total and dissolved heavy metals (lead, zinc, copper, cadmium, chromium, nickel, iron, manganese, mercury, arsenic and aluminium) and tributyltin (TBT).

Ongoing review of the site-specific trigger values is recommended for these parameters as more data becomes available. It is recommended to revise the site-specific trigger values every six months to a year with updated data pre-construction and to not make further changes once construction has begun.

Water quantity monitoring program

The project would not result in any meaningful impacts to hydrological attributes or changes in flow, as such there is no requirement of a water quantity monitoring program. Regular inspections of watercourses are recommended after any significant flooding event, with remediation measures implemented if required.

Construction and operation waterway water quality monitoring

Alexandra Canal

Waterway water quality monitoring is not required in Alexandra Canal. This is because:

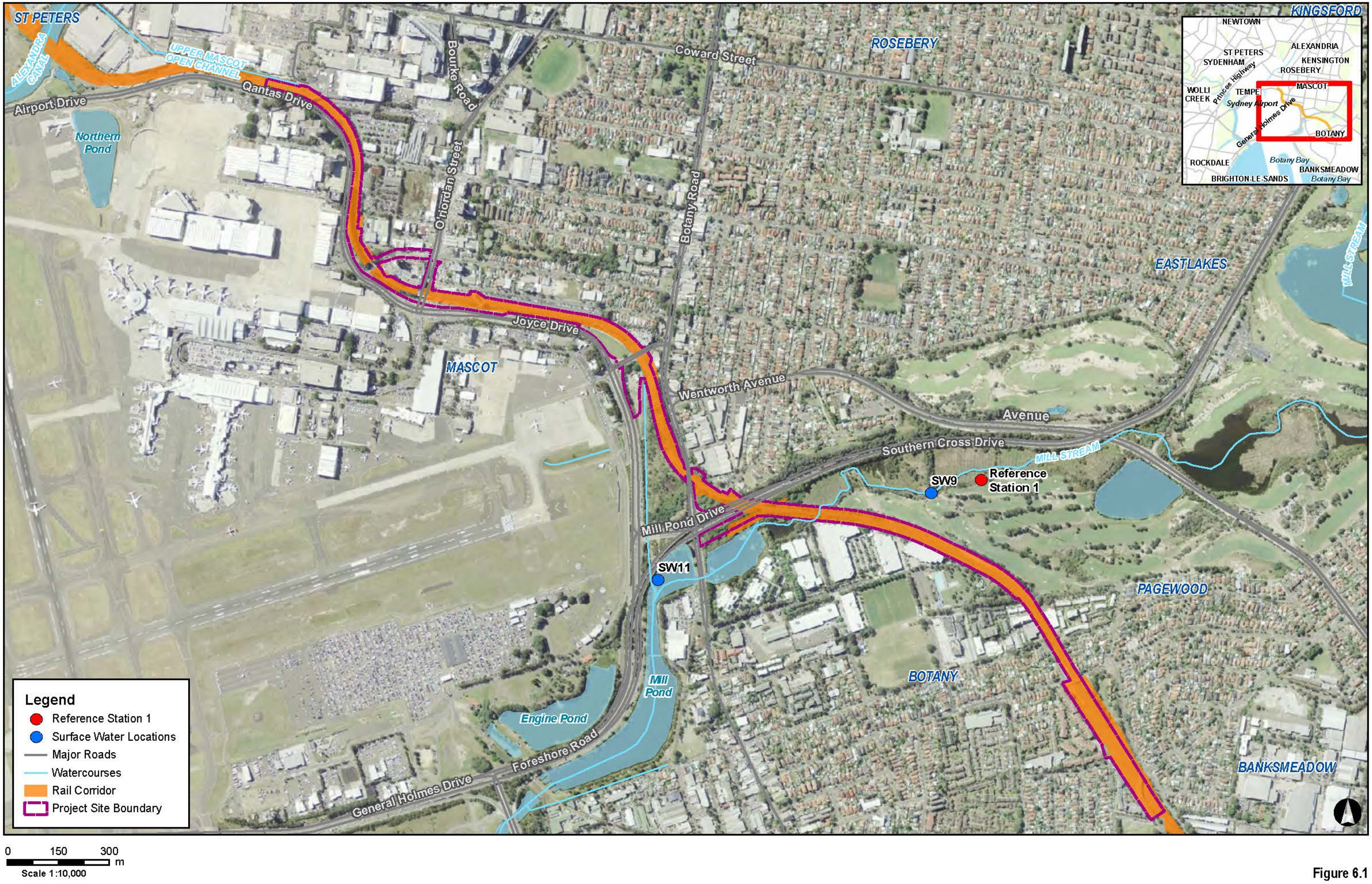
- construction water will not drain to Alexandra Canal
- the project impact to Alexandra Canal is minimal. (Project site to Alexandra Canal catchment is <0.1% of total drainage catchment)
- drainage to Alexandra Canal is through existing stormwater network and is mixed with upstream sources from the catchment, therefore the impact from the project is difficult to determine.

Since it is difficult to determine and the impact is minimal no monitoring of Alexandra Canal is recommended.

Mill Stream

Waterway monitoring is recommended at Mill Stream during construction works between Southern Cross Drive and Myrtle street (adjacent to residential properties). Monitoring is recommended upstream and downstream of the project site surface water inflow locations during construction. Monitoring would continue six months post construction works to demonstrate no meaningful impact from the project.

Reference station 1 and SW11 are recommended because the locations are upstream and downstream of project surface water inflow locations. The location of these monitoring stations is presented in Figure 6.1.



Author: David Naiken
Date: 7/08/2019
Map no: PS113386_GIS_077_A1

Figure 6.1

Surface Water Monitoring Locations

A number of contaminants (see Section 4.7), including physical and chemical stressors and toxicants, currently exceed the default trigger values in Appendix A for various environmental values. It is therefore considered appropriate to develop site specific trigger values based on the existing water quality and for aquatic ecosystems only for management of short term impacts and associated monitoring programs. The following site specific trigger values are proposed:

- For physical and chemical stressors: Use the least stringent of (1) the 80th percentile value from the monitoring data and (2) the adopted trigger value in Appendix A.
- For non-bio accumulative toxicants: Use the least stringent of (1) the 80th percentile value from the monitoring data and (2) the adopted trigger value in Appendix A.
- For bio accumulative toxicants: Use the least stringent of (1) the 80th percentile value from the monitoring data and (2) the 95% level of protection for species in marine waters (Adopted trigger value in Appendix A).

For this project the 80th percentile values are determined from the monitoring data at SW9 and SW11 on Mill Stream. Although reference site 1 is upstream of SW9, SW9 is still appropriate for establishing existing water quality conditions and setting trigger values. There is potential for SW9 to be downstream of inflows from the project site, therefore reference site 1 is recommended for construction and ongoing water quality monitoring.

Exceedances of the water quality objectives at downstream monitoring SW11 in Mill Stream would be investigated as follows:

- The concentration at SW11 would be compared to the concentration at reference station 1.
- If the concentration at reference station 1 exceeds or is equal to the concentration at SW11, no further action is required.
- If the concentration at reference station 1 is lower than the concentration at SW11 and exceeds the water quality trigger value (Appendix C), then the monitoring locations are reviewed against long-term averages.
- If the exceedance of the trigger value at SW11 and the lower concentrations at reference station 1, an investigation into the source of contamination and risks to environmental values would be undertaken.
- If the investigation indicates potential for risks to environmental values, an action plan to mitigate potential harm would be developed.

The short-term site specific trigger values are presented in Appendix C. The trigger values in Appendix C are indicative at this stage and should be refined prior to construction when further monitoring data is available.

It is recommended that the waterway monitoring program continue for at least six months after completion of construction works south of Southern Cross Drive. Sampling would be taken monthly, including a range of wet and dry conditions where possible. If after six months, where wet weather samples have also been taken. If it can be confirmed that there is no significant water quality impact monitoring can cease, otherwise it is recommended to continue waterway sampling for at least 12 months post construction works south of Southern Cross Drive.

No criteria was established for discharge monitoring because there will be no project discharges to waterways.

7. Conclusion

It is important to protect waterways from pollutants when designing, constructing and operating the proposal for the benefit of the environment and water users. This report sets out the results of a water quality impact assessment undertaken to inform design, construction planning and environmental assessment of the Botany Rail Duplication.

The project is located within the catchments of Alexandra Canal (which is a sub-catchment of the Cooks River catchment) and the Mill Stream catchment (which is a sub-catchment of the Georges River catchment). The identified environmental values for these catchments are:

- aquatic ecosystems
- visual amenity
- secondary contact recreation
- primary contact recreation
- aquatic food.

The management framework set out in the ANZECC (2000) guidelines was used to identify appropriate criteria to assess the existing water quality data for these environmental values. A review of existing environmental and water quality conditions indicated that both Alexandra Canal and Mill Stream catchments are currently in a poor condition as a result of historical industrial uses in the area and the urban environment. Baseline water quality data indicated that the assessment criteria indicated in the ANZECC (2000) guidelines for the identified environmental values was frequently not met for the Alexandra Canal and Mill Stream.

During construction, there is the potential to impact these waterways through activities such as construction of drainage and Mill Stream Bridge and retaining wall works which have physical impacts such as increasing sedimentation to waterways, increasing turbidity and changing bed and the bank conditions.

Standard construction management and mitigation strategies (as recommended in the Blue Book and widely adopted across the construction industry) to minimise sediment disturbance, mobilisation and runoff are recommended to be adopted during construction of the proposal. All construction impacts and mitigation measures would be documented in a SWMP a part of the proposal CEMP. It is considered that implementation of the recommended mitigation measures would ensure that construction of the proposal would not further degrade the water quality environment of the proposal site regarding the NSW Water Quality Objectives. Potential construction impacts would be short-term and manageable with application of appropriate construction mitigation measures.

During operation, there may be potential impact to waterways as per the pre-development condition through:

- potential chemical spill from trains and vehicles on the rail line
- operation of new culverts and Mill Stream bridge.

Ongoing detailed design would aim to minimise changes to flow regimes and potential operational scour and erosion at drainage headwall at the Mill Stream bridge location. Implementation of the recommended mitigation measures during operation will result in a low likelihood of impact to waterways and sensitive receiving environments. A water quality monitoring program in Mill Stream is recommended during construction and operation phases to identify non-conformances.

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Appendix A

Water quality trigger values

A1. Adopted trigger values for Alexandra Canal and Cooks River

Table A.1 shows the adopted trigger values for Alexandra Canal and Cooks River. Trigger values for physical and chemical stressors are based on the ANZECC (2000) default trigger values. Trigger values for toxicants are based on 80% (95% for bioaccumulative) protection level.

Table A.1 Adopted trigger values for Alexandra Canal and Cooks River (ANZECC 2000)

Pollutant		**Unit**	**LOR**	**Aquatic ecosystems (80% protection level)**	**Secondary contact recreation**	**Primary contact recreation**	**Aquatic foods**	**Adopted trigger value**
Notes: *bioaccumulative toxin 95% protection level instead of 80% protection adopted; +no values recommended in ANZECC (2000), values adopted from the national environmental management plan (NEMP) and since PFAS is bioaccumulative toxin 95% protection level instead of 80% protection adopted. Highlighted in red means the trigger values are determined by environmental values other than aquatic ecosystems.								
Inorganics	Alkalinity (Bicarbonate as CaCO3)	mg/L	1					
	Alkalinity (Carbonate as CaCO3)	mg/L	1					
	Alkalinity (Hydroxide) as CaCO3	mg/L	1					
	Alkalinity (total) as CaCO3	mg/L	1					
	Anions Total	meq/L	0.01					
	Calcium	mg/L	0.5					
	Cations Total	meq/L	0.01					
	Chloride	mg/L	1		400	400		400
	Ferrous Iron	mg/L	-					
	Ionic Balance	%	0.01					
	Nitrate (as N)	mg/L	0.002		10	10	100	10
	Nitrite (as N)	mg/L	0.002		1	1	0.1	0.1
	Nitrogen (Total Oxidised)	mg/L	0.002	0.015				0.015
	Nitrogen (Total)	mg/L	0.01	0.3				0.3

Pollutant		Unit	LOR	Aquatic ecosystems (80% protection level)	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value
	Phosphate (as P)	mg/L	0.005	0.005				
	pH (Lab)	pH units	0.01	7.0-8.5	6.5-8.5	5.0-9.0		7.0-8.5
	Sodium	mg/L	0.5					
	Sulphate (Filtered)	mg/L	1		400	400		400
	TDS	mg/L	5		1000		33000-37000	1000
	TSS	mg/L	5				10	10
	Turbidity NTU	NTU	0.1	0.5-10				0.5-10
MAH	1,2,4-triethylbenzene	µg/L	1					
	1,3,5-triethylbenzene	µg/L	1					
	Isopropylbenzene	µg/L	1					
	n-butylbenzene	µg/L	1					
	n-propylbenzene	µg/L	1					
	p-isopropyltoluene	µg/L	1					
	sec-butylbenzene	µg/L	1					
	Styrene	µg/L	1					
	tert-butylbenzene	µg/L	1					
Metals	Aluminium	mg/L	0.005					
	Aluminium (filtered)	mg/L	0.005		0.2	0.2	0.01	0.01
	Arsenic	mg/L	0.0002		0.05	0.05	0.03	0.03
	Arsenic (Filtered)	mg/L	0.0002		0.05	0.05	0.03	0.03

Pollutant		Unit	LOR	Aquatic ecosystems (80% protection level)	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value
	Cadmium	mg/L	0.00005		0.005	0.005	0.0005-0.005	0.005
	Cadmium (filtered)	mg/L	0.00005		0.005	0.005	0.0005-0.005	0.005
	Chromium (III+VI)	mg/L	0.0002	0.085	0.05	0.05	0.02	0.02
	Chroromium (III+VI) (Filtered)	mg/L	0.0002	0.085	0.05	0.05	0.02	0.02
	Copper	mg/L	0.0005	0.008	1	1	0.005	0.005
	Copper (Filtered)	mg/L	0.0005	0.008	1	1	0.005	0.005
	Iron	mg/L	0.002		0.3	0.3	0.01	0.01
	Iron (Filtered)	mg/L	0.002		0.3	0.3	0.01	0.01
	Lead	mg/L	0.0001	0.0044*	0.05	0.05		0.0044
	Lead (Filtered)	mg/L	0.0001	0.0044*	0.05	0.05		0.0044
	Magnesium	mg/L	0.5					
	Manganese	mg/L	0.0005		0.1	0.1	0.01	0.01
	Manganese (Filtered)	mg/L	0.0005		0.1	0.1	0.01	0.01
	Mercury	mg/L	0.00001	0.0004*	0.001	0.001	0.001	0.0004
	Mercury (Filtered)	mg/L	0.00001	0.0004*	0.001	0.001	0.001	0.0004
	Nickel	mg/L	0.0005	0.56	0.1	0.1	0.1	0.1
	Nickel (Filtered)	mg/L	0.0005	0.56	0.1	0.1	0.1	0.1
	Potassium (Filtered)	mg/L	0.5					
	Zinc	mg/L	0.001	0.043	5	5	0.005	0.005
	Zinc (Filtered)	mg/L	0.001	0.043	5	5	0.005	0.005

Pollutant		Unit	LOR	Aquatic ecosystems (80% protection level)	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value
Nutrients	Ammonia	mg/L	0.005	1.7	0.01	0.01	0.1	0.01
	Kjeldahl Nitrogen Total	mg/L	0.01					
	NOx as N in water	mg/L	-	0.015				0.015
	Total Phosphorus	mg/L	0.005	0.03				0.03
	Reactive Phosphorus as P	mg/L	0.001	0.005				0.005
Organochlorine Pesticides	4,4-DDE	µg/L	0.2					
	a-BHC	µg/L	0.2					
	Aldrin	µg/L	0.2		1	1		1
	Aldrin + Dieldrin	µg/L	0.5					
	b-BHC	µg/L	0.2					
	chlordane	µg/L	0.5				0.004	0.004
	Chlordane (cis)	µg/L	0.2					
	Chlordane (trans)	µg/L	0.2					
	d-BHC	µg/L	0.2					
	DDD	µg/L	0.2					
	DDT	µg/L	0.2					
	DDT+DDE+DDD	µg/L	0.5		3	3		
	Dieldrin	µg/L	0.2					
	Endosulfan I	µg/L	0.2	0.05	40	40	0.001	0.001
	Endosulfan II	µg/L	0.2					
	Endosulfan sulphate	µg/L	0.2					

Pollutant		Unit	LOR	Aquatic ecosystems (80% protection level)	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value
	Endrin	µg/L	0.2	0.02	1	1		0.02
	Endrin aldehyde	µg/L	0.2					
	Endrin ketone	µg/L	0.5					
	g-BHC (Lindane)	µg/L	0.2					
	Heptachlor	µg/L	0.2		3	3		3
	Heptachlor epoxide	µg/L	0.2					
	Methoxychlor	µg/L	0.2				0.004	0.004
Organophosporous pesticides	Azinophos methyl	µg/L	0.2					
	Bromophos-ethyl	µg/L	0.2					
	Carbophenothion	µg/L	0.5					
	Chlorfenvinphos	µg/L	0.5					
	Chlorpyrifos	µg/L	0.2					
	Chlorpyrifos-methyl	µg/L	0.2					
	Diazinon	µg/L	0.2					
	Dichlorvos	µg/L	0.2					
	Dimethoate	µg/L	0.2					
	Ethion	µg/L	0.2		6	6		6
	Fenitrothion	µg/L	0.2		20	20		20
	Fenthion	µg/L	0.5					
	Malathion	µg/L	0.2					
	Methyl parathion	µg/L	2					

Pollutant		Unit	LOR	Aquatic ecosystems (80% protection level)	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value
	Monocrotophos	µg/L	2					
	Prothiofos	µg/L	0.5					
	Ronnel	µg/L						
PAH	Benzo[b+j]fluoranthene	µg/L	1					
	Acenaphthene	µg/L	1				20	20
	Acenaphthylene	µg/L	1					
	Anthracene	µg/L	1					
	Benz(a)anthracene	µg/L	1					
	Benzo(a)pyrene	µg/L	0.5					
	Benzo(a)pyreneTEQ	µg/L	0.5					
	Benzo(a)pyreneTEQ (zero)	µg/L	0.5					
	Benzo(b+j)&Benzo(k)fluoranthene	µg/L	0.5					
	Benzo(,h,i)perylene	µg/L	1					
	Benzo(k)fluoranthene	µg/L	1					
	Chrysene	µg/L	1					
	Dibenz(a,h)anthracene	µg/L	1					
	Fluoranthene	µg/L	1					
	Fluorene	µg/L	1					
	Indeno(1,2,3-c,d)pyrene	µg/L	1					
	Naphthalene	µg/L	1					
	Phenanthrene	µg/L	1					

Pollutant		Unit	LOR	Aquatic ecosystems (80% protection level)	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value
	Pyrene	µg/L	1					
	Total +ve PAHs	µg/L	-					
	PAHs (Sum of total)	µg/L	0.5					
Pesticides	Demeton-S-methyl	µg/L	0.5					
	Fenamiphos	µg/L	0.5					
	Parathion	µg/L	0.2					
	Pirimphos-ethyl	µg/L	0.5					
PFAS	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	µg/L	0.001					
	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	µg/L	0.001					
	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	µg/L	0.0004					
	6:2 Fluorotelomer Sulfonate (6:2 FtS)	µg/L	0.0004					
	Perfluorobutane sulfonic acid (PFBS)	µg/L	0.0005					
	Perfluorobutanoic acid (PFBA)	µg/L	0.002					
	Perfluoroheptanoic acid (PFHpA)	µg/L	0.0005					
	Perfluorohexane sulfonic acid (PFHxS)	µg/L	0.0002					
	Perfluorohexanoic acid (PFHxA)	µg/L	0.0005					
	Perfluorooctane sulfonic acid (PFOS)	µg/L	0.0002	0.13+				0.13

Pollutant		Unit	LOR	Aquatic ecosystems (80% protection level)	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value
	Perfluorooctanoate (PFOA)	µg/L	0.0002	220+				220
	Perfluoropentanoic acid (PFPeA)	µg/L	0.0005					
	Sum of PFAS (WA DER List)	µg/L	0.0003					
	Sum of PFHxS and PFOS	µg/L	0.0003					
Phenols	2,4-dimethylphenol	µg/L	1					
	2-methylphenol	µg/L	1					
	2-nitrophenol	µg/L	1					
	3-&4-methylphenol	µg/L	2					
	4-chloro-3-methylphenol	µg/L	1					
	Phenol	µg/L	1	720				720
	Phenolics Total	µg/L	-					
Solvents	2-hexanone (MBK)	µg/L	50					
	Methyl Ethyl	µg/L	50					
	4-Methyl-2-pentanone	µg/L	50					
	Carbon disulfide	µg/L	5					
	Cyclohexane	mg/L	-					
	Vinyl acetate	µg/L	50					
TBT	Tributyltin as SN	ngSn/L	0.002				0.00001	0.00001
TPH	C_{10}–C_{36} (Sum of total)	µg/L	50					
	C_6–C_9	µg/L	10					
	C_{10}–C_{14}	µg/L	50					

Pollutant		Unit	LOR	Aquatic ecosystems (80% protection level)	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value
	C_{15}–C_{28}	µg/L	100					
	C_{29}–C_{36}	µg/L	50					
	C_{10}–C_{16}	mg/L	0.05					
	C_{16}–C_{34}	mg/L	0.1					
	C_{34}–C_{40}	mg/L	0.1					
	F2-NAPHTHALENE	mg/L	0.05	120				120
	C_{10}–C_{40} (Sum of total)	mg/L	0.1					
	C_{6}–C_{10} less BTEX (F1)	mg/L	0.01					
	C_{6}–C_{10}	mg/L	0.01					
VOC	cis-1,4-Dichloro-2-butene	µg/L	5					
	Pentachloroethane	µg/L	5					
	trans-1,4-Dichloro-2-butene	µg/L	5					
BTEXN	Benzene	µg/L	1	1300	10	10		10
	Ethylbenzene	µg/L	2				250	250
	Toluene	µg/L	2				250	250
	Xylene (m&p)	µg/L	2					
	Xylene (o)	µg/L	2					
	Xylene Total	µg/L	2					
	Naphthalene	µg/L	5					

Pollutant		Unit	LOR	Aquatic ecosystems (80% protection level)	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value
Chlorinated Hydrocarbons	1,1,1,2-tetrachloroethane	µg/L	1					
	1,1,1-trichloroethane	µg/L	1					
	1,1,2,2-tetrachloroethane	µg/L	1					
	1,1,2-trichloroethane	µg/L	1					
	1,1-dichloroethane	µg/L	1					
	1,1-dichloroethene	µg/L	1					
	1,1-dichloropropene	µg/L	1					
	1,2,3-trichloropropane	µg/L	1					
	1,2-dibromo-3-chloropropane	µg/L	1					
	1,2-dichloroethane	µg/L	1					
	1,2-dichloropropane	µg/L	1					
	1,3-dichloropropane	µg/L	1					
	2,2-dichloropropane	µg/L	1					
	Bromochloromethane	µg/L	1					
	Bromodichloromethane	µg/L	1					
	Bromoform	µg/L	1					
	Carbon tetrachloride	µg/L	1					
	Chlorodibromomethane	µg/L	1					
	Chloroethane	µg/L	10					
	Chloroform	µg/L	1					
	Chloromethane	µg/L	10					

Pollutant		Unit	LOR	Aquatic ecosystems (80% protection level)	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value
	cis-1,2-dichloroethene	µg/L	1					
	cis-1,3-dichloropropene	µg/L	1					
	Dibromomethane	µg/L	1					
	Hexachlorobutadiene	µg/L	1					
	Trichloroethene	µg/L	1					
	Tetrachloroethene	µg/L	1					
	trans-1,2-dichloroethene	µg/L	1					
	trans-1,3-dichloropropene	µg/L	1					
	Vinyl chloride	µg/L	10					
Halogenated Benzenes	1,2,3-trichlorobenzene	µg/L	1					
	1,2,4-trichlorobenzene	µg/L	1	80*				80
	1,2-dichlorobenzene	µg/L	1					
	1,3-dichlorobenzene	µg/L	1					
	1,4-dichlorobenzene	µg/L	1					
	2-chlorotoluene	µg/L	1					
	4-chlorotoluene	µg/L	1					
	Bromobenzene	µg/L	1					
	Chlorobenzene	µg/L	1					
	Hexachlorobenzene	µg/L	0.2					

Pollutant		Unit	LOR	Aquatic ecosystems (80% protection level)	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value
Halogenated Hydrocarbons	1,2-dibromoethane	µg/L	1					
	Bromomethane	µg/L	10					
	Dichlorodifluoromethane	µg/L	10					
	Iodomethane	µg/L	5					
	Trichlorofluoromethane	µg/L	10					
Halogenated Phenols	2,4,5-trichlorophenol	µg/L	1					
	2,4,6-trichlorophenol	µg/L	1					
	2,4-dichlorophenol	µg/L	1					
	2,6-dichlorophenol	µg/L	1					
	2-chlorophenol	µg/L	1					
	Pentachlorophenol	µg/L	2					

Notes: *bioaccumulative toxin 95% protection level instead of 80% protection adopted; ⁺No values recommended in ANZECC (2000), values adopted from the National Environmental Management Plan (NEMP) and since PFAS is bioaccumulative toxin 95% protection level instead of 80% protection adopted.

A2. Adopted trigger values for Mill Stream

Table A.2 shows the adopted trigger values for Mill Stream. Trigger values for physical and chemical stressors are based on the ANZEC (2000) default trigger values. Trigger values for toxicants are based on 95% (99% for bioaccumulative) protection level. The final column shows the accepted limits of contamination specified in Schedule 2 of the Airports (Environment Protection) Regulation 1997.

Table A.2 Adopted trigger values for Mill Stream (ANZECC 2000)

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
Notes: *bioaccumulative toxin 95% protection level instead of 80% protection adopted; +no values recommended in ANZECC(2000), values adopted from the national environmental management plan (NEMP) and since PFAS is bioaccumulative toxin 95% protection level instead of 90% protection adopted. Highlighted in red means the trigger values are determined by environmental values other than aquatic ecosystems.									
Inorganics	Alkalinity (Bicarbonate as CaCO3)	mg/L	1						
	Alkalinity (Carbonate as CaCO3)	mg/L	1						
	Alkalinity (Hydroxide) as CaCO3	mg/L	1						
	Alkalinity (total) as CaCO3	mg/L	1						
	Anions Total	meq/L	0.01						
	Calcium	mg/L	0.5						
	Cations Total	meq/L	0.01						
	Chloride	mg/L	1		400	400		**400**	
	Cyanide	mg/L	na						0.005
	Ferrous Iron	mg/L	-						
	Ionic Balance	%	0.01						

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
	Nitrate (as N)	mg/L	0.002		10	10	100	**10**	0.01
	Nitrite (as N)	mg/L	0.002		1	1	0.1	**0.1**	
	Nitrogen (Total Oxidised)	mg/L	0.002						
	Nitrogen (Total)	mg/L	0.01	0.3				**0.3**	
	Phosphate (as P)	mg/L	0.005						0.005
	pH (Lab)	pH units	0.01	7.0-8.5	6.5-8.5	5.0-9.0		**7.0-8.5**	Change < 0.2
	Sodium	mg/L	0.5						
	Sulphide	mg/L	na						0.002
	Sulphate (Filtered)	mg/L	1		400	400		**400**	
	TDS	mg/L	5		1000	1000	33000-37000	**1000**	
	TSS	mg/L	5				10	**10**	
	Turbidity NTU	NTU	0.1	0.5-10				0.5-10	
MAH	1,2,4-triethylbenzene	µg/L	1						
	1,3,5-triethylbenzene	µg/L	1						
	Isopropylbenzene	µg/L	1						
	n-butylbenzene	µg/L	1						
	n-propylbenzene	µg/L	1						
	p-isopropyltoluene	µg/L	1						
	sec-butylbenzene	µg/L	1						

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
	Styrene	µg/L	1						
	tert-butylbenzene	µg/L	1						
Metals	Aluminium	mg/L	0.005		0.2	0.2	0.01	**0.01**	-
	Aluminium (filtered)	mg/L	0.005		0.2	0.2	0.01	**0.03**	
	Antimony	mg/L	na						0.5
	Arsenic	mg/L	0.0002		0.05	0.05	0.03	**0.03**	0.05
	Arsenic (Filtered)	mg/L	0.0002		0.05	0.05	0.0005-0.005	**0.005**	0.05
	Cadmium	mg/L	0.00005	0.0055	0.005	0.005	0.0005-0.005	**0.005**	0.002
	Cadmium (filtered)	mg/L	0.00005	0.0055	0.005	0.005	0.0005-0.005	**0.005**	0.002
	Chromium (III+VI)	mg/L	0.0002	0.0044	0.05	0.05	0.02	**0.0044**	0.05
	Chroromium (III+VI) (Filtered)	mg/L	0.0002	0.0044	0.05	0.05	0.005	**0.0044**	0.05
	Copper	mg/L	0.0005	0.0013	1	1	0.005	**0.0013**	0.005
	Copper (Filtered)	mg/L	0.0005	0.0013	1	1	0.005	**0.00013**	0.005
	Iron	mg/L	0.002		0.3	0.3	0.01	**0.01**	-
	Iron (Filtered)	mg/L	0.002		0.3	0.3	0.01	**0.01**	
	Lead	mg/L	0.0001	0.0022*	0.05	0.05		**0.0022**	0.005
	Lead (Filtered)	mg/L	0.0001	0.0022*	0.05	0.05		**0.0022**	
	Magnesium	mg/L	0.5						
	Manganese	mg/L	0.0005		0.1	0.1	0.01	**0.01**	

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
	Manganese (Filtered)	mg/L	0.0005		0.1	0.1	0.01	**0.01**	
	Mercury	mg/L	0.00001	0.0001*	0.001	0.001	0.001	**0.0001**	0.0001 (0.000025 for methylmercury)
	Mercury (Filtered)	mg/L	0.00001	0.0001*	0.001	0.001	0.001	**0.0001**	0.0001 (0.000025 for methylmercury)
	Nickel	mg/L	0.0005	0.07	0.1	0.1	0.1	**0.07**	0.015
	Nickel (Filtered)	mg/L	0.0005	0.07	0.1	0.1	0.1	**0.07**	0.015
	Potassium (Filtered)	mg/L	0.5						
	Selenium	mg/L	na						0.07
	Silver	mg/L	na						0.001
	Thallium	mg/L	na						0.02
	Tin (tributyltin)	mg/L	na						0.00002
	Zinc	mg/L	0.001	0.015	5	5	0.005	**0.005**	0.05
	Zinc (Filtered)	mg/L	0.001	0.015	5	5	0.005	**0.005**	0.05
Nutrients	Ammonia	mg/L	0.005	0.91	0.01	0.01	0.1	**0.01**	0.005
	Kjeldahl Nitrogen Total	mg/L	0.01						
	NOx as N in water	mg/L	-	0.015				0.015	

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
	Total Phosphorus	mg/L	0.005	0.03				**0.03**	
	Reactive Phosphorus as P	mg/L	0.001	0.005				0.005	
Organochlorine Pesticides	4,4-DDE	µg/L	0.2						
	a-BHC	µg/L	0.2						
	Acrolein	µg/L	na						0.2
	Aldrin	µg/L	0.2		1	1		**1**	0.01
	Aldrin + Dieldrin	µg/L	0.5						
	b-BHC	µg/L	0.2						
	chlordane	µg/L	0.5				0.004	**0.004**	0.004
	Chlordane (cis)	µg/L	0.2						
	Chlordane (trans)	µg/L	0.2						
	d-BHC	µg/L	0.2						
	DDD	µg/L	0.2						
	DDE	µg/L	na						0.014
	DDT	µg/L	0.2						0.001
	DDT+DDE+DDD	µg/L	0.5		3	3		**3**	
	Dieldrin	µg/L	0.2						0.002
	Endosulfan I	µg/L	0.2	0.01	40	40		**0.01**	0.01
	Endosulfan II	µg/L	0.2						

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
	Endosulfan sulphate	µg/L	0.2						
	Endrin	µg/L	0.2	0.02	1	1		0.02	0.003
	Endrin aldehyde	µg/L	0.2						
	Endrin ketone	µg/L	0.5						
	g-BHC (Lindane)	µg/L	0.2						0.003
	Heptachlor	µg/L	0.2		3	3		**3**	0.01
	Heptachlor epoxide	µg/L	0.2						
	Lindane	µg/L	na						0.003
	Methoxychlor	µg/L	0.2				0.004	0.004	0.04
	Mirex	µg/L	na						0.001
	Parathon	µg/L	na						
Organophosporous pesticides	Azinophos methyl	µg/L	0.2						
	Bromophos-ethyl	µg/L	0.2						
	Carbophenothion	µg/L	0.5						
	Chlorfenvinphos	µg/L	0.5						
	Chlorpyrifos	µg/L	0.2						0.001
	Chlorpyrifos-methyl	µg/L	0.2						
	Diazinon	µg/L	0.2						
	Dichlorvos	µg/L	0.2						

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
	Dimethoate	µg/L	0.2						
	Ethion	µg/L	0.2		6	6		**6**	
	Fenitrothion	µg/L	0.2		20	20		**20**	
	Fenthion	µg/L	0.5						
	Malathion	µg/L	0.2						0.1
	Methyl parathion	µg/L	2						
	Monocrotophos	µg/L	2						
	Prothiofos	µg/L	0.5						
	Ronnel	µg/L							
PAH	Benzo[b+j]fluoranthene	µg/L	1						
	Acenaphthene	µg/L	1				20	**20**	
	Acenaphthylene	µg/L	1						
	Anthracene	µg/L	1						
	Benz(a)anthracene	µg/L	1						
	Benzo(a)pyrene	µg/L	0.5						
	Benzo(a)pyreneTEQ	µg/L	0.5						
	Benzo(a)pyreneTEQ (zero)	µg/L	0.5						
	Benzo(b+j)&Benzo(k)fluoranthene	µg/L	0.5						
	Benzo(,h,i)perylene	µg/L	1						

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
	Benzo(k)fluoranthene	µg/L	1						
	Chrysene	µg/L	1						
	Dibenz(a,h)anthracene	µg/L	1						
	Fluoranthene	µg/L	1						
	Fluorene	µg/L	1						
	Indeno(1,2,3-c,d)pyrene	µg/L	1						
	Naphthalene	µg/L	1						
	Phenanthrene	µg/L	1						
	Pyrene	µg/L	1						
	Total +ve PAHs	µg/L	-						
	PAHs (Sum of total)	µg/L	0.5						
Pesticides	Demeton-S-methyl	µg/L	0.5						
	Fenamiphos	µg/L	0.5						
	Parathion	µg/L	0.2						
	Pirimphos-ethyl	µg/L	0.5						
PFAS	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	µg/L	0.001						
	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	µg/L	0.001						
	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	µg/L	0.0004						

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
	6:2 Fluorotelomer Sulfonate (6:2 FtS)	µg/L	0.0004						
	Perfluorobutane sulfonic acid (PFBS)	µg/L	0.0005						
	Perfluorobutanoic acid (PFBA)	µg/L	0.002						
	Perfluoroheptanoic acid (PFHpA)	µg/L	0.0005						
	Perfluorohexane sulfonic acid (PFHxS)	µg/L	0.0002						
	Perfluorohexanoic acid (PFHxA)	µg/L	0.0005						
	Perfluorooctane sulfonic acid (PFOS)	µg/L	0.0002	0.13+				0.13	
	Perfluorooctanoate (PFOA)	µg/L	0.0002	220+				220	
	Perfluoropentanoic acid (PFPeA)	µg/L	0.0005						
	Sum of PFAS (WA DER List)	µg/L	0.0003						
	Sum of PFHxS and PFOS	µg/L	0.0003						
Phenols	2,4-dimethylphenol	µg/L	1						
	2-methylphenol	µg/L	1						
	2-nitrophenol	µg/L	1						
	3-&4-methylphenol	µg/L	2						

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
	4-chloro-3-methylphenol	µg/L	1						
	Phenol	µg/L	1						50
	Phenolics Total	µg/L	-						
Solvents	2-hexanone (MBK)	µg/L	50						
	Methyl Ethyl	µg/L	50						
	4-Methyl-2-pentanone	µg/L	50						
	Carbon disulfide	µg/L	5						
	Cyclohexane	mg/L	-						
	Vinyl acetate	µg/L	50						
TBT	Tributyltin as SN	ngSn/L	0.002				0.00001	**0.00001**	
TPH	C_{10}–C_{36} (Sum of total)	µg/L	50						
	C_6–C_9	µg/L	10						
	C_{10}–C_{14}	µg/L	50						
	C_{15}–C_{28}	µg/L	100						
	C_{29}–C_{36}	µg/L	50						
	C_{10}–C_{16}	mg/L	0.05						
	C_{16}–C_{34}	mg/L	0.1						
	C_{34}–C_{40}	mg/L	0.1						
	F2-NAPHTHALENE	mg/L	0.05	70				**120**	

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
	C_{10}–C_{40} (Sum of total)	mg/L	0.1						
	C_{6}–C_{10} less BTEX (F1)	mg/L	0.01						
	C_{6}–C_{10}	mg/L	0.01						
VOC	cis-1,4-Dichloro-2-butene	µg/L	5						
	Pentachloroethane	µg/L	5						
	trans-1,4-Dichloro-2-butene	µg/L	5						
BTEXN	Benzene	µg/L	1	900	10	10		**10**	300
	Ethylbenzene	µg/L	2				250		-
	Toluene	µg/L	2				250	**250**	
	Xylene (m&p)	µg/L	2						
	Xylene (o)	µg/L	2						
	Xylene Total	µg/L	2						
	Naphthalene	µg/L	5						
Chlorinated Hydrocarbons	1,1,1,2-tetrachloroethane	µg/L	1						
	1,1,1-trichloroethane	µg/L	1						
	1,1,2,2-tetrachloroethane	µg/L	1						
	1,1,2-trichloroethane	µg/L	1						
	1,1-dichloroethane	µg/L	1						
	1,1-dichloroethene	µg/L	1						

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
	1,1-dichloropropene	µg/L	1						
	1,2,3-trichloropropane	µg/L	1						
	1,2-dibromo-3-chloropropane	µg/L	1						
	1,2-dichloroethane	µg/L	1						
	1,2-dichloropropane	µg/L	1						
	1,3-dichloropropane	µg/L	1						
	2,2-dichloropropane	µg/L	1						
	Bromochloromethane	µg/L	1						
	Bromodichloromethane	µg/L	1						
	Bromoform	µg/L	1						
	Carbon tetrachloride	µg/L	1						
	Chlorodibromomethane	µg/L	1						
	Chloroethane	µg/L	10						
	Chloroform	µg/L	1						
	Chloromethane	µg/L	10						
	cis-1,2-dichloroethene	µg/L	1						
	cis-1,3-dichloropropene	µg/L	1						
	Dibromomethane	µg/L	1						
	Hexachlorobutadiene	µg/L	1						0.3

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
	Trichloroethene	µg/L	1						
	Tetrachloroethene	µg/L	1						
	trans-1,2-dichloroethene	µg/L	1						
	trans-1,3-dichloropropene	µg/L	1						
	Vinyl chloride	µg/L	10						
Halogenated Benzenes	1,2,3-trichlorobenzene	µg/L	1						
	1,2,4-trichlorobenzene	µg/L	1	20*					
	1,2-dichlorobenzene	µg/L	1						
	1,3-dichlorobenzene	µg/L	1						
	1,4-dichlorobenzene	µg/L	1						
	2-chlorotoluene	µg/L	1						
	4-chlorotoluene	µg/L	1						
	Bromobenzene	µg/L	1						
	Chlorobenzene	µg/L	1						
	Hexachlorobenzene	µg/L	0.2						

Pollutant		Unit	LOR	Aquatic ecosystems 95%	Secondary contact recreation	Primary contact recreation	Aquatic foods	Adopted trigger value	Airport 1997
Halogenated Hydrocarbons	1,2-dibromoethane	µg/L	1						
	Bromomethane	µg/L	10						
	Dichlorodifluoromethane	µg/L	10						
	Iodomethane	µg/L	5						
	Trichlorofluoromethane	µg/L	10						
Halogenated Phenols	2,4,5-trichlorophenol	µg/L	1						8
	2,4,6-trichlorophenol	µg/L	1						
	2,4-dichlorophenol	µg/L	1						
	2,6-dichlorophenol	µg/L	1						
	2-chlorophenol	µg/L	1						
	Pentachlorophenol	µg/L	2						0.2
Phthalate esters	di-n-butylphthalate	µg/L							4
	di(2-ethylhexy) phthalate	µg/L							0.6
	other phthalate esters	µg/L							0.2
Polyaromatic hydro-carbons	Polychlorinated biphenyls	µg/L							0.001
	Polycyclic aromatic hydrocarbons	µg/L							3

Appendix B
Water quality summary tables

B1. Water quality summary tables

Table B.1, Table B.2, Table B.3 and Table B.4 show the average, median, maximum and 80%iles monitored values at each sampling point compared to the adopted trigger values (refer to Appendix A). Pollutants shown in red highlight are for those that have median exceeded default trigger values.

Table B.1 Statistics of water quality data for selected parameters at SW1, SW2, SW3

Pollutant	Units	LOD	Trigger value	SW1				SW2				SW3			
				Average	Median	Max	80%iles	Average	Median	Max	80%iles	Average	Median	Max	80%iles
Aluminium	µg/L	5	10.00	214.94	165.00	498.00	380.60	188.76	174.00	429.00	300.20	191.18	140.00	542.00	318.20
Aluminium (Filtered)	µg/L	0.2	10.00	26.29	22.00	68.00	34.20	26.53	24.00	53.00	40.80	23.76	21.00	57.00	30.80
Arsenic	µg/L	0.2	30.00	2.02	2.00	2.90	2.34	2.02	2.00	2.80	2.40	2.04	2.10	2.60	2.40
Arsenic (Filtered)	µg/L	0.2	30.00	1.65	1.70	2.20	1.94	1.61	1.60	2.20	1.94	1.63	1.70	2.30	1.84
Chromium	µg/L	0.2	20.00	0.74	0.60	1.60	1.00	0.79	0.60	1.60	1.18	0.88	0.50	3.20	1.18
Chromium (Filtered)	µg/L	0.5	20.00	0.54	0.50	1.10	0.50	0.58	0.50	1.50	0.54	0.56	0.50	1.10	0.54
Copper	µg/L	0.5	5.00	3.71	2.00	11.00	7.60	3.59	2.00	11.00	6.20	3.53	2.00	10.00	6.40
Copper (Filtered)	µg/L	2	5.00	1.59	1.00	4.00	2.80	1.47	1.00	4.00	2.40	1.53	1.00	4.00	2.40
Iron	µg/L	2	10.00	338.35	338.00	583.00	495.20	316.06	279.00	536.00	492.80	303.35	282.00	571.00	441.60
Iron (Filtered)	µg/L	2	10.00	41.47	22.00	150.00	70.00	38.24	22.00	154.00	58.60	36.06	20.00	169.00	54.80
Lead	µg/L	0.1	4.40	4.10	3.50	9.30	6.72	3.78	3.00	10.60	5.60	3.65	2.90	9.50	5.92
Lead (Filtered)	µg/L	0.1	4.40	0.71	0.30	3.30	0.96	0.71	0.30	3.20	0.98	0.61	0.20	3.20	0.88
Manganese	µg/L	0.5	10.00	28.63	26.40	59.20	38.52	27.31	29.40	52.80	36.54	26.83	25.20	52.70	37.44

Pollutant	Units	LOD	Trigger value	SW1				SW2				SW3			
				Average	Median	Max	80%iles	Average	Median	Max	80%iles	Average	Median	Max	80%iles
Manganese (Filtered)	µg/L	0.5	10.00	24.55	25.50	52.90	32.56	24.15	24.60	51.80	32.26	21.88	21.90	48.90	30.12
Mercury	µg/L	0.005	0.40	0.89	0.01	13.00	0.02	0.83	0.01	9.00	0.01	0.54	0.01	8.00	0.01
Mercury (Filtered)	µg/L	0.005	0.40	0.48	0.01	7.00	0.02	0.42	0.01	6.00	0.01	0.48	0.01	7.00	0.01
Nickel	µg/L	0.5	100	1	1	1.50	1.30	0.94	0.90	1.50	1.14	0.99	1.00	1.90	1.38
Nickel (Filtered)	µg/L	0.5	100	1	1	1.30	1.04	0.89	0.80	1.40	1.24	0.82	0.80	1.40	1.00
Zinc	µg/L	1	5.00	39.94	32.00	109.00	58.40	38.00	29.00	110.00	51.80	37.76	26.00	119.00	58.00
Zinc (Filtered)	µg/L	1	5.00	27.88	21.00	61.00	47.20	27.59	21.00	64.00	48.80	27.00	20.00	74.00	46.40
Electrical conductivity (lab)	µS/cm	1	n/a	44,400.00	44,400.00	44,400.00	-	45,000.00	45,000.00	45,000.00	-	45,100.00	45,100.00	45,100.00	-
Total Dissolved Solids	mg/L	5	1,000	26,504	31,000	43,000.00	35,080.00	27,754.71	32,400.00	44,600.00	37,640.00	28,605.29	32,300.00	44,900.00	39,700.00
pH (Lab)	pH Units	0.01	7-8.5	7.59	7.70	8.07	7.82	7.65	7.71	8.17	7.84	7.68	7.82	8.19	7.85
Total Suspended Solids	mg/L	5	10.00	11.19	8.50	33.00	16.60	9.81	9.00	24.00	13.80	11.25	8.50	25.00	20.40
Turbidity	NTU	0.1	10.00	6.59	3.60	21.20	13.26	6.08	3.30	20.50	11.04	6.34	4.00	22.40	12.26
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	n/a	102.24	117.00	136.00	124.00	104.24	116.00	157.00	126.80	104.18	117.00	135.00	127.80

Pollutant	Units	LOD	Trigger value	SW1				SW2				SW3			
				Average	Median	Max	80%iles	Average	Median	Max	80%iles	Average	Median	Max	80%iles
Ammonia (as N)	mg/L	0.005	0.01	0.12	0.08	0.32	0.23	0.13	0.08	0.66	0.23	0.12	0.07	0.48	0.21
Nitrate (as N)	mg/L	0.002	10.00	0.163	0.133	0.42	0.30	0.17	0.10	0.41	0.31	0.16	0.11	0.42	0.28
Nitrite (as N)	mg/L	0.002	0.10	0.016	0.017	0.03	0.02	0.02	0.01	0.04	0.02	0.01	0.01	0.03	0.02
Total Kjeldahl Nitrogen	mg/L	0.01	n/a	0.68	0.46	2.32	1.00	0.60	0.44	1.93	0.91	0.62	0.49	1.80	0.83
Total Nitrogen (as N)	mg/L	0.01	0.30	0.86	0.67	2.53	1.21	0.78	0.66	2.00	1.23	0.80	0.77	1.89	1.10
Total Phosphorus	mg/L	0.005	0.03	0.06	0.06	0.28	0.08	0.06	0.05	0.26	0.07	0.05	0.05	0.18	0.07
Chloride	mg/L	1	400	12,234	14,100	19,000	16,140.00	12,269.41	14,100.00	19,200.00	16,560.00	12,555	14,400	19,000	17,400.00
Calcium	mg/L	0.5	n/a	290.00	336.00	418.00	387.60	285.41	324.00	413.00	389.00	293.76	349.00	429.00	388.40
Magnesium	mg/L	0.5	n/a	846.71	990.00	1,250.00	1,122.00	835.35	984.00	1,250.00	1,144.00	860.76	1,020.00	1,300.00	1,144.00
Potassium	mg/L	0.5	n/a	262.94	303.00	474.00	347.60	258.65	277.00	477.00	351.00	266.88	305.00	496.00	349.40
Sodium	mg/L	0.5	n/a	7,101.18	8,400.00	11,200.00	9,332.00	6,999.29	8,310.00	11,200.00	9,492.00	7,188.59	8,460.00	11,600.00	9,522.00
Sulfate (as SO_4^-) (Filtered)	mg/L	1	400	1,842	2,190	2,620	2,440.00	1,843.41	2,070.00	2,770.00	2,418.00	1,929	2,240	2,800.	2,620.00
PFOA	µg/L	0.0005	220	0	0	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.01
PFOS	µg/L	0.0002	0.13	0.0161	0.0127	0.04	0.02	0.01	0.01	0.03	0.02	0.01	0.01	0.03	0.02

*cell values highlighted red where the trigger value exceeded

Table B.2 Statistics of water quality data for selected parameters at SW4, SW5, SW6

Pollutant	Units	LOD	Trigger Value	SW4				SW5				SW6			
				Average	Median	Max	80%iles	Average	Median	Max	80%iLes	Average	Median	Max	80%iles
Aluminium	µg/L	0.2	10.00	186.65	117.00	648.00	318.00	202.94	116.00	621.00	433.20	232.53	93.00	1,460.00	356.80
Aluminium (Filtered)	µg/L	0.2	10.00	22.82	18.00	58.00	37.40	18.82	14.00	51.00	27.20	19.53	14.00	80.00	27.40
Arsenic	µg/L	0.2	30.00	2.04	2.10	2.70	2.28	2.05	1.90	2.90	2.34	2.02	2.00	2.40	2.24
Arsenic (Filtered)	µg/L	0.2	30.00	1.69	1.70	2.40	2.00	1.65	1.70	2.10	2.04	1.72	1.70	2.20	2.10
Chromium	µg/L	0.2	20.00	0.80	0.50	2.10	1.12	0.78	0.50	2.20	1.34	0.75	0.50	2.20	0.88
Chromium (Filtered)	µg/L	0.5	20.00	0.53	0.50	0.90	0.50	0.52	0.50	0.80	0.50	0.52	0.50	0.80	0.50
Copper	µg/L	0.5	5.00	3.35	2.00	13.00	5.60	3.88	2.00	15.00	8.80	3.06	2.00	11.00	5.20
Copper (Filtered)	µg/L	2	5.00	1.41	1.00	4.00	2.00	1.35	1.00	4.00	2.00	1.24	1.00	3.00	1.40
Iron	µg/L	2	10.00	284.65	213.00	760.00	463.60	312.71	172.00	901.00	671.20	282.12	155.00	1,020.00	489.80
Iron (Filtered)	µg/L	2	10.00	35.12	14.00	212.00	55.20	33.18	12.00	181.00	74.00	29.88	13.00	138.00	48.80
Lead	µg/L	0.1	4.40	3.28	2.40	8.50	4.92	3.40	2.10	8.80	7.80	3.71	1.80	16.00	7.06
Lead (Filtered)	µg/L	0.1	4.40	0.53	0.20	2.20	0.80	0.45	0.20	2.10	0.56	0.42	0.30	1.40	0.62
Manganese	µg/L	0.5	10.00	22.45	19.30	43.30	37.74	30.11	13.70	201.00	33.28	16.03	11.00	43.00	27.82
Manganese (Filtered)	µg/L	0.5	10.00	18.68	16.40	37.20	28.30	15.25	11.60	39.10	24.06	12.14	9.80	33.90	20.26
Mercury	µg/L	0.005	0.40	0.83	0.01	9.00	0.02	0.54	0.01	6.00	0.02	0.83	0.01	9.00	0.02

Pollutant	Units	LOD	Trigger Value	SW4				SW5				SW6			
				Average	Median	Max	80%iles	Average	Median	Max	80%iLes	Average	Median	Max	80%iles
Mercury (Filtered)	µg/L	0.005	0.40	0.65	0.01	10.00	0.02	0.30	0.01	4.00	0.01	0.42	0.01	5.00	0.01
Nickel	µg/L	0.5	100	0.92	0.80	1.70	1.38	1.04	0.80	3.80	1.48	19.38	0.50	317.00	1.32
Nickel (Filtered)	µg/L	0.5	100	0.81	0.70	1.40	1.14	0.79	0.70	1.90	0.90	0.71	0.60	1.60	1.00
Zinc	µg/L	1	5.00	29.94	20.00	105.00	39.80	34.29	20.00	172.00	51.80	44.47	13.00	385.00	46.20
Zinc (Filtered)	µg/L	1	5.00	21.59	15.00	60.00	30.80	18.18	13.00	52.00	25.40	14.59	13.00	36.00	21.80
Electrical conductivity (lab)	µS/cm	1	n/a	46,200.00	46,200.00	46,200.00	-	49,400.00	49,400.00	49,400.00	-	50,600.00	50,600.00	50,600.00	-
Total Dissolved Solids	mg/L	5	1,000	30,631.18	35,000.00	45,700.00	40,260.00	30,840.00	35,600.00	46,600.00	41,820.00	30,467.65	34,300.00	47,700.00	43,440.00
pH (Lab)	pH Units	0.01	7-8.5	7.75	7.85	8.15	7.93	7.78	7.88	8.20	7.98	7.80	7.90	8.16	8.00
Total Suspended Solids	mg/L	5	10.00	9.25	6.00	21.00	16.60	9.13	5.00	26.00	14.80	9.94	5.00	47.00	15.20
Turbidity	NTU	0.1	10.00	6.41	3.20	22.20	13.22	6.44	2.20	27.90	13.20	7.86	1.80	44.20	11.48
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	n/a	104.24	120.00	135.00	126.40	104.76	115.00	135.00	126.20	105.71	117.00	134.00	124.20
Ammonia (as N)	mg/L	0.005	0.01	0.09	0.06	0.36	0.18	0.07	0.04	0.22	0.14	0.06	0.02	0.20	0.15

Pollutant	Units	LOD	Trigger Value	SW4				SW5				SW6			
				Average	Median	Max	80%iles	Average	Median	Max	80%iLes	Average	Median	Max	80%iles
Nitrate (as N)	mg/L	0.002	10.00	0.15	0.09	0.46	0.27	0.13	0.08	0.40	0.23	0.15	0.06	0.84	0.24
Nitrite (as N)	mg/L	0.002	0.10	0.01	0.01	0.03	0.02	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.02
Total Kjeldahl Nitrogen	mg/L	0.01	n/a	0.48	0.37	1.24	0.82	0.43	0.27	1.17	0.76	0.35	0.21	1.07	0.65
Total Nitrogen (as N)	mg/L	0.01	0.30	0.65	0.57	1.32	1.07	0.58	0.50	1.43	0.98	0.52	0.37	1.62	0.90
Total Phosphorus	mg/L	0.005	0.03	0.05	0.04	0.10	0.07	0.04	0.03	0.10	0.06	0.04	0.03	0.12	0.07
Chloride	mg/L	1	400	13,410.94	14,700.00	20,300.00	18,620.00	13,451.76	15,300.00	19,900.00	18,080.00	13,695.18	15,600.00	19,600.00	17,680.00
Calcium	mg/L	0.5	n/a	309.71	346.00	446.00	406.40	320.76	371.00	457.00	416.80	326.12	395.00	438.00	422.40
Magnesium	mg/L	0.5	n/a	907.71	1,030.00	1,350.00	1,204.00	952.59	1,130.00	1,380.00	1,224.00	973.88	1,190.00	1,330.00	1,264.00
Potassium	mg/L	0.5	n/a	274.12	319.00	392.00	371.80	292.24	343.00	490.00	378.20	298.41	362.00	480.00	391.40
Sodium	mg/L	0.5	n/a	7,629.88	8,240.00	12,000.00	10,040.00	7,964.47	9,460.00	12,200.00	10,220.00	8,121.18	9,740.00	11,800.00	10,600.00
Sulfate (as SO_4^-) (Filtered)	mg/L	1	400	2,047	2,370	2,980	2,650.00	2,057	2,380	3,000	2,704.00	2,147	2,430	3,200	2,836.00
PFOA	µg/L	0.0005	220	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01
PFOS	µg/L	0.0002	0.13	0.01	0.01	0.03	0.02	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.01

*cell values highlighted red where the trigger value exceeded

Table B.3 Statistics of water quality data for selected parameters at SW7 and SW8

Pollutant	Units	LOD	Trigger Value	SW7				SW8			
				Average	Median	Max	80%ILES	Average	Median	Max	80%ILES
Aluminium	µg/L	5	10.00	256.96	146.50	1,610.00	295.60	203.41	101.00	1,820.00	190.80
Aluminium (Filtered)	µg/L	0.2	10.00	26.15	16.00	174.00	24.80	20.11	13.00	101.00	29.40
Arsenic	µg/L	0.2	30.00	2.03	2.10	2.60	2.26	2.05	2.00	2.60	2.24
Arsenic (Filtered)	µg/L	0.2	30.00	1.70	1.80	2.50	1.96	1.78	1.80	2.70	2.00
Chromium	µg/L	0.2	20.00	0.95	0.60	3.30	1.22	0.73	0.50	2.90	1.00
Chromium (Filtered)	µg/L	0.5	20.00	0.52	0.50	1.00	0.50	0.55	0.50	1.00	0.50
Copper	µg/L	0.5	5.00	3.62	2.00	16.00	5.60	3.04	1.00	20.00	3.40
Copper (Filtered)	µg/L	2	5.00	1.42	1.00	4.00	2.00	1.33	1.00	3.00	2.00
Iron	µg/L	2	10.00	373.08	225.00	1,400.00	616.40	255.52	164.00	1,360.00	339.60
Iron (Filtered)	µg/L	2	10.00	39.92	16.50	166.00	83.80	26.11	10.00	139.00	43.80
Lead	µg/L	0.1	4.40	3.64	2.40	13.40	4.06	2.30	1.60	11.00	3.28
Lead (Filtered)	µg/L	0.1	4.40	0.43	0.30	1.60	0.80	0.47	0.20	1.90	0.94
Manganese	µg/L	0.5	10.00	22.60	16.80	68.70	35.82	15.75	9.60	40.80	29.24
Manganese (Filtered)	µg/L	0.5	10.00	18.99	12.05	67.60	31.72	11.73	7.70	38.00	21.64
Mercury	µg/L	0.005	0.40	0.51	0.01	7.00	0.01	0.53	0.01	9.00	0.02

Pollutant	Units	LOD	Trigger Value	SW7				SW8			
				Average	Median	Max	80%ILES	Average	Median	Max	80%ILES
Mercury (Filtered)	µg/L	0.005	0.40	0.35	0.01	5.00	0.01	0.42	0.01	6.00	0.02
Nickel	µg/L	0.5	100	1.03	0.85	3.10	1.32	0.83	0.60	2.40	1.20
Nickel (Filtered)	µg/L	0.5	100	0.80	0.80	1.70	0.90	0.68	0.60	1.00	0.94
Zinc	µg/L	1	5.00	25.81	17.00	80.00	35.00	20.37	12.00	72.00	39.00
Zinc (Filtered)	µg/L	1	5.00	16.58	14.00	37.00	24.60	14.26	9.00	42.00	26.20
Electrical conductivity (lab)	µS/cm	1	n/a	48,200.00	48,200.00	48,200.00	#NUM!	52,900.00	52,900.00	52,900.00	#NUM!
Total Dissolved Solids	mg/L	5	1,000	29,778.50	34,100.00	47,800.00	40,060.00	31,668.89	36,500.00	51,800.00	40,580.00
pH (Lab)	pH Units	0.01	7-8.5	7.76	7.82	8.11	7.94	7.82	7.95	8.24	8.05
Total Suspended Solids	mg/L	5	10.00	10.33	6.50	47.00	13.00	9.04	5.00	52.00	10.00
Turbidity	NTU	0.1	10.00	6.94	3.40	47.00	8.26	6.27	2.20	53.50	7.26
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	n/a	108.12	113.50	182.00	130.00	105.93	117.00	141.00	128.00
Ammonia (as N)	mg/L	0.005	0.01	0.09	0.07	0.40	0.16	0.06	0.01	0.30	0.12
Nitrate (as N)	mg/L	0.002	10.00	0.17	0.06	1.27	0.19	0.13	0.05	0.93	0.19
Nitrite (as N)	mg/L	0.002	0.10	0.01	0.01	0.03	0.02	0.01	0.01	0.02	0.02
Total Kjeldahl Nitrogen	mg/L	0.01	n/a	0.48	0.30	1.46	0.83	0.39	0.32	1.14	0.72

Pollutant	Units	LOD	Trigger Value	SW7				SW8			
				Average	Median	Max	80%ILES	Average	Median	Max	80%ILES
Total Nitrogen (as N)	mg/L	0.01	0.30	0.66	0.45	2.18	1.13	0.54	0.37	1.85	0.93
Total Phosphorus	mg/L	0.005	0.03	0.05	0.04	0.14	0.08	0.04	0.02	0.10	0.07
Chloride	mg/L	1	400	13,321.81	15,150.00	20,000.00	17,360.00	14,100.74	16,100.00	20,200.00	18,340.00
Calcium	mg/L	0.5	n/a	296.62	340.50	436.00	399.60	322.00	363.00	453.00	418.00
Magnesium	mg/L	0.5	n/a	863.54	1,025.00	1,240.00	1,178.00	953.19	1,110.00	1,310.00	1,254.00
Potassium	mg/L	0.5	n/a	268.69	318.00	385.00	368.80	293.48	322.00	416.00	386.00
Sodium	mg/L	0.5	n/a	7,370.69	8,635.00	12,000.00	9,946.00	8,129.74	9,220.00	11,900.00	10,440.00
Sulfate (as SO_4^-) (Filtered)	mg/L	1	400	2,011.96	2,310.00	3,030.00	2,672.00	2,236.60	2,520.00	3,430.00	3,078.00
PFOA	µg/L	0.0005	220	0.01	0.01	0.05	0.01	0.01	0.00	0.05	0.01
PFOS	µg/L	0.0002	0.13	0.01	0.01	0.05	0.01	0.01	0.01	0.05	0.02

Table B.4 Statistics of water quality data for selected parameters at SW9, SW10, SW11

Pollutant	Units	LOD	Trigger Value	SW9				SW10				SW11			
				Average	Median	Max	80%ILES	Average	Median	Max	80%ILES	Average	Median	Max	80%ILES
Aluminium	µg/L	5	10.00	1,620.38	185.00	18,500.00	400.80	227.23	164.50	846.00	389.60	1,269.52	778.00	5,740.00	1,522.00
Aluminium (Filtered)	µg/L	0.2	10.00	20.15	19.00	44.00	25.40	29.88	26.00	67.00	42.00	131.68	110.00	268.00	189.00
Arsenic^	µg/L	0.2	30.00	15.79	1.80	168.00	6.46	3.76	2.90	12.30	4.66	2.03	1.80	5.20	2.50
Arsenic (Filtered)	µg/L	0.2	30.00	0.94	0.90	1.60	1.30	2.31	1.90	8.20	2.86	1.22	1.10	2.10	1.60
Chromium^	µg/L	0.2	4.40	2.93	0.50	31.50	1.12	1.71	1.15	7.90	1.96	2.28	1.60	11.80	2.16
Chromium (Filtered)	µg/L	0.5	4.40	0.23	0.20	0.40	0.30	0.35	0.20	1.10	0.40	0.66	0.70	0.90	0.80
Copper	µg/L	0.5	1.30	12.21	2.30	127.00	5.60	5.05	4.30	12.10	8.18	9.81	4.50	50.40	12.94
Copper (Filtered)	µg/L	2	1.30	1.63	1.40	3.80	2.76	1.45	1.15	4.00	2.12	2.12	1.60	5.60	3.16
Iron	µg/L	2	10.00	12,989.31	688.00	143,000.00	5,056.00	768.27	496.50	3,030.00	1,294.00	1,691.48	932.00	6,720.00	2,822.00
Iron (Filtered)	µg/L	2	10.00	208.00	206.00	356.00	302.40	182.42	198.50	318.00	268.40	272.40	276.00	433.00	353.40
Lead	µg/L	0.1	2.20	24.75	3.00	278.00	7.52	8.91	5.95	28.00	12.10	11.04	4.20	68.50	17.78
Lead (Filtered)	µg/L	0.1	2.20	0.39	0.20	1.80	0.60	0.97	0.85	2.00	1.38	0.72	0.60	1.90	1.16
Manganese	µg/L	0.5	10.00	856.71	70.80	8,650.00	580.80	81.25	33.85	410.00	168.20	45.28	34.90	152.00	54.92

Pollutant	Units	LOD	Trigger Value	SW9				SW10				SW11			
				Average	Median	Max	80%ILES	Average	Median	Max	80%ILES	Average	Median	Max	80%ILES
Manganese (Filtered)	µg/L	0.5	10.00	38.01	38.20	80.30	65.68	16.49	8.45	102.00	20.04	24.87	24.80	66.40	29.58
Mercury^	µg/L	0.005	0.10	15.78	0.01	193.00	2.43	0.66	0.01	12.00	0.02	0.49	0.01	9.00	0.02
Mercury^ (Filtered)	µg/L	0.005	0.10	0.62	0.01	6.00	0.41	0.24	0.01	5.00	0.01	0.24	0.01	5.00	0.01
Nickel	µg/L	0.5	70	1.92	0.50	17.80	0.82	0.80	0.60	2.40	1.12	1.52	1.00	6.00	2.04
Nickel (Filtered)	µg/L	0.5	70	0.57	0.50	0.90	0.66	0.56	0.50	1.40	0.50	0.69	0.70	1.00	0.80
Zinc	µg/L	1	5.00	112.85	30.00	1,090.00	60.60	27.85	19.50	110.00	43.00	84.00	42.00	364.00	117.80
Zinc (Filtered)	µg/L	1	5.00	17.77	15.00	39.00	22.40	6.77	5.00	25.00	9.60	29.40	27.00	68.00	34.80
Electrical conductivity (lab)	µS/cm	1	n/a	-	-	-	-	239.00	239.00	239.00	-	298.00	298.00	298.00	-
Total Dissolved Solids	mg/L	5	1,000	154.77	140.00	254.00	206.00	128.85	128.50	192.00	146.40	181.36	180.00	430.00	201.40
pH (Lab)	pH Units	0.01	7-8.5	7.07	7.04	7.57	7.31	7.58	7.43	9.62	7.93	7.13	7.11	7.55	7.36
Total Suspended Solids	mg/L	5	10.00	213.62	12.00	2,150.00	126.80	39.28	28.00	149.00	54.00	39.67	18.50	394.00	46.00
Turbidity	NTU	0.1	10.00	118.41	4.40	1,290.00	53.32	14.38	7.85	56.60	27.84	17.90	11.30	142.00	18.32

Pollutant	Units	LOD	Trigger Value	SW9				SW10				SW11			
				Average	Median	Max	80%ILES	Average	Median	Max	80%ILES	Average	Median	Max	80%ILES
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	n/a	48.23	49.00	62.00	55.20	45.85	46.00	70.00	55.60	53.76	55.00	82.00	70.20
Ammonia (as N)	mg/L	0.005	0.01	0.13	0.10	0.48	0.22	0.03	0.02	0.17	0.04	0.18	0.18	0.43	0.25
Nitrate (as N)	mg/L	0.002	10.00	0.38	0.37	0.62	0.53	0.09	0.04	0.49	0.16	0.56	0.52	1.93	0.70
Nitrite (as N)	mg/L	0.002	0.10	0.01	0.01	0.02	0.01	0.00	0.00	0.02	0.01	0.01	0.01	0.03	0.02
Total Kjeldahl Nitrogen	mg/L	0.01	n/a	0.39	0.39	0.84	0.52	0.68	0.49	1.74	1.09	0.55	0.46	2.28	0.60
Total Nitrogen (as N)	mg/L	0.01	0.30	0.80	0.81	1.21	0.93	0.91	0.61	3.08	1.47	1.12	0.93	2.74	1.40
Total Phosphorus	mg/L	0.005	0.03	0.02	0.01	0.09	0.04	0.06	0.03	0.26	0.06	0.06	0.03	0.34	0.06
Chloride	mg/L	1	400	28.85	29.00	35.00	32.00	28.31	29.00	33.00	32.00	33.16	35.00	43.00	38.80
Calcium	mg/L	0.5	n/a	13.85	15.00	16.00	16.00	14.62	15.00	19.00	16.60	20.60	21.00	29.00	26.60
Magnesium	mg/L	0.5	n/a	3.23	3.00	5.00	4.00	3.28	3.00	5.00	4.00	3.84	4.00	5.00	5.00
Potassium	mg/L	0.5	n/a	4.08	4.00	5.00	5.00	3.96	4.00	5.00	4.54	4.28	5.00	6.00	5.00
Sodium	mg/L	0.5	n/a	18.69	19.00	33.00	20.20	20.85	20.00	34.00	25.60	25.88	27.00	40.00	31.80

Pollutant	Units	LOD	Trigger Value	SW9				SW10				SW11			
				Average	Median	Max	80%ILES	Average	Median	Max	80%ILES	Average	Median	Max	80%ILES
Sulfate (as SO_4^-) (Filtered)	mg/L	1	400	10.00	9.00	15.00	13.20	10.32	10.00	16.00	12.00	24.44	26.00	32.00	29.80
PFOA	µg/L	0.0005	220	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.02
PFOS	µg/L	0.0002	0.13	0.02	0.02	0.03	0.02	0.04	0.04	0.07	0.05	0.06	0.06	0.13	0.07

* cell values highlighted in red where the trigger value exceeded

^Further review of data required as exceedance may be due to outliers

Appendix C
Trigger values for ongoing monitoring

C1. Site specific trigger values

Table C.1 Site specific trigger values based on site monitoring data for water quality monitoring at Mill Stream

Pollutants\Location	Unit	SW9	SW11
		Trigger Values	Trigger Values
Aluminium	µg/L	400.80	1,522.00
Aluminium (Filtered)	µg/L	25.40	189.00
Arsenic	µg/L	30.00	30.00
Arsenic (Filtered)	µg/L	30.00	30.00
Chromium	µg/L	4.40	4.40
Chromium (Filtered)	µg/L	4.40	4.40
Copper	µg/L	5.60	12.94
Copper (Filtered)	µg/L	2.76	3.16
Iron	µg/L	5056.00	2,822.00
Iron (Filtered)	µg/L	302.40	353.40
Lead	µg/L	7.52	17.78
Lead (Filtered)	µg/L	2.20	2.20
Manganese	µg/L	202.20	54.92
Manganese (Filtered)	µg/L	55.90	29.58
Mercury	µg/L	2.43	0.10
Mercury (Filtered)	µg/L	0.41	0.10
Nickel	µg/L	70.00	70.00
Nickel (Filtered)	µg/L	70.00	70.00
Zinc	µg/L	60.60	117.80
Zinc (Filtered)	µg/L	22.40	34.80
Electrical conductivity (lab)	µS/cm	-	-
Total Dissolved Solids	mg/L	1,000.00	1,000.00
pH (Lab)	pH Units	7.91	7.36
Total Suspended Solids	mg/L	126.80	46.00
Turbidity	NTU	53.32	18.32
Bicarbonate Alkalinity as CaCO3	mg/L	55.20	70.20
Ammonia (as N)	mg/L	0.22	0.25
Nitrate (as N)	mg/L	10.00	10.00

Pollutants\Location	Unit	SW9	SW11
		Trigger Values	Trigger Values
Nitrite (as N)	mg/L	0.10	0.10
Total Kjeldahl Nitrogen	mg/L	0.52	0.60
Total Nitrogen (as N)	mg/L	0.93	1.40
Total Phosphorus	mg/L	0.04	0.06
Chloride	mg/L	400.00	400.00
Calcium	mg/L	16.00	26.60
Magnesium	mg/L	4.00	5.00
Potassium	mg/L	5.00	5.00
Sodium	mg/L	20.20	31.80
Sulfate (as SO4-) (Filtered)	mg/L	400.00	400.00
PFOA	µg/L	220	220.00
PFOS	µg/L	0.13	0.13

Table C.2 Trigger values for water quality monitoring should discharge be required

Pollutants\Location	Unit	Revised Trigger value
Aluminium	µg/L	230
Aluminium (Filtered)	µg/L	28
Arsenic	µg/L	50
Arsenic (Filtered)	µg/L	50
Chromium	µg/L	85
Chromium (Filtered)	µg/L	85
Copper	µg/L	8
Copper (Filtered)	µg/L	8
Iron	µg/L	1000
Iron (Filtered)	µg/L	280
Lead	µg/L	2.2
Lead (Filtered)	µg/L	2.2
Manganese	µg/L	50
Manganese (Filtered)	µg/L	20
Mercury	µg/L	0.1
Mercury (Filtered)	µg/L	0.1
Nickel	µg/L	560
Nickel (Filtered)	µg/L	560
Zinc	µg/L	43
Zinc (Filtered)	µg/L	43
Electrical conductivity (lab)	µS/cm	-
Total Dissolved Solids	mg/L	1,000
pH (Lab)	pH Units	7.0-8.5
Total Suspended Solids	mg/L	10
Turbidity	NTU	10
Bicarbonate Alkalinity as CaCO3	mg/L	60
Ammonia (as N)	mg/L	0.1
Nitrate (as N)	mg/L	10
Nitrite (as N)	mg/L	1
Total Kjeldahl Nitrogen	mg/L	0.6
Total Nitrogen (as N)	mg/L	0.9

Pollutants\Location	Unit	Revised Trigger value
Total Phosphorus	mg/L	0.06
Chloride	mg/L	16,000
Calcium	mg/L	20
Magnesium	mg/L	4
Potassium	mg/L	4
Sodium	mg/L	30
Sulfate (as SO4-) (Filtered)	mg/L	400
PFOA	µg/L	220
PFOS	µg/L	0.13

Appendix D
Westconnex water quality data

D1. WestConnex water quality data

Water quality data was collected during construction phase monitoring for the New M5 project. A year (August 2016 – July 2017) of monthly sampling data was supplied (WestConnex, 2018).

Monitoring points SW02, SW06 and SW07 for the New M5 were in similar locations (respectively) to monitoring points SW2, SW7 and SW8 for this project (seeFigure 3.2 for approximate locations).

Table D.1 shows the 80th percentiles for SW02, SW06 and SW07 for the year of data provided. The trigger values in Table D.1 are based on the assessment criteria detailed in Section 3.4.4. It is evident that total nitrogen, iron, manganese, zinc and total phosphorus exceed the ANZECC (2000) water quality objectives at least 80 per cent of the time. These exceedances are indicated in red in Table D.1.

It is noted that the analysed data was collected during the construction phase of the New M5 project, and it is possible that runoff could have affected the baseline data.

Table D.1 New M5 construction phase water quality data (80th percentiles)

	Units	Source	Adopted trigger value	SW-02 80th percentile	SW-06 80th percentile	SW-07 80th percentile
Nitrite as N	mg/L	Aquatic foods	0.1	0.02	0.02	0.02
Nitrate as N	mg/L	Primary contact	10	0.25	0.11	0.17
Total Nitrogen as N	mg/L	Aquatic ecosystems	0.3	1.4	1	1
pH	pH units	Aquatic ecosystems	7.0-8.5	7.86	7.97	8.06
Suspended Solids	mg/L	Aquatic foods	10	17	10	16
Arsenic	mg/L	Aquatic foods	0.03	0.01	0.01	0.01
Cadmium	mg/L	Aquatic foods	0.005	0.001	0.001	0.001
Copper	mg/L	Aquatic foods	0.005	0.01	0.01	0.01
Iron	mg/L	Aquatic foods	0.01	0.5	0.12	0.1
Lead	mg/L	Aquatic ecosystems	0.012	0.01	0.01	0.01
Manganese	mg/L	Aquatic foods	0.01	0.0288	0.024	0.016
Mercury	mg/L	Aquatic foods	0.001	0.00004	0.0001	0.00019
Nickel	mg/L	Aquatic foods	0.01	0.01	0.01	0.01
Zinc	mg/L	Aquatic foods	0.005	0.105	0.05	0.05
Ammonia	mg/L	Primary contact	0.01	0.27	0.332	0.364
Total Phosphorus as P	mg/L	Aquatic ecosystems	0.03	0.27	0.1	0.07

Values in red indicate exceedance of trigger values

Appendix E

Comparison of Baseline Water Quality data against Schedule 2 of the Airport (Environmental Protection) Regulation water quality trigger value

Table E.1 Comparison of Mill Stream water quality monitoring data with trigger values based on acceptable limits set in Schedule 2 of the Airport (Environmental) Regulation 1997. Red highlighted means trigger value exceeded

Pollutants\Location	Unit	Trigger Value (Airport 1997)	SW9			SW10			SW11		
			Average	Median	Max	Average	Median	Max	Average	Median	Max
Aluminium	µg/L	-	1,620.38	185.00	18,500.00	227.23	164.50	846.00	711.09	778.00	5,740.00
Aluminium (Filtered)	µg/L	-	20.15	19.00	44.00	29.88	26.00	67.00	76.98	110.00	268.00
Arsenic	µg/L	50.00	15.79	1.80	168.00	3.76	2.90	12.30	3.10	1.80	5.20
Arsenic (Filtered)	µg/L	50.00	0.94	0.90	1.60	2.31	1.90	8.20	1.91	1.10	2.10
Chromium	µg/L	-	2.93	0.50	31.50	1.71	1.15	7.90	2.07	1.60	11.80
Chromium (Filtered)	µg/L	-	0.23	0.20	0.40	0.35	0.20	1.10	0.50	0.70	0.90
Copper	µg/L	5.00	12.21	2.30	127.00	5.05	4.30	12.10	7.33	4.50	50.40
Copper (Filtered)	µg/L	5.00	1.63	1.40	3.80	1.45	1.15	4.00	1.81	1.60	5.60
Iron	µg/L	-	12,989.31	688.00	143,000.00	768.27	496.50	3,030.00	1,227.50	932.00	6,720.00
Iron (Filtered)	µg/L	-	208.00	206.00	356.00	182.42	198.50	318.00	227.84	276.00	433.00
Lead	µg/L	5.00	24.75	3.00	278.00	8.91	5.95	28.00	10.17	4.20	68.50
Lead (Filtered)	µg/L	5.00	0.39	0.20	1.80	0.97	0.85	2.00	0.88	0.60	1.90
Manganese	µg/L	-	856.71	70.80	8,650.00	81.25	33.85	410.00	70.52	34.90	152.00
Manganese (Filtered)	µg/L	-	38.01	38.20	80.30	16.49	8.45	102.00	21.76	24.80	66.40
Mercury	µg/L	0.10	15.78	0.01	193.00	0.66	0.01	12.00	0.77	0.01	9.00
Mercury (Filtered)	µg/L	0.10	0.62	0.01	6.00	0.24	0.01	5.00	0.32	0.01	5.00
Nickel	µg/L	15.00	1.92	0.50	17.80	0.80	0.60	2.40	1.15	1.00	6.00

Pollutants\Location	Unit	Trigger Value (Airport 1997)	SW9			SW10			SW11		
			Average	Median	Max	Average	Median	Max	Average	Median	Max
Nickel (Filtered)	µg/L	15.00	0.57	0.50	0.90	0.56	0.50	1.40	0.63	0.70	1.00
Zinc	µg/L	50.00	112.85	30.00	1,090.00	27.85	19.50	110.00	54.59	42.00	364.00
Zinc (Filtered)	µg/L	50.00	17.77	15.00	39.00	6.77	5.00	25.00	17.38	27.00	68.00
Electrical conductivity (lab)	µS/cm	-	-	-	-	239.00	239.00	239.00	250.80	298.00	298.00
Total Dissolved Solids	mg/L	-	154.77	140.00	254.00	128.85	128.50	192.00	154.01	180.00	430.00
pH (Lab)	pH Units	6.5-9 or Change > 0.2	7.07	7.04	7.57	7.58	7.43	9.62	7.42	7.11	7.55
Total Suspended Solids	mg/L	Change <10%	213.62	12.00	2,150.00	39.28	28.00	149.00	41.44	18.50	394.00
Turbidity	NTU	-	118.41	4.40	1,290.00	14.38	7.85	56.60	16.76	11.30	142.00
Bicarbonate Alkalinity as CaCO3	mg/L	-	48.23	49.00	62.00	45.85	46.00	70.00	50.06	55.00	82.00
Ammonia (as N)	mg/L	0.005	0.13	0.10	0.48	0.03	0.02	0.17	0.10	0.18	0.43
Nitrate (as N)	mg/L	0.010	0.384	0.370	0.624	0.090	0.039	0.492	0.314	0.520	1.930
Nitrite (as N)	mg/L	-	0.009	0.011	0.017	0.004	0.002	0.019	0.009	0.013	0.032
Total Kjeldahl Nitrogen	mg/L	-	0.39	0.39	0.84	0.68	0.49	1.74	0.64	0.46	2.28
Total Nitrogen (as N)	mg/L	-	0.80	0.81	1.21	0.91	0.61	3.08	1.04	0.93	2.74
Total Phosphorus	mg/L	-	0.02	0.01	0.09	0.06	0.03	0.26	0.06	0.03	0.34
Chloride	mg/L	-	28.85	29.00	35.00	28.31	29.00	33.00	30.68	35.00	43.00
Calcium	mg/L	-	13.85	15.00	16.00	14.62	15.00	19.00	17.47	21.00	29.00
Magnesium	mg/L	-	3.23	3.00	5.00	3.28	3.00	5.00	3.57	4.00	5.00

Pollutants\Location	Unit	Trigger Value (Airport 1997)	SW9			SW10			SW11		
			Average	Median	Max	Average	Median	Max	Average	Median	Max
Potassium	mg/L	-	4.08	4.00	5.00	3.96	4.00	5.00	4.12	5.00	6.00
Sodium	mg/L	-	18.69	19.00	33.00	20.85	20.00	34.00	23.46	27.00	40.00
Sulfate (as SO4-) (Filtered)	mg/L	-	10.00	9.00	15.00	10.32	10.00	16.00	17.02	26.00	32.00
PFOA	µg/L	-	0.0123	0.0123	0.0154	0.0123	0.0133	0.0159	0.0127	0.0124	0.0229
PFOS	µg/L	-	0.0197	0.0185	0.0325	0.0406	0.0413	0.0742	0.0481	0.0552	0.1320

G2SJV Gateway to Sydney Joint Venture
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