# APPENDIX

# L

# Surface Water Quality Technical Report

**HELIDON TO CALVERT** ENVIRONMENTAL IMPACT STATEMENT

IR_1381

The Australian Government is delivering
Inland Rail through the Australian
Rail Track Corporation (ARTC), in
partnership with the private sector.

# Inland Rail Helidon to Calvert

## Appendix L – Surface Water Quality Technical Report

**Australian Rail Track Corporation**

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# Abbreviations

| Abbreviation | Explanation |
|---|---|
| AEP | Annual exceedance probability |
| Al Act | *Acquisition of Land Act 1967* (Qld) |
| ANZG 2018 | Australian and New Zealand Environment and Conservation Council/Agriculture and Resource Management Council of Australia and New Zealand guidelines for fresh and marine water quality updated as the Australia New Zealand Guidelines |
| ARD | Acid Rock Drainage |
| ARTC | Australian Rail Track Corporation |
| ASS | acid sulfate soils |
| BOM | Bureau of Meteorology |
| C2K | Calvert to Kagaru |
| CEMP | Construction Environmental Management Plan |
| Ch | Chainage (kilometre along proposed Project) |
| CIA | Cumulative impact assessment |
| Cth | Commonwealth |
| DA | Development Assessment |
| DAF | Department of Agriculture and Fisheries |
| DAWE | Department of Agriculture, Water and the Environment |
| DERM | Department of Environment and Resource Management |
| DES | Department of Environment and Science |
| DNRME | Department of Natural Resources, Mines and Energy |
| DRDMW | Department of Regional Development, Manufacturing and Water |
| DSDMIP | Department of State Development, Manufacturing, Infrastructure and Planning |
| DSITIA | Department of Science, Information Technology, Innovation and Arts |
| EAM | Environmental Assessment and Management |
| EC | Electrical Conductivity |
| EP Act | *Environmental Protection Act 1994* (Qld) |
| EP Reg | *Environmental Protection Regulation 2008* (Qld) |
| EPA | Environmental Protection Agency |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* (Cth) |
| EPP (Water and Wetland Biodiversity) | *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (Qld) |
| EV | Environmental Values |
| Fisheries Act | *Fisheries Act 1994* (Qld) |
| GDE | Groundwater dependent ecosystem |
| G2H | Gowrie to Helidon |
| HES | High ecological significance |
| H2C | Helidon to Calvert |
| IECA | International Erosion Control Association |
| Inland Rail | Melbourne to Brisbane Inland Rail |
| km | kilometres |
| $km^2$ | square kilometres |

| Abbreviation | Explanation |
|---|---|
| L/m$^3$ | Litres per cubic metre |
| L/s | Litres per second |
| LOR | Limit of Reporting |
| m | metre |
| m$^2$ | square metres |
| m$^3$ | cubic metres |
| ML | megalitres |
| mm/year | millimetres per year |
| MNES | Matters of national environmental significance |
| MSES | Matters of state environmental significance |
| NATA | National Association of Testing Authorities |
| NSW | New South Wales |
| PAH | Polycyclic aromatic hydrocarbons |
| Planning Act | *Planning Act 2016* (Qld) |
| QA/QC | Quality Assurance/Quality Control |
| QLD | Queensland |
| QWQG | Queensland Water Quality Guidelines |
| Ramsar wetlands | Wetlands of International Importance |
| RCP | Reinforced Concrete Pipe |
| RCBC | Reinforced Concrete Box Culvert |
| SDA | State Development Area |
| SDPWO Act | *State Development and Public Works Organisation Act 1971* (Qld) |
| SEQ | South East Queensland |
| SFRC | Southern Freight Rail Corridor |
| ShapingSEQ | South East Queensland Regional Plan 2017 |
| SPP | *State Planning Policy 2017* (Qld) |
| the proponent | Australian Rail Track Corporation Ltd |
| the Project | H2C Project alignment |
| ToR | Terms of Reference |
| TPC Act | *Transport Planning and Coordination Act 1994* (Qld) |
| UQ | University of Queensland |
| Water Act | *Water Act 2000* (Qld) |
| WIM | Waterway Identification Mapping |
| WMIP | Water Monitoring Information Portal (Qld) |
| WP | Water Plans |
| WQO | Water Quality Objectives |
| WTP | Water treatment plant |

# Glossary

| Term | Explanation |
|---|---|
| Acid sulfate soils (ASS) | Soils containing iron sulphides (Pyrite) which can produce sulphuric acids when disturbed (exposed to oxygen) through conversion of Pyrite. |
| Alignment | The proposed rail line of the Project |
| Annual exceedance probability (AEP) | The probability that a given rainfall total accumulated over a given duration that will be exceeded in any one year |
| AquaBAMM | The Aquatic biodiversity assessment mapping method used to determine aquatic conservation assessments |
| Aquascore | An overall conservation value of a wetland unit based on eight separate criteria of an AquaBAMM aquatic conservation unit |
| Ballast | Rock placed under the rail ties (sleepers) to provide stable support for a rail line |
| Catchment | Catchment at a particular point is the area of land that drains to that point |
| Chainage | A measure of distance along the rail corridor. The values are progressive from the start of each package (from Melbourne to Brisbane) with the terminus of each the alignment at the interface with the next package leading to Brisbane. |
| Cumulative impact area of influence | The area of the Project that incorporates other projects for assessment of cumulative impact. In matters relating to water quality, cumulative impact area of influence is specifically in relation to intra-catchment interaction between identified strategic projects with the potential to be additive to current Project impacts |
| Dispersive | A characteristic of soil indicating the potential for the breakdown of clay material into single clay particles in solution |
| Disturbance footprint | The Disturbance footprint is the disturbance footprint (both temporary and permanent) associated with the Project. The Disturbance footprint is the areas subject to direct disturbance |
| Ephemeral | Temporary, short-lived. An ephemeral waterway is one that flows following periods of heavy rainfall |
| Environmental Values (EVs) | The qualities of water that make it suitable for supporting aquatic ecosystems and human water uses |
| Hydrology | The study of rainfall or runoff process |
| Litres per second (L/S) | A measurement of flow rate |
| Limit of reporting (LOR) | The smallest concentration at which the laboratory can quantify the presence of a particular parameter of interest. This is usually dictated by the test methodology |
| Megalitres (ML) | A unit of measure of fluid, indicating equivalence of 1,000,000 litres |
| Micro Siemens per centimetre (µscm$^{-1}$) | A unit of electrical conductivity. µscm$^{-1}$ is calculated as a dimension of mass, length, time and electric current. A measurement of electrical conductivity which is dependent on concentration of ion in solution |
| Micrograms per litre (ugL$^{-1}$) | A measurement of mass concentration within a litre of a certain mixture (in this instance freshwater) |
| Milligrams per litre (mgL$^{-1}$) | A measurement of mass concentration within a litre of a certain mixture (in this instance freshwater) |
| Perennial | Lasting or enduring. A perennial watercourse has continuous flow all year-round during years of normal rainfall. |
| Permanent operational disturbance footprint | The areas of the Project that will be permanently and directly impacted by the operation of the rail line and associated facilities. |
| Pfafstetter coding system | A descriptive mechanism for the description of watershed/basin topology |
| pH units | The measurement of presence of Hydrogen ion concentration indicating from a range of 1-14, the degree of acidity or basicity, respectively |
| Project | The construction and operation of the Helidon to Calvert Project |
| Runoff | The amount of rainfall from a catchment that actually ends up as flowing water in the river or creek |

| Term | Explanation |
|---|---|
| Salinity | Refers to the amount of salt present in the soil or aquatic solution |
| Stream order | A measure of the relative size of a waterway |
| Surface water quality receptor | Aspects of particular surface water quality values throughout the water quality stud area. Sensitivity of the receptor is based on ecological values associated with intersecting watercourses (and related values) |
| Temporary construction disturbance footprint | The areas of the Project that will be directly impacted by the construction of the rail line, lay down areas and other areas that will only be used during construction and will be rehabilitated prior to operation and will only be used temporarily. |
| Track | The combination of rails, rail connectors, sleepers, ballast, points, crossings and any substitute devices |
| Velocity | The speed at which the waters are moving |
| Watercourse | A watercourse is a river, creek or other stream, including a stream in the form of an anabranch or a tributary, in which water flows permanently or intermittently, regardless of the frequency of flow events, specifically excluding drainage features. |
| Waterway | A waterway broadly describes water flow paths that have not been defined as watercourses. These include the excluded drainage features and unmapped watercourses (under the *Water Act 2000* (Qld)). |
| Water Quality Objectives (WQOs) | Long terms goals for water quality management. Generally, indicators of criteria for receiving waters to protect relevant EVs |
| Water quality receptor | A receptor is a feature, area or structure that may be affected by direct or indirect changes to the environment. |
| Water quality study area | The water quality study area was based on a 1 km buffer extending horizontally from both sides of the proposed alignment, as such, increasing the extent where multiple design options exist. The water quality study area was established to delineate the spatial extent of potential intersection of water sources with temporary and permanent disturbance footprints of the Project |
| Wetland | ▪ Areas shown on the Map of Referable Wetlands which is a document approved by the chief executive (Environment) on 4 November 2011 and published by the department, as amended from time to time by the chief executive under section 144D of the Environmental Protection Regulation 2008 (QLD); and<br>▪ Are wetlands as defined under the Queensland Wetlands Program as areas of permanent or periodic/intermittent inundation, with water that is static or flowing fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed 6 m, and possess one or more of the following attributes:<br>– At least periodically, the land supports plants or animals that are adapted to and dependent on living in wet conditions for at least part of their lifecycle; or<br>– The substratum is predominantly undrained soils that are saturated, flooded or ponded long enough to develop anaerobic conditions in the upper layers; or<br>– The substratum is not soil and is saturated with water or covered by water at some time. |
| Wetland of high ecological significance | Otherwise known as a high conservation value wetland, is a wetland that meets the definition of a wetland (above) and is shown as a wetland of high ecological significance or high conservation value wetland on the Map of Referable Wetlands |

# Executive summary

## The Project

Australian Rail Track Corporation (ARTC) is seeking approval to construct and operate the Helidon to Calvert (H2C) section of Inland Rail (the Project), which consists of approximately 47 kilometre (km) single track dual gauge railway with four crossing loops to accommodate double stack container freight trains up to 1,800 metres (m) long. It will also involve the construction of an approximately 850 m long tunnel through the Little Liverpool Range to facilitate the required gradient across the undulating topography. The Project is located within the Lockyer Creek and Bremer River catchments (of the Moreton hydrological basin) and, is expected to cross four main watercourses and several unnamed tributaries along the alignment.

## Purpose

This surface water quality technical report has been prepared to assess potential impacts of the proposed Project on surface water quality. This assessment addresses the relevant surface water quality terms of reference.

This report outlines the legislative framework and methodology for undertaking the surface water quality assessment and potential impacts related to the Project. This report describes the existing water quality for the water quality study area, providing a summary of the environmental values (EVs) and water quality objectives (WQOs) for the identified watercourses and waterways. The report also assesses the significance of potential impacts (with incorporation of mitigation and management measures) with respect to the current existing environment.

## Environment Values

Numerous EVs are noted for the each of the catchments located within the water quality study area. Within each of the catchments EVs include aquatic ecosystems, irrigation, farm supply/use, stock water, human consumer, secondary recreation, visual recreation and cultural and spiritual values.

## Water quality objectives

Water quality objectives for the relevant sub-catchments have been determined by the Queensland Government. Within these WQO’s, the most stringent protections are provided for aquatic ecosystems and these were selected as the basis for assessment.

## Existing environment

A summary of the existing surface water environment is provided below:

- The water quality study area was based on a 1 km buffer extending horizontally from both sides of the proposed alignment, including an increased the extent where multiple design options exist
- The water quality study area is situated within a region of typical hot and dry conditions with seasonally distributed rainfall; rainfall is predominant during summer months
- Surface water values relevant to the water quality study area are located within the Logan River and Bremer River catchments
- There watercourses defined under the *Water Act 2000* (Qld) (Water Act) are intersected by the Project alignment. These include Sandy Creek (Grantham), Lockyer Creek, Sandy Creek (Forest Hill), Laidley Creek and Western Creek

- There are no wetlands of international importance (Ramsar wetlands) within 10 km of the water quality study area, however two high ecological significant wetlands occur within the water quality study area
- The water quality study area passes through an area of moderate to high salinity hazard.

The current (2019) Healthy Land and Water report card indicates that the western catchments (including both the Lockyer Creek and Bremer River catchments) range in health from poor to good with overall grades decreasing in condition, temporally.

Aquascores have been generated for the wetlands within the water quality study area. The water quality monitoring sites associated with medium Aquascores (indicating moderate sensitivity) for riverine wetlands were those on sections of Lockyer Creek Sandy Creek (Grantham), Sandy Creek (Forest Hill), Laidley Creek and Western Creek.

Upon comparison with historical water quality data for Lockyer Creek, Purga Creek and Laidley Creek, water quality values observed during the three sampling rounds followed those of the gauging stations. Historic and field assessed water quality was identified as not currently meeting all WQOs for the protection of aquatic ecosystems, within each catchment.

## Surface water quality receptors

To maintain a conservative approach to assessment, all waterways within the water quality study area were nominated as moderate sensitivity water quality receptors. The moderate sensitivity was used a general indicator for the identification of potential impacts, associated mitigation measures and identification of residual impact after implementation of mitigation.

Due to the potential presence of the MNES species Australian Lungfish (*Neoceratodus forsteri*), Mary River Cod (*Maccullochella mariensis*) and two MSES wetlands within the Lower Lockyer Creek sub-catchment and Western Creek sub-catchment, respectively, both sub-catchments were identified as high sensitivity water quality receptors. Therefore, the defined watercourses of Upper Lockyer Creek and Western Creek sub catchments: Lockyer Creek and Western Creek are identified as highly sensitive water quality receptors.

## Potential impacts

Potential impacts were grouped into the following six discrete categories (with interplay between each category with regard to impact):

- Increase in debris
- Changes to receiving water quality and hydrology
- Increase in salinity
- Increases in erosion and sedimentation
- Increase in contaminants
- Exacerbation of listed impacts above, from inadequate rehabilitation processes.

## Significance residual impact assessment

To determine the significance of potential impacts of the Project upon the identified surface water quality receptors, sensitivity categories were applied to each of the receptors. The sensitivity of the potential impact was grouped into three distinct categories: high, moderate and low. These groupings were based on factors including, but not limited to, legislative status, resilience and representation in the broader landscape. In addition to sensitivity, the magnitude of each potential impact was assigned based on the extent, duration and resultant change to the receptor. The magnitude of impact was grouped into four categories: high, moderate, low and negligible. Both the sensitivity of an impact and the magnitude of the potential impact were used to determine the significance of a potential impact.

The proposed mitigation measures (after design considerations) for the Project were identified to reduce the initial magnitude and ultimately the significance of the potential impacts upon the identified receptors. Following the application of the mitigation hierarchy (i.e. avoid, minimise, mitigate) which included a range of mitigation measures and management plans the residual impacts to the identified receptors were reduced. After the application of mitigation, there will be a low residual significance of risk on water quality receptors for the following Project phases:

- During the construction phase, the combination of design considerations and mitigation measures relevant to surface water quality would be sufficient to mitigate most potential impacts, such that the residual significance would be low
- For the operational phase, the combination of design considerations and mitigation measures relevant to surface water quality would be sufficient to mitigate most potential impacts, such that the residual significance would be low.

## Cumulative impacts

A cumulative impact assessment (CIA) was undertaken where potential surface water impacts of the Project were assessed together with existing or planned surrounding activities and projects. The CIA identified a medium risk of potential impact occurring during construction phase activities through riparian vegetation loss from vegetation clearing/removal. Further mitigation measures (during detailed design) may be necessary and specific management practices applied to further limit potential cumulative impact.

# 1 Introduction

## 1.1 Purpose

The purpose of this report is to provide an overview of the existing surface water quality and the potential impacts from construction, operational and decommissioning (as it relates to construction) activities to surface water quality for the Project. Refer to EIS Appendix I: Terrestrial and aquatic ecology technical report and EIS Appendix M: Hydrology and flooding technical report for further information regarding matters pertaining to surface waters within the water quality study area.

This technical report outlines the legislative framework and methodology for undertaking the surface water quality assessment related to the Project. This report describes the existing water quality for the water quality study area (as defined in Section 1.3), providing a summary of the Environmental Values (EVs) and Water Quality Objectives (WQOs) for intersected sub-catchments.

Potential impacts to surface water quality resulting from construction, operation and decommissioning (as it relates to construction) of the Project are identified. An assessment of the impacts of the Project following the application of mitigation measures is also provided.

## 1.2 Project Overview and objectives

The Australian Rail Track Corporation (ARTC) propose to construct and operate the Project section of the Inland Rail Program (Inland Rail) which consists of approximately 47 km of single-track dual gauge railway with four crossing loops to accommodate double stack freight trains up to 1,800 m long. It will also involve the construction of an approximately 850 m long tunnel through the Little Liverpool Range to facilitate the required gradient across the undulating topography.

The design response to key environmental features has been developed in line with engineering constraints for the rail design. The rail design has been based on minimising environmental and social impacts, minimising disturbance to existing infrastructure and meeting engineering design criteria.

The objectives of the Project are to:

- Provide new rail infrastructure that meets the Inland Rail specifications to enable trains using the corridor to travel between Helidon and Calvert, connecting with other sections of Inland Rail at each end of the Project (i.e. the Gowrie to Helidon (G2H) and Calvert to Kagaru (C2K) sections)
- Minimise the potential for adverse environmental and social impacts.

The objectives of overall Inland Rail are to:

- Provide a rail link between Melbourne and Brisbane that is interoperable with train operations to Perth, Adelaide, and other locations on the standard gauge rail network to serve future rail freight demand, and stimulate growth for inter-capital and regional/bulk rail freight
- Provide an increase in productivity that will benefit consumers through lower freight transport costs
- Provide a step-change improvement in rail service quality in the Melbourne to Brisbane corridor and deliver a freight rail service that is competitive with road
- Improve road safety, ease congestion, and reduce environmental impacts by moving freight from road to rail
- Bypass bottlenecks within the existing metropolitan rail networks, and free up train paths for other services along the coastal route
- Act as an enabler for regional economic development along the Inland Rail corridor.

This chapter addresses the water section of the ToR for the Project. The ToR sets out the key requirements in relation to surface water and hydrology. Table 1.1 identifies the key requirements and a reference to where the relevant ToR requirements are addressed.

**Table 1.1 Terms of reference requirements**

| Terms of Reference requirements | Addressed in chapter |
|---|---|
| **Site Description** | |
| 10.7. Where relevant, describe, map and illustrate soil types and profiles of the project area at a scale relevant to the proposed project. Identify soils that would require particular management due to wetness, erosivity, depth, acidity, salinity, contamination or other relevant features. | Sections 5.4.1, 5.4.2, 5.4.3 and 5.9<br>Chapter 13, Section 13.6.2 |
| **Proposed construction and operations** | |
| 10.11. Describe the following information about the proposed project:<br>(d) location, design and capacity of water supply, wastewater conveyance and treatment, telecommunications, power generation, accommodation of site facilities and transmission infrastructure<br>(q) proposed upgrades, realignments, relocation, deviation or restricted access to roads and other infrastructure (e.g. water, electricity, telecommunications, sewerage) | Sections 2.1, 2.3, 2.7, 7.1.1 and 7.1.2<br>Chapter 13, Section 13.8.1 |
| **Information requirements** | |
| 11.24. The EIS must also provide details on the current state of groundwater and surface water in the region as well as any use of these resources. | Sections 5 and 6<br>Chapter 13, Sections 13.6.2 to 13.6.5 |
| **Existing environment – General** | |
| 11.36. Identify the water-related EVs and describe the existing surface water and groundwater regime within the study area and the adjoining waterways in terms of water levels, discharges and freshwater flows. | Sections 3.2.4, 5.1 to 5.11 and 6.1 to 6.3<br>Chapter 13, Sections 13.4.2 and 13.6.2 to 13.6.5 |
| 11.37. With reference to the EPP (Water and Wetland Biodiversity) 2009, section 9 of the EP Act, and SPP State Interest Guideline - Water Quality, identify the EVs of surface water within the project area and immediately downstream that may be affected by the project, including any human uses of the water and any cultural values. | Sections 3.2.4, 5 and 6<br>Chapter 13, Section 13.4.2 and 13.6 |
| 11.38. At an appropriate scale, detail the chemical, physical and biological characteristics of surface waters and groundwater within the area that may be affected by the project. Include a description of the natural water quality variability within the study area associated with climatic and seasonal factors, and flows. | Sections 5 to 6<br>Chapter 13, Sections 13.6.2 and 13.6.3 |
| 11.39. Describe any existing and/or constructed waterbodies adjacent to the preferred alignment. | Section 5.5.4<br>Chapter 13, Section 13.6.2.2 |
| **Impact assessment – Water Quality** | |
| 11.41. The assessment of impacts on water will be in accordance with the DEHP Information guideline for an environmental impact statement – ToR Guideline – Water, where relevant, located on the DEHP website. | Sections 4.1 and 4.2<br>Chapter 13, Sections 13.7 and 13.9 |
| 11.42. Identify the quantity, quality and location of all potential discharges of water and wastewater by the project, whether as point sources (such as controlled discharges) or diffuse sources (such as irrigation to land of treated sewage effluent). | Section 7 and 8.3.1<br>Chapter 13, Section 13.7.1 |
| 11.43. Assess the potential impacts of any discharges on the quality and quantity of receiving waters taking into consideration the assimilative capacity of the receiving environment and the practices and procedures that would be used to avoid or minimise impacts. | Section 7<br>Chapter 13, Sections 13.7.1, 13.8.1 and 13.9.1 |
| 11.44. Where significant cuttings or tunnelling is proposed, identify the presence of any sulphide minerals in rocks with potential to create acidic, metalliferous and saline drainage. Should they be found present, describe the practicality of avoiding their disturbance. If avoidance is not practicable, characterise the potential of the minerals to generate contaminated drainage and describe abatement measures that will be applied to avoid adverse impacts to surface and groundwater quality. | Sections 5.4.2, 5.4.3, 7.1 and 8<br>Chapter 13, Sections 13.7.1 and 13.8.1 |

| Terms of Reference requirements | Addressed in chapter |
|---|---|
| 11.45. Describe the potential impacts of in-stream works on hydrology and water quality. | Section 7.1<br>Chapter 13, Section 13.7 |
| 11.46. Undertake a salinity risk assessment in accordance with Part B of the Salinity Management Handbook, Investigating Salinity. In particular, consider how the project will change the hydrology of the project area and provide results of the risk assessment. | Sections 5.9 and 7.1<br>Chapter 13, Sections 13.6.2.5 and 13.7 |
| **Mitigation measures – Water Quality** | |
| 11.47. Describe how the WQOs identified above would be achieved, monitored and audited, and how environmental impacts would be avoided, or minimised and corrective actions would be managed. | Sections 7.1 and 8<br>Chapter 13, Section 13.8.1 |
| 11.48. Describe appropriate management and mitigation strategies and provide contingency plans for:<br>(a) potential accidental discharges of contaminants and sediments during construction and operation<br>(b) stormwater run-off from the project facilities and associated infrastructure during construction and operation, including the International Erosion Control Association, Best Practice Erosion & Sediment Control – November 2008, and the separation of clean stormwater run-off from disturbed and operational areas of the site<br>(c) flooding of relevant river systems, the effects of tropical cyclones and other extreme events<br>(d) management of acid sulfate soils and acid producing rock and associated leachate from excavations and disturbed areas. | Section 8<br>Chapter 13, Section 13.8.1 |
| 11.49. Describe treatment processes for all waste water produced as a result of the project. | Sections 8.2 and 8.3.2<br>Chapter 13, Sections 13.8.1.2 and 13.8.1.3 |
| 11.50. Propose suitable measures to avoid or mitigate the impacts of in-stream works on water quality and the stabilisation and rehabilitation of any such works. | Section 8<br>Chapter 13, Section 13.8 |
| 11.51. Where a salinity risk is identified, detail strategies to manage salinity ensuring the development must be managed so that it does not contribute to the degradation of soil, water and ecological resources or damage infrastructure via expression of salinity. See Part C of the Salinity management handbook second edition, Department of Environment and Resource Management (DERM) 2011. | Section 8<br>Chapter 13, Sections 13.8.1.2 and 13.8.1.3 |
| **Impact assessment – Water Resources** | |
| 11.52. Provide details of any proposed impoundment, extraction (i.e. volume and rate), discharge, use or loss of surface water or groundwater. Identify any approval or allocation that would be needed under the Water Act. | Sections 2.7, 3.1 and 7.2<br>Chapter 13, Sections 13.4.1 and 13.8.1.3 |
| 11.53. Detail any significant diversion or interception of overland flow. Include maps of suitable scale showing the location of diversions and other water-related infrastructure. | Section 2.5 and Figure 2.1<br>Chapter 13, Section 13.6.2.2 and Figure 13.3 |
| 11.54. Develop hydrological models as necessary to describe the inputs, movements, exchanges and outputs of all significant quantities and resources of surface water and groundwater that may be affected by the project. The models should address the range of climatic conditions that may be experienced at the site, and adequately assess the potential impacts of the project on water resources. This should enable a description of the project's impacts at the local scale and in a regional context including proposed:<br>(a) changes in flow regimes from structures and water take<br>(b) alterations to riparian vegetation and bank and channel morphology<br>(c) direct and indirect impacts arising from the project.<br>(d) impacts to aquatic ecosystems, including groundwater-dependent ecosystems and environmental flows. | Sections 7.1 and 7.2<br>Chapter 13, Sections 13.5.2, 13.7.1, 13.7.2 and 13.9.2<br>Appendix M, Sections 6 to 9 |

| Terms of Reference requirements | Addressed in chapter |
|---|---|
| 11.55. Provide information on the proposed water usage by the project, including:<br>(a) details of the estimated supply required to meet the demand for construction and full operation of the project, including timing of demands<br>(b) details of the quality and quantity of all water supplied to the site during the construction and operational phases based on minimum yield scenarios for water re-use, rainwater re-use and any bore water volumes<br>(c) a plan outlining actions to be taken in the event of failure of the main water supply<br>(d) sufficient hydrogeological information to support the assessment of any temporary water permit applications. | Sections 2.7 and 7.2<br>Chapter 13, Section 13.8.1.3 |
| 11.56. Describe proposed sources of water supply given the implication of any approvals required under the Water Act. Estimated rates of supply from each source (average and maximum rates) must be given and proposed water conservation and management measures must be described. | Sections 2.7 and 7.2<br>Chapter 13, Section 13.8.1.3 |
| 11.57. Determination of potable water demand must be made for the project, including the temporary demands during the construction period. Include details of any existing town water supply to meet such requirements. Detail should also be provided to describe any proposed on-site water storage and treatment for use by the site workforce. | Sections 2.7 and 7.2<br>Chapter 13, Section 13.8.1.3 |
| 11.58. Identify relevant Water Plans and Resources Operations Plans under the Water Act. Describe how the project will impact or alter these plans. The assessment should consider, in consultation with the Department of Natural Resources and Mines (DNRM), any need for:<br>(a) a resource operations licence<br>(b) an operations manual<br>(c) a distribution operations licence<br>(d) a water licence<br>(e) a water management protocol. | Section 2.7, 5.10 and 7.2<br>Chapter 13, Sections 13.6.3.2 and 13.8.1.3 |
| 11.59. Identify other water users that may be affected by the proposal and assess the project's potential impacts on other water users. | Sections 2.7, 5.10 and 7.2<br>Chapter 13, Section 13.6.2.3 and 13.8.1.2 |
| 11.60. Identify and quantify likely activities involving the excavation or placement of fill that will be undertaken in any watercourse, lake or spring. | Sections 2.3, 2.4, 2.5 and 7<br>Chapter 13, Section 13.7.1.1 |
| **Mitigation measures – Water Resources** | |
| 11.61. Provide designs for all infrastructure utilised in the treatment of on-site water including how any on-site water supplies are to be treated, contaminated water is to be disposed of and any decommissioning requirements and timing of temporary water supply/treatment infrastructure is to occur. | Sections 2.1, and 8<br>Chapter 13, Section 13.8.1.3 |
| 11.62. Describe measures to minimise impacts on surface water and ground water resources. | Section 8<br>Chapter 13, Section 13.8 |
| 11.63. Provide a policy outline of compensation, mitigation and management measures where impacts are identified. | Section 8<br>Chapter 13, Section 13.8 |
| **Existing environment – Flood Management** | |
| 11.64. A desktop assessment of the rail line and surrounding catchments must be undertaken and the potential for flooding qualitatively described. The desktop assessment must also identify any high-risk watercourse crossing or floodplain locations that warrant further detailed quantitative assessment. | Chapter 13, Sections 13.6.4, 13.9.2<br>Appendix M, Sections 3 and 5 |
| **Impact assessment – Flood Management** | |
| 11.65. For the locations assessed under paragraph 11.64, a flood study must be included in the EIS that includes:<br>(a) quantification of flood impacts on properties and existing infrastructure surrounding and external to the preferred alignment from redirection or concentration of flows<br>(b) identification of likely increased flood levels, increased flow velocities or increased time of flood inundation as a result of the project | Chapter 13, Section 13.9.2<br>a) Appendix M, Section 10<br>b) Appendix M, Section 10 |

| Terms of Reference requirements | Addressed in chapter |
|---|---|
| (c) details of all calculations along with descriptions of base data and any potential for loss of flood plain storage. | c) Appendix M, Sections 6 to 10 |
| 11.66. The flood study should address any requirements of local or regional planning schemes and current accepted practice and statutory requirements in relation to flood plain management. The method of modelling used in the study should be described and justified. | Chapter 13, Section 13.5.2<br>Appendix M, Sections 3 to 5 and 7 to 10 |
| 11.67. Describe flood risk for a range of annual exceedance probabilities (including probable maximum flood) for the site and assess how the project may change flooding characteristics Include a discussion of historical events and findings of the 'Big Flood Study'. | Chapter 13, Section 13.9.2<br>Appendix M, Sections 6, 8 and 9 |
| 11.68. The study should consider all infrastructure associated with the project including levees, roads and linear infrastructure. | Chapter 13, Sections 13.6.4 13.9.2<br>Appendix M, Section 9 |
| 11.69. The EIS should describe the consultation that has taken place with landholders along the alignment regarding modelled potential impacts of the project on flooding. It should also include a discussion of how the results of consultation have been considered by the proponent in the EIS process. | Chapter 13: Section 13.5.2.4 and 13.9.2<br>Appendix C, Section 6.8<br>Appendix M, Section 7.10 |
| 11.70. Reference must be made to relevant studies published by local governments. | Appendix M, Section 5.1 |
| **Mitigation measures – Flood Management** | |
| 11.71. Identify all proposed measures to avoid or minimise risks to life, property, infrastructure, community (including damage to other properties) and the environment as a result of project impacts during flood events—particularly flood risks on individual properties and businesses, including in and around Grantham, Gatton, Forest Hill, Laidley, Grandchester and Calvert. | Chapter 13, Sections 13.8.2 and 13.9.2<br>Appendix M, Section 9 |
| 11.93. Provide details, including maps, of the location of project works/infrastructure with respect to soil conservation works (contour banks, waterway discharge points, etc.). | Section 2<br>Chapter 13, Section 13.7.1 |
| **Climate** | |
| 11.166. Describe the climate patterns with particular regard to discharges to water and air and the propagation of noise related to the project. | Section 5.3<br>Chapter 13, Section 13.6.2.1 |
| 11.167. Climate information should be presented in a statistical form including long-term averages and extreme values, as necessary. | Section 5.3<br>Chapter 13, Section 13.6.2.1 |

## 1.3 Water quality study area

The water quality study area was based on a 1 km buffer extending horizontally from either side of the permanent operational and temporary construction disturbance footprint (as the Project disturbance footprint). The water quality study area was established to delineate the spatial extent of potential intersection of water sources with the Project disturbance footprint (refer Figure 1.1).

## 1.4 Overview of surface water environment

The water quality study area occurs across two hydrological catchment areas – the Lockyer Creek catchment between Helidon and east of Laidley, and the Bremer River catchment between Grandchester and Calvert. Both catchments are located within the wider Moreton hydrological basin.

A number of watercourses, waterways and waterbodies occur within the water quality study area, including; Sandy Creek, Lockyer Creek, Laidley Creek and Western Creek, and tributaries and drainage features of the aforementioned watercourses (refer Figure 1.2).

Map by: NCW / DTH Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pct\330-EAP-201908191155_Fig1.1_RegionalContext_Rev2.mxd Date: 16/03/2020 17:04

**Legend**

- ● Localities
- ┼ Existing rail
- 🟩 B2G project alignment
- 🟦 G2H project alignment
- 🟧 H2C project alignment
- 🟪 C2K project alignment
- 🟩 K2ARB project alignment
- 🟧 Major roads
- ▨ Water quality study area
- ☐ Local Government Areas

A3 scale: 1:600,000

0 4.5 9 13.5 18 22.5 km

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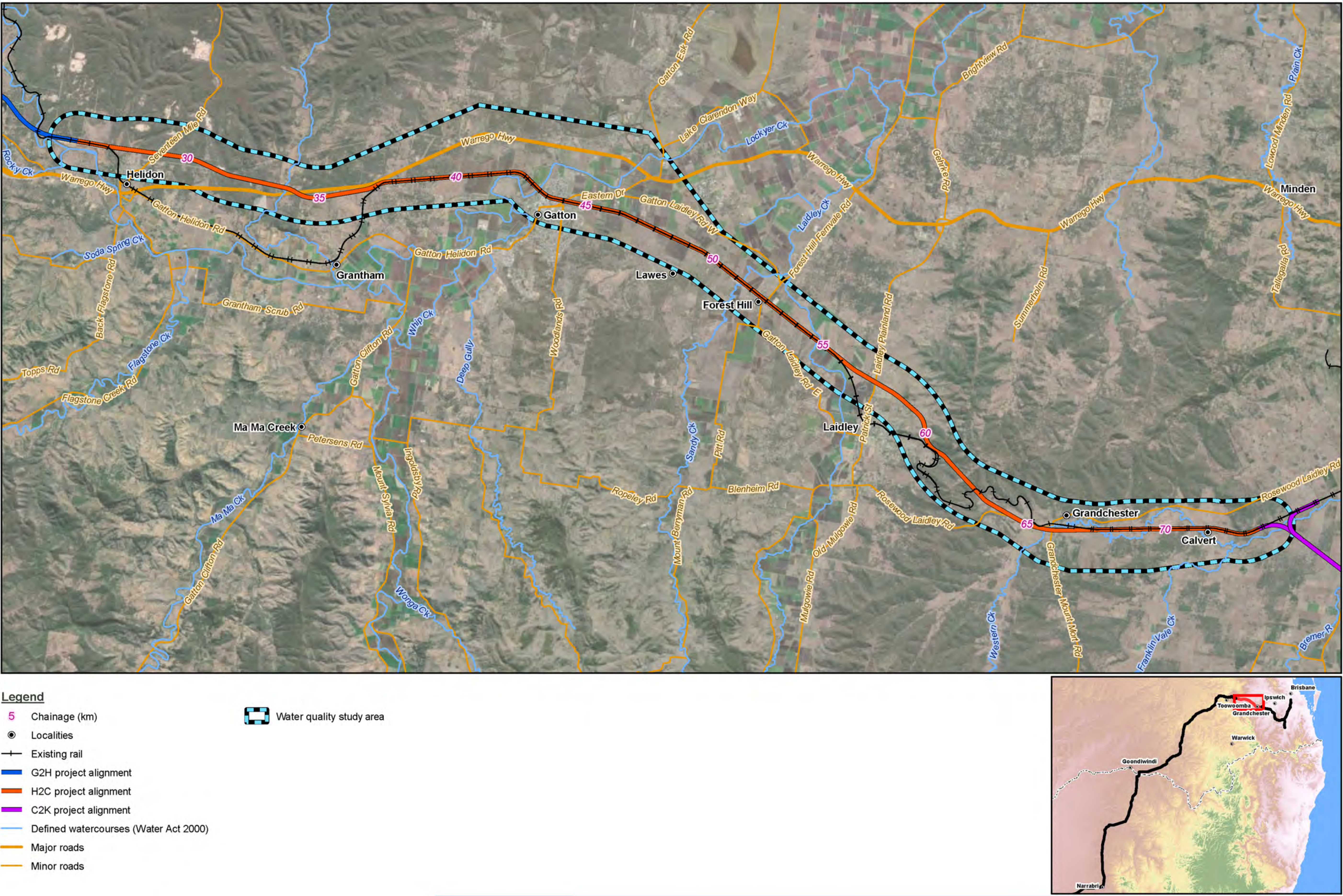
Coordinate System: GDA 1994 MGA Zone 56

## Helidon to Calvert

## Figure 1.1: Regional Context



Map by: NCW / DTH Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\Check\330-EAP-201908191155_Fig1.2_WaterAct_Rev1.mxd Date: 5/03/2020 10:12

**Legend**

5 Chainage (km)

● Localities

┼ Existing rail

G2H project alignment

H2C project alignment

C2K project alignment

Defined watercourses (Water Act 2000)

Major roads

Minor roads

Water quality study area

A3 scale: 1:130,000

0 1 2 3 4 5km

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## Helidon to Calvert

## Figure 1.2: Water quality study area

# 2 Project description

The Project includes the following key features:

- 47 km of single track dual gauge rail line with four crossing loops (56 km including loops) to accommodate 1,800 m long train sets
- The corridor identified for the Project will be of sufficient width to allow for the assessment of the land provision for possible future upgrades to the track to accommodate trains up to 3,600 m in length
- The approximately 850 m Little Liverpool Range tunnel, bridges and viaducts to accommodate topography and crossings of watercourses and waterways, roads and other infrastructure
- Approximately 34 km of embankments (excluding structures) and approximately 3,600,000 cubic metres ($m^3$) of cuttings along the length of the alignment, spanning approximately 7.6 km
- Approximately 2,500,000 $m^3$ of excavated material to be reused as fill (within the alignment)
- 105 waterway crossings along the length of the alignment including 19 bridge structures and 86 drainage structures
- A total of 31 bridges, including 13 rail-over-water, 6 rail-over-water-and-road (identified above), 6 rail-over-road, 4 road-over-rail, 1 rail-over-existing-rail, and one pedestrian-over-rail
- Tie-ins to the existing West Moreton System rail corridor at the Project boundary and other potential intermediate locations to be confirmed by operational modelling (approximately 24 km of parallel length)
- The construction of associated rail infrastructure, including maintenance sidings, rail maintenance access roads and signalling infrastructure to support the train control system
- Ancillary works, including 36 formed and 9 unformed road utility crossings, public utility crossings, realignments, signalling and communications, signage and fencing, and services and utilities within the Project alignment
- Environmental management measures including fauna management measures, landscaping, habitat rehabilitation and noise barriers
- Construction laydowns, storage, workspace and temporary access roads.

Construction activities for the Project will likely include temporary roads, upgrades and/or alterations to existing roads. The construction of the Project may also require relocation of some services, depending on their proximity to the construction zone. These aspects will be further examined in future design stages.

Subject to approval of the Project, construction of the Project is planned to start in 2021, and, is expected to be completed in 2026. Commissioning will continue until late 2026 when Inland Rail will become operational.

## 2.1 Tunnel infrastructure and drainage

For the proposed Project alignment, the presence of the Little Liverpool Range requires a tunnel to be constructed. The tunnel will be approximately 850 m long with a maximum cover of approximately 90 m. The tunnel will enter the western aspect of the Little Liverpool Range via a portal at Ch 61.84 km and exit the eastern aspect of the Little Liverpool Range via a portal at Ch 62.68 km.

Short-term inflows during construction were estimated at a maximum total short-term inflow rate of 2.56 L/s for the tunnel during construction (using the analytical method), with potentially higher flow rates over short durations (i.e. weeks to months) where locally higher permeability feature(s) are encountered.

A long-term inflow of approximately 0.54 L/s has been estimated for the tunnel using the analytical method. Under the scenario of elevated groundwater levels (+ 10 m) the estimated long-term inflow rate increased from 0.54 L/s to 1.30 L/sec for the length of the tunnel (850m). Short term flow rates during construction were not considered under the uncertainty analysis scenarios.

Generally, there is greater groundwater inflow expected during tunnel construction when compared with long term inflows. However, elevated groundwater inflows are expected to be of short duration and would decline after weeks or months to rates similar to long-term inflow rates. Limited tunnel-specific groundwater quality data is available for the Koukandowie Formation geology of the tunnel, however this indicated that the tunnel discharge will not meet some criteria of the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (Qld) (EPP (Water and Wetland Biodiversity)) objectives for the discharge sub-catchment of Western Creek. Collected wastewater is proposed to be stored within 200m$^3$ sumps at the eastern portal of the tunnel, prior to treatment.

## 2.2 Bridges

The Project requires 19 bridge structures (refer Table 2.1) over water and/or floodplains (of a total 31 bridges). The new bridge structures will be founded on driven precast or bored *in situ* piled foundations supporting *in situ* reinforced concrete substructures. Bridge superstructures are typically formed from pre-stressed precast concrete girders with *in situ* decks incorporating walkways, guardrails and barriers as appropriate. The bridges are of various lengths and spans to suit the alignment and topography.

**Table 2.1 New bridges structures and locations associated with the Project alignment**

| Bridge No | Bridge name | Chainage (at abutment) | Bridge type |
|---|---|---|---|
| 330-BR27 | Lagoon Creek 1 Loop | Ch 0.71 km | Rail bridge over waterway and road |
| 330-BR29 | Lagoon Creek 2 Loop | Ch 1.62 km | Rail bridge over waterway |
| 330-BR30 | Airforce Road | Ch 27.21 km | Road bridge over rail |
| 330-BR02 | UT1 Sandy Creek Bridge Rail Bridge | Ch 32.36 km | Rail bridge over waterway |
| 330-BR03 | Sandy Creek 1 | Ch 33.35 km | Rail bridge over waterway and road |
| 330-BR04 | Warrego Highway | Ch 34.04 km | Rail bridge over road |
| 330-BR05 | Philips Road | Ch 36.76 km | Rail bridge over road |
| 330-BR06 | Lockyer Creek | Ch 43.15 km | Rail bridge over waterway and road |
| 330-BR31 | Lockyer Creek QR Rail Bridge | Ch 43.15 km | Rail bridge over waterway and road |
| 330-BR08 | Gatton Station Pedestrian Bridge | Ch 43.48 km | Pedestrian bridge over rail |
| 330-BR09N | Eastern Drive Bridge Northbound | Ch 44.28 km | Road bridge over rail |
| 330-BR09S | Eastern Drive Bridge Southbound | Ch 44.29 km | Road bridge over rail |
| 330-BR10 | UT1 Laidley Creek | Ch 49.51 km | Rail bridge over waterway |
| 330-BR11 | UT2 Laidley Creek | Ch 50.26 km | Rail bridge over waterway |
| 330-BR12 | Sandy Creek 2 | Ch 51.37 km | Rail bridge over waterway |
| 330-BR13 | Sandy Creek 3 | Ch 51.59 km | Rail bridge over waterway |
| 330-BR14 | Laidley Creek | Ch 54.74 km | Rail bridge over waterway |
| 330-BR26 | Lagoon Creek 1 | Ch 55.82 km | Rail bridge over waterway and road |
| 330-BR28 | Lagoon Creek 2 | Ch 56.72 km | Rail bridge over waterway |
| 330-BR16 | Laidley Plainlands Road | Ch 57.29 km | Rail bridge over road |
| 330-BR32 | Francis Road | Ch 57.91 km | Rail bridge over road |
| 330-BR33 | Luck Road | Ch 58.81 km | Rail bridge over road |
| 330-BR17 | Paroz Road | Ch 59.33 km | Rail bridge over waterway and road |
| 330-BR18A | QR Rail Bridge | Ch 62.75 km | Rail bridge over rail |
| 330-BR18B | QR Access | Ch 62.76 km | Road bridge over rail |
| 330-BR19 | Rosewood Laidley Road | Ch 64.31 km | Rail bridge over road |
| 330-BR20 | Western Creek 1 | Ch 65.29 km | Rail bridge over waterway |

| Bridge No | Bridge name | Chainage (at abutment) | Bridge type |
|---|---|---|---|
| 330-BR21 | Western Creek 2 | Ch 67.62 km | Rail bridge over waterway |
| 330-BR25 | UT Western Creek | Ch 69.09 km | Rail bridge over waterway |
| 330-BR22 | Western Creek 3 | Ch 69.28 km | Rail bridge over waterway |
| 330-BR23 | Western Creek 4 | Ch 71.11 km | Rail bridge over waterway |

## 2.3 Cross-drainage infrastructure

The cross-drainage infrastructure (including existing culvert extensions) to be constructed along the Project alignment includes 51 reinforced pipe culverts (multiple cells in places), 19 bridges and 35 reinforced concrete box culverts (refer Table 2.2).

The locations of the new culverts have been selected to maintain the existing flow paths and minimise the potential impacts to flood depths upstream and downstream of the culverts. The cross-drainage structures have been designed in accordance with relevant industry standards. The design of new culverts has been informed by a hydrologic and hydraulic assessment of the culvert site, a geotechnical assessment, and a preliminary assessment of the existing structures. An assessment of flooding events has been undertaken for each structure.

Of the cross-drainage infrastructure, it is expected that the structures noted in Table 2.2 denote the discharge points (and associated waterway of interest) along the Project alignment. Cross-drainage structures associated with waterways are considered to act as a mechanism for potential impacts on water quality.

The total quantity of discharge water was not calculated (other than tunnel drainage), however the risk of water quality impacts was incorporated as part of the impact assessment across several facets, including dewatering of artificial impoundments and overland flow of construction water (refer Section 7).

Potential changes to water quality and introduction of contaminants associated with cross-drainage structure activities (refer Section 7.1) are assessed for the waterways identified in Table 2.2.

**Table 2.2 Summary of the drainage structures associated with the Project alignment waterways**

| Chainage[1] | Associated waterway | Type[2] | No. of cells | Diameter or width |
|---|---|---|---|---|
| Ch 40.05 km | Lockyer Creek | RCP | 2 | 1.5 |
| Ch 40.33 km | | RCP | 4 | 2.4 |
| Ch 42.19 km | | RCP | 1 | 0.9 |
| Ch 42.69 km | | RCP | 2 | 1.65 |
| 330-BR06 | | Bridge | - | - |
| Ch 43.94 km | | RCBC | 2 | 1.5 x 0.9 |
| Ch 44.44 km | | RCBC | 4 | 3 x 0.9 |
| Ch 46.48 km | | RCBC (extension) | 1 | 1.5 x 0.9 |
| Ch 47.22 km | | RCBC (extension) | 1 | 2.5 x 1.8 |
| Ch 47.24 km | | RCP | 10 | 1.2 |
| Ch 47.57 km | | RCP | 2 | 1.2 |
| Ch 47.81 km | | RCBC (extension) | 1 | 5 x 1.7 |
| Ch 48.46 km | | RCBC (extension) | 1 | 2.0 x 1.0 |
| 330-BR10 | | Bridge | - | - |
| Ch 49.57 km | | RCBC | 6 | 2.4 x 1.2 |
| 330-BR11 | | Bridge | - | - |
| 330-BR12 | | Bridge | - | - |

| Chainage[1] | Associated waterway | Type[2] | No. of cells | Diameter or width |
|---|---|---|---|---|
| 330-BR13 | Sandy Creek (Forest Hill) / Laidley Creek | Bridge | - | - |
| Hunt Street 3 | | RCBC | 5 | 1.2 x 0.45 |
| Hunt Street 2 | | RCBC | 4 | 1.8 x 0.9 |
| Hunt Street | | RCBC | 3 | 1.8 x 0.9 |
| Hunt Street 4 | | RCBC | 3 | 1.5 x 0.6 |
| Ch 52.55 km | | RCBC (extension) | 1 | 1.0 x 1.0 |
| Ch 52.67 km | | RCP | 2 | 0.9 |
| Ch 52.68 km | | RCP (extension) | 2 | 0.9 |
| Ch 53.50 km | | RCBC | 6 | 2.4 x 1.2 |
| Ch 53.50 km | | RCBC (extension) | 2 | 2.4 x 1.8 |
| Ch 53.97 km | | RCBC | 8 | 2.4 x 1.2 |
| Ch 53.99 km | | RCBC (extension) | 2 | 2.4 x 1.2 |
| 330-BR14 | | Bridge | - | - |
| Ch 55.45 km | | RCP (extension) | 1 | 0.9 |
| Ch 55.85 km | | RCP | 15 | 1.2 |
| 330-BR26 | | Bridge | - | - |
| 330-BR28 | | Bridge | - | - |
| Old Laidley Forest Hill Road | | RCBC | 3 | 1.8 x 0.9 |
| 330-BR16 | | Bridge | - | - |
| 330-BR20 | Western Creek | Bridge | - | - |
| Ch 65.88 km | | RCP | 7 | 1.2 |
| Ch 65.99 km | | RCP | 15 | 1.2 |
| Ch 66.03 km | | RCP | 15 | 1.2 |
| Ch 66.20 km | | RCP | 30 | 1.2 |
| Grandchester Mount Mort Access Road | | RCBC | 10 | 2.4 x 0.9 |
| Grandchester Mount Mort Road 1 | | RCBC | 13 | 2.4 x 1.2 |
| Grandchester Mount Mort Road 2 | | RCBC | 6 | 2.4 x 1.2 |
| Ch 66.43 km | | RCP | 20 | 1.2 |
| Ch 66.48 km | | RCP | 10 | 1.2 |
| Ch 66.52 km | | RCP | 10 | 1.2 |
| Ch 66.55 km | | RCP | 10 | 1.2 |
| Ch 66.58 km | | RCP | 10 | 1.2 |
| Ch 66.61 km | | RCP | 10 | 1.2 |
| Ch 66.76 km | | RCP | 10 | 1.2 |
| Ch 66.82 km | | RCP | 10 | 1.2 |
| Ch 66.93 km | | RCP | 30 | 1.2 |
| Ch 67.04 km | | RCP | 10 | 1.2 |
| Ch 67.25 km | | RCP | 5 | 1.2 |
| Ch 67.31 km | | RCP | 25 | 1.2 |
| Ch 67.36 km | | RCP | 3 | 1.2 |
| 330-BR21 | | Bridge | - | - |
| Ch 68.73 km | | RCP (extension) | 8 | 1.2 |

| Chainage[1] | Associated waterway | Type[2] | No. of cells | Diameter or width |
|---|---|---|---|---|
| 330-BR25 | | Bridge | - | - |
| 330-BR22 | | Bridge | - | - |
| Ch 69.90 km | | RCBC | 2 | 3 x 0.6 |
| Ch 69.91 km | | RCBC (extension) | 1 | 3 x 0.6 |
| Ch 69.98 km | | RCP | 15 | 1.2 |
| Ch 70.02 km | | RCP | 15 | 1.2 |
| Ch 70.05 km | | RCP (extension) | 4 | 1.05 |
| Ch 70.98 km | | RCBC (extension) | 4 | 1.5 x 1.8 |
| 330-BR23 | | Bridge | - | - |
| Ch 71.54 km | | RCP (extension) | 3 | 0.9 |
| Ch 71.88 km | | RCP (extension) | 2 | 0.9 |
| Ch 72.43 km | | RCP (extension) | 2 | 0.9 |
| Ch 73.21 km | | RCP (extension) | 7 | 0.9 |

**Table notes:**

1 Chainage numbers refer to distance along alignment from western start of alignment. 330-BR refers to discrete bridge numbers (chainage not included as bridges are restricted to waterway crossing rather than discrete alignment chainage). Street abbreviations denote drainage structures directly related with roadways.

2 RCP denotes reinforced concrete pipe. RCBC denotes reinforced concrete box culvert.

## 2.4 Waterway alterations

Existing drainage paths have been maintained where possible however diversions are required where a rail cutting, or embankment intersects an existing drainage path. In these locations, the existing drainage path will be diverted away from the Project alignment and connected back to the existing flow path.

To facilitate the Project the current design includes the following five alterations to existing unmapped watercourses (refer Figure 2.1). The alterations occur at the following chainages:

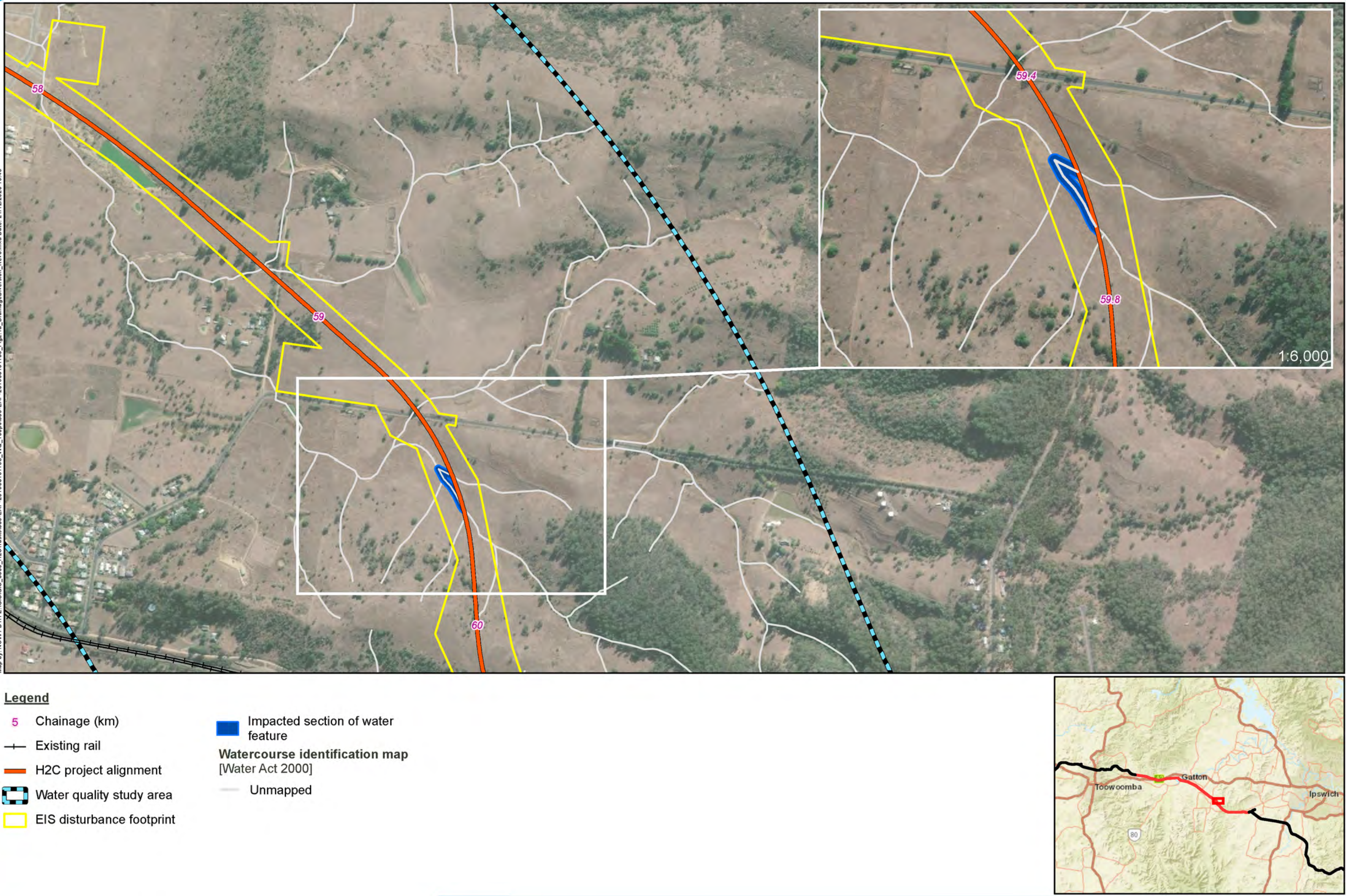
- Ch 59.57 km to Ch 59.67 km
- Ch 61.77 km to Ch 62.02 km
- Ch 63.44 km to Ch 63.53 km
- Ch 63.53 km to Ch 63.75 km
- Ch 64.05 km to Ch 64.17 km

An overland flow path will be altered from Ch 59.57 km. The overland flow path is not identified as a waterway under the DAF *Queensland Waterways for Waterway Barrier Works* spatial mapping.

An overland flow path will be altered from Ch 61.77 km. The overland flow path (draining to the Laidley Creek sub-catchment) runs on the top of the western portal of the proposed Little Liverpool Range tunnel (Ch 61.84 km) and drains into the rail corridor. A proposed diversion drain will intercept and divert part of the flow to the original receiving waterway as to minimise runoff flowing into the rail corridor. The proposed diversion drain will intercept and divert part of the flow to the cut drain at Ch 61.77 km where the drain is 2.5 m deep and has adequate capacity to contain the overland flow. The overland flow path is not identified as a waterway under the DAF *Queensland Waterways for Waterway Barrier Works* spatial mapping.

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Map by: NCW / DTH Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_Fig2.1a_DrainageDiversion_Rev3.mxd Date: 21/12/2020 15:49



**Legend**

5 Chainage (km)

Existing rail

H2C project alignment

Water quality study area

EIS disturbance footprint

Impacted section of water feature

**Watercourse identification map**
[Water Act 2000]

Unmapped

A3 scale: 1:10,000

0 0.1 0.2 0.3 0.4 0.5km

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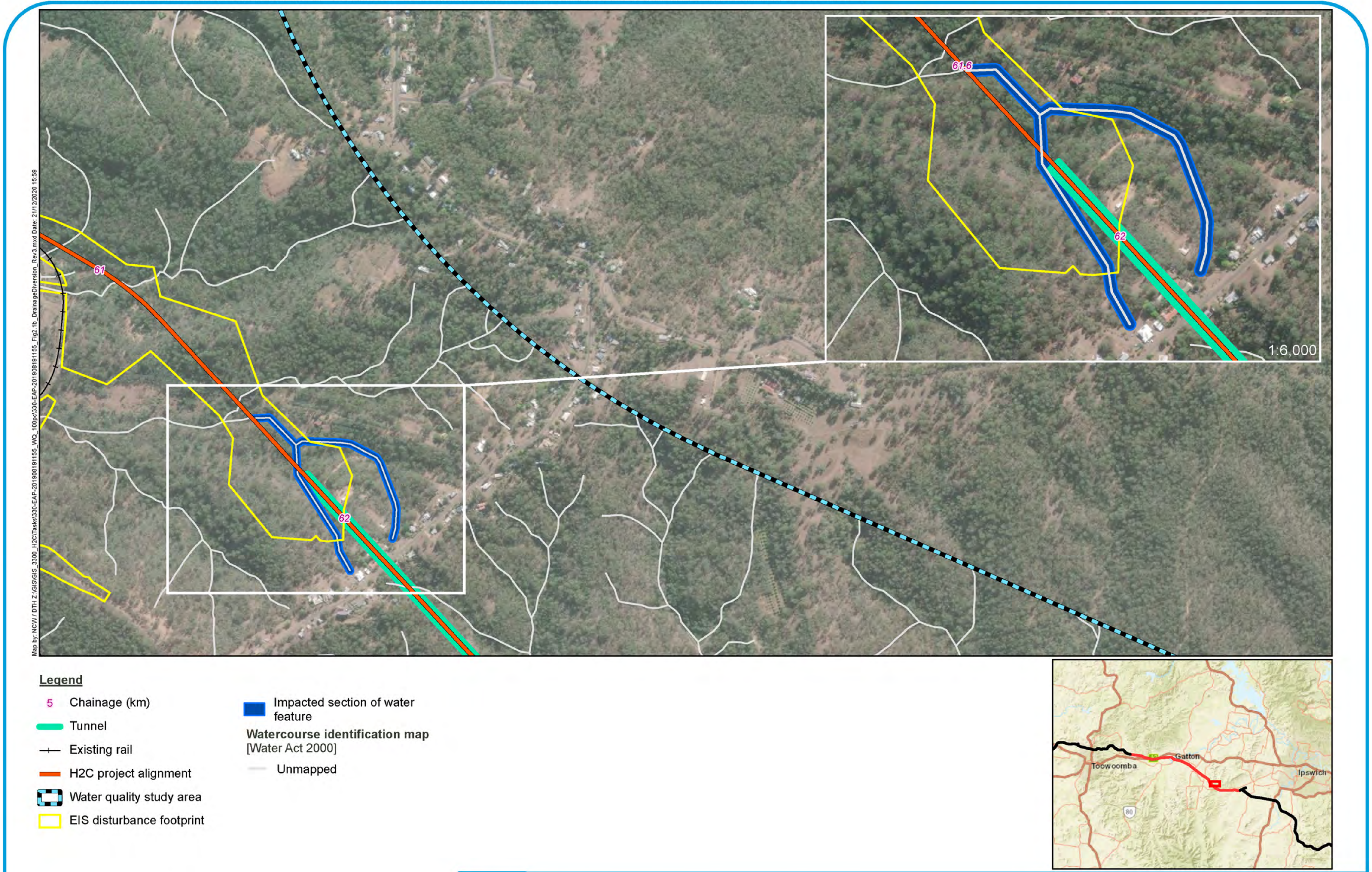
**Helidon to Calvert**
**Figure 2.1a:**
**Drainage diversion**

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



A3 scale: 1:10,000

0 0.1 0.2 0.3 0.4 0.5km

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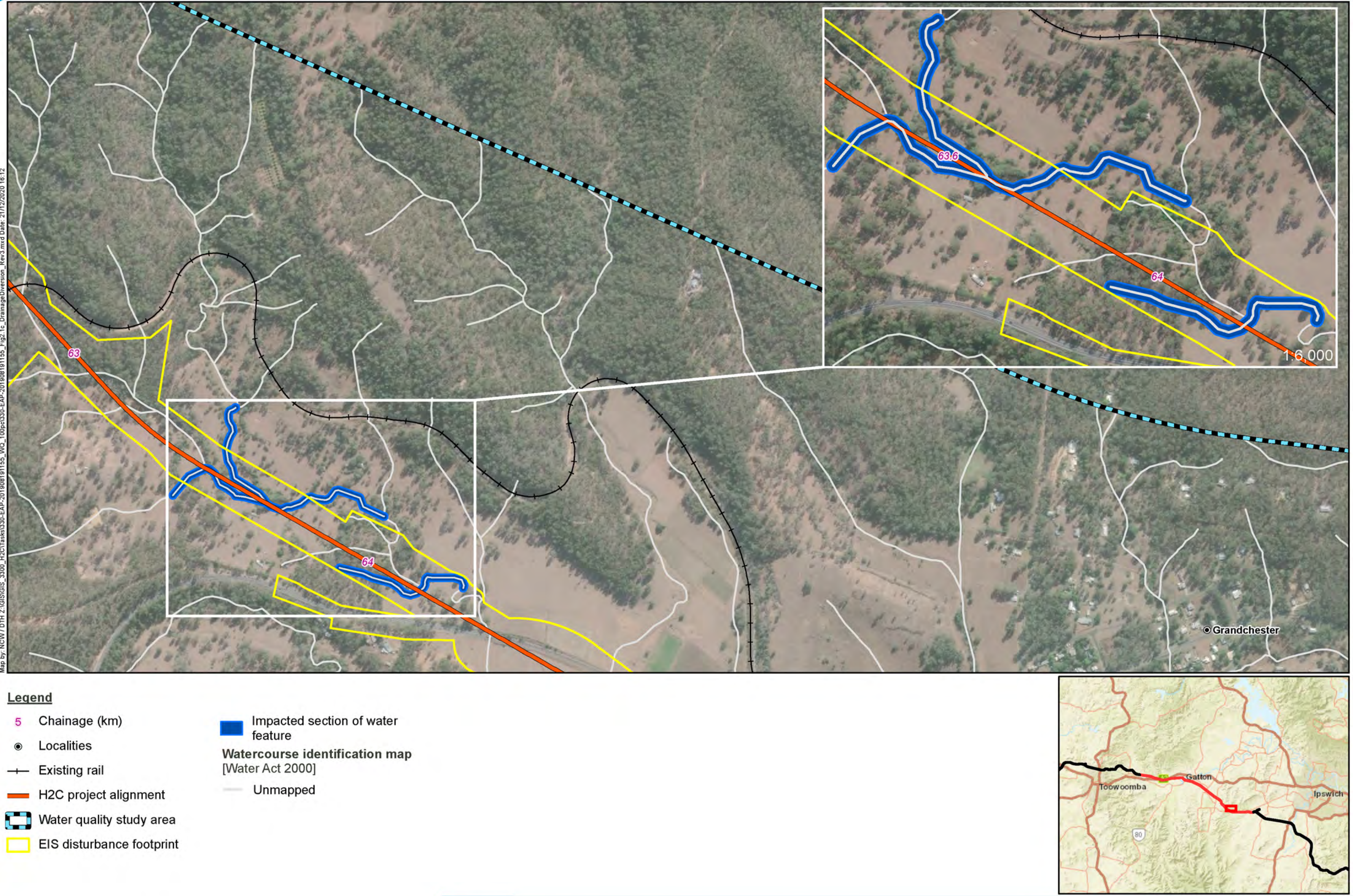
Coordinate System: GDA 1994 MGA Zone 56

**Helidon to Calvert**

**Figure 2.1b:**
**Drainage diversion**

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Map by: NCW / DTH Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_Fig2.1c_DrainageDiversion_Rev3.mxd Date: 21/12/2020 16:12



A3 scale: 1:10,000

0 0.1 0.2 0.3 0.4 0.5km

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# Helidon to Calvert
## Figure 2.1c:
## Drainage diversion

The Project alignment crosses an unmapped feature (as defined under the Water Act) flowing into an unnamed tributary of Western Creek between chainages Ch 63.44 km to Ch 63.75 km (310 m) and Ch 64.05 km to Ch 64.17 km (130 m). The diversion of the drainage features from Ch 63.44 km to Ch 63.75 km are identified as low risk of impact and moderate risk of impact waterway under the DAF Queensland Waterways for Waterway Barrier Works spatial mapping. The diversion from Ch 64.05 km to Ch 64.17 km is identified as a moderate risk of impact waterway under the DAF *Queensland Waterways for Waterway Barrier Works* spatial mapping (refer Section 5.5.2).

These drainage diversions will require approval under State code 10 in the State Development Assessment Provisions as a diversion for works that take or interfere with watercourse, lake or spring. Under the Planning Act 2016 (Qld) (Planning Act), the diversion may require approval as an assessable development under waterway barrier works (in accordance with DAF requirements and the Planning Act).

## 2.5 Erosion and sediment control basins

Temporary site drainage and water runoff management will be provided in line with the International Erosion Control Association Best Practice Erosion and Sediment Control Document and will minimise:

- Any runoff and sedimentation from Project activities to existing waterways
- Disturbance to the water quality of existing waterways along the alignment.

Six temporary erosion and sediment control basins are expected along the Project alignment. All sediment basins are passive which allows surface runoff from a catchment to flow into the sediment basin without the need for pumping. The total volume of all sediment basins is considered to be approximately 3,811 cubic metres ($m^3$).

Sediment basins (outlined in Table 2.3) have been sized to capture runoff from the exposed formation during a rain event. Once settled, the option to use this water for construction and dust suppression will exist. Over-sizing of sediment basins for water harvesting have not been included in the temporary construction disturbance footprint.

**Table 2.3 Sediment basins**

| Name | Type[1] | Catchment size ($m^2$) | Settling volume ($m^3$) | Settling storage ($m^3$)[2] | Total volume ($m^3$) | Surface area ($m^2$) |
|---|---|---|---|---|---|---|
| Sediment Basin 1 (Ch 37.0 km) | Passive | 26,980 | 313.00 | 156.50 | 470 | 501 |
| Sediment Basin 2 (Ch 43.0 km) | Passive | 10,970 | 127.00 | 63.50 | 191 | 256 |
| Sediment Basin 3 (Ch 57.0 km) | Passive | 26,159 | 304.00 | 152.00 | 456 | 547 |
| Sediment Basin 4 (Ch 57.5 km) | Passive | 67,787 | 788.00 | 394.00 | 1,182 | 1204 |
| Sediment Basin 5 (Ch 64.2 km) | Passive | 63,331 | 736.00 | 368.00 | 1,104 | 1192 |
| Sediment Basin 6 (Ch 65.6 km) | Passive | 23,421 | 272.00 | 136.00 | 408 | 491 |

**Table notes:**

1 Passive - Overland flow to sediment basin without pumping

2 If settling storage is not included, the basin must be maintained in an empty state as soon as possible following the cessation of a rainfall event. Any build-up of silt must be removed to ensure full capacity is maintained

- If sediment basin is constructed to store an 80th %ile 5-day storm event across the catchment (equivalent to 34mm), any inflows above this volume which discharges through the spillway is not subject to any discharge criteria
- If sediment basin is not constructed to store an 80th %ile 5-day storm event across the catchment (equivalent to 34mm), a turbidity limit of the background creek NTU + 10% at the time of discharge applies.

## 2.6 Project water requirements and usage

Water will be required for construction activities including dust control, site compaction and reinstatement during construction (refer Table 2.4 and Figure 2.2). Potential water sources have been investigated, including extraction of groundwater and/or surface water, private bores and watercourses. This will be further explored prior to construction in consultation with local councils and landowners. Where water is not available, it will be transported to the site via tanker truck and stored in temporary storage tanks.

Potable water for human consumption will be supplied via bottled water or potable water tanks. Non-potable wash water will be supplied using trailer-mounted storage tanks. Portable toilet facilities will be used where existing infrastructure is unavailable and sewage pump-out services will be utilised to remove waste off-site.

Activities during the construction phase with the highest water demand are:

- Soil conditioning
- General dust suppression
- Dust suppression and maintenance of laydown areas and haul roads.

Overall, an allowance in the range of 190 litres per cubic metre (L/m$^3$) of earthworks has been made in building up the estimated water demand requirements (100 L/m$^3$ for compaction of embankment, 50 L/m$^3$ for dust suppression and 40 L/m$^3$ for hail road maintenance). This is a conservative estimate based upon actual requirements recorded on the Toowoomba Second Range Crossing project during 2018.

Further to the allowances for earthworks compliance, an additional 10 litres per track metre is expected to be required. For tunnel construction 40 m$^3$/day may be required. Bulk concrete batching has an expected allowance of 200 L/m$^3$.Water sourcing and availability is a critical pathway within the construction program for the Project.

**Table 2.4 Construction water requirements**

| Construction activity/process | Uses/requirement | Approximate volume (ML) | Potential sources |
|---|---|---|---|
| Earthworks | Material conditioning and general dust suppression | 286 (conditioning)<br>143 (general dust suppression)<br>114 (haul road and laydown dust suppression) | River, dam or bore |
| Concrete (by concrete supplier) | Bridge and culvert locations | To be determined | Town mains due to quality requirements |
| Concrete) Project specific) | Bulk batching | Not yet quantified (medium quantity) | Priority town mains |
| Trackwork | Ballast dust suppression during ballasting and regulating activities | 0.48 | River, dam or bore |

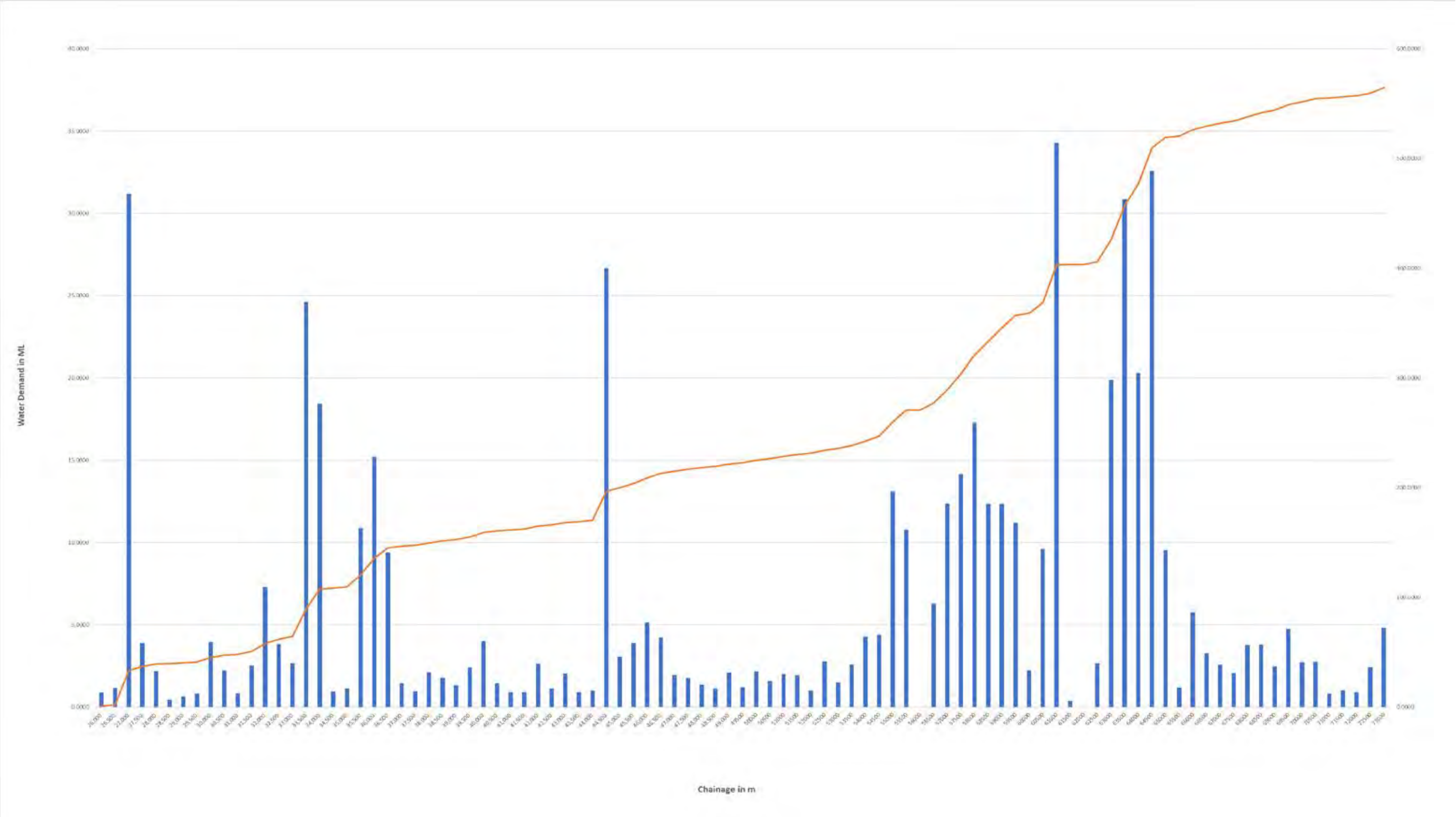

Figure 2.2 Water demand along Project alignment

### 2.6.1 Water sources

Water sourcing and availability is critical to the construction program for the Project. Sources of construction water will be finalised as the construction approach is refined during the detailed design phase of the Project (post-EIS) and will be dependent on:

- Climatic conditions in the lead up to construction, including soil moisture
- Confirmation of private water sources acquired for the Project (e.g. acquisition of land and registered interests such as farm dams and water entitlements)
- Confirmation of private water sources made available to the Project by landholders or other stakeholders under private agreement; including recycled water
- Confirmation of access agreements with local councils and State government agencies/corporations for sourcing of mains water for such activities as concrete batching purposes.

The hierarchy of preference for accessing construction water is generally anticipated to be as follows:

- Commercial water supplies where capacity exists: existing infrastructure, well understood water systems, available water volumes known, licensing in place
- Use of treated recycled water from tunnel dewatering activities during construction
- Treated water, e.g. from wastewater treatment plants (e.g. Wetalla Wastewater Treatment Plant) or recycled water pipelines
- Public surface water storages, i.e. dams and weirs
- Permanently (perennial) flowing watercourses
- Privately held water storages, i.e. dams or ring tanks, under private agreement
- Existing registered and licensed bores
- Drilling of new bores (least preferred option).

An assessment of the suitability of each source will need to be made for each construction activity requiring water, based on the following considerations:

- Legal access
- Volumetric requirement for the activity
- Water quality requirement for the activity, e.g. concrete batching plant will need potable water
- Source location relative to the location of need.

Extraction of water from a watercourse typically requires:

- A water entitlement, water allocation, water licence or water permit. Applications for resource entitlements are assessed against the relevant criteria in the Water Act, any relevant water resource plan and resource operations plan.
- A development permit for operational works for the taking or interfering of water under the *Planning Act 2016*.

The use of surface water and groundwater to supplement the construction demand for the Project may be considered if private owners of registered bores have capacity under their existing sustainable allocated entitlements that they wish to sell to ARTC or the construction contractor under private agreement.

Further options may need to be investigated depending on engagement with water resource owners and managers during the detailed design phase of the Project:

- Water supply (bulk supply) to meet the expected demand may be available from the Lake Clarendon and Lake Dyer (Bill Gunn Dam), however both of these dams are below 10 per cent capacity (as of February 2020)

- If water is to be drawn from watercourses (e.g. Lockyer Creek) then approvals will be required under the Planning Act and Water Act
- Further approvals will also be required to draw from groundwater bores.

No significant potable water requirements are considered in relation to constructive worker impact due to the lack of worker accommodation camps. Onsite water consumption will be expected to be provided for portable lavatories.

## 2.7 Proposed timing

There are three proposed phases (noting the pre-construction and rehabilitation phase are including in the construction phase) in the timing of the delivery of the Project. These phases consist of the following:

- Construction phase
- Operational phase
- Decommissioning (as it relates to construction).

Further details related to each of these phases is provided in Sections 2.7.1 and 2.7.2.

### 2.7.1 Construction phase

Following the expected conclusion of the Project's design, it is anticipated that pre-construction and land acquisition will occur. The construction phase is proposed from 2021 to 2026, with commissioning running into 2026, with the operational phase anticipated to begin in 2026. The construction program defines the following stages and activities:

- Site preparation including site clearance, construction camp establishment, installation of temporary and permanent fencing, installation of drainage and water management controls and construction of site access
- Civil works including bulk earthworks, construction of cuts and embankments, installation of permanent drainage controls, construction of temporary haul roads, bridge and waterway crossing construction
- Track works including the installation of the rail, signalling infrastructure and maintenance infrastructure
- Progressive decommissioning of laydown areas and demountable buildings
- Site rehabilitation and reinstatement.

### 2.7.2 Operational phase

The Project will form part of the rail network managed and maintained by ARTC. Train services will be provided by a variety of operators. Trains will be a mix of grain, bulk freight and other general freight.

Inland Rail as a whole will be operational once all 13 sections are complete, which is estimated to occur in 2026.

The Project will involve operation of a single rail track with crossing loops. Train speeds will vary according to axle loads and track geometry. It is estimated that the operation of Inland Rail will involve an annual average of about 33 train services per day in both directions (northbound and southbound) in 2026. This is then likely to increase to up to 47 train services per day in both directions in 2040.

During the operational phase, tunnel operations will require power and water supply for ventilation and fire safety. Electricity supply will also be needed for points, signalling and other infrastructure. It is anticipated that the supply of these services will be delivered by relevant providers under the terms of their respective approvals and/or assessment exemptions.

Standard ARTC maintenance activities will be undertaken during operations. Typically, these activities include minor maintenance works, such as bridge and culvert inspections, sleeper replacement, rail welding, rail grinding, ballast dropping and track tamping, through to major periodic maintenance, such as ballast cleaning and reconditioning of track.

# 3 Legislative, policy standards and guidelines

## 3.1 Commonwealth and State Legislation

This section describes the legislative, policy and management framework relevant to surface water quality for the Project, including:

- Legislative framework which applies to the assessment of surface water quality applicable to the Project at the Commonwealth, State and local levels, and provides the statutory context for which the surface water quality assessment has been undertaken
- Statutory approvals that may be required as a result of potential impacts to surface water quality, based on consideration of the overall approvals pathway for the Project and the scope of applicable exemptions under Queensland legislation.

An overview of the Commonwealth and State legislation that is relevant to the surface water quality values of the Project, outlining the intent of the legislation and applicability to the Project, is presented in Table 3.1.

Table 3.1 Legislation and policies relevant to the surface water quality values of the Project

| Legislation/Policy | Intent | Applicability |
|---|---|---|
| **Commonwealth** | | |
| *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) | The EPBC Act provides that any action (i.e. a Project, development, undertaking or series or activities) that has, will have or is likely to have a significant impact on an MNES or other matters protected under the EPBC Act such as the environment of Commonwealth land, requires approval from the Commonwealth Environment Minister.<br>Under Section 45 of the EPBC Act, the Australian Government and Queensland Government have implemented a bilateral agreement relating to environmental assessment. This agreement allows the Commonwealth Minister for the Department of Agriculture, Water and the Environment (DAWE) (formerly Department of the Environment and Energy to rely on specified environmental impact assessment processes of Queensland in assessing actions under the EPBC Act. | The EPBC Act is applicable to Projects that involve or have the potential to impact upon nationally and internationally important flora, fauna, ecological communities and heritage places – defined under the Act as MNES.<br>The Project is a controlled action (EPBC 2017/7883) as a result of the Project's potential impacts on listed threatened species and communities. The Project will be assessed under the bilateral agreement between the Queensland and Commonwealth governments.<br>Aquatic fauna MNES are noted from the Project area and are assessed within EIS Chapter 11: Flora and fauna. Water quality impacts are associated with the predicted habitat for MNES fauna and are considered applicable to assessment of aquatic MNES fauna habitat (as a threatening process).<br>Project activities do not involve coal seam gas and large coal mining development and are exempt from the trigger for MNES Water resources. |
| **State** | | |
| *Planning Act 2016* (Qld) (Planning Act) | The Planning Act sets out a planning system for development assessment, plan making and dispute resolution. The system is performance based, which allows for innovation and flexibility in how development can be achieved, whilst ensuring responsiveness to community needs and expectations.<br>Under the Planning Act, development is either accepted, assessable or prohibited. Assessment is carried out through the Development Assessment Rules (DA Rules). | The Project will trigger the requirement to obtain approval for aspects of development that are assessable under Schedule 10 of the Planning Regulation (and integrated through other legislation as part of the Development Assessment Rules process) following completion of the EIS process. |
| *Environmental Protection Act 1994* (Qld) (EP Act) | The objective of the EP Act is to achieve ecologically sustainable development by protecting Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.<br>Under the EP Act, environmental protection policies are developed to cover specific aspects of the environment. | The EVs of Queensland waterways, including those located within the water quality study area, are protected under the EP Act and the subordinate legislation. The Project triggers subordinate legislation under the EP Act, in regard to quality of Queensland waters. |
| Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (Qld) (EPP (Water and Wetland Biodiversity)) | The quality of Queensland waters is protected under the EPP (Water and Wetland Biodiversity). The EPP (Water and Wetland Biodiversity) seeks to achieve the objective of the EP Act in relation to Queensland waters. The EPP (Water and Wetland Biodiversity) seeks to achieve this purpose by identifying EVs and management goals for Queensland waters; stating water quality guidelines and objectives, to enhance or protect the EVs, provide a framework for decision making, and monitoring and report on the condition of Queensland waters. | The EPP (Water and Wetland Biodiversity) lists the EVs and WQOs which are considered by planners and managers when making decisions about development that may impact on waters and/or water quality. The Project will be required to assess the water quality within the area against the EPP (Water and Wetland Biodiversity) EVs and WQOs. |

| Legislation/Policy | Intent | Applicability |
|---|---|---|
| *Water Supply (Safety and Reliability) Act 2008* (Qld) | The *Water Supply (Safety and Reliability) Act 2008* provides for the safety and reliability of water supply. The purpose is achieved by-<br>▪ A regulatory framework for providing water and sewerage services in the State, including functions and powers of service providers<br>▪ A regulatory framework for providing recycled water and drinking recycled water and drinking water quality, primarily for protecting public health<br>▪ The regulatory framework for providing recycled water and drinking water quality, primarily for protected public health<br>▪ The regulation of referable dams<br>▪ Flood mitigation responsibilities<br>▪ Protecting the interests of customers of service providers. | The Project will need to satisfy the requirements of the *Water Supply (Safety and Reliability) Act 2008*. The Project will need to maintain consistency in water quality for the discharge of recycled water and surface water ensuring that the impacts on water supply and the interests of 'service providers' is not impacted. |
| *Water Act 2000* (Qld) (Water Act) | The Water Act provides for the sustainable management of non-tidal waters and other resources, together with the establishment and operation of water authorities, and for other purposes.<br>Under the Water Act, a watercourse is defined as:<br>A river, creek or other stream in the form of an anabranch or a tributary, in which water flows permanently or intermittently, regardless of the frequency of flow events-<br>▪ In a natural channel, whether artificially modified or not; or<br>▪ In an artificial channel that has changed the course of the stream.<br>The Queensland Government maintains Watercourse Identification Mapping (WIM), which identifies defined watercourses under the Water Act, as well as drainage features (not related under the Water Act).<br>Through the Planning Act, certain water related development is assessable under the Water Act and requires the assessment and approval for most works in a defined watercourse.<br>Where applications are made for the purposes of 'taking or interfering with water' (and including surface water, artesian water, and in some instances overland flow where regulated through a water management protocol (Moreton and Logan)), a Water Licence is required as evidence prior to lodging a Development Application.<br>In addition to the approvals triggered under the Planning Act, the Water Act regulates the undertakings of works that involve the excavating or placing fill in a watercourse, lake or spring. Under the Water Act, a proponent must obtain a Riverine Protection Permit to lawfully undertake these works unless the works can be undertaken in accordance with a Riverine Protection Permit Exemption Requirements (DNRME 2018). | The Project involves works within defined watercourses and as such the provisions of the Water Act may apply. Further the Project involves the removal of vegetation, excavation or placing fill in a waterway, lake or spring. This will require a Riverine Protection Permit to authorise excavation and the Project will apply for licencing under the Riverine Protection Permit as necessary (if exemption is not granted as a Government-owned corporation).<br>The Australian Rail Track Corporation Ltd is listed as an entity under Schedule 2 of the Riverine protection permit exemption requirements (WSS/2013/726).<br>Project activities that involve diversion or watercourses will require approval under works that take or interfere with watercourse, lake or spring (for interference with overland flow as diversion waterways are currently unmapped). |

| Legislation/Policy | Intent | Applicability |
|---|---|---|
| | Under the Water Act, Water Plans are instruments designed to allow for the sustainable *Water Plan (Moreton) 2007* (Water Plan (Moreton)) the associated amendment, *Water Plan (Moreton) (Supply Scheme Arrangements) Amendment Plan 2019.* The purpose of the plans is to:<br>■ To define the to define the availability of water in the plan area<br>■ To provide a framework for sustainably managing water and the taking of water<br>■ To identify priorities and mechanisms for dealing with future water requirements<br>■ To provide a framework for reversing, where practicable, degradation that has occurred in natural ecosystems<br>■ To provide a framework for—<br>– Establishing water allocations to take surface water<br>– Granting and amending water entitlements for groundwater and<br>Granting water entitlements for overland flow water. | |
| *Fisheries Act 1994* (Fisheries Act) | The Fisheries Act provides for the management, use, development and protection of fish habitats and resources, together with the management of aquaculture activities. The Fisheries Act hold provisions for the following:<br>■ Taking, causing damage to or disturbance to marine plants<br>■ Works in a declared fish habitat area<br>■ Constructing or raising waterway barrier works<br>■ Tidal water, fresh and marine aquaculture operations.<br>In accordance with Planning Act, operational work for the purposes of the above activities is assessable development, for which a Development Permit is required.<br>Under the provisions of the Fisheries Act and the Planning Act, a Development Permit for Operational Works involving Waterway Barrier Works is required for works which pose a barrier to fish passage (including permanent, partial and temporary barriers) within a waterway which is mapped by Department of Agricultural Fisheries (DAF) on the spatial data layer 'Queensland waterways for waterway barrier works' unless:<br>■ The works have a low impact to fisheries productivity and comply with DAF's requirements for 'works which are not waterway barrier works' which include (subject to specific design and construction requirements):<br>– New single or multi-span bridges<br>– Maintenance of existing bridge structures not subject to an existing permit<br>– Bank revetment | The Project transverses mapped waterways for waterway barrier works and therefore may trigger the requirement to obtain a Development Permit for Operational Works involving constructing or raising temporary and permanent waterway barrier works.<br>The Project will require licencing for major risk impact waterways to maintain connectivity and water quality. As such, while waterway barrier works are not explicitly related to water quality (as a physical barrier), incorporating waterway barrier works licencing codes into the water quality assessments underpins the precautionary principle methodology used throughout the development of the Project.<br>Where structures do not meet the accepted development requirements, development permits for operational works for constructing or raising a waterway barrier works will need to be obtained. Acceptable development requirements are defined in the DAF guideline: *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (2018), and at a minimum include standards such as:<br>■ Development work minimises impacts to waterways and fish habitats.<br>■ Where works are for the replacement of an existing waterway barrier work, the defunct waterway barrier work is to be completely removed as soon as possible and within four weeks of the completion of the replacement works.<br>■ For any part of the waterway bed or banks adjacent to the works that has been altered by the waterway barrier works, the site is restored and/or rehabilitated. |

| Legislation/Policy | Intent | Applicability |
|---|---|---|
|  | – Road resurfacing at waterway crossings<br>– Stormwater outlet construction. | For any part of the waterway bed or banks adjacent to the works that has been altered by the waterway barrier works, the site is restored and/or rehabilitated.<br>The Project will have accepted development and assessable development barrier works permits required.<br>- Further consultation with DAF is required to determine where works other than waterway crossings will trigger waterway barrier works and determine if any unmapped water features meet the definitions of a waterway for the purposes of the Fisheries Act. |
| South East Queensland (SEQ) Regional Plan 2017 (*ShapingSEQ*) | *ShapingSEQ* is the Queensland Government's plan to guide the future for the SEQ region.<br>*ShapingSEQ* is based on the understanding that the region relies on its environmental assets to support our communities and lifestyles.<br>*ShapingSEQ* provides strategies to protect and sustainably manage the region's catchments to ensure the quality and quantity of water in our waterways, aquifers, wetlands, estuaries, Moreton Bay and oceans meets the needs of the environment, industry and community | The Project water quality study area located within the Lockyer Valley and LGA has been identified as a key priority in the region shaping infrastructure and is considered to be consistent with *ShapingSEQ* via the adoption of WQO under Schedule 1 of EPP (Water and Wetland Biodiversity) as basis of existing environment condition. |
| State Planning Policy 2017 (including State Planning Policy – State Interest Guideline (Water Quality) 2016 | The State Planning Policy (SPP) is a key component of the Queensland land use planning system which expresses the State's interest (as defined under the Planning Act) in land use planning and development. The SPP defined the Queensland Government's state interests in land use planning and development which notably includes State transport infrastructure.<br>The SPP includes a SPP code (Water Quality Appendix 2) that provides performance outcomes to ensure development is planned, designed, constructed and operated to manage stormwater and wastewater in ways that support the protection of EVs identified in the EPP (Water and Wetland Biodiversity) | Whilst no components of the Project are assessable under the provisions of a local government planning schemes, State approval requirements will trigger the chief executive of Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP) as a referral agency for a number of applications. As such, relevant provisions of the SPP will require to be addressed as part of the supporting application materials to be submitted (around water quality performance outcomes with discharge from tunnel infrastructure) and will be considered in the assessment process. |

## 3.2 Water quality guidelines

Various water quality guidelines were used to assess the quality of surface waters within the water quality study area against defined reference conditions, which enabled the quantification of WQOs. Applicable guidelines are briefly described below and are used as an assessment tool for existing water quality conditions.

EIS information guideline – Water 2016 Queensland Government's DES have developed an informational guideline to assist in the development and assessment of water resources for EISs. This guideline was incorporated into the methodology, approach, and data sources for the surface water impact assessment. The guideline is complimentary to the Project-defined ToR, finalised in October 2017 by the Coordinator-General.

### 3.2.1 Australian and New Zealand guidelines for fresh and marine water quality

The Australian and New Zealand guidelines for fresh and marine water quality (ANZG 2018) provide a method for assessing water quality through comparison with guidelines derived from local reference values.

The guideline values were developed based on the following criteria:

- Level of environmental disturbance of surface waters (i.e. highly or slightly/moderately disturbed waters)
- Freshwater or saline surface water
- Waterbody elevation (i.e. upland or lowland aquatic environments)
- Biogeographic region (i.e. south-east or tropical Australia).

The ANZG 2018 guideline values can be regarded as guideline trigger values that can be modified into regional, local or site-specific guidelines, with consideration of the variability of the subject environment, soil type, rainfall and contaminant exposure. Exceedances of the guideline trigger values would indicate a potential environmental issue and may trigger an environmental management response.

### 3.2.2 Queensland Water Quality Guidelines

The Queensland Water Quality Guidelines (QWQG) (Department of Environment and Heritage Protection (DEHP) 2009) provide a framework for assessing water quality in Queensland via the setting of WQOs. The QWQG are intended to address the need identified in the ANZG 2018 Guidelines by providing:

- Guideline values (numbers) that are tailored to Queensland region and water types
- A process/framework for deriving and applying more locally specific guidelines for waters in Queensland.

### 3.2.3 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The EPP (Water and Wetland Biodiversity) provides a framework for:

- Identifying EVs for Queensland waters, and deciding the WQOs to protect or enhance those EVs
- Including the identified EVs and WQOs under Schedule 1 of the EPP (Water and Wetland Biodiversity).

### 3.2.4 Water quality objectives and environmental values relevant to the Project

The Queensland Department of Environment and Science (DES) has published two reports, aligning with EPP (Water and Wetland Biodiversity), relevant to the Project alignment listing relevant EVs and WQOs, including:

- *Bremer River environmental values and water quality objectives: Basin No 143 (part) including all tributaries of the Bremer River (Bremer River EV and WQOs) (Department of Environment and Resource Management* (DERM 2010a)
- *Lockyer Creek environmental values and water quality objectives: Basin No 143 (part) including all tributaries of the Lockyer Creek (Lockyer Creek EVs and WQOs)* (DERM 2010b).

The Project alignment traverses through five sub-catchments of the Bremer River and Lockyer Creek catchments which have varying applicable EVs as outlined in Table 3.2.

Within EPP (Water and Wetland Biodiversity), watercourses within each of these catchments are classified as moderately disturbed and corresponding WQOs are used for assessment of the existing condition. Due to the watercourses' definition across the water quality study area (slightly to moderately disturbed, as per ANZG 2018), default guideline values for heavy metals (under ANZG 2018) were conservatively based on 95 percent species protection.

Under the Bremer River EV and WQOs and Lockyer Creek EVs and WQOs document (DERM 2010a; 2010b) EVs are identified for protection for particular waters. The aquatic ecosystem EV is the default applying to all waters. Further WQOs applying to different EVs are identified for the aquatic ecosystem EVs and for EVs other than the aquatic ecosystem (e.g. human use).

WQOs have been developed under the provisions of the EPP (Water and Wetland Biodiversity) and EP Act. These WQOs have been developed to support and protect different EVs identified for waters within both the Lockyer Creek and Bremer River catchment areas. Under the EVs, it is expected that the achievement of each WQO is required to maintain existing water quality standards (or aspirational water quality standards), where present. Typically, WQOs are assessed against a median assessment of the existing environment, however for this assessment, grab samples were assessed against the WQO with reference to prevailing conditions and trending data in regard to seasonal environment conditions.

The applicable WQO for waterways (based in the Bremer River and Lockyer Creek catchments) within the water quality study area are outlined in Table 3.3 and Table 3.4. As indicated in Section 3.2.4, WQOs for the waterways proximal to the Project (refer Section 3.2.4) were selected to confer the highest protective status (protection of aquatic ecosystems).

**Table 3.2 Project alignment sub-catchment environmental values**

| **Environmental Values** | **Aquatic ecosystems** | **Irrigation** | **Farm supply/use** | **Stock water** | **Aquaculture** | **Human consumer** | **Primary recreation** | **Secondary recreation** | **Visual recreation** | **Drinking water** | **Industrial use** | **Cultural and spiritual values** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bremer River catchment** | | | | | | | | | | | | |
| Western Creek<br>(Site 9A, 10A, 18A) | ✓ | ✓ | ✓ | ✓ | - | - | - | ✓ | ✓ | - | - | ✓ |
| **Lockyer Creek catchment** | | | | | | | | | | | | |
| Sandy Creek (Grantham)<br>(Site 1A) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | ✓ |
| Sandy Creek (Forest Hill)<br>(Site 5A, 16A) | ✓ | ✓ | ✓ | ✓ | - | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✓ |
| Upper Lockyer Creek<br>(Site 2A, 3A. 4A, 11A, 12A, 15A) | ✓ | ✓ | ✓ | ✓ | - | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✓ |
| Laidley Creek<br>(Site 7A, 8A, 13A, 14A, 17A) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**Source:** DERM (2010a; 2010b)

**Table notes:**

Blank cells (-) indicate no environmental values alignment with particular parameter for the respective sub-catchment.
Site locations shown on Figure 4.1

**Table 3.3 Water quality objectives for moderately disturbed surface water ecosystems intersected by the Project**

| Catchment | Management intent | Turbidity | Total P | FRP | Chlorophyll a | Total N | Oxidised nitrogen | Ammonia N | Dissolved oxygen | pH | Organic N | TSS | Conductivity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (NTU) | (μgL$^{-1}$) | (μgL$^{-1}$) | (μgL$^{-1}$) | (μgL$^{-1}$) | (μgL$^{-1}$) | (μgL$^{-1}$) | (% saturated) | - | (μgL$^{-1}$) | (mgL$^{-1}$) | (μScm$^{-1}$) |
| **Lockyer Creek catchment** | | | | | | | | | | | | | |
| Laidley Creek | Moderately disturbed | < 6 | < 30 | < 20 | < 5 | < 500 | < 60 | < 20 | 85 – 110 | 6.5 – 8.0 | < 200 | < 6 | < 520 |
| Lower Lockyer Creek | Moderately disturbed | < 6 | < 30 | < 20 | < 5 | < 500 | < 60 | < 20 | 85 – 110 | 6.5 – 8.0 | < 200 | < 6 | < 520 |
| Sandy Creek – Grantham | Moderately disturbed | < 6 | < 30 | < 20 | < 5 | < 500 | < 60 | < 20 | 85 – 110 | 6.5 – 8.0 | < 200 | < 6 | < 520 |
| Tenthill Creek | Moderately disturbed | < 6 | < 30 | < 20 | < 5 | < 500 | < 60 | < 20 | 85 – 110 | 6.5 – 8.0 | < 200 | < 6 | < 520 |
| Upper Lockyer Creek | Moderately disturbed | < 6 | < 30 | < 20 | < 5 | < 500 | < 60 | < 20 | 85 – 110 | 6.5 – 8.0 | < 200 | < 6 | < 520 |
| **Bremer catchment** | | | | | | | | | | | | | |
| Western Creek | Moderately disturbed | < 17 | < 50 | < 20 | < 5 | < 500 | < 60 | < 20 | 85 – 110 | 6.5 – 8.0 | < 420 | < 6 | < 770 |

**Source:** DERM (2010a; 2010b)

**Table notes:**

NTU = Nephelometric Turbidity Units
μgL$^{-1}$ = micrograms per litre
mgL$^{-1}$ = milligrams per litre
μScm$^{-1}$ = microsiemens per centimetre
FRP = Filterable Reactive Phosphorus
Total N = Total Nitrogen
Total P = Total Phosphorus
pH = standard unit for expression of concentration of hydrogen ions in solution

**Table 3.4 Water quality objectives for 95% level of species protection heavy metals and other toxic contaminants for the Project**

| Sub-catchment | Arsenic (III) (mgL$^{-1}$) | Cadmium (mgL$^{-1}$) | Chromium (VI) (mgL$^{-1}$) | Copper (mgL$^{-1}$) | Lead (mgL$^{-1}$) | Mercury (mgL$^{-1}$) | Nickel (mgL$^{-1}$) | Zinc (mgL$^{-1}$) | Naphthalene (mgL$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| **Lockyer Creek catchment** | | | | | | | | | |
| Laidley Creek | 0.024 | 0.0002 | 0.0004 | 0.0014 | 0.0034 | 0.0006 | 0.011 | 0.008 | 0.016 |
| Lower Lockyer Creek | 0.024 | 0.0002 | 0.0004 | 0.0014 | 0.0034 | 0.0006 | 0.011 | 0.008 | 0.016 |
| Sandy Creek – Grantham | 0.024 | 0.0002 | 0.0004 | 0.0014 | 0.0034 | 0.0006 | 0.011 | 0.008 | 0.016 |
| Tenthill Creek | 0.024 | 0.0002 | 0.0004 | 0.0014 | 0.0034 | 0.0006 | 0.011 | 0.008 | 0.016 |
| Upper Lockyer Creek | 0.024 | 0.0002 | 0.0004 | 0.0014 | 0.0034 | 0.0006 | 0.011 | 0.008 | 0.016 |
| **Bremer River catchment** | | | | | | | | | |
| Western Creek | 0.024 | 0.0002 | 0.0004 | 0.0014 | 0.0034 | 0.0006 | 0.011 | 0.008 | 0.016 |

**Source:** ANZG (2018)

# 4 Methodology

## 4.1 Surface water quality assessment

The assessment methodology has been designed to provide sufficient information to provide existing receiving surface water condition (with reference to Schedule 1 of the EPP (Water and Wetland Biodiversity)) required for investigation of potential Project impacts, expected mitigation measures, a residual impact assessment and cumulative impact assessment. The desktop and field assessments (as a description of the existing environment) were used to determine the quality of receiving waters and were utilised in assessing the risk significance (in regard to qualification of potential contaminants) of specific potential impacts expected from the construction, operation and decommissioning phases of the Project.

Diffusive discharge into the receiving environment was likely to consist of overland flow from precipitation (and occur pre-dominantly along pre-existing drainage, passing through discharge lines associated with the alignment). Tunnel discharge was considered as the point source wastewater discharge for the Project.

Other potential Project impacts to the receiving environment were assessed (using a conservative approach) under normal construction and operating activity levels, with the expectation of low-level contamination without appropriate mitigation measures in place.

### 4.1.1 Literature and database review

This section details the desktop analysis undertaken to identify existing information pertaining to the surface water quality values of the water quality study area.

Details of the relevant database sources, search dates, search area parameters and type of information considered for the desktop study are summarised in Table 4.1 and are presented in Appendix D.

**Table 4.1 Database review summary**

| Database/data source name | Database search date | Database search areas | Data derived |
|---|---|---|---|
| Map of referable wetlands (DES) | 12 October 2020 | Water quality study area | Includes State significant, referable wetlands and wetland-associated regional ecosystems. |
| Queensland waterways for waterway barrier works (DAF) | 12 October 2020 | Water quality study area (and wider Lockyer Creek and Bremer River catchments) | Waterways where proposed waterway barrier works require assessment and approval under the Fisheries Act. |
| Watercourse identification mapping (Department of Regional Development, Manufacturing and Water (DRDMW)) | 12 October 2020 | Water quality study area (and gauging stations on watercourses intersecting the Project alignment) | Known extent of waterways and drainage features that are managed under the Water Act. |
| Fish habitat areas (DAF) | 12 October 2020 | Water quality study area | Boundaries of gazetted, declared fish habitat areas. |
| Matters of State environmental significance (DES) | 12 October 2020 | Water quality study area | Location of matters of State environmental significance including:<br>▪ Protected areas<br>▪ Marine parks<br>▪ Management A and Management B declared fish habitat areas<br>▪ Threatened and special least concern wildlife listed under the *Nature Conservation Act 1992*<br>▪ Regulated vegetation under the *Vegetation Management Act 1999* |

| Database/data source name | Database search date | Database search areas | Data derived |
|---|---|---|---|
| | | | Wetlands in a wetland protection area or wetlands of high ecological significance (HES)<br>Wetlands and waterways in high ecological value waters as defined in the EPP (Water and Wetland Biodiversity) Schedule 2<br>Legally secured offset areas. |
| Water monitoring information portal (DRDMW) | 12 October 2020 | Water quality study area (and wider Lockyer Creek and Bremer River catchments) | Information pertaining to stream height and stream flow values from the department's water monitoring stations throughout Queensland, historic streamflow data from decommissioned river and stream monitoring stations and the DRDMW water monitoring network site lists. |
| Climate data from the Bureau of Meteorology (BoM) | 12 October 2020 | Stations closest to water quality study area, to provide general climate | Climate data for the water quality study area, including rainfall, evaporation and temperature data. |
| Public notices of water licence applications | 17 May 2019 | Water quality study area | Public notices of water licence applications. |
| Queensland land use mapping program | 12 October 2020 | Water quality study area | Land use mapping which identifies land use patterns and changes. |
| Water Plans (Moreton) (DNRME) | 12 October 2020 | Water quality study area | Water Plans which provide information on how water is managed and accessed in the water plan area |
| Healthy Waterways report card | 12 October 2020 | Water quality study area (and wider Lockyer Creek and Bremer River catchments) | Includes healthy land and water report cards for Bremer and Logan catchment. |
| Aquatic Conservation Assessment (AquaBAMM) | 12 October 2020 | Water quality study area | AquaBAMM assesses the conservation values of aquatic ecosystems within a specific area |
| Queensland Springs Database (Queensland Government 2018) | 12 October 2020 | Water quality study area (and wider Lockyer Creek and Bremer River catchments) | The dataset provides a comprehensive catalogue of permanently saturated springs that have fixed locations and any associated surface expression groundwater dependant ecosystems (GDEs). |
| GDE Groundwater Dependent Ecosystem Atlas (BOM) | 12 October 2020 | Water quality study area | Aquatic GDEs. |
| Queensland GDE database (DES) | 12 October 2020 | Water quality study area | Aquatic GDEs. |

### 4.1.2 Field assessment

The surface water quality field assessment has been designed to provide sufficient information to produce this Surface Water Quality Technical Report which will be used to inform the EIS for the Project, whilst also providing existing EVs and potential impacts for the design. In addition to the field assessments, a desktop review of available and relevant water quality data to the Project was completed.

The data collection approach is consistent with the *Monitoring and Sampling Manual 2018: Environmental Protection (Water) Policy* (DES 2018a) which occur within Queensland. The surface water quality field assessment methodology is described in further detail below.

#### 4.1.2.1 Assessment timing

Three sampling events were planned and undertaken; one spring, one autumn and one summer assessment (refer Table 4.2). These were selected to efficiently incorporate varying environmental conditions (expected seasonal variation) as per the *Monitoring and Sampling manual: Environmental Protection (Water) Policy* (DES 2018a). Environmental conditions were identified as varied base flow and non-base flow surface water conditions (with the expectation this will be the typical environmental conditions encountered during construction and operational works related to the Project).

Dry conditions were noted throughout the monitoring period with the region (Lockyer Valley) fully drought-declared. The Lockyer Valley LGA has been drought declared after the second assessment was completed.

Due to dry (and no-flow) conditions within the water quality sample sites during the original summer assessment event, the timing of the assessment was extended into Autumn to obtain the best representative sample of existing environmental conditions.

*In situ* water quality field data was collected during each monitoring round in addition to samples collected for laboratory analysis. All *in situ* water quality field data and laboratory samples were collected by a suitably qualified and experienced environmental scientist.

**Table 4.2 Field assessment timing**

| Sampling event | Date[a] | Season |
|---|---|---|
| First | 9 October 2017 to 13 October 2017 | Spring |
| Second | 1 March 2018 to 2 March 2018 | Autumn |
| Third | 11 March 2019 to 12 March 2019 | Autumn |

**Table note:**

a Sampling dates were varied due to sampling timing associated with other surveys and quantity of dry sites.

#### 4.1.2.2 Assessment sites

The locations of 18 surface water quality monitoring sites were initially identified during desktop assessment as presented in Table 4.3 and Figure 4.1. Sites were located to target waterways which intersect the proposed Project alignment, with additional sites located upstream and downstream of the alignment intersection. The location of the monitoring sites were refined in the field, following ground truthing of the waterway alignment and factors such as land access and water availability.

As such, due to conditions and access across all water quality assessments, some of the sites were not assessed across the entire sampling period due to a lack of adequate water and land access for assessment. As such, 12 of the original 18 were used for the existing water quality assessment.

Watercourse names within Table 4.3 were determined by the Water Act watercourses.

**Table 4.3 Surface water quality survey sites**

| Site ID | Waterway | Position | Site location (GDA94) | | Water present at time of assessment | | |
|---|---|---|---|---|---|---|---|
| | | | Latitude | Longitude | October 2017 | March 2018 | March 2019 |
| H2C 2A | Un-named waterway | Located on the Project alignment | 27°32'55.35"S | 152°14'57.46"E | No | Yes | No |
| H2C 3A | Lockyer Creek | Located 240 m upstream of the Project alignment | 27°33'15.45"S | 152°16'26.19"E | Yes | No | Yes |
| H2C 4A | Lockyer Creek | Located 50 m downstream from the Project alignment | 27°33'9.72"S | 152°16'34.09"E | Yes | No | Yes |
| H2C 7A | Un-named waterway | Located 130 m downstream from the Project alignment | 27°36'55.02"S | 152°23'38.42"E | Yes | No | No |

| Site ID | Waterway | Position | Site location (GDA94) | | Water present at time of assessment | | |
|---|---|---|---|---|---|---|---|
| | | | Latitude | Longitude | October 2017 | March 2018 | March 2019 |
| H2C 9A | Western Creek | Located 130 m upstream of the Project alignment | 27°39'46.51"S | 152°27'44.11"E | Yes | No | No |
| H2C 10A | Western Creek | Located on the Project alignment | 27°39'51.80"S | 152°30'54.16"E | Yes | No | No |
| H2C 11A | Lockyer Creek | Located 1.35 km downstream from the Project alignment | 27°33'2.80"S | 152° 7'14.03"E | Yes | Yes | No |
| H2C 12A | Lockyer Creek | Located 1.2 km downstream from the Project alignment | 27°32'41.14"S | 152°17'0.19"E | Yes | No | No |
| H2C 13A | Laidley Creek | Located 1.1 km downstream from the Project alignment | 27°34'53.30"S | 152°22'2.30"E | No | Yes | No |
| H2C 14A | Laidley Creek | Located 400 m downstream from the Project alignment | 27°36'44.34"S | 152°23'2.46"E | No | Yes | No |
| H2C 17A | Laidley Creek | Located 2.1 km downstream from the Project alignment | 27°37'55.77"S | 152°23'11.74"E | Yes | Yes | No |
| H2C 18A | Western Creek | Located 350 m downstream from the Project alignment | 27°40'1.42"S | 152°31'9.38"E | Yes | No | Yes |

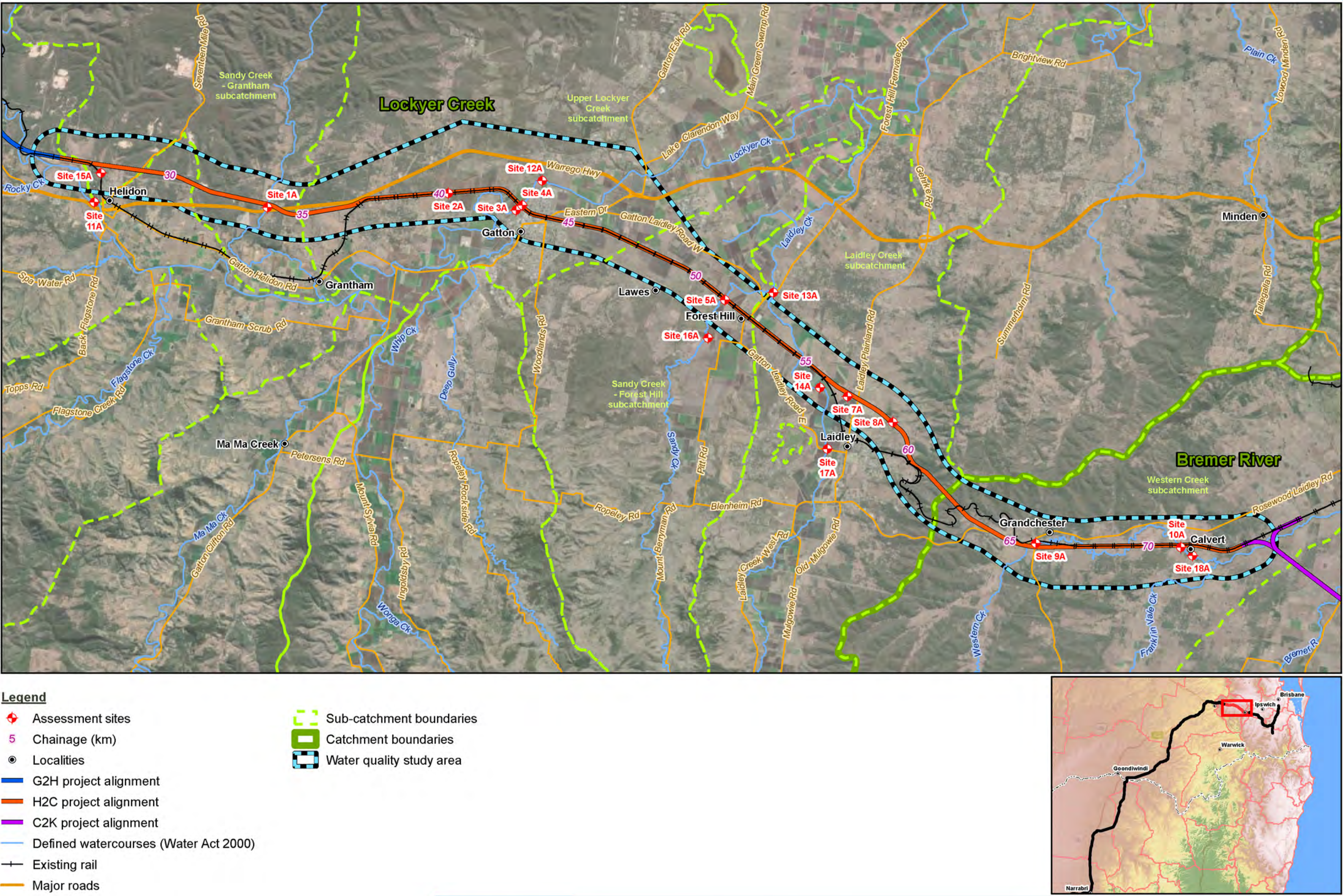

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**Figure 4.1:**
**Surface water quality field assessment sites**

#### 4.1.2.3 *In situ* analysis of surface water quality

A suite of water quality parameters was selected for the assessment of the existing environmental condition in relation to anticipated activities and associated impacts from the Project. Qualitative data was collected to provide contextual supplementary information in relation to the water quality values.

A fully serviced and calibrated YSI Professional Plus water quality meter and a TPS WP-88 Turbidity Meter were employed to record the following *in situ* water quality parameters:

- pH
- Temperature
- Electrical conductivity (actual and specific)
- Salinity
- Dissolved oxygen (dissolved and saturated)
- Turbidity.

Additionally, the following qualitative data was recorded:

- Time
- Water flow (none/low/moderate/high/flood/dry). Categorical water flow are based on visual observations, characteristics of which can be described as:
  - None – denotes standing water
  - Low – indicates low flow within bottom of channel
  - Moderate – denotes flow above bottom channel but under bankfull level
  - High – denotes bankfull level
  - Flood – denotes overtopping (exceeding bankfull level)
  - Dry – no water present
- Optical clarity (clear/slight/turbid/opaque/other)
- Odour (normal/sewage/hydrocarbon/chemical)
- Surface condition (none/dust/oily/leafy/algae)
- Algae cover (none/some/lots)
- Other visual observations/comments (colour, fish, presence of litter).

A photo and global positioning system point were collected from each sampling site.

Water quality meters were professionally calibrated within the month preceding field assessment events. Calibration certificates for the YSI Professional Plus water quality meter and a TPS WP-88 Turbidity Meter used during the sampling works are provided in Appendix A.

#### 4.1.2.4 Laboratory analysis of surface water quality

Before the commencement of field sampling a National Associated of Testing Authorities (NATA) accredited laboratory (Eurofins) was chosen and communicated with to understand their requirements for analysing the water samples collected.

Surface water samples were collected at each monitoring location listed in Table 4.3. The collected samples were submitted to Eurofins for analysis of the following water quality parameters (Limit of Reporting (LOR) indicates the lowest detection limit):

- pH (LOR – 0.1 pH units)
- Suspended solids (LOR – 1 $mgL^{-1}$)

- Turbidity (LOR – 1 NTU)
- Total phosphorus (as phosphate) (LOR – 0.05 $mgL^{-1}$ – assessments 1 and 2) (LOR - 0.01 $mgL^{-1}$ assessment 3)
- Reactive phosphorus (LOR – 0.01 $mgL^{-1}$)
- Speciated nitrogen (ammonia (LOR – 0.01 $mgL^{-1}$), nitrate (LOR – 0.02 $mgL^{-1}$), nitrite (LOR – 0.02 $mgL^{-1}$), organic nitrogen (LOR – 0.2 $mgL^{-1}$), total kjeldahl nitrogen (LOR – 0.2 $mgL^{-1}$), total nitrogen (LOR – 0.2 $mgL^{-1}$))
- Dissolved metals: arsenic (LOR – 0.001 $mgL^{-1}$), cadmium (LOR – 0.0002 $mgL^{-1}$), chromium (LOR – 0.001 $mgL^{-1}$), copper (LOR – 0.001 $mgL^{-1}$), lead (LOR – 0.001 $mgL^{-1}$), mercury (LOR – 0.0001 $mgL^{-1}$), nickel (LOR – 0.001 $mgL^{-1}$), zinc (LOR – 0.005 $mgL^{-1}$)
- Salinity (LOR – 20 $mgL^{-1}$)
- Electrical conductivity (LOR – 1 $\mu scm^{-1}$)
- Chlorophyll a (LOR – 5 $ugL^{-1}$)
- Polycyclic aromatic hydrocarbons (universal LOR – 0.001 $mgL^{-1}$).

The above parameters were analysed to establish a snapshot assessment of the existing water quality within the water quality study area, against specific catchment WQOs to protect aquatic ecosystems, as indicated by EPP (Water and Wetland Biodiversity). No further sampling for specific hydrocarbon or biocide was completed due to qualitative assessment of other hydrocarbon through olfactory/visual assessments during field sampling. Industry best-practice also requires the use of aquatic-friendly pesticides which removes the requirement for biocide assessment.

### 4.1.3 Sampling and laboratory quality assurance/quality control

Surface water quality samples were collected in accordance with industry-accepted standards and quality assured procedures, including the Monitoring and Sampling Manual 2018: Environmental Protection (Water and Wetland Biodiversity) Policy (DES 2018a). Field quality control included rigorous sample collection, decontamination procedures (where appropriate), and sample documentation.

Where possible, surface water quality samples were collected from the centre of the waterway, where the velocity is the highest. The mouth of the sampling container was held above the base of the channel to avoid disturbing or collecting any settled solids or materials.

The surface water quality samples were collected directly into the appropriate sampling bottles provided by the laboratory to avoid potential contamination associated with the use of intermediate containers. Where a sampling pole was required to be used to enable safe sample collection, the sampling bottle was placed on the pole and the sample collected directly into the sampling bottle. Samples were field filtered as required. Syringes and filters were flushed with water from the sampling site prior to use.

As each sample was collected it was labelled with a unique sample identifier, the initials of the sampler, the date and the Project number. All sample jars were filled leaving no headspace and placed immediately into ice-filled cooler boxes. All samples were transported in ice-filled coolers to prevent degradation of organic compounds. Chain of Custody documentation was completed, with data including sample identification, date sampled, matrix type, preservation method, analyses required and name of sampler (refer Appendix B).

The collection of quality control samples is essential to provide confidence in the results of sampling program and is part of the overall quality assurance program. The Queensland Monitoring and Sampling Manual (DES 2018a) provides guidance on the frequency of collection and purpose of quality control samples where duplicates are taken one per 10 samples for primary laboratory analysis. In line with the Queensland Monitoring and Sampling Manual (DES 2018a), one duplicate sample was taken on each round of water sampling for Quality Assurance (QA)/Quality Control (QC) purposes. Surface water quality samples were submitted to a NATA accredited laboratory (Eurofins) for analysis. Samples were analysed within applicable holding times by the laboratory.

Laboratory QA/QC included analysis of laboratory duplicates, method blanks, laboratory control samples, matrix spikes and surrogates. All laboratory QA/QC were within the acceptance range. All samples were collected into the appropriate sample containers for the analysis required and arrived at the laboratory chilled and within the relevant holding times.

Overall the reported analytical results are considered to be valid and representative of the concentrations of the analysed compounds at the sample locations at the time of sampling. Notably, limits of reporting were principally observed for metal and polycyclic aromatic hydrocarbons (PAH) analysis and were all below WQOs.

Relative percentage difference calculations were all considered acceptable under QC acceptance guidelines. On the basis of the analytical data validation process, the overall quality of the analytical data collected is considered to be of an acceptable standard for interpretive use.

### 4.1.4 Assessment of results

Field and laboratory results were compared against relevant WQOs as presented in Section 3.2.4.

The field obtained data was assessed against the data obtained during the desktop assessments to supplement identified data gaps and provide a contemporary assessment of the physical and chemical status of aquatic systems to be intersected by the Project alignment, against current WQOs.

WQOs and assessment of surface water quality monitoring results against the relevant WQOs is discussed in further detail in Section 6.2.

## 4.2 Impact assessment methodology

The surface water quality assessment for the Project uses a significance-based impact assessment framework to identify and assess Project related impacts in relation to water quality receptors.

For the purposes of the assessment, a significant impact depends upon the sensitivity of the surface water value, the quality of the environment which is impacted, and upon the intensity, duration, magnitude and potential spatial extent of the potential impacts. Determination of the sensitivity or vulnerability of the surface water quality receptor and the magnitude of the potential impacts facilitate the assessment of the significance of potential impacts. The following sections discuss and define impact magnitudes, receptor sensitivity and impact significance.

### 4.2.1 Magnitude of impacts

The magnitude of a potential impact is essential to the determination of its level of significance on sensitive receptors. For the purposes of this assessment, impact magnitude is defined as comprising the nature and extent of the potential impacts, including direct and indirect impacts. The impact magnitude is divided into five categories (refer Table 4.4). The magnitude of impacts is determined using assessment of potential impacts against existing condition, Project activities and potential impacts to facilitate an estimation of the extent, duration and frequency of the impacts (refer Table 4.5).

**Table 4.4 Criteria for magnitude**

| Magnitude | Description |
|---|---|
| Major | An impact that is widespread, permanent and results in substantial irreversible change to the water quality receptor. Avoidance through appropriate design responses or the implementation of environmental management controls are required to address the impact. |
| High | An impact that is widespread, long lasting and results in substantial and possibly irreversible change to the water quality receptor. Avoidance through appropriate design responses or the implementation of site-specific environmental management controls are required to address the impact. |

| Magnitude | Description |
|---|---|
| Moderate | An impact that extends beyond the area of disturbance to the surrounding area but is contained within the region where the Project is being developed. The impacts are short term and result in changes that can be ameliorated with specific environmental management controls. |
| Low | A localised impact that is temporary or short term and either unlikely to be detectable or could be effectively mitigated through standard environmental management controls. |
| Negligible | An extremely localised impact that is barely discernible and is effectively mitigated through standard environmental management controls. |

**Table 4.5 Timeframes for duration terms**

| Duration term | Timeframe – to be defined for each receptor type if required |
|---|---|
| Temporary | Days to months (i.e. 1 to 2 seasons; 3 to 6 months) |
| Short term | Up to 2 years (i.e. 6 to 24 months) |
| Medium term | From 2 to 11 years[1] |
| Long term/long lasting | From 11 to 21 years[2] |
| Permanent or irreversible | More than 21 years[3] |

**Table note:**

1 Derived from the term 'moderate' Environmental Assessment and Management (EAM) Risk Management Framework 2009 (Great Barrier Reef Marine Park Authority (GBRMPA) 2009)

2 Derived from the term 'major' EAM Risk Management Framework 2009 (GBRMPA 2009)

3 Derived from the term 'catastrophic' EAM Risk Management Framework 2009 (GBRMPA 2009)

### 4.2.2 Sensitivity

To assess the significance of potential impacts on sensitive receptors, sensitivity categories were applied to each of the features. The sensitivity categories are split into five discrete groups as described in Table 4.6. These groupings are based on qualitative assessments utilising information related to the sensitivity of the water quality receptor, in addition to the potential of a water quality receptor's occurrence within the receiving environment.

Through the determination of sensitivity categories for each of the water quality receptors, the features are then able to be assessed through a matrix against the magnitude of the potential Project impact type to indicate the level of significance for each of the impact types on the water quality receptors.

Sensitive features are treated individually. In the case where there are conflicting classes, the highest sensitivity is selected.

**Table 4.6 Sensitivity criteria for sensitive water quality receptors within the water quality study area**

| Sensitivity | Description |
|---|---|
| Major | ▪ The water quality receptor is listed on a recognised or statutory state, national or international register as being of conservation significance and/or<br>▪ The water quality receptor is entirely intact and wholly retains its intrinsic value and/or<br>▪ The water quality receptor is unique to the environment in which it occurs. It is isolated to the affected system/area, which is poorly represented in the region, state, country or the world and/or<br>▪ It has not been exposed to threatening processes, or they have not had a noticeable impact on the integrity of the water quality receptor<br>▪ Project activities would have an adverse effect on the value. |
| High | ▪ The water quality receptor is listed on a recognised or statutory state, national or international register as being of conservation significance and/or<br>▪ The sensitive receptor is intact and retains its intrinsic value and/or<br>▪ The water quality receptor is unique to the environment in which it occurs. It is isolated to the affected system/area, which is poorly represented in the region and/or<br>▪ The water quality receptor has not been exposed to threatening processes, or they have not had a noticeable impact on the integrity of the water quality receptor<br>▪ Project activities would have an adverse effect on the water quality receptor. |

| Sensitivity | Description |
|---|---|
| Moderate | - The water quality receptor is recorded as being important at a regional level, and may have been nominated for listing on recognised or statutory registers and/or<br>- The water quality receptor is in a moderate to good condition despite it being exposed to threatening processes. It retains many of its intrinsic characteristics and structural elements and/or<br>- The water quality receptor is relatively well represented in the systems/areas in which it occurs, but its abundance and distribution are exposed to threatening processes and/or<br>- Threatening processes have reduced the water quality receptor's resilience to change. Consequently, changes resulting from Project activities may lead to degradation of the prescribed value and/or<br>- Replacement of unavoidable losses is possible due to its abundance and distribution. |
| Low | - The water quality receptor is not listed on any recognised or statutory register. It might be recognised locally by relevant suitably qualified experts or organisations e.g. historical societies and/or<br>- The water quality receptor is in a poor to moderate condition as a result of threatening processes, which have degraded its intrinsic value and/or<br>- It is not unique or rare and numerous representative examples exist throughout the system/area and/or<br>- It is abundant and widely distributed throughout the host systems/areas and/or<br>- There is no detectable response to change or change does not result in further degradation of the water quality receptor and/or<br>- The abundance and wide distribution of the water quality receptor ensures replacement of unavoidable losses is achievable. |
| Negligible | - The water quality receptor is not listed on any recognised or statutory register and is not recognised locally by relevant suitably qualified experts or organisations and/or<br>- The water quality receptor is not unique or rare and numerous representative examples exist throughout the system/area and/or<br>- There is no detectable response to change or change does not result in further degradation of the water quality receptor. |

### 4.2.3 Significance of impact

The significance of a potential impact is a function of the significance of the water quality receptor, the sensitivity of the receptor and the magnitude of the potential impact. Although the sensitivity of the receptor will not change (i.e. is generally determined qualitatively by the interaction of the receptor's condition, adaptive capacity and resilience), the magnitude of the potential impact is variable and may be categorised quantitatively to facilitate the prediction of the significance of the potential impact.

Once the water quality receptor was identified, and the sensitivity of the receptor and the magnitude of the potential impact was determined, the assessment of the significance of the potential impact was derived through use of a five by five matrix (refer Table 4.7).

Following the identification of the level of significance (refer Table 4.8), mitigation measures were then applied to the potential (unmitigated) impacts to identify the residual (mitigated) impacts.

**Table 4.7 Significance assessment matrix**

| Magnitude of impact | Sensitivity | | | | |
|---|---|---|---|---|---|
| | Major | High | Moderate | Low | Negligible |
| Major | Major | Major | High | Moderate | Low |
| High | Major | Major | High | Moderate | Low |
| Moderate | High | High | Moderate | Low | Low |
| Low | Moderate | Moderate | Low | Negligible | Negligible |
| Negligible | Moderate | Low | Low | Negligible | Negligible |

**Table note:**

Significance categories as identified in Table 4.7 are defined in Table 4.6. Magnitude categories are defined in Table 4.4.

Table 4.8 Significance classifications

| Significance rating | Description |
|---|---|
| Major | Arises when an impact will potentially cause irreversible or widespread harm to a water quality receptor that is irreplaceable because of its uniqueness or rarity. Avoidance through appropriate design responses is the only effective mitigation. |
| High | Occurs when the proposed activities are likely to exacerbate threatening processes affecting the intrinsic characteristics and structural elements of the water quality receptor. While replacement of unavoidable losses is possible, avoidance through appropriate design responses is preferred to preserve its intactness or conservation status. |
| Moderate | Results in degradation of the water quality receptor due to the scale of the impact or its susceptibility to further change even though it may be reasonably resilient to change. The abundance of the water quality receptor ensures it is adequately represented in the region, and that replacement, if required, is achievable. |
| Low | Occurs where a water quality receptor is of local importance and temporary or transient changes will not adversely affect its viability provided standard environmental management controls are implemented. |
| Negligible | Does not result in any noticeable change and hence the proposed activities will have negligible effect on water quality receptors. This typically occurs where the activities are located in already disturbed areas. |

## 4.3 Cumulative impact assessment

### 4.3.1 General assessment methodology

The cumulative impacts of multiple Projects occurring in the vicinity of the water quality study area may contribute to impacts to water quality if not managed appropriately.

The cumulative impact assessment (CIA) for surface water quality was conducted based on the following principles:

- The CIA considered ‘State significant’ or ‘strategic’ projects outside of the Project that are in the public domain as being planned, constructed or operated at the time the Project terms of reference (ToR) were finalised (5 October 2017)
- The Inland Rail Projects immediately adjacent to the Project have been included in the CIA (e.g. the Project CIA considered the C2K and G2H projects)
- The area of influence for the purposes of the Project CIA for surface water quality was defined by the hydrological catchment area for the Project alignment
- Current operational Projects and commercial or agricultural operations that are in the areas of influence in the hydrological catchment area, and considered in the CIA, are accounted for, where appropriate, in this technical report
- The CIA is not retrospective. The CIA does not take into account impacts from past land use (e.g. vegetation clearing). The environment at the time of the Project ToR finalisation is the baseline for the Project CIA.

The CIA process is summarised below:

- A list of applicable Projects and operations for consideration in the CIA was prepared. Figure 4.2 illustrates the areas of spatial influence of the Project being assessed in the CIA, demonstrating the overlap of potential cumulative impact with the Projects and/or operations identified above.
- The temporal impact zone of influence was identified via identification of temporal overlaps between the Project and the Projects and/or operations identified above
- The CIA was conducted to determine the significance of cumulative impacts with respect to beneficial or detrimental effects
- Additional mitigation measures were proposed for cumulative impacts deemed to be of ‘medium’ or ‘high’ significance (refer Section 4.3.2) where it was considered within ARTC’s control to reduce the significance of those impacts.

### 4.3.2 Assessment matrix

Following the identification of each potential cumulative impact, a relevance factor score of Low, Medium and High was determined in consideration of the impacts, in accordance with the assessment matrix given in Table 4.9.

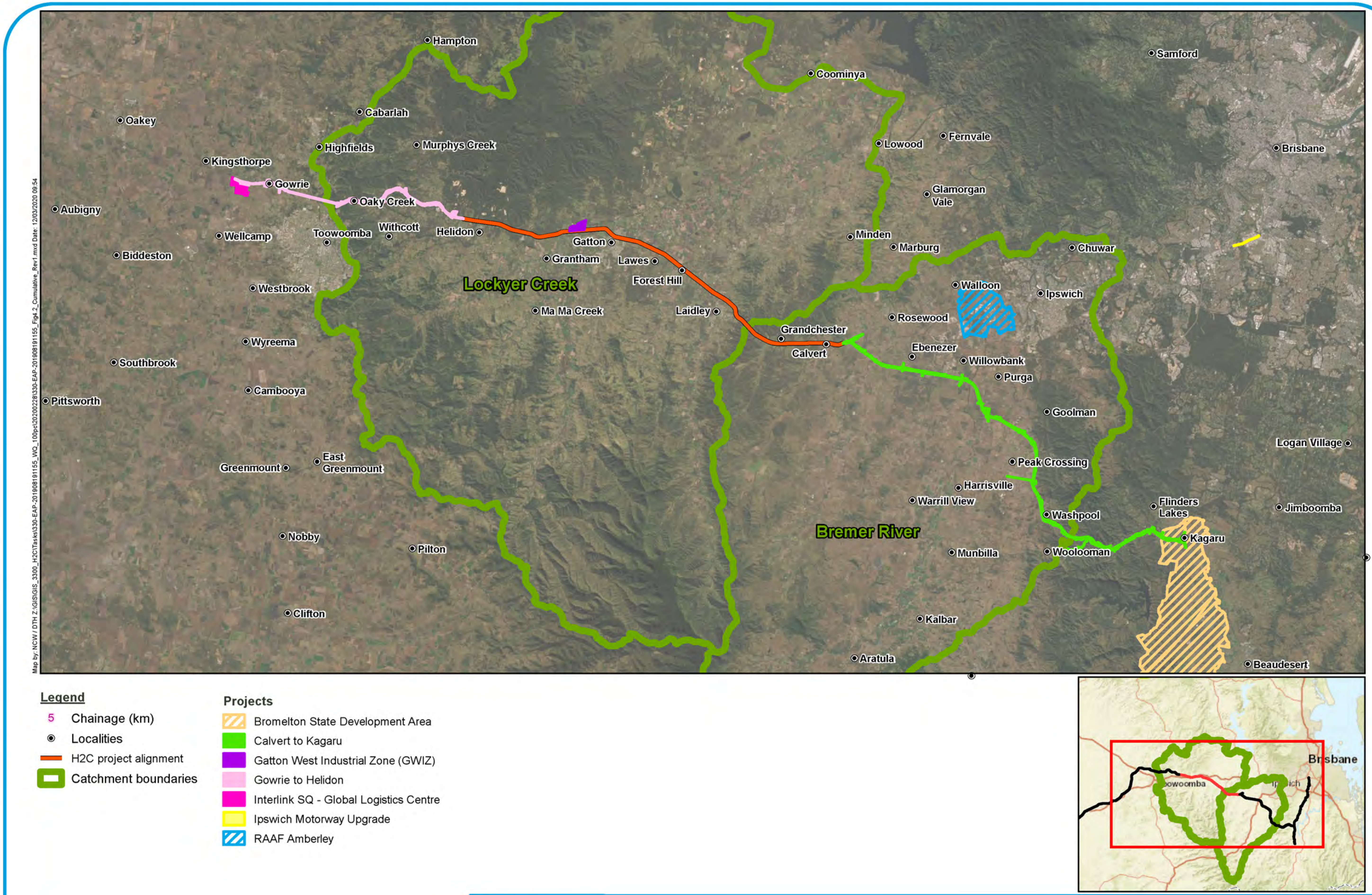
The significance of the impact has been determined by using professional judgement to select the most appropriate relevance factor for each aspect in Table 4.9 and summing the relevance factors. The sum of the relevance factors determines the impact significance and consequence which are summarised in Table 4.10. For example, if a surface water quality receptor such as riparian vegetation removal was considered to have a probability of impact of 2, duration of impact of 3, magnitude/intensity of impact of 1 and a sensitivity of receiving environment of 1 the significance of impact would be (2+3+1+1 = 7) = Medium.

**Table 4.9 Assessment matrix**

| **Aspect** | **Relevance factor** | | |
|---|---|---|---|
| | **Low** | **Medium** | **High** |
| Probability of impact | 1 | 2 | 3 |
| Duration of impact | 1 | 2 | 3 |
| Magnitude/Intensity of impact | 1 | 2 | 3 |
| Sensitivity of receiving environment | 1 | 2 | 3 |

**Table 4.10 Impact significance**

| **Impact significance** | **Sum of relevant factors** | **Consequence** |
|---|---|---|
| Low | 1 to 6 | Negative impacts need to be managed by standard environmental management practices. Special approval conditions unlikely to be necessary. Monitoring to be part of general Project monitoring program. |
| Medium | 7 to 9 | Mitigation measures likely to be necessary and specific management practices to be applied. Specific approval conditions are likely. Targeted monitoring program required, where appropriate. |
| High | 10 to 12 | Alternative actions will be considered and/or mitigation measures applied to demonstrate improvement. Specific approval conditions required. Targeted monitoring program necessary, where appropriate. |



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**Helidon to Calvert**

**Figure 4.2:**

**Relevant Projects to the cumulative impact assessment**

## 4.4 Assumptions of assessment

This report has been prepared based on publicly available information and field water sampling results. The description of the existing surface water condition in this report is a desktop study from publicly available data complemented by contemporary field water quality samples (with seasonal variation) to enable an assessment of existing environmental conditions.

Periods of minimal hydrological flow within the water courses across the Project was observed (during periods of fully declared drought conditions). Noting this, historic gauging stations across the water quality study area allowed for the existing environment to supplement the field assessment of available waters discharge and water quality parameters analysed indicated the region to experience cyclic, episodic hydrological regime of the water quality study area and aligned with the limited data obtained during the field assessment. As such, the field data gathered during this assessment was considered to be indicative of existing environmental conditions and relevant for assessment under the EIS ToR.

# 5 Description of environmental values/existing conditions

## 5.1 Local government areas

The proposed Project alignment travels through the local government areas (LGAs) of Lockyer Valley, between Helidon and Grandchester, and Ipswich between Grandchester and Calvert.

## 5.2 Catchment areas

The Project alignment travels through two catchments; the Lockyer Creek and Bremer River. Both catchments are located within the wider Moreton hydrological basin (refer Figure 5.1).

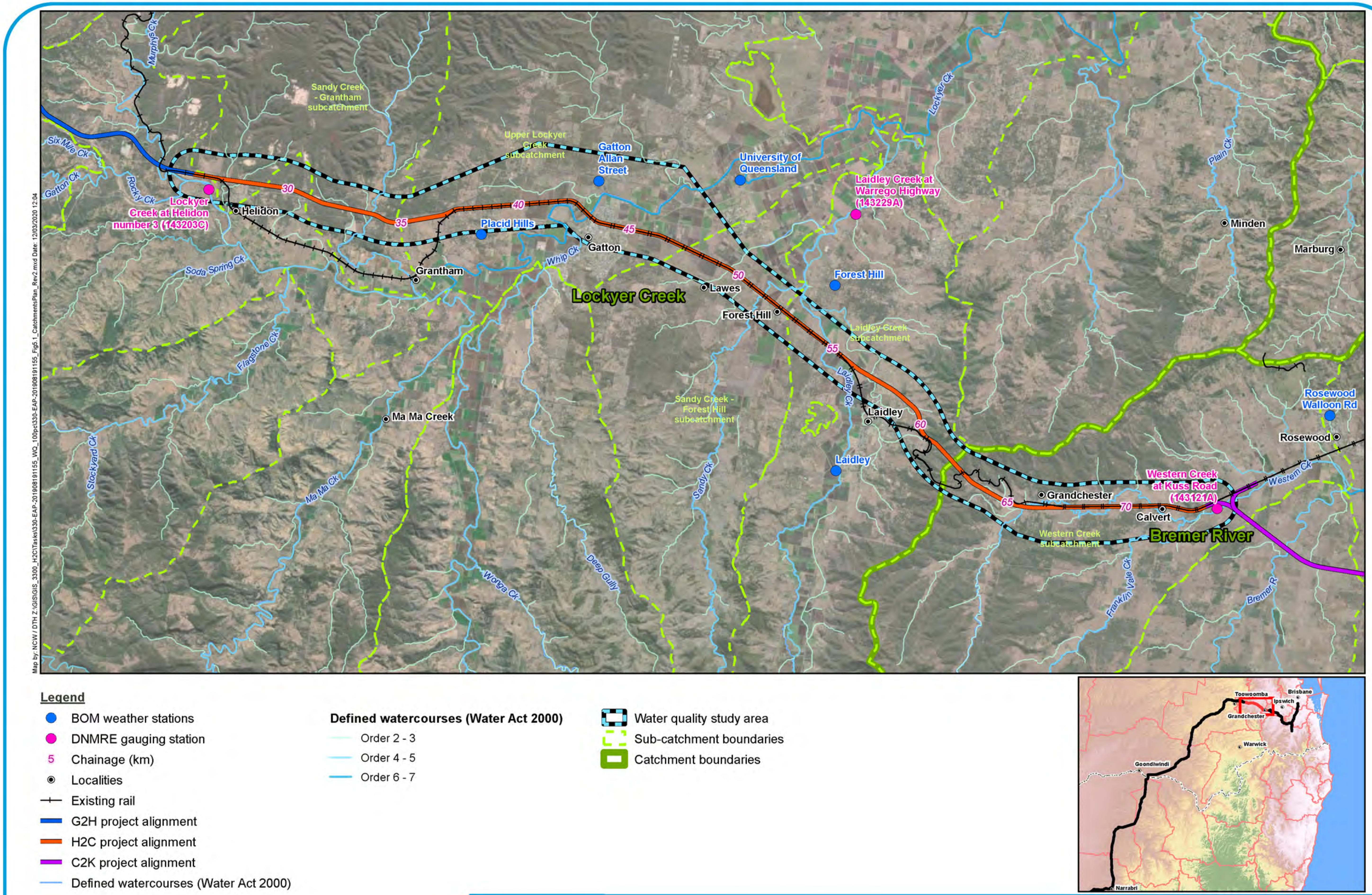
The Bremer River catchment is situated west of Brisbane within the LGAs of Ipswich and Scenic Rim and expands to an area of approximately 2,030 square kilometres (km$^2$) with the main Bremer River channel surrounded by smaller sub-catchments (DES 2016). Rainfall in the catchment is considered higher along its steeper sections which are situated to the south and east whilst the remainder of the catchment experiences average rainfall of under 1,000 millimetres per year (mm/year). The catchment supports a diverse range of land uses including agriculture, grazing and urban areas as well as featuring steep slopes (DES 2016).

The Lockyer Creek catchment is located west of Brisbane and east of Toowoomba, within the LGAs of Lockyer Valley, Somerset, Ipswich and Toowoomba. The catchment covers an area of approximately 3,000 km$^2$ with the main Lockyer Creek surrounded by several sub-catchments (DES 2015). The Lockyer Creek catchment experiences high rainfall in the south and parts of the north. The rest of the catchment has moderate to low rainfall. However due to the steep slopes in the upper reaches of the catchment, many streams can experience high flows despite the relatively low rainfall (DES 2015). Dominant land uses within the Lockyer catchment include: native bush, grazing, intensive agriculture and rural residential. The upper catchment remains mostly forested whereas the mid and lower catchment has been largely cleared.

## 5.3 Physical environment

### 5.3.1 Context

A review of the BoM climate data was undertaken and information was sourced from the nearest monitoring station at University of Queensland (UQ) Gatton (040082) approximately 6.7 km east of Gatton centre (BoM 2020a). The region has a typical hot and dry climate and typically experiences warm to hot summers and mild to cool winters. Rainfall is seasonally distributed with a distinct wet season occurring during the summer months of December through February and an extended dry season during the months of April through September. Mean maximum monthly temperatures typically range from 31.2°C in the summer to 21.5°C in the winter.



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## Helidon to Calvert

## Figure 5.1: Catchment areas

### 5.3.2 Rainfall

Rainfall data was collected from six weather stations across the water quality study area from 1894 to 2018. Both currently active and inactive stations indicated that the area receives an average of 806.8 mm of annual rainfall (BoM 2020a).

Table 5.1 identifies the recorded rainfall data for the six weather stations across the water quality study area. It can be determined that the water quality study area receives its heaviest rainfall in summer, with the highest recorded single rainfall event occurring in January 1974 with 757.0 mm. During the winter months, the water quality study area predominantly receives low to no rainfall (BoM 2020a). Due to the limited extent of the Project and the limited differences between annual, monthly and lowest rainfall between the stations, data for the UQ at Gatton station was used for interpretation of climate throughout the report.

**Table 5.1 Weather stations within proximity of water quality study area and rainfall data**

| Station # | Name | Locality | Operation date | Annual rainfall average (mm) | Month of highest rainfall/ amount (mm) | Month of lowest rainfall/ amount (mm) |
|---|---|---|---|---|---|---|
| 40449 | Placid Hills | Placid Hills | 1970-2018 | 810.3 | Jan (352.7) | Aug (0.0) |
| 40083 | Gatton Allan Street | Gatton | 1894-2018 | 776.7 | Jan (464.2) | Aug (0.0) |
| 40082 | UQ | Gatton | 1897-2018 | 772.4 | Jan (452.9) | Aug (0.0) |
| 40079 | Forest Hill | Forest Hill | 1894-2018 | 772.8 | Jan (521.3) | Sep (0.0) |
| 40716 | Laidley | Laidley | 1982-2018[1] | 827.2[1] | Jan (334.0)[1] | Aug (5.0)[1] |
| 40184 | Rosewood Walloon Road | Rosewood | 1894-2018 | 881.6 | Jan (757.0) | Aug (0.0) |

**Source:** BoM (2020a)

**Table note:**

BoM rainfall data only available for Laidley Station from 2009, 2010 and 2011.

### 5.3.3 Evaporation

There are only a small number of BoM weather stations that record daily evaporation. The closest BoM weather station that records evaporation is the Gatton DAF Research Station (040436), approximately 26 km north-west of Calvert. However, 2014 was the last year evaporation data was recorded. From 1974 to 2014 evaporation data for the water quality study area generally consists of higher evaporation in the summer months where the mean average evaporation rate was 7.4 mm compared to the winter months where the mean evaporation rate was 3.5 mm (BoM 2020a).

### 5.3.4 Temperature

The climate of the water quality study area remains relatively warm all year round with cooler temperatures occurring during winter nights and early mornings (BoM 2020a). Data collected from the UQ Gatton weather stations between 1897 and 2020 revealed an average maximum temperature of 31.2°C and an average minimum of 21.5°C. The hottest day ever recorded for the water quality study area occurred in January 2017 where it reached 45.7°C, whilst the coldest day recorded was -5.6°C in July 1972. Figure 5.2 provides the mean maximum and minimum temperature recorded at the UQ Gatton station (040082).

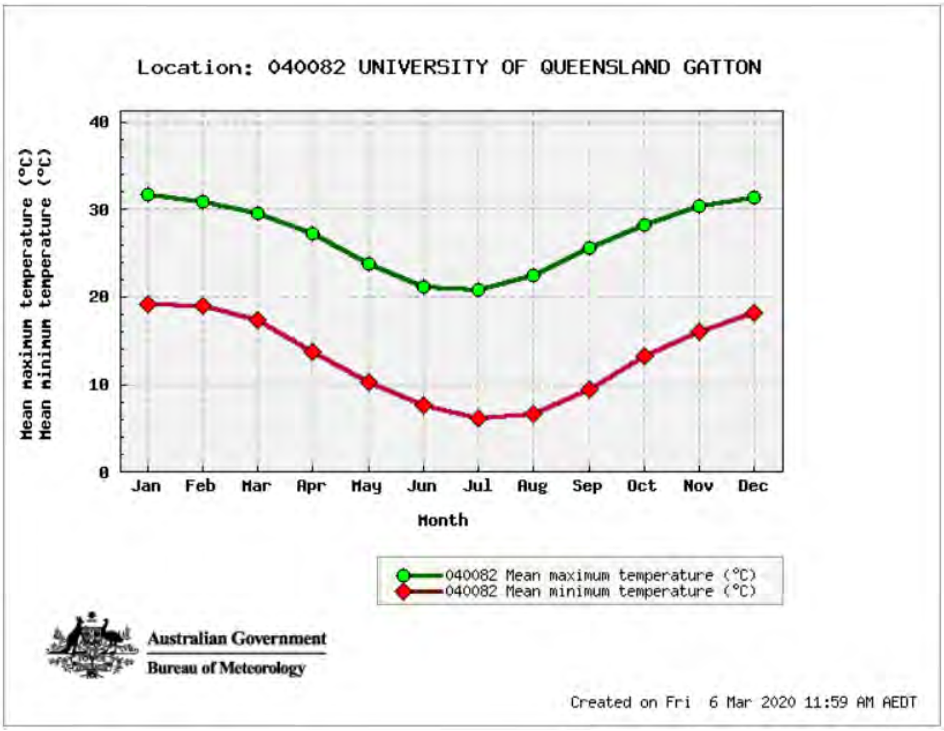


**Figure 5.2** **Mean maximum and minimum temperature for the water quality study area**

**Source:** BoM (2020a)

### 5.3.5 Gauging station water monitoring (discharge and water quality)

The DRDMW maintain a Water Monitoring Information Portal (WMIP) for stream gauge datasets typically including rainfall, stream flow and water quality basic data for numerous gauging stations across Queensland.

There are four stream flow monitoring stations located within the water quality study area that record real time data including flow creek data and other basic parameters. The stations and their location respective to the Project alignment are provided in Table 5.2. Conditions observed during the water quality monitoring events appear typical of the general stream flow observed with the gauging stations on Lockyer, Laidley and Western Creek, with low median discharge per day, and sub-optimal water quality, relative to WQOs (refer Table 5.3 and Table 5.4).

**Table 5.2** **Department of Natural Resources, Mines and Energy stream gauge sites**

| Station | Location in relation to the Project alignment |
|---|---|
| Lockyer Creek at Helidon number 3 (143203C) | Located 500 m downstream from the Project alignment at Lockyer Creek |
| Laidley Creek at Warrego Highway (143229A) | Located 5 km upstream of the Project alignment at Laidley Creek |
| Western Creek at Kuss Road (143121A) | Located 450 m downstream from the Project alignment at Western Creek |
| Purga Creek at Loamside (143113A) | Located 20 km downstream from the Project alignment at Purga Creek |

**Source:** DRDMW (formerly DNRME (2020))

**Table 5.3** **Summary of electrical conductivity, discharge and rainfall per month data for relevant Department of Natural Resources, Mines and Energy stream gauge sites (January 2015 to December 2018)**

| Station | Median rainfall (mm/month) | Median electrical conductivity (µScm$^{-1}$) [WQO] | Median discharge (Megalitres (ML) / day) |
|---|---|---|---|
| Lockyer Creek at Helidon number 3 (143203C) | 29.5 | 922.63 [520] | 0.525 |
| Laidley Creek at Warrego Highway (143229A) | N/A | 510 [520] | 0.35 |
| Western Creek at Kuss Road (143121A) | 52.5 | - | 1.105 |
| Purga Creek at Loamside (143113A) | N/A | 2168 [770] | 0.41 |

**Source:** DRDMW (formerly DNRME (2020))

**Table notes:**

1 Number in bracket denotes WQO for the given watercourse
2 Highlight denotes exceedance of WQO

Table 5.4 provides median water quality data from the DRDMW gauge sites for Lockyer Creek at Helidon number 3 (143203C) (1962-2018), Laidley Creek at Warrego Highway (143229A) and Purga Creek at Loamside (143113A). A representative site at Western Creek (Western Creek at Kuss Road) was not utilised for an assessment of water quality as a lack of reportable water quality exists for the gauging station. As, a surrogate, data from Purga Creek (Purga Creek at Loamside (143113A)) was utilised for water quality values for the Bremer River catchment.

As the three sites have been operating for different periods of time, Table 5.4 includes the number of samples collected for each parameter for each site. Comparison with historical water quality data indicates limited achievement of relevant WQO for each of the discrete watercourses (refer Table 5.3and Table 5.4). Additionally, although limited in terms of available data (due to highly seasonal flow), plots of streamflow (as stream discharge at megalitres per day against electrical conductivity (EC) indicate significant decreases in EC during periods of increased stream discharge (refer Appendix E and Appendix F).

**Table 5.4** **Department of Natural Resources, Mining and Energy gauge median water quality data**

| Water parameter | Lockyer Creek at Helidon number 3 (143203C) | | | Laidley Creek at Warrego Highway (143229A) | | | Purga Creek at Loamside (143113A) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Sample number | Recorded value | WQO | Sample number | Recorded value | WQO | Sample number | Recorded value | WQO |
| Turbidity (NTU) | 91 | 5 | 6 | 168 | 120 | 6 | 62 | 12.79 | <17 |
| Total suspended solids (mgL$^1$) | 90 | 8.5 | <6 | 165 | 162 | <6 | 70 | 17.80 | <6 |
| Ammonia (mgL$^1$) | - | - | <0.01 | 22 | 0.03 | <0.01 | 26 | 0.04 | <0.02 |
| Total nitrogen (mgL$^{-1}$) | 67 | 0.38 | <0.25 | 24 | 1.20 | <0.25 | 36 | 1.31 | <0.5 |
| Total P (mgL$^{-1}$) | 79 | 0.03 | <0.05 | 61 | 1.02 | <0.05 | 44 | 0.19 | <0.05 |

**Source:** DRDMW (formerly DNRME (2020))

**Table notes:**

Highlight denotes exceedance of WQO

Generally, the stream discharges between at these gauge sites (refer Figure 5.3, Figure 5.4, Figure 5.5 and Appendix E) typically show the same distinct seasonal distribution as rainfall, with the majority of flow occurring in summer months. Within all of the gauging station sites a high variance in flow was observed. High flow periods were typically short and interspersed by periods of low to no discharge.

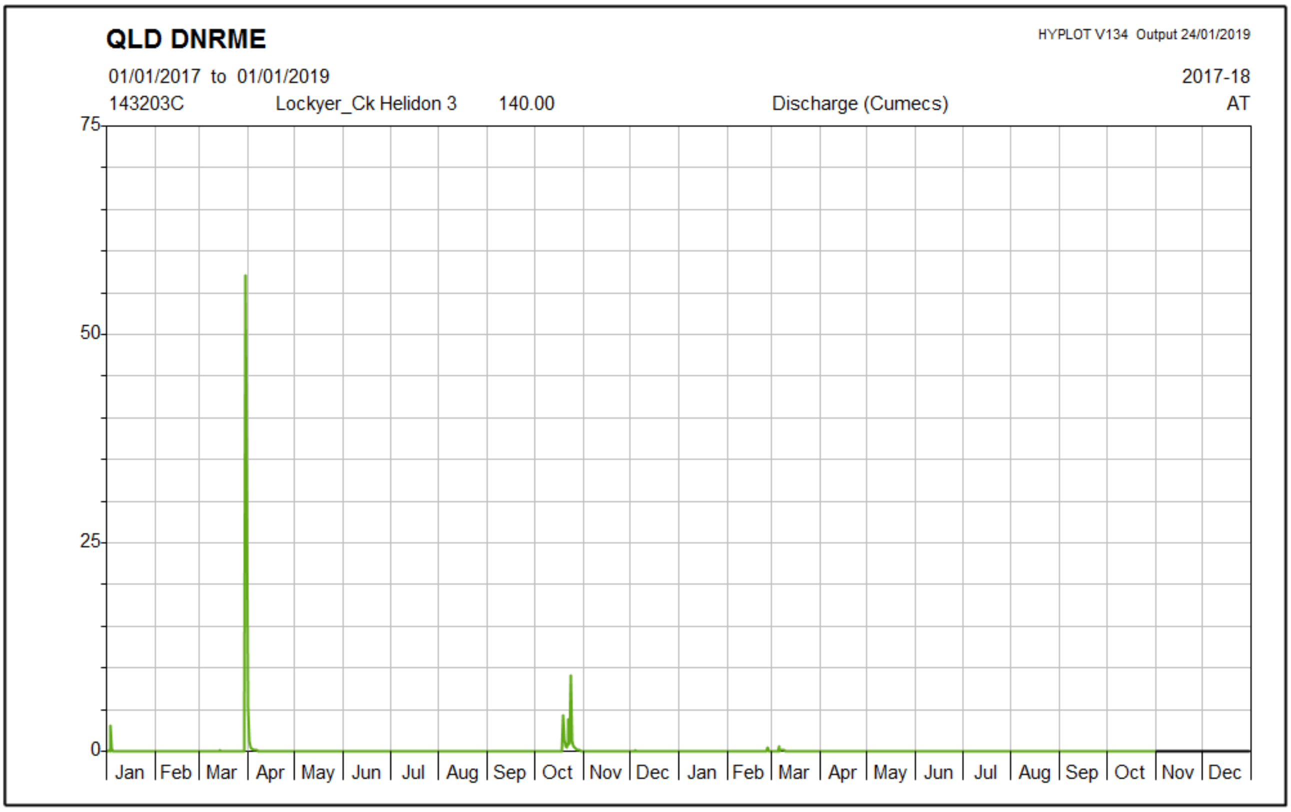


**Figure 5.3** Lockyer Creek at Helidon Number 3 stream discharge 2017 to 2018

**Source:** DRDMW (formerly DNRME (2020))

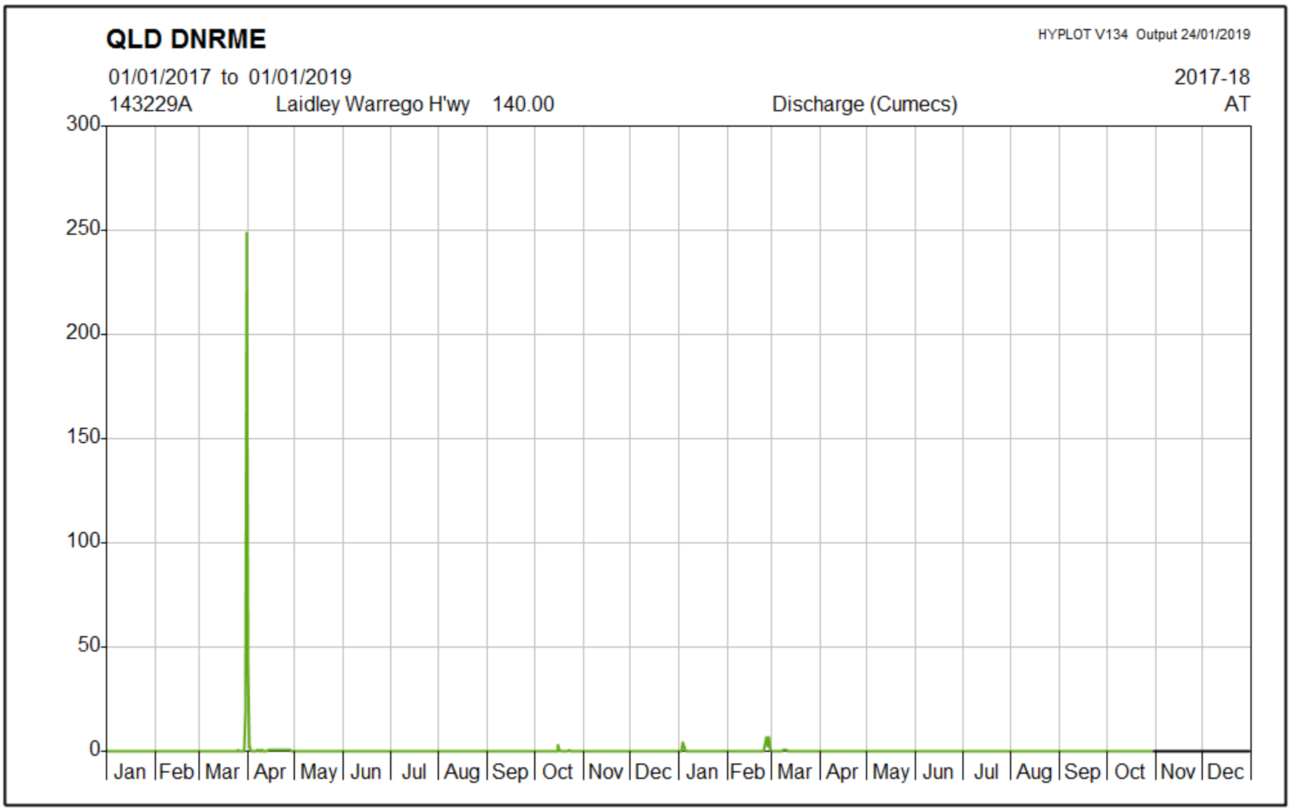


**Figure 5.4** Laidley Creek at Warrego Highway stream discharge 2017 to 2018

**Source:** DRDMW (formerly DNRME (2020))

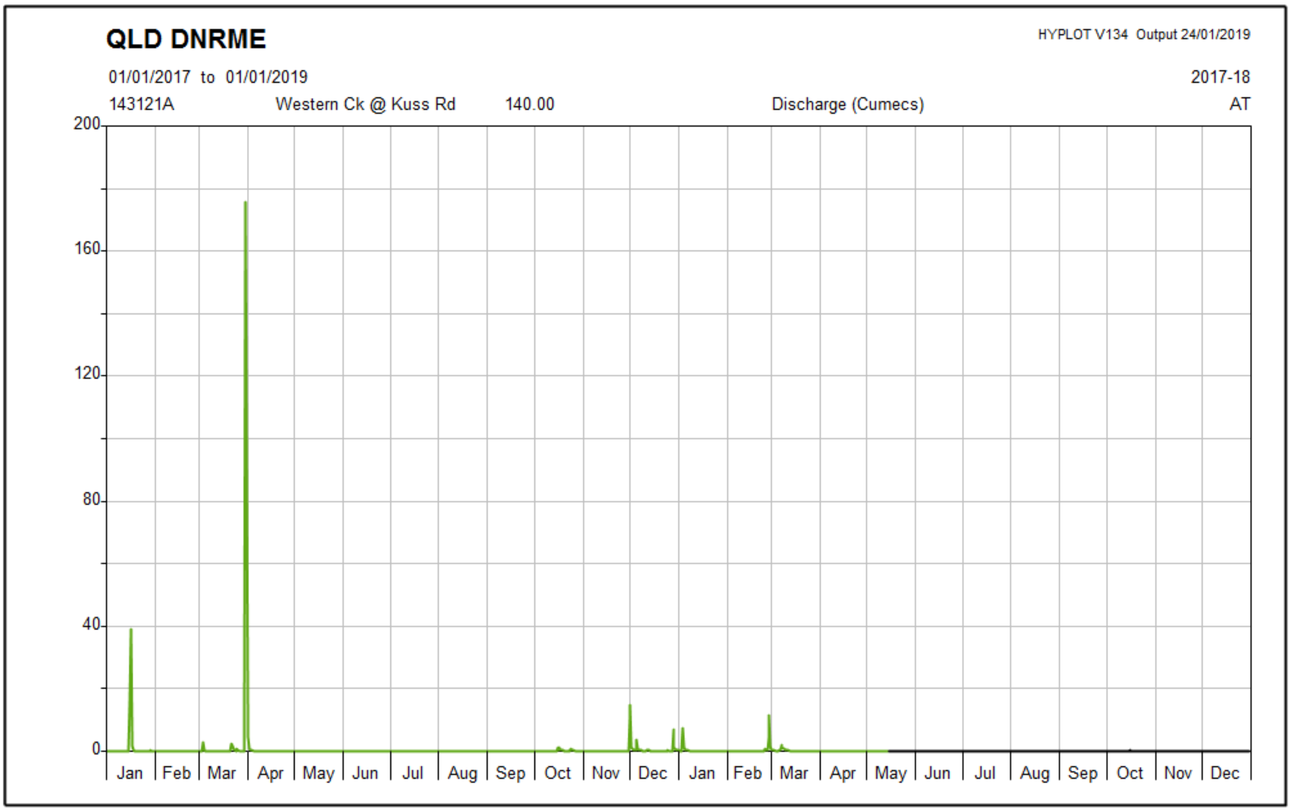


**Figure 5.5** Western Creek at Kuss Road stream discharge 2017 to 2018

**Source:** DRDMW (formerly DNRME (2020))

The stream water level for all gauging stations tends to fluctuate with general flow recorded as relatively low in comparison to periods of high flow. Of the DRDMW gauging stations used for historic seasonal comparison, all recorded lowest median seasonal discharge during Spring (refer Figures F-1 to F12 of Appendix F). Discharge at the three gauging stations was highest within the Summer/Autumn months (following general climatic condition) and was significantly reduced moving to Winter and Spring before gaining into Summer.

Electrical conductivity values typically adhered to stream discharge patterns across seasons with higher median EC noted in Lockyer Creek at Helidon and Purga Creek at Loamside during Winter and Spring (at ~1000-1100 µS/cm and ~3200-3400 µS/cm, respectively). Laidley Creek at Warrego Highway EC values were highest during Autumn and Winter (at ~460 µS/cm and ~340 µS/cm, respectively) and aligned with significant decreases in discharge from Summer (at ~200 µS/cm). Typically, as discharge decreased towards the drier seasons with general climatic condition, water quality decreased with an increase in conductivity values. The increase in EC with decreased discharge aligned with the field assessment across the water quality study area, where low flow conditions (and the continuation of dry conditions) resulted in higher EC across the field sampling events.

Typically, total suspended solids were highest following the periods of increased discharge during Summer at the Lockyer Creek at Helidon gauging station (~12 mg/L) and the Laidley Creek at Warrego Highway gauging station (~290 mg/L). At the Purga Creek gauging station, total suspend solid levels were highest during periods of low periods of discharge (~15 mg/L) with a clear trend present between declining discharge and increased total suspended solids.

Total nitrogen concentrations for Lockyer Creek at Helidon, Laidley Creek at Warrego Highway and Purga Creek at Loamside gauging stations noted periods of highest concentrations with increased discharge. An increase in total nitrogen concentrations at the Lockyer Creek at Helidon gauging station occurred with increases in discharge within Spring and continued to increase to peak during Summer and Autumn (~0.43 mg/L and ~0.42 mg/L, respectively). A similar trend was evident with the Laidley Creek and Warrego Highway and Purga Creek at Loamside gauging stations with peak total nitrogen concentrations aligning with peak discharge during Summer months (~1.7 mg/L and ~1.8 mg/L, respectively).

Total phosphorus concentrations for the Lockyer Creek at Helidon gauging station followed the same trend as per total nitrogen. With an increase in concentration with peak discharge during Summer months (to ~0.042 mg/L) following an increase in concentrations, aligned with a severe decrease in discharge from Winter to Spring (~0.017 mg/L to ~0.036 mg/L, respectively). This trend was evident within the Laidley Creek at Warrego Highway and Purga Creek at Loamside gauging stations with peak total phosphorus concentrations evident during Summer months (~1.1 mg/L and ~0.22 mg/L, respectively) after an increase during Spring (~0.95 mg/L and ~0.14 mg/L, respectively).

### 5.3.6 Fire hazard

A review of the bushfire prone areas through the DSDMIP development assessment mapping system (DSDMIP 2018) revealed scattered areas of 'Medium and High Potential Bushfire Intensity' existing throughout the water quality study area with an area of 'very high potential bushfire intensity' occurring between Laidley and Calvert.

### 5.3.7 Flood hazard

A review of the flood hazard areas through the DSDMIP development assessment mapping system revealed the northern section of the Project alignment to potentially intercept a Flood hazard area – level 1 (indicative of floodplain extent resolution only) near Placid Hills, Gatton and Laidley.

### 5.3.8 Climate change assessment

Climate change resilience, in explicit regard to water quality, is derived from expected climate change 1% Annual Exceedance Probability (AEP) pattern change. The selected representative concentration pathway which refers to greenhouse gas concentration trajectory, for the climate change analysis was 8.5 which represents a high emissions scenario. For the Project, representative concentration pathway 8.5 corresponds to an increase in temperature of 3.7 degrees Celsius in 2090 and an increase in rainfall intensity of 18.7 percent which was obtained from the Australian Rainfall and Runoff Guidelines.

The climate change factor increases the resultant 1% AEP local drainage water levels by a maximum of 2.8 m along the alignment. Modelled changes within Lockyer Creek indicate a 2.8 m change in peak water level during 1% AEP water levels, from 102.22 m to 105.01 m. The 2.8 m difference between these peak water levels is somewhat deceptive. Significant increases in peak water levels at these locations are as a result of varying floodplain and tailwater interactions. Under the 1% AEP event, flow through these culverts is limited to backflow from the northern side of the existing Queensland Rail (QR) rail embankment. However, during the 1% AEP climate change event, Lockyer Creek overbank flow reaches the upstream side of these culverts and has a significantly higher peak water surface level. As such, the difference between peak water surface levels at the upstream and downstream side of these culverts during the 1% AEP climate change event is approximately 2.2 m.

As both the 1% AEP current environment and 1% AEP climate change assessment were both noted as overtopping due to negative freeboard (at a maximum of -0.75 m), it would be expected that minimal changes to water quality would be experienced (in terms of differential from current values against current WQOs) from construction or operation of the Project. While the 1% AEP events do result in overtopping within some sections of the alignment (around Forest Hill), these impacts are currently expected with a 2% AEP event around the existing QR line and as such, do not contribute to any significant change to expected water quality regimes during flood events. As such water quality would be impacted under the modelled climate change assessment however would not be expected to differ significantly from current extreme flooding events (1% AEP).

For full details refer to EIS Appendix M: Hydrology and flooding technical report.

## 5.4 Geology, soils and topography

The assessment of existing condition of water quality within the Project water quality study area identified geological settings that may impact on current water quality conditions. These were generally separated into an overview of the geological and topographic setting which included soil acidity and soil texture. These were utilised to inform the current physio-chemical status of the watercourses, namely the salinity and pH condition of each sub-catchment.

### 5.4.1 Geological and topographic setting

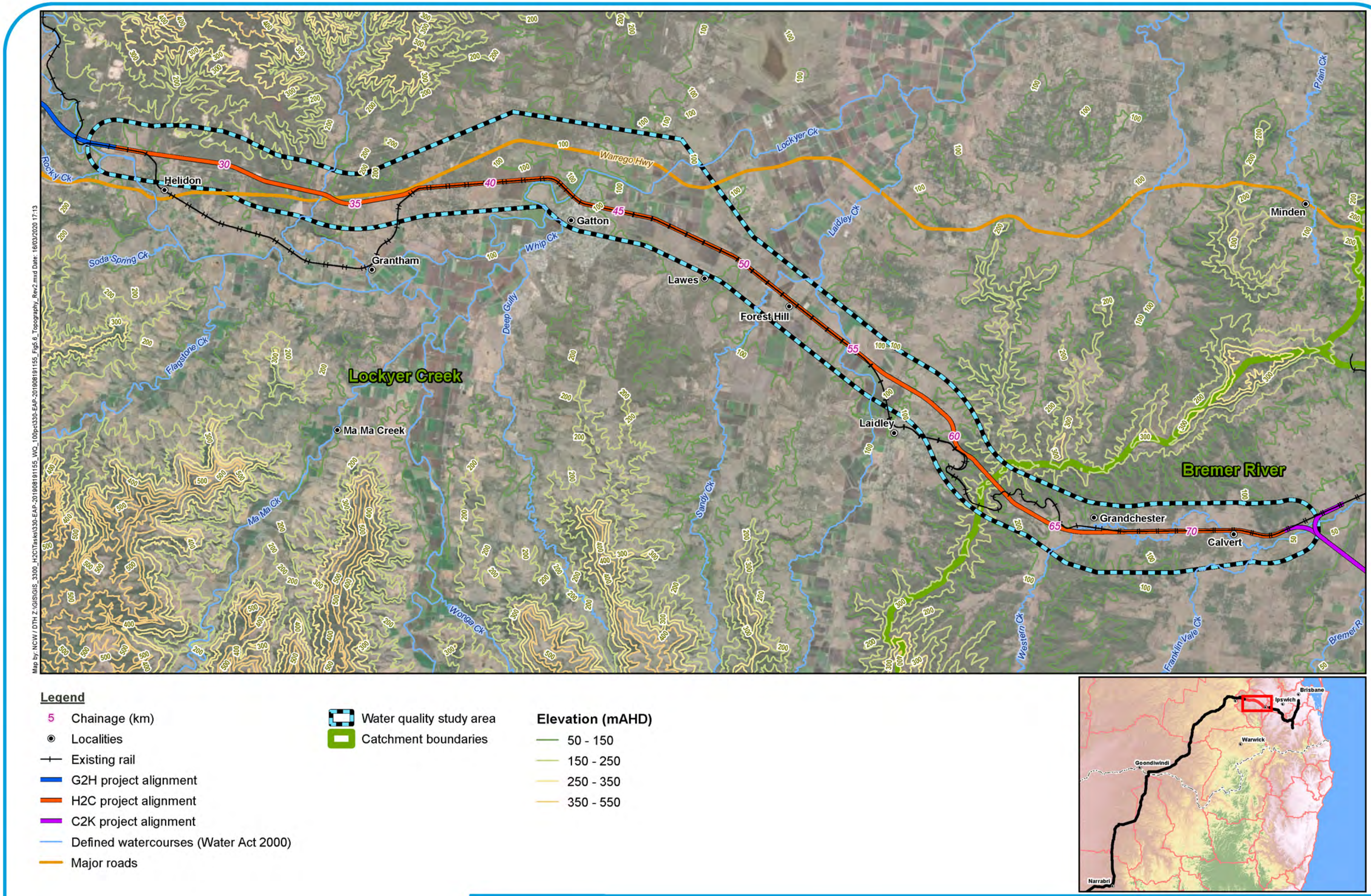
The water quality study area traverses through predominantly flat and flood prone terrain with one distinct area of rugged topography. The topography surrounding Helidon features undulating hills with moderate to low elevation as the alignment passes through the declining slopes of the Lockyer National Park towards Placid Hills.

Between Placid Hills and Laidley, flat terrain at approximately 100 m elevation exists along the Project alignment, leading to the base of the Little Liverpool Range. The peak elevation is reached as the alignment climbs Little Liverpool Range to an approximate elevation of 240 m, and then rapidly begins to descend towards Grandchester and Calvert, where the lowest elevation of the alignment at approximately 54 m elevation is reached at Western Creek (refer Figure 5.6). Eight geological layers were found to underlie the alignment between Helidon and Calvert based on a 1:100,000 scale detailed surface geology map of Queensland (DNRME 2017), which is illustrated in Figure 5.7 with further detail provided in Table 5.5.

**Table 5.5 Water quality study area geological units**

| Geological unit | Location | Age | Description |
|---|---|---|---|
| QPA-QLD | South of Adare | Pleistocene | A layer of clay, silt, sand and gravel on flood-plain alluvium on high terraces. The dominant rock type within this layer is alluvium. |
| Koukandowie Formation | West of Laidley to Calvert | Early Jurassic to Middle Jurassic | A layer of lithofeldspathic labile and sub-labile to quartzose sandstone, siltstone, shale, minor coal and ferruginous oolite marker dominated by arenite-mudrock. |
| TD-QLD> Woogaroo Subgroup | North of Helidon | Tertiary | A layer of duricrusted old land surface containing ferricrete, silcrete and indurated palaeosols at the top of a deep weathering profile on the Woogaroo Subgroup. The dominant rock within the layer is ferricrete. |
| QA-QLD | ▪ Helidon<br>▪ Gatton to Forest Hill<br>▪ Grandchester to Calvert | Quaternary | A layer of clay, silt, sand and gravel on a flood-plain dominated by alluvium. |
| Gatton Sandstone | ▪ Helidon<br>▪ North of Grantham to Gatton<br>▪ Fringe sections north of Laidley | Early Jurassic | A layer of lithic labile and feldspathic labile sandstone dominated by arenite rock. |
| QR-QLD | ▪ North of Helidon<br>▪ Ringwood<br>▪ South of Lawes<br>▪ Fringe sections north of Laidley<br>▪ East of Grandchester | Quaternary | A layer of clay, silt, sand, gravel and soil of colluvial and residual deposits dominated by colluvium rock. |
| Walloon Coal Measures | Calvert | Middle Jurassic | A layer of shale siltstone, sandstone and coal seams dominated by arenite-mudrock. |
| Woogaroo Subgroup | Helidon to Ringwood | Late Triassic to Early Jurassic | A sub-labile to quartzose sandstone, siltstone and quartz rich granule to cobble composed conglomerate also featuring coal. The dominant rock type within the layer is sedimentary rock. |

**Source:** DNRME (2017)



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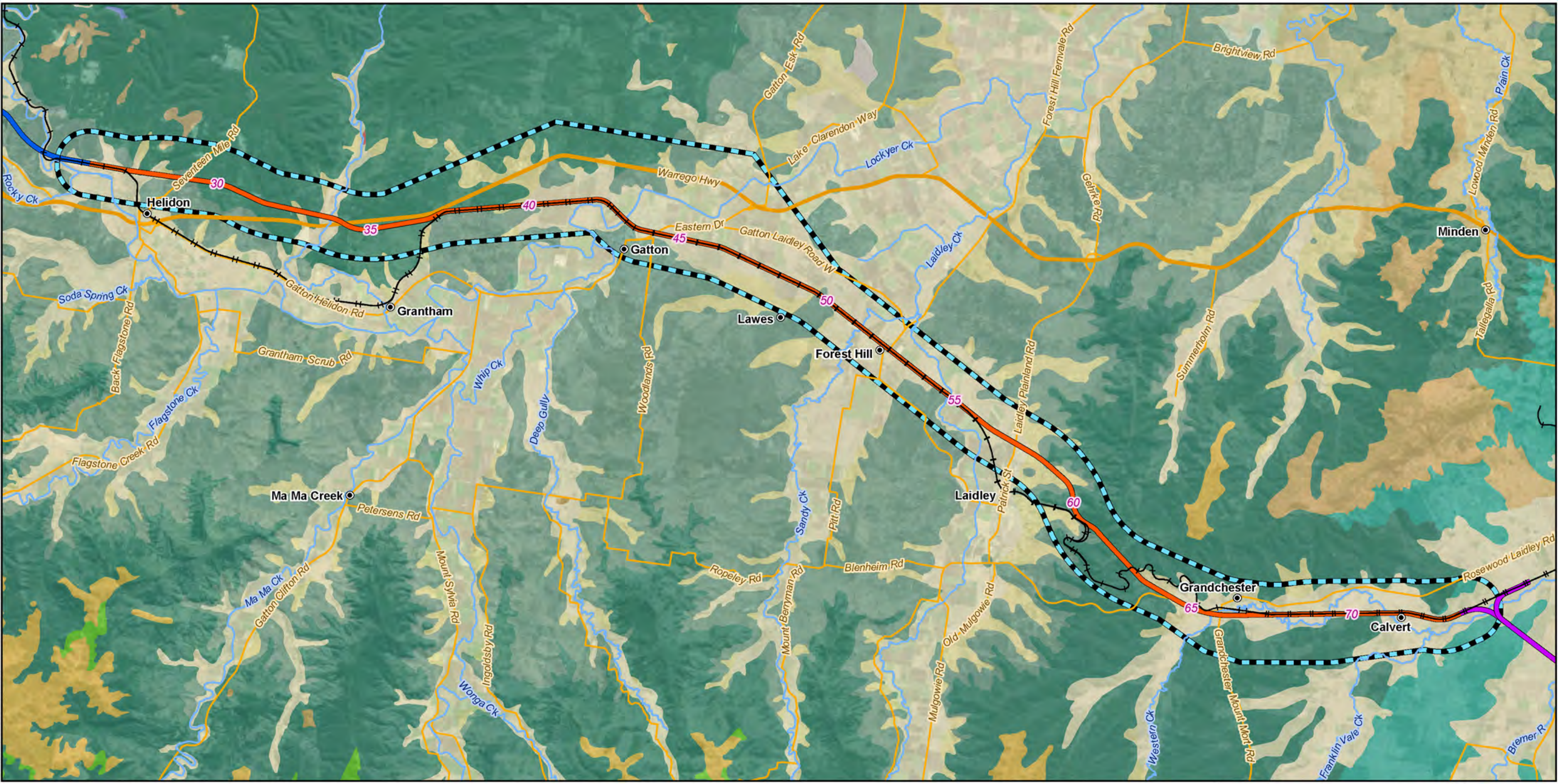
**Helidon to Calvert**
**Figure 5.6**
**Topography**



Map by: NCW / DTH Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_Fig5.7_Geology_Rev2.mxd Date: 12/03/2020 12:28

**Legend**

- 5 Chainage (km)
- ● Localities
- Existing rail
- G2H project alignment
- H2C project alignment
- C2K project alignment
- Major roads
- Minor roads
- Defined watercourses (Water Act 2000)
- Water quality study area

**Detailed surface geology**

**Jurassic**

- Eurombah Formation? (Jie?)

**Middle Jurassic**

- Walloon Coal Measures (Jw)

**Quaternary**

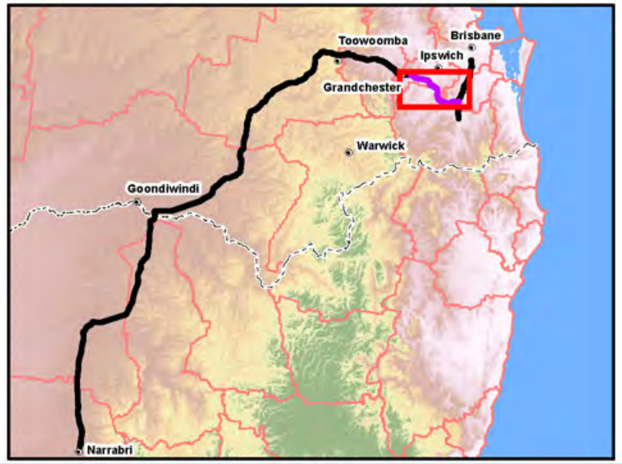
- Qa-QLD (Qa)

**Ungrouped**

- Buaraba Mudstone (Pccb)
- Buaraba Mudstone/aa (Psb/aa)
- Crows Nest Granite (Rgr)
- Eurombah Formation (Jie)
- Gatton Sandstone (Jbmg)
- Koukandowie Formation (Jbmk)
- Main Range Volcanics (Tm)
- Qaw-QLD (Qaw)
- Qha-QLD (Qha)
- Qha/1-QLD (Qha/1)
- Qpa-QLD (Qpa)
- Qpa/1-SEQ (Qpa/1)
- Qr-QLD (Qr)
- TQr-QLD (TQr)
- TQw-QLD (TQw)
- Td-QLD>Woogaroo Subgroup (Td>RJbw)
- Ts/3-SEQ (Ts/3)
- Tv-SEQ (Tv)
- Tv/2-SEQ (Tv/2)
- Water body (unspecified) (W)
- Woogaroo Subgroup (RJbw)

A3 scale: 1:130,000

0 1 2 3 4 5km



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## Helidon to Calvert

## Figure 5.7: Geology

The geological investigation indicated that the water quality study area is dominated by sandstone geology and predominantly underlain by a Jurassic Marburg Formation with scattered small areas of Quaternary alluvium and colluvium.

Alluvial and colluvial deposits were the dominant rock type present within the geological layers and can be attributed to recent Tertiary and Quaternary denudation (Willey 2003). The main form of alluvium deposit in the region was likely caused by prairie soils, black earths and grey clays which have developed on finer-grained sediment. Alluvium deposits in the region will potentially lead to the deposition of sand, silt or silty clay at the base of hillslopes and along floodplains (Department of Science, Information Technology, Innovation and the Arts (DSITIA) 2012).

Arenites are another rock present within the geological layers of the region. Arenites are identified as texturally clean matrix free or matrix poor sandstone that allow cement precipitates to form in what were originally empty intergranular pores (UPRM Geology Department 2012).

A study of the soil distribution and physical properties indicated that parent material strongly influences soil development in the area.

### 5.4.2 Soil condition

#### 5.4.2.1 Soil description

The Australian Soil Resource Information System (Commonwealth Scientific and industrial research organisation (CSIRO) 2014) Level 5 (1:100,000 or better quality) Australian Soil Classification mapping indicated five distinct soil types including vertosols, sodosols, dermosols and chromosols to occur in the water quality study area (refer Figure 5.8).

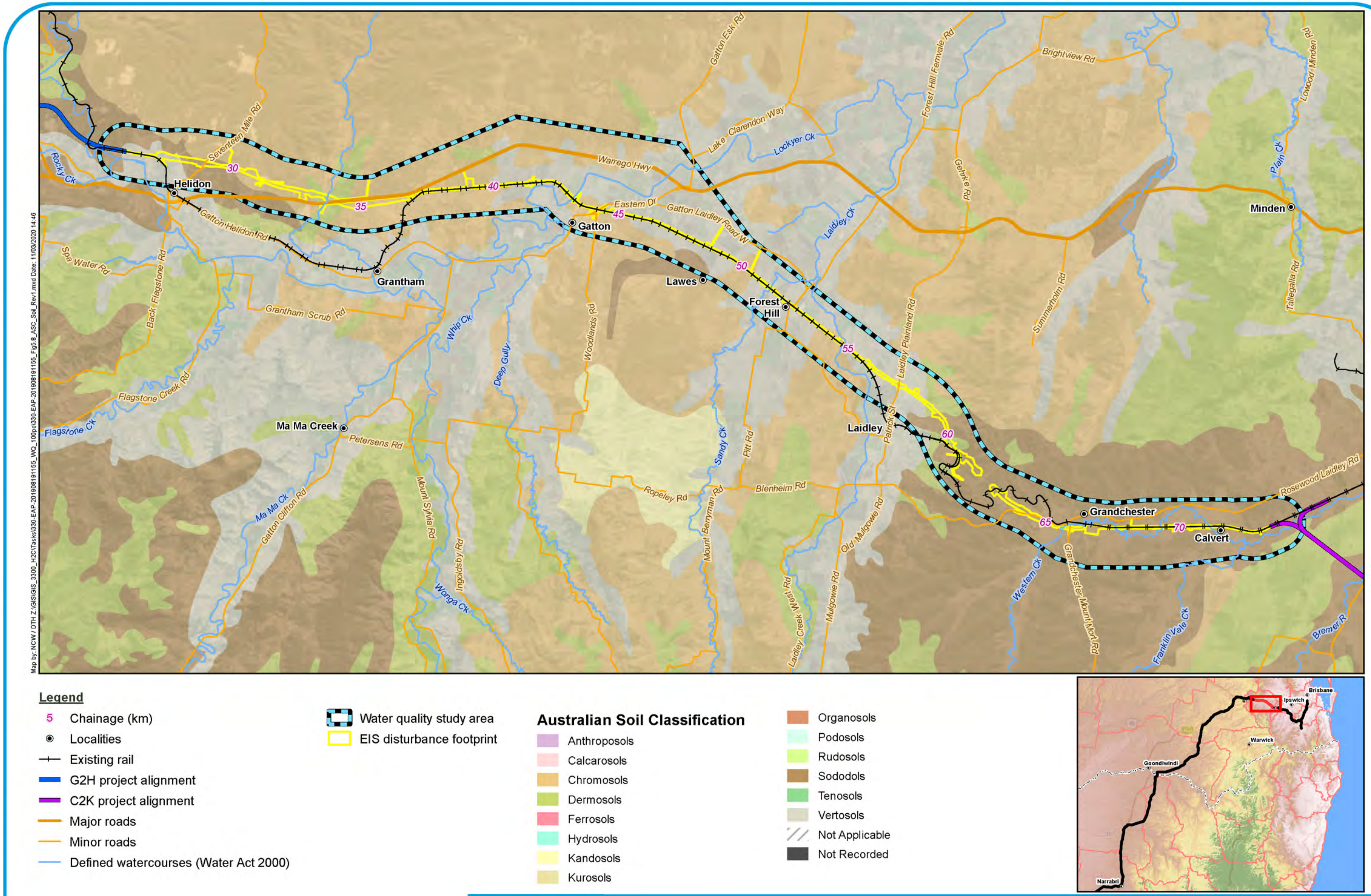
The low hills of Helidon are underlain by large areas of vertosols and chromosols and remain a regular occurrence as the alignment reaches Laidley and the dense vegetation of the Little Liverpool Range.

Vertosols are identified as a cracking clay soil with a clay field texture and a crusty surface horizon at a depth of 0.03 m or less in thickness (Isbell & National Committee on Soil and Terrain 2016). Vertosols are often found in imperfectly drained sites with annual rainfall up to 1,150 mm and in well-drained sites with annual rainfall up to 900 mm.

Chromosols in the water quality study area have moderate agricultural potential due to moderate chemical fertility, water holding capacity and susceptibility to soil acidification causing structural decline (Gray & Murphy 2002). The soils are also defined as strong textural contrast soils that are neither strongly acidic nor sodic in the upper B horizon. In imperfectly drained sites, chromosols can be found in areas of annual rainfall between 250 mm and 900 mm, whilst in well-drained sites, annual rainfall between 350 mm and 1,400 mm is necessary for chromosols to be present.

Minor layers of dermosols, at Helidon and Lawes, and sodosols, nearing Citrus Valley, intercept the major soil types along the water quality study area between Helidon and Laidley.

Dermosols are defined as a black, self-mulching cracking clays defined by the absence of a strong texture contrast, although they have a well-structured B2 horizon containing low levels of free iron. The soils are normally found in areas of imperfectly drained sites with annual rainfall between 550 mm and 1,350 mm and in well-drained sites, having annual rainfall between 450 mm and 1,200 mm. Dermosols generally have a high agricultural potential given their good structure, moderate to high chemical fertility and high water holding capacity (Gray & Murphy 2002).



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## Helidon to Calvert
## Figure 5.8: Australian soil classification

#### 5.4.2.2 Soil acidity

An assessment of surface soil pH, using Australian Soil Resource Information System mapping (Fitzpatrick et al. 2011), revealed the water quality study area's soil acidity to range between 4.8 and 6.5 pH. Areas of acidic 4.8 to 5.5 pH soil dominate the underlaying surface at Helidon and Placid Hills, as well as the downhill slopes of the Little Liverpool Range.

Moderately acidic 5.5 to 6.0 pH soils are featured at Gatton, Forest Hill and Laidley whilst three scattered patches of slightly acidic to neutral soils between 6.0 and 6.5 pH were located around Citrus Valley, Lawes and the downhill slopes of the range. The only patch of strongly acidic 3.0 to 4.8 pH soil was found to underlie the water quality study area from Grandchester to Calvert.

#### 5.4.2.3 Soil texture

A range of soil textures existed within the A horizon of the water quality study area from light clays (35 per cent to 45 percent) to sandy loam (10 per cent to 20 percent), as indicated by the Australian soil resource information system textural and clay content mapping layer (Fitzpatrick et al. 2011).

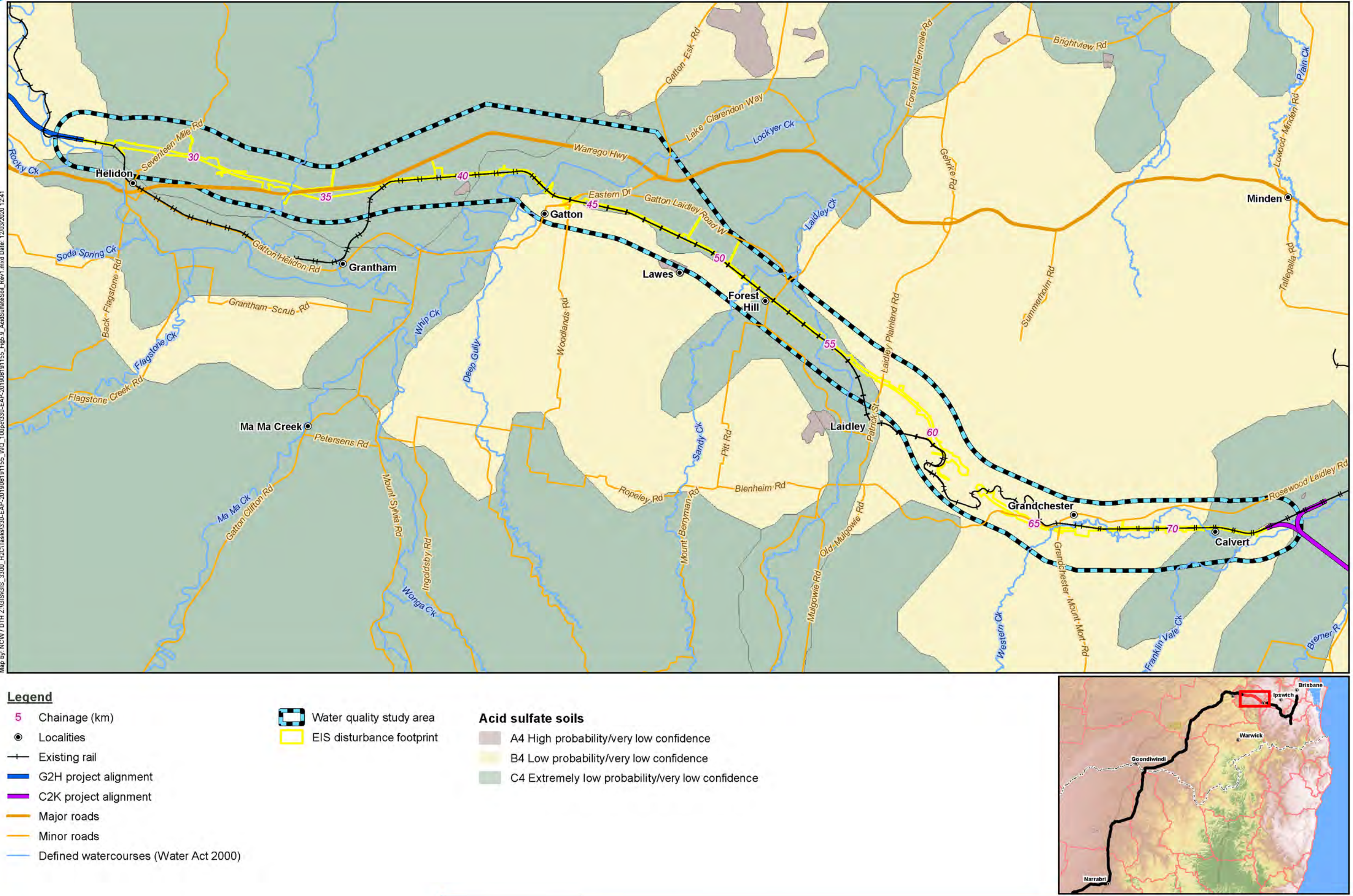
Light clay was the dominant texture of soil along the proposed alignment featuring heavily within the soils of Helidon, Gatton, Forest Hill and Laidley. A small layer of reduced clay content soil, silty or sandy clay loam (20 to 30 percent) runs along the alignment between Helidon and Placid Hills, Gatton and Forest Hill as well as featuring heavily beyond the Little Liverpool Range approaching Calvert. More sand consisting soil, sandy loam (10 to 20 percent), dominates the northern portion of the alignment surrounding Ringwood and south Adare as well as a small area through Grandchester and north of Calvert.

### 5.4.3 Acid sulfate soils and acid rock drainage

An assessment of Acid-sulfate soils (ASS) using the National Acid Sulfate Soils Atlas (Fitzpatrick et al. 2011) indicated 'No Known Occurrence' between Helidon and Gatton, a small section between Forest Hill and Laidley and again at Calvert. A 'Low Probability' of ASS underlies the southern area of the alignment between Gatton and Forest Hill and the complete extent of the alignment between Laidley and Grandchester, with a small patch at Calvert. 'High Probability' ASS intercept the alignment north-east of Placid Hills and again on the southern border south of Lawes (refer Figure 5.9). Acid sulfate soils are often associated with low-lying areas such as alluvial plains, where groundwater is generally close to the surface and materials in reducing condition along coastal regions (RTA 2005). As such minimal areas of ASS were expected to occur along the alignment due to a lack of typical site condition of presence.

Acid Rock Drainage (ARD) occurs naturally when sulphide minerals are exposed to air and water. This process is accelerated through excavation activities which increase rock exposure to air, water, and microorganisms. The resulting drainage may be neutral to acidic with dissolved heavy metals and significant sulfate levels. This would inform the management of potential ARD cuttings in the sedimentary units prior to construction works. Site inspections prior to the construction of cuts would provide an opportunity to visually examine surface outcrop for sulphide minerals or remnant products indicative of sulphide mineralisation and provide information from these inspections to inform the management of potential ARD from cuttings prior to construction works. Any excavated material which is suspected to contain sulphides will be stockpiled, lined and covered (as appropriate) to manage and minimise rainfall infiltration and potential leaching. Where possible, treatment and onsite reuse are preferred to off-site disposal. A case-by-case assessment of the suitability of material for treatment and reuse will be required.

Periodic sampling of discharge waters from the deep cuts intersecting groundwater is recommended to assess the potential for ARD processes taking place. Screening of the seepage water onsite for pH (trending down) and EC (trending up) and comparison to the baseline groundwater monitoring program results/trends will allow for indication of ARD processes. If ARD-contaminated discharge water is found to be generated from the deep cuts, this water may need to be impounded in ponds and neutralised via treatment with hydrated lime or dilution prior to release into the surrounding catchment or other discharge mechanism.



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**Helidon to Calvert**

**Figure 5.9: Acid sulfate soils**

## 5.5 Waterways and waterbodies

### 5.5.1 Defined watercourses

Under the Water Act a watercourse is defined as a river, creek or other stream which includes a stream in the form of an anabranch or a tributary where water flows either permanently or intermittently regardless of flow frequency. A watercourse however does not include any section of a feature that has a tidal influence or is upstream or downstream from a defined limit.

A number of watercourses and waterbodies occur within the water quality study area (refer Sections 5.5.2 and 5.5.3). Note Tenthill Creek crosses into the water quality study area for a total of 200 m, however, does not intersect the Project alignment.

Defined watercourses intersected by the proposed Project alignment include:

- Sandy Creek (Grantham) – at chainage location Ch 33.70 km
- Lockyer Creek – at chainage location Ch 43.20 km
- Sandy Creek (Forest Hill) – at chainage location Ch 51.40 km
- Laidley Creek – at chainage location Ch 54.80 km
- Western Creek – at chainage locations Ch 65.70 km, Ch 67.60 km, Ch 69.30 km and Ch 71.10 km.

Unmapped waterways are intersected by the Project alignment are quantified using waterways barrier works mapping and stream order mapping (refer Sections 5.5.2 and 5.5.3).The unmapped waterways will be required to be verified during the detailed design phase to determine status under the Water Act. Further consultation with DRDMW and DAF, along with Department of Transport and Main Roads (DTMR) is required to determine the status of the watercourses under the Water Act and where applicable the Fisheries Act.

Further details of the intersection of these watercourses and artificial waterbodies and the Project alignment are provided in Sections 5.5.3 and 5.5.4.

Table 5.6 provides a summary of the larger watercourses crossed by the proposed Project alignment. Further details of the watercourses and water quality monitoring sites are presented in Appendix C.

**Table 5.6 Summary of assessed waterways within the water quality study area**

| Waterway | Description |
|---|---|
| Lockyer Creek | Lockyer Creek is a defined watercourse, that begins below the Great Dividing Range, proximal to Helidon. The creek is approximately 114 km long and is a tributary of the Brisbane River. The proposed intersection of the Project alignment and Lockyer Creek is situated near the town of Gatton. Typical land use surrounding the Lockyer Creek water quality assessment sites (and proximal catchment) varied between a modified landscape consisting of rural residential, recreational, grazing, irrigated cropping and non-remnant vegetated areas.<br>There was limited riparian cover on both sides of the river with a high composition of exotic species. The creek bed comprised moderately compacted soft sands, mud and clay. Limited emergent macrophyte vegetation was observed along the assessment sites. Within the site, numerous artificial infrastructure including bridges were evident. |

| Waterway | Description |
|---|---|
|  | <br>Lockyer Creek at Project alignment waterway crossing – Oct 2017 sampling event |
| Sandy Creek (Grantham) | Sandy Creek is a defined watercourse that discharges into Lockyer Creek, downstream of Grantham. The creek appears ephemeral with a well-defined channel and is likely to flow seasonally. Typical land use surrounding the Sandy Creek assessment (and proximal catchment) sites varied between a modified landscape consisting of grazing and irrigated cropping.<br>The water quality assessment sites were moderately disturbed with surrounding land use converted to grazing. Riparian vegetation was moderately impacted and occurred as semi-continuous stands of mature vegetation, with a greater proportion as exotic species. Limited macrophyte vegetation was evident during inspections.<br>The creek bed was stable and comprised an array of sediment, cobble, pebble and gravel. Limited variability in stream characteristics were noted.<br><br>Sandy Creek at the Project alignment waterway crossing – Oct 2017 sampling event |
| Laidley Creek | Laidley Creek is a defined watercourse that discharges into Lockyer Creek, downstream of Forest Hill. The creek was considered ephemeral with a well-defined channel, noting some channel modifications are present (as culvert locations). Typical land use surrounding the Laidley Creek assessment (and proximal catchment) sites varied between a modified landscape consisting of grazing and irrigated cropping areas. |

| Waterway | Description |
|---|---|
| | The water quality assessment sites were moderately disturbed with infrastructure and conversion of surrounding land use to grazing. Riparian vegetation was impacted and consisted of a semi-continuous vegetation, consisting of a major proportion of exotic species. Limited macrophyte vegetation was evident during surveys.<br><br>Laidley Creek downstream of the Project alignment waterway crossing – Oct 2017 sampling event |
| Western Creek | Western Creek is a defined watercourse that discharges into the Bremer River, downstream of Rosewood. The stream appears seasonal, with a well-defined channel, noting some channel modifications are present. Typical land use surrounding the Western Creek assessment (and proximal catchment) sites varied between a modified landscape consisting of rural residential, grazing and irrigated cropping areas.<br>The water quality assessment sites were moderately disturbed with infrastructure (riparian offtake pumping) and conversion of surrounding land use to grazing. Riparian vegetation was impacted and consisted of discrete groups of vegetation on the left bank with semi-continuous vegetation on the right bank. Riparian vegetation comprised an even proportion of native and exotic species. Limited macrophyte vegetation was evident during surveys and mainly comprised Pondweed (*Potamogeton*).<br><br>Western Creek at the Project alignment waterway crossing – Oct 2017 sampling event |

### 5.5.2 Waterways for waterway barrier works mapping

A review of the waterway barrier works was made to cover all watercourses (as defined by the Water Act) and to utilise high value fish connectivity mapping to inform potential water quality impacts from the Project. This approach was selected as it supported the pre-cautionary principle underpinning the assessment of the existing environment and the assessment of water quality impacts.

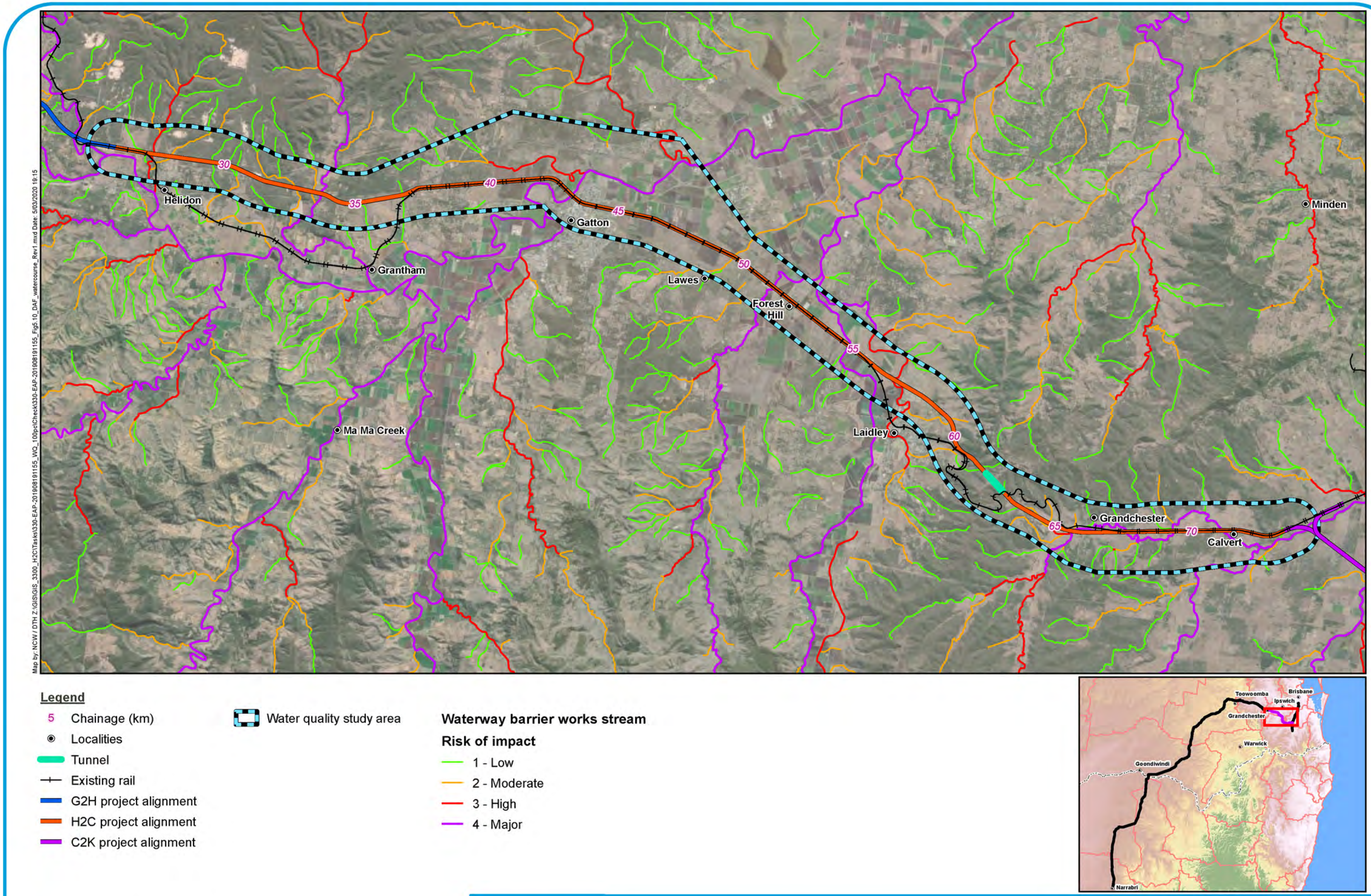
The review of the DAF Queensland Waterways for Waterway Barrier Works mapping identified a total of 26 waterways for waterway barrier works which are crossed by the Project alignment. Of the 26 waterways, several of the waterways are crossed by the alignment several times. These waterways are classified as follows:

- Low risk of impact (category 1) – nine waterways mapped as 'Low' intercept the alignment
- Moderate risk of impact (category 2) – seven waterways mapped as 'Moderate' intercept the alignment
- High risk of impact (category 3) – two waterways mapped as 'High' intercept the alignment
- Major risk of impact (category 4) – eight waterways mapped as 'Major' intercept the alignment.

Table 5.7 identifies the waterways which are crossed by the alignment and the relevant stream order. Figure 5.10 identifies the location of the DAF mapped waterways for waterway barrier works. The level of risk relating to each waterway will be considered by the detailed design team responsible for the design of infrastructure such as culverts, bridges and other potential barriers. This will occur during the detailed design stage of the Project.

**Table 5.7 Waterways for waterway barrier works that intercept the proposed alignment**

| Waterway impact risk (DAF) | Waterway (approximate chainage) |
|---|---|
| Major (Category 4) | Sandy Creek [Grantham] (Ch 33.60 km)<br>Lockyer Creek (Ch 43.20 km)<br>Sandy Creek [Forest Hill] (Ch 1.40 km)<br>Laidley Creek (Ch 54.80 km)<br>Western Creek (Ch 65.70 km)<br>Western Creek (Ch 67.60 km)<br>Western Creek (Ch 69.30 km)<br>Western Creek (Ch 71.10 km) |
| High (Category 3) | Un-named tributary of Lockyer Creek (Ch 27.40 km)<br>Un-named tributary of Laidley Creek (Ch 56.80 km) |
| Moderate (Category 2) | Un-named tributary of Lockyer Creek (Ch 28.10 km)<br>Un-named tributary of Sandy Creek [Grantham] (Ch 32.80 km)<br>Un-named tributary of Sandy Creek [Grantham] (Ch 33.40 km)<br>Un-named tributary of Sandy Creek [Forest Hill] (Ch 49.50 km)<br>Un-named tributary of Laidley Creek (Ch 59.40 km)<br>Un-named tributary of Western Creek (Ch 64.40 km)<br>Un-named tributary of Western Creek (Ch 64.80 km) |
| Low (Category 1) | Un-named tributary of Lockyer Creek (Ch 27.10 km)<br>Un-named tributary of Lockyer Creek (Ch 29.60 km)<br>Un-named tributary of Lockyer Creek (Ch 30.20 km, Ch 30.50 km)<br>Un-named tributary of Sandy Creek [Grantham] (Ch 35.10 km)<br>Un-named tributary of Lockyer Creek (Ch 36.80 km)<br>Un-named tributary of Laidley Creek (Ch 61.60 km)<br>Un-named tributary of Western Creek (Ch 63.00 km)<br>Un-named tributary of Western Creek (Ch 63.60 km)<br>Un-named tributary of Western Creek (Ch 73.30 km) |



A3 scale: 1:130,000

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**Helidon to Calvert**

**Figure 5.10:**
**Mapped waterway barrier works within the proposed H2C alignment**

### 5.5.3 Stream order

Queensland uses the stream order system adopted from Strahler (1952) in which waterways are given an 'order' according to the number of additional tributaries associated with each waterway. This system is used to provide an indication on waterway complexity and therefore the potential aquatic habitat present. In addition to providing for an indication of habitat complexity, stream order mapping identifies waterways that may be currently unmapped under the Water Act.

Headwaters or 'new' flow paths are given a stream order of one (or 'first order'). Where two first order flow paths converge, the new stream is referred to as a second order stream. Where two second order streams join, a third order stream is formed. Third order streams and above are considered likely to reflect valuable fish habitat, capable of supporting viable populations.

The stream orders for waterways contained within the water quality study area are outlined in Table 5.8. The stream order of intersecting waterways was used to further inform the existing environment and potential impacts to maintain the precautionary principle approach used throughout the assessment.

**Table 5.8 Stream orders present within the water quality study area**

| Stream order (DRDMW) | Waterway (approximate chainage) |
|---|---|
| 6 | Lockyer Creek (Ch 43.20 km) |
| 4 | Sandy Creek [Grantham] (Ch 33.60 km)<br>Sandy Creek [Forest Hill] (Ch 51.40 km)<br>Laidley Creek (Ch 54.80 km)<br>Western Creek (Ch 65.70 km)<br>Western Creek (Ch 67.60 km)<br>Western Creek (Ch 69.30 km)<br>Western Creek (Ch 71.10 km) |
| 3 | Un-named tributary of Lockyer Creek (Ch 27.40 km)<br>Un-named tributary of Laidley Creek (Ch 56.80 km) |
| 2 | Un-named tributary of Lockyer Creek (Ch 28.10 km)<br>Un-named tributary of Sandy Creek [Grantham] (Ch 32.80 km)<br>Un-named tributary of Sandy Creek [Grantham] (Ch 33.40 km)<br>Un-named tributary of Sandy Creek [Forest Hill] (Ch 49.50 km)<br>Un-named tributary of Laidley Creek (Ch 59.40 km)<br>Un-named tributary of Western Creek (Ch 64.40 km)<br>Un-named tributary of Western Creek (Ch 64.80 km)<br>Un-named tributary of Western Creek (Ch 73.30 km) |
| 1 | Un-named tributary of Lockyer Creek (Ch 27.10 km)<br>Un-named tributary of Lockyer Creek (Ch 29.60 km)<br>Un-named tributary of Lockyer Creek (Ch 30.20 km)<br>Un-named tributary of Lockyer Creek (Ch 30.50 km)<br>Un-named tributary of Sandy Creek [Grantham] (Ch 35.10 km)<br>Un-named tributary of Lockyer Creek (Ch 36.80 km)<br>Un-named tributary of Laidley Creek (Ch 61.10 km)<br>Un-named tributary of Laidley Creek (Ch 61.60 km)<br>Un-named tributary of Western Creek (Ch 63.00 km)<br>Un-named tributary of Western Creek (Ch 63.60 km)<br>Un-named tributary of Western Creek (Ch 72.00 km)<br>Un-named tributary of Western Creek (Ch 72.40 km) |

**Source:** DNMRE (2020)

### 5.5.4 Artificial/constructed waterbodies

There are a number of artificial/constructed waterbodies (a total of 21) located within the water quality study area and that are intersected by Project alignment (refer Figure 5.11 and Appendix G). These artificial/constructed waterbodies are predominantly rural farm dams used by stock and typically occur along unnamed drainage features. Artificial wetlands are considered to provide environmental value however are not considered as an MNES, MSES or matter of local environmental significance value waterbodies. Artificial waterbodies dewatering strategies are considered with Section 8.2.

The artificial/constructed waterbodies that are intersected by the Project alignment are provided in Table 5.9.

**Table 5.9 Artificial waterbodies intersected by the Project alignment**

| Artificial Waterbody (approximate chainage (km)) | Associated waterway |
|---|---|
| Ch 27.00 km, Ch 27.95 km, Ch 28.21 km, Ch 28.50 km (4 of 21) | Unmapped waterway of Lockyer Creek |
| Ch 32.50 km, Ch 33.90 km (2 of 21) | Unmapped waterway of Sandy Creek (Grantham) |
| Ch 36.85 km (1 of 21) | Unmapped waterway of Lockyer Creek |
| Ch 47.40 km, Ch 49.95 km (2 of 21) | Drainage feature (Water Act) of Laidley Creek |
| Ch 58.15 km, Ch 58.25 – 58.45 km, Ch 58.80 km (3 of 21) | Unmapped waterway of Lagoon Creek |
| Ch 60.30 km, Ch 60.95 km (2 of 21) | Unmapped waterway of Laidley Creek |
| Ch 63.20 km, Ch 66.00 km, Ch 66.35 km, Ch 67.00 km, Ch 70.55 km, Ch 70.90 km, Ch 71.00 km (7 of 21) | Unmapped waterway of Western Creek |

## 5.6 Aquatic ecosystem values

Detailed information on the aquatic ecosystem values at each water quality monitoring site is provided in the EIS Appendix I: Terrestrial and aquatic ecology technical report, including a description of the physical environment and aquatic habitat at each site and existing local impacts.

The water quality study area includes the following aquatic habitats (as defined by Environmental Protection Agency (EPA) (2005)):

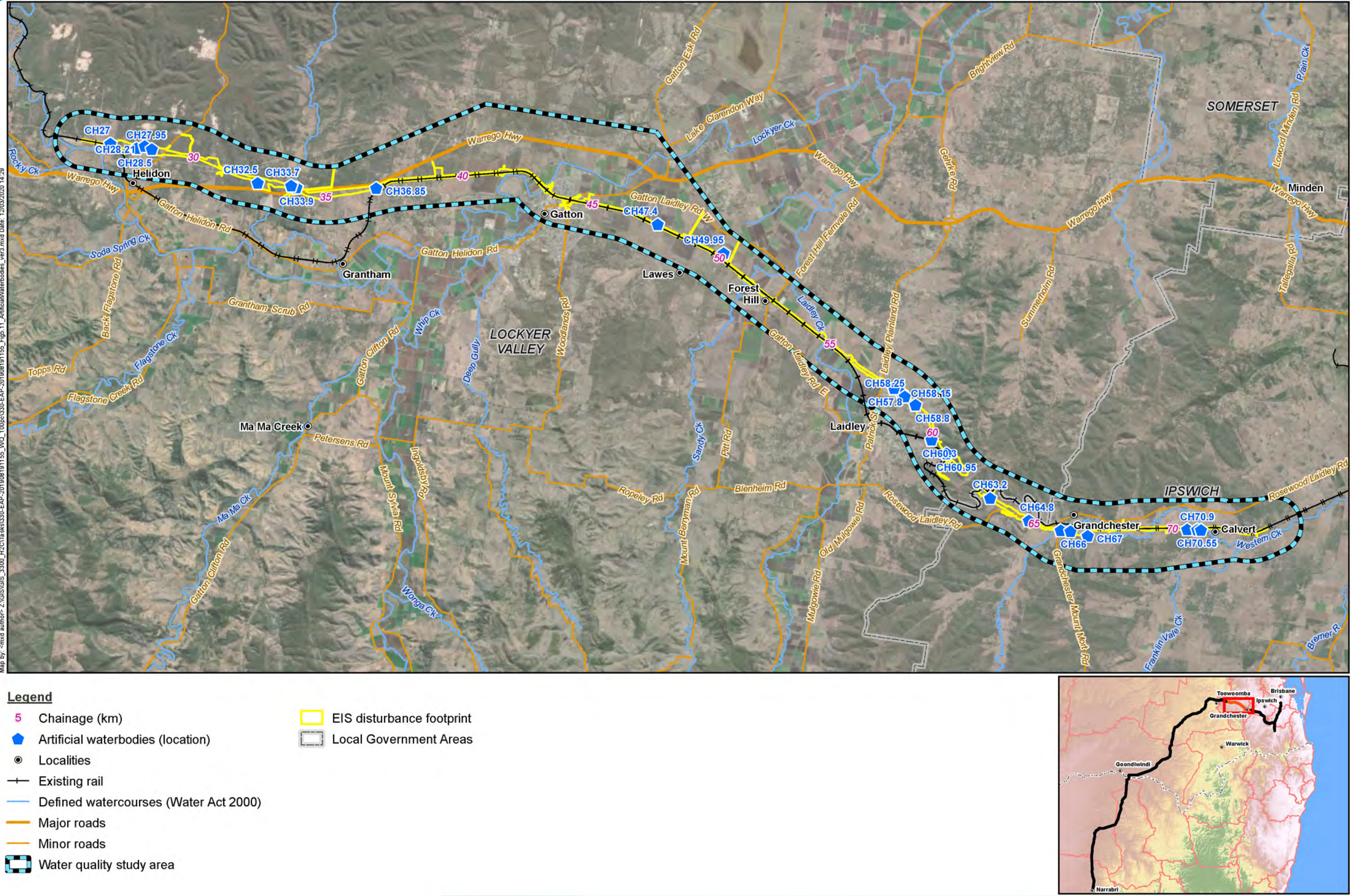
- Riverine wetlands– wetlands contained within channel that are not dominated by trees, shrubs, persistent emergent and emergent mosses or lichens
- Palustrine – Wetlands dominated by trees, shrubs, persistent emergent and emergent mosses or lichens
- Lacustrine – wetlands contained within a topographic depression or dammed river channel, lacking trees, shrubs, persistent emergent and emergent mosses or lichens and covering more than eight hectares.

Whilst some of these aquatic waterways contained no surface water at the time of assessment, they do provide habitat value for a number of aquatic species that are likely to occur in the landscape. Habitats with permanent water are likely to support the most diverse and abundant aquatic communities, however waterways with seasonal water provide periodically available habitat and act as pathways for fauna.

Aquatic ecosystem values were identified to confirm the habitat values aligned with predictive habitat mapping of Matters of National Environmental Significance (MNES) species; Australian Lungfish (*Neoceratodus forsteri*), a green alga (*Lychnothamnus barbatus*), Mary River Cod (*Maccullochella mariensis*) and MSES wetlands within the water quality study area.

Sandy Creek (Grantham), Lockyer Creek, Sandy Creek (Forest Hill), Laidley Creek and Western Creek as they were intersected by the alignment were considered to have the highest aquatic ecosystem values. These coincided with the presence of MNES and MSES ecological values and were considered in protection of water quality condition across the water quality study area.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



**Legend**

- 5 Chainage (km)
- ⬟ Artificial waterbodies (location)
- ◉ Localities
- ┼ Existing rail
- — Defined watercourses (Water Act 2000)
- — Major roads
- — Minor roads
- ▭ Water quality study area
- ▭ EIS disturbance footprint
- ▭ Local Government Areas

A3 scale: 1:130,000

0 1 2 3 4 5km

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**Helidon to Calvert**

**Figure 5.11:**
**Artificial/constructed waterbodies**

## 5.7 AquaBAMM aquatic conservation assessment

The aquatic conservation assessment using AquaBAMM assesses the conservation and ecological value of wetland systems based on a series of national and international criteria, including naturalness (aquatic and catchment), diversity and richness, threatened species/ecosystems, priority species/ecosystem, special features, connectivity and representativeness (DEHP 2015).

The AquaBAMM scores for each catchment are separated into both riverine and non-riverine wetland categories with the eight discrete criteria spatially assessed across the catchment as a whole. The resulting modelled score (as a categorical, standardised score of overall ecological value) gives an indicative representation of expected wetland ecological value (refer Table 5.10).

**Table 5.10 Aquatic conservation assessment of wetlands associated with the water quality study area**

| Catchment | AquaBAMM score (%) | | | | |
|---|---|---|---|---|---|
| | Very low | Low | Medium | High | Very high |
| **Riverine wetlands** | | | | | |
| Lockyer Creek catchment | 4% of the catchment had an Aquascore of very low | 0% of the catchment had an Aquascore of low | 50% of the catchment had an Aquascore of medium | 6% of the catchment had an Aquascore of high | 40% of the catchment had an Aquascore of very high |
| Bremer River Catchment | 3% of the catchment had an Aquascore of very low | 3% of the catchment had an Aquascore of low | 64% of the catchment had an Aquascore of medium | 12% of the catchment had an Aquascore of high | 18% of the catchment had an Aquascore of very high |
| **Non-riverine wetlands** | | | | | |
| Lockyer Creek (non-riverine wetland) * | 0% of the catchment had an Aquascore of very low | 0% of the catchment had an Aquascore of low | 1% of the catchment had an Aquascore of medium | 20% of the catchment had an Aquascore of high | 78% of the catchment had an Aquascore of very high |
| Bremer River (non-riverine wetland) | 5% of the catchment had an Aquascore of very low | 1% of the catchment had an Aquascore of low | 64% of the catchment had an Aquascore of medium | 0% of the catchment had an Aquascore of high | 30% of the catchment had an Aquascore of very high |

**Source:** DEHP (2015)

**Table note:**

* Rounding (<1%) within AquaBAMM *very low* and *low* categories resulted in 99% overall score

The results of the Aquascore riverine assessment against each water quality monitoring site are presented in Table 5.11. All of the monitoring sites had Aquascores of Medium indicating a moderate condition across the Project alignment.

**Table 5.11 Specific Riverine AquaBAMM Aquascore for all water quality monitoring sites**

| Aquascore | Monitoring site | Associated watercourse |
|---|---|---|
| Very Low | Nil | - |
| Low | Nil | - |
| Medium | 2A, 3A, 4A, 7A, 9A, 10A, 11A, 12A, 13A, 14A, 17A, 18A | Lockyer Creek Sandy Creek (Grantham), Sandy Creek (Forest Hill), Laidley Creek and Western Creek |
| High | Nil | - |
| Very High | Nil | - |

**Source:** DEHP (2015)

## 5.8 Sensitive environmental areas

This section provides a summary of sensitive environmental areas known within the water quality study area. Identified sensitive environmental areas for the Project include: wetlands areas, identified fish habitat and groundwater dependent areas within receiving waters. Sensitive environmental areas were included within the impact assessment as a *high* sensitive category (as per Table 4.6).

### 5.8.1 Wetlands

There are no Wetlands of International Importance (Ramsar wetlands) in, or within 10 km of the water quality study area. Several high ecological significance (under EPP (Water and Wetland Biodiversity)), are present within the water quality study area with some intersecting with the Project alignment, specifically at the western end of the water quality study area, proximal to Lockyer Creek (Ch 27.40 km). Two high ecological significance wetlands (MSES) are located at the eastern end of the water quality study area, proximal to Western Creek (Ch 72.40 km and Ch 73.20 km) (refer Figure 5.12).These are located approximately <100 m from the current Project alignment.

Of the approximately 11,870 hectares (ha) of the water quality study area, approximately 87 ha (0.73 per cent) are either State significant, high ecological significance wetlands or high ecological value wetlands. Of the potential 87 ha, a minimum of 6.44 ha is anticipated to be potentially disturbed by Project works.

### 5.8.2 Fish habitat

Under the Fisheries Act, a declared fish habitat area is an area protected against physical disturbance from coastal development, while still allowing legal fishing. There are no declared fish habitat areas mapped within the water quality study area. The nearest gazetted fish habitat area is located approximately 120 km downstream of the water quality study area.

### 5.8.3 Groundwater dependent ecosystems

GDE are ecosystems that require access to groundwater on a permanent or periodic basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services.

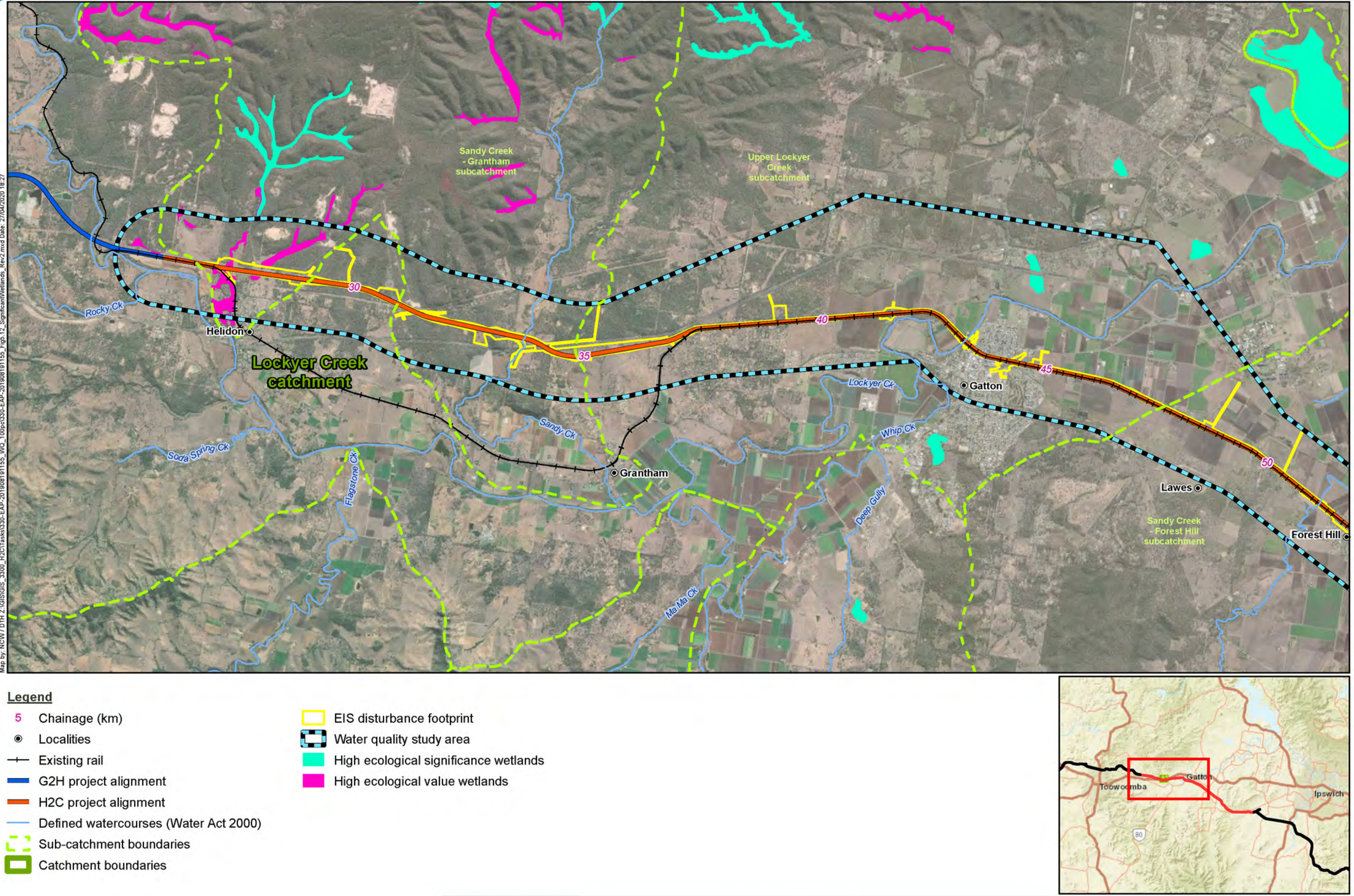
The GDE Atlas (BoM 2020b) identifies three types of ecosystems:

- Aquatic ecosystems that rely on the surface expression of groundwater – this includes surface water ecosystems which may have a groundwater component (i.e. rivers, wetlands, springs)
- Terrestrial ecosystems that rely on the subsurface presence of groundwater – this includes all vegetation ecosystems
- Subterranean ecosystems – this includes cave and aquifer ecosystems.

As the assessment using the BoM atlas is modelled at a large scale, the identification of potential GDEs in the Atlas therefore does not confirm that a particular ecosystem is groundwater dependent. Noting this, the Atlas has identified several potential aquatic and terrestrial groundwater dependent systems including wetland systems and watercourses.

A review of refined scale potential GDE mapping (DES 2018b) was undertaken and the following GDEs aquifer categories have the potential to occur within the water quality study area:

- Unconsolidated sedimentary aquifers
- Consolidated sedimentary aquifers
- Metamorphic rock aquifers.



Map by: NCW / DTH Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pct\330-EAP-201908191155_Fig5.12_SignificantWetlands_Rev2.mxd Date: 27/04/2020 18:27

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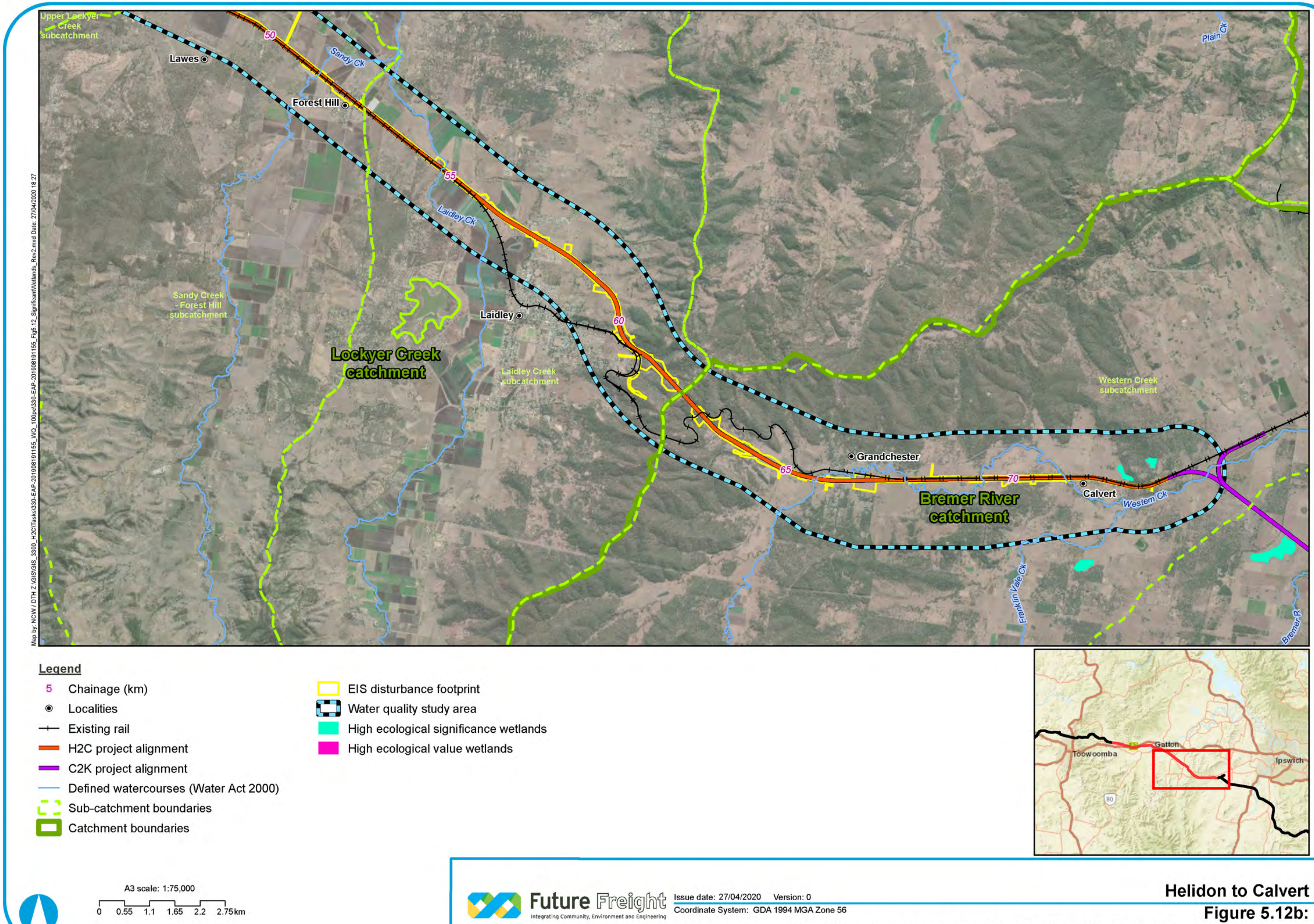
## Helidon to Calvert

Figure 5.12a:
Ecologically significant wetlands in the vicinity of the water quality study area



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Helidon to Calvert

Figure 5.12b:
Ecologically significant wetlands in the vicinity of the water quality study area

Surface water expression areas (aquatic groundwater dependent ecosystems) are considered to be the aspect of relevance to the surface water quality environment and are described alongside terrestrial groundwater dependent environments below. As a conservative approach has been used to consider impact to GDEs, moderate and high confidence modelling of surface area have been identified within the existing environment. Terrestrial groundwater dependent and spring ecosystems are considered within this report, however, are not considered further than supporting information.

As no field-truthing of these environments was undertaken, it has been assumed for the purposes of the EIS, that the modelled extent of the aquatic GDEs are accepted as true presence, and thus form a potentially sensitive receptor.

### 5.8.3.1 Aquatic groundwater dependent ecosystems

There are numerous known, high confidence and moderate confidence aquatic GDEs (from regional studies) associated with the water quality study area, including the Lockyer Creek, Laidley Creek and Western Creek (and their tributaries). Typically, these are modelled as surface area expression wetlands proximal to the disturbance area and 20.53 ha are present within the water quality study area. Noting this, 0.00 ha are intersected by the disturbance footprint. The known, high confidence and moderate confidence surface area groundwater areas are illustrated in Figure 5.13.

### 5.8.3.2 Terrestrial groundwater dependent ecosystems

Within the water quality study area, several terrestrial GDEs (from regional studies) are either intersected or proximal to the proposed Project alignment. Within the water quality study area, 415.43 ha are present with 8.09 ha intersected by the disturbance footprint.

### 5.8.3.3 Springs

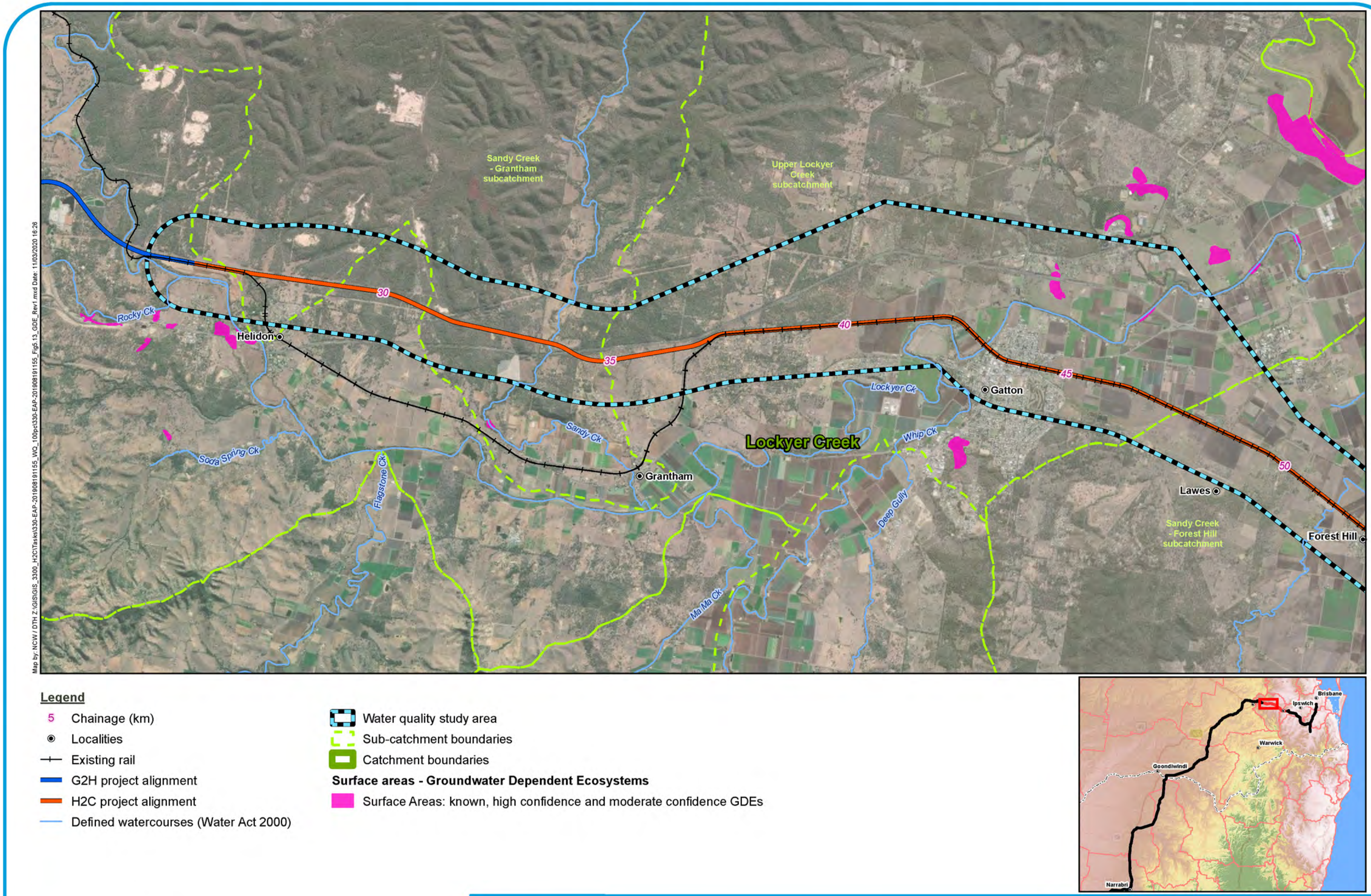
No incidental observation of springs occurred during surface water quality field assessments associated with the EIS or identified from the GDE Atlas (BoM 2020b and DES 2020) within the water quality study area. Within the water quality study area, 0.00 ha are present or intersected by the disturbance footprint.

## 5.9 Salinity hazard

The water quality study area was broken down by the Australian Hydrologic Geospatial Fabric Catchment GIS layer, into smaller sub-catchments (using Pfafstetter coding system) to enable a more precise analysis of the potential Project impacts. The sub-catchments were analysed for Salinity Hazard in accordance with Part B Investigating Salinity of the Salinity Management Handbook (DERM 2011).

Once broken down into sub-catchments, the soils layer was intersected with the sub-catchments layer to identify which soils were dominant in each of the sub-catchments. Soil type characteristics were then applied to give a low, moderate, or high rating to each of the dominant soil types, to give an indication of inherent salt store.

Salinity hazard within the water quality study area (relative to soils) was assessed using the EC mapping layer (Fitzpatrick et al. 2011). The map revealed that the area underlying Helidon to Ringwood begins with high conductivity soil (1.0 decisiemens per metre (dS/m) to 2.0 dS/m) which declines in conductivity approaching Ringwood to very low (0.05 dS/m to 0.1 dS/m) conductivity soil. The water quality study area between Gatton and Grandchester predominantly features high conductivity soil becoming mildly conductive (0.25 dS/m to 0.5 dS/m) from Laidley onward. An area of very low conductivity soil occurs through Grandchester and north of Calvert which directly correlates with more sandy soil.



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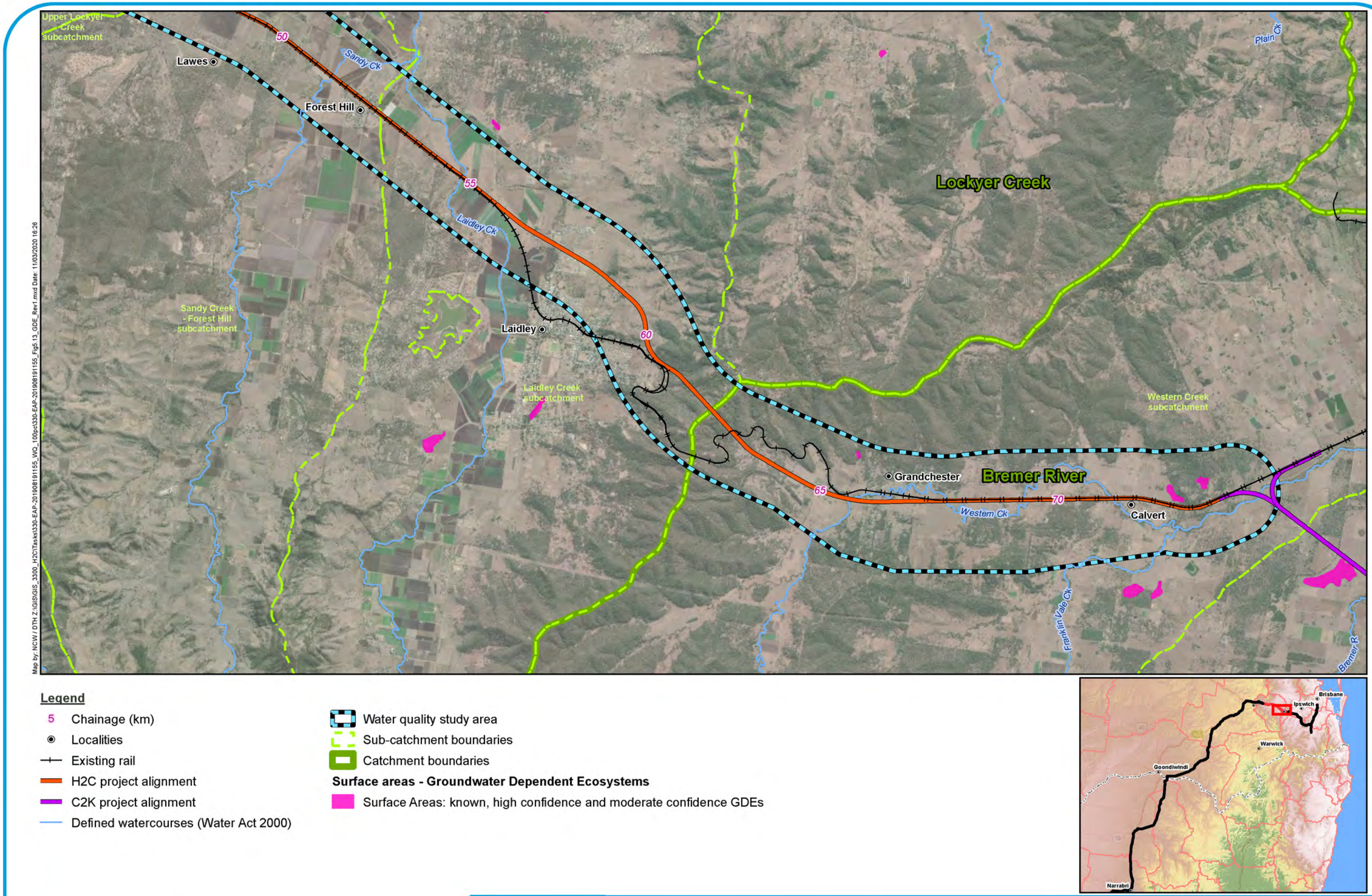
Helidon to Calvert

Figure 5.13a:

Aquatic groundwater dependent ecosystems in the vicinity of the water quality study area



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**Helidon to Calvert**

**Figure 5.13b:**

**Aquatic groundwater dependent ecosystems in the vicinity of the water quality study area**

The water table occurs in the alluvial sediments of Laidley Creek and Lockyer Creek and Western Creek alluvial sediments east of Little Liverpool Range. Depths to groundwater in the alluvial sediments are anticipated to be between 5 and 15 m, with shallow groundwater typically occurring near active watercourses where fill/embankments and/or bridges are proposed. No cuttings are proposed through alluvial sediments, but groundwater mounding may occur below significant embankments in areas of shallow groundwater and compressible materials.

The overall salinity hazard map was developed from the factors addressed above (refer Figure 5.14). In areas where there is a high potential salinity hazard, it is expected that potential changes to flow regimes may result in an increase in secondary salinity issues.

## 5.10 Surface water resources and licenced water uses

The Water Act provides a framework under which catchment-based Water Plans (WPs) and water management protocols are developed in Queensland. Water plans establish a framework for sharing water between human consumptive needs and EVs. Water management protocols are developed in parallel with the WPs and provide a framework for the implementation of water allocations and administrative directions.

Water resource catchments (and water supply buffer area) associated with the water quality study area (refer Appendix H) are limited to the Project water quality study area associated with the Lockyer Creek catchment. Human requirements for drinking water quality supply are considered to be covered by the protection of aquatic ecosystem environmental values (due to stringency of water quality objectives).

Surface water resources within the water quality study area are primarily managed by the Water Plan (Moreton) 2007 (Moreton Water Plan). The Moreton Water Plan includes performance indicators and objectives such as:

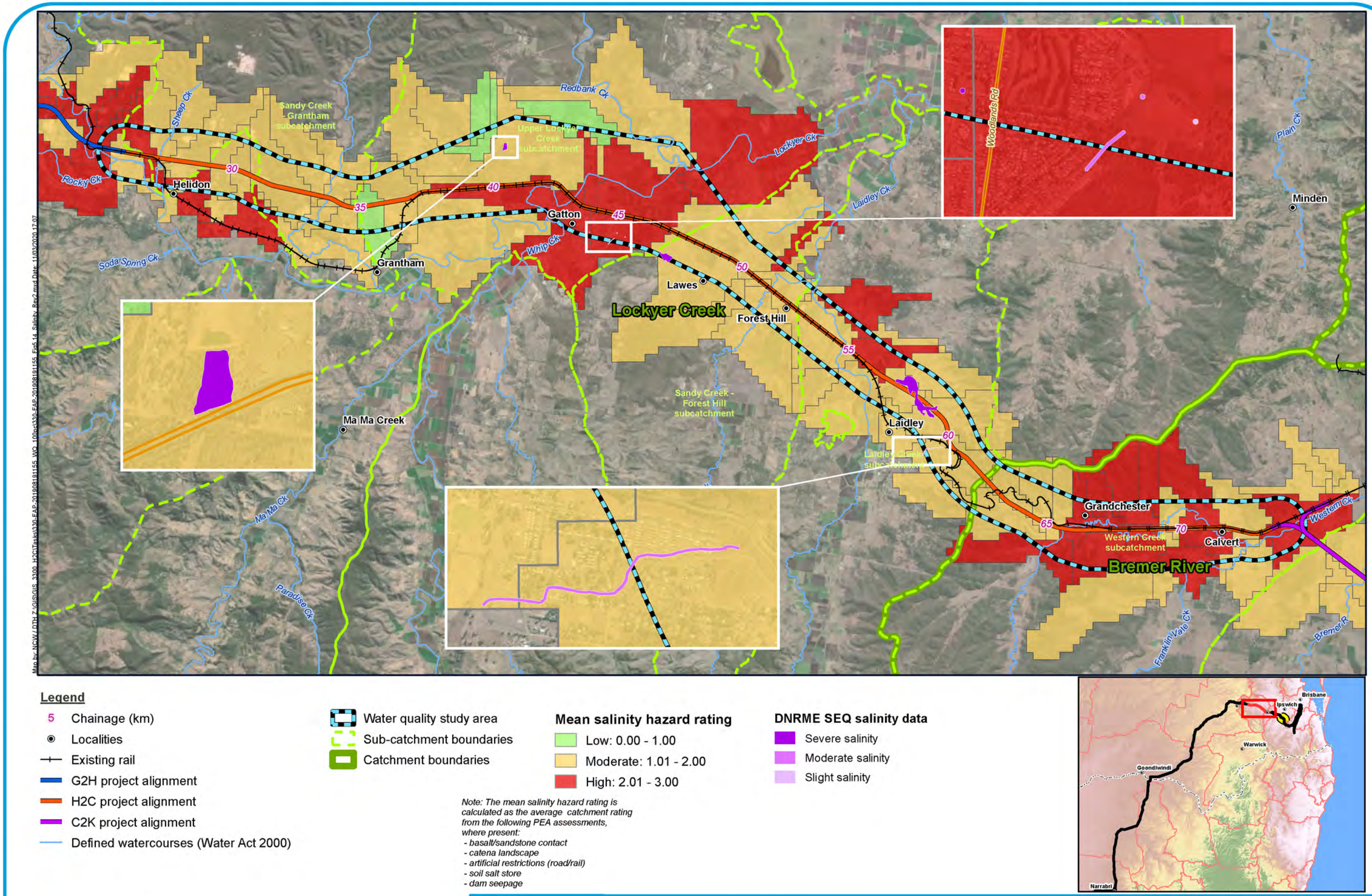
- Environmental flow objectives: assessing periods of low flow and medium to high flow
- Water allocation security objectives.

The Moreton Water Management Protocol implements the Moreton Water Plan*.* The Water Management Protocol defines the rules that govern the allocation and management of water to achieve the Water Plan outcomes.

Significant changes to the hydraulic regime of the watercourses are not expected to occur with design practices which account for typical hydrological flow to which the water plans pertain. Ecological and general outcomes for the Moreton Water Plan (i.e. achieving ecological outcomes consistent with supporting natural outcomes by minimising changes to natural flow regimes) will not be impacted with minimal variance to typical hydrological flow. As such, the Project is expected to comply with the Moreton Basin water plans.

The current Moreton Water Plan has a total supplemented surface water allocation of 397,495 ML and an un-supplemented surface water allocation of 28,502 ML. Un-supplemented groundwater allocation is currently 137 ML. To identify immediate impacts on surface water resource users, the number of water licences were accessed to identify potential water quality receptors.

Within the water quality study area, licensed water users (refer Table 5.12) and unlicensed water usage comprises recreational, commercial and domestic uses. The area provides opportunity for various recreational activities that use the waterways including canoeing, water skiing and fishing. Water usage within the water quality study area is dominated by stock use, farming and rural domestic uses. Stock water is supplied from rivers in the wet season and for the rest of the year by groundwater, natural waterholes or constructed artificial waterbodies.



*Note: The mean salinity hazard rating is calculated as the average catchment rating from the following PEA assessments, where present:*
- *basalt/sandstone contact*
- *catena landscape*
- *artificial restrictions (road/rail)*
- *soil salt store*
- *dam seepage*

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**Helidon to Calvert**

**Figure 5.14:**
**Regional mean salinity hazard rating for the region proximal to the water quality study area**

Water resource catchments (and water supply buffer area) associated with the water quality study area (refer Appendix H) are limited to the Project water quality study area associated with the Lockyer Creek Catchment. Human requirements for drinking water quality supply are considered to be covered by the protection of aquatic ecosystem environmental values (due to stringency of water quality objectives).

Identification of potential impacts to surface water users is outlined in Section 7.2.

**Table 5.12 2018-2019 Water licences relevant to the water quality study area (under Water Regulation 2016)**

| Water source | No of water licences |
|---|---|
| Helidon Sandstone (Groundwater Source) | 4 |
| Laidley Creek (Surface Water Source) | 9 |
| Laidley Creek (Alluvial Aquifer Source) | 35 |
| Lockyer Creek (Surface Water Source) | 22 |
| Lockyer Creek (Alluvial Aquifer Source) | 45 |
| Redbank Creek (Alluvial Aquifer Source) | 3 |
| Sandy Creek (Alluvial Aquifer Source) | 6 |
| **TOTAL** | **124** |

**Source:** DNRME 2019

## 5.11 Water quality receptors

A receptor is a feature, area or structure that may be affected by direct or indirect changes to the environment. The water quality receptors were assessed against relevant legislation and the overarching ecological values used to feed potential impacts which included:

- Queensland's natural environment (including utilisation by native flora and fauna)
- Finite natural resources, with specific regard to wetlands
- Watercourses conducive to the maintenance of existing land forms, ecological health and biodiversity.

Due to the interconnected nature of the watercourses intersecting the Project alignment and residing within the greater water quality study area, the water quality receptors for the existing environment (as a whole of package) were assigned a sensitivity based on several factors:

- Protection by State legislation (with acknowledgement of potential habitat for MNES species)
- Important for biodiversity
- Existing moderate sensitivity, high exposure to impacts (as per EPP (Water and Wetland Biodiversity) categorisation).

To maintain a conservative approach to assessment, all waterways within the water quality study area were nominated as moderate sensitivity water quality receptors (due to their classification of disturbance under EPP (Water and Wetland Biodiversity)). The moderate sensitivity was used a general indicator for the identification of potential impacts, associated mitigation measures and identification of residual impact after implementation of mitigation.

Due to the potential presence of the MNES species Australian lungfish (*Neoceratodus forsteri*), Mary River cod (*Maccullochella mariensis*) and two MSES wetlands within the Lower Lockyer Creek sub-catchment and Western Creek sub-catchment, respectively, both sub-catchments were identified as high sensitivity water quality receptors. Therefore, the defined watercourses of Upper Lockyer Creek and Western Creek sub catchments: Lockyer Creek and Western Creek are identified as highly sensitive water quality receptors.

# 6 Surface water quality assessment

## 6.1 Desktop review of water quality within the Lockyer and Bremer Catchments

### 6.1.1 Healthy Land and Water

The healthy land and water monitoring program provides a regional assessment of the health for each of SEQs major catchments, river estuaries and Moreton Bay zones. A generalised report card is produced annually for each catchment (from a variety of aquatic parameters) to indicate waterway health in SEQ, ranging from an ‘A’ for excellent to ‘F’ for failed ecosystem health.

Freshwater ecosystem health is considered across a variety of indicators including:

- Ecosystem processes
- Fish
- Invertebrates
- Physical – chemical, and
- Riparian extent.

The water quality study area is located within the Lockyer and Bremer catchment areas.

#### 6.1.1.1 Lockyer and Bremer catchment

The Healthy Land and Water report card (HWAC 2020) found that the western catchments (including the Lockyer and Bremer sub-catchments) range from poor to good, with overall grades decreasing in condition over recent years of assessment. The western catchments have experienced a continual decline in freshwater stream health as a result of dry weather and poor vegetation cover. Therefore, the western catchments are highly susceptible to future erosion caused by storms and flooding. Table 6.1 and Table 6.2 provide the overall results for the Lockyer and Bremer sub-catchments from 2010 to 2018.

Table 6.1 **Lockyer catchment report card results from 2010 to 2018**

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** |
| Overall condition | The overall environmental condition of Lockyer is poor (D) | The overall environmental condition of Lockyer is poor (D+) | The overall environmental condition of Lockyer is poor (D+) | The overall environmental condition of Lockyer is poor (D) | The overall environmental condition of Lockyer is poor (D) | The overall environmental condition of Lockyer is poor (D+) | The overall environmental condition of Lockyer is poor (D+) | The overall environmental condition of Lockyer is poor (D+) | The overall environmental condition of the Lockyer is poor (D+) |
| Ecosystem processes | 0.75 (good) | 0.85 (good) | 0.84 (good) | 0.72 (average) | 0.68 (average) | 0.82 (good) | 0.86 (excellent) | 0.82 (good) | 0.95 (excellent) |
| Fish | 0.59 (fair) | 0.60 (average) | 0.70 (average) | 0.76 (good) | 0.77 (good) | 0.65 (average) | 0.69 (average) | 0.69 (average) | 0.68 (average) |
| Invertebrates | 0.77 (good) | 0.87 (excellent) | 0.89 (excellent) | 0.89 (excellent) | 0.80 (good) | 0.89 (excellent) | 0.81 (good) | 0.81 (good) | 0.81 (good) |
| Physical/chemical | 0.82 (good) | 0.85 (good) | 0.80 (good) | 0.73 (average) | 0.73 (average) | 0.86 (excellent) | 0.82 (good) | 0.82 (good) | 0.83 (good) |
| Riparian | Not assessed | | 0.40 (poor) | | 0.40 (poor) | | 0.40 (poor) | | 0.40 (poor) |

**Source:** HWAC (2020)

Table 6.2 **Bremer catchment report card results from 2010 to 2018**

| Category | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** |
| Overall condition | The overall environmental condition of the Bremer is poor (E) | The overall environmental condition of the Bremer is poor (E) | The overall environmental condition of the Bremer is poor (D-) | The overall environmental condition of the Bremer is average (C-) | The overall environmental condition of the Bremer is poor (D) | The overall environmental condition of Bremer is poor (D-) | The overall environmental condition of the Bremer is poor (D+) | The overall environmental condition of the Bremer is poor (D-) | The overall condition of the Bremer is poor (D+). |
| Ecosystem processes | 0.73 (average) | 0.92 (excellent) | 0.86 (excellent) | 0.82 (good) | 0.78 (good) | 0.94 (excellent) | 0.94 (excellent) | 0.99 (excellent) | 0.96 (excellent) |
| Fish | 0.73 (average) | 0.75 (good) | 0.75 (good) | 0.80 (good) | 0.76 (good) | 0.75 (good) | 0.79 (good) | 0.74 (good) | 0.75 (good) |
| Invertebrates | 0.83 (good) | 0.88 (excellent) | 0.93 (excellent) | 0.90 (excellent) | 0.84 (good) | 0.86 (excellent) | 0.89 (excellent) | 0.88 (excellent) | 0.84 (excellent) |
| Physical/ chemical | 0.83 (good) | 0.85 (excellent) | 0.84 (good) | 0.83 (good) | 0.78 (good) | 0.91 (excellent) | 0.88 (excellent) | 0.87 (excellent) | 0.88 (excellent) |
| Riparian | Not assessed | | 0.56 (fair) | | 0.56 (fair) | | 0.56 (fair) | | 0.56 (fair) |

**Source:** HWAC (2020)

## 6.2 Field assessment of surface water quality

### 6.2.1 General conditions

To capture the best representation of stream flow behaviour from the water quality study area, stream flow data was retrieved from the gauging station from the Lockyer Creek catchment, downstream from the water quality study area. Noting the limitation of this data, in reference to assessment of stream flow from those catchments removed from Lockyer Creek, the approximation of flow derived from this gauging station allows for general inferences to be made.

The weather conditions leading up to the first sampling event were generally clear and dry. Table 6.3 identifies that 75.6 mm of rain was recorded in the week leading up to the first sampling event. However, with the exception of this significant rainfall event on the 3 October 2017, minimal reliable rainfall was observed with only 11 mm of rain recorded for the preceding month. Stream flow rates (in terms of passage over the gauging station control), indicate that no surface base flow was observed downstream of the gauging station preceding the first water quality sampling event. Whilst base flow would be predicted to increase with the significant rainfall experienced on the 3 October 2017, the lack of flow demonstrates that general seasonal conditions were a higher contributor to overall stream flow.

Weather conditions leading up to the second sampling event were generally hot with some minimal yet consistent rainfall with 62.2 mm of rainfall recorded in the week leading up to the second sampling event (refer Table 6.4). Noting this, stream flow rates fell sharply immediately preceding the second round of water sampling, as observed in the minimal to low flow rates observed across the monitoring sites.

Weather conditions leading up to the third sampling event were generally hot with very high temperatures (>38°C) experienced during the sampling event. Rainfall was typically lacking before the sampling events with the exception of a minor amount of precipitation immediately prior to sampling, however this was not enough to charge watercourses flow (over gauges) within the water quality study area (refer Table 6.5).

**Table 6.3 Rainfall (BoM Station 40082) and stream flow (Lockyer Creek at Rifle Range Road) prior to October 2017 sampling event (9 to 13 October 2017)**

| Day/date | Rainfall (mm daily) | Lockyer Creek Stream flow (Avg ML per day) | Western Creek stream flow (Avg ML per day) |
|---|---|---|---|
| Monday 02/10/2017 | 7.4 | 0.00 | 0.00 |
| Tuesday 03/10/2017 | 62.0 | 0.00 | 0.00 |
| Wednesday 04/10/2017 | 1.4 | 0.00 | 0.00 |
| Thursday 05/10/2017 | 0.0 | 0.00 | 0.00 |
| Friday 06/10/2017 | 0.0 | 0.00 | 0.00 |
| Saturday 07/10/2017 | 4.6 | 0.00 | 0.00 |
| Sunday 08/10/2017 | 0.2 | 0.00 | 0.00 |
| Monday 09/10/2017 | 0.0 | 0.00 | 0.00 |
| Tuesday 10/10/2017 | 0.0 | 0.00 | 0.00 |
| Wednesday 11/10/2017 | 1.6 | 0.00 | 0.00 |
| Thursday 12/10/2017 | 1.4 | 0.00 | 0.00 |
| Friday 13/10/2017 | 2.2 | 0.00 | 0.00 |

**Source:** BoM 2020a, DNRME (2020)

**Table 6.4** **Rainfall (BoM Station 40082) and stream flow (Lockyer Creek at Rifle Range Road) prior to March 2018 sampling event (1 and 2 March 2018)**

| Day/date | Rainfall (mm daily) | Lockyer Creek Stream flow (Avg ML per day) | Western Creek stream flow (Avg ML per day) |
|---|---|---|---|
| Monday 19/02/2018 | 0.0 | 3.36 | 0.00 |
| Tuesday 20/02/2018 | 36.8 | 4.41 | 0.00 |
| Wednesday 21/02/2018 | 0.2 | 4.73 | 0.00 |
| Thursday 22/02/2018 | 0.2 | 4.36 | 0.00 |
| Friday 23/02/2018 | 2.4 | 2.28 | 0.00 |
| Saturday 24/02/2018 | 15.6 | 0.78 | 3.57 |
| Sunday 25/02/2018 | 7.0 | 0.23 | 47.16 |
| Monday 26/02/2018 | 23.8 | 0.34 | 55.42 |
| Tuesday 27/02/2018 | 80.0 | 5.84 | 508.49 |
| Wednesday 28/02/2018 | 0.2 | 6.65 | 82.92 |
| Thursday 01/03/2018 | 0.0 | 1.84 | 37.62 |
| Friday 02/03/2018 | 0.0 | 0.52 | 23.42 |

**Source:** BoM 2020a, DRDMW (formerly DNRME (2020))

**Table 6.5** **Rainfall (BoM Station 40082) and stream flow (Lockyer Creek at Rifle Range Road) prior to March 2019 sampling event (12 and 13 March 2019)**

| Day/date | Rainfall (mm daily) | Lockyer Creek Stream flow (Avg ML per day) | Western Creek stream flow (Avg ML per day) |
|---|---|---|---|
| Tuesday 05/03/2019 | 0.0 | 0.22 | 0.00 |
| Wednesday 06/03/2019 | 0.0 | 0.00 | 0.00 |
| Thursday 07/03/2019 | 0.0 | 1.80 | 0.00 |
| Friday 08/03/2019 | 1.4 | 3.20 | 0.00 |
| Saturday 09/03/2019 | 0.0 | 1.37 | 0.00 |
| Sunday 10/03/2019 | 0.0 | 1.94 | 0.00 |
| Monday 11/03/2019 | 0.0 | 1.33 | 0.00 |
| Tuesday 12/03/2019 | 0.0 | 0.69 | 0.00 |
| Wednesday 13/03/2019 | 0.0 | 0.30 | 0.00 |

**Source:** BoM 2020a, DRDMW (formerly DNRME (2020))

### 6.2.2 Summary of field and laboratory assessed surface water quality data

Across the sampling events, pH values within both the Lockyer Creek and Bremer River catchment assessment sites varied between meeting WQOs and exceeding WQOs (refer Table 6.6, Table 6.7and Table 6.8). Due to the presence of low flow conditions throughout the majority of the water sampling events, the observed pH values were considered typical of the prevailing environmental conditions.

Turbidity values were typically above threshold levels for most of the assessed waterways (refer Table 6.6). Most water sampling was conducted during the first round of sampling and turbidity values were typically low (in association with limited flow at sites of collection), whilst still exceeding threshold levels. Within the first round of sampling, exceedances were noted in waterways associated with the Lockyer Creek and Bremer River catchments. Due to limited flow conditions during the second round of sampling, a limited number of waterways were sampled, however turbidity values indicated potential overland sedimentation movement and potential liberation of sediment within these waterways. Within the third round of sampling, turbidity values were typically elevated in pooled samples.

EC levels during all sampling events were mostly elevated but are not considered to be atypical, given the low flow conditions experienced during the water sampling events, and historic data from gauging stations. Notably, EC values were significantly outside WQOs and suggest limited assimilative capacity of the environment to further salinity impact, specifically with low flow conditions (refer Table 6.6).

In line with other physio-chemical parameters, dissolved oxygen concentrations within the waterways demonstrated the disparity in flow conditions, with a high number of sites not meeting WQOs (within both the Lockyer Creek and Bremer River catchments) (refer Table 6.6). Within the water quality monitoring data, optimal dissolved oxygen concentrations that met WQO were observed in two separate water quality sampling sites and events.

Additionally, chlorophyll *a* concentrations typically failed to meet WQOs for both the Lockyer Creek and Bremer River catchment waterways (refer Table 6.7). The heightened chlorophyll *a* concentration coincided with low flow conditions, suspended solids and elevated nutrient concentrations (specifically heightened phosphate, total nitrogen and organic nitrogen concentrations), which may contribute to an increase in phytoplankton biomass within the waterways.

In line with the healthy waterways (HWAC 2020) assessment of both catchments, the waterways assessed within the water quality study area contained some indicators of anthropogenic degradation, noting that assessments were made during periods of low-flow (i.e. outside of first flush conditions) and the corresponding physio-chemical conditions within the catchment (refer Table 6.7). Specifically, with the exception of site 17A, nutrient concentrations (of either Total P, Total N or Ammonia) did not meet WQOs for the Lockyer Creek catchment whilst the Bremer River catchment sites did not exhibit the same level of elevated nutrients (as total P, Ammonia, Nitrate, Nitrite, organic N and total N). Elevated nutrients were only observed in site 18A. Noting this, existing conditions (low flow conditions) are likely to have facilitated higher TN and organic nitrogen levels and are not explicitly considered outside of WQO guidelines.

Four WQO exceedances in dissolved metal concentrations were noted within the water quality study area (refer Table 6.8). Minor WQO exceedances were observed in dissolved copper concentrations, whilst below levels required for physiological impact on aquatic organisms were observed in 2A and 13A and additional minor WQO exceedances in zinc were observed in 4A and 14A. Laboratory analysis of PAH concentrations at all sites were below detection limits, indicating no continued point source contamination of sampled sites, although it is recognised that these compounds are volatile and may not be very persistent in the environment. Dissolved metals and polyaromatic hydrocarbon concentrations typically adhered to the water quality objective for both the Lockyer Creek and Bremer River catchments, indicating limited contamination or naturally elevated concentrations from surrounding land use. Noting this, only the water column was assessed and the absence of anoxic conditions, and high nutrient concentrations within the waterways have the potential to mask the specific dissolved metal concentrations within the waterways. Again, the results obtained are specific to low flow conditions.

In summary, it is evident that current conditions within waterways relevant to the water quality study area generally do not currently meet WQOs during low flow conditions, principally for EC, chlorophyll *a*, turbidity (and associated total suspended solids), nitrogen species and phosphorus for the Lockyer Creek and Bremer River catchment. There was evidence of potentially anthropogenic impact on nutrient concentrations and sub-optimal physio-chemical conditions were present across the water quality study area.

A general summary description of water quality encountered for the water quality study area is presented in Appendix C, Table C-1. A general description of each site is provided in Appendix C, Table C-2.

### 6.2.3 Field assessment water quality results

The field-assessed water quality results for the sampling events is provided in Table 6.6.

**Table 6.6 Water quality data measured *in situ* from waterways within the water quality study area**

| Site | Date | pH | EC ($\mu$scm$^{-1}$) | Temperature (°C) | Turbidity (NTU) | Salinity (ppt) | Dissolved oxygen (mgL$^{-1}$) | Dissolved oxygen (%) |
|---|---|---|---|---|---|---|---|---|
| **Lockyer Creek catchment** | | | | | | | | |
| **Lockyer Creek WQO** | **-** | **6.5 – 8.0** | **< 520** | **n/a** | **< 6** | **n/a** | **n/a** | **85 – 110** |
| H2C 2A<br>Un-named | 11/10/2017 | Dry at time of sampling | | | | | | |
| | 01/03/2018 | 7.39 | 3,600 | 32.8 | 5.4 | 2.08 | 4.8 | 69.3 |
| | 11/03/2019 | Dry at time of sampling | | | | | | |
| H2C 3A<br>Lockyer Creek | 12/10/2017 | 7.52 | 870 | 24.3 | 0.2 | 7.44 | 3.32 | 41.5 |
| | 01/03/2018 | Dry at time of sampling | | | | | | |
| | 12/03/2019 | 9.21 | 1,065 | 29.4 | 13.5 | 0.48 | 15.55 | 205.4 |
| H2C 4A<br>Lockyer Creek | 09/10/2017 | 7.5 | 510 | 23.9 | 2.7 | 1.04 | 4.56 | 54 |
| | 01/03/2018 | Dry at time of sampling | | | | | | |
| | 12/03/2019 | 8.94 | 866 | 29.2 | 62 | 0.39 | 13.54 | 176.6 |
| H2C 7A<br>Un-named | 11/10/2017 | 7.0 | 740 | 22.9 | 6.6 | 1.54 | 2.35 | 27.0 |
| | 02/03/2018 | Dry at time of sampling | | | | | | |
| | 12/03/2019 | No access at time of sample | | | | | | |
| H2C 11A<br>Lockyer Creek | 09/10/2017 | 9.32 | 1,400 | 26.7 | 46.1 | 1.24 | 9.61 | 120.8 |
| | 01/03/2018 | 8.44 | 1,100 | 24.7 | 53.5 | 0.65 | 5.1 | 61.4 |
| | 11/03/2019 | Dry at time of sampling | | | | | | |
| H2C 12A<br>Lockyer Creek | 10/10/2017 | 8.33 | 970 | 24.7 | 33.8 | 1.56 | 6.35 | 76.0 |
| | 01/03/2018 | Dry at time of sampling | | | | | | |
| | 12/03/2019 | Dry at time of sampling | | | | | | |
| H2C 13A<br>Laidley Creek | 13/10/2017 | Dry at time of sampling | | | | | | |
| | 02/03/2018 | 7.96 | 310 | 25.2 | 24 | 0.16 | 5.15 | 63 |
| | 12/03/2019 | Dry at time of sampling | | | | | | |
| H2C 14A<br>Laidley Creek | 13/10/2017 | Dry at time of sampling | | | | | | |
| | 02/03/2018 | 8.14 | 300 | 24.7 | 19.7 | 0.16 | 4.9 | 60 |
| | 12/03/2019 | Dry at time of sampling | | | | | | |
| H2C 17A<br>Laidley Creek | 13/01/2017 | 7.62 | 850 | 23.5 | 0.1 | 5.86 | 3.02 | 32.5 |
| | 02/03/2018 | 8.05 | 340 | 25.1 | 13.7 | 0.18 | 7.32 | 86.5 |
| | 12/03/2019 | Dry at time of sampling | | | | | | |
| **Bremer River catchment** | | | | | | | | |
| **Western Creek WQO** | **-** | **6.5 – 8.0** | **< 770** | **n/a** | **< 17** | **n/a** | **n/a** | **85 – 110** |
| H2C 9A<br>Western Creek | 11/10/2017 | 7.52 | 2,200 | 21.9 | 6.6 | 2.03 | 0 | 0.2 |
| | 01/03/2018 | Dry at time of sampling | | | | | | |
| | 12/03/2019 | Dry at time of sampling | | | | | | |

| Site | Date | pH | EC (µscm-1) | Temperature (°C) | Turbidity (NTU) | Salinity (ppt) | Dissolved oxygen (mgL-1) | Dissolved oxygen (%) |
|---|---|---|---|---|---|---|---|---|
| H2C 10A Western Creek | 11/10/2017 | 7.62 | 3,800 | 21.2 | 6.7 | 6.95 | 0.90 | 11.8 |
| | 01/03/2018 | Dry at time of sampling | | | | | | |
| | 12/03/2019 | Dry at time of sampling | | | | | | |
| H2C 18A Western Creek | 13/10/2017 | 7.45 | 2,300 | 23.2 | 2.0 | 6.89 | 3.03 | 37.0 |
| | 01/03/2018 | Dry at time of sampling | | | | | | |
| | 12/03/2019 | 6.43 | 3,381 | 28.9 | 13.7 | 1.63 | 6.45 | 85.1 |

**Source:** WQO from DERM (2010a, 2010b)

**Table notes:**

1 Highlighted colour where value is above WQO or outside WQO range where applicable
Ppt = parts per thousand

### 6.2.4 Laboratory assessed water quality results

A summary of the laboratory results for the water quality sampling is provided in Table 6.7 and Table 6.8.

Table 6.7 Laboratory results for water quality monitoring sites for the water quality study area

| Site | Date | pH | Chlorophyll a ($mgL^{-1}$) | Total P ($mgL^{-1}$) | Suspended solids ($mgL^{-1}$) | Filtered Reactive Phosphorus ($mgL^{-1}$) | Turbidity (NTU) | Ammonia ($mgL^{-1}$) | Nitrate ($mgL^{1}$) | Nitrite ($mgL^{1}$) | Organic nitrogen ($mgL^{-1}$) | Total kjeldahl nitrogen ($mgL^{-1}$) | Total nitrogen ($mgL^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lockyer Creek catchment** | | | | | | | | | | | | | |
| **Lockyer Creek WQO** | **-** | **6.5 – 8.0** | **< 5** | **< 0.03** | **<6** | **<0.015** | **<5** | **< 0.01** | **-** | **-** | **< 0.2** | **-** | **< 0.25** |
| H2C 2A<br>Un-named | 11/10/2017 | | Dry at time of sampling | | | | | | | | | | |
| | 01/03/2018 | 7.9 | < 5 | 0.32 | 2.8 | 0.13 | 1.7 | 0.03 | 37 | 0.34 | 1.9 | 1.9 | 43 |
| | 11/03/2019 | | Dry at time of sampling | | | | | | | | | | |
| H2C 3A<br>Lockyer Creek | 12/10/2017 | 8.3 | < 10 | < 0.05 | 1.6 | <0.05 | < 1 | 0.03 | < 0.02 | <0.02 | 0.3 | 0.3 | 0.3 |
| | 01/03/2018 | | Dry at time of sampling | | | | | | | | | | |
| | 12/03/2019 | 9.1 | <5 | 0.06 | 11 | 0.05 | 2.9 | 0.18 | <0.02 | <0.02 | 0.7 | 0.9 | 0.88 |
| H2C 4A<br>Lockyer Creek | 09/10/2017 | 8.1 | < 10 | 0.10 | < 1 | 0.1 | 2.3 | 0.13 | 0.43 | 0.04 | < 0.2 | 0.2 | 0.7 |
| | 01/03/2018 | | Dry at time of sampling | | | | | | | | | | |
| | 12/03/2019 | 8.7 | 6.4 | 0.10 | 67 | 0.01 | 42 | <0.01 | <0.02 | <0.02 | 0.67 | 0.7 | 0.67 |
| H2C 7A<br>Un-named | 11/10/2017 | 8.1 | < 10 | 0.13 | 4.4 | 0.11 | 1.7 | 0.13 | 0.19 | < 0.02 | 0.5 | 0.6 | 0.8 |
| | 02/03/2018 | | Dry at time of sampling | | | | | | | | | | |
| | 12/03/2019 | | No access at time of sample | | | | | | | | | | |
| H2C 11A<br>Lockyer Creek | 09/10/2017 | 9.3 | < 10 | 0.10 | 47 | <0.05 | 36 | 0.11 | < 0.02 | < 0.02 | 0.49 | 0.6 | 0.6 |
| | 01/03/2018 | 8.5 | 29 | 0.19 | 53 | | 32 | < 0.01 | < 0.02 | < 0.02 | 0.7 | 0.7 | 0.7 |
| | 11/03/2019 | | Dry at time of sampling | | | | | | | | | | |
| H2C 12A<br>Lockyer Creek | 10/10/2017 | 8.4 | 87 | 0.10 | 19 | <0.05 | 9.6 | <0.01 | <0.02 | <0.02 | 0.4 | 0.4 | 0.4 |
| | 01/03/2018 | | Dry at time of sampling | | | | | | | | | | |
| | 12/03/2019 | | Dry at time of sampling | | | | | | | | | | |
| H2C 13A<br>Laidley Creek | 13/10/2017 | | Dry at time of sampling | | | | | | | | | | |
| | 02/03/2018 | 8.0 | < 5 | 0.44 | 13 | | 17 | 0.04 | 0.13 | < 0.02 | 0.6 | 0.6 | 0.74 |
| | 12/03/2019 | | Dry at time of sampling | | | | | | | | | | |

| Site | Date | pH | Chlorophyll a (mgL$^{-1}$) | Total P (mgL$^{-1}$) | Suspended solids (mgL$^{-1}$) | Filtered Reactive Phosphorus (mgL$^{-1}$) | Turbidity (NTU) | Ammonia (mgL$^{-1}$) | Nitrate (mgL$^{1}$) | Nitrite (mgL$^{1}$) | Organic nitrogen (mgL$^{-1}$) | Total kjeldahl nitrogen (mgL$^{-1}$) | Total nitrogen (mgL$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H2C 14A<br>Laidley Creek | 13/10/2017 | | Dry at time of sampling | | | | | | | | | | |
| | 02/03/2018 | 8.1 | < 5 | 0.40 | 11 | | 14 | 0.02 | 0.20 | < 0.02 | 0.5 | 0.5 | 0.72 |
| | 12/03/2019 | | Dry at time of sampling | | | | | | | | | | |
| H2C 17A<br>Laidley Creek | 11/10/2017 | 8.2 | < 10 | 0.27 | 7.0 | 0.21 | 2.1 | 0.02 | 0.03 | < 0.02 | 0.3 | 0.3 | 0.3 |
| | 02/03/2018 | 8.3 | 6.0 | 0.39 | 21 | | 8.4 | 0.02 | 0.16 | 0.03 | 0.3 | 0.3 | 0.49 |
| | 12/03/2019 | | Dry at time of sampling | | | | | | | | | | |
| **Bremer River catchment** | | | | | | | | | | | | | |
| **Western Creek WQO** | **-** | **6.5 – 8.0** | **<17** | **< 0.05** | **<6** | **<0.02** | **< 17** | **< 0.02** | **-** | **-** | **< 0.42** | **-** | **<0.5** |
| H2C 9A<br>Western Creek | 11/10/2017 | 8.2 | < 10 | 0.15 | 11 | <0.05 | 4.8 | < 0.01 | 0.03 | < 0.02 | 0.2 | 0.2 | 0.2 |
| | 01/03/2018 | | Dry at time of sampling | | | | | | | | | | |
| | 12/03/2019 | | Dry at time of sampling | | | | | | | | | | |
| H2C 10A<br>Western Creek | 11/10/2017 | 8.4 | < 5 | 0.06 | 7.2 | <0.05 | 3.3 | < 0.01 | 0.05 | <0.02 | 0.4 | 0.4 | 0.4 |
| | 01/03/2018 | | Dry at time of sampling | | | | | | | | | | |
| | 12/03/2019 | | Dry at time of sampling | | | | | | | | | | |
| H2C 18A<br>Western Creek | 11/10/2017 | 8.1 | < 5 | 0.05 | 2.5 | <0.05 | 2.6 | 0.02 | < 0.02 | < 0.02 | 0.6 | 0.6 | 0.6 |
| | 01/03/2018 | | Dry at time of sampling | | | | | | | | | | |
| | 12/03/2019 | 6.3 | 18 | 0.01 | 21 | 0.01 | 18 | 0.2 | <0.02 | <0.02 | 1.3 | 1.3 | 1.3 |

**Source:** WQO from DERM (2010a, 2010b)

**Table notes:**

1 Highlighted colour where value is above WQO or outside WQO range where applicable

Table 6.8 Dissolved metal and indicative PAH laboratory results for water quality monitoring sites.

| Site | Date | Arsenic (III) (mgL$^{-1}$) | Cadmium (mgL$^{-1}$) | Chromium (VI) (mgL$^{-1}$) | Copper (mgL$^{-1}$) | Lead (mgL$^{-1}$) | Mercury (mgL$^{-1}$) | Nickel (mgL$^{-1}$) | Zinc (mgL$^{-1}$) | Naphthalene (mgL$^{1}$) (PAH) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lockyer Creek catchment** | | | | | | | | | | |
| **Lockyer Creek WQO** | **-** | **0.024** | **0.0002** | **0.0004** | **0.0014** | **0.0034** | **0.0006** | **0.011** | **0.008** | **0.016** |
| H2C 2A<br>Un-named | 11/10/2017 | Dry at time of sampling | | | | | | | | |
| | 01/03/2018 | <0.001 | <0.0002 | <0.001 | 0.004 | <0.001 | <0.0001 | 0.006 | <0.005 | <0.001 |
| | 11/03/2019 | Dry at time of sampling | | | | | | | | |
| H2C 3A<br>Lockyer Creek | 11/10/2017 | <0.001 | <0.0002 | <0.001 | <0.001 | <0.001 | <0.0001 | 0.002 | <0.005 | <0.001 |
| | 01/03/2018 | Dry at time of sampling | | | | | | | | |
| | 12/03/2019 | 0.002 | <0.0002 | <0.001 | 0.002 | <0.001 | <0.0001 | 0.001 | 0.005 | <0.001 |
| H2C 4A<br>Lockyer Creek | 09/10/2017 | <0.001 | <0.0002 | <0.001 | 0.002 | <0.001 | <0.0001 | 0.002 | 0.011 | <0.001 |
| | 01/03/2018 | Dry at time of sampling | | | | | | | | |
| | 12/03/2019 | <0.001 | <0.0002 | <0.001 | <0.001 | <0.001 | <0.0001 | 0.002 | <0.005 | <0.001 |
| H2C 7A<br>Un-named | 11/10/2017 | <0.001 | <0.0002 | <0.001 | <0.001 | <0.001 | <0.0001 | 0.003 | <0.005 | <0.001 |
| | 02/03/2018 | Dry at time of sampling | | | | | | | | |
| | 12/03/2019 | No access at time of sample | | | | | | | | |
| H2C 11A<br>Lockyer Creek | 09/10/2017 | 0.002 | <0.0002 | <0.001 | 0.001 | <0.001 | <0.0001 | 0.003 | <0.005 | <0.001 |
| | 01/03/2018 | 0.001 | <0.0002 | <0.001 | <0.001 | <0.001 | <0.0001 | 0.002 | <0.005 | <0.001 |
| | 11/03/2019 | Dry at time of sampling | | | | | | | | |
| H2C 12A<br>Lockyer Creek | 10/10/2017 | <0.001 | <0.0002 | <0.001 | 0.001 | <0.001 | <0.0001 | 0.005 | <0.005 | <0.001 |
| | 01/03/2018 | Dry at time of sampling | | | | | | | | |
| | 12/03/2019 | Dry at time of sampling | | | | | | | | |
| H2C 13A<br>Laidley Creek | 13/10/2017 | Dry at time of sampling | | | | | | | | |
| | 02/03/2018 | <0.001 | <0.0002 | <0.001 | 0.003 | <0.001 | <0.0001 | 0.006 | <0.005 | <0.001 |
| | 12/03/2019 | Dry at time of sampling | | | | | | | | |

| Site | Date | Arsenic (III) (mgL$^{-1}$) | Cadmium (mgL$^{-1}$) | Chromium (VI) (mgL$^{-1}$) | Copper (mgL$^{-1}$) | Lead (mgL$^{-1}$) | Mercury (mgL$^{-1}$) | Nickel (mgL$^{-1}$) | Zinc (mgL$^{-1}$) | Naphthalene (mgL$^{1}$) (PAH) |
|---|---|---|---|---|---|---|---|---|---|---|
| H2C 14A<br>Laidley Creek | 13/10/2017 | Dry at time of sampling | | | | | | | | |
| | 02/03/2018 | <0.001 | <0.0002 | <0.001 | 0.001 | <0.001 | <0.0001 | 0.002 | 0.012 | <0.001 |
| | 12/03/2019 | Dry at time of sampling | | | | | | | | |
| H2C 17A<br>Laidley Creek | 11/10/2017 | <0.001 | <0.0002 | <0.001 | <0.001 | <0.001 | <0.0001 | 0.002 | <0.005 | <0.001 |
| | 02/03/2018 | <0.001 | <0.0002 | <0.001 | <0.001 | <0.001 | <0.0001 | 0.001 | <0.005 | <0.001 |
| | 12/03/2019 | Dry at time of sampling | | | | | | | | |
| **Bremer River catchment** | | | | | | | | | | |
| **Bremer - Western Creek** | **-** | **0.024** | **0.0055** | **0.0004** | **0.0014** | **0.0034** | **0.0006** | **0.011** | **0.008** | **0.016** |
| H2C 9A<br>Western Creek | 11/10/2017 | 0.001 | <0.0002 | <0.001 | <0.001 | <0.001 | <0.0001 | <0.001 | <0.005 | <0.001 |
| | 01/03/2018 | Dry at time of sampling | | | | | | | | |
| | 12/03/2019 | Dry at time of sampling | | | | | | | | |
| H2C 10A<br>Western Creek | 11/10/2017 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 | <0.0001 | 0.002 | <0.005 | <0.001 |
| | 01/03/2018 | Dry at time of sampling | | | | | | | | |
| | 12/03/2019 | Dry at time of sampling | | | | | | | | |
| H2C 18A<br>Western Creek | 11/10/2017 | <0.001 | <0.0002 | <0.001 | <0.001 | <0.001 | <0.0001 | 0.002 | <0.005 | <0.001 |
| | 01/03/2018 | Dry at time of sampling | | | | | | | | |
| | 12/03/2019 | 0.002 | <0.0002 | <0.001 | <0.001 | <0.001 | <0.0001 | 0.004 | <0.005 | <0.001 |

**Source:** WQO from ANZG (2018)

**Table notes:**

1 Highlighted colour where value is above WQO or outside WQO range where applicable

## 6.3 Summary of existing surface water quality condition

Upon comparison with historical water quality data for Lockyer Creek, Laidley Creek and Purga Creek (refer Section 5.3.5) (as a general proxy for the water quality study area), water quality values observed during the three sampling rounds typically followed those of the gauging stations. Water quality was typically outside of WQOs with TSS exceeding WQOs historically and within the current assessment. Total nitrogen and phosphorus as a typical anthropogenic contaminant also followed historical data with WQO exceedance noted throughout the entire assessment period.

Whilst WQOs generally do not meet historical mean values, results from the three sampling rounds conducted for the EIS suggest that compliance with WQOs is affected by highly seasonal water flow conditions observed throughout the water quality study area. Within the gauging stations, a majority of the quantified water quality parameters (i.e. TSS, ammonia, total nitrogen and total phosphorus) did not meet WQOs. The gauging stations indicate the discharges along Lockyer Creek, Laidley Creek and Purga Creek were highly variable and indicate that the low flow conditions experienced across periods of the entire monitoring period are not atypical. Water quality (specifically physio-chemical parameters and laboratory analysed data) was observed to improve with an increase with hydrological flow and the assimilative capacity would be expected to be greatest during high flow conditions.

Moderate Aquascore riverine wetlands have been modelled along the Project alignment and correspond to the healthy water assessment of each catchment. The assessment indicates typical processes are ‘good’ with poor riparian condition throughout the catchment. While exceedances of WQO were noted within particular parameters throughout the entire assessment period, water quality can be generalised to be meeting a large variety of WQOs (including metals and PAH analysis).

In summary, habitat conditions during assessment were not considered atypical (in terms of periods of low surface hydrological flow), however clear impacts of diminished flow conditions were noted throughout the assessment. In regard to the field assessment, water quality parameters improved with a higher surface hydrological flow within the second field assessment and, where water persisted, decreased in the third assessment.

# 7 Potential impacts

Surface water quality impacts have been identified as potential impacts that will require management to avoid/minimise with design measures and further *in situ* mitigation measures as required. Potential impacts were assessed with consideration of the existing surface water quality condition, sensitivity of water quality receptors (including acknowledgment of downstream impacts and the assimilative capacity of the surrounding catchment).

The assessment of surface water quality included consideration of the assimilative capacity of the receiving environment through historical and existing compliance with existing WQOs and input from the existing surface water environment assessment from a variety of watercourses within both the Bremer River and Lockyer Creek catchments. Currently, the existing environment does not meet all the WQO criteria for each catchment; as such, the assimilative capacity was assessed within qualitative risk of degradation of water quality (against WQO) from potential Project impacts. It is noted that EC at high flow significantly decreases and it is considered likely that assimilative capacity of the watercourses within the water quality study area will be higher during higher flow conditions (refer Appendix E and Appendix F). In contrast, the lowest assimilative capacity and highest realisation of impact would occur during periods of extended low flow (such as those currently experienced). Noting this, potential impacts from the Project would likely occur with periods of continued rainfall, resulting in higher hydrological flow and greater assimilative capacity in regard to potential impacts.

Within this impact assessment, the total quantity of wastewater (across the entire disturbance footprint) was not calculated as the quantities are only considered for tunnel wastewater discharge during construction and operational works. Wastewater is considered to fall within two categories: on-site and off-site produced. On-site wastewater is considered to be produced by the Project and relates to construction and operational phases. Off-site wastewater is considered to be produced from overland flow passing through the disturbance footprint associated with Project (including through longitudinal drainage to cross-drainage infrastructure) with export through drainage away from the site. On-site wastewater is considered to be contained by the six sediment control basins utilised for construction.

Point source discharge for the Project is anticipated only to occur along cut-and-fill lines. The principle discharges are considered to occur at cross-drainage infrastructure points as associated with potential upward seepage from aquifers. Given discharges will be reliant on the water quality and quantity of overland flows at these points any impacts are likely to be minor.

Wastewater quality was incorporated as part of the significant impact assessment across several facets, including dewatering of artificial impoundments and tunnelling, and, overland flow of construction water.

A long-term inflow of approximately 0.54 L/s has been estimated for the tunnel using the analytical method. Under the scenario of elevated groundwater levels (+ 10 m) the estimated long-term inflow rate increased from 0.54 L/s to 1.30 L/sec for the length of the tunnel (850m). These have been considered as the principal wastewater discharge from the Project. Risk of water quality impacts was incorporated as part of the impact assessment across several facets, including dewatering of artificial impoundments and overland flow of construction water.

Through information gathered during the assessment process, sensitive receptors within the receiving environment (refer Section 1) which have the potential to be subject to significant impacts, have been identified within the water quality study area. These sensitive receptors are considered for the identification of potential impacts, associated mitigation measures and identification of residual impact after implementation of mitigation. All the waterways within the water quality study area identified as moderate sensitivity water quality receptors. Due to the presence of the MNES species, Mary River cod (*Maccullochella mariensis*) and Australian Lungfish (*Neoceratodus forsteri*) and two MSES wetlands within the Lower Lockyer Creek sub-catchment and Western Creek sub-catchment, respectively, both sub-catchments were identified as high sensitivity water quality receptors.

Mitigation measures have been developed to reduce the potential magnitude of impacts and are detailed further in Section 8.

## 7.1 Surface water quality impacts

### 7.1.1 Construction phase impacts

A number of construction phase (including pre-construction phase) activities which are likely to impact the surface water quality are discussed below:

- Increased debris is considered to have the potential to impact all watercourses and waterbodies along the Project alignment due to conveyance through overland flow pathways to both static waterbodies and flowing watercourses and unmapped waterways. Increased debris and rubbish is considered to have the potential to result in a degradation of surface water quality receptors via both direct and indirect impacts. The potential impact to surface water quality values includes; a reduction in water flow (via mechanical blockages), loss of ecosystem values (via smothering and aquatic ecological value impact) and direct leachate impacts (via the accumulation of rubbish and debris blown off or washed away from a construction area into nearby waterways).
- Changes to receiving surface water quality and hydrology (principally from increased water turbidity and sedimentation load) are considered to result in indirect and direct impacts on surface water quality receptors. Without adequate mitigation measures in place, the indirect potential impact from potential changes to overland flow pathways and diversions are considered a high risk of impacting surface water quality receptors associated with both flowing watercourses and unmapped waterways, and static waterbodies occurring downstream of the Project works. Indirect surface water quality changes may occur downstream as a result of increased turbidity and sedimentation associated with an increase in mobilisation of sediment-bound metals and other substances. The mobilised substances have an increased potential to directly impact surface water quality values and indirectly impact aquatic ecosystem values. In addition, increased water turbidity and sedimentation may also result in significant changes to localised hydrological regimes, especially in pinch points (such as existing culverts) which may result in smothering of aquatic flora receptors, leading to a direct impact on surface water quality receptors. Alteration of surface water quality and hydrology from increased turbidity and sedimentation load may occur from a variety of Project activities such as:
    - Construction works resulting in elevated sediment concentrations in surface water runoff as a result of inadequate erosion sediment controls
    - Construction works involving disturbance to the riparian corridor may result in erosion and scouring of streambanks
    - Physical disturbance of stream beds and banks leading to a reduction in stability during construction of creek crossings
    - Erosion of cleared riparian areas and inadequate rehabilitation processes
    - Altered hydrological regimes from drainage flow change due to diversion at western tunnel portal
    - Dewatering works resulting in an increase of sediment loads from dewatering activities near excavations and water quality issues from dewatering activities associated with tunnel infrastructure works. Dewatering associated with decommissioning artificial waterbodies that intersect the Project disturbance footprint may additionally cause an increase in erosion and sedimentation of watercourses and drainage features if dewatering activities are not adequately managed.
    - Vegetation clearing, which could leave exposed soils prone to erosion
    - Bank-cutting to re-direct the drainage feature at the western tunnel portal
    - Potential erosion risk associated with soils exposed during topsoil stripping, earthworks, excavation and trenching activities required for infrastructure development
    - Changes to the physical attributes of waterways from removal of buffering vegetation.

- Altered hydrology and subsequent water chemistry changes are considered potential direct and indirect impacts from Project activities. Alteration to the hydrological regime of the Western Creek catchment associated with tunnel dewatering is considered a potential direct impact on surface water quality receptors through potential changes in wetting and drying regimes. This is considered to indirectly impact surface water quality receptors downstream of the dewatering release through diversion changes to overland flow pathways and through potential changes to aquatic ecological values. Potential surface water quality changes from Project activities are considered a direct impact and have potential to impact all surface water quality receptors associated with the Project. Potential impact is expected to occur from all Project activities associated with potential changes to hydrology, especially those resulting in the liberation of contaminants (typically associated with problematic soils from any potential changes to hydrology). The direct impact on surface water quality receptors is considered to have a localised indirect impact on aquatic ecological receptors through degradation of water quality parameters. Project activities considered to cause a potential impact on hydrology and water chemistry are:
  - Clearing activities and construction of infrastructure, resulting in changes to habitat form (biotic and abiotic) through alteration of hydrological regime (flow and quality)
  - Accidental spills and leaks of chemicals or fuels from construction equipment or fuel storages, which could introduce chemicals into overland flows
  - Overland flow diversions (i.e. Project Chainages Ch 61.84 km, Ch 63.44 km and Ch 64.04 km)
  - Introduction of exotic weed species
  - Increase of sediment loads from dewatering activities near excavations and surface water quality issues from dewatering activities associated with tunnel infrastructure works, including the removal of wastewater from the tunnel during construction and operation. Dewatering associated with decommissioning artificial waterbodies that intersect the Project disturbance footprint may additionally cause an increase in erosion and sedimentation of watercourses and drainage features if dewatering activities are not adequately managed.
  - Subsoil exposure within excavations which have the potential to result in the leachate of acid rock drainage from the soil into overland flow
  - The erosion of stockpiled materials, which could lead to increased nutrient concentrations in overland flow
  - Impact to proximal wetlands, with high sensitivity receptor areas associated with Lockyer Creek and Western Creek
  - Dewatering of tunnel infrastructure may result in changes to water quality within Western Creek tributaries due to potential disparity in groundwater discharge from tunnel construction, resulting in potentially high impact to aquatic ecology and surface water quality
- Increase in salinity at a localised and regional scope are considered potential indirect impacts from the Project activities. Salinity impacts on surface water quality receptors are considered to potentially occur from a variety of Project activities and have the capacity to result in regional impacts derived from point source impacts associated with the Project works. Salinity issues are considered to have a direct impact on surface water quality receptors within the Project disturbance footprint and are further considered to have an indirect impact on ecosystem services (and water quality receptors) downstream of the point source salinity impact. Project activities considered to cause a potential increase in localised and regional salinity are due to:
  - Project alignment directly intersecting moderate to high salinity hazard rating areas potentially resulting in discharge of saline runoff into proximal waterways, particularly within the high salinity hazard rating areas that have been modelled as occurring along the Project alignment
  - Disturbance of saline soils during construction, which may increase salinity pressures in overland flows through identified high risk salinity hazard areas

- Erosion and sedimentation increases are considered a direct impact from Project activities. These are considered to have a direct impact on surface water quality receptors at a localised scope. At a regional scope after transport downstream from the point source, the impact is considered to be indirect. Transport of sediment and eroded material can be washed off into cleared areas or stockpiled areas during rainfall events. This may increase sediment loads and turbidity within waterways and potentially increase nutrient loads. Direct impact from degradation of surface water quality will be realised from changes to light conditions and loss of ecosystem services due to changes to aquatic flora and fauna structure. Project activities considered to potentially increase sedimentation and erosion primary involve:
  - In-stream earthworks leading to changes in surface water quality due to the number of new bridge structures and culverts that will be required for the Project
  - Stockpiling of sediment (e.g. from cut and fill processes), mulch or other materials near waterways has the potential for runoff during rain events and impacts to the water quality of nearby waterways
  - Inappropriate rehabilitation of riparian vegetation work areas
- Introduction of contaminants from a variety of sources during construction is considered to be a direct impact from Project activities. The introduction of contaminants is considered to have direct impact on receptors through direct changes to surface water quality parameters. The direct changes to surface water quality parameters are considered to have the potential for indirect changes to aquatic ecosystem services, leading to the potential for further impacts on surface water quality receptors. Project activities considered to increase the potential introduction of contaminants include:
  - Chemical, fuel and oil spills due to inappropriate storage controls and refuelling/maintenance procedures
  - Heavy metals entering waterways from rail grinding and welding
  - Compounds leaching from ballast materials
  - Spills associated with train derailments or breakdowns
  - Salts mobilised from surface soils or shallow groundwater changes
  - Dewatering activities leading to liberation of toxicants from potentially contaminated land
  - Disturbance of contaminated lands near waterways resulting in contaminated runoff entering waterways
  - Inadequately treated dewatering of tunnel infrastructure may result in hydrocarbons being introduced to the Laidley Creek and Western Creek tributaries during construction activities, resulting in a potentially high impact to surface water quality.

### 7.1.2 Operational phase impacts

Potential impacts and the operational phase activities likely to impact the surface water quality include:

- Increased debris due to:
  - Potential for rubbish and debris from operations to be blown off or washed away from the Project into proximal watercourses.
- Altered hydrology and water chemistry (increase in salinity) due to:
  - Changes to receiving water quality from tunnel dewatering discharge and point discharge from culvert locations along the disturbance footprint. Principally, the intrusion of groundwater into the tunnel, and, the associated dewatering regime may impact on the receiving watercourse, particularly in regard to salinity
  - Changes to hydrological regime with Western Creek catchment associated with tunnel discharge due to improper hydrological flows from the treated discharge water

- Introduction of contaminants from a variety of sources during operation due to:
  - Oil and grease spills – there is the potential for oil and grease from rolling stock to enter the waterways after heavy rainfall events without appropriate controls.
  - Heavy metals from maintenance rail grinding and welding
  - Compounds leaching from ballast materials
  - Accidental spills from freight carriages during routine operations
  - Chemicals, including fuels and oils used for construction machinery (as an artefact of potential construction impact)
  - Structural failure – with the introduction of bridge or culverts within waterways, should these structures fail, there is the potential for impacts to water quality either from potential contaminants (debris) or from detained water flushing from collapsed structures. Structural failure also has the capacity to alter flow regimes and increase potential secondary salinity issues, with flow on issues resulting in surface water quality degradation
  - Maintenance of the rail line or machinery near waterways (such as the crossing loops associated with Laidley Creek at approximately Ch 55.09 km to Ch 57.29 km) has the potential to mobilise sediments from disturbed areas and increase the potential for litter or rubbish to enter waterways. Oils and greases and other contaminants such as metals have the potential to enter waterways from spills, and for impact from the use of environmental toxicants (such as biocides) to maintain operating infrastructure areas. Maintenance activities may result in the potential introduction of biocides, resulting in a loss of ecosystem service and subsequent direct and indirect impacts on water quality. These activities have the potential to impact nearby waterways, through discharge points without appropriate mitigation.
- Increase in erosion and sedimentation resulting from:
  - Earthworks and erosion of exposed soils (as an artefact of potential construction impact)
  - Construction of culverts and bridges within or nearby waterways. Potential for continued erosion and sedimentation without appropriate rehabilitation in these areas exists. This can increase sediment loads and turbidity within waterways. Increased sedimentation may then also impact the functioning of culverts should deposition become too high.

## 7.2 Impacts to surface water users

There is the potential to impact upon licenced users of surface water (refer Table 5.12) if the quality of water or the flow of water changes within offtake locations on Laidley Creek and Lockyer Creek (including indirect impact to downstream users). The design of the alignment will ensure that the changes to flow are minimised and will not impact users.

A hydrology and flooding study has been undertaken separately to this report (refer EIS Appendix M: Hydrology and flooding technical report) detailing potential impacts to a suite of design flood events including consideration of change in flood levels, flow distributions, velocities and inundation periods. Whilst changes to hydraulic regimes may occur (due to new infrastructure) at 1% AEP conditions, changes to base-flow and low-flow conditions are not expected (refer EIS Appendix M: Hydrology and flooding technical report) and will not significantly impede current surface water resource use. Noting this, potential small changes to flow during construction if barriers are placed within watercourses during high flow events, however the potential for this to occur is low.

The impact to water plans (supply and conveyance) within the disturbance footprint will be minimal due to limited overland flow interference and no diversions of high-stream order defined watercourses (i.e. those used for conveyance and/or water harvesting). The current drainage diversions will be directed towards existing drainage feature and are not considered to reduce current hydrological regimes with the Laidley Creek and Western Creek sub-catchments. The affected waterway flow paths involve those related to a proposed diversion drain at Ch 61.75 km within the Laidley Creek sub catchment and a waterway diversion at chainages Ch 63.44 km to Ch 63.75 km (310 m) and Ch 64.04 km to Ch 64.17 km (130 m) within the Western Creek sub catchment.

Potential further impact to water plans may be expected due to the requirement for construction water, however this is expected to be regulated by the necessary authorities and will be conducted in accordance with the strategy for sourcing construction water (refer Section 2.6).

Project water requirements have been further identified to be potentially available from Wivenhoe Dam (refer Section 2.6). It is expected that the offtake of water from this impoundment will comply with water plans and will not result in a change in water quality, from unregulated use of surface water resources, due to Project activities. Should water be required from the proximal perennial watercourses; Murphys Creek, Lockyer Creek, Laidley Creek or the Bremer River, it is expected that approvals will be sought with the relevant agency under the Water Act.

Impact to the surface water users will revolve principally around the impact on water quality from the identified potential impacts in Section 7.1; including increased debris, altered water quality and hydrology, altered water chemistry, salinity increase, an increase in erosion and sedimentation and introduction of contaminants. When considered at a highly conservative level, impacts to water quality as a result of Project activities during construction may have transient impacts to local water users, potentially restricting access to human drinking water, stock water and crop irrigation. As significant hydraulic changes are not expected from take or conveyance of construction water, impact to surface water users are considered to be restricted to those mentioned above.

Water quality protection of aquatic ecosystems will confer protection to current existing condition within the water quality study area, and water users downstream of the disturbance footprint. Therefore, identification of potential impact, mitigation measures (refer Section 8) and resulting impact assessment (refer Section 9) identifies any impact to surface water users. Noting that significant impacts on water quality of surface water users are not considered to occur within Project activities, the resource licence holder (Seqwater) may require to be informed when works are to occur in proximity to surface water offtakes (i.e. Laidley Creek and Lockyer Creek).

# 8 Mitigation

This section outlines both the mitigation measures included as part of the design and the mitigation measures that are proposed for application in future phases the Project to manage predicted impacts to water quality. Mitigation measures have been developed to minimise impacts associated with construction and operation of the Project. Mitigation strategies have been developed based on the following hierarchical criteria:

- Primary: avoid potential impacts where possible during Project design
- Secondary: minimise the severity and/or duration of the impact during Project design
- Last: apply mitigation measures for unavoidable impacts.

## 8.1 Design considerations

The mitigation measures and controls presented in Table 8.1 are factored into the design and will be further implemented during the detailed design phases of the Project. These design considerations are proposed to minimise the environmental impacts of the Project and therefore contribute to a lowering of the initial impact risk rating for each potential impact before the application of *in situ* mitigation (refer Table 8.2).

**Table 8.1 Initial mitigation of relevance to surface water quality**

| Aspect | Initial design measures |
|---|---|
| Interference with existing surface water, and, water quality | ▪ The Project utilises the existing sections of the West Moreton rail system rail corridors as much as possible to avoid introducing a new linear infrastructure corridor across watercourses and floodplains, where feasible<br>▪ Watercourse crossing structures (including culverts, viaducts and bridges) are designed to minimise the need for ongoing maintenance and inspection to maintain aquatic fauna (e.g. fish) passage and minimise the risk of blockages in reference to *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (1 October 2018) (DAF 2018)<br>▪ Bridges, viaducts and waterway crossings are designed to minimise impacts to bed, banks and environmental flows, in accordance with relevant regulatory requirements (as per requirements of DAF and the Fisheries Act)<br>▪ The design has been developed to avoid the need to permanently divert watercourses, as defined and mapped under the Water Act (it is noted that three discrete unmapped waterways are currently subject to diversion)<br>▪ The design has been developed to minimise impacts to watercourses, riparian vegetation and in-stream flora and habitats by adopting a crossing structure hierarchy where viaducts and bridges are preferred to culverts<br>▪ Bridge structures are provided in the design over the following watercourses, to minimise disturbance of aquatic habitats: Sandy Creek (Grantham), Lockyer Creek, Laidley Creek, Sandy Creek (Forest Hill) and Western Creek<br>▪ Scour and erosion protection measures have been incorporated into the design in areas determined to be at risk, such as around culvert headwalls, drainage discharge pathways and bridge abutments<br>▪ Scour protection measures have been included around culvert entrances and exits, on disturbed stream banks and around waterfront land to avoid erosion<br>▪ Cross-drainage structures have been incorporated into the design where the Project intercepts existing drainage lines and watercourses. The type of cross-drainage structure in the design depends on various factors such as the natural topography, rail formation levels, design flow and soil type<br>▪ The design includes six sediment basins (for construction). All sediment basins are passive which allows surface runoff from a catchment to flow into the sediment basin without the need for pumping. |

## 8.2 Proposed mitigation measures

To manage Project risks during construction a number of mitigation measures have been proposed for implementation in future phases of Project delivery, as presented in Table 8.2. These proposed mitigation measures have been identified to address Project specific issues and opportunities, address legislative requirements, accepted government plans, policy and practice.

Table 8.2 identifies the relevant Project phase, the aspect to be managed, and the proposed mitigation measure, which is then factored into the assessment of residual significance in Table 9.1.

Within the water quality assessment of impacts and risk significance, pre-construction has been grouped with construction due to the similarity in potential impact. In addition to the standard *in situ* mitigation measures indicated in Table 8.2, further management frameworks are proposed for tunnel dewatering treatment, surface water quality (receiving environment) monitoring and salinity management (refer Sections 8.3.2, 8.3.3 and 8.3.4).

In addition to the mitigation measures identified above and as part of the detailed design phase, when finalised positions of infrastructure elements (e.g. abutments/piers etc) are known and detailed soil studies are complete, geomorphological assessment of identified risk locations will be undertaken.

Chapter 23: Outline Environmental Management Plan provides further context and the framework for implementation of these proposed mitigation and management measures

**Table 8.2** **Proposed (*in situ*) surface water quality mitigation measures**

| Delivery phase | Aspect | Proposed mitigation measures |
|---|---|---|
| Detailed design | Water quality of waterways | Seek to further refine the disturbance footprint identified and assessed in the EIS, to avoid, and where avoidance is not possible, further minimise impacts to all waterways including defined watercourses, currently unmapped waterways and drainage features (defined by *Water Act 2000* (Qld) and water quality of Sandy Creek (Grantham), Lockyer Creek, Sandy Creek (Forest Hill), Laidley Creek, Western Creek their tributaries and downstream impoundments or users by:<br>■ Avoiding, then minimising the extent and duration of temporary waterway diversions.<br>■ Avoiding, then minimising the extent of permanent waterway diversions or realignments. Where unavoidable, permanent waterway realignment/diversion design to include simulation of natural features e.g. meanders, pools, riffles, shaded and open sections, deep and shallow sections and different types of sub-strata, depending on the pre-disturbance environmental values.<br>■ Planning and defining maintenance activity locations, construction compounds and storage areas, and management procedures.<br>■ Undertaking preconstruction water quality monitoring and detailed design hydraulic modelling to inform temporary and permanent drainage design. Requirements for treatment controls, scour protection, to be incorporated where necessary to achieve modelled compliance with established objectives. Temporary and permanent measures must be appropriate to the site conditions, responding to the erosion risk assessment, environmental receptors, climatic zone and seasonal factors.<br>■ Developing Erosion and Sediment Control Plans, in accordance with International Erosion Control Association (IECA), for implementation during pre-construction, construction and commissioning, which will establish and specify the monitoring and performance objectives for handover on completion of construction.<br>■ Ensuring the disturbance footprint defined during detailed design allows sufficient space for provision of the required temporary and permanent erosion and sediment control measures/pollution control measures.<br>■ Designing batters, cuts and other exposed surfaces to reduce erosion risk.<br>■ Designing watercourse crossing structures (including culverts and bridges) to minimise the need for ongoing maintenance and inspection to maintain aquatic fauna (e.g. fish) passage and minimise the risk of debris deposition during large flow events in accordance with relevant regulatory requirements. |
| | Monitoring | Develop the surface water monitoring framework to inform the development of the Construction Environmental Management Plan (CEMP) and the Water Quality Monitoring Program. It will identify monitoring locations at discharge points, and locations in watercourses where works are being undertaken. It will include the relevant water quality objectives, parameters, and criteria, and specific monitoring locations, frequency and duration identified in consultation with relevant regulators to reduce impacts to surface water quality.<br>Commence water quality monitoring in accordance with the surface water quality monitoring framework for an adequate period of time to acquire representative data prior to construction at waterway crossing locations (e.g. Lockyer Creek – upstream of, downstream of, and at the intersection of the Project disturbance footprint and watercourse) to establish baseline water conditions and provide a sufficient seasonal dataset prior to the commencement of construction. |
| | Drainage design, erosion sediment control | Water quality matters will inform permanent drainage design for the rail and road realignments (i.e. requirements for treatment train controls where necessary to comply with established water quality objectives through scour protection) and to inform erosion and sediment control plans.<br>Design defines temporary and permanent stormwater, erosion and sediment/pollution control measures in Erosion and Sediment Control Plans and Reinstatement and Rehabilitation Plans, that each comply with IECA guidelines. The plans will also establish and specify the monitoring and performance objectives for handover on completion of construction. |

| Delivery phase | Aspect | Proposed mitigation measures |
|---|---|---|
| | Construction water | Develop a dewatering strategy where dewatering of artificial impoundments is required (artificial impoundments within the disturbance footprint have been identified in Table 5.9) to comply with the *Biosecurity Act 2014* to take reasonable measure to avoid the spread of pest species (with capacity to affect water quality) and in accordance with any required aquatic fauna species management plans.<br>Requirements for construction water (volumes, quality, demand curves, approvals requirements and lead times) will be defined during detailed design and construction planning. This will include identification of opportunities to utilise dewatered artificial impoundments (where impacted within the disturbance footprint) for construction purposes.<br>Construction water sources and demand will utilise a hierarchical approach to confirming the suitability of water sources, with a focus on utilising existing sustainable allocated water entitlements.<br>Licences, approvals and agreements to access water from sources identified in the finalised construction water strategy will be obtained. These may include water licences under the Water Act or access agreements with bulk water suppliers or private landholders.<br>Specify performance criteria in the CEMP for construction water requirements to minimise the risk of adverse water quality, environmental or health impacts and avoid the use of potable water where non-potable sources can be applied. |
| | Tunnel dewatering | Groundwater quality and modelling will be undertaken to inform the design for the Little Liverpool Range tunnel dewatering treatment facility.<br>Develop a treatment and discharge plan, consistent with the tunnel dewatering treatment framework for implementation at the tunnel dewatering plant. The collected water will be required to meet the water quality objectives defined for Western Creek, and schedule release periods as necessary so as to minimise changes in hydrological regime, physical and chemical characteristics and ecological processes. |
| | Flooding and hydrology | Incorporate outcomes from consultation with stakeholders including directly impacted landholders, local government authorities, State Government departments and recognised subject matter experts to inform and refine the Project design.<br>Continue to refine Project design in response to hydraulic modelling outcomes. This includes addressing flood impact objectives which include consideration of peak water levels, flow distribution, velocities and duration of inundation. This will confirm bridge lengths, culvert sizing and numbers, localised scour and erosion protection measures for both rail, road and other permanent Project infrastructure.<br>Undertake a Project flood risk assessment to inform the siting and scale of temporary construction areas (including stockpiles, construction compounds, access, laydown areas etc.).<br>Construction planning reviews of the design to locate plant and equipment maintenance activities and chemical/hazardous goods storage facilities in accordance with the risk assessment and incorporate appropriate location specific controls and procedures to minimise the risk and avoid impacts to waterways, aquatic habitats, and groundwater.<br>Impacts must be determined at all drainage structures and waterways affected by Project works. The change in flood levels and impacts on infrastructure and properties outside the rail corridor must be justified for a range of events up to and including the 1% AEP event. |
| Pre-construction | Erosion and sediment control (water quality related) | Erosion and sediment control plans will be developed as part of the CEMP, in accordance with relevant regulatory requirements and best practice IECA guidelines. The Erosion and Sediment Control Plan will include the following procedures and protocols relevant to potential impacts on water quality values:<br>■ Soil/land conservation objectives for the Project<br>■ Management of problem soils, such as:<br>– Acid sulfate soils, which may occur in proximity to water storages<br>– Erosive or dispersive soils, such as sodosols that are expected to be encountered at approximately Ch 62.00 km to Ch 70.00 km (associated with Grandchester) |

| Delivery phase | Aspect | Proposed mitigation measures |
|---|---|---|
| | | – Cracking clays (vertosols) that are expected to be encountered in the disturbance footprint associated with the alignment in proximity of Forest Hill and Laidley (principally associated with waterways)<br>– Saline soils, particularly in high salinity hazard areas such as those modelled at approximately Ch 45.00 km and Ch 67.00 km.<br>■ Specification of the type and location of erosion and sediment controls. The erosion and sediment control measures will be developed by a Certified Professional in Erosion and Sediment Control and be in accordance with the International Erosion Control Association Best Practice Erosion and Sediment Control (2008). The Soil Management Plan will include:<br>– Locations for specific temporary/permanent erosion and sediment control measures<br>– Sediment retention basins (six included in the design)<br>– Scour protection (included in the design)<br>– Sediment fencing<br>– Berms and other surface flow redirection through disturbance areas.<br>■ Nomination of location-specific erosion controls will include consideration of site conditions, proximity to environmental receptors, adjoining land uses and climatic and seasonal factors with incorporation of an erosion risk assessment.<br>■ Minimise the area of disturbance during each stage to that required to enable the safe construction, operation and maintenance of the rail corridor:<br>■ Scheduling and management of works (within dry periods) with consideration to periods of higher rainfall (summer months)<br>■ Establish and specify the monitoring and performance objectives for handover on completion of construction<br>■ Stockpiling and management/segregation of topsoil where it contains native plants seedbank or weed material<br>■ Vehicle, machinery and imported fill hygiene protocols and documentation, in accordance with the requirements of the *Biosecurity Act 2014* (Qld)<br>■ Requirements for training, inspections, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction.<br>The Erosion and Sediment Control Plans are to include a process for site and activity specific preparation when forecasted large or high intensity wet weather events are predicted. This may include but not be limited to removing plant and equipment out of riparian zones, stabilising/covering live work areas, additional application of soil binders/veneers and pre event treatment and dewatering of sediment basins. |
| | Water quality | Review and adjust (as required) the surface water monitoring framework and develop the Water Quality Monitoring Program as part of the Surface Water Sub-plan of the CEMP. The Water Quality Monitoring Program will include (as a minimum):<br>■ Representative background monitoring data for an adequate period of time, commencing in 2020, required for surface water quality to establish baseline water conditions prior to the commencement of construction<br>■ Identification of works and activities during construction and operation of the Project, including runoff, emergencies and spill events, that have the potential to impact on surface water quality of potentially affected waterways and riparian land (via discharge points)<br>■ A risk management framework for evaluation of the risks to surface water quality and ecosystems in the receiving environment, including definition of impacts that trigger contingency and ameliorative measures<br>■ The identification of locality specific and construction activity erosion and sediment control and stormwater management requirements relating to surface waters during construction, commissioning and operation |

| Delivery phase | Aspect | Proposed mitigation measures |
|---|---|---|
|  |  | - The presentation of WQO trigger values, standards and parameters against which any changes to water quality will be assessed, having regard to the relevant water quality guidelines and ANZG 2018 Guidelines. Where alternate guidelines are used to establish water quality goals, justification for this will be provided, As a minimum this should include values for:<br>– TSS. Equivalent to corresponding background (mg/L)<br>– Turbidity. Equivalent to corresponding background (NTU)<br>– pH 6.5-8<br>– Oils and grease (no visible films). If oils and grease are visually evident, a sample will be forwarded to the laboratory for analysis<br>- Establishment of construction and operational phase surface water monitoring locations including waterways, waterbodies and wetlands, (e.g. construction monitoring of Lockyer Creek – upstream of, downstream of, and at the intersection of the Project disturbance footprint and watercourse and operation tunnel dewatering into the Western Creek sub-catchment), which are representative of the potential extent of impacts from the Project, including relevant analytes and frequency of monitoring<br>- Identification of seasonal factors with the potential to influence water quality at the monitoring sites<br>- A monitoring period following the completion of construction (i.e. until the affected waterways, drainage infrastructure and landscaped or rehabilitated areas are certified by a suitably qualified and experienced independent expert as being stabilised and rehabilitated to an acceptable condition, unless otherwise approved or directed by regulatory authorities. Surface water quality during baseflow conditions that meet pre-construction up and downstream background monitoring, and/or WQOs will confirm adequate rehabilitation<br>- The post-construction monitoring must also confirm the establishment of operational water control measures which will be identified as part of drainage during detailed design of the Project (such as vegetated buffer strips basins and vegetated swales)<br>- Contingency and ameliorative measures in the event that adverse impacts to water quality are identified, with reference to the impact triggers defined as part of the water quality monitoring program<br>- Surface water quality samples are to be collected and analysed in accordance with industry-accepted standards and quality assured procedures, with laboratory analysis undertaken by NATA accredited facilities.<br>Dewatering/extraction of water from artificial impoundments will be undertaken after consultation with relevant stakeholders.<br>To the extent possible and where required, stage construction activities to utilise dewatered artificial impoundments to reduce external water requirements.<br>Dewatering strategies will be required to comply with the *Biosecurity Act 2014* (Qld) to take reasonable measure to avoid the spread of pest species (with capacity to affect water quality).<br>Undertake site inspections prior to the construction of cuts, including visual examination of surface outcrops for sulphide minerals or evidence of sulphide mineralisation. Utilise the information from these inspections to inform the management of potential ARD from cuttings prior to construction works.<br>Any excavated material which is suspected to contain sulphides will be stockpiled, lined and covered (as appropriate) to manage and minimise rainfall infiltration and potential leaching. Where possible, treatment and onsite reuse are preferred to off-site disposal. A case-by-case assessment of the suitability of material for treatment and reuse will be required.<br>Routine sampling of discharge waters from the deep cuts intersecting groundwater will be undertaken to assess the potential for ARD processes taking place. Screening of the seepage water onsite for pH (trending down) and electrical conductance (EC) (trending up) and comparison to the baseline groundwater monitoring program results/trends will allow for indication of ARD processes. Further laboratory analyses for the key analytes pH, total dissolved solids (TDS), EC, total suspended solids (TSS), alkalinity, and dissolved metals will validate the presence or absence of ARD. |

| Delivery phase | Aspect | Proposed mitigation measures |
|---|---|---|
| | | If ARD-contaminated discharge water is found to be generated from the deep cuts, this water will need to be impounded in ponds and neutralised via treatment (hydrated lime or dilution or similar) prior to release into the surrounding catchment or other discharge mechanism.<br>Identification and/or reuse of contaminated, hazardous or potentially contaminated material on site (i.e. soil, ballast) will be subject to a risk assessment and managed accordingly. |
| Construction and commissioning | Erosion and sediment control | Clearing extents are limited to the disturbance footprint, and clearing is scheduled to minimise the exposure time of unprotected materials to prevent sedimentation of receiving waterways.<br>Appropriate erosion and sediment control measures are to be implemented for each stage or element of the construction works, in accordance with the progressive revisions of the Erosion and Sediment Control Plans that are undertaken by a CPESC in accordance with IECA guidelines. Stages/elements are expected to include (but not be limited to):<br>■ Vegetation clearing and grubbing<br>■ Temporary access tracks and/or temporary waterway crossings<br>■ Early installation of stormwater drainage and clean water catch drains to divert clean water flows through/around the construction site<br>■ Bulk earthworks and interim topography changes<br>■ Waterway diversions<br>■ Bridge and culvert works<br>■ Ballast placement<br>■ Reinstatement activities<br>■ Rehabilitation and landscape activities.<br>Temporary waterway crossings are rehabilitated in accordance with the Reinstatement and Rehabilitation Plan.<br>Where practical and or in accordance with specific flora and fauna management plans, vegetation clearing, and ground disturbing works will be staged sequentially/across the proposal to minimise areas exposed to erosion and sediment risk of receiving waterways and drainage lines in accordance with the general environmental duty of the *Environmental Protection Act 1994 (Qld)*. |
| | Water quality | The surface water monitoring framework will include the relevant water quality objectives, parameters, and criteria, and specific monitoring locations, frequency and duration identified in consultation with relevant regulators to reduce impacts to surface water quality.<br>To the extent possible, schedule works to utilise dewatered artificial impoundments along the disturbance footprint to reduce external water requirements. Dewatering strategies will be required to comply with the *Biosecurity Act 2014* (Qld) to take reasonable measure to avoid the spread of pest species (with capacity to affect water quality).<br>In the event that water quality objectives cannot be achieved for waters to be released, alternate treatment/disposal options are to be implemented prior to release or re-use.<br>Implementation of the Water Quality Monitoring Program.<br>Water will need to meet the established water quality objectives for receiving waterways before being released/discharged into local waterways. Water that does not comply with relevant water quality objectives will either be:<br>■ Treated on-site to enable discharge<br>■ Used for construction water purposes that is not quality dependent, if safe to do so (e.g. dust suppression)<br>■ Removed from site for disposal at an appropriately licensed facility. |

| Delivery phase | Aspect | Proposed mitigation measures |
|---|---|---|
| | | Bulk storage areas for dangerous goods and hazardous materials will be located away from areas of social and environmental receptors such that offsite impacts or risks from any foreseeable hazard scenario will not exceed the dangerous dose for the defined land use zone, i.e. either sensitive, commercial/community, or industrial, in accordance with the intent of the SPP.<br>Appropriate register and records of chemicals, hydrocarbons and hazardous substances and materials on site will be maintained up to date as required by the CEMP. Where appropriate this will include a relevant risk assessment prior to the substance coming to, and being used on site, plus a dangerous goods manifest and Safety Data Sheet Register.<br>Licenced transporters operating in compliance with *Australian Code for the Transport of Dangerous Goods by Road & Rail* will be utilised for the transportation of dangerous goods.<br>Chemicals stored and handled as part of construction activities will be managed in accordance with:<br>▪ The Work Health Safety Act 2011 (Qld) and Regulation<br>▪ AS 2187:1998 *Explosives – storage, transport and use*<br>▪ AS 1940:2017 *Storage and Handling of Flammable and Combustible Liquids*<br>▪ AS 3780:2008 *The Storage and Handling of Corrosive Substances*<br>▪ The requirements of chemical safety data sheets<br>▪ Any relevant ERA conditions.<br>Procedures will be established for safe and effective fuel, oil and chemical storage and handling. This includes storing these materials within roofed, bunded areas. The bunding will have floors and walls that are lined with an impermeable material to prevent leaching and spills.<br>Construction tasks will be scheduled to avoid, where possible, bulk earthwork activities within the 1% AEP during periods of elevated flood risk. Where works cannot be scheduled outside of this time period, activity-specific flood readiness and response planning will be required. This planning will be developed in consultation with the relevant local government and Queensland Fire and Emergency Services.<br>Laydown areas and other construction facilities that are located within the 1% AEP will be temporary. Their planning and function in supporting construction will reflect the local flood risk. For example, hazardous goods will not be bulk stored in these locations.<br>Mobile plant will not be stored in the 1% AEP when not scheduled to be in use for construction purposes.<br>Plant maintenance and refuelling will be carried out with appropriate interception measures in place to avoid impacts to waterways and aquatic habitats. The buffer distances are based on regulated vegetation watercourse buffers distances for non-coastal and coastal bioregions, respectively.<br>Appropriate spill control materials including booms and absorbent materials will be onsite at refuelling facilities at all times.<br>Appropriate waste bins will be located in laydown areas to facilitate segregation and appropriate containment of waste materials. |
| | Construction water | The extraction of water will occur in accordance with licenses, approvals and/or agreements.<br>Volume monitoring during extraction will be required for each source point, with extraction logs maintained.<br>Extraction reporting will occur, as required, in accordance with requirements of relevant licenses, approvals and/or agreements obtained to cover this activity. |
| | Waterways | Maintenance activities and refuelling will be carried out at an appropriate distance from riparian vegetation and waterways, with appropriate measures in place to avoid impacts to surface water quality. Where this is not achievable due to type of activities (e.g. piling activities within a riparian zone), additional mitigation measures must be implemented to prevent impacts on water quality. |

| Delivery phase | Aspect | Proposed mitigation measures |
|---|---|---|
| Operation | Water quality | Operational tunnel dewatering into the Western Creek sub-catchment will be required to meet the established water quality objectives (or interim water quality guidelines) for receiving waterways before being released/discharged into local waterways. Water that does not comply with relevant water quality objectives will either be:<br>▪ Treated on-site to enable discharge<br>▪ Removed from site for disposal at an appropriately licensed facility.<br>The effectiveness of permanent erosion controls (e.g. scour protection or vegetated swales) will be monitored as part of the maintenance inspection schedule for the Project, as prescribed in the Operation EMP:<br>▪ Controls that are found to be failing or not performing as intended will either be modified or replaced, as required<br>▪ Vegetation on the rail embankment slopes will be maintained to prevent slope face degradation.<br>Maintenance of surface and subsurface drains will be required to ensure continued effectiveness and to minimise risk of impact to surrounding and downstream environments and structures. |
| | Hydrology and Flooding | Inspections will be carried out of cross-drainage structures in accordance with ARTC's *Structures Inspection Engineering Code of Practice* (ETE-09-01) to identify defects and conditions that may affect waterway and drainage system capacity or indicate increased risk of flooding such as:<br>▪ Scour<br>▪ Blockages due to debris build up<br>▪ Indication of floods overtopping a structure<br>▪ Culvert or drain damage or collapse. |

## 8.3 Management framework

The management frameworks described in this section will be developed during detailed design with implementation under pre-construction/construction phase and continuation into operation as required.

### 8.3.1 Runoff and discharge

Under the surface water monitoring framework to be developed, discharge and runoff will be monitored as part of the surface water monitoring required for the CEMP. It will identify monitoring locations at discharge points, and selected locations in waterways where works are being undertaken.

Particular discharge and runoff management will be required for the release of collected water from within the tunnel infrastructure and will require specific management in regard to release into receiving waters. As discharge will likely involve a drainage feature proximal to the western tunnel portal, specific management of the hydrological regime of release will be required, in the form of periods of water/dewatering releases into the drainage feature to minimise a change in hydrological regime and ecological processes.

In the event that WQOs cannot be achieved for receiving waters, alternate treatment/disposal options as adaptive management actions (i.e. disposal options in line with potential down-time of water treatment plant) are to be implemented in accordance with any relevant and applicable condition of approval or legislation and regulations in place.

### 8.3.2 Tunnel dewatering treatment

Water quality characteristics of groundwater tunnel drainage are expected to generally meet (EPP (Water and Wetland Biodiversity)) discharge criteria as regional WQOs for Western Creek. Further assessment will be required during the detailed design phase. This water will likely be processed through a WTP and include hydrocarbon and first flush separation before being released to Western Creek. The discharged water will be expected to meet the WQOs for the protection of aquatic ecosystems of Western Creek (under Schedule 1 of the EPP (Water and Wetland Biodiversity)) (refer Section 3.2.4).

A typical water treatment plant is proposed as the base design for consideration as part of the disturbance footprint and power consumption requirements. Particular discharge and runoff management will be required for the release of collected water from within the tunnel infrastructure. Specific management will be required in regard to release into receiving waters.

The water treatment facilities that may be required could include:

- Screening treatment
- Detention tanks
- Aeration/flocculation tanks
- Chemical treatment
- Water pumping facilities
- Sludge storage.

As discharge will likely involve a drainage feature (as an overland flow route to Western Creek) proximal to the western portal, specific management of the hydrological regime of release will be required. This is expected in the form of periods of water/dewatering releases into the drainage feature (an overland flow path under Water Act) to minimise a change in hydrological regime and ecological processes.

The collected water (long-term inflow currently estimated approximately 0.54 L/s) will be required to meet the WQOs for Western Creek (refer Table 3.3) and will likely require processing through a WTP include hydrocarbon separation.

Water from the WTP may require further pre-discharge to meet WQOs, as the water may become overtreated. To mitigate significant impact on the receiving waters, discharge will need to be monitored to ensure discharge does not result in the release of over-cleaned (water that is not representative of localised water quality parameters under WQO), treated water into the receiving waters.

Short-term inflows during construction were estimated to be in the order of 0.6 L/s with a maximum total short-term inflow rate of 2.56 L/s for the tunnel during construction with potentially higher flow rates over short durations (i.e. weeks to months) where locally higher permeability features are encountered will also need to meet adopted WQOs.

Water collection and treatment requirements will be confirmed during detailed design.

### 8.3.3 Surface water quality (receiving environment) monitoring recommendations

A Water Quality Monitoring Program (WQMP) (as part of the surface water sub-plan) is proposed to monitor the effectiveness of mitigation measures for surface water quality. This will be conducted prior to and throughout construction and decommissioning phases of the Project. During operations, it is expected the WQMP will be limited to monitoring discharge from the WTP into Western Creek.

The WQMP will be developed concurrently with the detailed CEMP and include:

- Identification of works and activities during construction and operation of the Project, including runoff, emergencies and spill events, that have the potential to impact on surface water quality of potentially affected waterways and riparian land (via discharge points)
- A risk management framework for evaluation of the risks to surface water quality and ecosystems in the receiving environment, including definition of impacts that trigger contingency and ameliorative measures
- The identification of environmental management measures relating to surface waters during construction, operation including erosion and sediment control and stormwater management measures
- The presentation of WQO trigger values, standards and parameters against which any changes to water quality will be assessed, having regard to the relevant water quality guidelines and ANZG 2018 guidelines –where alternate guidelines are used to establish water quality goals, justification for this will be provided
- Representative background monitoring data for surface water quality to establish baseline water conditions prior to the commencement of construction
- Identification of construction and operational phase surface water monitoring locations (if the EIS surface water monitoring locations are not continued) including waterways, waterbodies and wetlands, which are representative of the potential extent of impacts from the Project, including relevant analytes and frequency of monitoring –analytes are considered to be those relevant to identified impacts including turbidity, EC, hydrocarbons and dissolved metals
- Commitment to a monitoring period following the completion of construction or until the affected waterways and/or groundwater quality are certified by a suitably qualified and experienced independent professional as being rehabilitated to an acceptable condition, unless otherwise approved or directed by regulatory authorities – surface water quality during baseflow conditions that meet background monitoring and/or WQOs will confirm adequate rehabilitation
- The monitoring will also confirm the establishment of operational water control measures which will be identified as part of drainage during detailed design of the Project (such as vegetated buffer strips basins and vegetated swales)
- Contingency and ameliorative measures in the event that adverse impacts to water quality are identified, with reference to the impact triggers defined as part of the water quality monitoring program
- Surface water quality samples will be collected in accordance with industry-accepted standards and quality assured procedures, including the Queensland Monitoring and Sampling Manual (DES 2018a).

### 8.3.4 Salinity management

Salinity management (in regard to surface water quality) will be addressed by implementation of the Erosion and Sediment Control Plan and through characterisation of soil conditions across the water quality study area. This will be undertaken at a suitable scale in accordance with the CEMP prior to construction to inform design and environmental management measures. This includes identification of potential/actual acid sulfate soils, reactive soils, erosive soils, dispersive soils, saline soils, acidic soils, alkaline soils and contaminated land. The characterisation is considered to be used within the Erosion and Sediment Control Plan to identify problematic soils and assist the management of salinity during works and following the implementation of the Reinstatement and Rehabilitation Plan.

# 9 Significance assessment and mitigation measures

A significance assessment has been undertaken following the impact assessment framework (refer Sections 7 and 8). The significance impact assessment was generated using a conservative approach aligned with a conceptual model of projected impacts. This was coupled with all Project activities that may have a detrimental impact on the quality of surface water quality via proximal discharge points associated with the Project disturbance footprint.

The high sensitivity value of MNES and MSES associated environments (refer Section 5.11) within the Project have been assessed separately with the remainder of the Project environments in relation to water quality, resulting in two discrete sensitivity assessments (refer Table 9.1). To account for habitat disturbance to MNES through changes to water quality, the high sensitivity is linked to defined watercourses within the Lower Lockyer Creek sub-catchment and Western Creek sub-catchment

Impacts on water quality are based on a model of expected occurrences, regarding projected impacts (potential and specific) from Project activities. As such, critical failure of infrastructure is not considered a viable impact for impact significance assessment.

In summary, potential impacts from Project activities resulting in potential adverse effects on surface water quality included:

- Increased debris
- Changes to receiving water quality and hydrology
- Increase in salinity
- Increases in erosion and sedimentation
- Increase in contaminants
- Exacerbation of listed impacts above, from inadequate rehabilitation processes.

It is expected these categories may interface and have the capacity to compound existing or new impacts as they arise (e.g. increased erosion resulting in compounding effect of contaminant leachate and water chemistry changes).

Within Table 9.1, the specific impact (sectioned under the potential impact category) are assessed as a qualitative significance of impact with the design considerations (or initial mitigation) factored into the Project design.

Additional mitigation and management measures (*in situ* mitigation), including those listed in relevant sub-plans (refer Section 8), were then applied as appropriate to the phase of the Project to reduce the level of potential impact. These are documented under the heading proposed additional mitigations.

The residual significance of the potential impacts was then reassessed after mitigation and management measures were applied. The initial significance levels were compared to the residual significance levels to assess the effectiveness of the mitigation and management measures.

**Table 9.1 Significant assessment including mitigation measures relevant to surface water quality**

| Aspect | Potential impact | Specific impact | Phase | Sensitivity | Initial impact significance[1] | | Residual impact significance of risk[2] | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Magnitude | Significance | Magnitude | Significance |
| Erosion and sediment control | Increased debris | Contamination of waterway from debris from the Project to be blown into or washed into waterway | Pre-construction and construction | Moderate | Low | Low | Negligible | Low |
| | | | Operation | | | | | |
| | | | Pre-construction and construction | High[3] | Low | Moderate | Negligible | Low |
| | | | Operation | | | | | |
| | | Restriction of flow within the waterways if too much debris is introduced to waterway or is stuck in culverts or creek crossings | Pre-construction and construction | Moderate | Moderate | Moderate | Negligible | Low |
| | | | Operation | | | | | |
| | | | Pre-construction and construction | High[3] | Moderate | High | Negligible | Low |
| | | | Operation | | | | | |
| Water quality<br>Waterways | Changes to receiving water quality and hydrology | Routine tunnel dewatering operations resulting in a reduction of receiving water quality and changes to hydrological regimes specific to tributary of Western Creek | Pre-construction and construction | Moderate | Major | High | Negligible | Low |
| | | | Operation | | | | | |
| | | Diversion of overland flow influencing local hydrological regime and subsequent water quality specific to tributary of Laidley Creek | Pre-construction and construction | Moderate | Moderate | Moderate | Low | Low |
| | | | Operation | | | | | |
| | | Diversion of overland flow influencing local hydrological regime and subsequent water quality specific to tributaries of Western Creek | Pre-construction and construction | Moderate | Moderate | Moderate | Low | Low |
| | | | Operation | | | | | |
| | | Changes to receiving water quality from dewatering of artificial waterbodies | Pre-construction and construction | Moderate | Low | Low | Low | Low |
| | | | Pre-construction and construction | High[3] | Low | Moderate | Low | Low |
| Erosion and sediment control<br>Water quality | Increase in salinity | Increased salinity in proximal watercourses from land disturbance | Pre-construction and construction | Moderate | High | High | Negligible | Low |
| | | | | High[3] | High | Major | Negligible | Low |

| Aspect | Potential impact | Specific impact | Phase | Sensitivity | Initial impact significance[1] | | Residual impact significance of risk[2] | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Magnitude | Significance | Magnitude | Significance |
| Erosion and sediment control<br>General interference with existing surface water | Increases in erosion and sedimentation | Disturbance of the bed, banks and riparian zone of waterways | Pre-construction and construction | Moderate | High | High | Negligible | Low |
| | | | Operation | | Moderate | Moderate | Negligible | Low |
| | | | Pre-construction and construction | High[3] | High | Major | Negligible | Low |
| | | | Operation | | Moderate | High | Negligible | Low |
| | | Increased turbidity and sedimentation; and potential mobilisation of contaminants through erosion from disturbance activities near waterways | Pre-construction and construction | Moderate | High | High | Negligible | Low |
| | | | Operation | | Moderate | Moderate | Negligible | Low |
| | | | Pre-construction and construction | High[3] | High | Major | Negligible | Low |
| | | | Operation | | Moderate | High | Negligible | Low |
| | | Increased turbidity and potential mobilisation of contaminants from stockpiled areas | Pre-construction and construction | Moderate | Moderate | Moderate | Negligible | Low |
| | | | Pre-construction and construction | High[3] | Moderate | High | Negligible | Low |
| | | Increased turbidity and potential mobilisation of contaminants from dewatering activities near excavations | Pre-construction and construction | Moderate | Moderate | Moderate | Negligible | Low |
| | | | Pre-construction and construction | High[3] | Moderate | High | Negligible | Low |
| | | Increased sedimentation can impact the function of culverts/creek crossing and impede flow of the waterway | Pre-construction and construction | Moderate | Moderate | Moderate | Negligible | Low |
| | | | Operation | | Low | Low | Negligible | Low |
| | | | Pre-construction and construction | High[3] | Moderate | High | Negligible | Low |
| | | | Operation | | Low | Moderate | Negligible | Low |
| Erosion and sediment control<br>Water quality<br>Waterways | Increase in contaminants | Contamination of waterway from inadequate storage of fuels, oils and contaminants | Pre-construction and construction | Moderate | Low | Low | Negligible | Low |
| | | | Operation | | | | | |
| | | | Pre-construction and construction | High[3] | Low | Moderate | Negligible | Low |
| | | | Operation | | | | | |
| | | Runoff from areas of disturbed contaminated lands nearby waterways | Pre-construction and construction | Moderate | Low | Low | Negligible | Low |
| | | | Pre-construction and construction | High[3] | Low | Moderate | Negligible | Low |

| Aspect | Potential impact | Specific impact | Phase | Sensitivity | Initial impact significance[1] | | Residual impact significance of risk[2] | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Magnitude | Significance | Magnitude | Significance |
| | | Introduction of contaminants from stockpiled areas | Pre-construction and construction | Moderate | Low | Low | Negligible | Low |
| | | | Pre-construction and construction | High[3] | Low | Moderate | Negligible | Low |
| | | Contaminants can enter waterways after rainfall events from rolling stock or after weed control activities | Operation | Moderate | Moderate | Moderate | Negligible | Low |
| | | | Operation | High[3] | Moderate | High | Negligible | Low |
| | | Potential contamination of waterways from failed equipment or from failed infrastructure | Pre-construction and construction | Moderate | Moderate | Moderate | Negligible | Low |
| | | | Operation | | | | | |
| | | | Pre-construction and construction | High[3] | Moderate | High | Negligible | Low |
| | | | Operation | | | | | |
| Erosion and sediment control | Exacerbation of listed impacts above, from inadequate rehabilitation processes | Potential for sedimentation and increased turbidity within waterways if areas are either not rehabilitated or inadequate rehabilitation occurs | Pre-construction and construction | Moderate | Moderate | Moderate | Negligible | Low |
| | | | Operation | | | | | |
| | | | Pre-construction and construction | High[3] | Moderate | High | Negligible | Low |
| | | | Operation | | | | | |
| | | Inadequate rehabilitation increasing erosion and sedimentation within waterways impacting the function of culverts/creek crossing and impeding flow of the waterway | Pre-construction and construction | Moderate | Moderate | Moderate | Negligible | Low |
| | | | Operation | | | | | |
| | | | Pre-construction and construction | High[3] | Moderate | High | Negligible | Low |
| | | | Operation | | | | | |

**Table notes:**

1 Includes implementation of design mitigation specified in Section 8.1

2 Includes proposed mitigation measures specified in Section 8.2

3 Defined watercourses of Lower Lockyer Creek and Western Creek sub catchments: Lockyer Creek and Western Creek

# 10 Cumulative impacts

Cumulative impacts were assessed using the methodology identified in Section 4.3, incorporating the projects depicted in Figure 4.2 and Table 10.1. The cumulative impacts of multiple projects occurring in the vicinity of the water quality study area may contribute to impacts to water quality if not managed appropriately. The majority of potential impacts identified as a result of the Project are common to all projects throughout the region and are therefore cumulative in nature. Two projects have been identified within the cumulative impact area of influence (refer Section 4.3), which are either currently underway or are going through the EIS process, all of which will likely result in some extent of:

- Riparian vegetation loss from vegetation clearing/removal
- Potential impacts to aquatic fauna species both through impacts to water quality and barrier works
- Displacement of flora and fauna species from invasion of weed and pest species
- Reduction in the connectivity of waterways
- Increase in erosion and sedimentation in the waterways
- Increase in litter (waste)
- Saline discharge into proximal waterways.
- Increase in surface salinity around alluvial waterways (refer Table 10.2).

Of the list of potential projects, the projects assessed for the CIA are typically major infrastructure or primary industry operations. Of the seven potential interacting projects, the following were identified to have the highest potential for cumulative impact:

- Inland Rail Project - Gowrie to Helidon
- Inland Rail Project - Calvert to Kagaru.

All of these projects are subject to environmental controls either through EIS assessment processes, operational licences such as an Environmental Authority under the EP Act or through the implementation of detailed environmental management plans. Noting that proximal projects within the cumulative area of influence have been assessed as operating/constructing as ‘business-as-usual’ (i.e. likelihood of occurrence of impact with standard operating procedures), the CIA was compiled with the consideration of other projects abiding by environmental authorities and specified conditions of approval.

The results of the significance assessment of these cumulative impacts are presented in Table 10.3. Following consideration of the probability of impact, duration of impact, magnitude of impact and sensitivity of the receiving environment, the significance has been assessed to be low in terms of significant risk rating.

Table 10.1 Projects considered within the cumulative assessment

| Project and proponent | Location | Description | Assessment status | Construction dates | Construction jobs | Operation years | Operation jobs | Relationship to the Project |
|---|---|---|---|---|---|---|---|---|
| Gowrie to Helidon (ARTC) | Rail alignment from Gowrie to Helidon | 26 km single-track dual-gauge freight railway as part of the ARTC Inland Rail Program | Draft EIS being prepared by ARTC | 2021 – 2026 | 1,800 | >50 years | 20 | Potential overlap of construction for the Project and G2H |
| Calvert to Kagaru (ARTC) | Rail alignment from Calvert to Kagaru | 53 km single-track dual-gauge freight railway as part of the ARTC Inland Rail Project | Draft EIS being prepared by ARTC | 2021 – 2026 | 1,600 | >50 years | 20 | Potential overlap of construction for the Project and C2K |
| Bromelton State Development Area (SDA) | Bromelton, Qld | Delivery of critical infrastructure within the Bromelton SDA will support future development and economic growth. This includes a trunk water main and the Beaudesert Town Centre Bypass. This infrastructure provides opportunities to build on the momentum of current development activities by major landowners in the SDA. | Scheme created in 2012.<br>Approved by Governor in Council, December 2017 | 2016 - 2031 | - | - | - | Ongoing development approximately 55 km at the Bromelton SDA may compete for construction resources. There may also be an increase in heavy vehicles using the surrounding highways |
| Ipswich Motorway Upgrade Rocklea to Darra (remaining sections) | Western Brisbane, Qld | Addressing of congestion and extensive delays in the Ipswich Motorway corridor by a range of road upgrades along 7 km of Ipswich Motorway between Rocklea and Darra. | Project listen on Queensland Infrastructure Initiative List – EIS not yet initiated | 2016/17 to 2020-2021 | TBA | TBA | TBA | Construction periods may overlap resulting in competition for construction resources and increased traffic on surrounding highways |
| RAAF Base Amberley future works | RAAF Base Amberley | White paper dedicated future upgrades to RAAF Base Amberley at a cost of $1 B | N/A | 2016 - 2022 | 7,000 | - | TBA | Ongoing development at RAAF Base Amberley may see increase in road traffic with heavy vehicles and further increase as the Project construction occurs |
| Gatton West Industrial Zone (GWIZ) | 3 km north west Gatton | Industrial development including a transport and logistics hub on the Warrego Highway | N/A | 2019-2024 | 13.5FTE |  | TBA | May increase road traffic and increase need for rail resources |

| Project and proponent | Location | Description | Assessment status | Construction dates | Construction jobs | Operation years | Operation jobs | Relationship to the Project |
|---|---|---|---|---|---|---|---|---|
| InterlinkSQ | 13 km west of Toowoomba | 200 ha of new transport, logistics and business hub. Located on the narrow-gauge regional rail network and interstate network. Located at the junction of the Gore, Warrego and New England Highways. |  | 2017-2037 |  |  | 1500 | Ongoing development could compete for of construction resources. There may also be an increase of heavy vehicles using the surrounding highways |

### Table 10.2 Potential cumulative water quality impacts

| Potential Cumulative Impact | Gowrie to Helidon (ARTC)<br>Calvert to Kagaru (ARTC) |
|---|---|
| Riparian vegetation loss from vegetation clearing/removal | Potential overlapping loss of sensitive receptor (riparian vegetation communities) with works involving watercourse and associated crossings. Impact may be compounded with interface between current Project and other listed Projects in regard to decreased resilience to biotic and abiotic factors. Potential consequence involves loss of bank stability, loss of diversity and consequential reduction in water quality values due to decreased performance of localised 'whole-system'. |
| Potential impacts to aquatic fauna species both through impacts to water quality and barrier works | Potential for cumulative downstream impacts (from overlapping Projects – in regard to watercourses flowing within and between Projects) from water quality issues associated with overland works and waterway barrier works. Cumulative impacts would be expected to occur in relatively short spatial distances (as cumulative point -source impacts) and would be expected to 'dilute' with increasing distance downstream from point source impact. |
| Displacement of flora and fauna species from invasion of weed and pest species | Potential for significant cumulative impacts between Projects, with increasing risk associated with impact occurring on single watercourse (sub-catchment). Displacement from invasive species will result in further impact on aquatic water quality values downstream. Limited spatial interface between Projects is not considered to be an inherent mitigating factor in regard to this impact, as cumulative impact will be increased (specifically in regard to proliferation of invasive flora downstream of impact) with each progressive source of impact associated with these Projects. |
| Reduction in the connectivity of waterways | Potential for impact to be realised with improper work practices associated with waterway crossings, with progressive accumulation of impact between each Project. Whole catchment may be impacted from separate Projects on separate watercourses, however the greatest cumulative impacts would be expected with spatial interface between separate Projects. Water quality degradation likely from impediment of waterway connectivity with associated decrease in ecosystem resilience. |
| Increase in erosion and sedimentation in the waterways | Potential of cumulative impact of watercourse sedimentation increase from simultaneous activities within hydrological catchments (particularly de-watering activities and stockpiling of spoil/resources). Cumulative impacts in regard to erosion may arise from impaction of watercourse structure/hydrological regimes and may be further impacted by cumulative impacts on riparian vegetation loss. Cumulative impact is expected to gain in potential and magnitude with downstream movement of impact, particularly in regard to erosive process and associated sedimentation impacts on hydrological regime change, increasing further impacts. |
| Increase in litter (waste) | Potential for cumulative impact from waste on water quality issues, in regard to contamination of watercourse from in-blow or direct deposition of waste into watercourses. Expectation of cumulative impacts associated with similar hydrological catchments (primarily sub-catchments) with greatest potential for cumulative impact with spatial interface between Projects. Expectation of reduced environmental resilience with increasing waste load and waste type within watercourses. |
| Saline discharge into proximal waterways | Overlapping construction activities related to high salinity risk rating area within the disturbance footprint with potential for poor erosion and sediment control management to increase potential of erosive sodosol discharge. Limited spatial difference between the Projects increases potential cumulative impact. |
| Increase in surface salinity around alluvial waterways | Overlapping construction activities in regard to clearing of vegetation within alluvial-based watercourses increases potential of highly-localised groundwater rise and salinity risk during high-rainfall events. Limited spatial difference between the Projects increases potential cumulative impact. |

**Table 10.3 Summary of cumulative impact assessment**

| Cumulative impact | Phase | Relevance factor of aspects | | | | Sum of relevance factors | Impact significance |
|---|---|---|---|---|---|---|---|
| | | Probability | Magnitude | Duration | Sensitivity | | |
| Riparian vegetation loss from vegetation clearing/removal | Construction | 2 | 1 | 2 | 2 | 7 | Medium |
| | Operations | 1 | 1 | 1 | | 5 | Low |
| | Decommissioning | 1 | 1 | 1 | | 5 | Low |
| Potential impacts to aquatic fauna species both through impacts to water quality and barrier works | Construction | 1 | 1 | 2 | 2 | 6 | Low |
| | Operations | 1 | 1 | 2 | | 6 | Low |
| | Decommissioning | 1 | 1 | 2 | | 6 | Low |
| Displacement of flora and fauna species from invasion of weed and pest species | Construction | 1 | 1 | 2 | 2 | 6 | Low |
| | Operations | 1 | 1 | 2 | | 6 | Low |
| | Decommissioning | 1 | 1 | 2 | | 6 | Low |
| Reduction in the connectivity of waterways | Construction | 1 | 1 | 2 | 2 | 6 | Low |
| | Operations | 1 | 1 | 2 | | 6 | Low |
| | Decommissioning | 1 | 1 | 2 | | 6 | Low |
| Increase in erosion and sedimentation in the waterways | Construction | 1 | 1 | 2 | 2 | 6 | Low |
| | Operations | 1 | 1 | 2 | | 6 | Low |
| | Decommissioning | 1 | 1 | 2 | | 6 | Low |
| Increase in litter (waste) | Construction | 1 | 1 | 1 | 2 | 5 | Low |
| | Operations | 1 | 1 | 1 | | 5 | Low |
| | Decommissioning | 1 | 1 | 1 | | 5 | Low |
| Saline discharge into proximal watercourses | Construction | 1 | 1 | 2 | 2 | 6 | Low |
| | Operations | 1 | 2 | 1 | | 6 | Low |
| | Decommissioning | 1 | 2 | 1 | | 6 | Low |

| Cumulative impact | Phase | Relevance factor of aspects | | | | Sum of relevance factors | Impact significance |
|---|---|---|---|---|---|---|---|
| | | Probability | Magnitude | Duration | Sensitivity | | |
| Increase in surface salinity around alluvial watercourses | Construction | 1 | 1 | 2 | 2 | 6 | Low |
| | Operations | 1 | 1 | 2 | | 6 | Low |
| | Decommissioning | 1 | 1 | 2 | | 6 | Low |

**Table notes:**

1. Table 4.10 defines the consequences of the impact significance ratings, as follows:
   **Low** (sum of relevance factors = 1 to 5): Negative impacts need to be managed by standard environmental management practices. Special conditions unlikely to be necessary. Monitoring to be part of general Project monitoring program
   **Medium** (sum of relevance factors = 6 to 9): Mitigation measure likely to be necessary and specific management practices to be applied. Specific conditions are likely. Targeted monitoring program required
   **High** (sum of relevance factors = 10 to 12): Alternative actions will be considered and/or mitigation measures applied to demonstrate improvement. Specific conditions expected to be required. Targeted monitoring program necessary.

# 11 Conclusions

The water quality study area covers the Bremer River and Lockyer Creek catchments, with several sub-catchments intersecting the Project disturbance footprint. Historic and field assessed water quality was identified as not currently meeting all WQOs for the protection of aquatic ecosystems, within each catchment.

The surface water quality assessment addressed a range of surface water resource ToR. These included ToR relating to existing environment (11.36 to 11.39), impact assessment (11.41 to 11.46), mitigation measures (11.47 to 11.51) and water resource impact assessment (11.52 to 11.53, 11.58 to 11.63, 11.166 and 11.167).

All waterways within the water quality study area have been identified as sensitive receptors within the receiving environment, which have the potential to be subject to significant impacts. These were nominated as moderate water quality receptors for:

- Identification of potential impacts
- Associated mitigation measures and
- Identification of residual impact after implementation of mitigation.

All waterways within the water quality study area were nominated as moderate sensitivity water quality receptors, with the exception of the Upper Lockyer Creek and Western Creek sub catchments: Lockyer Creek and Western Creek which were identified as highly sensitive water quality receptors due to the potential presence of MNES species. Due to the moderate and high sensitivity of the water quality receptors within the water quality study area, significance of impact was assessed against these criteria.

A significance assessment was undertaken and assessed the residual impact of identified potential impacts after assessment of design considerations and additional mitigation measures. The assessment identified:

- During the construction phase, the combination of design considerations and mitigation measures relevant to surface water quality would be sufficient to mitigate potential impacts, such that the residual significance would be low
- For the operational phase, the combination of design considerations and mitigation measures relevant to surface water quality would be sufficient to mitigate potential impacts, such that the residual significance would be low.

The significant impact assessment has identified that with design considerations and mitigation measures in place, the risk of significance of impact from construction (including pre-construction), operation and decommissioning phase activities is low. It is not expected that significant residual impacts on surface water quality will occur as a result of the Project.

A cumulative impact assessment considering the impact of other Projects was considered. The cumulative impacts of several projects within the water quality study area included: riparian vegetation loss from vegetation clearing/removal, potential impacts to aquatic fauna species both through impacts to water quality and barrier works, displacement of flora and fauna species from invasion of weed and pest species, reduction in the connectivity of waterways, an increase in erosion and sedimentation in the waterways, an increase in litter (waste), saline discharge into proximal waterways and an increase in surface salinity around alluvial waterways.

The cumulative impact assessment identified a medium risk of potential impact occurring during construction phase activities through riparian vegetation loss from vegetation clearing/removal. The riparian vegetation loss was considered to have potential to impact water quality through erosion and sedimentation. It is considered that mitigation measures are likely to be necessary and specific management practices to be applied.

This assessment has identified a potential cumulative impact on water quality from riparian vegetation loss. Overall potential surface water quality impacts during the construction and operation phase can be managed to a low residual risk level using the proposed design and mitigation measures.

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# APPENDIX

# L

# Surface Water Quality Technical Report

## Appendix A Surface Water Quality Monitoring Equipment Calibration Certificates

**HELIDON TO CALVERT** ENVIRONMENTAL IMPACT STATEMENT

*AirMet Scientific P/L*
*7-11 Ceylon Street*
*Nunawading*
*Victoria 3131, Australia*

# Calibration Certificate

*This document hereby certifies that this instrument detailed has been calibrated to the parameters listed below.*

*Certificate Print Date:* 8 August, 2018
*Calibration Date:* 7 August, 2018
*Next Calibration Due:* 7 February, 2019

**Call ID: 00221210**

*Job / SO Number: 232072*

**Customer:** Aurecon Australia Pty Ltd
**Type:** Water Meter
**Model:** WATERMETER
**Serial No:** 10C101386
**Description:** Generic water meter

| Sensor | Serial No | Standard Solutions | Certified | Solution # (Bottle #) | Instrument Reading | Units |
|---|---|---|---|---|---|---|
| Ph | | Rowe Scientific Ph4 | NIST | 307927 | | Ph |
| Ph | | Rowe Scientific Ph7 | NIST | 307928 | | Ph |
| Dissolved Oxygen | | Air | NIST | N/A | | % |
| Dissolved Oxygen | | Sodium Sulphite | NIST | 5253 | | % |
| EC | | Electro solution | NIST | 304153 | | ms |
| Redox | | Zobell 231 | NIST | 311901/311902 | | mV |
| | | | | | | |

**Completed by:** *Sen Philip* **Signed:** SenPhilip

Australian Standard Alarm Levels ☐

*AirMet Scientific P/L*
*7-11 Ceylon Street*
*Nunawading*
*Victoria 3131, Australia*

# Calibration Certificate

*This document hereby certifies that this instrument detailed has been calibrated to the parameters listed below.*

*Certificate Print Date:* 20 February, 2018
*Calibration Date:* 20 February, 2018
*Next Calibration Due:* 20 August, 2018

**Call ID: 00215089**

*Job / SO Number: 228942.*

**Customer:** Aurecon Aust Pty Ltd

**Type:** Water Meter

**Model:** WATERMETER

**Serial No:** U7602

**Description:** TPS WP88

| Sensor | Serial No | Standard Solutions | Certified | Solution # (Bottle #) | Instrument Reading | Units |
|---|---|---|---|---|---|---|
| Turbidity | | Distilled Water | NIST | N/A | 0.00 | NTU |
| Turbidity | | 50NTU Turbidity Solu | NIST | NH1310 | 50 | NTU |
| Turbidity | | 360NTU Turbidity Sol | NIST | 305542 | 360 | NTU |
| | | | | | | |
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| | | | | | | |

**Completed by:** *Daniel Crampsie*

**Signed:**

Australian Standard Alarm Levels ☐

*AirMet Scientific P/L*
*7-11 Ceylon Street*
*Nunawading*
*Victoria 3131, Australia*

# Calibration Certificate

*This document hereby certifies that this instrument detailed has been calibrated to the parameters listed below.*

*Certificate Print Date:* 15 September, 2017
*Calibration Date:* 15 September, 2017
*Next Calibration Due:* 15 March, 2018

**Call ID: 00210490**

*Job / SO Number:*

**Customer:** Aurecon Aust Pty Ltd
**Type:** Water Meter
**Model:** WATERMETER
**Serial No:** U7602
**Description:** TPS WP88

| Sensor | Serial No | Standard Solutions | Certified | Solution # (Bottle #) | Instrument Reading | Units |
|---|---|---|---|---|---|---|
| Turbidity | | Distilled Water | NIST | N/A | 0.0 | NTU |
| Turbidity | | 50NTU Turbidity Sol | NIST | NH1310 | 50 | NTU |
| Turbidity | | 360NTU Turbidity Sol | NIST | 305542 | 360 | NTU |
| | | | | | | |
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**Completed by:** *Daniel Crampsie*
**Signed:**

Australian Standard Alarm Levels ☐

AirMet Scientific P/L
7-11 Ceylon Street
Nunawading
Victoria 3131, Australia

# Calibration Certificate

*This document hereby certifies that this instrument detailed has been calibrated to the parameters listed below.*

*Certificate Print Date:* 8 August, 2018
*Calibration Date:* 7 August, 2018
*Next Calibration Due:* 7 February, 2019

**Call ID: 00221211**

*Job / SO Number: 232072*

**Customer:** Aurecon Aust Pty Ltd
**Type:** Water Meter
**Model:** WATERMETER
**Serial No:** U7602
**Description:** TPS WP88

| Sensor | Serial No | Standard Solutions | Certified | Solution # (Bottle #) | Instrument Reading | Units |
|---|---|---|---|---|---|---|
| Turbidity | | Distilled Water | NIST | N/A | 0.0 | NTU |
| Turbidity | | 100NTU Turbidity Sol | NIST | 322306 | 100 | NTU |
| Turbidity | | 360NTU Turbidity Sol | NIST | 305542 | 360 | NTU |
| | | | | | | |
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| | | | | | | |

**Completed by:** *Sen Philip*
**Signed:** SenPhilip

Australian Standard Alarm Levels ☐

*AirMet Scientific P/L*
*7-11 Ceylon Street*
*Nunawading*
*Victoria 3131, Australia*

# Calibration Certificate

*This document hereby certifies that this instrument detailed has been calibrated to the parameters listed below.*

*Certificate Print Date:* 20 February, 2018
*Calibration Date:* 20 February, 2018
*Next Calibration Due:* 20 August, 2018

**Call ID:** **00215092**

*Job / SO Number:*

**Customer:** Aurecon Australia Pty Ltd
**Type:** Water Meter
**Model:** WATERMETER
**Serial No:** 10C101386
**Description:** Generic water meter

| Sensor | Serial No | Standard Solutions | Certified | Solution # (Bottle #) | Instrument Reading | Units |
|---|---|---|---|---|---|---|
| Ph | | Rowe Scientific Ph4 | NIST | 307927 | 4.00 | Ph |
| Ph | | Rowe Scientific Ph7 | NIST | 307928 | 7.00 | Ph |
| Dissolved Oxygen | | Do Solution | NIST | 5253 | 0.00 | % |
| Dissolved Oxygen | | Air | NIST | AIR | 100 | % |
| EC | | Electro solution | NIST | 304153 | 2655 | ms |
| Redox | | Zobell 231 | NIST | 300321, 311902 | 233 | mV |
| | | | | | | |

**Completed by:** *Daniel Crampsie*
**Signed:**

Australian Standard Alarm Levels ☐

*AirMet Scientific P/L*
*7-11 Ceylon Street*
*Nunawading*
*Victoria 3131, Australia*

# Calibration Certificate

*This document hereby certifies that this instrument detailed has been calibrated to the parameters listed below.*

*Certificate Print Date:* 15 September, 2017
*Calibration Date:* 15 September, 2017
*Next Calibration Due:* 15 March, 2018

**Call ID: 00210491**

*Job / SO Number: 226343.*

| | | | |
|---|---|---|---|
| **Customer:** | Aurecon Australia Pty Ltd | **Type:** | Water Meter |
| **Model:** | WATERMETER | **Serial No:** | 10C101386 |
| **Description:** | Generic water meter | | |

| Sensor | Serial No | Standard Solutions | Certified | Solution # (Bottle #) | Instrument Reading | Units |
|---|---|---|---|---|---|---|
| Ph | | Rowe Scientific Ph4 | NIST | 299742 | 4.00 | Ph |
| Ph | | Rowe Scientific Ph7 | NIST | 295218 | 7.00 | Ph |
| Dissolved Oxygen | | Air | NIST | N/A | 100 | % |
| Dissolved Oxygen | | Sodium Sulphite | NIST | 4955 | 0.00 | % |
| EC | | Electro solution | NIST | 300739 | 2444 | ms |
| Redox | | Zobell 231 | NIST | 298242, 295477 | 242 | mV |
| | | | | | | |

**Completed by:** *Daniel Crampsie* **Signed:**

Australian Standard Alarm Levels ☐

airmet
Work with Confidence

# Calibration Certificate

AirMet Scientific P/L
51 Ross Street (via
Durong Street)
Newstead
QLD 4006, Australia
Tel: 07 3220 8600
Fax: 07 3220 8686

*This document certifies that the instrument detailed has been calibrated to the parameters*

Certificate Print Date: 21-Feb-2019
Calibration Date: 20-Feb-2019
Next Calibration Due: 19-Aug-2019
Call ID: 235490
Job Number: S2354900002

**Customer:** Aurecon Australia Pty Ltd-ID 403401
**Serial No:** U0529
**Description:** TPS WP-88 Turbidity Meter

## Calibration Summary

**Frequency:** 180 Days
**Temp:** 24°C
**Humidity:** 60%
**As Found:** Out of Tolerance
**Certificate:** S2354900002
**Result:** Pass

| | As Found | | As Left (Cal Status) | |
|---|---|---|---|---|
| **Desc** | **Actual** | **Result** | **Actual** | **Result** |
| 0 NTU | 1.5 | Fail | 0.0 | Pass |
| 100 NTU | 97.0 | Fail | 100.0 | Pass |
| 1000 NTU | 995.0 | Fail | 1000.0 | Pass |

**Standard Used**

| Equip ID | Description | Valid Until | Cert |
|---|---|---|---|
| 330217 | 1000NTU Turbidity | 01/06/2019 | |
| 322306 | Turbidity: 100 NTU Standard Turbidity Solution | 29/11/2019 | |

**Completed By:** Sen Philip

**Signed:** Sen Philip

airmet
Work with Confidence

AirMet Scientific P/L
51 Ross Street (via
Durong Street)
Newstead
QLD 4006, Australia
Tel: 07 3220 8600
Fax: 07 3220 8686

# Calibration Certificate

*This document certifies that the instrument detailed has been calibrated to the parameters*

| | | | |
|---|---|---|---|
| Certificate Print Date: | 21-Feb-2019 | Call ID: | 235490 |
| Calibration Date: | 20-Feb-2019 | Job Number: | S2354900001 |
| Next Calibration Due: | 19-Aug-2019 | | |

**Customer:** Aurecon Australia Pty Ltd-ID 403401 **Serial No:** 10C101386

**Description:** Watermeter

## Calibration Summary

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Frequency:** | 180 Days | **Temp:** | 24°C | **As Found:** | Out of Tolerance | **Result:** | Pass |
| | | **Humidity:** | 60% | **Certificate:** | S2354900001 | | |

| | As Found | | As Left (Cal Status) | |
|---|---|---|---|---|
| **Desc** | **Actual** | **Result** | **Actual** | **Result** |
| DO Zero | 0.4 | Pass | 0.0 | Pass |
| DO 100% | 92.0 | Fail | 100.0 | Pass |
| EC @22 ˚C | 2900.0 | Fail | 2602.0 | Pass |
| ORP @ 22˚C | 235.6 | Pass | 236.0 | Pass |
| pH 7 | 7.16 | Pass | 7.0 | Pass |
| pH 4 | 4.14 | Pass | 4.0 | Pass |

**Standard Used**

| Equip ID | Description | Valid Until | Cert |
|---|---|---|---|
| 322349 | Conductivity (2760 us/cm @ 25 deg) | 29/12/2019 | |
| 325420 | Zobel A: 1/50 mole K3Fe(CN) 6 in 0.1molar KCl | 26/08/2023 | |
| 320612 | PH4 (pH = 4.01 +/- 0.02 @ 25 deg) | 29/10/2019 | |
| 320613 | PH7 (pH = 7.00 +/- 0.02 @ 25 deg) | 29/10/2019 | |
| 325421 | Zobel B: 1/50 mole K4Fe(CN) 6 in 0.1molar KCl | 26/08/2023 | |
| 5928 | DO Powder (Sodium Suplphite Solution) | 01/03/2020 | |

**Completed By:** Sen Philip

**Signed:** Sen Philip

# APPENDIX

# L

## Surface Water Quality Technical Report

## Appendix B Surface Water Quality Site Investigation Laboratory Results

**HELIDON TO CALVERT** ENVIRONMENTAL IMPACT STATEMENT

IR_1381

**Appendix B - Raw laboratory data from the three sampling rounds**

| Site | H2C 2A | H2C 3A | H2C 3A | H2C 4A | H2C 4A | H2C 7A | H2C 9A | H2C 10A | H2C 11A | H2C 11A | H2C 12A | H2C 13A | H2C 14A | H2C 17A | H2C 17A | H2C 18A | H2C 18A | H2C DUP1 | H2C DUP2 | H2C TRIP 1 | H2C DUPLICATE 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Mar-18 | Oct-17 | Mar-19 | Oct-17 | Mar-19 | Oct-17 | Oct-17 | Oct-17 | Oct-17 | Mar-18 | Oct-17 | Mar-18 | Mar-18 | Oct-17 | Mar-18 | Oct-17 | Mar-19 | Oct-17 | Oct-17 | Oct-17 | Mar-19 |
| Ammonia (as N) | 0.03 | 0.03 | 0.18 | 0.13 | < 0.01 | 0.13 | < 0.01 | < 0.01 | 0.11 | < 0.01 | < 0.01 | 0.04 | 0.02 | 0.02 | 0.02 | 0.02 | 0.2 | 0.13 | 0.01 | 0.01 | < 0.01 |
| Chlorophyll a | < 5 | < 10 | < 5 | < 10 | 6.4 | < 10 | < 10 | < 5 | < 10 | 29 | 87 | < 5 | < 5 | < 10 | < 5 | < 5 | 18 | < 5 | < 10 | < 10 | 21 |
| Conductivity (at 25Â°C) | 3600 | 870 | 710 | 510 | 480 | 740 | 2200 | 3800 | 1400 | 1100 | 970 | 310 | 300 | 850 | 340 | 2300 | 3000 | 510 | 2200 | 1900 | 490 |
| Dissolved Oxygen | 7.2 | 8.7 | 9 | 8.6 | 9 | 8.1 | 7.3 | 8.3 | 9.3 | 5.9 | 8.6 | 6.9 | 7.1 | 8 | 7.8 | 8 | 8.7 | 8.6 | 7.4 | 7.4 | 9 |
| Dissolved Oxygen (% Saturation) | 80 | 97 | - | 95 | < 0.05 | 90 | 81 | 92 | 110 | 64 | 96 | 77 | 78 | 89 | 87 | 89 |  | 96 | 83 | 83 |  |
| Nitrate & Nitrite (as N) |  | < 0.05 | < 0.05 | 0.47 | 9 | 0.2 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 0.14 | 0.22 | < 0.05 | 0.19 | < 0.05 | < 0.05 | 0.45 | < 0.05 | < 0.05 | < 0.05 |
| Nitrate (as N) |  | < 0.02 | < 0.02 | 0.43 | < 0.05 | 0.19 | 0.03 | 0.05 | < 0.02 | < 0.02 | < 0.02 | 0.13 | 0.2 | 0.03 | 0.16 | < 0.02 | < 0.02 | 0.41 | 0.03 | 0.04 | < 0.02 |
| Nitrite (as |  | < 0.02 | < 0.02 | 0.04 | < 0.02 | < 0.02 | < 0.02 | < 0.02 | < 0.02 | < 0.02 | < 0.02 | < 0.02 | < 0.02 | < 0.02 | 0.03 | < 0.02 | < 0.02 | 0.04 | < 0.02 | < 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 1.9 | 0.3 | 0.7 | <0.2 | < 0.02 | 0.5 | 0.2 | 0.4 | 0.49 | 0.7 | 0.4 | 0.6 | 0.5 | 0.3 | 0.3 | 0.6 | 1.3 | 0.27 | 0.4 | 0.3 | 0.67 |
| pH | 7.9 | 8.3 | 9.1 | 8.1 | 0.67 | 8.1 | 8.2 | 8.4 | 9.3 | 8.5 | 8.4 | 8 | 8.1 | 8.2 | 8.3 | 8.1 | 6.3 | 8.1 | 8.2 | 8.3 | 8.7 |
| Phosphate total (as P) | 0.32 | < 0.05 | 0.06 | 0.1 | 8.7 | 0.13 | 0.15 | 0.06 | 0.1 | 0.19 | 0.1 | 0.44 | 0.4 | 0.27 | 0.39 | 0.05 | 0.01 | 0.11 | 0.17 | 0.17 | 0.1 |
| Phosphorus reactive (as P) | 0.13 | < 0.05 | 0.05 | 0.1 | 0.1 | 0.11 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 0.25 | 0.21 | 0.21 | 0.2 | < 0.05 | 0.01 | 0.1 | < 0.05 | < 0.05 | 0.01 |
| Salinity (determined from EC)* | 1900 | 430 | 340 | 250 | 230 | 360 | 1100 | 2000 | 700 | 500 | 480 | 150 | 140 | 420 | 160 | 1200 | 1600 | 250 | 1100 | 960 | 230 |
| Suspended Solids | 2.8 | 1.6 | 11 | < 1 | 67 | 4.4 | 11 | 7.2 | 47 | 53 | 19 | 13 | 11 | 7 | 21 | 2.5 | 21 | < 1 | 7 | 10 | 49 |
| Total Kjeldahl Nitrogen (as N) | 1.9 | 0.3 | 0.9 | 0.2 | 0.7 | 0.6 | 0.2 | 0.4 | 0.6 | 0.7 | 0.4 | 0.6 | 0.5 | 0.3 | 0.3 | 0.6 | 1.3 | 0.4 | 0.4 | 0.3 | 0.7 |
| Total Nitrogen (as N) | 43 | 0.3 | 0.88 | 0.7 | 0.67 | 0.8 | 0.2 | 0.4 | 0.6 | 0.7 | 0.4 | 0.74 | 0.72 | 0.3 | 0.49 | 0.6 | 1.3 | 0.85 | 0.4 | 0.3 | 0.71 |
| Turbidity | 1.7 | < 1 | 2.9 | 2.3 | 42 | 1.7 | 4.8 | 3.3 | 36 | 32 | 9.6 | 17 | 14 | 2.1 | 8.4 | 2.6 | 18 | 1.8 | 4.7 | 2.9 | 24 |
| Arsenic (filtered) | < 0.001 | < 0.001 | 0.002 | < 0.001 | < 0.001 | < 0.001 | 0.001 | < 0.001 | 0.002 | 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.002 | < 0.001 | 0.001 | 0.001 | < 0.001 |
| Cadmium (filtered) | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.004 | < 0.001 | < 0.001 | 0.002 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.001 | < 0.001 | 0.001 | 0.003 | 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.002 | < 0.001 | < 0.001 | < 0.001 |
| Lead (filtered) | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mercury (filtered)** | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| **Nickel (filtered)** | 0.006 | 0.002 | 0.001 | 0.002 | 0.002 | 0.003 | < 0.001 | 0.002 | 0.003 | 0.002 | 0.005 | 0.006 | 0.002 | 0.002 | 0.001 | 0.002 | 0.004 | 0.002 | < 0.001 | < 0.001 | 0.002 |
| **Zinc (filtered)** | < 0.005 | < 0.005 | 0.005 | 0.011 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | 0.012 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | 0.009 | < 0.005 | < 0.005 | < 0.005 |
| **Acenaphthene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Acenaphthylene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Anthracene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Benz(a)anthracene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Benzo(a)pyrene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Benzo(b&j)fluoranthene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Benzo(g.h.i) perylene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Benzo(k)fluoranthene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Chrysene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Dibenz(a.h) anthracene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Fluoranthene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Fluorene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Indeno(1.2.3-cd)pyrene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Naphthalen** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Phenanthrene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Pyrene** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **Total PAH*** | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| **p-Terphenyl-d14 (surr.)** | 112 | 140 | 108 | 85 | 51 | 81 | 99 | 80 | 70 | 104 | 140 | 52 | 61 | 84 | 87 | 58 | 74 | 81 | 146 | 69 | 56 |
| **2-Fluorobiphenyl (surr.)** | 79 | 143 | 112 | 79 | 54 | 69 | 95 | 74 | 62 | 73 | 147 | 56 | 63 | int | 69 | int | 71 | 103 | 145 | int | 59 |

# Surface water quality results – Round 1 (October 2017)

# CHAIN OF CUSTODY RECORD

ABN 50 005 085 521

☐ Eurofins | mgt Sydney Lab
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2 Kingston Town Close, Oakleigh, VIC 3166
P : +61 3 8564 5000 F : +61 3 8564 5090
E : EnviroSampleVic@eurofins.com.au

| | | | | | |
|---|---|---|---|---|---|
| Company | Aurecon | Purchase Order | 500569 | Project Manager | Leesa Leathbridge |
| Address | Level 14, 32 Turbot Street, Brisbane, QLD | Eurofins \| mgt Quote № | 160329AUR | Project № | Inland Rail |
| Contact Name | Leesa Leathbridge | | | | |
| Contact Phone № | 07 3173 8730 | | | | |
| Special Direction | * 2 eskies in total | | | | |
| Relinquished by (Signature) (Time / Date) | Leesa Leathbridge<br>2:15pm 13.10.17. | | | | |

| | |
|---|---|
| Project Name | Baseline Surface Water Monitoring |
| Electronic Results Format | |
| Email for Results | leesa.leathbridge@aurecongroup.com |
| Turn Around Requirements | ☐ 1 DAY* ☐ 2 DAY* ☐ 3 DAY*<br>☑ 5 DAY (Std.) ☐ Other ( )<br>* Surcharges apply |
| Method of Shipment | ☐ Courier (# )<br>☑ Hand Delivered<br>☐ Postal |

Analysis (Note: Where metals are requested, please specify "Total" or "Filtered")

| № | Client Sample ID | Date | Matrix | pH | Suspended Solids (SS) | Turbidity | Speciated nitrogens (ammonia, nitrate, nitrite, organic nitrogen, oxidised nitrogen, total kjeldahl nitrogen, total nitrogen) | Electrical conductivity (Actual + Specific) | M8 - 8 metals | Total Phosphorus | Reactive Phosphorus | Chlorophyll a | Polycyclic aromatic hydrocarbons (PAH) | Salinity (ppt) | Dissolved oxygen (% saturation) | Dissolved oxygen (mg/L) | | | 1L Plastic | 250mL Plastic | 125mL Plastic | 200mL Amber Glass | 40mL vial | 125mL Amber Glass | 60mL plastic | 500 mL plastic | Sample Comments / DG Hazard Warning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | H2C 11A | 09/10/17 | W | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | 1 | | | 2 | 1 | |
| 2 | H2C 4A | 09/10/17 | W | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | 1 | | | 2 | 1 | |
| 3 | H2C 12A | 10/10/17 | W | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | 1 | | | 2 | 1 | |
| 4 | H2C 9A | 11/10/17 | W | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | 1 | | | 2 | 1 | |
| 5 | H2C 7A | 11/10/17 | W | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | 1 | | | 2 | 1 | |
| 6 | H2C 3A | 12/10/17 | W | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | 1 | | | 2 | 1 | |
| 7 | H2C 10A | 11/10/17 | W | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | 1 | | | 2 | 1 | |
| 8 | H2C Dup 1 | — | W | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | 1 | | | 2 | 1 | |
| 9 | H2C Dup 2 | — | W | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | 1 | | | 2 | 1 | |
| 10 | H2C Trip 1 | — | W | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | 1 | | | 2 | 1 | |
| 11 | H2C 17A | 13/10/17 | W | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | 1 | | | 2 | 1 | |
| 12 | H2C 18A | 13/10/17 | W | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | 1 | | | 2 | 1 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Laboratory Use Only | Received By | Krystel Bryant | SYD \| [✓ BNE] \| MEL \| PER \| ADL \| NEW \| DAR | Date | 13/10/17 | Time | 3:01 PM | Signature | | Temperature | 18·27°C |
| | Received By | | SYD \| BNE \| MEL \| PER \| ADL \| NEW \| DAR | Date | __/__/__ | Time | __:__ | Signature | | Report № | |

QS3009_R4 Modified by: S. Kojima Approved by: T. Lakeland Approved on: 11 August 2015

Submission of samples to the laboratory will be deemed as acceptance of Eurofins | mgt Standard Terms and Conditions unless agreed otherwise. A copy of Eurofins | mgt Standard Terms and Conditions is available on request.

15.9
14.6
14.2
14.60°C

| | | | # CON NOTES | POST CODE |
|---|---|---|---|---|
| ☐ | ☐ CN | ☒ HD | | |
| ☐ AP | ☐ CR | ☐ | | MASS |

18.8
19.8
16.2
18.27°C

Krystel Bryant
13/10/17
3:01 PM

# Certificate of Analysis

**NATA Accredited**
**Accreditation Number 1261**
**Site Number 20794**

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

**Aurecon Australia (BRIS) Pty Ltd**
**Level 14, 32 Turbot St**
**Brisbane**
**QLD 4001**

| | |
|---|---|
| **Attention:** | **LEESA LEATHBRIDGE** |
| **Report** | **567573-W** |
| Project name | BASELINE SURFACE WATER MONITORING |
| Project ID | INLAND RAIL |
| Received Date | Oct 13, 2017 |

| **Client Sample ID** | | | **H2C 11A** | **H2C 4A** | **H2C 12A** | **H2C 9A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B17-Oc14979** | **B17-Oc14980** | **B17-Oc14981** | **B17-Oc14982** |
| **Date Sampled** | | | **Oct 09, 2017** | **Oct 09, 2017** | **Oct 10, 2017** | **Oct 11, 2017** |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene[N07] | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 62 | 79 | 147 | 95 |
| p-Terphenyl-d14 (surr.) | 1 | % | 70 | 85 | 140 | 99 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.11 | 0.13 | < 0.01 | < 0.01 |
| Chlorophyll a | 5 | ug/L | < 10 | < 10 | 87 | < 10 |
| Conductivity (at 25°C) | 1 | uS/cm | 1400 | 510 | 970 | 2200 |
| Dissolved Oxygen | 0.01 | mg/L | 9.3 | 8.6 | 8.6 | 7.3 |
| Dissolved Oxygen (% Saturation) | | % | 110 | 95 | 96 | 81 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | < 0.05 | 0.47 | < 0.05 | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | < 0.02 | 0.43 | < 0.02 | 0.03 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | 0.04 | < 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 0.49 | <0.2 | 0.4 | 0.2 |
| pH | 0.1 | pH Units | 9.3 | 8.1 | 8.4 | 8.2 |
| Phosphate total (as P) | 0.05 | mg/L | 0.10 | 0.10 | 0.10 | 0.15 |
| Phosphorus reactive (as P) | 0.05 | mg/L | < 0.05 | 0.10 | < 0.05 | < 0.05 |
| Salinity (determined from EC)* | 20 | mg/L | 700 | 250 | 480 | 1100 |
| Suspended Solids | 1 | mg/L | 47 | < 1 | 19 | 11 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 0.6 | 0.2 | 0.4 | 0.2 |

| **Client Sample ID**<br>**Sample Matrix**<br>**Eurofins \| mgt Sample No.**<br>**Date Sampled**<br>Test/Reference | LOR | Unit | **H2C 11A**<br>**Water**<br>**B17-Oc14979**<br>**Oct 09, 2017** | **H2C 4A**<br>**Water**<br>**B17-Oc14980**<br>**Oct 09, 2017** | **H2C 12A**<br>**Water**<br>**B17-Oc14981**<br>**Oct 10, 2017** | **H2C 9A**<br>**Water**<br>**B17-Oc14982**<br>**Oct 11, 2017** |
|---|---|---|---|---|---|---|
| | | | | | | |
| Total Nitrogen (as N) | 0.2 | mg/L | 0.6 | 0.7 | 0.4 | 0.2 |
| Turbidity | 1 | NTU | 36 | 2.3 | 9.6 | 4.8 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | 0.002 | < 0.001 | < 0.001 | 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | 0.001 | 0.002 | 0.001 | < 0.001 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | 0.003 | 0.002 | 0.005 | < 0.001 |
| Zinc (filtered) | 0.005 | mg/L | < 0.005 | 0.011 | < 0.005 | < 0.005 |

| **Client Sample ID**<br>**Sample Matrix**<br>**Eurofins \| mgt Sample No.**<br>**Date Sampled**<br>Test/Reference | LOR | Unit | **H2C 7A**<br>**Water**<br>**B17-Oc14983**<br>**Oct 11, 2017** | **H2C 3A**<br>**Water**<br>**B17-Oc14984**<br>**Oct 11, 2017** | **H2C 10A**<br>**Water**<br>**B17-Oc14985**<br>**Oct 11, 2017** | **H2C DUP1**<br>**Water**<br>**B17-Oc14986**<br>**Oct 11, 2017** |
|---|---|---|---|---|---|---|
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene$^{N07}$ | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 69 | 143 | 74 | 103 |
| p-Terphenyl-d14 (surr.) | 1 | % | 81 | 140 | 80 | 81 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.13 | 0.03 | < 0.01 | 0.13 |
| Chlorophyll a | 5 | ug/L | < 10 | < 10 | < 5 | < 5 |
| Conductivity (at 25°C) | 1 | uS/cm | 740 | 870 | 3800 | 510 |
| Dissolved Oxygen | 0.01 | mg/L | 8.1 | 8.7 | 8.3 | 8.6 |
| Dissolved Oxygen (% Saturation) | | % | 90 | 97 | 92 | 96 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | 0.20 | < 0.05 | < 0.05 | 0.45 |
| Nitrate (as N) | 0.02 | mg/L | 0.19 | < 0.02 | 0.05 | 0.41 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | < 0.02 | 0.04 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 0.5 | 0.3 | 0.4 | 0.27 |
| pH | 0.1 | pH Units | 8.1 | 8.3 | 8.4 | 8.1 |

| **Client Sample ID** | | | **H2C 7A** | **H2C 3A** | **H2C 10A** | **H2C DUP1** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B17-Oc14983** | **B17-Oc14984** | **B17-Oc14985** | **B17-Oc14986** |
| **Date Sampled** | | | **Oct 11, 2017** | **Oct 11, 2017** | **Oct 11, 2017** | **Oct 11, 2017** |
| Test/Reference | LOR | Unit | | | | |
| | | | | | | |
| Phosphate total (as P) | 0.05 | mg/L | 0.13 | < 0.05 | 0.06 | 0.11 |
| Phosphorus reactive (as P) | 0.05 | mg/L | 0.11 | < 0.05 | < 0.05 | 0.10 |
| Salinity (determined from EC)* | 20 | mg/L | 360 | 430 | 2000 | 250 |
| Suspended Solids | 1 | mg/L | 4.4 | 1.6 | 7.2 | < 1 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 0.6 | 0.3 | 0.4 | 0.4 |
| Total Nitrogen (as N) | 0.2 | mg/L | 0.8 | 0.3 | 0.4 | 0.85 |
| Turbidity | 1 | NTU | 1.7 | < 1 | 3.3 | 1.8 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | 0.002 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | 0.003 | 0.002 | 0.002 | 0.002 |
| Zinc (filtered) | 0.005 | mg/L | < 0.005 | < 0.005 | < 0.005 | 0.009 |

| **Client Sample ID** | | | **H2C DUP2** | **H2C TRIP 1** | **H2C 17A** | **H2C 18A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B17-Oc14987** | **B17-Oc14988** | **B17-Oc14989** | **B17-Oc14990** |
| **Date Sampled** | | | **Oct 11, 2017** | **Oct 11, 2017** | **Oct 11, 2017** | **Oct 11, 2017** |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene$^{N07}$ | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 145 | int | int | int |
| p-Terphenyl-d14 (surr.) | 1 | % | 146 | 69 | 84 | 58 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.01 | 0.01 | 0.02 | 0.02 |
| Chlorophyll a | 5 | ug/L | < 10 | < 10 | < 10 | < 5 |
| Conductivity (at 25°C) | 1 | uS/cm | 2200 | 1900 | 850 | 2300 |
| Dissolved Oxygen | 0.01 | mg/L | 7.4 | 7.4 | 8.0 | 8.0 |
| Dissolved Oxygen (% Saturation) | | % | 83 | 83 | 89 | 89 |

| **Client Sample ID**<br>**Sample Matrix**<br>**Eurofins \| mgt Sample No.**<br>**Date Sampled**<br>Test/Reference | LOR | Unit | **H2C DUP2**<br>**Water**<br>**B17-Oc14987**<br>**Oct 11, 2017** | **H2C TRIP 1**<br>**Water**<br>**B17-Oc14988**<br>**Oct 11, 2017** | **H2C 17A**<br>**Water**<br>**B17-Oc14989**<br>**Oct 11, 2017** | **H2C 18A**<br>**Water**<br>**B17-Oc14990**<br>**Oct 11, 2017** |
|---|---|---|---|---|---|---|
| | | | | | | |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | 0.03 | 0.04 | 0.03 | < 0.02 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | < 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 0.4 | 0.3 | 0.3 | 0.6 |
| pH | 0.1 | pH Units | 8.2 | 8.3 | 8.2 | 8.1 |
| Phosphate total (as P) | 0.05 | mg/L | 0.17 | 0.17 | 0.27 | 0.05 |
| Phosphorus reactive (as P) | 0.05 | mg/L | < 0.05 | < 0.05 | 0.21 | < 0.05 |
| Salinity (determined from EC)* | 20 | mg/L | 1100 | 960 | 420 | 1200 |
| Suspended Solids | 1 | mg/L | 7.0 | 10 | 7.0 | 2.5 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 0.4 | 0.3 | 0.3 | 0.6 |
| Total Nitrogen (as N) | 0.2 | mg/L | 0.4 | 0.3 | 0.3 | 0.6 |
| Turbidity | 1 | NTU | 4.7 | 2.9 | 2.1 | 2.6 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | 0.001 | 0.001 | < 0.001 | < 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | 0.002 | 0.002 |
| Zinc (filtered) | 0.005 | mg/L | < 0.005 | < 0.005 | < 0.005 | < 0.005 |

## Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

| **Description** | **Testing Site** | **Extracted** | **Holding Time** |
|---|---|---|---|
| Polycyclic Aromatic Hydrocarbons | Melbourne | Oct 17, 2017 | 7 Day |
| - Method: LTM-ORG-2130 PAH and Phenols in Water by GCMS | | | |
| Chlorophyll a | Melbourne | Oct 16, 2017 | 2 Day |
| - Method: APHA Method 10200H | | | |
| Conductivity (at 25°C) | Melbourne | Oct 16, 2017 | 28 Day |
| - Method: LTM-INO-4030 | | | |
| Dissolved Oxygen | Melbourne | Oct 16, 2017 | 1 Day |
| - Method: LTM-INO-4130 Determination of Dissolved Oxygen using a DO meter | | | |
| Dissolved Oxygen (% Saturation) | Melbourne | Oct 16, 2017 | 1 Day |
| - Method: LTM-INO-4130 Determination of Dissolved Oxygen using a DO meter | | | |
| pH | Melbourne | Oct 16, 2017 | 0 Hours |
| - Method: LTM-GEN-7090 pH in water by ISE | | | |
| Phosphate total (as P) | Melbourne | Oct 16, 2017 | 28 Day |
| - Method: APHA 4500-P E. Phosphorous | | | |
| Phosphorus reactive (as P) | Melbourne | Oct 16, 2017 | 2 Day |
| - Method: APHA4500-PO4 | | | |
| Salinity (determined from EC)* | Melbourne | Oct 16, 2017 | 0 Day |
| Suspended Solids | Melbourne | Oct 16, 2017 | 7 Days |
| - Method: LTM-INO-4070 Analysis of Suspended Solids in Water by Gravimetry | | | |
| Turbidity | Melbourne | Oct 16, 2017 | 2 Day |
| - Method: LTM-INO-4140 Turbidity by Nephelometric Method | | | |
| Metals M8 filtered | Melbourne | Oct 16, 2017 | 28 Day |
| - Method: LTM-MET-3040 Metals in Waters by ICP-MS | | | |
| Nitrogens (speciated) | | | |
| Ammonia (as N) | Melbourne | Oct 16, 2017 | 28 Day |
| - Method: APHA 4500-NH3 Ammonia Nitrogen by FIA | | | |
| Nitrate & Nitrite (as N) | Melbourne | Oct 16, 2017 | 28 Day |
| - Method: APHA 4500-NO3/NO2 Nitrate-Nitrite Nitrogen by FIA | | | |
| Nitrate (as N) | Melbourne | Oct 16, 2017 | 7 Day |
| - Method: APHA 4500-NO3 Nitrate Nitrogen by FIA | | | |
| Nitrite (as N) | Melbourne | Oct 16, 2017 | 2 Day |
| - Method: APHA 4500-NO2 Nitrite Nitrogen by FIA | | | |
| Organic Nitrogen (as N) | Melbourne | Oct 13, 2017 | 7 Day |
| - Method: APHA 4500 Organic Nitrogen (N) | | | |
| Total Kjeldahl Nitrogen (as N) | Melbourne | Oct 16, 2017 | 7 Day |
| - Method: APHA 4500 TKN | | | |

**Company Name:** Aurecon Australia (BRIS) Pty Ltd
**Address:** Level 14, 32 Turbot St
Brisbane
QLD 4001

**Order No.:** 500569
**Report #:** 567573
**Phone:** 07 3173 8000
**Fax:** +61 7 3173 8001

**Received:** Oct 13, 2017 3:00 PM
**Due:** Oct 20, 2017
**Priority:** 5 Day
**Contact Name:** LEESA LEATHBRIDGE

**Project Name:** BASELINE SURFACE WATER MONITORING
**Project ID:** INLAND RAIL

**Eurofins | mgt Analytical Services Manager : Ryan Gilbert**

| **Sample Detail** | | | | | | Chlorophyll a | Conductivity (at 25°C) | Dissolved Oxygen | Dissolved Oxygen (% Saturation) | pH | Phosphate total (as P) | Phosphorus reactive (as P) | Salinity (determined from EC)* | Suspended Solids | Turbidity | Polycyclic Aromatic Hydrocarbons | Metals M8 filtered | Nitrogens (speciated) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Melbourne Laboratory - NATA Site # 1254 & 14271** | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **Sydney Laboratory - NATA Site # 18217** | | | | | | | | | | | | | | | | | | |
| **Brisbane Laboratory - NATA Site # 20794** | | | | | | | | | | | | | | | | | | |
| **Perth Laboratory - NATA Site # 23736** | | | | | | | | | | | | | | | | | | |
| **External Laboratory** | | | | | | | | | | | | | | | | | | |
| **No** | **Sample ID** | **Sample Date** | **Sampling Time** | **Matrix** | **LAB ID** | | | | | | | | | | | | | |
| 1 | H2C 11A | Oct 09, 2017 | | Water | B17-Oc14979 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 2 | H2C 4A | Oct 09, 2017 | | Water | B17-Oc14980 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 3 | H2C 12A | Oct 10, 2017 | | Water | B17-Oc14981 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 4 | H2C 9A | Oct 11, 2017 | | Water | B17-Oc14982 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 5 | H2C 7A | Oct 11, 2017 | | Water | B17-Oc14983 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 6 | H2C 3A | Oct 11, 2017 | | Water | B17-Oc14984 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 7 | H2C 10A | Oct 11, 2017 | | Water | B17-Oc14985 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 8 | H2C DUP1 | Oct 11, 2017 | | Water | B17-Oc14986 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 9 | H2C DUP2 | Oct 11, 2017 | | Water | B17-Oc14987 | X | X | X | X | X | X | X | X | X | X | X | X | X |

| | | | | | |
|---|---|---|---|---|---|
| **Company Name:** | Aurecon Australia (BRIS) Pty Ltd | **Order No.:** | 500569 | **Received:** | Oct 13, 2017 3:00 PM |
| **Address:** | Level 14, 32 Turbot St<br>Brisbane<br>QLD 4001 | **Report #:** | 567573 | **Due:** | Oct 20, 2017 |
| | | **Phone:** | 07 3173 8000 | **Priority:** | 5 Day |
| | | **Fax:** | +61 7 3173 8001 | **Contact Name:** | LEESA LEATHBRIDGE |
| **Project Name:** | BASELINE SURFACE WATER MONITORING | | | | |
| **Project ID:** | INLAND RAIL | | | | |

**Eurofins | mgt Analytical Services Manager : Ryan Gilbert**

| **Sample Detail** | | | | | | Chlorophyll a | Conductivity (at 25°C) | Dissolved Oxygen | Dissolved Oxygen (% Saturation) | pH | Phosphate total (as P) | Phosphorus reactive (as P) | Salinity (determined from EC)* | Suspended Solids | Turbidity | Polycyclic Aromatic Hydrocarbons | Metals M8 filtered | Nitrogens (speciated) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Melbourne Laboratory - NATA Site # 1254 & 14271** | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **Sydney Laboratory - NATA Site # 18217** | | | | | | | | | | | | | | | | | | |
| **Brisbane Laboratory - NATA Site # 20794** | | | | | | | | | | | | | | | | | | |
| **Perth Laboratory - NATA Site # 23736** | | | | | | | | | | | | | | | | | | |
| 10 | H2C TRIP 1 | Oct 11, 2017 | | Water | B17-Oc14988 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 11 | H2C 17A | Oct 11, 2017 | | Water | B17-Oc14989 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 12 | H2C 18A | Oct 11, 2017 | | Water | B17-Oc14990 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **Test Counts** | | | | | | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |

# Internal Quality Control Review and Glossary

## General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

## Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as RPD

## Units

| | |
|---|---|
| **mg/kg:** milligrams per kilogram | **mg/L:** milligrams per litre |
| **ug/L:** micrograms per litre | **ppm:** Parts per million |
| **ppb:** Parts per billion | **%:** Percentage |
| **org/100mL:** Organisms per 100 millilitres | **NTU:** Nephelometric Turbidity Units |
| **MPN/100mL:** Most Probable Number of organisms per 100 millilitres | |

## Terms

| | |
|---|---|
| **Dry** | Where a moisture has been determined on a solid sample the result is expressed on a dry basis. |
| **LOR** | Limit of Reporting. |
| **SPIKE** | Addition of the analyte to the sample and reported as percentage recovery. |
| **RPD** | Relative Percent Difference between two Duplicate pieces of analysis. |
| **LCS** | Laboratory Control Sample - reported as percent recovery. |
| **CRM** | Certified Reference Material - reported as percent recovery. |
| **Method Blank** | In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water. |
| **Surr - Surrogate** | The addition of a like compound to the analyte target and reported as percentage recovery. |
| **Duplicate** | A second piece of analysis from the same sample and reported in the same units as the result to show comparison. |
| **USEPA** | United States Environmental Protection Agency |
| **APHA** | American Public Health Association |
| **TCLP** | Toxicity Characteristic Leaching Procedure |
| **COC** | Chain of Custody |
| **SRA** | Sample Receipt Advice |
| **QSM** | Quality Systems Manual ver 5.1 US Department of Defense |
| **CP** | Client Parent - QC was performed on samples pertaining to this report |
| **NCP** | Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within. |
| **TEQ** | Toxic Equivalency Quotient |

## QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results<10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

## QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

**Quality Control Results**

| Test | Units | Result 1 | | | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|
| **Method Blank** | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | | |
| Acenaphthene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Acenaphthylene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Anthracene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benz(a)anthracene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(a)pyrene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(b&j)fluoranthene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(g.h.i)perylene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(k)fluoranthene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Chrysene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Dibenz(a.h)anthracene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Fluoranthene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Fluorene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Indeno(1.2.3-cd)pyrene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Naphthalene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Phenanthrene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Pyrene | mg/L | < 0.001 | | | 0.001 | Pass | |
| **Method Blank** | | | | | | | |
| Ammonia (as N) | mg/L | < 0.01 | | | 0.01 | Pass | |
| Chlorophyll a | ug/L | < 5 | | | 5 | Pass | |
| Dissolved Oxygen (% Saturation) | % | 100 | | | | N/A | |
| Nitrate & Nitrite (as N) | mg/L | < 0.05 | | | 0.05 | Pass | |
| Nitrate (as N) | mg/L | < 0.02 | | | 0.02 | Pass | |
| Nitrite (as N) | mg/L | < 0.02 | | | 0.02 | Pass | |
| Phosphate total (as P) | mg/L | < 0.05 | | | 0.05 | Pass | |
| Phosphorus reactive (as P) | mg/L | < 0.05 | | | 0.05 | Pass | |
| Suspended Solids | mg/L | < 1 | | | 1 | Pass | |
| Total Kjeldahl Nitrogen (as N) | mg/L | < 0.2 | | | 0.2 | Pass | |
| Turbidity | NTU | < 1 | | | 1 | Pass | |
| **Method Blank** | | | | | | | |
| **Heavy Metals** | | | | | | | |
| Arsenic (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Cadmium (filtered) | mg/L | < 0.0002 | | | 0.0002 | Pass | |
| Chromium (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Copper (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Lead (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Mercury (filtered) | mg/L | < 0.0001 | | | 0.0001 | Pass | |
| Nickel (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Zinc (filtered) | mg/L | < 0.005 | | | 0.005 | Pass | |
| **LCS - % Recovery** | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | | |
| Acenaphthene | % | 108 | | | 70-130 | Pass | |
| Acenaphthylene | % | 117 | | | 70-130 | Pass | |
| Anthracene | % | 109 | | | 70-130 | Pass | |
| Benz(a)anthracene | % | 112 | | | 70-130 | Pass | |
| Benzo(a)pyrene | % | 121 | | | 70-130 | Pass | |
| Benzo(b&j)fluoranthene | % | 126 | | | 70-130 | Pass | |
| Benzo(g.h.i)perylene | % | 108 | | | 70-130 | Pass | |
| Benzo(k)fluoranthene | % | 119 | | | 70-130 | Pass | |
| Chrysene | % | 124 | | | 70-130 | Pass | |
| Dibenz(a.h)anthracene | % | 104 | | | 70-130 | Pass | |

| Test | | | Units | Result 1 | | | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|---|---|
| Fluoranthene | | | % | 127 | | | 70-130 | Pass | |
| Fluorene | | | % | 126 | | | 70-130 | Pass | |
| Indeno(1.2.3-cd)pyrene | | | % | 109 | | | 70-130 | Pass | |
| Naphthalene | | | % | 100 | | | 70-130 | Pass | |
| Phenanthrene | | | % | 125 | | | 70-130 | Pass | |
| Pyrene | | | % | 126 | | | 70-130 | Pass | |
| **LCS - % Recovery** | | | | | | | | | |
| Ammonia (as N) | | | % | 91 | | | 70-130 | Pass | |
| Nitrate & Nitrite (as N) | | | % | 92 | | | 70-130 | Pass | |
| Nitrate (as N) | | | % | 92 | | | 70-130 | Pass | |
| Nitrite (as N) | | | % | 95 | | | 70-130 | Pass | |
| Phosphate total (as P) | | | % | 82 | | | 70-130 | Pass | |
| Phosphorus reactive (as P) | | | % | 114 | | | 70-130 | Pass | |
| Suspended Solids | | | % | 104 | | | 70-130 | Pass | |
| Total Kjeldahl Nitrogen (as N) | | | % | 106 | | | 70-130 | Pass | |
| **LCS - % Recovery** | | | | | | | | | |
| **Heavy Metals** | | | | | | | | | |
| Arsenic (filtered) | | | % | 110 | | | 80-120 | Pass | |
| Cadmium (filtered) | | | % | 110 | | | 80-120 | Pass | |
| Chromium (filtered) | | | % | 105 | | | 80-120 | Pass | |
| Copper (filtered) | | | % | 108 | | | 80-120 | Pass | |
| Lead (filtered) | | | % | 103 | | | 80-120 | Pass | |
| Mercury (filtered) | | | % | 95 | | | 70-130 | Pass | |
| Nickel (filtered) | | | % | 108 | | | 80-120 | Pass | |
| Zinc (filtered) | | | % | 112 | | | 80-120 | Pass | |
| **Test** | **Lab Sample ID** | **QA Source** | **Units** | **Result 1** | | | **Acceptance Limits** | **Pass Limits** | **Qualifying Code** |
| **Spike - % Recovery** | | | | | | | | | |
| | | | | Result 1 | | | | | |
| Ammonia (as N) | M17-Oc15002 | NCP | % | 83 | | | 70-130 | Pass | |
| Nitrate & Nitrite (as N) | M17-Oc15002 | NCP | % | 90 | | | 70-130 | Pass | |
| Nitrate (as N) | M17-Oc15002 | NCP | % | 90 | | | 70-130 | Pass | |
| Nitrite (as N) | M17-Oc15002 | NCP | % | 93 | | | 70-130 | Pass | |
| Phosphate total (as P) | M17-Oc14879 | NCP | % | 81 | | | 70-130 | Pass | |
| Total Kjeldahl Nitrogen (as N) | M17-Oc07052 | NCP | % | 71 | | | 70-130 | Pass | |
| **Spike - % Recovery** | | | | | | | | | |
| | | | | Result 1 | | | | | |
| Phosphorus reactive (as P) | B17-Oc14982 | CP | % | 108 | | | 70-130 | Pass | |
| **Spike - % Recovery** | | | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | Result 1 | | | | | |
| Acenaphthene | B17-Oc14985 | CP | % | 76 | | | 70-130 | Pass | |
| Acenaphthylene | B17-Oc14985 | CP | % | 85 | | | 70-130 | Pass | |
| Anthracene | B17-Oc14985 | CP | % | 79 | | | 70-130 | Pass | |
| Benz(a)anthracene | B17-Oc14985 | CP | % | 72 | | | 70-130 | Pass | |
| Benzo(a)pyrene | B17-Oc14985 | CP | % | 88 | | | 70-130 | Pass | |
| Benzo(b&j)fluoranthene | B17-Oc14985 | CP | % | 89 | | | 70-130 | Pass | |
| Benzo(g.h.i)perylene | B17-Oc14985 | CP | % | 72 | | | 70-130 | Pass | |
| Benzo(k)fluoranthene | B17-Oc14985 | CP | % | 70 | | | 70-130 | Pass | |
| Chrysene | B17-Oc14985 | CP | % | 75 | | | 70-130 | Pass | |
| Dibenz(a.h)anthracene | B17-Oc14985 | CP | % | 72 | | | 70-130 | Pass | |
| Fluoranthene | B17-Oc14985 | CP | % | 77 | | | 70-130 | Pass | |
| Fluorene | B17-Oc14985 | CP | % | 87 | | | 70-130 | Pass | |
| Indeno(1.2.3-cd)pyrene | B17-Oc14985 | CP | % | 73 | | | 70-130 | Pass | |
| Naphthalene | B17-Oc14985 | CP | % | 81 | | | 70-130 | Pass | |
| Phenanthrene | B17-Oc14985 | CP | % | 81 | | | 70-130 | Pass | |

| Test | Lab Sample ID | QA Source | Units | Result 1 | | | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|---|---|
| Pyrene | B17-Oc14985 | CP | % | 84 | | | 70-130 | Pass | |
| **Spike - % Recovery** | | | | | | | | | |
| **Heavy Metals** | | | | Result 1 | | | | | |
| Arsenic (filtered) | B17-Oc14988 | CP | % | 105 | | | 70-130 | Pass | |
| Cadmium (filtered) | B17-Oc14988 | CP | % | 99 | | | 70-130 | Pass | |
| Chromium (filtered) | B17-Oc14988 | CP | % | 102 | | | 70-130 | Pass | |
| Copper (filtered) | B17-Oc14988 | CP | % | 98 | | | 70-130 | Pass | |
| Lead (filtered) | B17-Oc14988 | CP | % | 98 | | | 70-130 | Pass | |
| Mercury (filtered) | B17-Oc14988 | CP | % | 87 | | | 70-130 | Pass | |
| Nickel (filtered) | B17-Oc14988 | CP | % | 97 | | | 70-130 | Pass | |
| Zinc (filtered) | B17-Oc14988 | CP | % | 101 | | | 70-130 | Pass | |
| **Test** | **Lab Sample ID** | **QA Source** | **Units** | **Result 1** | | | **Acceptance Limits** | **Pass Limits** | **Qualifying Code** |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Ammonia (as N) | M17-Oc15002 | NCP | mg/L | 1.9 | 1.8 | 2.0 | 30% | Pass | |
| Chlorophyll a | B17-Oc14979 | CP | ug/L | < 10 | < 10 | <1 | 30% | Pass | |
| Conductivity (at 25°C) | M17-Oc15023 | NCP | uS/cm | 1400 | 1400 | 1.0 | 30% | Pass | |
| Nitrate & Nitrite (as N) | M17-Oc15002 | NCP | mg/L | < 0.05 | < 0.05 | <1 | 30% | Pass | |
| Nitrate (as N) | M17-Oc15002 | NCP | mg/L | 0.03 | 0.03 | 5.0 | 30% | Pass | |
| Nitrite (as N) | M17-Oc15002 | NCP | mg/L | < 0.02 | < 0.02 | <1 | 30% | Pass | |
| pH | M17-Oc15023 | NCP | pH Units | 7.9 | 7.8 | pass | 30% | Pass | |
| Phosphate total (as P) | M17-Oc14978 | NCP | mg/L | 0.10 | 0.09 | 11 | 30% | Pass | |
| Total Kjeldahl Nitrogen (as N) | M17-Oc14978 | NCP | mg/L | 0.3 | 0.3 | 8.0 | 30% | Pass | |
| Turbidity | M17-Oc12949 | NCP | NTU | < 1 | < 1 | <1 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Phosphorus reactive (as P) | B17-Oc14981 | CP | mg/L | < 0.05 | < 0.05 | <1 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | Result 1 | Result 2 | RPD | | | |
| Acenaphthene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Acenaphthylene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Anthracene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benz(a)anthracene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(a)pyrene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(b&j)fluoranthene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(g.h.i)perylene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(k)fluoranthene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Chrysene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Dibenz(a.h)anthracene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Fluoranthene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Fluorene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Indeno(1.2.3-cd)pyrene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Naphthalene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Phenanthrene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Pyrene | B17-Oc14984 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Dissolved Oxygen | B17-Oc14984 | CP | mg/L | 8.7 | 8.8 | 1.0 | 30% | Pass | |
| Dissolved Oxygen (% Saturation) | B17-Oc14984 | CP | % | 97 | 98 | 1.0 | 30% | Pass | |

| **Duplicate** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Heavy Metals** | | | | Result 1 | Result 2 | RPD | | | |
| Arsenic (filtered) | B17-Oc14988 | CP | mg/L | 0.001 | 0.001 | 5.0 | 30% | Pass | |
| Cadmium (filtered) | B17-Oc14988 | CP | mg/L | < 0.0002 | < 0.0002 | <1 | 30% | Pass | |
| Chromium (filtered) | B17-Oc14988 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Copper (filtered) | B17-Oc14988 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Lead (filtered) | B17-Oc14988 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Mercury (filtered) | B17-Oc14988 | CP | mg/L | < 0.0001 | < 0.0001 | <1 | 30% | Pass | |
| Nickel (filtered) | B17-Oc14988 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Zinc (filtered) | B17-Oc14988 | CP | mg/L | < 0.005 | < 0.005 | <1 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Suspended Solids | B17-Oc14989 | CP | mg/L | 7.0 | 5.6 | 22 | 30% | Pass | |

## Comments

### Sample Integrity

| | |
|---|---|
| Custody Seals Intact (if used) | N/A |
| Attempt to Chill was evident | Yes |
| Sample correctly preserved | Yes |
| Appropriate sample containers have been used | Yes |
| Sample containers for volatile analysis received with minimal headspace | Yes |
| Samples received within HoldingTime | Yes |
| Some samples have been subcontracted | No |

### Qualifier Codes/Comments

| Code | Description |
|---|---|
| N07 | Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs |

### Authorised By

| | |
|---|---|
| Ryan Gilbert | Analytical Services Manager |
| Alex Petridis | Senior Analyst-Metal (VIC) |
| Alex Petridis | Senior Analyst-Organic (VIC) |
| Huong Le | Senior Analyst-Inorganic (VIC) |
| Joseph Edouard | Senior Analyst-Organic (VIC) |

**Glenn Jackson**

**National Operations Manager**

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

# Surface water quality results – Round 2 (March 2018)

# CHAIN OF CUSTODY RECORD

ABN 50 005 085 521

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☐ **Eurofins | mgt Melbourne Lab** 2 Kingston Town Close Oakleigh VIC 3166 P: +61 3 8564 5000 F: +61 3 8564 5090 E: EnviroSampleVic@eurofins.com.au

Company: Aurecon

Address: Level 14, 32 Turbot Street, Brisbane, QLD

Contact Name: Leesa Leathbridge

Contact Phone №: 07 3173 8730

Special Direction: # 6 eskies in total

Relinquished by (Signature):

(Time / Date): 13.41 2.3.2018

Purchase Order: 23200

Eurofins | mgt Quote №: 160329AUR

Project Manager: Leesa Leathbridge

Project №: Inland Rail Project

Project Name: Baseline Surface Water Monitoring

Electronic Results Format:

Email for Results: leesa.leathbridge@aurecongroup.com

Turn Around Requirements: ☐ 1 DAY* ☐ 2 DAY* ☐ 3 DAY* ☑ 5 DAY (Std.) ☐ Other ( )

Method of Shipment: ☐ Courier (# ) ☑ Hand Delivered ☐ Postal

Analysis (Note: Where metals are requested please specify "Total" or "Filtered")

| № | Client Sample ID | Date | Matrix | pH | Suspended Solids (SS) | Turbidity | Speciated nitrogens (ammonia, nitrate, nitrite, organic nitrogen, oxidised nitrogen, total kjeldahl nitrogen, total nitrogen) | Electrical conductivity (Actual and specific) | M8 - 8 metals | Total Phosphorus | Reactive Phosphorus | Chlorophyll a | Polycyclic aromatic hydrocarbons (PAH) | Salinity (ppt) | Dissolved oxygen (% saturation) | Dissolved oxygen (mg/L) | Containers: 1L Plastic | 250mL Plastic | 125mL Plastic | 200mL Amber Glass | 40mL vial | 125mL Amber Glass | Jar | 60 ml plastic | Sample Comments / DG Hazard Warning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | G2H 1A | 01/03/2018 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 2 | G2H DUP1 | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 3 | G2H TRIP1 | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 4 | G2H2A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 5 | G2H 3A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 6 | H2C 2A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 7 | H2C 13A | 02/03/2018 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 8 | H2C 14A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 9 | H2C 17A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 10 | C2K 1A (Alt) | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 11 | | | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 12 | | | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |

**Laboratory Use Only**

Received By: Palombo SYD | [✓ BNE] | MEL | PER | ADL | NEW | DAR Date 2/3/18 Time 1:40 Signature Temperature 13.2

Received By: SYD | BNE | MEL | PER | ADL | NEW | DAR Date __/__/__ Time ____ Signature Report №

Submission of samples to the laboratory will be deemed as acceptance of Eurofins | mgt Standard Terms and Conditions unless agreed otherwise. A copy of Eurofins | mgt Standard Terms and Conditions is available on request

# CHAIN OF CUSTODY RECORD

ABN 50 005 085 521

☐ **Eurofins | mgt Sydney Lab**
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☐ **Eurofins | mgt Melbourne Lab**
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E EnviroSampleVic@eurofins.com.au

Company: Aurecon
Address: Level 14, 32 Turbot Street, Brisbane, QLD
Contact Name: Leesa Leathbridge
Contact Phone №: 07 3173 8730
Special Direction: # 6 eskies in total
Relinquished by (Signature)
(Time / Date): 13 34 2 3 2018

Purchase Order: 23200
Eurofins | mgt Quote №: 160329AUR

Project Manager: Leesa Leathbridge
Project №: Inland Rail Project

Project Name: Baseline Surface Water Monitoring
Electronic Results Format:
Email for Results: leesa.leathbridge@aurecongroup.com

Turn Around Requirements: ☐ 1 DAY* ☐ 2 DAY* ☐ 3 DAY* ☑ 5 DAY (Std ) ☐ Other ( )

Method of Shipment: ☐ Courier (# ) ☑ Hand Delivered ☐ Postal

Analysis (Note: Where metals are requested, please specify "Total" or "Filtered")

Containers

| № | Client Sample ID | Date | Matrix | pH | Suspended Solids (SS) | Turbidity | Speciated nitrogens (ammonia, nitrate, nitrite, organic nitrogen, oxidised nitrogen, total kjeldahl nitrogen, total nitrogen) | Electrical conductivity (Actual and specific) | M8 - 8 metals | Total Phosphorus | Reactive Phosphorus | Chlorophyll a | Polycyclic aromatic hydrocarbons (PAH) | Salinity (ppt) | Dissolved oxygen (% saturation) | Dissolved oxygen (mg/L) | 1L Plastic | 250mL Plastic | 125mL Plastic | 200mL Amber Glass | 40mL vial | 125mL Amber Glass | Jar | 60 ml plastic | Sample Comments / DG Hazard Warning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | C2K11A | 27/02/18 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 2 | C2K10A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 3 | C2K9A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 4 | C2K7A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 5 | C2K8A | 28/02/18 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 6 | C2K7A (Alt) | 28/02/18 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 7 | C2K 13A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 8 | C2K6A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 9 | C2K 12A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 10 | C2K 5A (1) | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 11 | C2K 5A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 12 | C2K DUP1 | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |

**Laboratory Use Only**

Received By B. Palumbo SYD | [✓ BNE] | MEL | PER | ADL | NEW | DAR Date 2 3 18 Time 1 40 Signature Temperature 13.2

Received By SYD | BNE | MEL | PER | ADL | NEW | DAR Date __/__/__ Time __ Signature Report №

Submission of samples to the laboratory will be deemed as acceptance of Eurofins | mgt Standard Terms and Conditions unless agreed otherwise. A copy of Eurofins | mgt Standard Terms and Conditions is available on request.

# CHAIN OF CUSTODY RECORD

ABN 50 005 085 521

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E EnviroSampleVic@eurofins.com.au

Company: Aurecon
Address: Level 14, 32 Turbot Street, Brisbane, QLD
Contact Name: Leesa Leathbridge
Contact Phone №: 07 3173 8730
Special Direction: # 6 eskies in total
Relinquished by (Signature):
(Time / Date): 13 34 2/3/2018

Purchase Order: 23200
Eurofins | mgt Quote №: 160329AUR

Project Manager: Leesa Leathbridge
Project №: Inland Rail Project

Project Name: Baseline Surface Water Monitoring
Electronic Results Format:
Email for Results: leesa.leathbridge@aurecongroup.com

Turn Around Requirements: ☐ 1 DAY* ☐ 2 DAY* ☐ 3 DAY* ☑ 5 DAY (Std) ☐ Other ( )
* Surcharges apply

Method of Shipment: ☐ Courier (# ) ☑ Hand Delivered ☐ Postal

Analysis (Note: Where metals are requested, please specify "Total" or "Filtered")

Containers

| № | Client Sample ID | Date | Matrix | pH | Suspended Solids (SS) | Turbidity | Speciated nitrogens (ammonia, nitrate, nitrite, organic nitrogen, oxidised nitrogen, total kjeldahl nitrogen, total nitrogen) | Electrical conductivity (Actual and specific) | M8 - 8 metals | Total Phosphorus | Reactive Phosphorus | Chlorophyll a | Polycyclic aromatic hydrocarbons (PAH) | Salinity (ppt) | Dissolved oxygen (% saturation) | Dissolved oxygen (mg/L) | 1L Plastic | 250mL Plastic | 125mL Plastic | 200mL Amber Glass | 40mL vial | 125mL Amber Glass | Jar | 60 ml plastic | Sample Comments / DG Hazard Warning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | C2KTRIP | 28/02/18 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 2 | C2K14A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 3 | C2K2A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 4 | H2C 11A | 01/03/18 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 5 | H2C15A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 6 | G2H 10A (Alt) | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 7 | G2H 9A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 8 | G2H 8A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 9 | G2H 7A (Alt) | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 10 | G2H 6A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 11 | G2H 5A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 12 | G2H 4A | " | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |

**Laboratory Use Only**

Received By B. Palambi SYD | [✓ BNE] | MEL | PER | ADL | NEW | DAR Date 2/3/18 Time 1 40 Signature Temperature 13.2

Received By SYD | BNE | MEL | PER | ADL | NEW | DAR Date __/__/__ Time __:__ Signature Report №

**Submission of samples to the laboratory will be deemed as acceptance of Eurofins | mgt Standard Terms and Conditions unless agreed otherwise. A copy of Eurofins | mgt Standard Terms and Conditions is available on request.**

# Certificate of Analysis

**NATA Accredited**
**Accreditation Number 1261**
**Site Number 20794**

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

**Aurecon Australia (BRIS) Pty Ltd**
**Level 14, 32 Turbot St**
**Brisbane**
**QLD 4001**

**Attention:** **LEESA LEATHBRIDGE**

**Report** **587469-W**
Project name BASELINE SURFACE WATER MONITORING
Project ID INLAND RAIL PROJECT
Received Date Mar 02, 2018

| **Client Sample ID** | | | **G2H 1A** | **G2H DUP1** | **G2H TRIP1** | **G2H 2A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B18-Ma02442** | **B18-Ma02443** | **B18-Ma02444** | **B18-Ma02446** |
| **Date Sampled** | | | **Mar 01, 2018** | **Mar 01, 2018** | **Mar 01, 2018** | **Mar 01, 2018** |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene$^{N07}$ | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 101 | 50 | 60 | 66 |
| p-Terphenyl-d14 (surr.) | 1 | % | 95 | 53 | 54 | 87 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.04 | 0.17 | 0.03 | 0.04 |
| Chlorophyll a | 5 | ug/L | < 5 | < 5 | < 5 | < 5 |
| Conductivity (at 25°C) | 1 | uS/cm | 760 | 770 | 760 | 430 |
| Dissolved Oxygen | 0.01 | mg/L | 8.0 | 7.6 | 7.9 | 8.2 |
| Dissolved Oxygen (% Saturation) | | % | 88 | 85 | 87 | 91 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | 1.9 | 1.9 | 1.8 | 1.3 |
| Nitrate (as N) | 0.02 | mg/L | 1.9 | 1.9 | 1.8 | 1.2 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | < 0.02 | 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 1.3 | 0.6 | 1.2 | 0.7 |
| pH (at 25°C) | 0.1 | pH Units | 8.0 | 7.9 | 8.1 | 8.3 |
| Phosphate total (as P) | 0.05 | mg/L | 1.2 | 1.3 | 1.1 | 0.11 |
| Phosphorus reactive (as P) | 0.05 | mg/L | 0.92 | 0.90 | 0.92 | < 0.05 |
| Salinity (determined from EC)* | 20 | mg/L | 370 | 380 | 370 | 210 |
| Suspended Solids | 1 | mg/L | 2.0 | 3.2 | 3.5 | 2.6 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 1.3 | 0.8 | 1.2 | 0.7 |

| **Client Sample ID** | | | **G2H 1A** | **G2H DUP1** | **G2H TRIP1** | **G2H 2A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B18-Ma02442** | **B18-Ma02443** | **B18-Ma02444** | **B18-Ma02446** |
| **Date Sampled** | | | **Mar 01, 2018** | **Mar 01, 2018** | **Mar 01, 2018** | **Mar 01, 2018** |
| Test/Reference | LOR | Unit | | | | |
| | | | | | | |
| Total Nitrogen (as N) | 0.2 | mg/L | 2.2 | 2.7 | 3.0 | 2.0 |
| Turbidity | 1 | NTU | 2.8 | 2.5 | 2.4 | 3.1 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | 0.011 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | 0.008 | 0.009 | 0.008 | 0.002 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | 0.003 | 0.007 | 0.003 | 0.001 |
| Zinc (filtered) | 0.005 | mg/L | 0.052 | 0.054 | 0.051 | < 0.005 |

| **Client Sample ID** | | | **G2H 3A** | **H2C 2A** | **H2C 13A** | **H2C 14A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B18-Ma02447** | **B18-Ma02448** | **B18-Ma02449** | **B18-Ma02450** |
| **Date Sampled** | | | **Mar 01, 2018** | **Mar 01, 2018** | **Mar 02, 2018** | **Mar 02, 2018** |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene$^{N07}$ | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 73 | 79 | 56 | 63 |
| p-Terphenyl-d14 (surr.) | 1 | % | 83 | 112 | 52 | 61 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | < 0.01 | 0.03 | 0.04 | 0.02 |
| Chlorophyll a | 5 | ug/L | < 5 | < 5 | < 5 | < 5 |
| Conductivity (at 25°C) | 1 | uS/cm | 410 | 3600 | 310 | 300 |
| Dissolved Oxygen | 0.01 | mg/L | 8.4 | 7.2 | 6.9 | 7.1 |
| Dissolved Oxygen (% Saturation) | | % | 93 | 80 | 77 | 78 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | 1.4 | 37 | 0.14 | 0.22 |
| Nitrate (as N) | 0.02 | mg/L | 1.4 | 37 | 0.13 | 0.20 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | 0.34 | < 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 0.8 | 1.9 | 0.6 | 0.5 |
| pH (at 25°C) | 0.1 | pH Units | 8.1 | 7.9 | 8.0 | 8.1 |

| **Client Sample ID**<br>**Sample Matrix**<br>**Eurofins \| mgt Sample No.**<br>**Date Sampled**<br>Test/Reference | LOR | Unit | **G2H 3A**<br>**Water**<br>**B18-Ma02447**<br>**Mar 01, 2018** | **H2C 2A**<br>**Water**<br>**B18-Ma02448**<br>**Mar 01, 2018** | **H2C 13A**<br>**Water**<br>**B18-Ma02449**<br>**Mar 02, 2018** | **H2C 14A**<br>**Water**<br>**B18-Ma02450**<br>**Mar 02, 2018** |
|---|---|---|---|---|---|---|
| | | | | | | |
| Phosphate total (as P) | 0.05 | mg/L | 0.24 | 0.32 | 0.44 | 0.40 |
| Phosphorus reactive (as P) | 0.05 | mg/L | < 0.05 | 0.13 | 0.25 | 0.21 |
| Salinity (determined from EC)* | 20 | mg/L | 200 | 1900 | 150 | 140 |
| Suspended Solids | 1 | mg/L | 5.9 | 2.8 | 13 | 11 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 0.8 | 1.9 | 0.6 | 0.5 |
| Total Nitrogen (as N) | 0.2 | mg/L | 2.2 | 43 | 0.74 | 0.72 |
| Turbidity | 1 | NTU | 2.8 | 1.7 | 17 | 14 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | 0.001 | 0.004 | 0.003 | 0.001 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | 0.002 | 0.006 | 0.006 | 0.002 |
| Zinc (filtered) | 0.005 | mg/L | 0.006 | < 0.005 | < 0.005 | 0.012 |

| **Client Sample ID**<br>**Sample Matrix**<br>**Eurofins \| mgt Sample No.**<br>**Date Sampled**<br>Test/Reference | LOR | Unit | **H2C 17A**<br>**Water**<br>**B18-Ma02451**<br>**Mar 02, 2018** | **C2K 1A (ALT)**<br>**Water**<br>**B18-Ma02452**<br>**Mar 02, 2018** | **C2K 11A**<br>**Water**<br>**B18-Ma02453**<br>**Feb 27, 2018** | **C2K 10A**<br>**Water**<br>**B18-Ma02454**<br>**Feb 27, 2018** |
|---|---|---|---|---|---|---|
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene$^{N07}$ | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 69 | 57 | 72 | 69 |
| p-Terphenyl-d14 (surr.) | 1 | % | 87 | 70 | 83 | 78 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.02 | 0.02 | 0.05 | 0.02 |
| Chlorophyll a | 5 | ug/L | < 5 | < 5 | < 5 | 6.0 |
| Conductivity (at 25°C) | 1 | uS/cm | 340 | 290 | 49 | 470 |
| Dissolved Oxygen | 0.01 | mg/L | 7.8 | 6.8 | 4.1 | 7.9 |
| Dissolved Oxygen (% Saturation) | | % | 87 | 75 | 45 | 88 |

| Client Sample ID | | | H2C 17A | C2K 1A (ALT) | C2K 11A | C2K 10A |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B18-Ma02451** | **B18-Ma02452** | **B18-Ma02453** | **B18-Ma02454** |
| **Date Sampled** | | | **Mar 02, 2018** | **Mar 02, 2018** | **Feb 27, 2018** | **Feb 27, 2018** |
| Test/Reference | LOR | Unit | | | | |
| | | | | | | |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | 0.19 | 0.25 | < 0.05 | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | 0.16 | 0.20 | < 0.02 | < 0.02 |
| Nitrite (as N) | 0.02 | mg/L | 0.03 | 0.05 | < 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 0.3 | 1.0 | 0.6 | 0.5 |
| pH (at 25°C) | 0.1 | pH Units | 8.3 | 7.7 | 6.8 | 8.0 |
| Phosphate total (as P) | 0.05 | mg/L | 0.39 | 0.48 | 0.18 | 0.06 |
| Phosphorus reactive (as P) | 0.05 | mg/L | 0.20 | 0.32 | < 0.05 | < 0.05 |
| Salinity (determined from EC)* | 20 | mg/L | 160 | 140 | 30 | 230 |
| Suspended Solids | 1 | mg/L | 21 | 22 | 33 | 14 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 0.3 | 1.0 | 0.6 | 0.5 |
| Total Nitrogen (as N) | 0.2 | mg/L | 0.49 | 1.3 | 0.6 | 0.5 |
| Turbidity | 1 | NTU | 8.4 | 58 | 32 | 9.0 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | < 0.001 | 0.003 | < 0.001 | < 0.001 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | 0.001 | 0.004 | < 0.001 | < 0.001 |
| Zinc (filtered) | 0.005 | mg/L | < 0.005 | 0.008 | < 0.005 | < 0.005 |

| Client Sample ID | | | C2K 9A | C2K 7A | C2K 8A | C2K 7A (ALT) |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B18-Ma02455** | **B18-Ma02456** | **B18-Ma02457** | **B18-Ma02458** |
| **Date Sampled** | | | **Feb 27, 2018** | **Feb 27, 2018** | **Feb 28, 2018** | **Feb 28, 2018** |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene$^{N07}$ | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 59 | 60 | 81 | 81 |
| p-Terphenyl-d14 (surr.) | 1 | % | 58 | 60 | 81 | 108 |

| **Client Sample ID**<br>**Sample Matrix**<br>**Eurofins \| mgt Sample No.**<br>**Date Sampled**<br>Test/Reference | LOR | Unit | **C2K 9A**<br>**Water**<br>**B18-Ma02455**<br>**Feb 27, 2018** | **C2K 7A**<br>**Water**<br>**B18-Ma02456**<br>**Feb 27, 2018** | **C2K 8A**<br>**Water**<br>**B18-Ma02457**<br>**Feb 28, 2018** | **C2K 7A (ALT)**<br>**Water**<br>**B18-Ma02458**<br>**Feb 28, 2018** |
|---|---|---|---|---|---|---|
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.03 | 0.03 | 0.02 | < 0.01 |
| Chlorophyll a | 5 | ug/L | < 5 | < 5 | < 5 | < 5 |
| Conductivity (at 25°C) | 1 | uS/cm | 160 | 180 | 180 | 140 |
| Dissolved Oxygen | 0.01 | mg/L | 7.5 | 8.3 | 7.9 | 8.4 |
| Dissolved Oxygen (% Saturation) | | % | 83 | 92 | 87 | 93 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | 0.06 | 0.07 | 0.07 | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | 0.04 | 0.07 | 0.06 | < 0.02 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | < 0.02 | 0.03 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 0.8 | 0.9 | 0.7 | 0.5 |
| pH (at 25°C) | 0.1 | pH Units | 7.4 | 7.7 | 7.6 | 7.4 |
| Phosphate total (as P) | 0.05 | mg/L | 0.08 | 0.09 | 0.07 | 0.07 |
| Phosphorus reactive (as P) | 0.05 | mg/L | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Salinity (determined from EC)* | 20 | mg/L | 80 | 90 | 90 | 70 |
| Suspended Solids | 1 | mg/L | 45 | 14 | 7.7 | 10 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 0.8 | 0.9 | 0.7 | 0.5 |
| Total Nitrogen (as N) | 0.2 | mg/L | 0.86 | 0.97 | 0.77 | 0.5 |
| Turbidity | 1 | NTU | 140 | 120 | 99 | 90 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | 0.002 | 0.001 | < 0.001 | < 0.001 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | 0.002 | 0.001 | < 0.001 | < 0.001 |
| Zinc (filtered) | 0.005 | mg/L | 0.009 | < 0.005 | 0.010 | < 0.005 |

| **Client Sample ID**<br>**Sample Matrix**<br>**Eurofins \| mgt Sample No.**<br>**Date Sampled**<br>Test/Reference | LOR | Unit | **C2K 13A**<br>**Water**<br>**B18-Ma02459**<br>**Feb 28, 2018** | **C2K 6A**<br>**Water**<br>**B18-Ma02460**<br>**Feb 28, 2018** | **C2K 12A**<br>**Water**<br>**B18-Ma02461**<br>**Feb 28, 2018** | **C2K 5A (1)**<br>**Water**<br>**B18-Ma02462**<br>**Feb 28, 2018** |
|---|---|---|---|---|---|---|
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene[N07] | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |

| Client Sample ID | | | C2K 13A | C2K 6A | C2K 12A | C2K 5A (1) |
|---|---|---|---|---|---|---|
| Sample Matrix | | | Water | Water | Water | Water |
| Eurofins \| mgt Sample No. | | | B18-Ma02459 | B18-Ma02460 | B18-Ma02461 | B18-Ma02462 |
| Date Sampled | | | Feb 28, 2018 | Feb 28, 2018 | Feb 28, 2018 | Feb 28, 2018 |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 99 | 79 | 55 | 79 |
| p-Terphenyl-d14 (surr.) | 1 | % | 64 | 118 | 58 | 113 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | < 0.01 | 0.02 | 0.07 | 0.19 |
| Chlorophyll a | 5 | ug/L | < 5 | < 5 | < 5 | < 5 |
| Conductivity (at 25°C) | 1 | uS/cm | 200 | 250 | 180 | 130 |
| Dissolved Oxygen | 0.01 | mg/L | 7.4 | 7.3 | 7.3 | 2.8 |
| Dissolved Oxygen (% Saturation) | | % | 82 | 80 | 81 | 32 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | < 0.05 | < 0.05 | 0.19 | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | 0.19 | < 0.02 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | < 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 0.6 | 0.7 | 0.6 | 1.1 |
| pH (at 25°C) | 0.1 | pH Units | 7.6 | 7.6 | 7.3 | 6.8 |
| Phosphate total (as P) | 0.05 | mg/L | 0.07 | 0.08 | 0.08 | 0.12 |
| Phosphorus reactive (as P) | 0.05 | mg/L | < 0.05 | < 0.05 | < 0.05 | 0.07 |
| Salinity (determined from EC)* | 20 | mg/L | 95 | 120 | 90 | 65 |
| Suspended Solids | 1 | mg/L | 20 | 26 | 6.4 | 17 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 0.6 | 0.7 | 0.7 | 1.1 |
| Total Nitrogen (as N) | 0.2 | mg/L | 0.6 | 0.7 | 0.89 | 1.1 |
| Turbidity | 1 | NTU | 120 | 98 | 97 | 56 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | 0.001 | 0.001 | 0.002 | 0.003 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | 0.001 | 0.001 | 0.001 | 0.002 |
| Zinc (filtered) | 0.005 | mg/L | 0.011 | 0.006 | < 0.005 | 0.009 |

| Client Sample ID | | | C2K 5A | C2K DUP1 | C2K TRIP | C2K 14A |
|---|---|---|---|---|---|---|
| Sample Matrix | | | Water | Water | Water | Water |
| Eurofins \| mgt Sample No. | | | B18-Ma02463 | B18-Ma02464 | B18-Ma02465 | B18-Ma02466 |
| Date Sampled | | | Feb 28, 2018 | Feb 28, 2018 | Feb 28, 2018 | Feb 28, 2018 |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene[N07] | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |

| **Client Sample ID** | | | **C2K 5A** | **C2K DUP1** | **C2K TRIP** | **C2K 14A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B18-Ma02463** | **B18-Ma02464** | **B18-Ma02465** | **B18-Ma02466** |
| **Date Sampled** | | | **Feb 28, 2018** | **Feb 28, 2018** | **Feb 28, 2018** | **Feb 28, 2018** |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 53 | 105 | 84 | 68 |
| p-Terphenyl-d14 (surr.) | 1 | % | 64 | 132 | 117 | 88 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.28 | 0.15 | 0.23 | 0.02 |
| Chlorophyll a | 5 | ug/L | 11 | 19 | 19 | < 5 |
| Conductivity (at 25°C) | 1 | uS/cm | 270 | 270 | 260 | 220 |
| Dissolved Oxygen | 0.01 | mg/L | 7.4 | 7.9 | 7.2 | 7.7 |
| Dissolved Oxygen (% Saturation) | | % | 82 | 87 | 80 | 85 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | < 0.02 | < 0.02 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | < 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 1.2 | 1.2 | 1.2 | 0.7 |
| pH (at 25°C) | 0.1 | pH Units | 8.5 | 8.9 | 8.9 | 7.6 |
| Phosphate total (as P) | 0.05 | mg/L | 0.07 | 0.06 | 0.05 | 0.09 |
| Phosphorus reactive (as P) | 0.05 | mg/L | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Salinity (determined from EC)* | 20 | mg/L | 130 | 130 | 125 | 110 |
| Suspended Solids | 1 | mg/L | 25 | 10 | 12 | 9.3 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 1.5 | 1.4 | 1.4 | 0.7 |
| Total Nitrogen (as N) | 0.2 | mg/L | 1.5 | 1.4 | 1.4 | 0.7 |
| Turbidity | 1 | NTU | 7.9 | 6.9 | 7.0 | 62 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | 0.002 | 0.002 | 0.002 | < 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | 0.002 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | 0.002 |
| Zinc (filtered) | 0.005 | mg/L | < 0.005 | < 0.005 | < 0.005 | < 0.005 |

| **Client Sample ID** | | | **C2K 2A** | **H2C 11A** | **G2H 10A (ALT)** | **G2H 9A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B18-Ma02467** | **B18-Ma02468** | **B18-Ma02470** | **B18-Ma02471** |
| **Date Sampled** | | | **Feb 28, 2018** | **Mar 01, 2018** | **Mar 01, 2018** | **Mar 01, 2018** |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |

| **Client Sample ID** | | | **C2K 2A** | **H2C 11A** | **G2H 10A (ALT)** | **G2H 9A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B18-Ma02467** | **B18-Ma02468** | **B18-Ma02470** | **B18-Ma02471** |
| **Date Sampled** | | | **Feb 28, 2018** | **Mar 01, 2018** | **Mar 01, 2018** | **Mar 01, 2018** |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Benzo(b&j)fluoranthene$^{N07}$ | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 77 | 73 | 96 | 76 |
| p-Terphenyl-d14 (surr.) | 1 | % | 83 | 104 | 127 | 94 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.07 | < 0.01 | 0.19 | < 0.01 |
| Chlorophyll a | 5 | ug/L | < 5 | 29 | 12 | < 5 |
| Conductivity (at 25°C) | 1 | uS/cm | 200 | 1100 | 510 | 810 |
| Dissolved Oxygen | 0.01 | mg/L | 5.8 | 5.9 | 4.6 | 5.9 |
| Dissolved Oxygen (% Saturation) | | % | 65 | 64 | 51 | 65 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | 0.05 | < 0.05 | 0.23 | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | 0.05 | < 0.02 | 0.21 | < 0.02 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 0.7 | 0.7 | 0.6 | 0.3 |
| pH (at 25°C) | 0.1 | pH Units | 7.4 | 8.5 | 7.8 | 8.0 |
| Phosphate total (as P) | 0.05 | mg/L | 0.54 | 0.19 | 0.25 | 0.09 |
| Phosphorus reactive (as P) | 0.05 | mg/L | 0.36 | < 0.05 | 0.06 | < 0.05 |
| Salinity (determined from EC)* | 20 | mg/L | 100 | 500 | 250 | 400 |
| Suspended Solids | 1 | mg/L | 49 | 53 | 170 | 4.0 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 0.8 | 0.7 | 0.8 | 0.3 |
| Total Nitrogen (as N) | 0.2 | mg/L | 0.85 | 0.7 | 1.0 | 0.3 |
| Turbidity | 1 | NTU | 95 | 32 | 420 | 2.8 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | < 0.001 | 0.001 | 0.001 | < 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | 0.004 | < 0.001 | 0.003 | < 0.001 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | 0.004 | 0.002 | 0.009 | < 0.001 |
| Zinc (filtered) | 0.005 | mg/L | < 0.005 | < 0.005 | 0.005 | < 0.005 |

| **Client Sample ID** | | | **G2H 7A (ALT)** | **G2H 6A** | **G2H 5A** | **G2H 4A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B18-Ma02473** | **B18-Ma02474** | **B18-Ma02475** | **B18-Ma02476** |
| **Date Sampled** | | | **Mar 01, 2018** | **Mar 01, 2018** | **Mar 01, 2018** | **Mar 01, 2018** |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene$^{N07}$ | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 70 | 104 | 81 | 86 |
| p-Terphenyl-d14 (surr.) | 1 | % | 96 | 147 | 107 | 120 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.02 | 0.03 | 0.11 | < 0.01 |
| Chlorophyll a | 5 | ug/L | < 5 | < 5 | < 5 | < 5 |
| Conductivity (at 25°C) | 1 | uS/cm | 570 | 800 | 950 | 1000 |
| Dissolved Oxygen | 0.01 | mg/L | 5.7 | 6.8 | 8.4 | 6.7 |
| Dissolved Oxygen (% Saturation) | | % | 64 | 75 | 93 | 74 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | 0.46 | 0.31 | 0.18 | 0.13 |
| Nitrate (as N) | 0.02 | mg/L | 0.41 | 0.30 | 0.17 | 0.12 |
| Nitrite (as N) | 0.02 | mg/L | 0.05 | < 0.02 | < 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 1.2 | 0.4 | 0.3 | 0.3 |
| pH (at 25°C) | 0.1 | pH Units | 7.6 | 8.1 | 8.6 | 8.4 |
| Phosphate total (as P) | 0.05 | mg/L | 0.09 | 0.12 | 0.17 | 0.25 |
| Phosphorus reactive (as P) | 0.05 | mg/L | < 0.05 | < 0.05 | 0.06 | 0.08 |
| Salinity (determined from EC)* | 20 | mg/L | 280 | 400 | 460 | 490 |
| Suspended Solids | 1 | mg/L | 89 | 18 | 18 | 30 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 1.2 | 0.4 | 0.4 | 0.3 |
| Total Nitrogen (as N) | 0.2 | mg/L | 1.7 | 0.7 | 0.58 | 0.43 |
| Turbidity | 1 | NTU | 210 | 28 | 11 | 19 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | 0.002 | < 0.001 | < 0.001 | < 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | 0.006 | 0.001 | 0.002 | 0.001 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | 0.006 | 0.004 | 0.003 | 0.003 |
| Zinc (filtered) | 0.005 | mg/L | < 0.005 | < 0.005 | 0.011 | < 0.005 |

## Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

| **Description** | **Testing Site** | **Extracted** | **Holding Time** |
|---|---|---|---|
| Polycyclic Aromatic Hydrocarbons | Melbourne | Mar 08, 2018 | 7 Day |
| - Method: LTM-ORG-2130 PAH and Phenols in Water by GCMS | | | |
| Chlorophyll a | Melbourne | Mar 06, 2018 | 2 Day |
| - Method: APHA Method 10200H | | | |
| Conductivity (at 25°C) | Melbourne | Mar 05, 2018 | 28 Day |
| - Method: LTM-INO-4030 Conductivity | | | |
| Dissolved Oxygen | Melbourne | Mar 05, 2018 | 1 Day |
| - Method: LTM-INO-4130 Determination of Dissolved Oxygen using a DO meter | | | |
| Dissolved Oxygen (% Saturation) | Melbourne | Mar 05, 2018 | 1 Day |
| - Method: LTM-INO-4130 Determination of Dissolved Oxygen using a DO meter | | | |
| pH (at 25°C) | Melbourne | Mar 05, 2018 | 0 Hours |
| - Method: LTM-GEN-7090 pH in water by ISE | | | |
| Phosphate total (as P) | Melbourne | Mar 05, 2018 | 28 Day |
| - Method: APHA 4500-P E. Phosphorous | | | |
| Phosphorus reactive (as P) | Melbourne | Mar 05, 2018 | 2 Day |
| - Method: APHA4500-PO4 | | | |
| Salinity (determined from EC)* | Brisbane | Mar 08, 2018 | 0 Day |
| Suspended Solids | Melbourne | Mar 05, 2018 | 7 Days |
| - Method: LTM-INO-4070 Analysis of Suspended Solids in Water by Gravimetry | | | |
| Turbidity | Melbourne | Mar 06, 2018 | 2 Day |
| - Method: LTM-INO-4140 Turbidity by Nephelometric Method | | | |
| Metals M8 filtered | Melbourne | Mar 05, 2018 | 28 Day |
| - Method: LTM-MET-3040 Metals in Waters by ICP-MS | | | |
| Nitrogens (speciated) | | | |
| Ammonia (as N) | Melbourne | Mar 05, 2018 | 28 Day |
| - Method: APHA 4500-NH3 Ammonia Nitrogen by FIA | | | |
| Nitrate & Nitrite (as N) | Melbourne | Mar 05, 2018 | 28 Day |
| - Method: APHA 4500-NO3/NO2 Nitrate-Nitrite Nitrogen by FIA | | | |
| Nitrate (as N) | Melbourne | Mar 05, 2018 | 7 Day |
| - Method: APHA 4500-NO3 Nitrate Nitrogen by FIA | | | |
| Nitrite (as N) | Melbourne | Mar 05, 2018 | 2 Day |
| - Method: APHA 4500-NO2 Nitrite Nitrogen by FIA | | | |
| Organic Nitrogen (as N) | Melbourne | Mar 02, 2018 | 7 Day |
| - Method: APHA 4500 Organic Nitrogen (N) | | | |
| Total Kjeldahl Nitrogen (as N) | Melbourne | Mar 05, 2018 | 7 Day |
| - Method: APHA 4500 TKN | | | |

## Repeat Samples

| **Description** | **Testing Site** | **Extracted** | **Holding Time** |
|---|---|---|---|
| Nitrogens (speciated) | | | |
| Nitrate & Nitrite (as N) | Melbourne | Mar 08, 2018 | 28 Day |
| - Method: APHA 4500-NO3/NO2 Nitrate-Nitrite Nitrogen by FIA | | | |
| Nitrate (as N) | Melbourne | Mar 08, 2018 | 7 Day |
| - Method: APHA 4500-NO3 Nitrate Nitrogen by FIA | | | |
| Nitrite (as N) | Melbourne | Mar 08, 2018 | 2 Day |
| - Method: APHA 4500-NO2 Nitrite Nitrogen by FIA | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Company Name:** | Aurecon Australia (BRIS) Pty Ltd | **Order No.:** | 23200 | **Received:** | Mar 2, 2018 1:40 PM |
| **Address:** | Level 14, 32 Turbot St<br>Brisbane<br>QLD 4001 | **Report #:** | 587469 | **Due:** | Mar 9, 2018 |
| | | **Phone:** | 07 3173 8000 | **Priority:** | 5 Day |
| | | **Fax:** | +61 7 3173 8001 | **Contact Name:** | LEESA LEATHBRIDGE |
| **Project Name:** | BASELINE SURFACE WATER MONITORING | | | | |
| **Project ID:** | INLAND RAIL PROJECT | | | | |

**Eurofins | mgt Analytical Services Manager : Ryan Gilbert**

| **Sample Detail** | | | | | | Chlorophyll a | Conductivity (at 25°C) | Dissolved Oxygen | Dissolved Oxygen (% Saturation) | pH (at 25°C) | Phosphate total (as P) | Phosphorus reactive (as P) | Salinity (expressed as TDS)* | Suspended Solids | Turbidity | Polycyclic Aromatic Hydrocarbons | Metals M8 filtered | Nitrogens (speciated) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Melbourne Laboratory - NATA Site # 1254 & 14271** | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **Sydney Laboratory - NATA Site # 18217** | | | | | | | | | | | | | | | | | | |
| **Brisbane Laboratory - NATA Site # 20794** | | | | | | | | | | | | | | | | | | |
| **Perth Laboratory - NATA Site # 23736** | | | | | | | | | | | | | | | | | | |
| **External Laboratory** | | | | | | | | | | | | | | | | | | |
| **No** | **Sample ID** | **Sample Date** | **Sampling Time** | **Matrix** | **LAB ID** | | | | | | | | | | | | | |
| 1 | G2H 1A | Mar 01, 2018 | | Water | B18-Ma02442 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 2 | G2H DUP1 | Mar 01, 2018 | | Water | B18-Ma02443 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 3 | G2H TRIP1 | Mar 01, 2018 | | Water | B18-Ma02444 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 4 | G2H 2A | Mar 01, 2018 | | Water | B18-Ma02446 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 5 | G2H 3A | Mar 01, 2018 | | Water | B18-Ma02447 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 6 | H2C 2A | Mar 01, 2018 | | Water | B18-Ma02448 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 7 | H2C 13A | Mar 02, 2018 | | Water | B18-Ma02449 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 8 | H2C 14A | Mar 02, 2018 | | Water | B18-Ma02450 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 9 | H2C 17A | Mar 02, 2018 | | Water | B18-Ma02451 | X | X | X | X | X | X | X | X | X | X | X | X | X |

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**Phone:** 07 3173 8000
**Fax:** +61 7 3173 8001

**Received:** Mar 2, 2018 1:40 PM
**Due:** Mar 9, 2018
**Priority:** 5 Day
**Contact Name:** LEESA LEATHBRIDGE

**Project Name:** BASELINE SURFACE WATER MONITORING
**Project ID:** INLAND RAIL PROJECT

**Eurofins | mgt Analytical Services Manager : Ryan Gilbert**

| **Sample Detail** | | | | | | Chlorophyll a | Conductivity (at 25°C) | Dissolved Oxygen | Dissolved Oxygen (% Saturation) | pH (at 25°C) | Phosphate total (as P) | Phosphorus reactive (as P) | Salinity (expressed as TDS)* | Suspended Solids | Turbidity | Polycyclic Aromatic Hydrocarbons | Metals M8 filtered | Nitrogens (speciated) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Melbourne Laboratory - NATA Site # 1254 & 14271** | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **Sydney Laboratory - NATA Site # 18217** | | | | | | | | | | | | | | | | | | |
| **Brisbane Laboratory - NATA Site # 20794** | | | | | | | | | | | | | | | | | | |
| **Perth Laboratory - NATA Site # 23736** | | | | | | | | | | | | | | | | | | |
| 10 | C2K 1A (ALT) | Mar 02, 2018 | | Water | B18-Ma02452 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 11 | C2K 11A | Feb 27, 2018 | | Water | B18-Ma02453 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 12 | C2K 10A | Feb 27, 2018 | | Water | B18-Ma02454 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 13 | C2K 9A | Feb 27, 2018 | | Water | B18-Ma02455 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 14 | C2K 7A | Feb 27, 2018 | | Water | B18-Ma02456 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 15 | C2K 8A | Feb 28, 2018 | | Water | B18-Ma02457 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 16 | C2K 7A (ALT) | Feb 28, 2018 | | Water | B18-Ma02458 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 17 | C2K 13A | Feb 28, 2018 | | Water | B18-Ma02459 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 18 | C2K 6A | Feb 28, 2018 | | Water | B18-Ma02460 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 19 | C2K 12A | Feb 28, 2018 | | Water | B18-Ma02461 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 20 | C2K 5A (1) | Feb 28, 2018 | | Water | B18-Ma02462 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 21 | C2K 5A | Feb 28, 2018 | | Water | B18-Ma02463 | X | X | X | X | X | X | X | X | X | X | X | X | X |

| | | | | | |
|---|---|---|---|---|---|
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**Eurofins | mgt Analytical Services Manager : Ryan Gilbert**

| **Sample Detail** | | | | | | Chlorophyll a | Conductivity (at 25°C) | Dissolved Oxygen | Dissolved Oxygen (% Saturation) | pH (at 25°C) | Phosphate total (as P) | Phosphorus reactive (as P) | Salinity (expressed as TDS)* | Suspended Solids | Turbidity | Polycyclic Aromatic Hydrocarbons | Metals M8 filtered | Nitrogens (speciated) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Melbourne Laboratory - NATA Site # 1254 & 14271** | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **Sydney Laboratory - NATA Site # 18217** | | | | | | | | | | | | | | | | | | |
| **Brisbane Laboratory - NATA Site # 20794** | | | | | | | | | | | | | | | | | | |
| **Perth Laboratory - NATA Site # 23736** | | | | | | | | | | | | | | | | | | |
| 22 | C2K DUP1 | Feb 28, 2018 | | Water | B18-Ma02464 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 23 | C2K TRIP | Feb 28, 2018 | | Water | B18-Ma02465 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 24 | C2K 14A | Feb 28, 2018 | | Water | B18-Ma02466 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 25 | C2K 2A | Feb 28, 2018 | | Water | B18-Ma02467 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 26 | H2C 11A | Mar 01, 2018 | | Water | B18-Ma02468 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 27 | G2H 10A (ALT) | Mar 01, 2018 | | Water | B18-Ma02470 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 28 | G2H 9A | Mar 01, 2018 | | Water | B18-Ma02471 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 29 | G2H 7A (ALT) | Mar 01, 2018 | | Water | B18-Ma02473 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 30 | G2H 6A | Mar 01, 2018 | | Water | B18-Ma02474 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 31 | G2H 5A | Mar 01, 2018 | | Water | B18-Ma02475 | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 32 | G2H 4A | Mar 01, 2018 | | Water | B18-Ma02476 | X | X | X | X | X | X | X | X | X | X | X | X | X |

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| **Sample Detail** | Chlorophyll a | Conductivity (at 25°C) | Dissolved Oxygen | Dissolved Oxygen (% Saturation) | pH (at 25°C) | Phosphate total (as P) | Phosphorus reactive (as P) | Salinity (expressed as TDS)* | Suspended Solids | Turbidity | Polycyclic Aromatic Hydrocarbons | Metals M8 filtered | Nitrogens (speciated) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Melbourne Laboratory - NATA Site # 1254 & 14271** | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **Sydney Laboratory - NATA Site # 18217** | | | | | | | | | | | | | |
| **Brisbane Laboratory - NATA Site # 20794** | | | | | | | | | | | | | |
| **Perth Laboratory - NATA Site # 23736** | | | | | | | | | | | | | |
| **Test Counts** | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 |

## Internal Quality Control Review and Glossary

### General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

### Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

### Units

**mg/kg:** milligrams per kilogram

**ug/L:** micrograms per litre

**ppb:** Parts per billion

**org/100mL:** Organisms per 100 millilitres

**MPN/100mL:** Most Probable Number of organisms per 100 millilitres

**mg/L:** milligrams per litre

**ppm:** Parts per million

**%:** Percentage

**NTU:** Nephelometric Turbidity Units

### Terms

| | |
|---|---|
| **Dry** | Where a moisture has been determined on a solid sample the result is expressed on a dry basis. |
| **LOR** | Limit of Reporting. |
| **SPIKE** | Addition of the analyte to the sample and reported as percentage recovery. |
| **RPD** | Relative Percent Difference between two Duplicate pieces of analysis. |
| **LCS** | Laboratory Control Sample - reported as percent recovery. |
| **CRM** | Certified Reference Material - reported as percent recovery. |
| **Method Blank** | In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water. |
| **Surr - Surrogate** | The addition of a like compound to the analyte target and reported as percentage recovery. |
| **Duplicate** | A second piece of analysis from the same sample and reported in the same units as the result to show comparison. |
| **USEPA** | United States Environmental Protection Agency |
| **APHA** | American Public Health Association |
| **TCLP** | Toxicity Characteristic Leaching Procedure |
| **COC** | Chain of Custody |
| **SRA** | Sample Receipt Advice |
| **QSM** | Quality Systems Manual ver 5.1 US Department of Defense |
| **CP** | Client Parent - QC was performed on samples pertaining to this report |
| **NCP** | Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within. |
| **TEQ** | Toxic Equivalency Quotient |

### QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results<10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

### QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

**Quality Control Results**

| Test | Lab Sample ID | Units | Result | Repeat | | | | Qualifying Code |
|---|---|---|---|---|---|---|---|---|
| **Repeat Analysis** | | | | | | | | |
| Nitrate & Nitrite (as N) | B18-Ma02448 | mg/L | 37 | 41 | | | | |
| Nitrate (as N) | B18-Ma02448 | mg/L | 37 | 41 | | | | |
| Nitrite (as N) | B18-Ma02448 | mg/L | 0.34 | < 0.4 | | | | |
| **Test** | | **Units** | **Result 1** | | | **Acceptance Limits** | **Pass Limits** | **Qualifying Code** |
| **Method Blank** | | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | | | |
| Acenaphthene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Acenaphthylene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Anthracene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benz(a)anthracene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(a)pyrene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(b&j)fluoranthene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(g.h.i)perylene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(k)fluoranthene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Chrysene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Dibenz(a.h)anthracene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Fluoranthene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Fluorene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Indeno(1.2.3-cd)pyrene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Naphthalene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Phenanthrene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Pyrene | | mg/L | < 0.001 | | | 0.001 | Pass | |
| **Method Blank** | | | | | | | | |
| Ammonia (as N) | | mg/L | < 0.01 | | | 0.01 | Pass | |
| Chlorophyll a | | ug/L | < 5 | | | 5 | Pass | |
| Dissolved Oxygen (% Saturation) | | % | 98 | | | | N/A | |
| Nitrate & Nitrite (as N) | | mg/L | < 0.05 | | | 0.05 | Pass | |
| Nitrate (as N) | | mg/L | < 0.02 | | | 0.02 | Pass | |
| Nitrite (as N) | | mg/L | < 0.02 | | | 0.02 | Pass | |
| Phosphate total (as P) | | mg/L | < 0.05 | | | 0.05 | Pass | |
| Phosphorus reactive (as P) | | mg/L | < 0.05 | | | 0.05 | Pass | |
| Suspended Solids | | mg/L | < 1 | | | 1 | Pass | |
| Total Kjeldahl Nitrogen (as N) | | mg/L | < 0.2 | | | 0.2 | Pass | |
| Turbidity | | NTU | < 1 | | | 1 | Pass | |
| **Method Blank** | | | | | | | | |
| **Heavy Metals** | | | | | | | | |
| Arsenic (filtered) | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Cadmium (filtered) | | mg/L | < 0.0002 | | | 0.0002 | Pass | |
| Chromium (filtered) | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Copper (filtered) | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Lead (filtered) | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Mercury (filtered) | | mg/L | < 0.0001 | | | 0.0001 | Pass | |
| Nickel (filtered) | | mg/L | < 0.001 | | | 0.001 | Pass | |
| Zinc (filtered) | | mg/L | < 0.005 | | | 0.005 | Pass | |
| **LCS - % Recovery** | | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | | | |
| Acenaphthene | | % | 106 | | | 70-130 | Pass | |
| Acenaphthylene | | % | 110 | | | 70-130 | Pass | |
| Anthracene | | % | 96 | | | 70-130 | Pass | |
| Benz(a)anthracene | | % | 96 | | | 70-130 | Pass | |

| Test | | | Units | Result 1 | | | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|---|---|
| Benzo(a)pyrene | | | % | 105 | | | 70-130 | Pass | |
| Benzo(b&j)fluoranthene | | | % | 76 | | | 70-130 | Pass | |
| Benzo(g.h.i)perylene | | | % | 89 | | | 70-130 | Pass | |
| Benzo(k)fluoranthene | | | % | 84 | | | 70-130 | Pass | |
| Chrysene | | | % | 84 | | | 70-130 | Pass | |
| Dibenz(a.h)anthracene | | | % | 120 | | | 70-130 | Pass | |
| Fluoranthene | | | % | 80 | | | 70-130 | Pass | |
| Fluorene | | | % | 109 | | | 70-130 | Pass | |
| Indeno(1.2.3-cd)pyrene | | | % | 124 | | | 70-130 | Pass | |
| Naphthalene | | | % | 95 | | | 70-130 | Pass | |
| Phenanthrene | | | % | 102 | | | 70-130 | Pass | |
| Pyrene | | | % | 104 | | | 70-130 | Pass | |
| **LCS - % Recovery** | | | | | | | | | |
| Ammonia (as N) | | | % | 109 | | | 70-130 | Pass | |
| Nitrate & Nitrite (as N) | | | % | 103 | | | 70-130 | Pass | |
| Nitrate (as N) | | | % | 83 | | | 70-130 | Pass | |
| Nitrite (as N) | | | % | 110 | | | 70-130 | Pass | |
| Phosphate total (as P) | | | % | 89 | | | 70-130 | Pass | |
| Phosphorus reactive (as P) | | | % | 106 | | | 70-130 | Pass | |
| Suspended Solids | | | % | 98 | | | 70-130 | Pass | |
| Total Kjeldahl Nitrogen (as N) | | | % | 91 | | | 70-130 | Pass | |
| **LCS - % Recovery** | | | | | | | | | |
| **Heavy Metals** | | | | | | | | | |
| Arsenic (filtered) | | | % | 90 | | | 80-120 | Pass | |
| Cadmium (filtered) | | | % | 92 | | | 80-120 | Pass | |
| Chromium (filtered) | | | % | 92 | | | 80-120 | Pass | |
| Copper (filtered) | | | % | 93 | | | 80-120 | Pass | |
| Lead (filtered) | | | % | 96 | | | 80-120 | Pass | |
| Mercury (filtered) | | | % | 102 | | | 70-130 | Pass | |
| Nickel (filtered) | | | % | 93 | | | 80-120 | Pass | |
| Zinc (filtered) | | | % | 94 | | | 80-120 | Pass | |
| **Test** | **Lab Sample ID** | **QA Source** | **Units** | **Result 1** | | | **Acceptance Limits** | **Pass Limits** | **Qualifying Code** |
| **Spike - % Recovery** | | | | | | | | | |
| **Heavy Metals** | | | | Result 1 | | | | | |
| Arsenic (filtered) | M18-Ma03965 | NCP | % | 92 | | | 70-130 | Pass | |
| Cadmium (filtered) | M18-Ma03965 | NCP | % | 96 | | | 70-130 | Pass | |
| Chromium (filtered) | M18-Ma03965 | NCP | % | 97 | | | 70-130 | Pass | |
| Copper (filtered) | M18-Ma03965 | NCP | % | 92 | | | 70-130 | Pass | |
| Lead (filtered) | M18-Ma03965 | NCP | % | 100 | | | 70-130 | Pass | |
| Mercury (filtered) | P18-Ma01481 | NCP | % | 81 | | | 70-130 | Pass | |
| Nickel (filtered) | M18-Ma03965 | NCP | % | 96 | | | 70-130 | Pass | |
| Zinc (filtered) | M18-Ma03965 | NCP | % | 96 | | | 70-130 | Pass | |
| **Spike - % Recovery** | | | | | | | | | |
| | | | | Result 1 | | | | | |
| Ammonia (as N) | B18-Ma02448 | CP | % | 101 | | | 70-130 | Pass | |
| Nitrite (as N) | B18-Ma02448 | CP | % | 106 | | | 70-130 | Pass | |
| **Spike - % Recovery** | | | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | Result 1 | | | | | |
| Acenaphthene | B18-Ma02451 | CP | % | 78 | | | 70-130 | Pass | |
| Acenaphthylene | B18-Ma02451 | CP | % | 90 | | | 70-130 | Pass | |
| Anthracene | B18-Ma02451 | CP | % | 84 | | | 70-130 | Pass | |
| Benz(a)anthracene | B18-Ma02451 | CP | % | 86 | | | 70-130 | Pass | |
| Benzo(a)pyrene | B18-Ma02451 | CP | % | 74 | | | 70-130 | Pass | |
| Benzo(b&j)fluoranthene | B18-Ma02451 | CP | % | 106 | | | 70-130 | Pass | |

| Test | Lab Sample ID | QA Source | Units | Result 1 |  |  | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|---|---|
| Benzo(g.h.i)perylene | B18-Ma02451 | CP | % | 72 |  |  | 70-130 | Pass |  |
| Benzo(k)fluoranthene | B18-Ma02451 | CP | % | 119 |  |  | 70-130 | Pass |  |
| Chrysene | B18-Ma02451 | CP | % | 86 |  |  | 70-130 | Pass |  |
| Dibenz(a.h)anthracene | B18-Ma02451 | CP | % | 100 |  |  | 70-130 | Pass |  |
| Fluoranthene | B18-Ma02451 | CP | % | 98 |  |  | 70-130 | Pass |  |
| Fluorene | B18-Ma02451 | CP | % | 74 |  |  | 70-130 | Pass |  |
| Indeno(1.2.3-cd)pyrene | B18-Ma02451 | CP | % | 92 |  |  | 70-130 | Pass |  |
| Naphthalene | B18-Ma02451 | CP | % | 112 |  |  | 70-130 | Pass |  |
| Phenanthrene | B18-Ma02451 | CP | % | 82 |  |  | 70-130 | Pass |  |
| Pyrene | B18-Ma02451 | CP | % | 100 |  |  | 70-130 | Pass |  |
| **Spike - % Recovery** |  |  |  |  |  |  |  |  |  |
|  |  |  |  | Result 1 |  |  |  |  |  |
| Ammonia (as N) | B18-Ma02451 | CP | % | 95 |  |  | 70-130 | Pass |  |
| Nitrate & Nitrite (as N) | B18-Ma02451 | CP | % | 94 |  |  | 70-130 | Pass |  |
| Nitrate (as N) | B18-Ma02451 | CP | % | 93 |  |  | 70-130 | Pass |  |
| Nitrite (as N) | B18-Ma02451 | CP | % | 120 |  |  | 70-130 | Pass |  |
| Phosphate total (as P) | B18-Ma02451 | CP | % | 85 |  |  | 70-130 | Pass |  |
| **Spike - % Recovery** |  |  |  |  |  |  |  |  |  |
|  |  |  |  | Result 1 |  |  |  |  |  |
| Phosphorus reactive (as P) | B18-Ma02453 | CP | % | 89 |  |  | 70-130 | Pass |  |
| **Spike - % Recovery** |  |  |  |  |  |  |  |  |  |
|  |  |  |  | Result 1 |  |  |  |  |  |
| Phosphorus reactive (as P) | B18-Ma02463 | CP | % | 90 |  |  | 70-130 | Pass |  |
| **Spike - % Recovery** |  |  |  |  |  |  |  |  |  |
| **Polycyclic Aromatic Hydrocarbons** |  |  |  | Result 1 |  |  |  |  |  |
| Acenaphthene | B18-Ma02467 | CP | % | 77 |  |  | 70-130 | Pass |  |
| Acenaphthylene | B18-Ma02467 | CP | % | 83 |  |  | 70-130 | Pass |  |
| Anthracene | B18-Ma02467 | CP | % | 85 |  |  | 70-130 | Pass |  |
| Benz(a)anthracene | B18-Ma02467 | CP | % | 86 |  |  | 70-130 | Pass |  |
| Benzo(a)pyrene | B18-Ma02467 | CP | % | 78 |  |  | 70-130 | Pass |  |
| Benzo(b&j)fluoranthene | B18-Ma02467 | CP | % | 75 |  |  | 70-130 | Pass |  |
| Benzo(g.h.i)perylene | B18-Ma02467 | CP | % | 86 |  |  | 70-130 | Pass |  |
| Benzo(k)fluoranthene | B18-Ma02467 | CP | % | 78 |  |  | 70-130 | Pass |  |
| Chrysene | B18-Ma02467 | CP | % | 85 |  |  | 70-130 | Pass |  |
| Dibenz(a.h)anthracene | B18-Ma02467 | CP | % | 82 |  |  | 70-130 | Pass |  |
| Fluoranthene | B18-Ma02467 | CP | % | 106 |  |  | 70-130 | Pass |  |
| Fluorene | B18-Ma02467 | CP | % | 78 |  |  | 70-130 | Pass |  |
| Indeno(1.2.3-cd)pyrene | B18-Ma02467 | CP | % | 77 |  |  | 70-130 | Pass |  |
| Naphthalene | B18-Ma02467 | CP | % | 90 |  |  | 70-130 | Pass |  |
| Phenanthrene | B18-Ma02467 | CP | % | 83 |  |  | 70-130 | Pass |  |
| Pyrene | B18-Ma02467 | CP | % | 104 |  |  | 70-130 | Pass |  |
| **Spike - % Recovery** |  |  |  |  |  |  |  |  |  |
|  |  |  |  | Result 1 |  |  |  |  |  |
| Ammonia (as N) | B18-Ma02468 | CP | % | 110 |  |  | 70-130 | Pass |  |
| Nitrate & Nitrite (as N) | B18-Ma02468 | CP | % | 82 |  |  | 70-130 | Pass |  |
| Nitrate (as N) | B18-Ma02468 | CP | % | 82 |  |  | 70-130 | Pass |  |
| Nitrite (as N) | B18-Ma02468 | CP | % | 119 |  |  | 70-130 | Pass |  |
| **Test** | **Lab Sample ID** | **QA Source** | **Units** | **Result 1** |  |  | **Acceptance Limits** | **Pass Limits** | **Qualifying Code** |
| **Duplicate** |  |  |  |  |  |  |  |  |  |
|  |  |  |  | Result 1 | Result 2 | RPD |  |  |  |
| Conductivity (at 25°C) | B18-Ma02442 | CP | uS/cm | 760 | 760 | <1 | 30% | Pass |  |
| pH (at 25°C) | B18-Ma02442 | CP | pH Units | 8.0 | 8.0 | pass | 30% | Pass |  |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Duplicate** | | | | | | | | | |
| **Heavy Metals** | | | | Result 1 | Result 2 | RPD | | | |
| Arsenic (filtered) | M18-Ma04999 | NCP | mg/L | 0.066 | 0.066 | 1.0 | 30% | Pass | |
| Cadmium (filtered) | M18-Ma04999 | NCP | mg/L | < 0.0002 | < 0.0002 | <1 | 30% | Pass | |
| Chromium (filtered) | M18-Ma04999 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Copper (filtered) | M18-Ma04999 | NCP | mg/L | 0.046 | 0.046 | <1 | 30% | Pass | |
| Lead (filtered) | M18-Ma04999 | NCP | mg/L | 0.003 | 0.003 | 1.0 | 30% | Pass | |
| Mercury (filtered) | M18-Ma04999 | NCP | mg/L | < 0.0001 | < 0.0001 | <1 | 30% | Pass | |
| Nickel (filtered) | M18-Ma04999 | NCP | mg/L | 0.016 | 0.016 | 2.0 | 30% | Pass | |
| Zinc (filtered) | M18-Ma04999 | NCP | mg/L | 0.11 | 0.11 | <1 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Dissolved Oxygen (% Saturation) | B18-Ma02447 | CP | % | 93 | 93 | <1 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Ammonia (as N) | B18-Ma02448 | CP | mg/L | 0.03 | 0.03 | 6.0 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Dissolved Oxygen | B18-Ma02449 | CP | mg/L | 6.9 | 7.1 | 2.0 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | Result 1 | Result 2 | RPD | | | |
| Acenaphthene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Acenaphthylene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Anthracene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benz(a)anthracene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(a)pyrene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(b&j)fluoranthene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(g.h.i)perylene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(k)fluoranthene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Chrysene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Dibenz(a.h)anthracene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Fluoranthene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Fluorene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Indeno(1.2.3-cd)pyrene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Naphthalene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Phenanthrene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Pyrene | B18-Ma02450 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Ammonia (as N) | B18-Ma02451 | CP | mg/L | 0.02 | 0.02 | 12 | 30% | Pass | |
| Conductivity (at 25°C) | B18-Ma02451 | CP | uS/cm | 340 | 350 | 2.0 | 30% | Pass | |
| Nitrate & Nitrite (as N) | B18-Ma02451 | CP | mg/L | 0.19 | 0.20 | 7.0 | 30% | Pass | |
| Nitrate (as N) | B18-Ma02451 | CP | mg/L | 0.16 | 0.18 | 11 | 30% | Pass | |
| Nitrite (as N) | B18-Ma02451 | CP | mg/L | 0.03 | 0.03 | 17 | 30% | Pass | |
| pH (at 25°C) | B18-Ma02451 | CP | pH Units | 8.3 | 8.3 | pass | 30% | Pass | |
| Turbidity | B18-Ma02451 | CP | NTU | 8.4 | 8.0 | 4.0 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Phosphorus reactive (as P) | B18-Ma02453 | CP | mg/L | < 0.05 | < 0.05 | <1 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Dissolved Oxygen (% Saturation) | B18-Ma02457 | CP | % | 87 | 88 | 1.0 | 30% | Pass | |
| Suspended Solids | B18-Ma02457 | CP | mg/L | 7.7 | 9.3 | 20 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Dissolved Oxygen | B18-Ma02459 | CP | mg/L | 7.4 | 7.4 | 1.0 | 30% | Pass | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Conductivity (at 25°C) | B18-Ma02461 | CP | uS/cm | 180 | 180 | 1.0 | 30% | Pass | |
| pH (at 25°C) | B18-Ma02461 | CP | pH Units | 7.3 | 7.4 | pass | 30% | Pass | |
| Turbidity | B18-Ma02461 | CP | NTU | 97 | 96 | <1 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Phosphorus reactive (as P) | B18-Ma02463 | CP | mg/L | < 0.05 | < 0.05 | <1 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | Result 1 | Result 2 | RPD | | | |
| Acenaphthene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Acenaphthylene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Anthracene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benz(a)anthracene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(a)pyrene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(b&j)fluoranthene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(g.h.i)perylene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(k)fluoranthene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Chrysene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Dibenz(a.h)anthracene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Fluoranthene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Fluorene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Indeno(1.2.3-cd)pyrene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Naphthalene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Phenanthrene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Pyrene | B18-Ma02466 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Dissolved Oxygen (% Saturation) | B18-Ma02467 | CP | % | 65 | 67 | 3.0 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Ammonia (as N) | B18-Ma02468 | CP | mg/L | < 0.01 | < 0.01 | <1 | 30% | Pass | |
| Nitrate & Nitrite (as N) | B18-Ma02468 | CP | mg/L | < 0.05 | < 0.05 | <1 | 30% | Pass | |
| Nitrate (as N) | B18-Ma02468 | CP | mg/L | < 0.02 | < 0.02 | <1 | 30% | Pass | |
| Nitrite (as N) | B18-Ma02468 | CP | mg/L | < 0.02 | < 0.02 | <1 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Dissolved Oxygen | B18-Ma02470 | CP | mg/L | 4.6 | 4.4 | 3.0 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Phosphate total (as P) | B18-Ma02473 | CP | mg/L | 0.09 | 0.09 | 3.0 | 30% | Pass | |
| Total Kjeldahl Nitrogen (as N) | B18-Ma02473 | CP | mg/L | 1.2 | 1.5 | 22 | 30% | Pass | |
| Turbidity | B18-Ma02473 | CP | NTU | 210 | 210 | 1.0 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Conductivity (at 25°C) | B18-Ma02475 | CP | uS/cm | 950 | 960 | 1.0 | 30% | Pass | |
| pH (at 25°C) | B18-Ma02475 | CP | pH Units | 8.6 | 8.6 | pass | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Chlorophyll a | B18-Ma02476 | CP | ug/L | < 5 | < 5 | <1 | 30% | Pass | |

## Comments

## Sample Integrity

| | |
|---|---|
| Custody Seals Intact (if used) | N/A |
| Attempt to Chill was evident | Yes |
| Sample correctly preserved | Yes |
| Appropriate sample containers have been used | Yes |
| Sample containers for volatile analysis received with minimal headspace | Yes |
| Samples received within HoldingTime | Yes |
| Some samples have been subcontracted | No |

## Comments

## Qualifier Codes/Comments

| Code | Description |
|---|---|
| N07 | Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs |

## Authorised By

| | |
|---|---|
| Ryan Gilbert | Analytical Services Manager |
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**National Operations Manager**

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Celebrating 30 years Testing and Protecting Human Health

# Certificate of Analysis

**NATA Accredited**
**Accreditation Number 1261**
**Site Number 1254**

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

**Aurecon Australia (BRIS) Pty Ltd**
**Level 14, 32 Turbot St**
**Brisbane**
**QLD 4001**

**Attention:** **LEESA LEATHBRIDGE**

**Report** **588540-W**
Project name BASELINE SURFACE WATER MONITORING
Project ID INLAND RAIL PROJECT
Received Date Mar 07, 2018

| **Client Sample ID** | | | **H2C 3A** | **H2C 4A** | **H2C 7A** | **H2C 9A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **M18-Ma09925** | **M18-Ma09926** | **M18-Ma09927** | **M18-Ma09928** |
| **Date Sampled** | | | **Mar 06, 2018** | **Mar 06, 2018** | **Mar 06, 2018** | **Mar 06, 2018** |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene$^{N07}$ | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 84 | 119 | 57 | 106 |
| p-Terphenyl-d14 (surr.) | 1 | % | 148 | 81 | 60 | 104 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.08 | 0.01 | 0.04 | 0.22 |
| Chlorophyll a | 5 | ug/L | 77 | 110 | 92 | 110 |
| Conductivity (at 25°C) | 1 | uS/cm | 590 | 350 | 280 | 1800 |
| Dissolved Oxygen | 0.01 | mg/L | 8.5 | 8.5 | 7.0 | 4.6 |
| Dissolved Oxygen (% Saturation) | | % | 95 | 93 | 78 | 50 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | < 0.05 | 0.06 | < 0.05 | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | < 0.02 | 0.04 | < 0.02 | < 0.02 |
| Nitrite (as N) | 0.02 | mg/L | 0.02 | < 0.02 | < 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 0.21 | < 0.2 | 0.60 | 0.39 |
| pH (at 25°C) | 0.1 | pH Units | 8.3 | 8.4 | 7.4 | 7.4 |
| Phosphate total (as P) | 0.05 | mg/L | 0.50 | 0.39 | 0.81 | 0.46 |
| Phosphorus reactive (as P) | 0.05 | mg/L | 0.43 | 0.22 | 0.44 | < 0.05 |
| Salinity (determined from EC)* | 20 | mg/L | 290 | 170 | 140 | 910 |
| Suspended Solids | 1 | mg/L | 18 | 23 | 15 | 94 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 0.3 | < 0.2 | 0.6 | 0.6 |

| Client Sample ID | | | H2C 3A | H2C 4A | H2C 7A | H2C 9A |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **M18-Ma09925** | **M18-Ma09926** | **M18-Ma09927** | **M18-Ma09928** |
| **Date Sampled** | | | **Mar 06, 2018** | **Mar 06, 2018** | **Mar 06, 2018** | **Mar 06, 2018** |
| Test/Reference | LOR | Unit | | | | |
| | | | | | | |
| Total Nitrogen (as N) | 0.2 | mg/L | 0.29 | < 0.2 | 0.63 | 0.61 |
| Turbidity | 1 | NTU | 8.2 | 16 | 6.1 | 58 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | 0.002 | 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | 0.002 | 0.002 | < 0.001 | < 0.001 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | 0.002 | 0.001 | 0.004 | < 0.001 |
| Zinc (filtered) | 0.005 | mg/L | < 0.005 | < 0.005 | < 0.005 | < 0.005 |

| Client Sample ID | | | H2C 10A | H2C 12A | H2C 18A | H2C DUP1 |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **M18-Ma09929** | **M18-Ma09930** | **M18-Ma09931** | **M18-Ma09932** |
| **Date Sampled** | | | **Mar 06, 2018** | **Mar 06, 2018** | **Mar 06, 2018** | **Mar 06, 2018** |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene[N07] | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 82 | 111 | 72 | 96 |
| p-Terphenyl-d14 (surr.) | 1 | % | 81 | 133 | 82 | 120 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.05 | 0.43 | 0.05 | 0.05 |
| Chlorophyll a | 5 | ug/L | 220 | 83 | < 10 | 87 |
| Conductivity (at 25°C) | 1 | uS/cm | 230 | 430 | 1400 | 640 |
| Dissolved Oxygen | 0.01 | mg/L | 5.2 | 7.5 | 6.5 | 9.0 |
| Dissolved Oxygen (% Saturation) | | % | 57 | 82 | 71 | 97 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | < 0.05 | 0.18 | < 0.05 | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | < 0.02 | 0.09 | < 0.02 | 0.02 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | 0.09 | < 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 0.60 | 0.44 | 0.56 | < 0.2 |
| pH (at 25°C) | 0.1 | pH Units | 7.2 | 8.4 | 7.7 | 8.4 |

| **Client Sample ID** | | | **H2C 10A** | **H2C 12A** | **H2C 18A** | **H2C DUP1** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **M18-Ma09929** | **M18-Ma09930** | **M18-Ma09931** | **M18-Ma09932** |
| **Date Sampled** | | | **Mar 06, 2018** | **Mar 06, 2018** | **Mar 06, 2018** | **Mar 06, 2018** |
| Test/Reference | LOR | Unit | | | | |
| | | | | | | |
| Phosphate total (as P) | 0.05 | mg/L | 0.41 | 0.71 | 0.20 | 0.53 |
| Phosphorus reactive (as P) | 0.05 | mg/L | 0.15 | 0.58 | < 0.05 | 0.43 |
| Salinity (determined from EC)* | 20 | mg/L | 110 | 210 | 700 | 310 |
| Suspended Solids | 1 | mg/L | 33 | 16 | 6.2 | 16 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 0.6 | 0.9 | 0.6 | < 0.2 |
| Total Nitrogen (as N) | 0.2 | mg/L | 0.64 | 1.1 | 0.62 | < 0.2 |
| Turbidity | 1 | NTU | 49 | 4.3 | 3.9 | 7.6 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | 0.006 | 0.001 | 0.001 | < 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | 0.005 | 0.001 | < 0.001 | 0.002 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | 0.003 | 0.002 | < 0.001 | 0.002 |
| Zinc (filtered) | 0.005 | mg/L | 0.007 | < 0.005 | < 0.005 | < 0.005 |

| **Client Sample ID** | | | **H2C TRIP1** |
|---|---|---|---|
| **Sample Matrix** | | | **Water** |
| **Eurofins \| mgt Sample No.** | | | **M18-Ma09933** |
| **Date Sampled** | | | **Mar 06, 2018** |
| Test/Reference | LOR | Unit | |
| **Polycyclic Aromatic Hydrocarbons** | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 |
| Benzo(b&j)fluoranthene$^{N07}$ | 0.001 | mg/L | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 91 |
| p-Terphenyl-d14 (surr.) | 1 | % | 110 |
| | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.03 |
| Chlorophyll a | 5 | ug/L | 91 |
| Conductivity (at 25°C) | 1 | uS/cm | 580 |
| Dissolved Oxygen | 0.01 | mg/L | 9.1 |
| Dissolved Oxygen (% Saturation) | | % | 99 |

| **Client Sample ID** | | | **H2C TRIP1** |
|---|---|---|---|
| **Sample Matrix** | | | **Water** |
| **Eurofins \| mgt Sample No.** | | | **M18-Ma09933** |
| **Date Sampled** | | | **Mar 06, 2018** |
| Test/Reference | LOR | Unit | |
| | | | |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | < 0.02 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | < 0.2 |
| pH (at 25°C) | 0.1 | pH Units | 8.5 |
| Phosphate total (as P) | 0.05 | mg/L | 0.56 |
| Phosphorus reactive (as P) | 0.05 | mg/L | 0.43 |
| Salinity (determined from EC)* | 20 | mg/L | 280 |
| Suspended Solids | 1 | mg/L | 15 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 0.2 |
| Total Nitrogen (as N) | 0.2 | mg/L | < 0.2 |
| Turbidity | 1 | NTU | 7.9 |
| **Heavy Metals** | | | |
| Arsenic (filtered) | 0.001 | mg/L | < 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | 0.002 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | 0.002 |
| Zinc (filtered) | 0.005 | mg/L | < 0.005 |

## Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

| Description | Testing Site | Extracted | Holding Time |
|---|---|---|---|
| Polycyclic Aromatic Hydrocarbons | Melbourne | Mar 14, 2018 | 7 Day |
| - Method: LTM-ORG-2130 PAH and Phenols in Water by GCMS | | | |
| Chlorophyll a | Melbourne | Mar 16, 2018 | 2 Day |
| - Method: APHA Method 10200H | | | |
| Conductivity (at 25°C) | Melbourne | Mar 13, 2018 | 28 Day |
| - Method: LTM-INO-4030 Conductivity | | | |
| Dissolved Oxygen | Melbourne | Mar 08, 2018 | 1 Day |
| - Method: LTM-INO-4130 Determination of Dissolved Oxygen using a DO meter | | | |
| Dissolved Oxygen (% Saturation) | Melbourne | Mar 09, 2018 | 1 Day |
| - Method: LTM-INO-4130 Determination of Dissolved Oxygen using a DO meter | | | |
| pH (at 25°C) | Melbourne | Mar 13, 2018 | 0 Hours |
| - Method: LTM-GEN-7090 pH in water by ISE | | | |
| Phosphate total (as P) | Melbourne | Mar 13, 2018 | 28 Day |
| - Method: APHA 4500-P E. Phosphorous | | | |
| Phosphorus reactive (as P) | Melbourne | Mar 13, 2018 | 2 Day |
| - Method: APHA4500-PO4 | | | |
| Salinity (determined from EC)* | Melbourne | Mar 13, 2018 | 0 Day |
| Suspended Solids | Melbourne | Mar 13, 2018 | 7 Days |
| - Method: LTM-INO-4070 Analysis of Suspended Solids in Water by Gravimetry | | | |
| Turbidity | Melbourne | Mar 13, 2018 | 2 Day |
| - Method: LTM-INO-4140 Turbidity by Nephelometric Method | | | |
| Metals M8 filtered | Melbourne | Mar 13, 2018 | 28 Day |
| - Method: LTM-MET-3040 Metals in Waters by ICP-MS | | | |
| Nitrogens (speciated) | | | |
| Ammonia (as N) | Melbourne | Mar 13, 2018 | 28 Day |
| - Method: APHA 4500-NH3 Ammonia Nitrogen by FIA | | | |
| Nitrate & Nitrite (as N) | Melbourne | Mar 13, 2018 | 28 Day |
| - Method: APHA 4500-NO3/NO2 Nitrate-Nitrite Nitrogen by FIA | | | |
| Nitrate (as N) | Melbourne | Mar 13, 2018 | 7 Day |
| - Method: APHA 4500-NO3 Nitrate Nitrogen by FIA | | | |
| Nitrite (as N) | Melbourne | Mar 13, 2018 | 2 Day |
| - Method: APHA 4500-NO2 Nitrite Nitrogen by FIA | | | |
| Organic Nitrogen (as N) | Melbourne | Mar 08, 2018 | 7 Day |
| - Method: APHA 4500 Organic Nitrogen (N) | | | |
| Total Kjeldahl Nitrogen (as N) | Melbourne | Mar 13, 2018 | 7 Day |
| - Method: APHA 4500 TKN | | | |

**Company Name:** Aurecon Australia (BRIS) Pty Ltd
**Address:** Level 14, 32 Turbot St
Brisbane
QLD 4001

**Order No.:** 23200
**Report #:** 588540
**Phone:** 07 3173 8000
**Fax:** +61 7 3173 8001

**Received:** Mar 7, 2018 3:36 PM
**Due:** Mar 15, 2018
**Priority:** 5 Day
**Contact Name:** LEESA LEATHBRIDGE

**Project Name:** BASELINE SURFACE WATER MONITORING
**Project ID:** INLAND RAIL PROJECT

**Eurofins | mgt Analytical Services Manager : Ryan Gilbert**

| **Sample Detail** | | | | | | Chlorophyll a | Conductivity (at 25°C) | Dissolved Oxygen | Dissolved Oxygen (% Saturation) | pH (at 25°C) | Phosphate total (as P) | Phosphorus reactive (as P) | Salinity (determined from EC)* | Suspended Solids | Turbidity | Polycyclic Aromatic Hydrocarbons | Metals M8 | Metals M8 filtered | Nitrogens (speciated) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Melbourne Laboratory - NATA Site # 1254 & 14271** | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **Sydney Laboratory - NATA Site # 18217** | | | | | | | | | | | | | | | | | | | |
| **Brisbane Laboratory - NATA Site # 20794** | | | | | | | | | | | | | | | | | | | |
| **Perth Laboratory - NATA Site # 23736** | | | | | | | | | | | | | | | | | | | |
| **External Laboratory** | | | | | | | | | | | | | | | | | | | |
| **No** | **Sample ID** | **Sample Date** | **Sampling Time** | **Matrix** | **LAB ID** | | | | | | | | | | | | | | |
| 1 | H2C 3A | Mar 06, 2018 | | Water | M18-Ma09925 | X | X | X | X | X | X | X | X | X | X | X | | X | X |
| 2 | H2C 4A | Mar 06, 2018 | | Water | M18-Ma09926 | X | X | X | X | X | X | X | X | X | X | X | | X | X |
| 3 | H2C 7A | Mar 06, 2018 | | Water | M18-Ma09927 | X | X | X | X | X | X | X | X | X | X | X | | X | X |
| 4 | H2C 9A | Mar 06, 2018 | | Water | M18-Ma09928 | X | X | X | X | X | X | X | X | X | X | X | | X | X |
| 5 | H2C 10A | Mar 06, 2018 | | Water | M18-Ma09929 | X | X | X | X | X | X | X | X | X | X | X | | X | X |
| 6 | H2C 12A | Mar 06, 2018 | | Water | M18-Ma09930 | X | X | X | X | X | X | X | X | X | X | X | X | | X |
| 7 | H2C 18A | Mar 06, 2018 | | Water | M18-Ma09931 | X | X | X | X | X | X | X | X | X | X | X | | X | X |
| 8 | H2C DUP1 | Mar 06, 2018 | | Water | M18-Ma09932 | X | X | X | X | X | X | X | X | X | X | X | | X | X |
| 9 | H2C TRIP1 | Mar 06, 2018 | | Water | M18-Ma09933 | X | X | X | X | X | X | X | X | X | X | X | | X | X |

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**Fax:** +61 7 3173 8001

**Received:** Mar 7, 2018 3:36 PM
**Due:** Mar 15, 2018
**Priority:** 5 Day
**Contact Name:** LEESA LEATHBRIDGE

**Project Name:** BASELINE SURFACE WATER MONITORING
**Project ID:** INLAND RAIL PROJECT

**Eurofins | mgt Analytical Services Manager : Ryan Gilbert**

| **Sample Detail** | Chlorophyll a | Conductivity (at 25°C) | Dissolved Oxygen | Dissolved Oxygen (% Saturation) | pH (at 25°C) | Phosphate total (as P) | Phosphorus reactive (as P) | Salinity (determined from EC)* | Suspended Solids | Turbidity | Polycyclic Aromatic Hydrocarbons | Metals M8 | Metals M8 filtered | Nitrogens (speciated) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Melbourne Laboratory - NATA Site # 1254 & 14271** | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **Sydney Laboratory - NATA Site # 18217** | | | | | | | | | | | | | | |
| **Brisbane Laboratory - NATA Site # 20794** | | | | | | | | | | | | | | |
| **Perth Laboratory - NATA Site # 23736** | | | | | | | | | | | | | | |
| **Test Counts** | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 1 | 8 | 9 |

# Internal Quality Control Review and Glossary

## General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

## Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

## Units

**mg/kg:** milligrams per kilogram

**ug/L:** micrograms per litre

**ppb:** Parts per billion

**org/100mL:** Organisms per 100 millilitres

**MPN/100mL:** Most Probable Number of organisms per 100 millilitres

**mg/L:** milligrams per litre

**ppm:** Parts per million

**%:** Percentage

**NTU:** Nephelometric Turbidity Units

## Terms

| | |
|---|---|
| **Dry** | Where a moisture has been determined on a solid sample the result is expressed on a dry basis. |
| **LOR** | Limit of Reporting. |
| **SPIKE** | Addition of the analyte to the sample and reported as percentage recovery. |
| **RPD** | Relative Percent Difference between two Duplicate pieces of analysis. |
| **LCS** | Laboratory Control Sample - reported as percent recovery. |
| **CRM** | Certified Reference Material - reported as percent recovery. |
| **Method Blank** | In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water. |
| **Surr - Surrogate** | The addition of a like compound to the analyte target and reported as percentage recovery. |
| **Duplicate** | A second piece of analysis from the same sample and reported in the same units as the result to show comparison. |
| **USEPA** | United States Environmental Protection Agency |
| **APHA** | American Public Health Association |
| **TCLP** | Toxicity Characteristic Leaching Procedure |
| **COC** | Chain of Custody |
| **SRA** | Sample Receipt Advice |
| **QSM** | Quality Systems Manual ver 5.1 US Department of Defense |
| **CP** | Client Parent - QC was performed on samples pertaining to this report |
| **NCP** | Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within. |
| **TEQ** | Toxic Equivalency Quotient |

## QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results<10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

## QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

**Quality Control Results**

| Test | Units | Result 1 | | | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|
| **Method Blank** | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | | |
| Acenaphthene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Acenaphthylene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Anthracene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benz(a)anthracene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(a)pyrene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(b&j)fluoranthene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(g.h.i)perylene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(k)fluoranthene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Chrysene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Dibenz(a.h)anthracene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Fluoranthene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Fluorene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Indeno(1.2.3-cd)pyrene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Naphthalene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Phenanthrene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Pyrene | mg/L | < 0.001 | | | 0.001 | Pass | |
| **Method Blank** | | | | | | | |
| Ammonia (as N) | mg/L | < 0.01 | | | 0.01 | Pass | |
| Dissolved Oxygen (% Saturation) | % | 100 | | | | N/A | |
| Nitrate & Nitrite (as N) | mg/L | < 0.05 | | | 0.05 | Pass | |
| Nitrate (as N) | mg/L | < 0.02 | | | 0.02 | Pass | |
| Nitrite (as N) | mg/L | < 0.02 | | | 0.02 | Pass | |
| Phosphate total (as P) | mg/L | < 0.05 | | | 0.05 | Pass | |
| Phosphorus reactive (as P) | mg/L | < 0.05 | | | 0.05 | Pass | |
| Suspended Solids | mg/L | < 1 | | | 1 | Pass | |
| Total Kjeldahl Nitrogen (as N) | mg/L | < 0.2 | | | 0.2 | Pass | |
| Turbidity | NTU | < 1 | | | 1 | Pass | |
| **Method Blank** | | | | | | | |
| **Heavy Metals** | | | | | | | |
| Arsenic (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Cadmium (filtered) | mg/L | < 0.0002 | | | 0.0002 | Pass | |
| Chromium (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Copper (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Lead (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Mercury (filtered) | mg/L | < 0.0001 | | | 0.0001 | Pass | |
| Nickel (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Zinc (filtered) | mg/L | < 0.005 | | | 0.005 | Pass | |
| **LCS - % Recovery** | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | | |
| Acenaphthene | % | 115 | | | 70-130 | Pass | |
| Acenaphthylene | % | 116 | | | 70-130 | Pass | |
| Anthracene | % | 104 | | | 70-130 | Pass | |
| Benz(a)anthracene | % | 99 | | | 70-130 | Pass | |
| Benzo(a)pyrene | % | 112 | | | 70-130 | Pass | |
| Benzo(b&j)fluoranthene | % | 108 | | | 70-130 | Pass | |
| Benzo(g.h.i)perylene | % | 90 | | | 70-130 | Pass | |
| Benzo(k)fluoranthene | % | 126 | | | 70-130 | Pass | |
| Chrysene | % | 113 | | | 70-130 | Pass | |
| Dibenz(a.h)anthracene | % | 73 | | | 70-130 | Pass | |
| Fluoranthene | % | 106 | | | 70-130 | Pass | |

| Test | | | Units | Result 1 | | | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|---|---|
| Fluorene | | | % | 116 | | | 70-130 | Pass | |
| Indeno(1.2.3-cd)pyrene | | | % | 83 | | | 70-130 | Pass | |
| Naphthalene | | | % | 120 | | | 70-130 | Pass | |
| Phenanthrene | | | % | 124 | | | 70-130 | Pass | |
| Pyrene | | | % | 125 | | | 70-130 | Pass | |
| **LCS - % Recovery** | | | | | | | | | |
| Ammonia (as N) | | | % | 74 | | | 70-130 | Pass | |
| Nitrate & Nitrite (as N) | | | % | 98 | | | 70-130 | Pass | |
| Nitrate (as N) | | | % | 97 | | | 70-130 | Pass | |
| Nitrite (as N) | | | % | 83 | | | 70-130 | Pass | |
| Phosphate total (as P) | | | % | 97 | | | 70-130 | Pass | |
| Phosphorus reactive (as P) | | | % | 116 | | | 70-130 | Pass | |
| Suspended Solids | | | % | 115 | | | 70-130 | Pass | |
| Total Kjeldahl Nitrogen (as N) | | | % | 110 | | | 70-130 | Pass | |
| **LCS - % Recovery** | | | | | | | | | |
| **Heavy Metals** | | | | | | | | | |
| Arsenic (filtered) | | | % | 95 | | | 80-120 | Pass | |
| Cadmium (filtered) | | | % | 97 | | | 80-120 | Pass | |
| Chromium (filtered) | | | % | 92 | | | 80-120 | Pass | |
| Copper (filtered) | | | % | 89 | | | 80-120 | Pass | |
| Lead (filtered) | | | % | 104 | | | 80-120 | Pass | |
| Mercury (filtered) | | | % | 100 | | | 70-130 | Pass | |
| Nickel (filtered) | | | % | 88 | | | 80-120 | Pass | |
| Zinc (filtered) | | | % | 94 | | | 80-120 | Pass | |
| **Test** | **Lab Sample ID** | **QA Source** | **Units** | **Result 1** | | | **Acceptance Limits** | **Pass Limits** | **Qualifying Code** |
| **Spike - % Recovery** | | | | | | | | | |
| | | | | Result 1 | | | | | |
| Ammonia (as N) | M18-Ma07562 | NCP | % | 74 | | | 70-130 | Pass | |
| Nitrate & Nitrite (as N) | M18-Ma07562 | NCP | % | 98 | | | 70-130 | Pass | |
| Nitrate (as N) | M18-Ma07562 | NCP | % | 98 | | | 70-130 | Pass | |
| Nitrite (as N) | M18-Ma07562 | NCP | % | 81 | | | 70-130 | Pass | |
| Phosphate total (as P) | M18-Ma07542 | NCP | % | 78 | | | 70-130 | Pass | |
| Phosphorus reactive (as P) | P18-Ma09789 | NCP | % | 118 | | | 70-130 | Pass | |
| Total Kjeldahl Nitrogen (as N) | M18-Ma07542 | NCP | % | 102 | | | 70-130 | Pass | |
| **Spike - % Recovery** | | | | | | | | | |
| **Heavy Metals** | | | | Result 1 | | | | | |
| Arsenic (filtered) | M18-Ma10627 | NCP | % | 98 | | | 70-130 | Pass | |
| Cadmium (filtered) | M18-Ma10627 | NCP | % | 91 | | | 70-130 | Pass | |
| Chromium (filtered) | M18-Ma10627 | NCP | % | 91 | | | 70-130 | Pass | |
| Copper (filtered) | M18-Ma10627 | NCP | % | 86 | | | 70-130 | Pass | |
| Lead (filtered) | M18-Ma10627 | NCP | % | 98 | | | 70-130 | Pass | |
| Mercury (filtered) | M18-Ma10449 | NCP | % | 72 | | | 70-130 | Pass | |
| Nickel (filtered) | M18-Ma10627 | NCP | % | 86 | | | 70-130 | Pass | |
| Zinc (filtered) | M18-Ma10627 | NCP | % | 89 | | | 70-130 | Pass | |
| **Spike - % Recovery** | | | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | Result 1 | | | | | |
| Acenaphthene | M18-Ma09930 | CP | % | 82 | | | 70-130 | Pass | |
| Acenaphthylene | M18-Ma09930 | CP | % | 89 | | | 70-130 | Pass | |
| Anthracene | M18-Ma09930 | CP | % | 90 | | | 70-130 | Pass | |
| Benz(a)anthracene | M18-Ma09930 | CP | % | 71 | | | 70-130 | Pass | |
| Benzo(a)pyrene | M18-Ma09930 | CP | % | 82 | | | 70-130 | Pass | |
| Benzo(b&j)fluoranthene | M18-Ma09930 | CP | % | 89 | | | 70-130 | Pass | |
| Benzo(g.h.i)perylene | M18-Ma09930 | CP | % | 73 | | | 70-130 | Pass | |
| Benzo(k)fluoranthene | M18-Ma09930 | CP | % | 105 | | | 70-130 | Pass | |

| Test | Lab Sample ID | QA Source | Units | Result 1 | | | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|---|---|
| Chrysene | M18-Ma09930 | CP | % | 97 | | | 70-130 | Pass | |
| Dibenz(a.h)anthracene | M18-Ma09930 | CP | % | 72 | | | 70-130 | Pass | |
| Fluoranthene | M18-Ma09930 | CP | % | 112 | | | 70-130 | Pass | |
| Fluorene | M18-Ma09930 | CP | % | 88 | | | 70-130 | Pass | |
| Indeno(1.2.3-cd)pyrene | M18-Ma09930 | CP | % | 71 | | | 70-130 | Pass | |
| Naphthalene | M18-Ma09930 | CP | % | 94 | | | 70-130 | Pass | |
| Phenanthrene | M18-Ma09930 | CP | % | 88 | | | 70-130 | Pass | |
| Pyrene | M18-Ma09930 | CP | % | 98 | | | 70-130 | Pass | |
| **Test** | **Lab Sample ID** | **QA Source** | **Units** | **Result 1** | | | **Acceptance Limits** | **Pass Limits** | **Qualifying Code** |
| **Duplicate** | | | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | Result 1 | Result 2 | RPD | | | |
| Acenaphthene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Acenaphthylene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Anthracene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benz(a)anthracene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(a)pyrene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(b&j)fluoranthene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(g.h.i)perylene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(k)fluoranthene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Chrysene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Dibenz(a.h)anthracene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Fluoranthene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Fluorene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Indeno(1.2.3-cd)pyrene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Naphthalene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Phenanthrene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Pyrene | M18-Ma10515 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Ammonia (as N) | M18-Ma10449 | NCP | mg/L | 0.54 | 0.52 | 3.0 | 30% | Pass | |
| Chlorophyll a | M18-Ma16227 | NCP | ug/L | < 5 | < 5 | <1 | 30% | Pass | |
| Dissolved Oxygen | B18-Ma07531 | NCP | mg/L | 8.2 | 8.1 | 1.0 | 30% | Pass | |
| Nitrate & Nitrite (as N) | M18-Ma10449 | NCP | mg/L | < 0.05 | < 0.05 | <1 | 30% | Pass | |
| Nitrate (as N) | M18-Ma10449 | NCP | mg/L | < 0.02 | < 0.02 | <1 | 30% | Pass | |
| Nitrite (as N) | M18-Ma10449 | NCP | mg/L | < 0.02 | < 0.02 | <1 | 30% | Pass | |
| Phosphate total (as P) | M18-Ma09925 | CP | mg/L | 0.50 | 0.56 | 10 | 30% | Pass | |
| Phosphorus reactive (as P) | P18-Ma09826 | NCP | mg/L | < 0.05 | < 0.05 | <1 | 30% | Pass | |
| Total Kjeldahl Nitrogen (as N) | M18-Ma09925 | CP | mg/L | 0.3 | 0.2 | 17 | 30% | Pass | |
| Turbidity | S18-Ma09590 | NCP | NTU | 63 | 64 | 2.0 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| **Heavy Metals** | | | | Result 1 | Result 2 | RPD | | | |
| Arsenic (filtered) | M18-Ma10627 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Cadmium (filtered) | M18-Ma10627 | NCP | mg/L | < 0.0002 | < 0.0002 | <1 | 30% | Pass | |
| Chromium (filtered) | M18-Ma10627 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Copper (filtered) | M18-Ma10627 | NCP | mg/L | 0.011 | 0.011 | 5.0 | 30% | Pass | |
| Lead (filtered) | M18-Ma10627 | NCP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Mercury (filtered) | M18-Ma10627 | NCP | mg/L | < 0.0001 | < 0.0001 | <1 | 30% | Pass | |
| Nickel (filtered) | M18-Ma10627 | NCP | mg/L | 0.001 | 0.001 | 15 | 30% | Pass | |
| Zinc (filtered) | M18-Ma10627 | NCP | mg/L | 0.010 | 0.009 | 4.0 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Conductivity (at 25°C) | M18-Ma09927 | CP | uS/cm | 280 | 280 | 1.0 | 30% | Pass | |
| pH (at 25°C) | M18-Ma09927 | CP | pH Units | 7.4 | 7.3 | pass | 30% | Pass | |

| **Duplicate** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Result 1 | Result 2 | RPD | | | |
| Dissolved Oxygen (% Saturation) | M18-Ma09929 | CP | % | 57 | 54 | 5.0 | 30% | Pass | |
| Suspended Solids | M18-Ma09929 | CP | mg/L | 33 | 30 | 9.0 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Suspended Solids | M18-Ma09931 | CP | mg/L | 6.2 | 7.2 | 15 | 30% | Pass | |

## Comments

### Sample Integrity

| | |
|---|---|
| Custody Seals Intact (if used) | N/A |
| Attempt to Chill was evident | Yes |
| Sample correctly preserved | Yes |
| Appropriate sample containers have been used | Yes |
| Sample containers for volatile analysis received with minimal headspace | Yes |
| Samples received within HoldingTime | Yes |
| Some samples have been subcontracted | No |

### Qualifier Codes/Comments

| Code | Description |
|---|---|
| N07 | Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs |

### Authorised By

| | |
|---|---|
| Ryan Gilbert | Analytical Services Manager |
| Alex Petridis | Senior Analyst-Metal (VIC) |
| Joseph Edouard | Senior Analyst-Organic (VIC) |
| Michael Brancati | Senior Analyst-Inorganic (VIC) |

**Glenn Jackson**

**National Operations Manager**

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

## Surface water quality results – Round 3 (March 2019)

# CHAIN OF CUSTODY RECORD

ABN 50 005 085 521

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Company | **Aurecon** | Purchase Order | **23200** | Project Manager | **Shannah Brown** | Project Name | **Baseline Surface Water Monitoring** |
| Address | **Level 14, 32 Turbot Street, Brisbane, QLD** | Eurofins \| mgt Quote № | **160329AUR** | Project № | **Inland Rail Project** | Electronic Results Format | |
| Contact Name | **James Bone** | | | | | Email for Results | **james.bone@aurecongroup.com**<br>**gabriella.singh@aurecongroup.com** |
| Contact Phone № | **james.bone@aurecongroup.com** | | | | | Turn Around Requirements | ☐ 1 DAY* ☐ 2 DAY* ☐ 3 DAY* *Surcharges apply<br>☑ 5 DAY (Std.) ☐ Other ( ) |
| Special Direction | # 3 **eskies in total** | | | | | Method of Shipment | ☐ Courier (# )<br>☑ Hand Delivered<br>☐ Postal |
| Relinquished by (Signature) (Time / Date) | 5:24 13/3/19 | | | | | | |

Analysis (Note: Where metals are requested, please specify "Total" or "Filtered")

| № | Client Sample ID | Date | Matrix | pH | Suspended Solids (SS) | Turbidity | Speciated nitrogens (ammonia, nitrate, nitrite, organic nitrogen, oxidised nitrogen, total kjeldahl nitrogen, total nitrogen) | Electrical conductivity (Actual and specific) | M8 - 8 metals | Total Phosphorus | Reactive Phosphorus | Chlorophyll a | Polycyclic aromatic hydrocarbons (PAH) | Salinity (ppt) | Dissolved oxygen (% saturation) | Dissolved oxygen (mg/L) | | | Containers: 1L Plastic | 250mL Plastic | 125mL Plastic | 200mL Amber Glass | 40mL vial | 125mL Amber Glass | Jar | 60 ml plastic | Sample Comments / DG Hazard Warning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | G2H 1A | 11/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | | | 2 | | | 1 | | | | 2 | |
| 2 | G2H 2A | 11/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | | | 2 | | | 1 | | | | 2 | |
| 3 | G2H 3A | 11/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | | | 2 | | | 1 | | | | 2 | |
| 4 | G2H 9A | 11/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | | | 2 | | | 1 | | | | 2 | |
| 5 | G2H Duplicate 1 | 11/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | | | 2 | | | 1 | | | | 2 | |
| 6 | H2C 4A | 12/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | | | 2 | | | 1 | | | | 2 | |
| 7 | H2C Duplicate 2 | 12/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | | | 2 | | | 1 | | | | 2 | |
| 8 | H2C 3A | 12/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | | | 2 | | | 1 | | | | 2 | |
| 9 | H2C 18A | 12/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | | | 2 | | | 1 | | | | 2 | |
| 10 | C2K 5A | 13/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | | | 2 | | | 1 | | | | 2 | |
| 11 | C2K 6A | 13/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | | | 2 | | | 1 | | | | 2 | |
| 12 | C2K 13A | 13/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | | | 2 | | | 1 | | | | 2 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Laboratory Use Only | Received By | | SYD \| [✓ BNE] \| MEL \| PER \| ADL \| NEW \| DAR | Date | 13/3/19 | Time | ~~13~~:1729 | Signature | | Temperature | 22.2 °c |
| | Received By | | SYD \| BNE \| MEL \| PER \| ADL \| NEW \| DAR | Date | __/__/__ | Time | __:__ | Signature | | Report № | 645158 |

QS3009_R4 Modified by: S. Kojima Approved by: T. Lakeland Approved on: 11 August 2015

Submission of samples to the laboratory will be deemed as acceptance of Eurofins | mgt Standard Terms and Conditions unless agreed otherwise. A copy of Eurofins | mgt Standard Terms and Conditions is available on request.

# CHAIN OF CUSTODY RECORD

ABN 50 005 085 521

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Company: Aurecon
Address: Level 14, 32 Turbot Street, Brisbane, QLD
Contact Name: James Bone
Contact Phone №: james.bone@aurecongroup.com
Special Direction: # 3 eskies in total
Relinquished by (Signature) (Time / Date): 5:29 13/3/19

Purchase Order: 23200
Eurofins | mgt Quote №: 160329AUR
Project Manager: Shannah Brown
Project №: Inland Rail Project
Project Name: Baseline Surface Water Monitoring
Electronic Results Format:
Email for Results: james.bone@aurecongroup.com
gabriella.singh@aurecongroup.com

Turn Around Requirements: ☐ 1 DAY* ☐ 2 DAY* ☐ 3 DAY* ☑ 5 DAY (Std.) ☐ Other ( )
* Surcharges apply

Method of Shipment: ☐ Courier (# ) ☑ Hand Delivered ☐ Postal

Analysis (Note: Where metals are requested, please specify "Total" or "Filtered")

| № | Client Sample ID | Date | Matrix | pH | Suspended Solids (SS) | Turbidity | Speciated nitrogens (ammonia, nitrate, nitrite, organic nitrogen, oxidised nitrogen, total kjeldahl nitrogen, total nitrogen) | Electrical conductivity (Actual and specific) | M8 - 8 metals | Total Phosphorus | Reactive Phosphorus | Chlorophyll a | Polycyclic aromatic hydrocarbons (PAH) | Salinity (ppt) | Dissolved oxygen (% saturation) | Dissolved oxygen (mg/L) | 1L Plastic | 250mL Plastic | 125mL Plastic | 200mL Amber Glass | 40mL vial | 125mL Amber Glass | Jar | 60 ml plastic | Sample Comments / DG Hazard Warning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | C2K 10A | 13/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 2 | C2K duplicate 3 | 13/3/19 | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 3 | | | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 4 | | | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 5 | | | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 6 | | | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 7 | | | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 8 | | | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 9 | | | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 10 | | | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 11 | | | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |
| 12 | | | W | X | X | X | X | X | X | X | X | X | X | X | X | X | 2 | | | 1 | | | | 2 | |

**Laboratory Use Only**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Received By | | SYD \| [✓ BNE] \| MEL \| PER \| ADL \| NEW \| DAR | Date | 13/3/19 | Time | 17 29 | Signature | | Temperature 22.2°C |
| Received By | | SYD \| BNE \| MEL \| PER \| ADL \| NEW \| DAR | Date | __/__/__ | Time | __:__ | Signature | | Report № 645158 |

QS3009_R4 Modified by: S. Kojima Approved by: T. Lekeland Approved on: 11 August 2015

Submission of samples to the laboratory will be deemed as acceptance of Eurofins | mgt Standard Terms and Conditions unless agreed otherwise. A copy of Eurofins | mgt Standard Terms and Conditions is available on request.

# Certificate of Analysis

**Aurecon Australia (BRIS) Pty Ltd**
**Level 14, 32 Turbot St**
**Brisbane**
**QLD 4001**

**NATA Accredited**
**Accreditation Number 1261**
**Site Number 20794**

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The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

**Attention:** **James Bone**

**Report** **645158-W**
Project name BASELINE SURFACE WATER MONITORING
Project ID INLAND RAIL PROJECT
Received Date Mar 13, 2019

| **Client Sample ID** | | | **G2H1A** | **G2H 2A** | **G2H 3A** | **G2H 9A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B19-Ma15933** | **B19-Ma15934** | **B19-Ma15935** | **B19-Ma15936** |
| **Date Sampled** | | | **Mar 11, 2019** | **Mar 11, 2019** | **Mar 11, 2019** | **Mar 11, 2019** |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene$^{N07}$ | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 50 | 65 | 64 | 52 |
| p-Terphenyl-d14 (surr.) | 1 | % | 123 | 62 | 65 | 54 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | < 0.01 | < 0.01 | < 0.01 | 0.04 |
| Chlorophyll a | 5 | ug/L | < 5 | < 5 | < 5 | 7.5 |
| Conductivity (at 25°C) | 1 | uS/cm | 920 | 440 | 380 | 1800 |
| Dissolved Oxygen | 0.01 | mg/L | 9.1 | 9.2 | 9.0 | 9.0 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | 2.1 | 0.71 | 1.1 | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | 2.1 | 0.70 | 1.0 | < 0.02 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | < 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 1.1 | < 0.2 | 1.2 | 0.42 |
| pH (at 25°C) | 0.1 | pH Units | 8.3 | 8.5 | 8.3 | 8.4 |
| Phosphate total (as P) | 0.01 | mg/L | 0.12 | 0.04 | 0.06 | 0.01 |
| Phosphorus reactive (as P) | 0.01 | mg/L | 0.10 | 0.02 | 0.03 | 0.01 |
| Salinity (determined from EC)* | 20 | mg/L | 450 | 210 | 180 | 930 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 1.1 | < 0.2 | 1.2 | 0.5 |
| Total Nitrogen (as N) | 0.2 | mg/L | 3.2 | 0.71 | 1.3 | 0.46 |
| Total Suspended Solids Dried at 103–105°C | 1 | mg/L | 13 | 3.8 | 4.9 | 13 |
| Turbidity | 1 | NTU | 2.5 | 1.8 | 2.1 | 7.1 |

| **Client Sample ID**<br>**Sample Matrix**<br>**Eurofins \| mgt Sample No.**<br>**Date Sampled**<br>Test/Reference | LOR | Unit | **G2H1A**<br>**Water**<br>**B19-Ma15933**<br>**Mar 11, 2019** | **G2H 2A**<br>**Water**<br>**B19-Ma15934**<br>**Mar 11, 2019** | **G2H 3A**<br>**Water**<br>**B19-Ma15935**<br>**Mar 11, 2019** | **G2H 9A**<br>**Water**<br>**B19-Ma15936**<br>**Mar 11, 2019** |
|---|---|---|---|---|---|---|
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | 0.002 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | < 0.001 | 0.001 | 0.001 | < 0.001 |
| Zinc (filtered) | 0.005 | mg/L | 0.025 | < 0.005 | < 0.005 | < 0.005 |

| **Client Sample ID**<br>**Sample Matrix**<br>**Eurofins \| mgt Sample No.**<br>**Date Sampled**<br>Test/Reference | LOR | Unit | **G2H DUPLICATE 1**<br>**Water**<br>**B19-Ma15937**<br>**Mar 11, 2019** | **H2C 4A**<br>**Water**<br>**B19-Ma15938**<br>**Mar 12, 2019** | **H2C DUPLICATE 2**<br>**Water**<br>**B19-Ma15939**<br>**Mar 12, 2019** | **H2C 3A**<br>**Water**<br>**B19-Ma15940**<br>**Mar 12, 2019** |
|---|---|---|---|---|---|---|
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene$^{N07}$ | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 56 | 54 | 59 | 112 |
| p-Terphenyl-d14 (surr.) | 1 | % | 53 | 51 | 56 | 108 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.06 | < 0.01 | < 0.01 | 0.18 |
| Chlorophyll a | 5 | ug/L | 7.5 | 6.4 | 21 | < 5 |
| Conductivity (at 25°C) | 1 | uS/cm | 1700 | 480 | 490 | 710 |
| Dissolved Oxygen | 0.01 | mg/L | 9.0 | 9.0 | 9.0 | 9.0 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | < 0.02 | < 0.02 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | < 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 0.35 | 0.67 | 0.71 | 0.70 |
| pH (at 25°C) | 0.1 | pH Units | 8.4 | 8.7 | 8.7 | 9.1 |
| Phosphate total (as P) | 0.01 | mg/L | < 0.01 | 0.10 | 0.06 | 0.06 |
| Phosphorus reactive (as P) | 0.01 | mg/L | 0.01 | 0.01 | 0.03 | 0.05 |
| Salinity (determined from EC)* | 20 | mg/L | 880 | 230 | 240 | 340 |

| **Client Sample ID** | | | **G2H DUPLICATE 1** | **H2C 4A** | **H2C DUPLICATE 2** | **H2C 3A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B19-Ma15937** | **B19-Ma15938** | **B19-Ma15939** | **B19-Ma15940** |
| **Date Sampled** | | | **Mar 11, 2019** | **Mar 12, 2019** | **Mar 12, 2019** | **Mar 12, 2019** |
| Test/Reference | LOR | Unit | | | | |
| | | | | | | |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 0.4 | 0.7 | 0.7 | 0.9 |
| Total Nitrogen (as N) | 0.2 | mg/L | 0.41 | 0.67 | 0.71 | 0.88 |
| Total Suspended Solids Dried at 103–105°C | 1 | mg/L | 12 | 67 | 49 | 11 |
| Turbidity | 1 | NTU | 6.6 | 42 | 24 | 2.9 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | 0.002 | < 0.001 | < 0.001 | 0.002 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | < 0.001 | 0.002 | 0.002 | 0.001 |
| Zinc (filtered) | 0.005 | mg/L | < 0.005 | < 0.005 | < 0.005 | 0.005 |

| **Client Sample ID** | | | **H2C 18A** | **C2K 5A** | **C2K 6A** | **C2K 13A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B19-Ma15941** | **B19-Ma15942** | **B19-Ma15943** | **B19-Ma15944** |
| **Date Sampled** | | | **Mar 12, 2019** | **Mar 13, 2019** | **Mar 13, 2019** | **Mar 13, 2019** |
| Test/Reference | LOR | Unit | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene[N07] | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 71 | 53 | 51 | 67 |
| p-Terphenyl-d14 (surr.) | 1 | % | 74 | 50 | 57 | 79 |
| | | | | | | |
| Ammonia (as N) | 0.01 | mg/L | 0.20 | < 0.01 | 0.67 | < 0.01 |
| Chlorophyll a | 5 | ug/L | 18 | 32 | < 5 | 20 |
| Conductivity (at 25°C) | 1 | uS/cm | 3000 | 380 | 3400 | 2000 |
| Dissolved Oxygen | 0.01 | mg/L | 8.7 | 9.1 | 8.5 | 8.9 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | < 0.05 | < 0.05 | 0.06 | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | 0.06 | < 0.02 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | < 0.02 | < 0.02 | < 0.02 |

| **Client Sample ID** | | | **H2C 18A** | **C2K 5A** | **C2K 6A** | **C2K 13A** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B19-Ma15941** | **B19-Ma15942** | **B19-Ma15943** | **B19-Ma15944** |
| **Date Sampled** | | | **Mar 12, 2019** | **Mar 13, 2019** | **Mar 13, 2019** | **Mar 13, 2019** |
| Test/Reference | LOR | Unit | | | | |
| | | | | | | |
| Organic Nitrogen (as N) | 0.2 | mg/L | 1.3 | 1.6 | 1.2 | 0.59 |
| pH (at 25°C) | 0.1 | pH Units | 6.3 | 9.1 | 8.3 | 8.4 |
| Phosphate total (as P) | 0.01 | mg/L | 0.01 | 0.01 | 0.02 | 0.01 |
| Phosphorus reactive (as P) | 0.01 | mg/L | 0.01 | 0.01 | 0.01 | 0.01 |
| Salinity (determined from EC)* | 20 | mg/L | 1600 | 180 | 1800 | 1000 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 1.3 | 1.6 | 1.9 | 0.6 |
| Total Nitrogen (as N) | 0.2 | mg/L | 1.3 | 1.6 | 1.9 | 0.59 |
| Total Suspended Solids Dried at 103–105°C | 1 | mg/L | 21 | 36 | 42 | 24 |
| Turbidity | 1 | NTU | 18 | 21 | 34 | 9.7 |
| **Heavy Metals** | | | | | | |
| Arsenic (filtered) | 0.001 | mg/L | 0.002 | 0.002 | 0.001 | 0.006 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | 0.004 | < 0.001 | 0.003 | 0.002 |
| Zinc (filtered) | 0.005 | mg/L | < 0.005 | < 0.005 | < 0.005 | < 0.005 |

| **Client Sample ID** | | | **C2K 10A** | **C2K DUPLICATE 3** |
|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B19-Ma15945** | **B19-Ma15946** |
| **Date Sampled** | | | **Mar 13, 2019** | **Mar 13, 2019** |
| Test/Reference | LOR | Unit | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | |
| Acenaphthene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Acenaphthylene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Anthracene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Benz(a)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Benzo(a)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Benzo(b&j)fluoranthene[N07] | 0.001 | mg/L | < 0.001 | < 0.001 |
| Benzo(g.h.i)perylene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Benzo(k)fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Chrysene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Dibenz(a.h)anthracene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Fluoranthene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Fluorene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Indeno(1.2.3-cd)pyrene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Naphthalene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Phenanthrene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Pyrene | 0.001 | mg/L | < 0.001 | < 0.001 |
| Total PAH* | 0.001 | mg/L | < 0.001 | < 0.001 |
| 2-Fluorobiphenyl (surr.) | 1 | % | 74 | 79 |
| p-Terphenyl-d14 (surr.) | 1 | % | 78 | 80 |

| **Client Sample ID** | | | **C2K 10A** | **C2K DUPLICATE 3** |
|---|---|---|---|---|
| **Sample Matrix** | | | **Water** | **Water** |
| **Eurofins \| mgt Sample No.** | | | **B19-Ma15945** | **B19-Ma15946** |
| **Date Sampled** | | | **Mar 13, 2019** | **Mar 13, 2019** |
| Test/Reference | LOR | Unit | | |
| | | | | |
| Ammonia (as N) | 0.01 | mg/L | < 0.01 | < 0.01 |
| Chlorophyll a | 5 | ug/L | < 5 | < 5 |
| Conductivity (at 25°C) | 1 | uS/cm | 2700 | 2700 |
| Dissolved Oxygen | 0.01 | mg/L | 9.0 | 9.0 |
| Nitrate & Nitrite (as N) | 0.05 | mg/L | < 0.05 | < 0.05 |
| Nitrate (as N) | 0.02 | mg/L | < 0.02 | < 0.02 |
| Nitrite (as N) | 0.02 | mg/L | < 0.02 | < 0.02 |
| Organic Nitrogen (as N) | 0.2 | mg/L | 0.29 | 0.34 |
| pH (at 25°C) | 0.1 | pH Units | 8.2 | 8.4 |
| Phosphate total (as P) | 0.01 | mg/L | 0.01 | < 0.01 |
| Phosphorus reactive (as P) | 0.01 | mg/L | 0.01 | 0.10 |
| Salinity (determined from EC)* | 20 | mg/L | 1400 | 1400 |
| Total Kjeldahl Nitrogen (as N) | 0.2 | mg/L | 0.3 | 0.3 |
| Total Nitrogen (as N) | 0.2 | mg/L | 0.29 | 0.34 |
| Total Suspended Solids Dried at 103–105°C | 1 | mg/L | 13 | 10 |
| Turbidity | 1 | NTU | 7.4 | 5.2 |
| **Heavy Metals** | | | | |
| Arsenic (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 |
| Cadmium (filtered) | 0.0002 | mg/L | < 0.0002 | < 0.0002 |
| Chromium (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 |
| Copper (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 |
| Lead (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 |
| Mercury (filtered) | 0.0001 | mg/L | < 0.0001 | < 0.0001 |
| Nickel (filtered) | 0.001 | mg/L | < 0.001 | < 0.001 |
| Zinc (filtered) | 0.005 | mg/L | < 0.005 | < 0.005 |

## Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

| **Description** | **Testing Site** | **Extracted** | **Holding Time** |
|---|---|---|---|
| Polycyclic Aromatic Hydrocarbons | Melbourne | Mar 15, 2019 | 7 Day |
| - Method: LTM-ORG-2130 PAH and Phenols in Soil and Water | | | |
| Chlorophyll a | Melbourne | Mar 20, 2019 | 2 Day |
| - Method: LTM-INO-4340 Chlorophyll a in Waters | | | |
| Conductivity (at 25°C) | Melbourne | Mar 18, 2019 | 28 Day |
| - Method: LTM-INO-4030 Conductivity | | | |
| Dissolved Oxygen | Melbourne | Mar 16, 2019 | 1 Day |
| - Method: LTM-INO-4130 Determination of Dissolved Oxygen using a DO meter | | | |
| pH (at 25°C) | Melbourne | Mar 18, 2019 | 0 Hours |
| - Method: LTM-GEN-7090 pH in water by ISE | | | |
| Phosphate total (as P) | Melbourne | Mar 15, 2019 | 28 Day |
| - Method: APHA 4500-P E. Phosphorus | | | |
| Phosphorus reactive (as P) | Melbourne | Mar 15, 2019 | 2 Day |
| - Method: APHA4500-PO4 | | | |
| Salinity (determined from EC)* | Melbourne | Mar 18, 2019 | 0 Day |
| - Method: LTM-INO-4030 | | | |
| Total Suspended Solids Dried at 103–105°C | Melbourne | Mar 15, 2019 | 7 Days |
| - Method: LTM-INO-4070 Analysis of Suspended Solids in Water by Gravimetry | | | |
| Turbidity | Melbourne | Mar 20, 2019 | 2 Day |
| - Method: Turbidity by classical using APHA 2130B (LTM-INO-4140) | | | |
| Metals M8 filtered | Brisbane | Mar 14, 2019 | 28 Day |
| - Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS | | | |
| Nitrogens (speciated) | | | |
| Ammonia (as N) | Melbourne | Mar 15, 2019 | 28 Day |
| - Method: APHA 4500-NH3 Ammonia Nitrogen by FIA | | | |
| Nitrate & Nitrite (as N) | Melbourne | Mar 15, 2019 | 28 Day |
| - Method: APHA 4500-NO3/NO2 Nitrate-Nitrite Nitrogen by FIA | | | |
| Nitrate (as N) | Melbourne | Mar 15, 2019 | 28 Day |
| - Method: APHA 4500-NO3 Nitrate Nitrogen by FIA | | | |
| Nitrite (as N) | Melbourne | Mar 15, 2019 | 2 Day |
| - Method: APHA 4500-NO2 Nitrite Nitrogen by FIA | | | |
| Organic Nitrogen (as N) | Melbourne | Mar 13, 2019 | 7 Day |
| - Method: APHA 4500 Organic Nitrogen (N) | | | |
| Total Kjeldahl Nitrogen (as N) | Melbourne | Mar 15, 2019 | 7 Day |
| - Method: LTM-INO-4040 Phosphate and Nitrogen in waters by Continuous Flow Analysis (CFA) | | | |

**Company Name:** Aurecon Australia (BRIS) Pty Ltd
**Address:** Level 14, 32 Turbot St
Brisbane
QLD 4001

**Order No.:** 23200
**Report #:** 645158
**Phone:** 07 3173 8000
**Fax:** +61 7 3173 8001

**Received:** Mar 13, 2019 5:29 PM
**Due:** Mar 20, 2019
**Priority:** 5 Day
**Contact Name:** James Bone

**Project Name:** BASELINE SURFACE WATER MONITORING
**Project ID:** INLAND RAIL PROJECT

**Eurofins | mgt Analytical Services Manager : Ryan Gilbert**

| **Sample Detail** | | | | | | Chlorophyll a | Conductivity (at 25°C) | Dissolved Oxygen | pH (at 25°C) | Phosphate total (as P) | Phosphorus reactive (as P) | Salinity (determined from EC)* | Total Suspended Solids Dried at 103–105°C | Turbidity | Polycyclic Aromatic Hydrocarbons | Metals M8 | Nitrogens (speciated) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Melbourne Laboratory - NATA Site # 1254 & 14271** | | | | | | X | X | X | X | X | X | X | X | X | X | | X |
| **Sydney Laboratory - NATA Site # 18217** | | | | | | | | | | | | | | | | | |
| **Brisbane Laboratory - NATA Site # 20794** | | | | | | | | | | | | | | | | X | |
| **Perth Laboratory - NATA Site # 23736** | | | | | | | | | | | | | | | | | |
| **External Laboratory** | | | | | | | | | | | | | | | | | |
| **No** | **Sample ID** | **Sample Date** | **Sampling Time** | **Matrix** | **LAB ID** | | | | | | | | | | | | |
| 1 | G2H1A | Mar 11, 2019 | | Water | B19-Ma15933 | X | X | X | X | X | X | X | X | X | X | X | X |
| 2 | G2H 2A | Mar 11, 2019 | | Water | B19-Ma15934 | X | X | X | X | X | X | X | X | X | X | X | X |
| 3 | G2H 3A | Mar 11, 2019 | | Water | B19-Ma15935 | X | X | X | X | X | X | X | X | X | X | X | X |
| 4 | G2H 9A | Mar 11, 2019 | | Water | B19-Ma15936 | X | X | X | X | X | X | X | X | X | X | X | X |
| 5 | G2H DUPLICATE 1 | Mar 11, 2019 | | Water | B19-Ma15937 | X | X | X | X | X | X | X | X | X | X | X | X |
| 6 | H2C 4A | Mar 12, 2019 | | Water | B19-Ma15938 | X | X | X | X | X | X | X | X | X | X | X | X |
| 7 | H2C DUPLICATE 2 | Mar 12, 2019 | | Water | B19-Ma15939 | X | X | X | X | X | X | X | X | X | X | X | X |
| 8 | H2C 3A | Mar 12, 2019 | | Water | B19-Ma15940 | X | X | X | X | X | X | X | X | X | X | X | X |

| | | | | | |
|---|---|---|---|---|---|
| **Company Name:** | Aurecon Australia (BRIS) Pty Ltd | **Order No.:** | 23200 | **Received:** | Mar 13, 2019 5:29 PM |
| **Address:** | Level 14, 32 Turbot St<br>Brisbane<br>QLD 4001 | **Report #:** | 645158 | **Due:** | Mar 20, 2019 |
| | | **Phone:** | 07 3173 8000 | **Priority:** | 5 Day |
| | | **Fax:** | +61 7 3173 8001 | **Contact Name:** | James Bone |
| **Project Name:** | BASELINE SURFACE WATER MONITORING | | | | |
| **Project ID:** | INLAND RAIL PROJECT | | | | |

**Eurofins | mgt Analytical Services Manager : Ryan Gilbert**

| **Sample Detail** | | | | | | Chlorophyll a | Conductivity (at 25°C) | Dissolved Oxygen | pH (at 25°C) | Phosphate total (as P) | Phosphorus reactive (as P) | Salinity (determined from EC)* | Total Suspended Solids Dried at 103–105°C | Turbidity | Polycyclic Aromatic Hydrocarbons | Metals M8 | Nitrogens (speciated) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Melbourne Laboratory - NATA Site # 1254 & 14271** | | | | | | X | X | X | X | X | X | X | X | X | X | | X |
| **Sydney Laboratory - NATA Site # 18217** | | | | | | | | | | | | | | | | | |
| **Brisbane Laboratory - NATA Site # 20794** | | | | | | | | | | | | | | | | X | |
| **Perth Laboratory - NATA Site # 23736** | | | | | | | | | | | | | | | | | |
| 9 | H2C 18A | Mar 12, 2019 | | Water | B19-Ma15941 | X | X | X | X | X | X | X | X | X | X | X | X |
| 10 | C2K 5A | Mar 13, 2019 | | Water | B19-Ma15942 | X | X | X | X | X | X | X | X | X | X | X | X |
| 11 | C2K 6A | Mar 13, 2019 | | Water | B19-Ma15943 | X | X | X | X | X | X | X | X | X | X | X | X |
| 12 | C2K 13A | Mar 13, 2019 | | Water | B19-Ma15944 | X | X | X | X | X | X | X | X | X | X | X | X |
| 13 | C2K 10A | Mar 13, 2019 | | Water | B19-Ma15945 | X | X | X | X | X | X | X | X | X | X | X | X |
| 14 | C2K DUPLICATE 3 | Mar 13, 2019 | | Water | B19-Ma15946 | X | X | X | X | X | X | X | X | X | X | X | X |
| **Test Counts** | | | | | | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |

# Internal Quality Control Review and Glossary

## General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure, April 2011 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

## Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

## Units

| | | |
|---|---|---|
| **mg/kg:** milligrams per kilogram | **mg/L:** milligrams per litre | **ug/L:** micrograms per litre |
| **ppm:** Parts per million | **ppb:** Parts per billion | **%:** Percentage |
| **org/100mL:** Organisms per 100 millilitres | **NTU:** Nephelometric Turbidity Units | **MPN/100mL:** Most Probable Number of organisms per 100 millilitres |

## Terms

| | |
|---|---|
| **Dry** | Where a moisture has been determined on a solid sample the result is expressed on a dry basis. |
| **LOR** | Limit of Reporting. |
| **SPIKE** | Addition of the analyte to the sample and reported as percentage recovery. |
| **RPD** | Relative Percent Difference between two Duplicate pieces of analysis. |
| **LCS** | Laboratory Control Sample - reported as percent recovery. |
| **CRM** | Certified Reference Material - reported as percent recovery. |
| **Method Blank** | In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water. |
| **Surr - Surrogate** | The addition of a like compound to the analyte target and reported as percentage recovery. |
| **Duplicate** | A second piece of analysis from the same sample and reported in the same units as the result to show comparison. |
| **USEPA** | United States Environmental Protection Agency |
| **APHA** | American Public Health Association |
| **TCLP** | Toxicity Characteristic Leaching Procedure |
| **COC** | Chain of Custody |
| **SRA** | Sample Receipt Advice |
| **QSM** | US Department of Defense Quality Systems Manual Version 5.2 2018 |
| **CP** | Client Parent - QC was performed on samples pertaining to this report |
| **NCP** | Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within. |
| **TEQ** | Toxic Equivalency Quotient |

## QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results<10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.2 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

## QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

**Quality Control Results**

| Test | Units | Result 1 | | | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|
| **Method Blank** | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | | |
| Acenaphthene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Acenaphthylene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Anthracene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benz(a)anthracene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(a)pyrene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(b&j)fluoranthene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(g.h.i)perylene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Benzo(k)fluoranthene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Chrysene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Dibenz(a.h)anthracene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Fluoranthene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Fluorene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Indeno(1.2.3-cd)pyrene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Naphthalene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Phenanthrene | mg/L | < 0.001 | | | 0.001 | Pass | |
| Pyrene | mg/L | < 0.001 | | | 0.001 | Pass | |
| **Method Blank** | | | | | | | |
| Ammonia (as N) | mg/L | < 0.01 | | | 0.01 | Pass | |
| Chlorophyll a | ug/L | < 5 | | | 5 | Pass | |
| Nitrate & Nitrite (as N) | mg/L | < 0.05 | | | 0.05 | Pass | |
| Nitrate (as N) | mg/L | < 0.02 | | | 0.02 | Pass | |
| Nitrite (as N) | mg/L | < 0.02 | | | 0.02 | Pass | |
| Phosphate total (as P) | mg/L | < 0.01 | | | 0.01 | Pass | |
| Phosphorus reactive (as P) | mg/L | 0.01 | | | 0.01 | Pass | |
| Total Kjeldahl Nitrogen (as N) | mg/L | < 0.2 | | | 0.2 | Pass | |
| Total Suspended Solids Dried at 103–105°C | mg/L | < 1 | | | 1 | Pass | |
| Turbidity | NTU | < 1 | | | 1 | Pass | |
| **Method Blank** | | | | | | | |
| **Heavy Metals** | | | | | | | |
| Arsenic (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Cadmium (filtered) | mg/L | < 0.0002 | | | 0.0002 | Pass | |
| Chromium (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Copper (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Lead (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Mercury (filtered) | mg/L | < 0.0001 | | | 0.0001 | Pass | |
| Nickel (filtered) | mg/L | < 0.001 | | | 0.001 | Pass | |
| Zinc (filtered) | mg/L | < 0.005 | | | 0.005 | Pass | |
| **LCS - % Recovery** | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | | |
| Acenaphthene | % | 81 | | | 70-130 | Pass | |
| Acenaphthylene | % | 80 | | | 70-130 | Pass | |
| Anthracene | % | 74 | | | 70-130 | Pass | |
| Benz(a)anthracene | % | 104 | | | 70-130 | Pass | |
| Benzo(a)pyrene | % | 119 | | | 70-130 | Pass | |
| Benzo(b&j)fluoranthene | % | 118 | | | 70-130 | Pass | |
| Benzo(g.h.i)perylene | % | 121 | | | 70-130 | Pass | |
| Benzo(k)fluoranthene | % | 121 | | | 70-130 | Pass | |
| Chrysene | % | 119 | | | 70-130 | Pass | |
| Dibenz(a.h)anthracene | % | 114 | | | 70-130 | Pass | |
| Fluoranthene | % | 95 | | | 70-130 | Pass | |

| Test | Units | Result 1 | | | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|
| Fluorene | % | 89 | | | 70-130 | Pass | |
| Indeno(1.2.3-cd)pyrene | % | 71 | | | 70-130 | Pass | |
| Naphthalene | % | 70 | | | 70-130 | Pass | |
| Phenanthrene | % | 92 | | | 70-130 | Pass | |
| Pyrene | % | 93 | | | 70-130 | Pass | |
| **LCS - % Recovery** | | | | | | | |
| Ammonia (as N) | % | 100 | | | 70-130 | Pass | |
| Nitrate & Nitrite (as N) | % | 100 | | | 70-130 | Pass | |
| Nitrate (as N) | % | 100 | | | 70-130 | Pass | |
| Nitrite (as N) | % | 119 | | | 70-130 | Pass | |
| Phosphate total (as P) | % | 113 | | | 70-130 | Pass | |
| Total Kjeldahl Nitrogen (as N) | % | 91 | | | 70-130 | Pass | |
| Total Suspended Solids Dried at 103–105°C | % | 108 | | | 70-130 | Pass | |
| **LCS - % Recovery** | | | | | | | |
| **Heavy Metals** | | | | | | | |
| Arsenic (filtered) | % | 89 | | | 80-120 | Pass | |
| Cadmium (filtered) | % | 88 | | | 80-120 | Pass | |
| Chromium (filtered) | % | 90 | | | 80-120 | Pass | |
| Copper (filtered) | % | 89 | | | 80-120 | Pass | |
| Lead (filtered) | % | 88 | | | 80-120 | Pass | |
| Mercury (filtered) | % | 94 | | | 70-130 | Pass | |
| Nickel (filtered) | % | 90 | | | 80-120 | Pass | |
| Zinc (filtered) | % | 89 | | | 80-120 | Pass | |

| Test | Lab Sample ID | QA Source | Units | Result 1 | | | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|---|---|
| **Spike - % Recovery** | | | | | | | | | |
| | | | | Result 1 | | | | | |
| Ammonia (as N) | M19-Ma16921 | NCP | % | 92 | | | 70-130 | Pass | |
| Nitrate & Nitrite (as N) | M19-Ma16921 | NCP | % | 92 | | | 70-130 | Pass | |
| Nitrate (as N) | M19-Ma16921 | NCP | % | 92 | | | 70-130 | Pass | |
| Nitrite (as N) | M19-Ma16921 | NCP | % | 103 | | | 70-130 | Pass | |
| **Spike - % Recovery** | | | | | | | | | |
| **Heavy Metals** | | | | Result 1 | | | | | |
| Arsenic (filtered) | B19-Ma15933 | CP | % | 100 | | | 70-130 | Pass | |
| Cadmium (filtered) | B19-Ma15933 | CP | % | 99 | | | 70-130 | Pass | |
| Chromium (filtered) | B19-Ma15933 | CP | % | 83 | | | 70-130 | Pass | |
| Copper (filtered) | B19-Ma15933 | CP | % | 80 | | | 70-130 | Pass | |
| Lead (filtered) | B19-Ma15933 | CP | % | 81 | | | 70-130 | Pass | |
| Mercury (filtered) | B19-Ma15933 | CP | % | 82 | | | 70-130 | Pass | |
| Nickel (filtered) | B19-Ma15933 | CP | % | 83 | | | 70-130 | Pass | |
| Zinc (filtered) | B19-Ma15933 | CP | % | 82 | | | 70-130 | Pass | |
| **Spike - % Recovery** | | | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | Result 1 | | | | | |
| Acenaphthene | B19-Ma15938 | CP | % | 98 | | | 70-130 | Pass | |
| Acenaphthylene | B19-Ma15938 | CP | % | 94 | | | 70-130 | Pass | |
| Anthracene | B19-Ma15938 | CP | % | 85 | | | 70-130 | Pass | |
| Benz(a)anthracene | B19-Ma15938 | CP | % | 96 | | | 70-130 | Pass | |
| Benzo(a)pyrene | B19-Ma15938 | CP | % | 102 | | | 70-130 | Pass | |
| Benzo(b&j)fluoranthene | B19-Ma15938 | CP | % | 104 | | | 70-130 | Pass | |
| Benzo(g.h.i)perylene | B19-Ma15938 | CP | % | 89 | | | 70-130 | Pass | |
| Benzo(k)fluoranthene | B19-Ma15938 | CP | % | 77 | | | 70-130 | Pass | |
| Chrysene | B19-Ma15938 | CP | % | 78 | | | 70-130 | Pass | |
| Dibenz(a.h)anthracene | B19-Ma15938 | CP | % | 80 | | | 70-130 | Pass | |
| Fluoranthene | B19-Ma15938 | CP | % | 74 | | | 70-130 | Pass | |
| Fluorene | B19-Ma15938 | CP | % | 92 | | | 70-130 | Pass | |

| Test | Lab Sample ID | QA Source | Units | Result 1 | | | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|---|---|
| Indeno(1.2.3-cd)pyrene | B19-Ma15938 | CP | % | 70 | | | 70-130 | Pass | |
| Naphthalene | B19-Ma15938 | CP | % | 76 | | | 70-130 | Pass | |
| Phenanthrene | B19-Ma15938 | CP | % | 86 | | | 70-130 | Pass | |
| Pyrene | B19-Ma15938 | CP | % | 75 | | | 70-130 | Pass | |
| **Spike - % Recovery** | | | | | | | | | |
| | | | | Result 1 | | | | | |
| Phosphate total (as P) | B19-Ma15943 | CP | % | 102 | | | 70-130 | Pass | |
| **Spike - % Recovery** | | | | | | | | | |
| **Heavy Metals** | | | | Result 1 | | | | | |
| Arsenic (filtered) | B19-Ma15943 | CP | % | 94 | | | 70-130 | Pass | |
| Cadmium (filtered) | B19-Ma15943 | CP | % | 96 | | | 70-130 | Pass | |
| Chromium (filtered) | B19-Ma15943 | CP | % | 96 | | | 70-130 | Pass | |
| Copper (filtered) | B19-Ma15943 | CP | % | 94 | | | 70-130 | Pass | |
| Lead (filtered) | B19-Ma15943 | CP | % | 86 | | | 70-130 | Pass | |
| Mercury (filtered) | B19-Ma15943 | CP | % | 89 | | | 70-130 | Pass | |
| Nickel (filtered) | B19-Ma15943 | CP | % | 94 | | | 70-130 | Pass | |
| Zinc (filtered) | B19-Ma15943 | CP | % | 93 | | | 70-130 | Pass | |
| **Test** | **Lab Sample ID** | **QA Source** | **Units** | **Result 1** | | | **Acceptance Limits** | **Pass Limits** | **Qualifying Code** |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Ammonia (as N) | M19-Ma16921 | NCP | mg/L | 1.7 | 1.7 | 1.0 | 30% | Pass | |
| Chlorophyll a | B19-Ma15933 | CP | ug/L | < 5 | < 5 | <1 | 30% | Pass | |
| Conductivity (at 25°C) | B19-Ma15933 | CP | uS/cm | 920 | 910 | <1 | 30% | Pass | |
| Nitrate & Nitrite (as N) | M19-Ma16921 | NCP | mg/L | 0.45 | 0.44 | 2.0 | 30% | Pass | |
| Nitrate (as N) | M19-Ma16921 | NCP | mg/L | 0.45 | 0.44 | 2.0 | 30% | Pass | |
| Nitrite (as N) | M19-Ma16921 | NCP | mg/L | < 0.02 | < 0.02 | <1 | 30% | Pass | |
| pH (at 25°C) | B19-Ma15933 | CP | pH Units | 8.3 | 8.3 | pass | 30% | Pass | |
| Phosphate total (as P) | B19-Ma15933 | CP | mg/L | 0.12 | 0.12 | 1.0 | 30% | Pass | |
| Salinity (determined from EC)* | M19-Ma16795 | NCP | mg/L | 630 | 650 | 3.0 | 30% | Pass | |
| Total Kjeldahl Nitrogen (as N) | B19-Ma15933 | CP | mg/L | 1.1 | 1.3 | 19 | 30% | Pass | |
| Turbidity | M19-Ma21125 | NCP | NTU | 1.8 | 1.8 | 1.0 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| | | | | Result 1 | Result 2 | RPD | | | |
| Total Suspended Solids Dried at 103–105°C | B19-Ma15675 | NCP | mg/L | 40 | 37 | 8.0 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | | | | Result 1 | Result 2 | RPD | | | |
| Acenaphthene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Acenaphthylene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Anthracene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benz(a)anthracene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(a)pyrene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(b&j)fluoranthene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(g.h.i)perylene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Benzo(k)fluoranthene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Chrysene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Dibenz(a.h)anthracene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Fluoranthene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Fluorene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Indeno(1.2.3-cd)pyrene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Naphthalene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Phenanthrene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Pyrene | B19-Ma15937 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |

| **Duplicate** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Result 1 | Result 2 | RPD | | | |
| Dissolved Oxygen | B19-Ma15937 | CP | mg/L | 9.0 | 8.8 | 2.0 | 30% | Pass | |
| **Duplicate** | | | | | | | | | |
| **Heavy Metals** | | | | Result 1 | Result 2 | RPD | | | |
| Arsenic (filtered) | B19-Ma15942 | CP | mg/L | 0.002 | 0.002 | 2.0 | 30% | Pass | |
| Cadmium (filtered) | B19-Ma15942 | CP | mg/L | < 0.0002 | < 0.0002 | <1 | 30% | Pass | |
| Chromium (filtered) | B19-Ma15942 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Copper (filtered) | B19-Ma15942 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Lead (filtered) | B19-Ma15942 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Mercury (filtered) | B19-Ma15942 | CP | mg/L | < 0.0001 | < 0.0001 | <1 | 30% | Pass | |
| Nickel (filtered) | B19-Ma15942 | CP | mg/L | < 0.001 | < 0.001 | <1 | 30% | Pass | |
| Zinc (filtered) | B19-Ma15942 | CP | mg/L | < 0.005 | < 0.005 | <1 | 30% | Pass | |

## Comments

## Sample Integrity

| | |
|---|---|
| Custody Seals Intact (if used) | N/A |
| Attempt to Chill was evident | Yes |
| Sample correctly preserved | Yes |
| Appropriate sample containers have been used | Yes |
| Sample containers for volatile analysis received with minimal headspace | Yes |
| Samples received within HoldingTime | Yes |
| Some samples have been subcontracted | No |

## Qualifier Codes/Comments

| Code | Description |
|---|---|
| N07 | Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs |

## Authorised By

| | |
|---|---|
| Ryan Gilbert | Analytical Services Manager |
| Joseph Edouard | Senior Analyst-Organic (VIC) |
| Julie Kay | Senior Analyst-Inorganic (VIC) |
| Steven Trout | Senior Analyst-Metal (QLD) |

**Glenn Jackson**

**General Manager**

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

# APPENDIX

# L

# Surface Water Quality Technical Report

## **Appendix C** General Field Assessment Water Quality Conditions

**HELIDON TO CALVERT** ENVIRONMENTAL IMPACT STATEMENT

IR_1381

# Appendix C

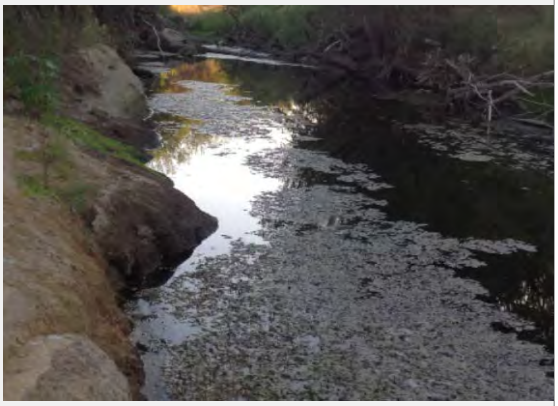
# General field assessment water quality conditions

**Table C.1 Summary of the general conditions for the water quality Project sampling sites (October 2017 to March 2019)**

| Monitoring location and waterbody | Date | Water flow (none/ low/ mod/ high/ flood/ dry | Turbidity (clear/ slight/ turbid/ opaque/ other) | Odour (normal/ sewage/ hydrocarbon/ chemical) | Surface condition (none/ dust/ oily/ leafy/ algae) | Algae cover (none/ some/ lots) | Visual observation/ comments |
|---|---|---|---|---|---|---|---|
| H2C 2A<br>Un-named | 11/10/2017 | Dry at time of sample | | | | | |
| | 01/03/2018 | None (Pool) | Clear | None | None | None | - |
| | 11/03/2019 | Dry at time of sample | | | | | |
| H2C 3A<br>Lockyer Creek | 12/10/2017 | None (Pool) | Slight | Normal | None | Some | Downstream of rail bridge crossing. Adjacent to recreational vehicle park<br>Litter present |
| | 01/03/2018 | Dry at time of sample | | | | | |
| | 12/03/2019 | None (Pool) | Turbid | Normal | Algae | Some | - |
| H2C 4A<br>Lockyer Creek | 09/10/2017 | Low | Turbid | Normal | Leafy dusty | Some | Road and rail crossing |
| | 01/03/2018 | Dry at time of sample | | | | | |
| | 12/03/2019 | None (Pool) | Turbid | Normal | Leafy | None | Road and rail crossing |
| H2C 5A<br>Sandy Creek | 09/10/2017 | Dry at time of sample | | | | | |
| | 01/03/2018 | Dry at time of sample | | | | | |
| | 12/03/2019 | Dry at time of sample | | | | | |
| H2C 7A<br>Un-named | 11/10/2017 | None (Pool) | Turbid | Normal | Oily | Some | Road crossing<br>Litter present<br>Oil on surface<br>Rusty star pickets in water |
| | 02/03/2018 | Dry at time of sample | | | | | |
| | 12/03/2019 | No access at time of sample | | | | | |
| H2C 9A<br>Western Creek | 11/10/2017 | None (Pool) | Turbid | Normal | Oily, dusty and leafy | Some | Litter present<br>Road crossing |
| | 01/03/2018 | Dry at time of sample | | | | | |
| | 12/03/2019 | Dry at time of sample | | | | | |
| H2C 10A<br>Western Creek | 11/10/2017 | None (Pool) | Turbid | Normal | Oily<br>Leafy | Some | Road crossing<br>Litter present<br>Flood debris |
| | 01/03/2018 | Dry at time of sample | | | | | |
| | 12/03/2019 | Dry at time of sample | | | | | |

| Monitoring location and waterbody | Date | Water flow (none/ low/ mod/ high/ flood/ dry | Turbidity (clear/ slight/ turbid/ opaque/ other) | Odour (normal/ sewage/ hydrocarbon/ chemical) | Surface condition (none/ dust/ oily/ leafy/ algae) | Algae cover (none/ some/ lots) | Visual observation/ comments |
|---|---|---|---|---|---|---|---|
| H2C 11A<br>Lockyer Creek | 0/10/2017 | None (Pool) | Opaque | Normal | Grass on surface | Some | Thick grass cover<br>Pool of water<br>Lots of macrophytes |
| | 01/03/2018 | None (Pool) | Slight | None | Dust, pollen, foam | None | Foam present |
| | 11/03/2019 | Dry at time of sample | | | | | |
| H2C 12A<br>Lockyer Creek | 10/10/2018 | None (Pool) | Opaque | Normal | Leafy, dusty<br>Little oily | Some | Road crossing<br>Powerline crossing<br>Litter present |
| | 01/03/2018 | Dry at time of sample | | | | | |
| | 12/03/2019 | Dry at time of sample | | | | | |
| H2C 13A<br>Laidley Creek | 13/10/2018 | Dry at time of sample | | | | | |
| | 02/03/2018 | Moderate | Clear | None | None | None | - |
| | 12/03/2019 | Dry at time of sample | | | | | |
| H2C 14A<br>Laidley Creek | 13/10/2018 | Dry at time of sample | | | | | |
| | 02/03/2018 | Low | Clear | None | None | None | - |
| | 12/03/2019 | Dry at time of sample | | | | | |
| H2C 16A<br>Sandy Creek | 09/10/2017 | Dry at time of sample | | | | | |
| | 02/03/2018 | Dry at time of sample | | | | | |
| | 12/03/2019 | Dry at time of sample | | | | | |
| H2C 17A<br>Laidley Creek | 13/10/2017 | Low | Slight | Normal | Leafy<br>Oil sheen | Some | Downstream of road bridge<br>Blue rock present |
| | 02/03/2018 | Moderate | Clear | None | None | None | - |
| | 12/03/2019 | Dry at time of sample | | | | | |
| H2C 18A<br>Western Creek | 13/10/2017 | None (Pool) | Turbid | Normal | Leafy<br>Oily sheen | Some | Swimming hole |
| | 01/03/2018 | Dry at time of sample | | | | | |
| | 12/03/2019 | None (Pool) | Opaque | Normal | Leafy | Some | Noted cattle access |

**Table C.2** **Site description with indicative photos indicating physical habitat during water quality assessments (October 2017-March 2019)**

| Site | Description |
|---|---|
| H2C 1A | The site was located on Sandy Creek at the proposed Project alignment waterway crossing location. Artificial bank protection measures present, which included fence structures. There was no water present at the time of the assessment. |
|  | <br>Photo 1 from the first field assessment (October 2017)<br><br>Photo 2 from the third field assessment (March 2019) |
| H2C 2A | The site was located on unnamed tributary within the Lockyer Creek catchment, at the proposed Project alignment waterway crossing location. Reinforced concrete pipe (RCP) culverts were present associated with the bridge crossing. Artificial bank protection measures present, which included fence structures. Vegetation was present within the watercourse. There was no water present at the time of the assessment. |
|  | <br>Photo 1 from first field assessment (October 2017)<br><br>Photo 2 from third field assessment (March 2019) |
| H2C 3A | The site was located at Lockyer Creek, downstream of the proposed alignment. No artificial bank protection measures were present. One bank had significant vegetation cover whilst the other had sections of bare rock/sandstone. Water was present as a standing pool at time of assessment. |
|  | <br>Photo 1 from first field assessment (October 2017)<br><br>Photo 2 from third field assessment (March 2019) |

<table>
<tr><th>Site</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">H2C 4A</td><td colspan="2">The site was located on Lockyer Creek, at the proposed Project alignment waterway crossing location. A railway bridge and road crossing were present with associated stormwater piping. Rip rap and blue rock lining was present along the bank at the bridge abutments as a bank protection measures. Debris was also present under the bridge. Water flow was considered low at time of assessment.</td></tr>
<tr><td><br>Photo 1 from first field assessment (October 2017)</td><td><br>Photo 2 from third field assessment (March 2019)</td></tr>
<tr><td rowspan="2">H2C 5A</td><td colspan="2">The site was located on Sandy Creek, at the proposed Project alignment waterway crossing location. Artificial bank protection measures include the concrete bridge abutments and associated fence structures. Two RCPs were present associated with the road crossing. There was no water present at the time of the assessment. It appears that the creek has not experienced high flow for a prolonged period, resulting in a large degree of vegetation present within the creek bed.</td></tr>
<tr><td><br>Photo 1 from first field assessment (October 2017)</td><td><br>Photo 2 from third field assessment (March 2019)</td></tr>
<tr><td rowspan="2">H2C 7A</td><td colspan="2">The site was located on an unnamed tributary within the Lockyer Creek catchment, downstream of the proposed Project alignment. Three box culverts were present associated with the road bridge. Artificial bank protection measures were present in the form of concrete bridge abutments and fence structures. A small pool of water was present at the time of the first field assessment.</td></tr>
<tr><td><br>Photo 1 from first field assessment (October 2017)</td><td>No access at time of sample</td></tr>
</table>

<table>
<tr><th>Site</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">H2C 8A</td><td colspan="2">The site was located on an un-named tributary within the Lockyer Creek catchment at the proposed Project alignment waterway crossing location. Two RCPs were present associated with the road crossing. Artificial bank protection measures were present in the form of fence structures. There was no water present at the time of assessment.</td></tr>
<tr><td><br>Photo 1 from first field assessment (October 2017)</td><td><br>Photo 2 from third field assessment (March 2019)</td></tr>
<tr><td rowspan="2">H2C 9A</td><td colspan="2">The site was located on Western Creek, at the proposed Project alignment waterway crossing location. Both banks demonstrated a moderate level of erosion with high vegetation cover consisted of native and exotic vegetation. Water was present as a standing pool at time of the first field assessment.</td></tr>
<tr><td><br>Photo 1 from first field assessment (October 2017)</td><td><br>Photo from third field assessment (March 2019)</td></tr>
<tr><td rowspan="2">H2C 10A</td><td colspan="2">The site was located at Western Creek, at the proposed Project alignment waterway crossing location. Artificial bank protection measures present, included rip rap concrete and concrete abutments associated with the bridge crossing. Water was present as a standing pool at time of the first field assessment.</td></tr>
<tr><td><br>Photo 1 from first field assessment (October 2017)</td><td><br>Photo 2 from the third field assessment (March 2019)</td></tr>
</table>

<table>
<tr><th>Site</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">H2C 11A</td><td colspan="2">The site was located on Lockyer Creek, downstream of the proposed Project alignment. No artificial bank protection measure was present. There was floating aquatic vegetation present on the surface of the water during the first field assessment. Continuous riparian vegetation was present on both banks of the watercourse. Water was present as a standing pool at time of the first field assessment.</td></tr>
<tr><td><br>Photo 1 from first field assessment (October 2017)</td><td><br>Photo 2 from third field assessment (March 2019)</td></tr>
<tr><td rowspan="2">H2C 12A</td><td colspan="2">The site was located on Lockyer Creek, upstream of the proposed Project alignment. Rip rap concrete lining and fence structures were present along the bank at the bridge abutments as a bank protection measure. Limited riparian vegetation was present. Water was present as a standing pool at time of the first field assessment.</td></tr>
<tr><td><br>Photo 1 from first field assessment (October 2017)</td><td>No access at time of sample</td></tr>
<tr><td rowspan="2">H2C 13A</td><td colspan="2">The site was located on Lockyer Creek, upstream of the proposed Project alignment. Rip rap and concrete lining was present along the bank at the bridge abutments as a bank protection measure. There was no water present at the time of assessment.</td></tr>
<tr><td><br>Photo 1 from first field assessment (October 2017)</td><td><br>Photo 2 from third field assessment (March 2019)</td></tr>
</table>

<table>
<tr><th>Site</th><th colspan="2">Description</th></tr>
<tr><td>H2C 14A</td><td colspan="2">The site was located at Laidley Creek, downstream of the proposed Project alignment. Rip rap and concrete lining was present along the bank at the bridge abutments as a bank protection measure. Three box culverts were present associated with the bridge structure. There was no water present at the time of assessment.</td></tr>
<tr><td></td><td><br>Photo 1 from first field assessment (October 2017)</td><td><br>Photo 2 from third field assessment (March 2019)</td></tr>
<tr><td>H2C 15A</td><td colspan="2">The site was located at an unnamed tributary within the Lockyer Creek sub catchment, downstream of the proposed Project alignment. Two RCPs were present associated with the road crossing. Rip rap and concrete lining was present along the bank at the bridge abutments as a bank protection measure. There was no water present at the time of assessment.</td></tr>
<tr><td></td><td><br>Photo 1 from first field assessment (October 2017)</td><td><br>Photo 2 from third field assessment (March 2019)</td></tr>
<tr><td>H2C 16A</td><td colspan="2">The site was located on Sandy Creek upstream of the proposed Project alignment. Two RCPs were present associated with the road crossing. There were no artificial bank protection measures present. There was no water present at the time of assessment. A high degree of vegetation was present within the channel indicating a prolonged lack of high-flow conditions.</td></tr>
<tr><td></td><td><br>Photo 1 from first field assessment (October 2017)</td><td><br>Photo 2 from third field assessment (March 2019)</td></tr>
</table>

| Site | Description | |
|---|---|---|
| H2C 17A | The site was located at Laidley Creek, downstream of the proposed Project alignment. Rip rap and concrete lining was present along the bank at the bridge abutments as a bank protection measure. A concrete discharge pipe from the adjacent cropland was also present. Water flow was considered low at time of first field assessment. | |
| | <br>Photo 1 from first field assessment (October 2017) | <br>Photo 2 from third field assessment (March 2019) |
| H2C 18A | The site was located at Western Creek, downstream of the proposed Project alignment. There was no artificial bank protection measures present. Water was present as a standing pool at time of assessment. | |
| | <br>Photo 1 from first field assessment (October 2017) | <br>Photo from third field assessment (March 2019) |

**Table note:**

1 Water quality assessment sites physical assessments were undertaken during the first sampling event (09-13 Oct 2017). As such they, indicate general features after a prolonged period in the absence of regular rainfall.

# APPENDIX L

## Surface Water Quality Technical Report

## **Appendix D** Database Interrogation Data

**HELIDON TO CALVERT** ENVIRONMENTAL IMPACT STATEMENT

IR_1381

# Watercourses

27°27'21"S 152°6'13"E

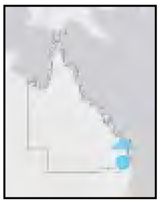
27°27'21"S 152°19'20"E

27°38'58"S 152°6'13"E

27°38'58"S 152°19'20"E

A product of

Queensland Globe



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Scale: 1:122856 -

Printed at: A4 -

Print date: 9/3/2020 -

**Datum:** Geocentric Datum of Australia 1994 -
**Projection:** Web Mercator EPSG 102100 -

For more information, visit - https://qldglobe.information.qld.gov.au/help-info/Contact-us.html -

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27°29'30"S 152°16'43"E

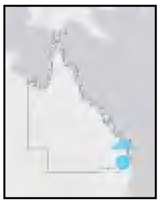
27°29'30"S 152°29'50"E

27°41'7"S 152°16'43"E

27°41'7"S 152°29'50"E

A product of

**Queensland Globe**



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N

0 2.5 km

Scale: 1:122856 -

Printed at: A4 -
Print date: 9/3/2020 -
**Datum:** Geocentric Datum of Australia 1994 -
**Projection:** Web Mercator EPSG 102100 -

For more information, visit -
https://qldglobe.information.qld.gov.au/help-info/Contact-us.html -

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27°32'56"S 152°24'9"E

27°32'56"S 152°37'15"E

27°44'33"S 152°24'9"E

27°44'33"S 152°37'15"E

A product of

Queensland Globe

Legend located on next page

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Scale: 1:122856

Printed at: A4 -

Print date: 9/3/2020 -

**Datum:** Geocentric Datum of Australia 1994 -

**Projection:** Web Mercator EPSG 102100

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## Legend

K_IR_3300000_D_ENV_PL_PERMANENT_DISTURBANCE_FOOTPRINT_CAD.KMZ - poly

🟩

Coastline

—

Lake

Reservoir

Canal area

Watercourse line

- — Major Watercourse -
- — Minor Watercourse -
- - - Major Culvert -
- - - Minor Culvert -

Watercourse area

Water area edge

—

Drainage Divisions

□

Drainage Basins

□

Drainage Sub-basins

⬚

Spring [defined by Water Act 2000]

S

Lake [defined by Water Act 2000]

L

Downstream limit [defined by Water Act 2000]

●

Watercourse [defined by Water Act 2000]

—

Drainage feature [defined by Water Act 2000]

—

Water plan waterholes and lakes

- ● Augmented waterhole
- ● Protected waterhole
- ● Significant waterhole

wetland

Cities and Towns

○

## Attribution

DigitalGlobe, Earthstar Geographics

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## Legend

### Road

- 🟥 Highway
- 🟥 Main
- ▭ Local
- ▬ Private

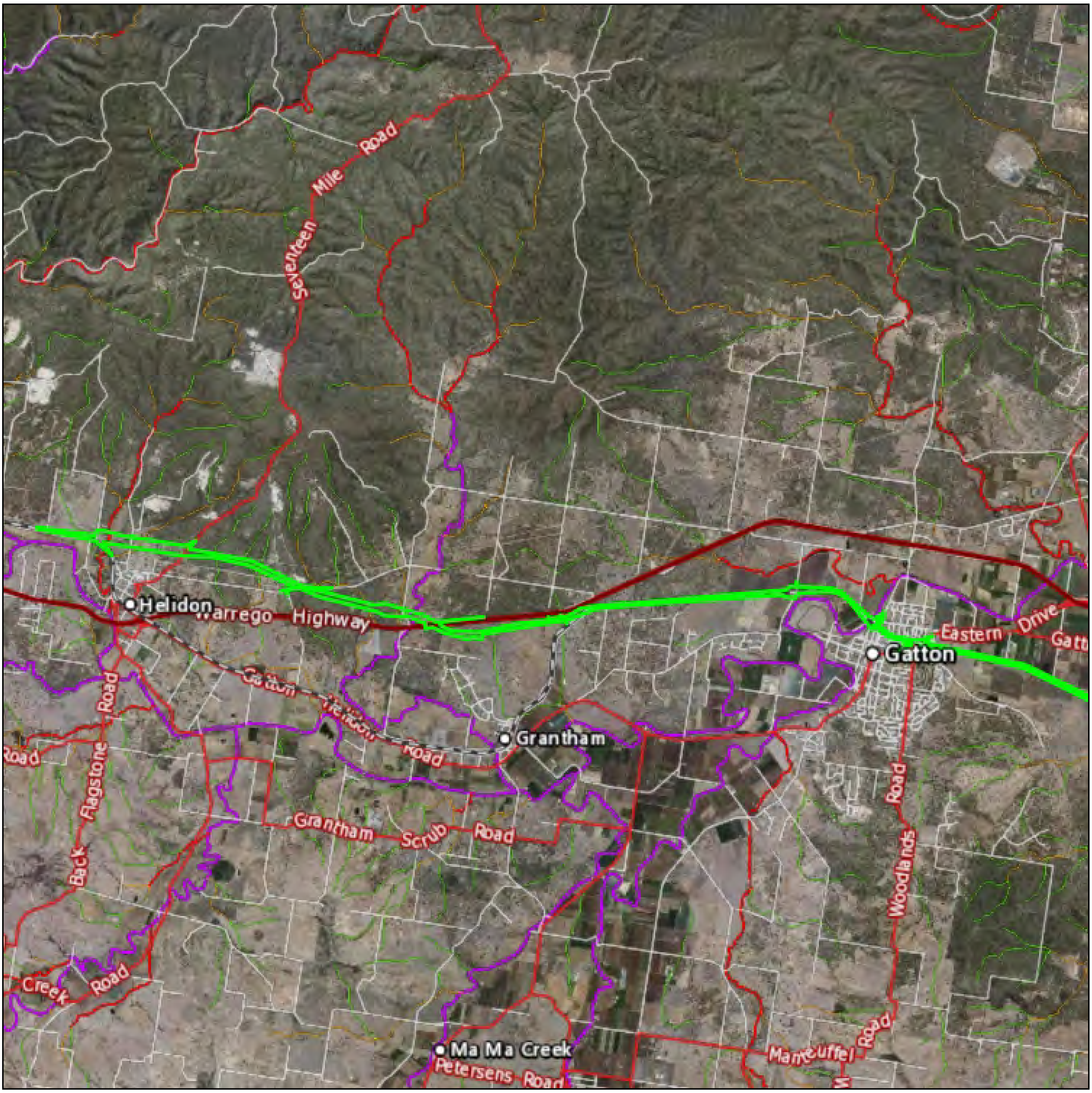
### Railway

- ▬

# Waterways for waterway barrier works

27°26'32"S 152°6'3"E

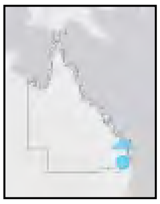
27°26'32"S 152°19'9"E



27°38'10"S 152°6'3"E

27°38'10"S 152°19'9"E

A product of Queensland Globe



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Print date: 9/3/2020 -

**Datum:** Geocentric Datum of Australia 1994 -
**Projection:** Web Mercator EPSG 102100 -

For more information, visit - https://qldglobe.information.qld.gov.au/help-info/Contact-us.html -

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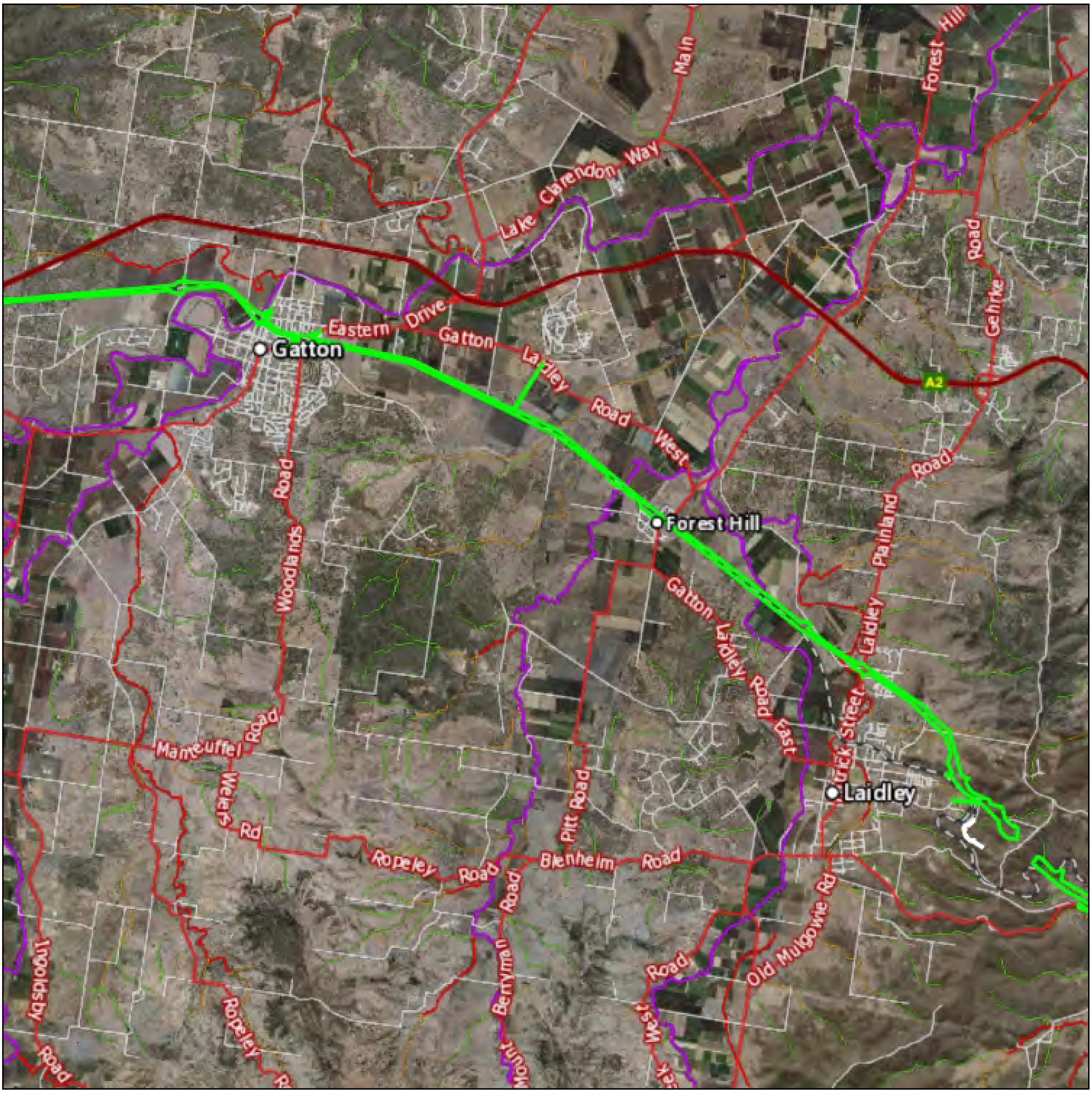
# Waterways for waterway barrier works

27°29'49"S 152°13'27"E

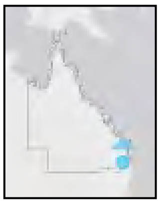
27°29'49"S 152°26'34"E



27°41'26"S 152°13'27"E

27°41'26"S 152°26'34"E

A product of Queensland Globe



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0 2.5 km

Scale: 1:122856 -

Printed at: A4 -

Print date: 9/3/2020 -

**Datum:** Geocentric Datum of Australia 1994 -
**Projection:** Web Mercator EPSG 102100 -

For more information, visit - https://qldglobe.information.qld.gov.au/help-info/Contact-us.html -

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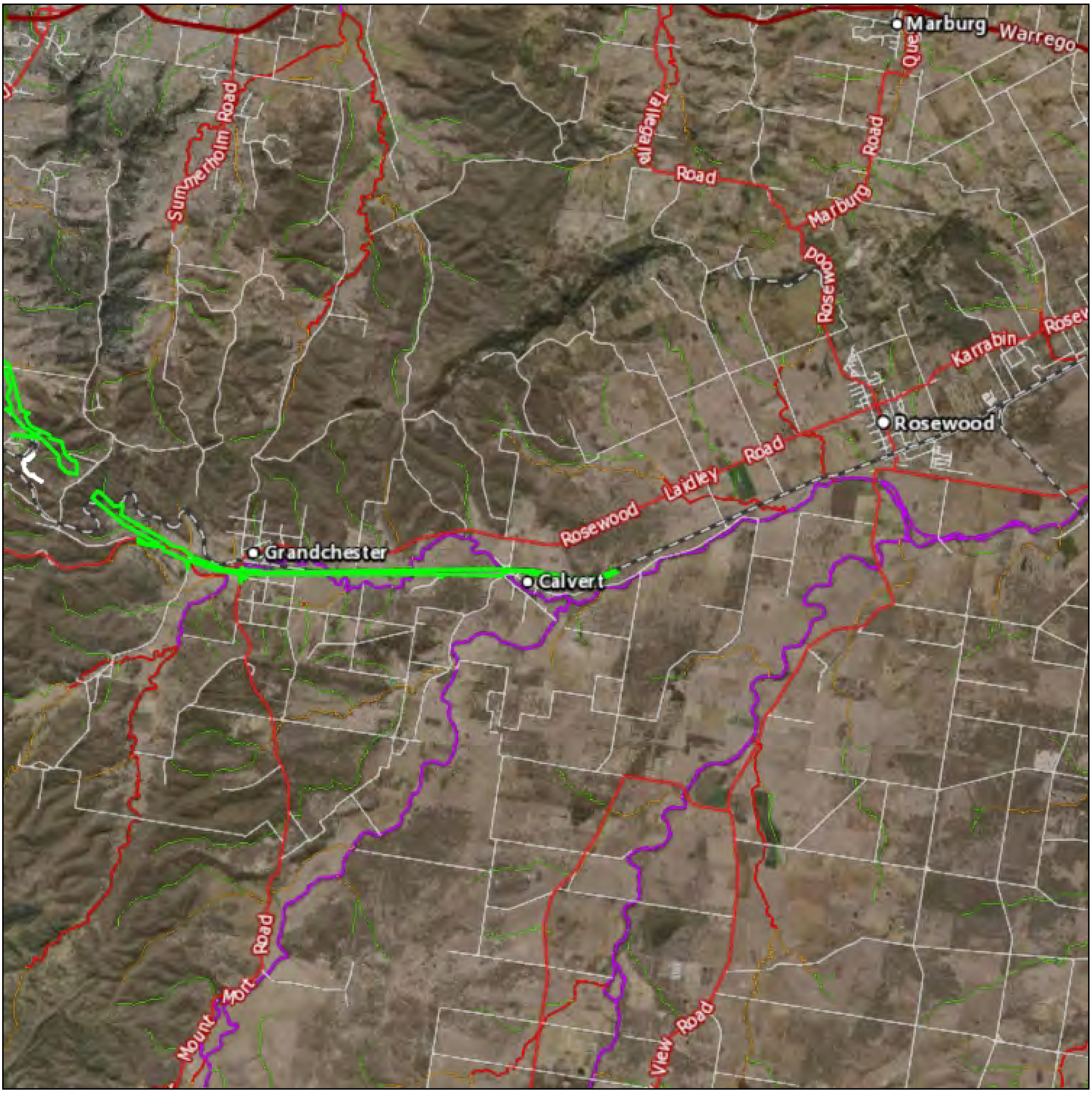
# Waterways for waterway barrier works

27°33'44"S 152°24'50"E

27°33'44"S 152°37'56"E



27°45'21"S 152°24'50"E

27°45'21"S 152°37'56"E

A product of Queensland Globe

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0 2.5 km

Scale: 1:122856

Printed at: A4 -

Print date: 9/3/2020 -

**Datum:** Geocentric Datum of Australia 1994 -

**Projection:** Web Mercator EPSG 102100

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Department of Natural Resources, Mines and Energy

# Waterways for waterway barrier works

## Legend

### K_IR_3300000_D_ENV_PL_PERMANENT_DISTURBANCE_FOOTPRINT_CAD.KMZ - poly

🟩

### Queensland waterways for waterway barrier works

- — Major -
- — High -
- — Moderate -
- — Low -

### Railway

▬

### Cities and Towns

○

### Road

- ▬ Highway -
- ▬ Main -
- ▭ Local -
- ▬ Private -

## Attribution

DigitalGlobe, Earthstar Geographics

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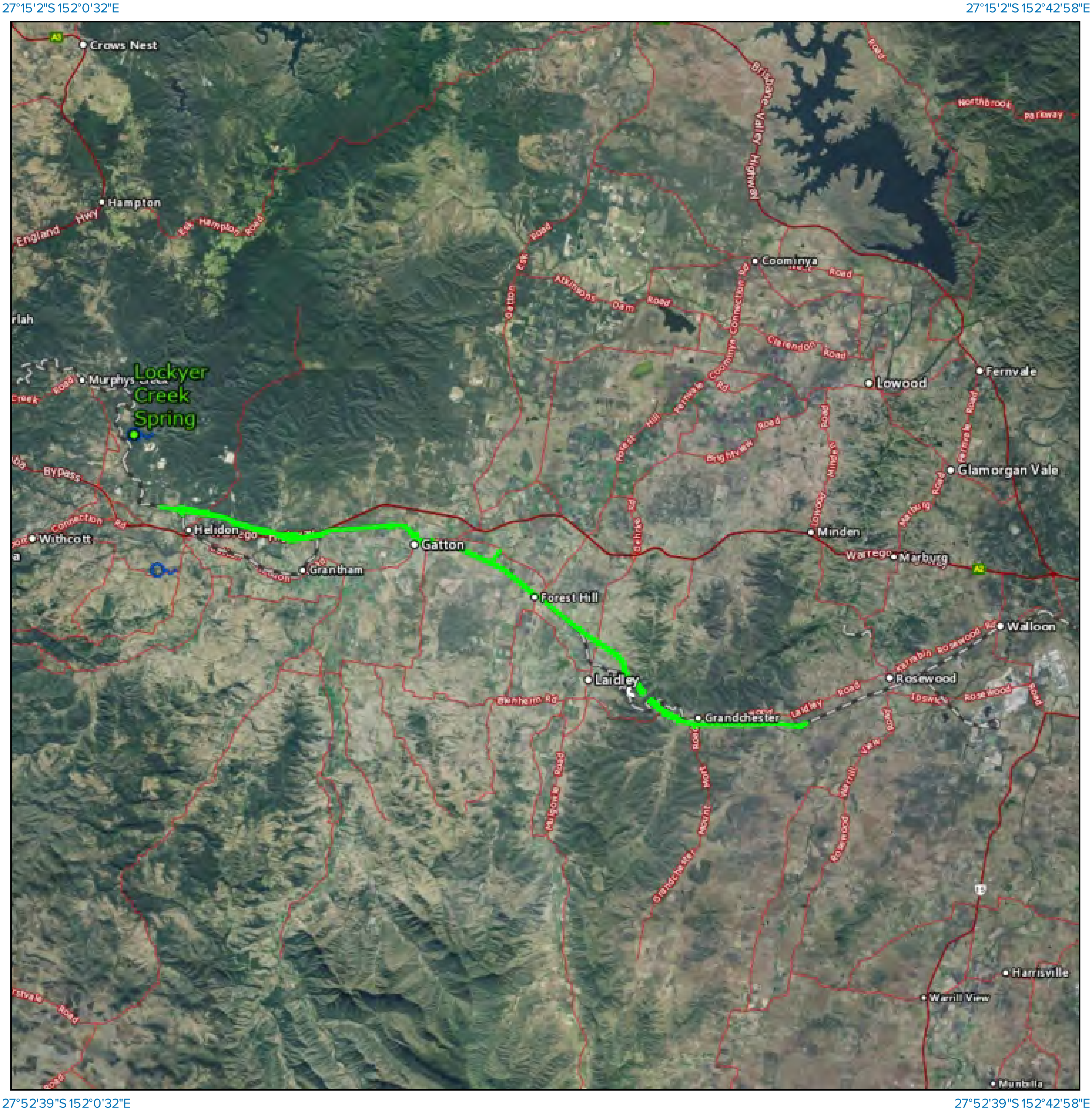
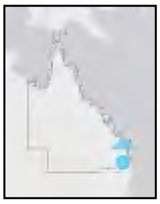
# Queensland springs



A product of

**Queensland Globe**



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Scale: 1:397770

Printed at: A4 -

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# Queensland springs

## Legend

### K_IR_3300000_D_ENV_PL_PERMANENT_DISTURBANCE_FOOTPRINT_CAD.KMZ - poly

🟩

### Active springs

- ○ Permanently active spring
- ○ Intermittently active spring

### Inactive springs

○

### GAB spring net sites

○

### Springs - conservation significance

- ● Very High
- ● High
- ● Medium
- ● Very Low

### GABORA groundwater dependent ecosystem springs

●

### Cities and Towns

○

### Railway

▬

### Road

- ▬ Highway
- ▬ Main
- ▬ Local
- ▬ Private

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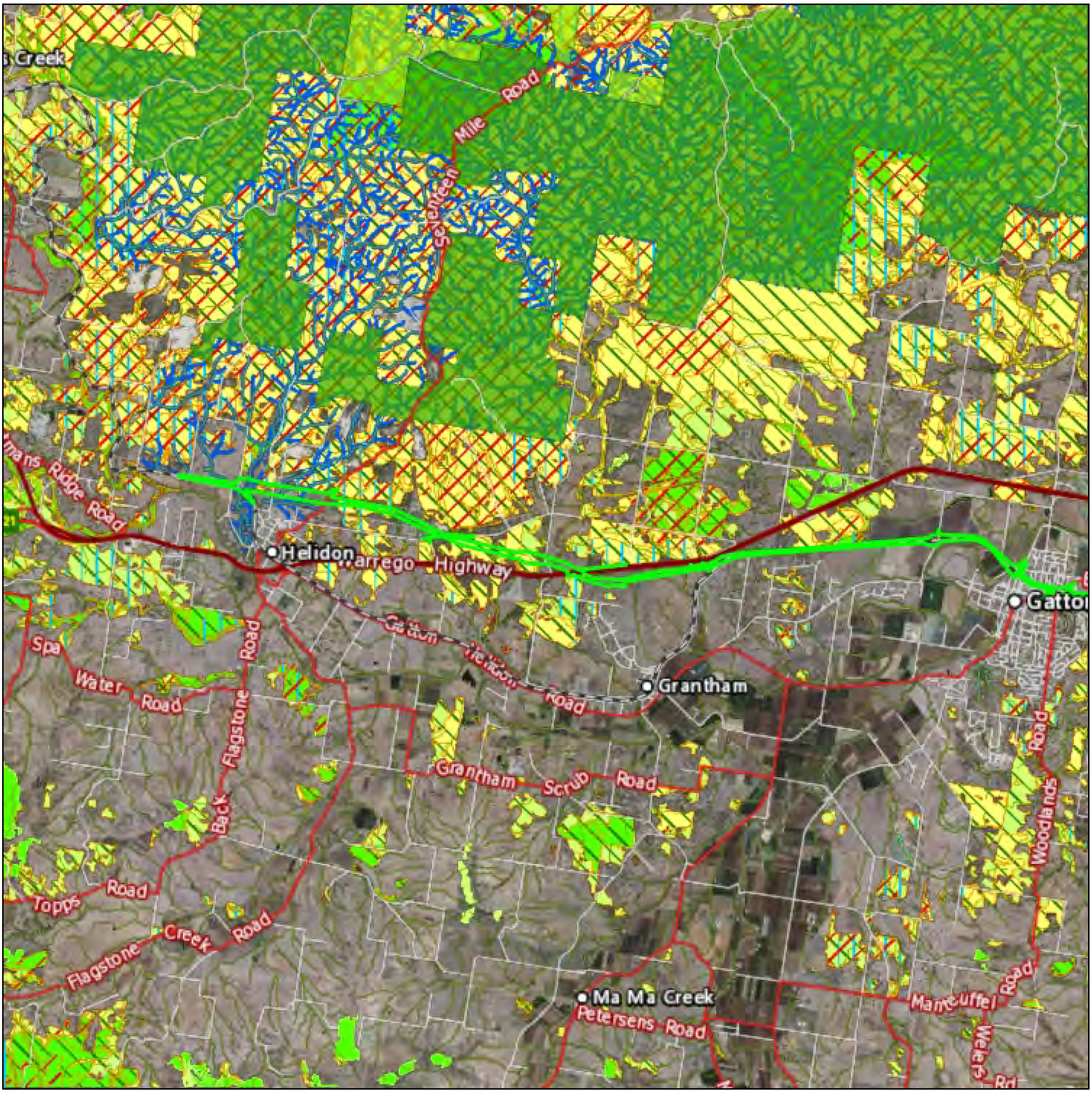
© State of Queensland (Department of Natural Resources, Mines and Energy) 2019

# MSES

27°27'6"S 152°4'20"E

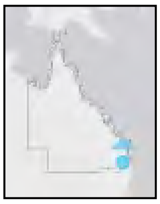
27°27'6"S 152°17'26"E



27°38'43"S 152°4'20"E

27°38'43"S 152°17'26"E

A product of Queensland Globe



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Scale: 1:122856 -

Printed at: A4 -

Print date: 9/3/2020 -

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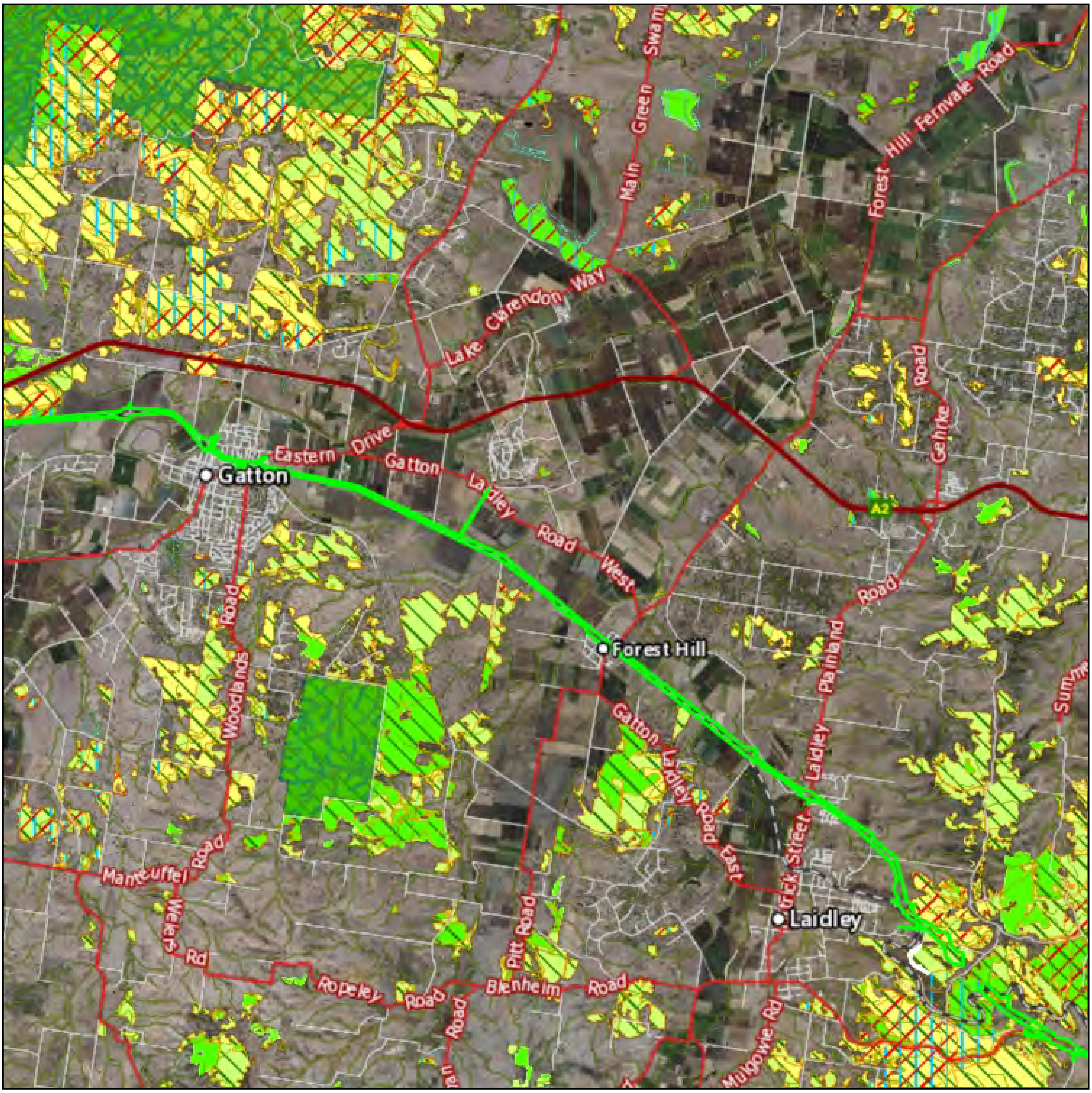
# MSES

27°28'28"S 152°14'7"E

27°28'28"S 152°27'13"E

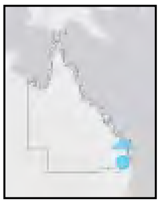


27°40'5"S 152°14'7"E

27°40'5"S 152°27'13"E

A product of

Queensland Globe



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Scale: 1:122856

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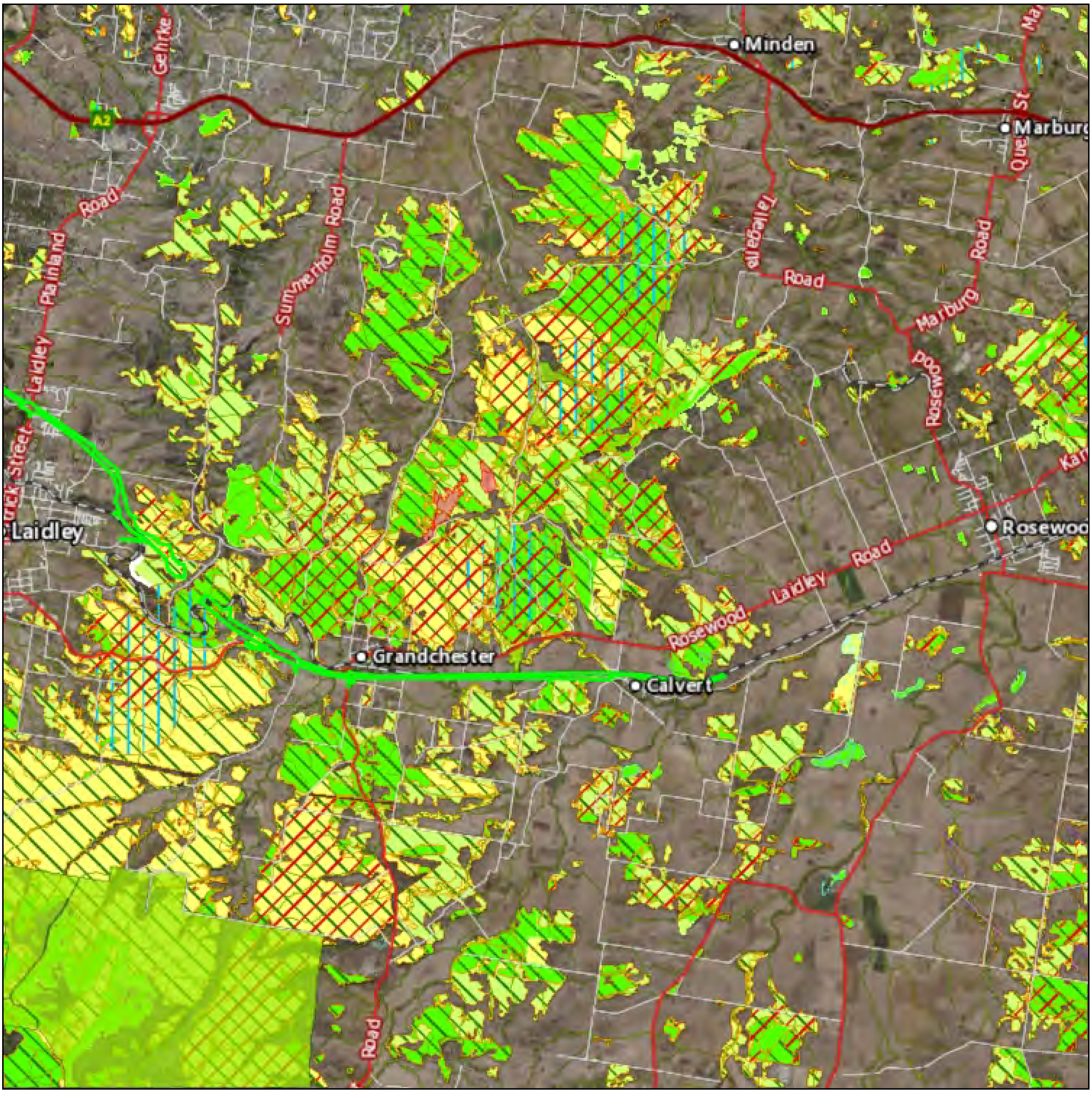
# MSES -

27°32'38"S 152°23'31"E

27°32'38"S 152°36'38"E



27°44'14"S 152°23'31"E

27°44'14"S 152°36'38"E

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Legend located on next page

N

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Scale: 1:122856

Printed at: A4 -

Print date: 9/3/2020 -

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# MSES

## Legend

K_IR_3300000_D_ENV_PL_PERMANENT_DISTURBANCE_FOOTPRINT_CAD.KMZ - poly

🟩

MSES protected area [estates]

🟩

MSES protected area [nature refuges]

🟩

MSES marine park [highly protected]

🟪

MSES declared fish habitat area [A and B areas]

🟦

MSES legally secured offset area [offset register]

🟥

MSES legally secured offset area [vegetation offsets]

🟧

MSES regulated vegetation [defined watercourse]

—

MSES declared high ecological value waters [watercourse]

—

MSES declared high ecological value waters [wetland]

MSES high ecological significance wetlands

◫

MSES strategic environmental area [designated precinct]

▦

MSES regulated vegetation [category B - endangered or of concern]

🟩

MSES regulated vegetation [category C- endangered or of concern]

🟩

MSES regulated vegetation [category R- GBR riverine]

🟩

MSES regulated vegetation [essential habitat]

🟨

MSES regulated vegetation [100m from wetland]

🟩

MSES wildlife habitat [endangered or vulnerable]

▨

MSES wildlife habitat [special least concern

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◫

animal]

◫

MSES wildlife habitat [SEQ koala habitat - core]

▧

# MSES -

## Legend

### MSES wildlife habitat [SEQ koala habitat - locally refined]

▨

### Railway

—

### Cities and Towns

○

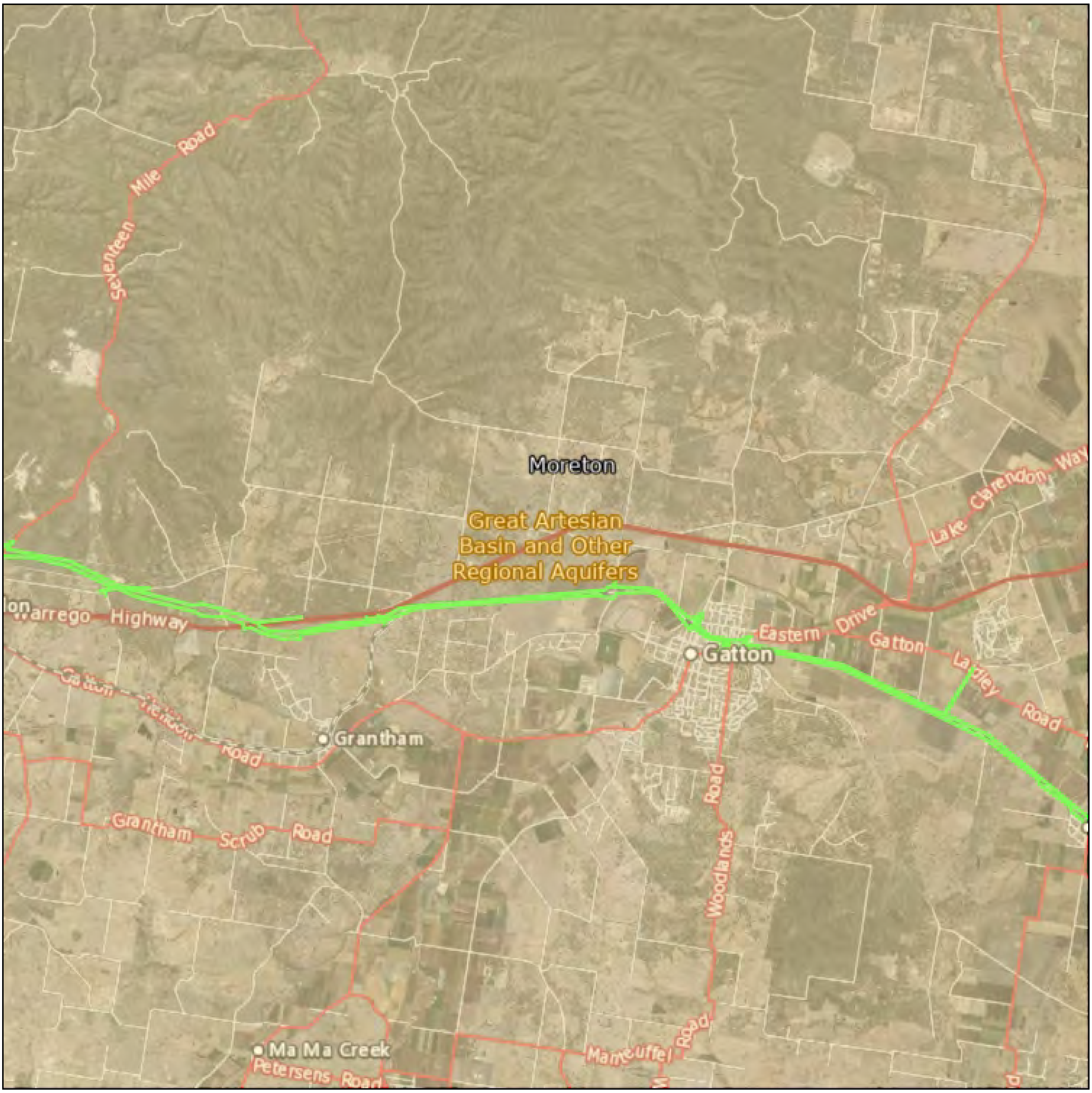
### Road

- — Highway
- — Main
- — Local
- — Private

# Water plan

27°26'32"S 152°8'15"E

27°26'32"S 152°21'21"E



27°38'9"S 152°8'15"E

27°38'9"S 152°21'21"E

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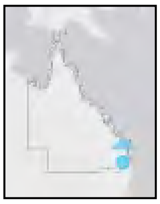

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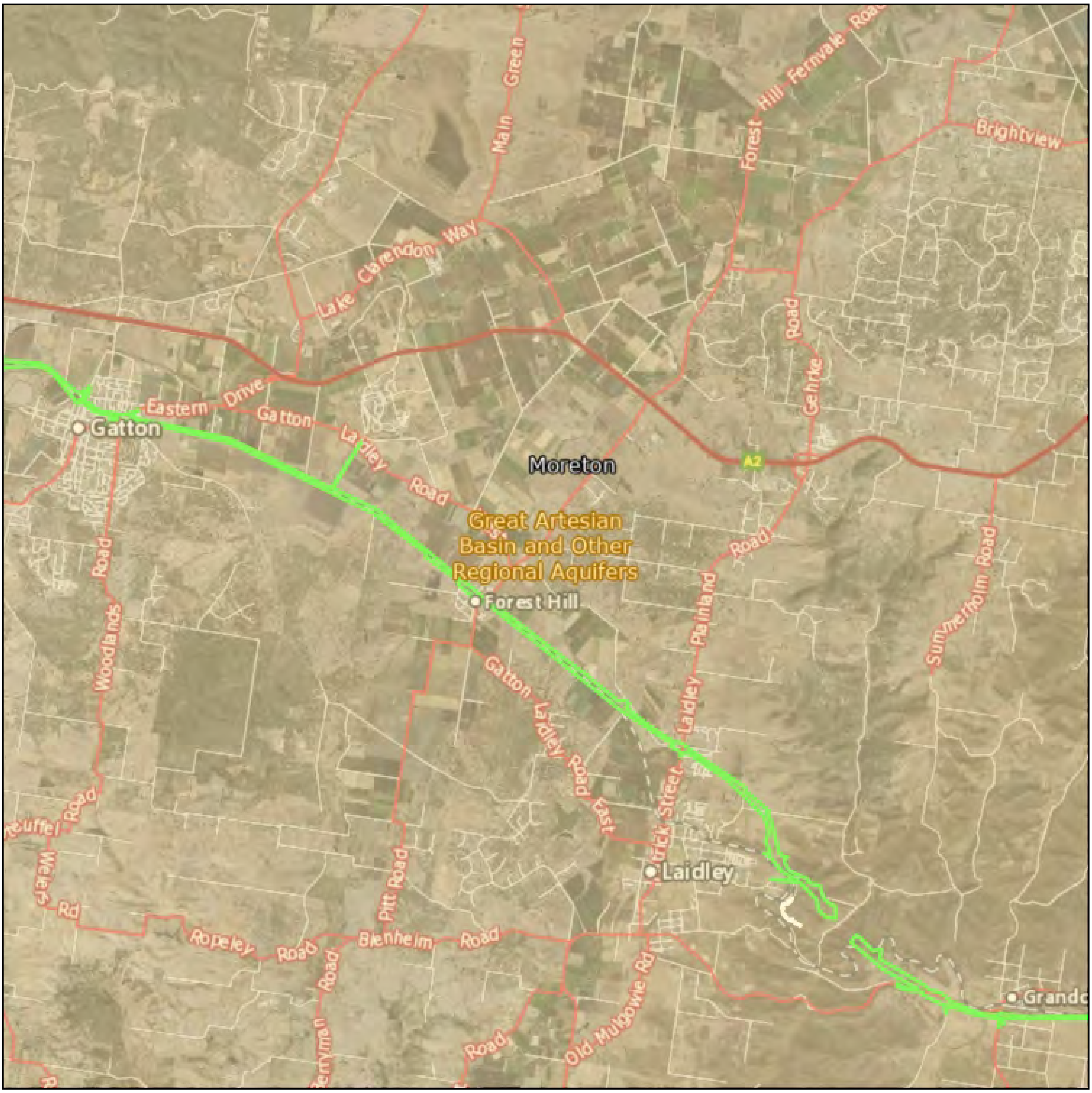
# Water plans

27°28'58"S 152°15'39"E

27°28'58"S 152°28'46"E



27°40'35"S 152°15'39"E

27°40'35"S 152°28'46"E

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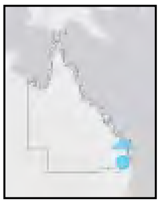
Legend located on next page



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Scale: 1:122856

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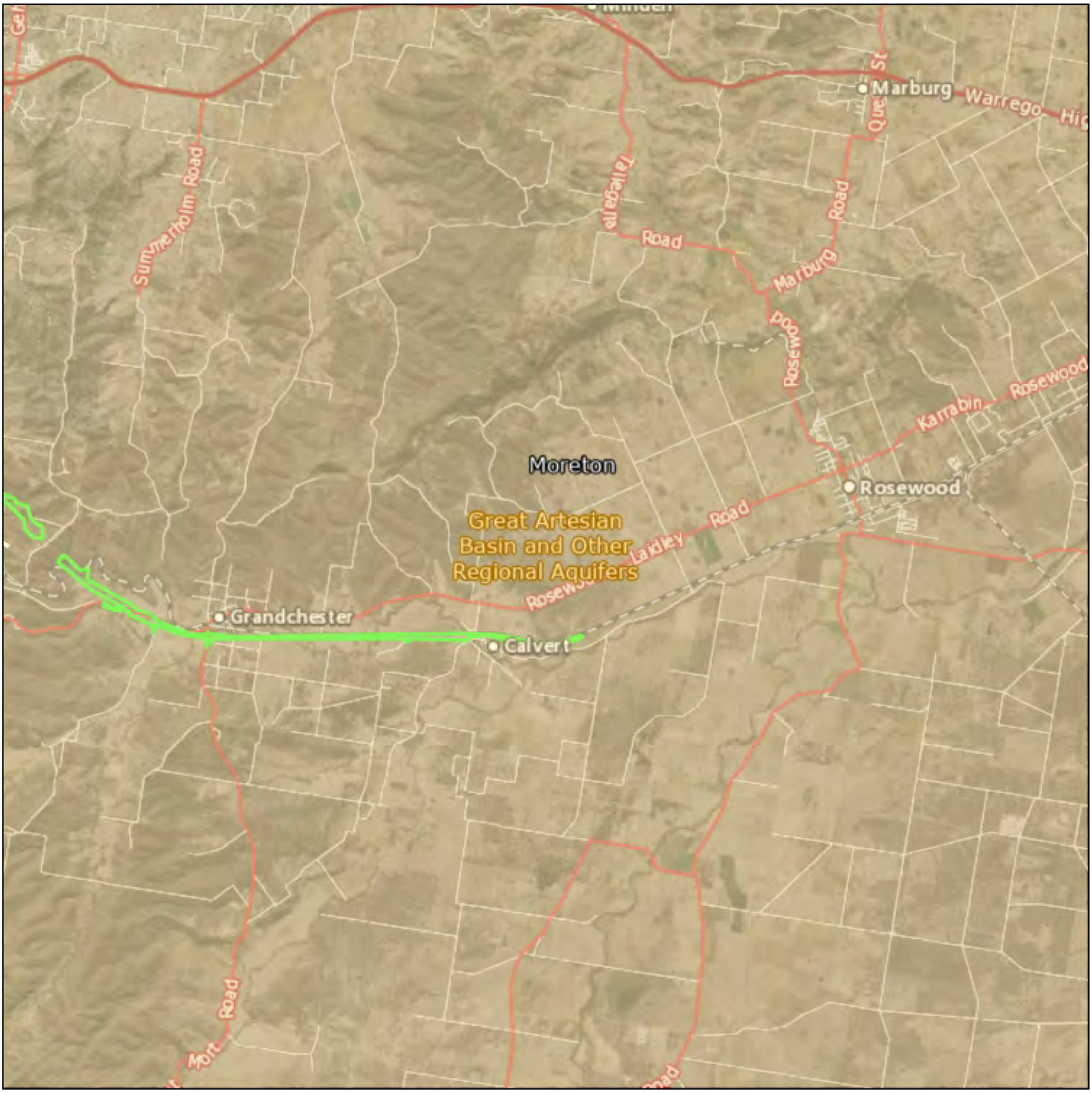
27°33'3"S 152°25'15"E

27°33'3"S 152°38'21"E



27°44'40"S 152°25'15"E

27°44'40"S 152°38'21"E

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Legend located on next page

N

0 2.5 km

Scale: 1:122856

Printed at: A4 -
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## Legend

K_IR_3300000_D_ENV_PL_PERMANENT_DISTURBANCE_FOOTPRINT_CAD.KMZ - poly

🟩

Water plan areas except GABORA

Water plan area Great Artesian Basin and Other Regional Aquifers [GABORA]

🟨

Cities and Towns

○

Road

▬ Highway

▬ Main

▭ Local

▬ Private

Railway

▬

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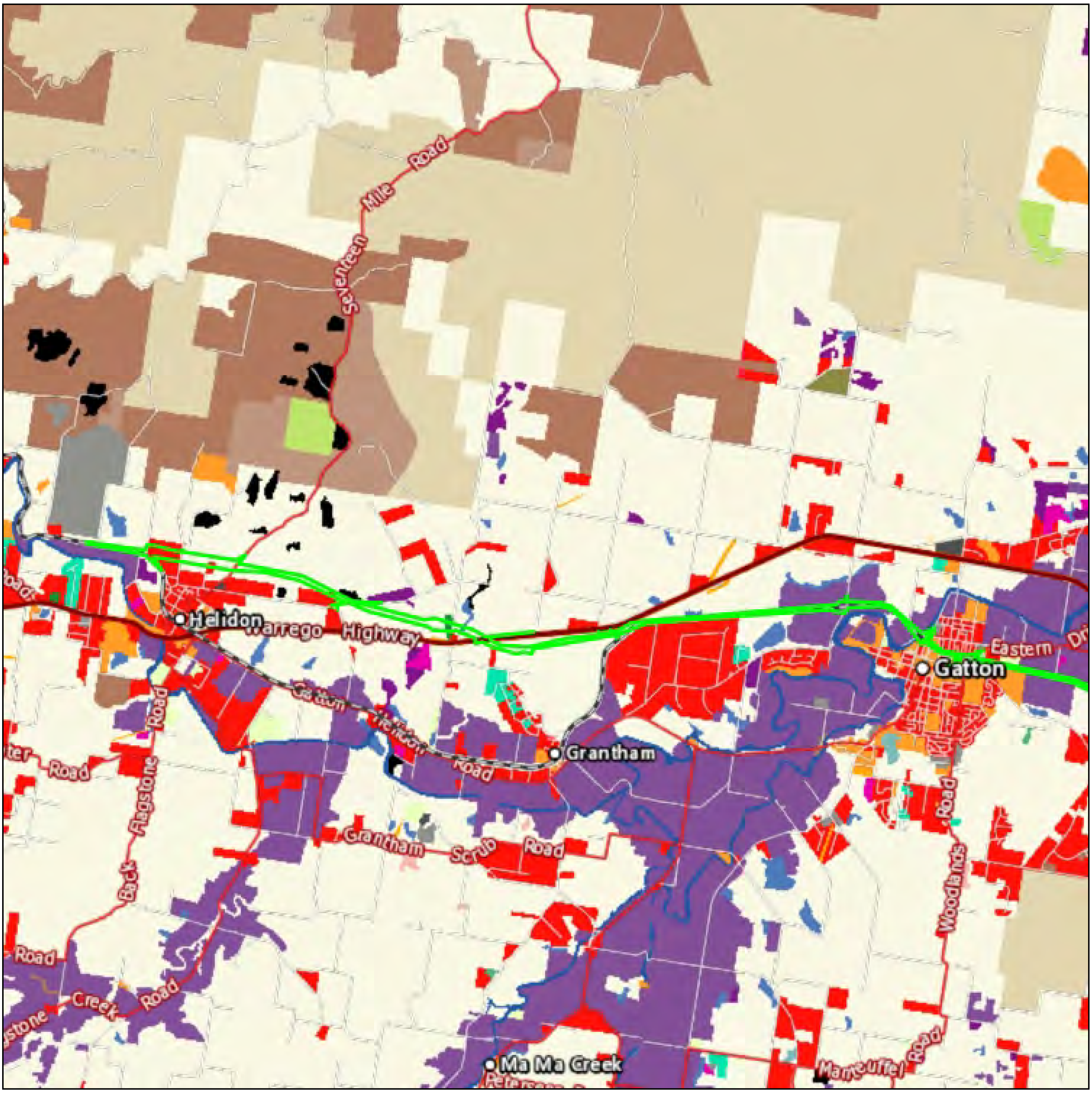
# Land use

27°26'23"S 152°5'27"E

27°26'23"S 152°18'33"E



27°38'0"S 152°5'27"E

27°38'0"S 152°18'33"E

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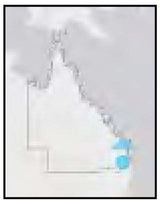

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# Land use -

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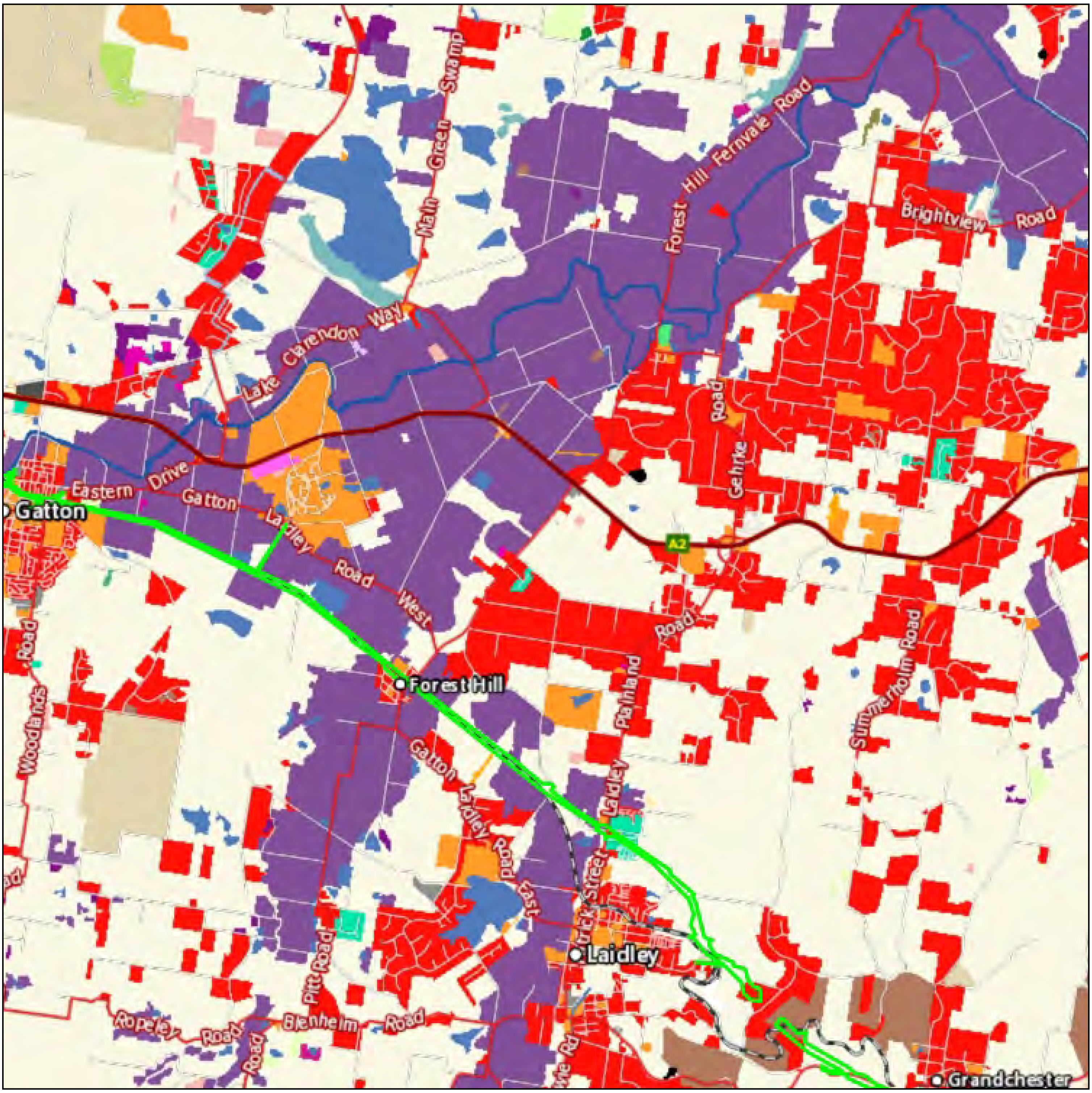
# Land use -

27°28'5"S 152°16'34"E

27°28'5"S 152°29'40"E



27°39'42"S 152°16'34"E

27°39'42"S 152°29'40"E

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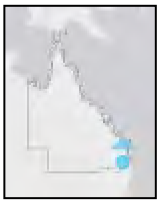
Queensland Globe



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Scale: 1:122856

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# Land use

## Legend

### K_IR_3300000_D_ENV_PL_PERMANENT_DISTURBANCE_FOOTPRINT_CAD.KMZ - poly

🟩

### Road

- ▬ Highway -
- ▬ Main -
- ▬ Local -
- ▬ Private -

### Railway

▬

### Cities and Towns

○

### Queensland Land Use - Current

- 🟨 Nature conservation
- 🟫 Managed resource protection
- 🟫 Other minimal use
- ⬜ Grazing native vegetation
- 🟩 Production forestry
- 🟩 Plantation forestry
- 🟩 Grazing modified pastures
- 🟩 Cropping
- 🟩 Perennial horticulture
- 🟩 Seasonal horticulture
- 🟩 Land in transition
- 🟪 Irrigated plantation forestry
- 🟪 Irrigated modified pastures
- 🟪 Irrigated cropping
- 🟪 Irrigated perennial horticulture
- 🟪 Irrigated seasonal horticulture
- 🟪 Irrigated land in transition
- 🟪 Intensive horticulture
- 🟥 Intensive animal husbandry
- ⬛ Manufacturing and industrial
- 🟥 Residential
- 🟧 Services
- 🟨 Utilities
- 🟧 Transport and communication
- ⬛ Mining
- ⬛ Waste treatment and disposal

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# Land use

Legend

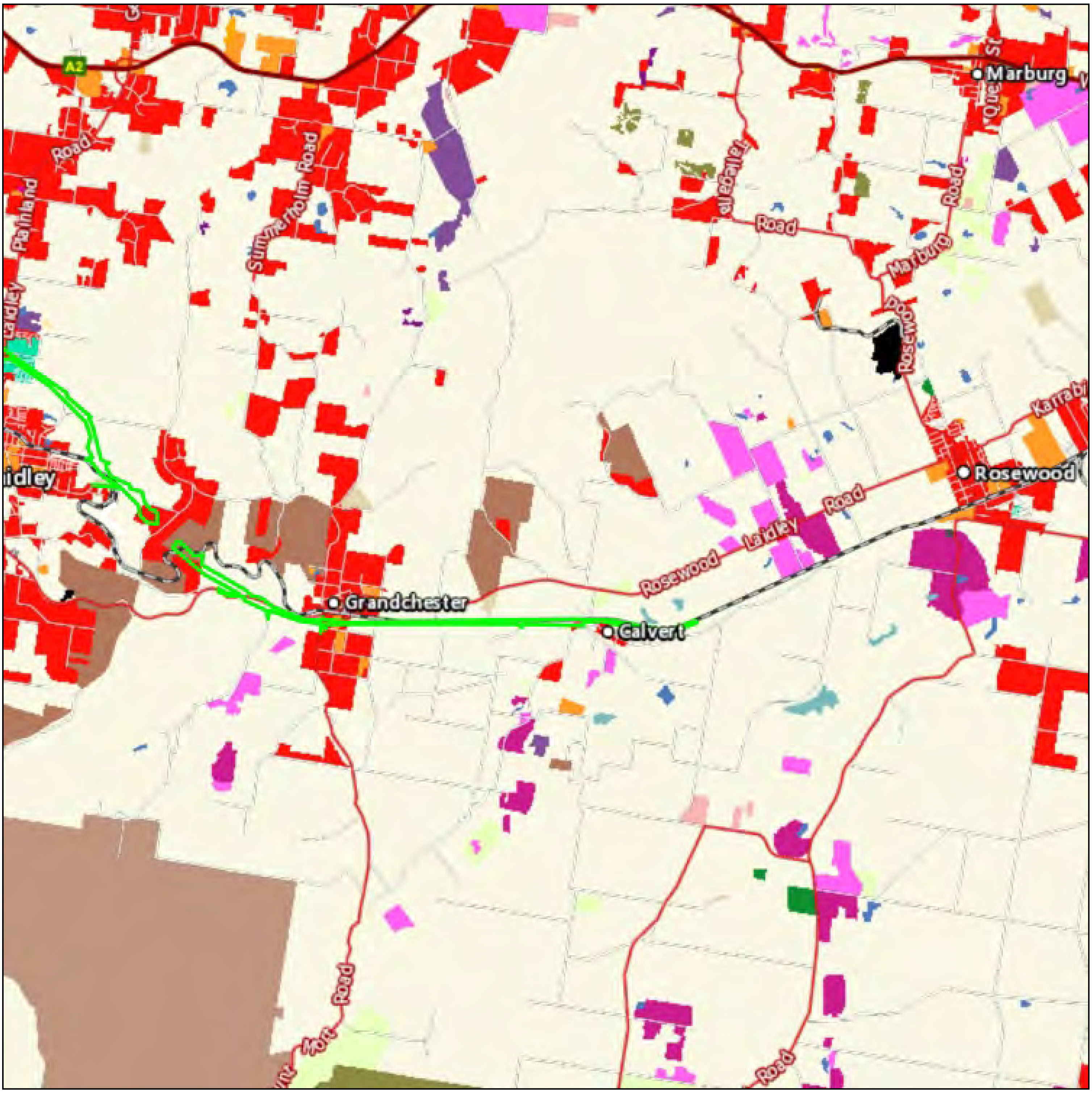
## Queensland Land Use - Current (cont)

- 🟦 Lake
- 🟦 Reservoir/dam
- 🟦 River
- 🟦 Channel/aqueduct
- 🟩 Marsh/wetland
- 🟦 Estuary/coastal waters

# Land use -

27°33'12"S 152°23'51"E

27°33'12"S 152°36'58"E



27°44'49"S 152°23'51"E

27°44'49"S 152°36'58"E

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Legend located on next page

N

0 2.5 km

Scale: 1:122856

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# Land use

## Legend

### K_IR_3300000_D_ENV_PL_PERMANENT_DISTURBANCE_FOOTPRINT_CAD.KMZ - poly

🟩

### Road

▬ Highway -

▬ Main -

▬ Local -

▬ Private -

### Cities and Towns

○

### Railway

▬

### Queensland Land Use - Current

🟨 Nature conservation

🟫 Managed resource protection

🟫 Other minimal use

⬜ Grazing native vegetation

🟩 Production forestry

🟩 Plantation forestry

🟩 Grazing modified pastures

🟩 Cropping

🟩 Perennial horticulture

🟩 Seasonal horticulture

🟩 Land in transition

🟪 Irrigated plantation forestry

🟪 Irrigated modified pastures

🟪 Irrigated cropping

🟪 Irrigated perennial horticulture

🟪 Irrigated seasonal horticulture

🟪 Irrigated land in transition

🟪 Intensive horticulture

🟥 Intensive animal husbandry

⬛ Manufacturing and industrial

🟥 Residential

🟧 Services

🟨 Utilities

🟧 Transport and communication

⬛ Mining

⬛ Waste treatment and disposal

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# Land use

Legend

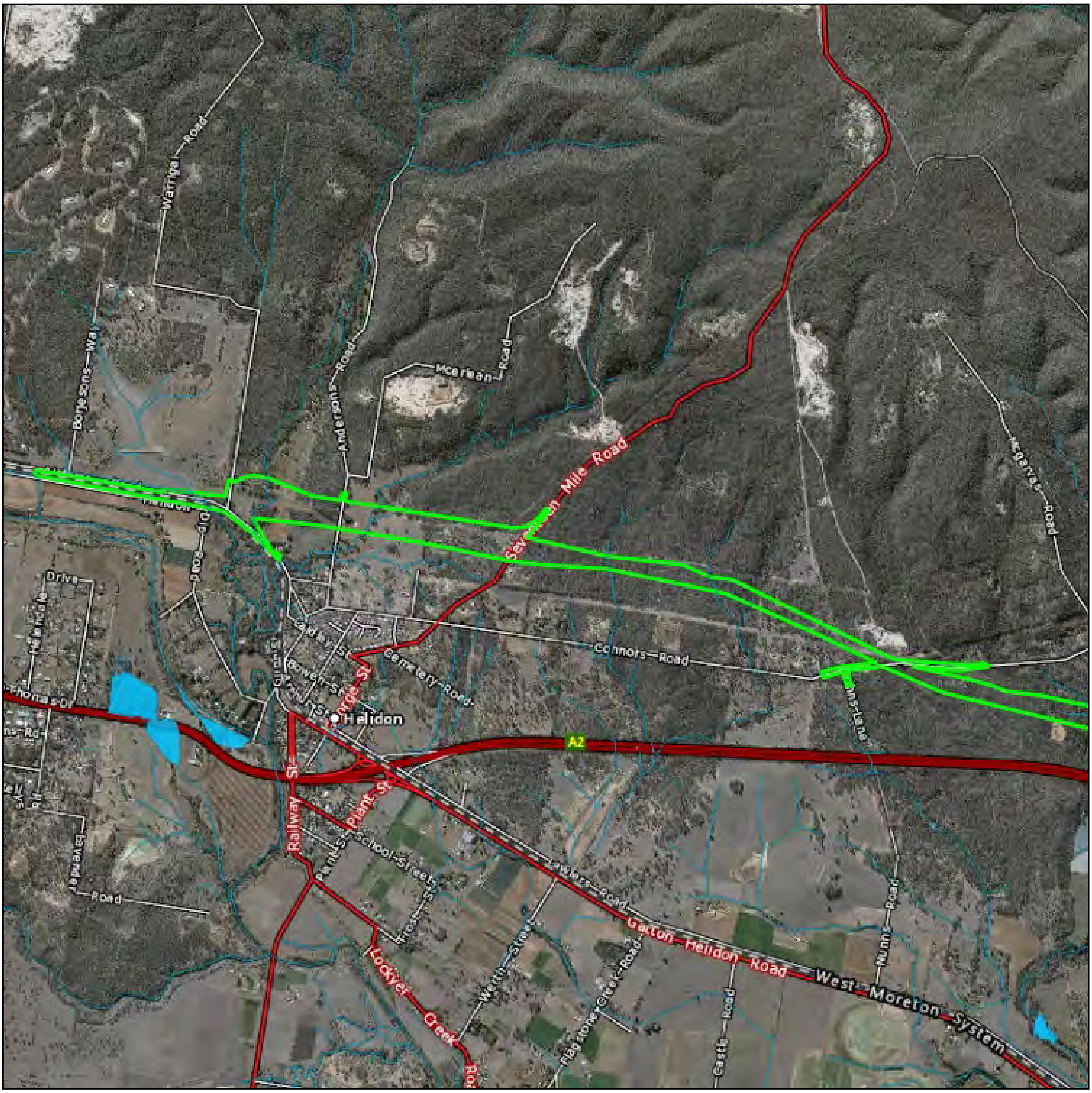
### Queensland Land Use - Current (cont)

- 🟦 Lake
- 🟦 Reservoir/dam
- 🟦 River
- 🟦 Channel/aqueduct
- 🟩 Marsh/wetland
- 🟦 Estuary/coastal waters

# Queensland GDEs database search

27°30'37"S 152°6'20"E

27°30'37"S 152°10'23"E



27°34'12"S 152°6'20"E

27°34'12"S 152°10'23"E

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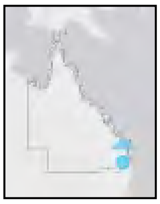

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27°31'7"S 152°10'15"E

27°31'7"S 152°14'18"E

27°34'42"S 152°10'15"E

27°34'42"S 152°14'18"E

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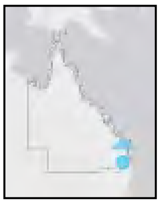
Queensland Globe



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Scale: 1:37946 -

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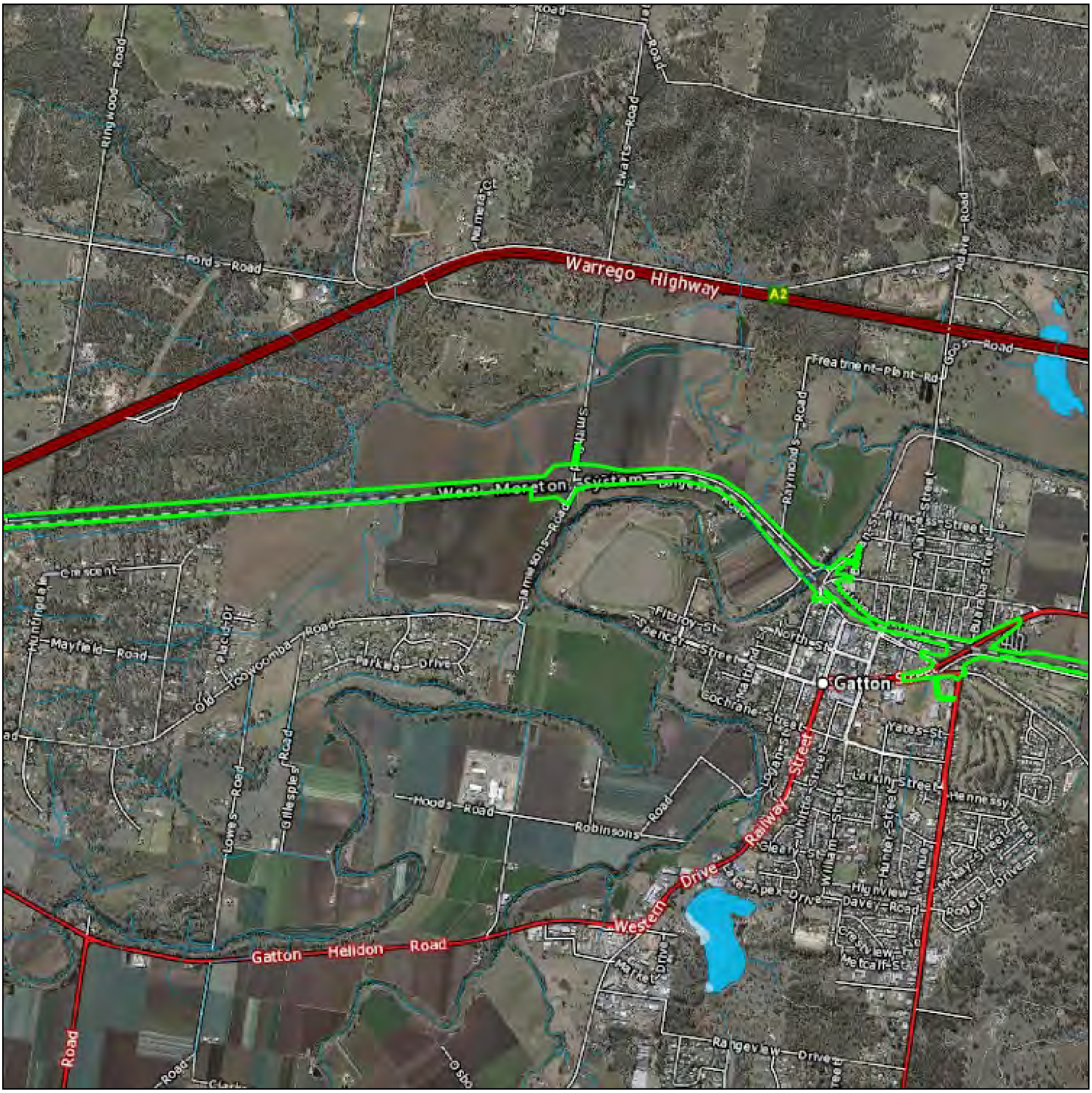
27°31'16"S 152°13'30"E

27°31'16"S 152°17'33"E



27°34'51"S 152°13'30"E

27°34'51"S 152°17'33"E

A product of

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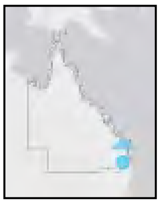

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27°31'41"S 152°17'1"E

27°31'41"S 152°21'4"E

27°35'16"S 152°17'1"E

27°35'16"S 152°21'4"E

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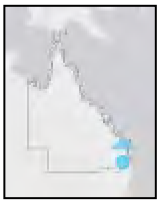

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Scale: 1:37946 -

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27°33'57"S 152°20'8"E

27°33'57"S 152°24'11"E

27°37'32"S 152°20'8"E

27°37'32"S 152°24'11"E

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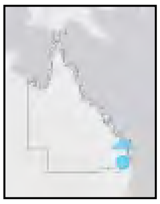

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27°35'42"S 152°23'2"E

27°35'42"S 152°27'5"E

27°39'17"S 152°23'2"E

27°39'17"S 152°27'5"E

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N

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27°37'19"S 152°25'51"E 27°37'19"S 152°29'54"E

27°40'54"S 152°25'51"E 27°40'54"S 152°29'54"E

A product of

Queensland Globe

N

0 1 km

Scale: 1:37946 -

Printed at: A4 -
Print date: 9/3/2020 -
**Datum:** Geocentric Datum of Australia 1994 -
**Projection:** Web Mercator EPSG 102100 -

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Queensland Government
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Legend located on next page

N

0 1 km

Scale: 1:37946

Printed at: A4 -
Print date: 9/3/2020 -
**Datum:** Geocentric Datum of Australia 1994 -
**Projection:** Web Mercator EPSG 102100

For more information, visit
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Queensland Government
Department of Natural Resources, Mines and Energy

## Legend

### K_IR_3300000_D_ENV_PL_PERMANENT_DISTURBANCE_FOOTPRINT_CAD.KMZ - poly

🟩

### Surface GDE points [spring ecosystems]

- ◆ Known GDE
- ◆ Derived GDE - moderate confidence

### Surface GDE lines

- — Known GDE
- — Derived GDE - high confidence
- — Derived GDE - moderate confidence
- — Derived GDE - low confidence

### Surface GDE areas

- 🟦 81-100% Known GDE
- 🟦 81-100% Derived GDE - high confidence
- 🟦 81-100% Derived GDE - moderate confidence
- 🟦 81-100% Derived GDE - low confidence
- ▨ 01-80% Derived GDE - high confidence
- ▨ 01-80% Derived GDE - moderate confidence
- ▨ 01-80% Derived GDE - low confidence

### Road

- ▬ Highway
- ▬ Main
- ▬ Local
- ▬ Private

### Railway

▬

### Cities and Towns

○

## Attribution

DigitalGlobe

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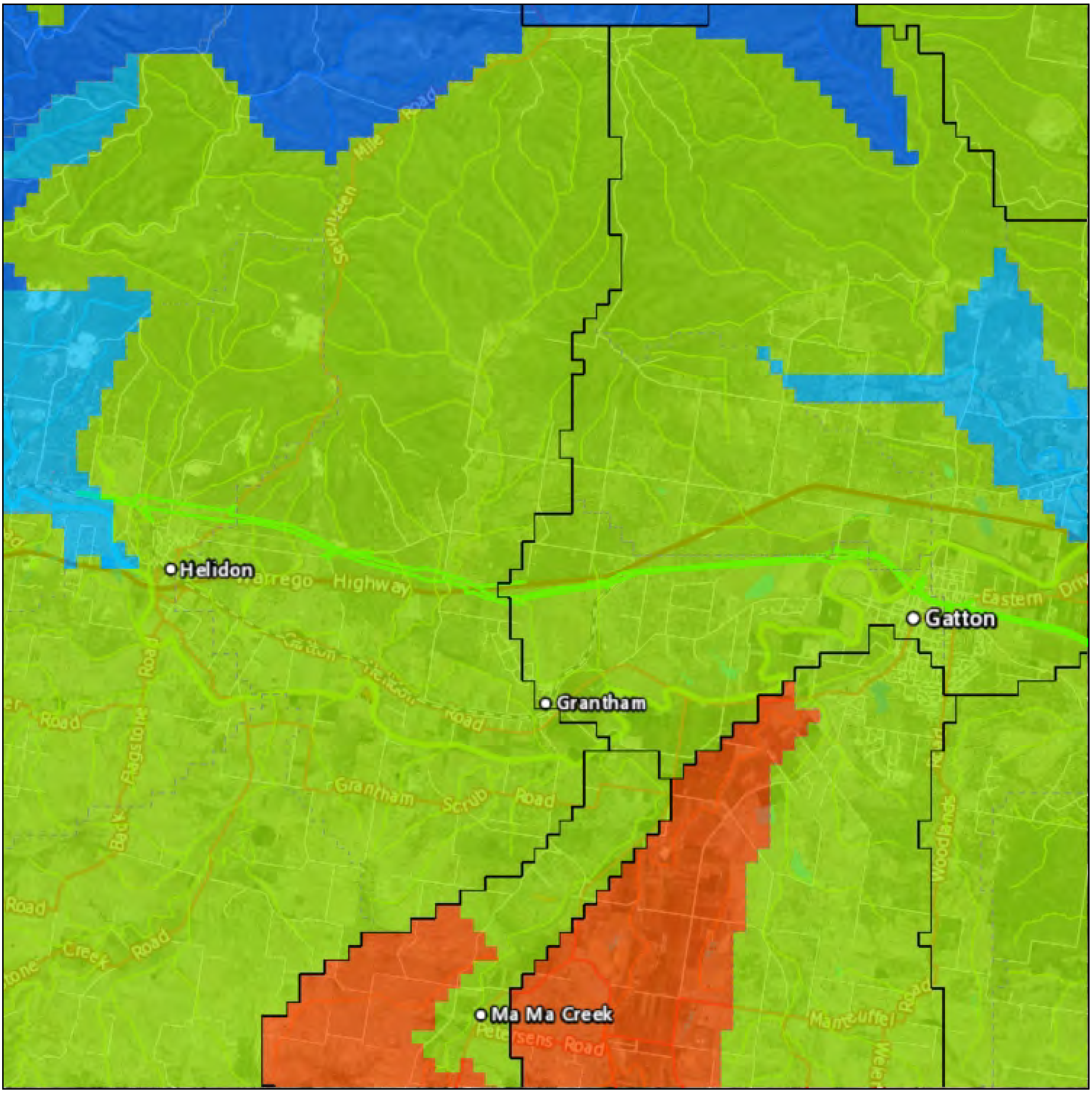
# Aquatic conservation assessment

27°26'55"S 152°5'33"E

27°26'55"S 152°18'40"E



27°38'32"S 152°5'33"E

27°38'32"S 152°18'40"E

A product of

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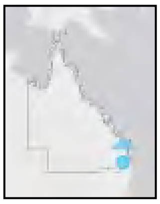

N

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Scale: 1:122856 -

Printed at: A4 -

Print date: 9/3/2020 -

**Datum:** Geocentric Datum of Australia 1994 -
**Projection:** Web Mercator EPSG 102100 -

For more information, visit - https://qldglobe.information.qld.gov.au/help-info/Contact-us.html -

Queensland Government
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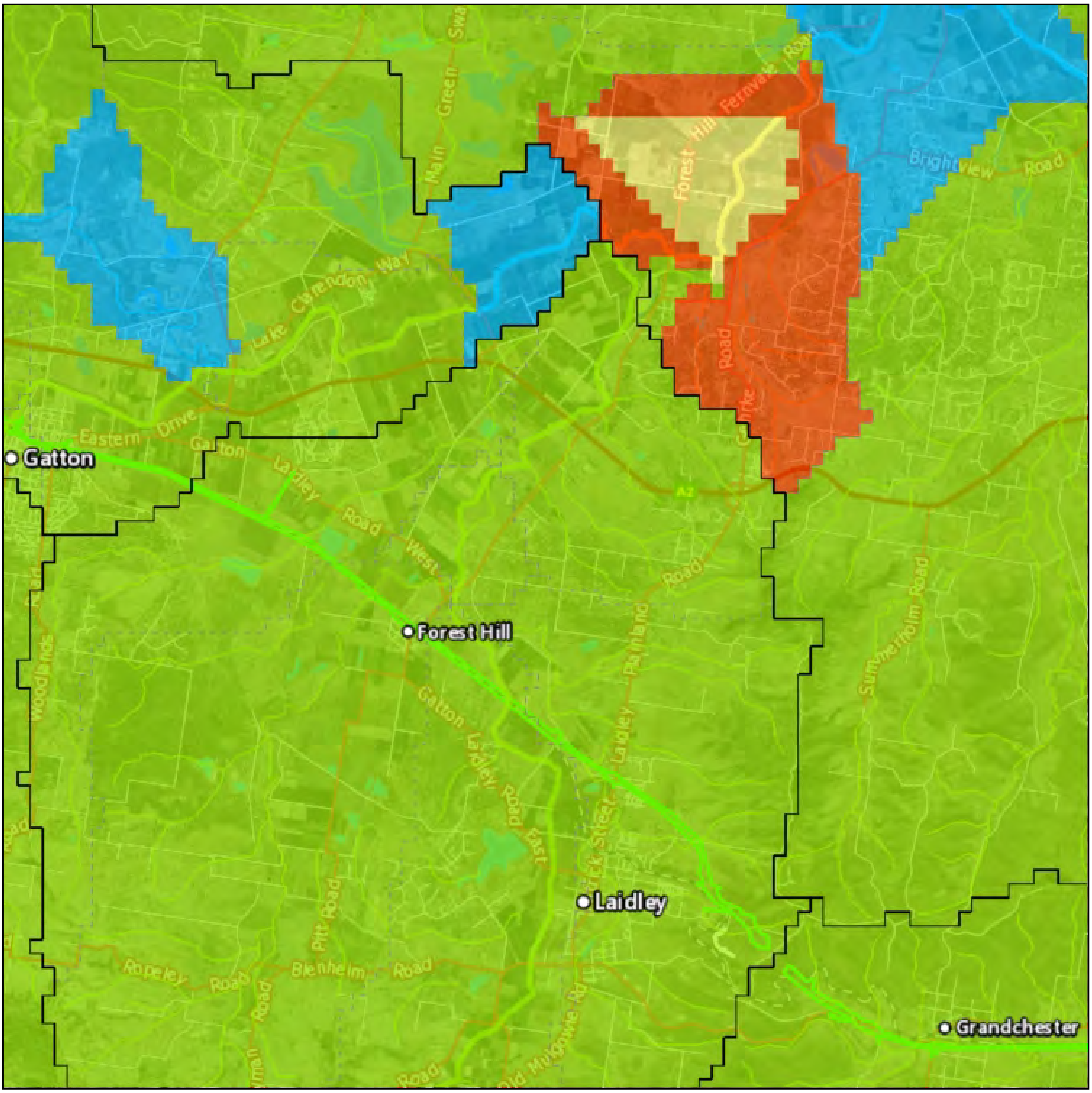
27°28'39"S 152°16'28"E

27°28'39"S 152°29'34"E



27°40'16"S 152°16'28"E

27°40'16"S 152°29'34"E

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N

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Scale: 1:122856

Printed at: A4 -
Print date: 9/3/2020 -
**Datum:** Geocentric Datum of Australia 1994 -
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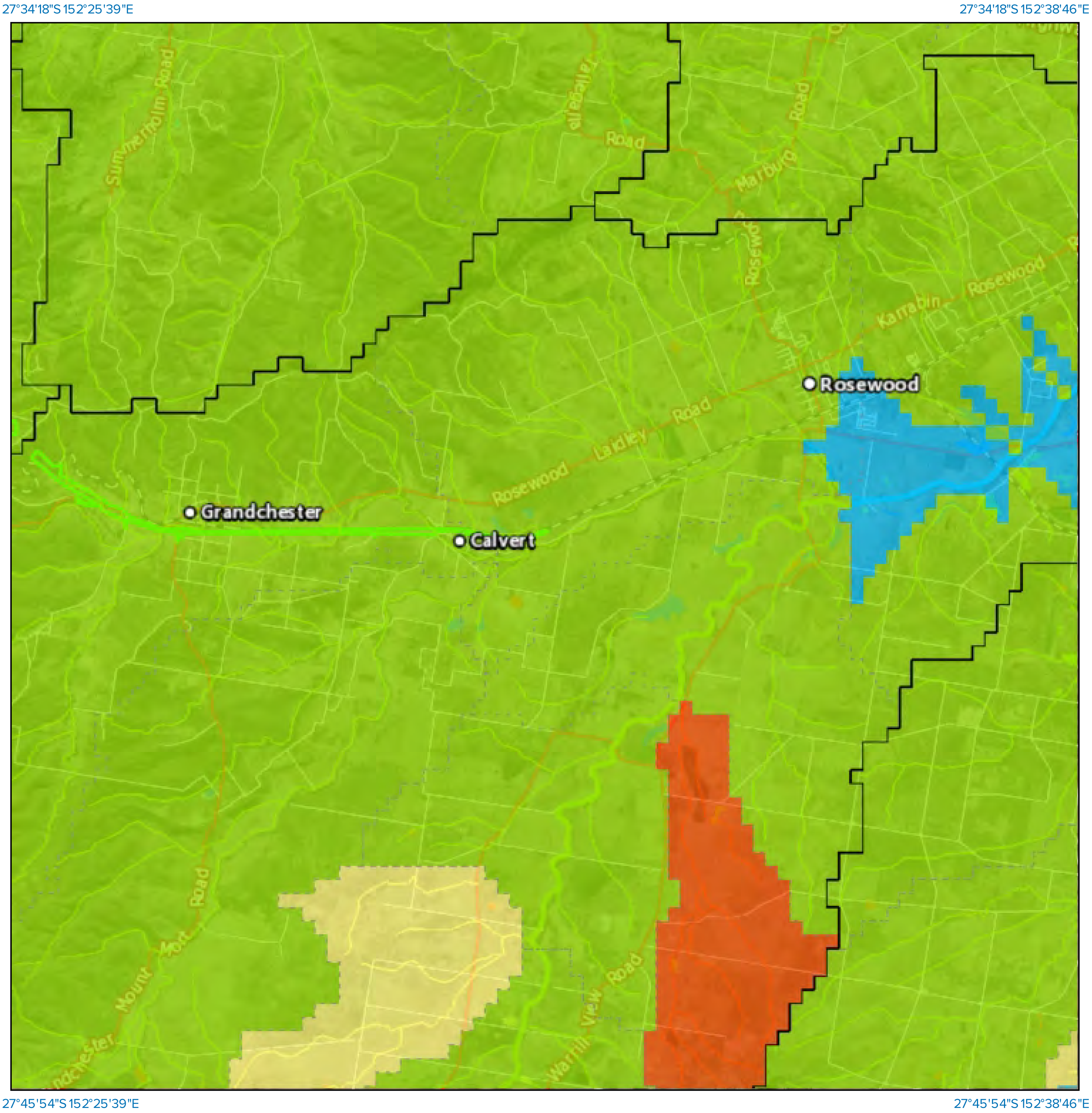

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N

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Scale: 1:122856

Printed at: A4 -
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Queensland Government
Department of Natural Resources, Mines and Energy

## Legend

### K_IR_3300000_D_ENV_PL_PERMANENT_DISTURBANCE_FOOTPRINT_CAD.KMZ - poly

🟩

### Riverine subcatchments

☐

### Riverine subsections

⬚

### Buffered streams - conservation significance

- 🟦 Very High -
- 🟦 High -
- 🟩 Medium -
- 🟨 Low -
- 🟧 Very Low -

### Riverine spatial units - conservation significance

- 🟦 Very High -
- 🟦 High -
- 🟩 Medium -
- 🟨 Low -
- 🟧 Very Low -

### Non-riverine subcatchments

☐

### Non-riverine subsections

⬚

### Springs - conservation significance

- ● Very High -
- ● High -
- ● Medium -
- ● Very Low -

### Non-riverine wetlands - conservation significance

- 🟦 Very High -
- 🟦 High -
- 🟩 Medium -
- 🟨 Low -
- 🟧 Very Low -

### Cities and Towns

○

### Road

- ▬ Highway -
- ▬ Main -
- ▬ Local -
- ▬ Private -

### Railway

▬

## Attribution

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Australian Government
Bureau of Meteorology

# Climate statistics for Australian locations

## Monthly climate statistics

## All years of record

### Site information

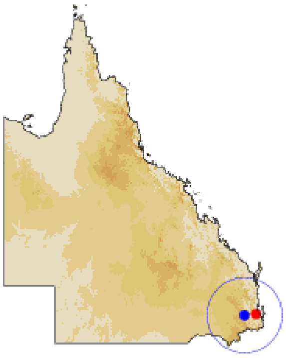
**Site name:** UNIVERSITY OF QUEENSLAND GATTON
**Site number:** 040082
**Latitude:** 27.54 °S **Longitude:** 152.34 °E
**Elevation:** 89 m
**Commenced:** 1897 **Status:** Open
**Latest available data:** 22 Aug 2019

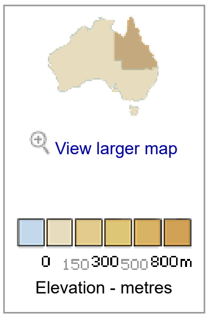
### Additional information

Additional site information

### Nearest alternative sites

1. 040436 GATTON DAFF RESEARCH STN (0.9km)
2. 040004 AMBERLEY AMO (37.8km)
3. 041103 TOOWOOMBA (40.0km)





**View:** ● Main statistics ○ All available **Period:** Use all years of data ▼ **Text size:** ● Normal ○ Large

| Statistics | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual | Years | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature | | | | | | | | | | | | | | | |
| Mean maximum temperature (°C) | 31.6 | 30.8 | 29.6 | 27.2 | 23.8 | 21.1 | 20.8 | 22.5 | 25.6 | 28.2 | 30.2 | 31.3 | 26.9 | 97 | 1913<br>2019 |
| Mean minimum temperature (°C) | 19.1 | 19.0 | 17.3 | 13.7 | 10.2 | 7.6 | 6.2 | 6.7 | 9.5 | 13.2 | 16.0 | 18.1 | 13.0 | 96 | 1913<br>2019 |
| Rainfall | | | | | | | | | | | | | | | |
| Mean rainfall (mm) | 110.1 | 99.4 | 79.6 | 48.2 | 45.2 | 41.5 | 36.1 | 26.7 | 34.8 | 65.0 | 78.5 | 99.2 | 770.2 | 117 | 1897<br>2019 |
| Decile 5 (median) rainfall (mm) | 94.9 | 84.5 | 72.2 | 35.7 | 27.2 | 25.5 | 25.6 | 21.1 | 27.4 | 51.8 | 72.2 | 82.9 | 773.1 | 121 | 1897<br>2019 |
| Mean number of days of rain ≥ 1 mm | 8.1 | 7.6 | 7.4 | 4.8 | 4.6 | 4.0 | 3.8 | 3.6 | 4.0 | 6.2 | 6.6 | 8.0 | 68.7 | 121 | 1897<br>2019 |
| Other daily elements | | | | | | | | | | | | | | | |
| Mean daily sunshine (hours) | | | | | | | | | | | | | | 9 | 1974<br>1984 |
| Mean number of clear days | | | | | | | | | | | | | | | |
| Mean number of cloudy days | | | | | | | | | | | | | | | |
| 9 am conditions | | | | | | | | | | | | | | | |
| Mean 9am temperature (°C) | 25.8 | 25.3 | 24.0 | 21.1 | 17.2 | 14.0 | 13.0 | 14.7 | 18.5 | 21.9 | 24.0 | 25.4 | 20.4 | 86 | 1913<br>2010 |
| Mean 9am relative humidity (%) | 67 | 70 | 69 | 70 | 73 | 74 | 71 | 66 | 61 | 60 | 61 | 64 | 67 | 56 | 1938<br>2010 |
| Mean 9am wind speed (km/h) | 10.2 | 9.9 | 9.6 | 8.9 | 10.0 | 11.7 | 11.6 | 11.0 | 10.3 | 10.8 | 10.9 | 10.4 | 10.4 | 44 | 1965<br>2010 |
| 3 pm conditions | | | | | | | | | | | | | | | |
| Mean 3pm temperature (°C) | | | | | | | | | | | | | | 8 | 1995<br>2010 |
| Mean 3pm relative humidity (%) | | | | | | | | | | | | | | 8 | 1995<br>2010 |
| Mean 3pm wind speed (km/h) | | | | | | | | | | | | | | 8 | 1995<br>2010 |

red = highest value blue = lowest value

Product IDCJCM0027 Prepared at Thu 22 Aug 2019 02:39:56 AM EST

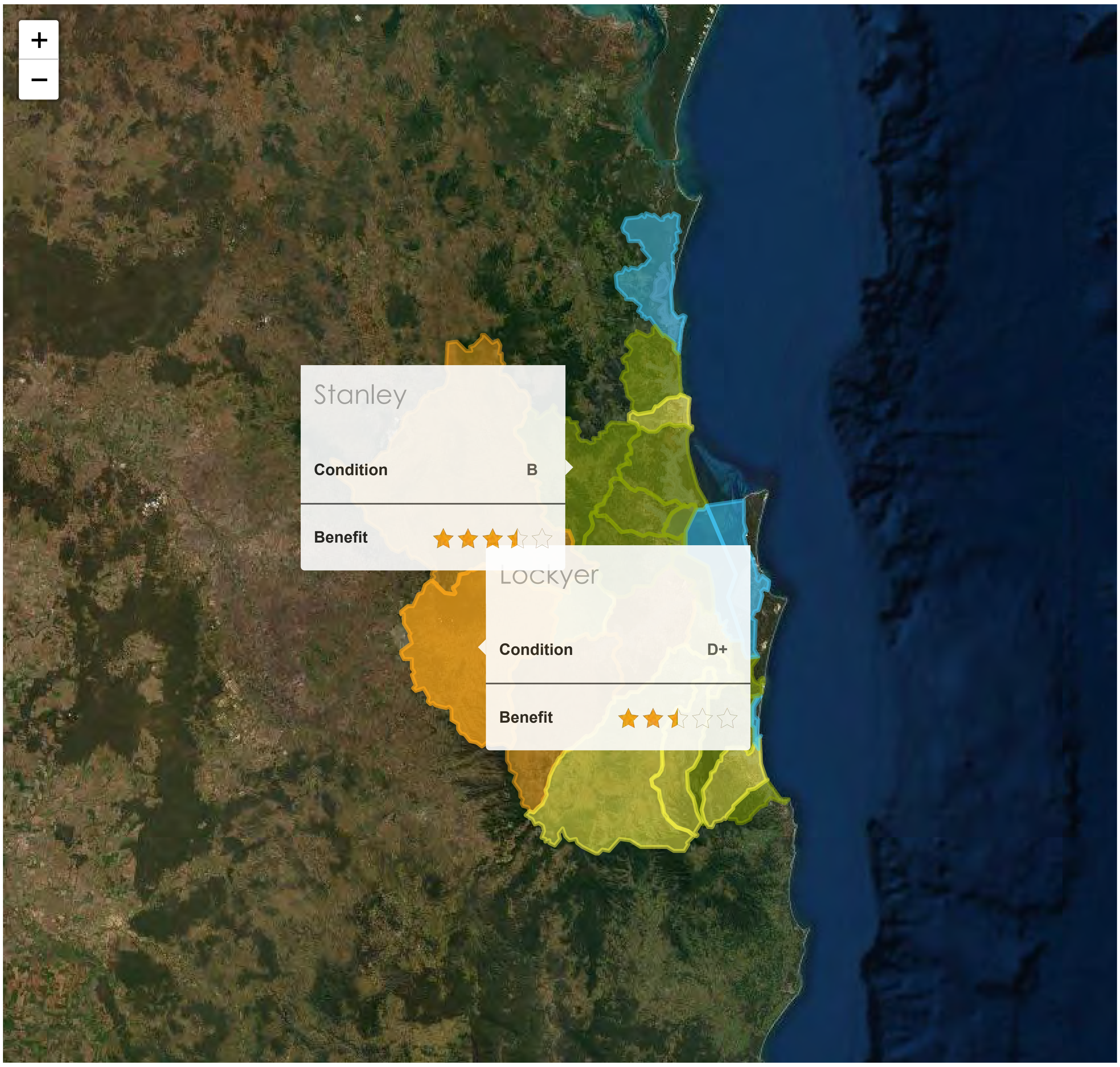
Monthly statistics are only included if there are more than 10 years of data. The number of years (provided in the 2nd last column of the table) may differ between elements if the observing program at the site changed. More detailed data for individual sites can be obtained by contacting the Bureau.

## Related Links

- This page URL: http://www.bom.gov.au/climate/averages/tables/cw_040082.shtml
- About climate averages: http://www.bom.gov.au/climate/cdo/about/about-stats.shtml
- Bureau of Meteorology website: http://www.bom.gov.au

Page created: Thu 22 Aug 2019 02:39:56 AM EST

This page was created at **on**



CLOSE ALL —

## Lockyer

The Lockyer catchment is located west of Brisbane and east of Toowoomba. The Lockyer joins the Brisbane River downstream of Lake Wivenhoe. The upper catchment remains forested whilst the mid and lower catchment has been largely cleared. The catchment has the highest proportion of land used for intensive agriculture in South East Queensland. Irrigation has regulated water flow and changed groundwater dynamics. Numerous impoundments are present in the catchment. Instability of stream banks and gully erosion due to degradation of the riparian vegetation occurs.

For more information see the Lockyer Catchment Story

## Environmental Condition Grade 2018

A B C **D+** F

The condition of the catchment remains poor (D+).

### Why?

- Pollutant loads (sediment and nutrients) generated in the catchment increased slightly, though remained very low. This is because 2017 and 2018 were both below average rainfall years in the Lockyer catchment.
- The extent of stream bank vegetation throughout the catchment remains poor, with only 69% of stream banks vegetated.

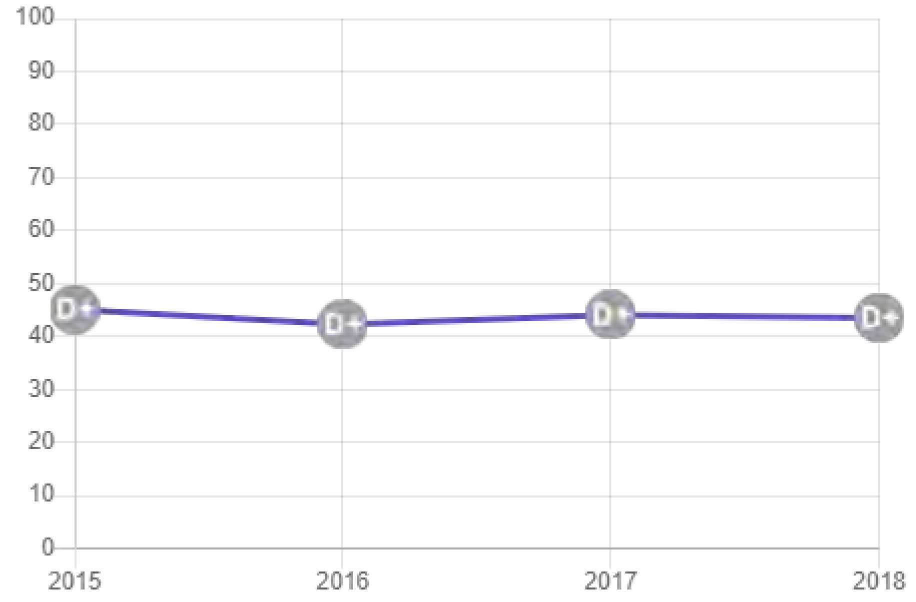
- The health of freshwater creeks in the catchment improved slightly this year though overall health remains very poor. The fish community health at the sites in Deep Gully and Laidley Creek contributed to improvements.

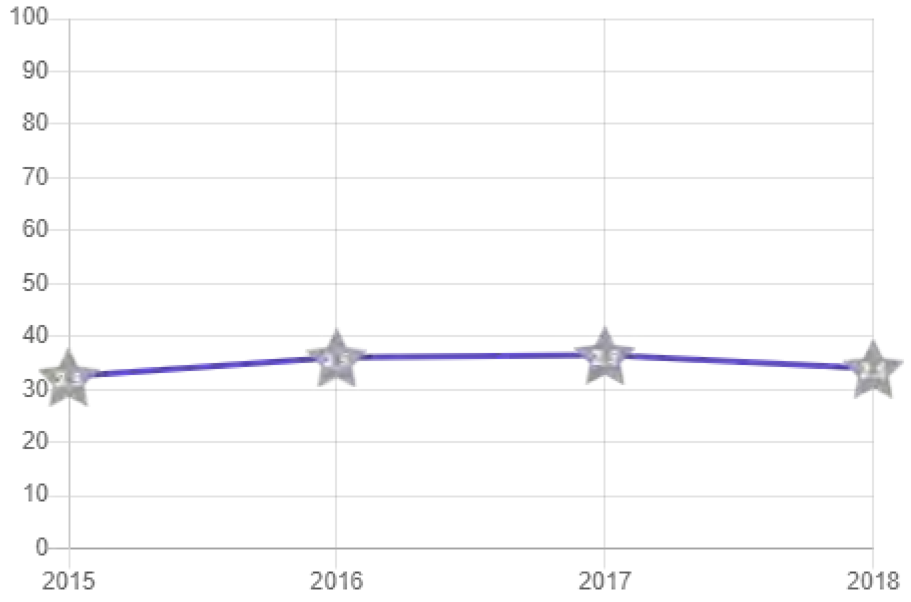
## Waterway Benefit Rating 2018

★★⯪☆☆

- Poor catchment condition results in only moderate numbers of residents (37%) satisfied with their local waterways.
- Despite these results, residents still value their local waterways for recreation. High numbers of residents (45%) valued their local waterway as a place of rest and relaxation or for social interaction with friends and family. 29% of residents enjoy recreating in or alongside their local waterway at least monthly. The most frequent recreation activities include walking or running (29 days/year) and enjoying nature (9 days/year). They picnicked, swam or cycled on average 2 days/year, and rarely other activities.

## Changes Over Time


Condition Grade


Benefit Rating

Select regions to compare

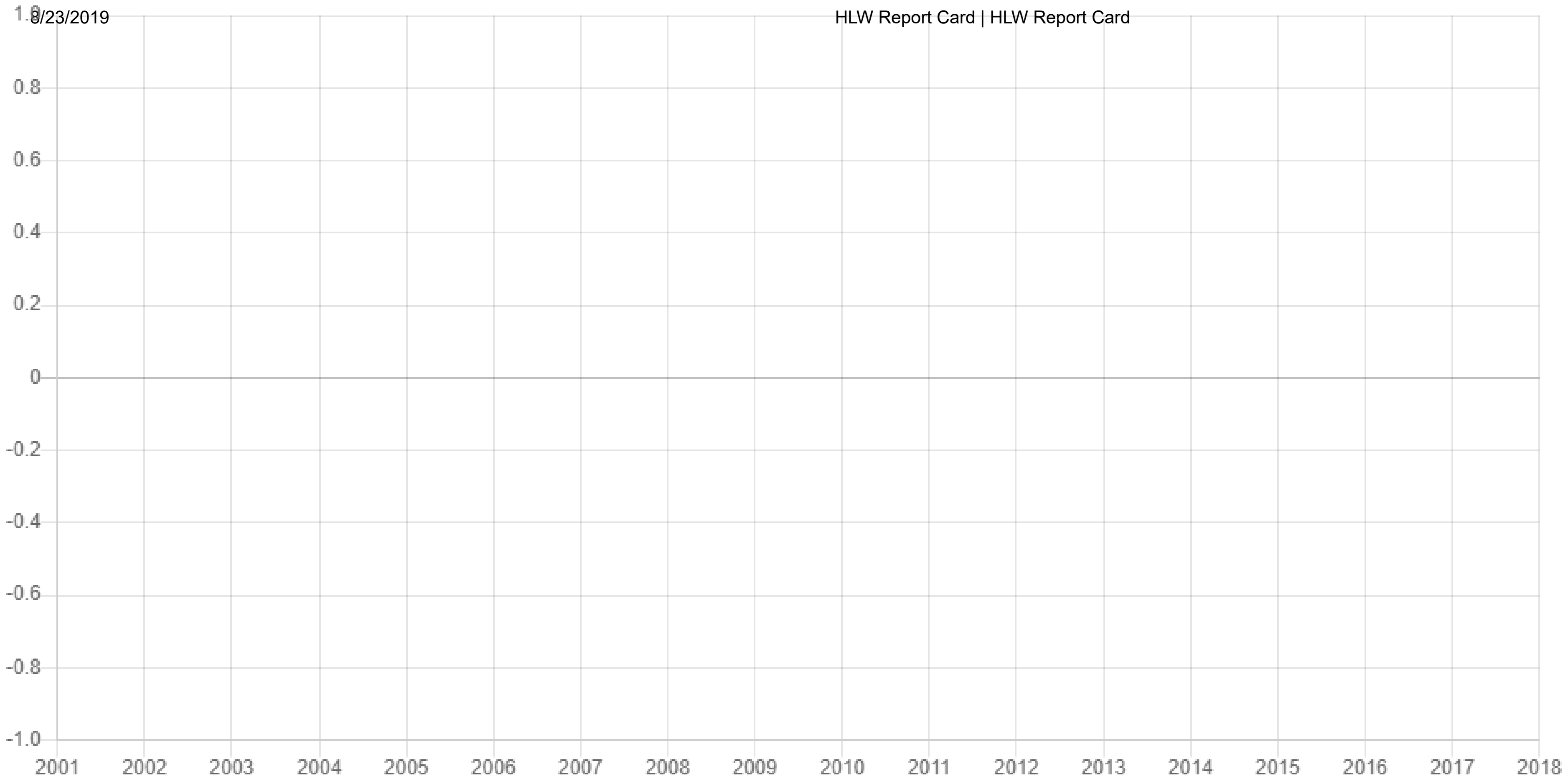
Pimpama-Coomera Tallebudgera-Currumbin Nerang Albert Redland Lower Brisbane Mid Brisbane Pine Caboolture Noosa Maroochy Mooloolah Stanley
Upper Brisbane Lockyer Bremer Logan Pumicestone Catchment Broadwater Southern Bay Central Bay Western Bay Eastern Bay

## Ways To Improve Waterway Health And Benefits

- Protecting the existing critical streambank vegetation and wetlands from clearing and weed infestation is key to maintaining catchment condition and protecting agricultural land from erosion in the face of increasing extreme events like floods. Currently 69% of streambanks in the Lockyer catchment are vegetated.
- Improving access and use of waterways increases the community's connection with their waterways and motivation to protect them. 66% of residents feel nature in general is an important part of their lives, however only half of those are motivated to protect their local waterways (27%) or feel it is their personal responsibility (33%).
- Campaigns to highlight the value of waterways to the community can improve feelings of responsibility and willingness to engage in or support waterway protection activities. Focus campaigns around residents' top environmental issue of concern to increase traction, which are #1 water supply/drought, #2 litter pollution and #3 weeds and pest infestation, for residents of the Lockyer catchment.
- Moderate numbers of residents are willing to donate time (28%) to local waterway protection. As such, create opportunities and incentives for residents to make changes around their properties or in their local waterway to improve waterway condition.

## Trends

Turbidity (NTU)



## Select regions to compare

### Catchments

- Pimpama-Coomera
- Tallebudgera-Currumbin
- Nerang
- Albert
- Redland
- Lower Brisbane
- Mid Brisbane
- Pine
- Caboolture
- Noosa
- Maroochy
- Mooloolah
- Stanley
- Upper Brisbane
- Lockyer
- Bremer
- Logan
- Pumicestone Catchment

### Estuaries

- Logan Estuary
- Albert Estuary
- Bremer Estuary
- Brisbane Estuary
- Cabbage Tree Estuary
- Caboolture Estuary
- Coomera Estuary
- Currumbin Estuary
- Maroochy Estuary
- Mooloolah Estuary
- Nerang Estuary
- Noosa Estuary
- Oxley Estuary
- Pimpama Estuary
- Pine Estuary
- Pumicestone Estuary
- Tallebudgera Estuary
- Tingalpa Estuary
- Eprapah Estuary

### Bays

- Broadwater
- Southern Bay
- Central Bay
- Western Bay
- Bramble Bay
- Eastern Bay
- Eastern Banks
- Waterloo Bay
- Deception Bay

## Select indicator to view trend

### Benefit

- Connection
- Access & use
- Satisfaction
- Personal benefits
- Recreational use

### Freshwater

- Ecosystem processes
- Fish
- Bugs
- Physical chemical

### Habitat

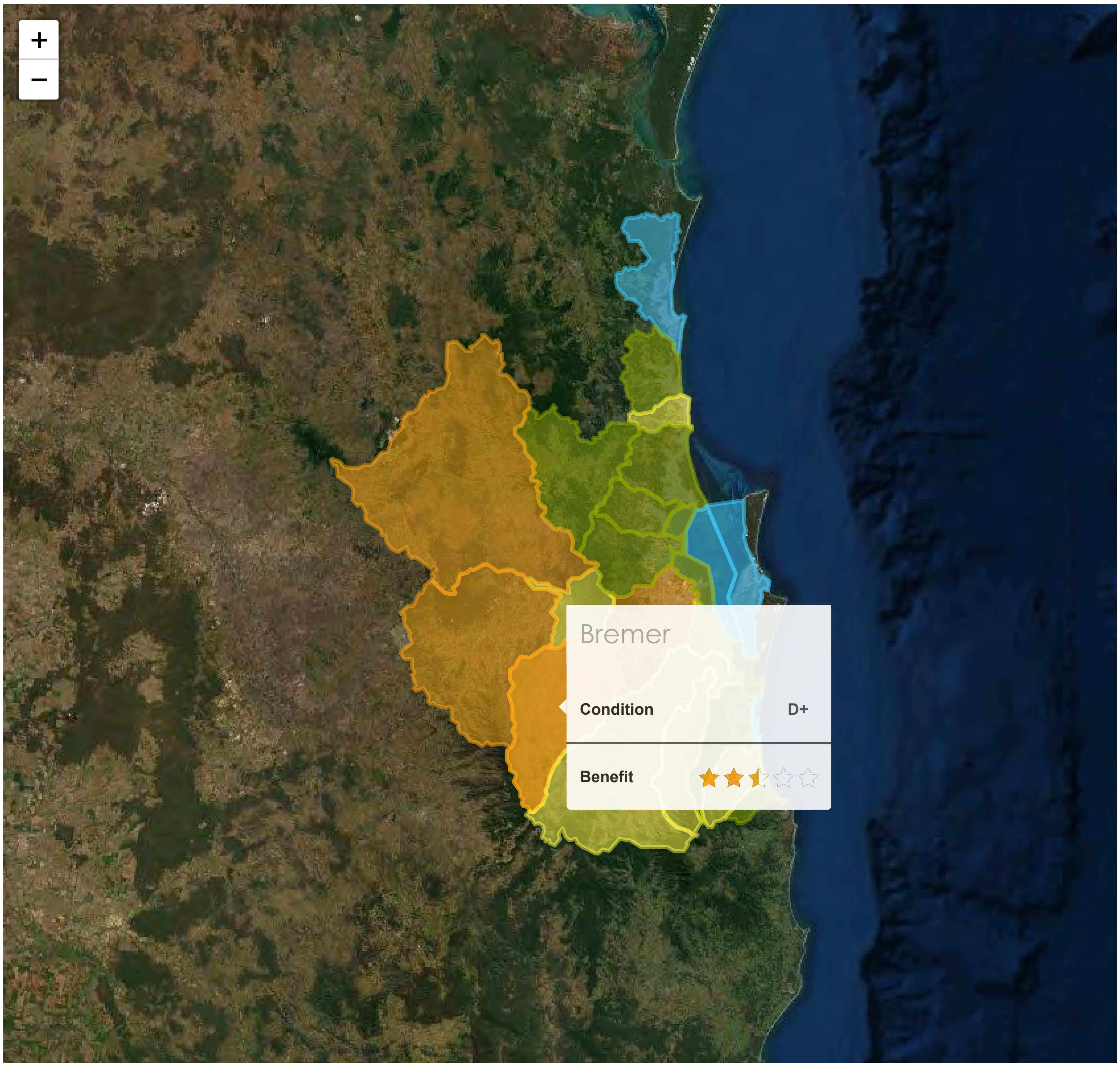
- Riparian extent
- Freshwater wetlands

### Pollutant

- Nitrogen load
- Phosphorus load
- Sediment load

---

## Actions



CLOSE ALL —

## Bremer

The Bremer River catchment is located west of Brisbane and flows into the Brisbane River. It is mostly urbanised with areas of rural landuse the majority of which has been cleared for cattle grazing. Some areas of natural bush remain in the upper catchment. Riparian vegetation is significantly modified with little vegetation remaining. Widespread channel and gully erosion occurs in the river and its tributaries. Four waste water treatment plants and other point sources discharge to the catchments waterways contributing to sediment and nutrient loads.

For more information see the Bremer Catchment Story

## Environmental Condition Grade 2018

A B C **D+** F

Add Content

Catchment condition improved though remains poor (D+).

Why?

- Pollutant loads decreased, from low to very low. Sediment and nutrients generated from the land decreased, compared with elevated levels in 2017 which was due to the influence of ex-Tropical Cyclone Debbie, particularly in Warrill Creek.
- The health of freshwater creeks in the catchment remains poor. Bug community health and ecosystem processes declined slightly, particularly at the Western Creek, Warrill Creek and Purga Creek sites.
- Sediment and nutrients generated from the land decreased, compared with 2017 which was elevated due to the influence of ex-Tropical Cyclone Debbie.
- In the mid to upper reaches of the estuary, the overall water quality has improved slightly this year due to the lower pollutant loads runoff from the land. However, the overall health of the estuary remains very poor due to high nutrient concentrations and very poor water clarity.

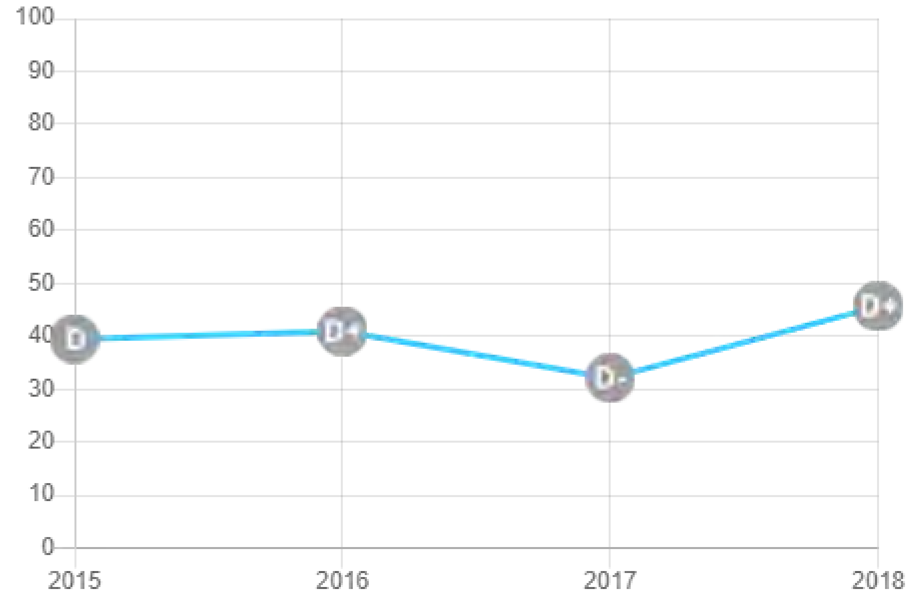
## Waterway Benefit Rating 2018

★★⯨☆☆

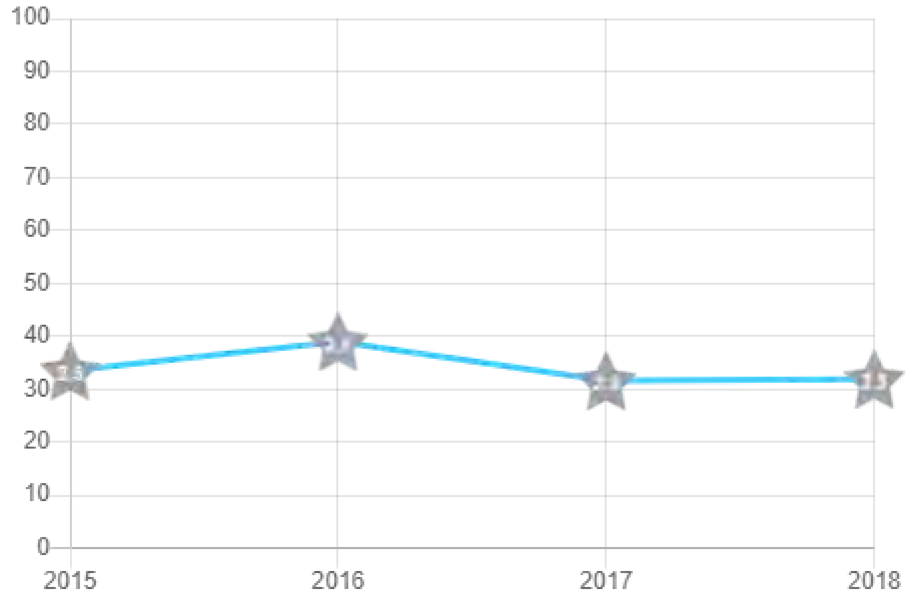
- Poor catchment condition, results in only moderate numbers of residents (37%) that are satisfied with the usability and accessibility of their local waterways (compared with 58% for all of SEQ).
- Despite this, residents report they do value their local waterways for recreation. 23% recreate in or alongside their local waterway on a monthly basis. Residents reported their recreational use of local waterways was predominantly walking or running (11 days/year) and enjoying nature (8 days/year). They picnicked or camped on average 2 days/year, and rarely other activities.
- Lower pollutant loads in the catchment this year meant the amount of mud removed from drinking water at the Boonah-Kalbar treatment plants was lower (210 kg/ML). This is compared to 2017 which was affected by ex-Tropical Cyclone Debbie (1794 kg/ML).

## Changes Over Time

### Condition Grade



### Benefit Rating



Select regions to compare

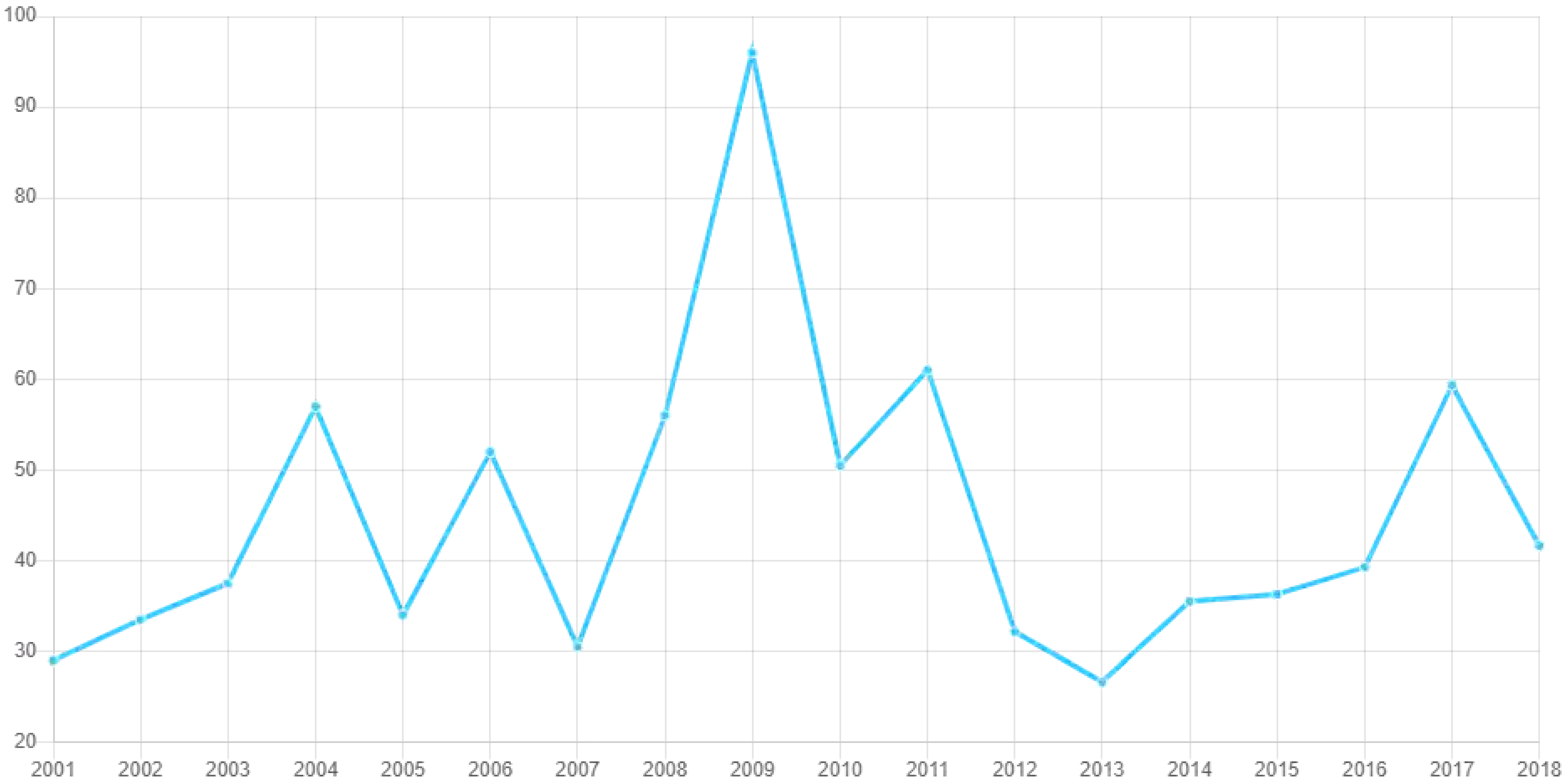
Pimpama-Coomera Tallebudgera-Currumbin Nerang Albert Redland Lower Brisbane Mid Brisbane Pine Caboolture Noosa Maroochy Mooloolah Stanley Upper Brisbane Lockyer Bremer Logan Pumicestone Catchment Broadwater Southern Bay Central Bay Western Bay Eastern Bay

## Ways To Improve Waterway Health And Benefits

- Protecting streambank vegetation and wetlands from clearing and weed infestation is key to maintaining catchment condition in the face of projected increasing population and development. Over the next 25 years Ipswich City Council area is projected to be one of the fastest growing urbanised areas in SEQ, with a 75% expansion in the urban footprint. 56% of streambanks in the Bremer catchment have vegetation and the retention of these will be critical for mitigating the increasing pressures that come with expansion.
- The naturalisation of creek channels in the urban landscape, such as the Small Creek project, increases the accessibility and usability of local waterways. In turn this improves the community's emotional connection with their local waterways and their motivation to use and protect them.
- Improving access and use of waterways increases the community's motivation to protect them. 59% of residents feel nature in general is an important part of their lives, however only a very small number are motivated to protect their local waterways (15%) or feel it is their personal responsibility (30%).
- Campaigns to highlight the value of waterways to the community can improve feelings of responsibility and willingness to engage in or support waterway protection activities. Events such as the Ipswich City Council Fishing and Water Fest aim to celebrate local waterways and increase awareness and value of the Bremer River catchment.
- Focus future campaigns around resident's top environmental concerns to increase traction, which are Litter, water pollution, extinctions of local plants and animals, and loos of natural beauty.

## Trends

## Turbidity (NTU)



## Select regions to compare

### Catchments

- Pimpama-Coomera
- Tallebudgera-Currumbin
- Nerang
- Albert
- Redland
- Lower Brisbane
- Mid Brisbane
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- Noosa
- Maroochy
- Mooloolah
- Stanley
- Upper Brisbane
- Lockyer
- Bremer
- Logan
- Pumicestone Catchment

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- Pine Estuary
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- Tallebudgera Estuary
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- Eprapah Estuary

### Bays

- Broadwater
- Southern Bay
- Central Bay
- Western Bay
- Bramble Bay
- Eastern Bay
- Eastern Banks
- Waterloo Bay
- Deception Bay

## Select indicator to view trend

### Benefit

- Connection
- Access & use
- Satisfaction
- Personal benefits
- Recreational use

### Estuarine/marine

- Turbidity
- Chlorophyll-a
- Total nitrogen
- Dissolved oxygen
- Total phosphorus

### Freshwater

- Ecosystem processes
- Fish
- Bugs
- Physical chemical

### Habitat

- Riparian extent
- Freshwater wetlands

### Pollutant

- Nitrogen load
- Phosphorus load
- Sediment load

---

## Actions

Produced at the Indooroopilly Sciences Centre by the Spatial Information and Mapping Group,
Natural Resource Information Management, Natural Resource Sciences,
**Department of Natural Resources, Mines.** ***Workspace - /projects1/cv18670.***

Drainage, coastline and town data supplied courtesy of Geoscience Australia Canberra, ACT 2004).

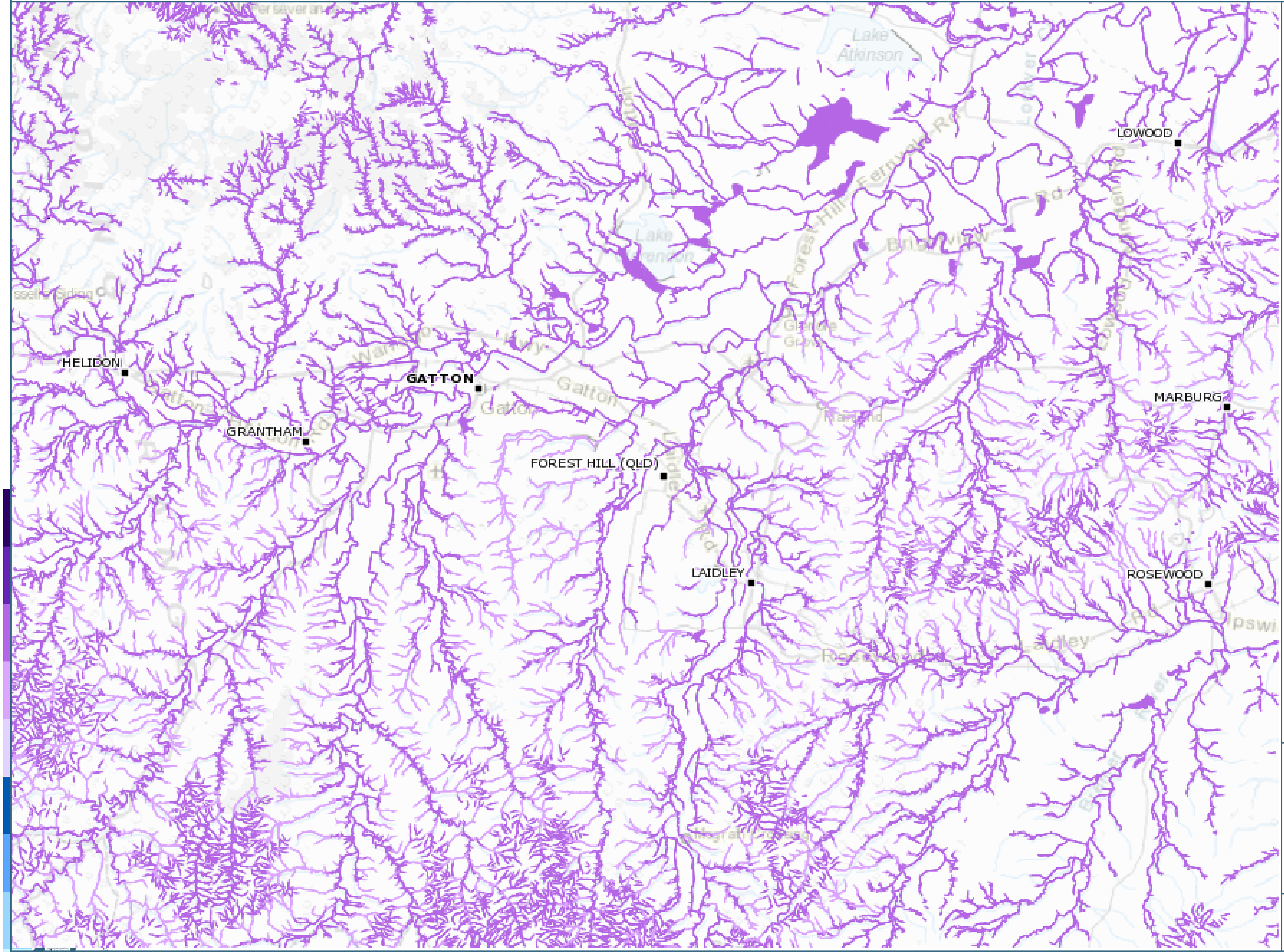
```
QLD DNRME
                                                    HYSITREP - Site Summary Repor
                                              143203C - Lockyer Creek at Helidon

SITE DESCRIPTION
Site:                     143203C Lockyer_Ck Helidon 3
Site Name:                Lockyer Creek at Helidon Number 3
Commence:                 19/11/1987
Cease:
Map:                      9342
Local Map Reference:      125530
Grid Ref: Zone:           56    Easting:  412568.000      Northing:  6953177.000
Grid Datum:               MGA94 Map Grid of Australia 1994
Latitude:                 -27.542280000   27°32'32.2"S
Longitude:                152.114500000 152°06'52.2"E
Lat/Long Datum:           GDA94Geodetic Datum of Australia 1994
Elevation:                128.000
Comment:                  MRHI FNARH

STATION DESCRIPTION
Stream Distance:          99.300 km from station to mouth
Zero Gauge:               128.625
Datum:                    AHD Aust. Height Datum
Control:                  Control Weir

CTF Level:                0.450
Max Gauged Stage:         3.400
Max Gauge Date:           12/04/1988
D'stream from Dam:        False
Min Peak Discharge:       20.000
Time between Peaks:       1440 Mins
Bed Slope:                0.00380
Catchment Area:           357.000

RATING TABLES
 Var                            Var                           Start       Start
 From                           To                            Date        Time
  100.00 Level (Metres)          140 Discharge (Cumecs)       10/11/1987  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)       06/03/2004  05:30
  100.00 Level (Metres)          140 Discharge (Cumecs)       10/01/2011  14:40
  100.00 Level (Metres)          140 Discharge (Cumecs)       10/01/2011  15:40
  100.00 Level (Metres)          140 Discharge (Cumecs)       22/02/2011  15:00

TIME-BASED TABLES
Var                                       Interp   Extend   Date
 998.00  Catch. Area (Sq Km)              No       Yes      01/01/1850 00:00   35
 998.00  Catch. Area (Sq Km)              No       Yes      01/01/2020 00:00   35
1130.00  AHD Adjust                       No       Yes      01/01/1900 00:00   12

GAUGINGS
  Var                           Var                                             Gau
 From                            To                         Date         Time      N
  100 Level (Metres)            140 Discharge (Cumecs)      03/12/1987  14:10      1
  100 Level (Metres)            140 Discharge (Cumecs)      17/12/1987  15:00      2
  100 Level (Metres)            140 Discharge (Cumecs)      13/02/1988  13:15      3
  100 Level (Metres)            140 Discharge (Cumecs)      18/02/1988  13:30      4
  100 Level (Metres)            140 Discharge (Cumecs)      19/02/1988  12:10      5
  100 Level (Metres)            140 Discharge (Cumecs)      22/02/1988  10:30      6
```

```
QLD DNRME
                                                   HYSITREP - Site Summary Repor
                                             143229A - Laidley Creek at Warrego

SITE DESCRIPTION
Site:                     143229A Laidley Warrego H'wy
Site Name:                Laidley Creek at Warrego Highway
Commence:                 31/10/1990
Cease:
Map:                      9342/11
Local Map Reference:      429506
Grid Ref: Zone:           56    Easting:  439677.800      Northing:  6952135.000
Grid Datum:               MGA94 Map Grid of Australia 1994
Latitude:                 -27.553163890   27°33'11.4"S
Longitude:                152.388997220 152°23'20.4"E
Lat/Long Datum:           GDA94Geodetic Datum of Australia 1994
Comment:

STATION DESCRIPTION
Stream Distance:          5.000 km from station to mouth
Zero Gauge:               76.313
Datum:                    AHD Aust. Height Datum
Control:                  Two Metre Crump

CTF Level:                0.505
Max Gauged Stage:         7.654
Max Gauge Date:           28/01/2013
D'stream from Dam:        False
Spillway Level:           76.818
Min Peak Discharge:       20.000
Time between Peaks:       1440 Mins
Catchment Area:           462.000

RATING TABLES
 Var                            Var                         Start       Start
 From                           To                          Date        Time
  100.00 Level (Metres)          140 Discharge (Cumecs)     30/10/1990  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     01/01/2001  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     18/11/2008  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     28/09/2010  14:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     28/09/2010  16:30
  100.00 Level (Metres)          140 Discharge (Cumecs)     20/12/2013  12:00

TIME-BASED TABLES
Var                                      Interp   Extend   Date
 998.00  Catch. Area (Sq Km)             No       Yes      21/09/1999 00:00   46
1130.00  AHD Adjust                      No       Yes      01/01/1900 00:00    7

GAUGINGS
  Var                         Var                                               Gau
 From                          To                        Date         Time       N
  100 Level (Metres)          140 Discharge (Cumecs)     01/11/1990  13:10       1
  100 Level (Metres)          140 Discharge (Cumecs)     06/11/1990  09:10       2
  100 Level (Metres)          140 Discharge (Cumecs)     07/11/1990  09:30       3
  100 Level (Metres)          140 Discharge (Cumecs)     13/12/1991  13:25       4
  100 Level (Metres)          140 Discharge (Cumecs)     13/12/1991  14:40       5
  100 Level (Metres)          140 Discharge (Cumecs)     25/02/1992  08:05       6
  100 Level (Metres)          140 Discharge (Cumecs)     26/03/1996  14:50       7
```

```
QLD DNRME
                                                    HYSITREP - Site Summary Repor
                                                 143121A - Western Creek at Kuss

SITE DESCRIPTION
Site:                      143121A Western Ck @ Kuss Rd
Site Name:                 Western Creek at Kuss Road
Commence:                  22/09/2011
Cease:
Grid Ref: Zone:            56    Easting:  454831.800      Northing:  6939842.00
Grid Datum:                MGA94 Map Grid of Australia 1994
Latitude:                  -27.664892000   27°39'53.6"S
Longitude:                 152.541985000 152°32'31.1"E
Lat/Long Datum:            GDA94Geodetic Datum of Australia 1994
Elevation:                 53.000
Comment:

STATION DESCRIPTION
Stream Distance:           7.000 km from station to mouth
Zero Gauge:                45.436
Datum:                     AHD Aust. Height Datum
Control:                   Natural

Max Gauged Stage:          7.050
Max Gauge Date:            26/02/2013
D'stream from Dam:         False
Catchment Area:            213.000

RATING TABLES
 Var                            Var                            Start       Start
 From                           To                             Date        Time
  100.00 Level (Metres)          140 Discharge (Cumecs)        22/09/2011  12:35
  100.00 Level (Metres)          140 Discharge (Cumecs)        28/03/2014  06:00
  100.00 Level (Metres)          140 Discharge (Cumecs)        18/04/2016  11:05

TIME-BASED TABLES
Var                                         Interp   Extend   Date
 998.00  Catch. Area (Sq Km)                No       Yes      27/06/2012 16:00   21

GAUGINGS
  Var                         Var                                                  Gau
 From                         To                         Date          Time         N
  100 Level (Metres)          140 Discharge (Cumecs)     22/09/2011  11:35          1
  100 Level (Metres)          140 Discharge (Cumecs)     14/10/2011  10:50          2
  100 Level (Metres)          140 Discharge (Cumecs)     02/11/2011  09:06          3
  100 Level (Metres)          140 Discharge (Cumecs)     24/11/2011  11:35          4
  100 Level (Metres)          140 Discharge (Cumecs)     24/11/2011  13:25          5
  100 Level (Metres)          140 Discharge (Cumecs)     24/11/2011  15:15          6
  100 Level (Metres)          140 Discharge (Cumecs)     29/01/2012  13:36          7
  100 Level (Metres)          140 Discharge (Cumecs)     01/03/2012  08:04          8
  100 Level (Metres)          140 Discharge (Cumecs)     10/07/2012  11:35          9
  100 Level (Metres)          140 Discharge (Cumecs)     13/11/2012  10:35         10
  100 Level (Metres)          140 Discharge (Cumecs)     26/02/2013  13:45         11
  100 Level (Metres)          140 Discharge (Cumecs)     01/05/2013  12:16         12
  100 Level (Metres)          140 Discharge (Cumecs)     28/10/2013  10:35         13
  100 Level (Metres)          140 Discharge (Cumecs)     05/02/2014  10:50         14
  100 Level (Metres)          140 Discharge (Cumecs)     18/03/2014  13:10         15
  100 Level (Metres)          140 Discharge (Cumecs)     05/05/2014  09:05         16
```

```
QLD DNRME
                                                   HYSITREP - Site Summary Repor
                                                  143113A - Purga Creek at Loams

SITE DESCRIPTION
Site:                     143113A Purga_Ck Loamside
Site Name:                Purga Creek at Loamside
Commence:                 23/11/1973
Cease:
Map:                      9442
Local Map Reference:      732376
Grid Ref: Zone:           56    Easting:  473330.000      Northing:  6937878.900
Grid Datum:               MGA94 Map Grid of Australia 1994
Latitude:                 -27.683042000   27°40'59.0"S
Longitude:                152.729516000 152°43'46.3"E
Lat/Long Datum:           GDA94Geodetic Datum of Australia 1994
Comment:                  MRHI

STATION DESCRIPTION
Stream Distance:          6.800 km from station to mouth
Zero Gauge:               18.478
Datum:                    AHD Aust. Height Datum
Control:                  Sand Gravel

CTF Level:                0.530
Max Gauged Stage:         5.590
Max Gauge Date:           21/01/1982
D'stream from Dam:        False
Min Peak Discharge:       20.000
Time between Peaks:       1440 Mins
Catchment Area:           215.000

RATING TABLES
 Var                            Var                         Start       Start
 From                           To                          Date        Time
  100.00 Level (Metres)          140 Discharge (Cumecs)     23/11/1973  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     25/05/1974  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     04/06/1974  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     27/02/1975  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     25/10/1975  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     29/11/1976  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     16/10/1977  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     24/01/1979  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     22/04/1979  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     23/11/1979  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     02/01/1981  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     04/11/1981  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     25/12/1981  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     07/03/1982  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     23/06/1983  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     08/10/1983  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     02/10/1986  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     17/10/1987  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     05/04/1988  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     16/09/1988  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     30/03/1990  00:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     21/02/1992  22:00
  100.00 Level (Metres)          140 Discharge (Cumecs)     06/01/1993  20:00
```

# Groundwater Dependent Ecosystems Atlas



Aquatic GDE

1:259,601

Kilometres 5 10

Data Source: Bureau of Meteorology, Geoscience Australia and State/Territory lead water agencies. Refer to metadata for further information: Click here

Australian Albers GDA94

Unclassified potential GDE (national assessment)

Australian Government
Bureau of Meteorology

Date: 23 August, 2019

# Groundwater Dependent Ecosystems Atlas

Terrestrial GDE (no data)

Terrestrial GDE

1:259,601

Kilometres 5 10

Data Source: Bureau of Meteorology, Geoscience Australia and State/Territory lead water agencies. Refer to metadata for further information: Click here

Australian Albers GDA94

Unclassified potential GDE (national assessment)

ecosystems analysed

Date: 23 August, 2019

# APPENDIX

# L

## Surface Water Quality Technical Report

## Appendix E DNRME Water Information Portal Streamflow and Discharge

**HELIDON TO CALVERT** ENVIRONMENTAL IMPACT STATEMENT

IR_1381

# Appendix E

# DRDMW water information portal streamflow and discharge

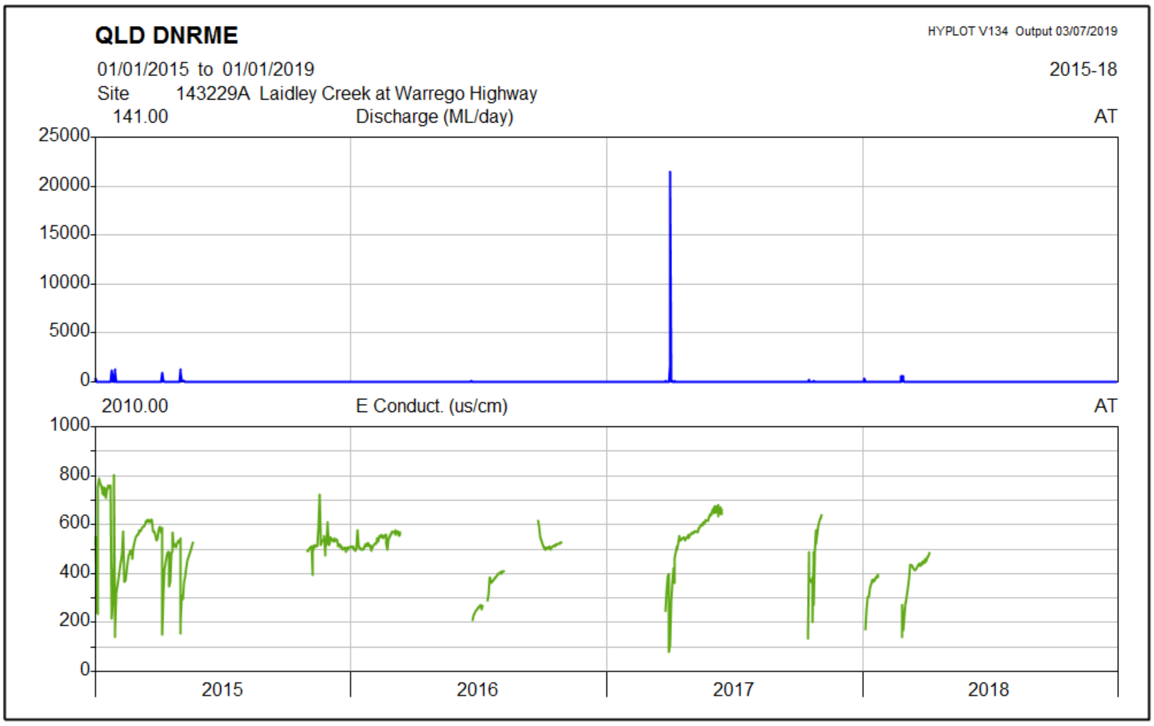


**Figure D.1** **Lockyer Creek at Helidon number 3 (143203C) streamflow (discharge ML/day) against electrical conductivity**

**Source:** DRDMW (formerly DNRME (2019))

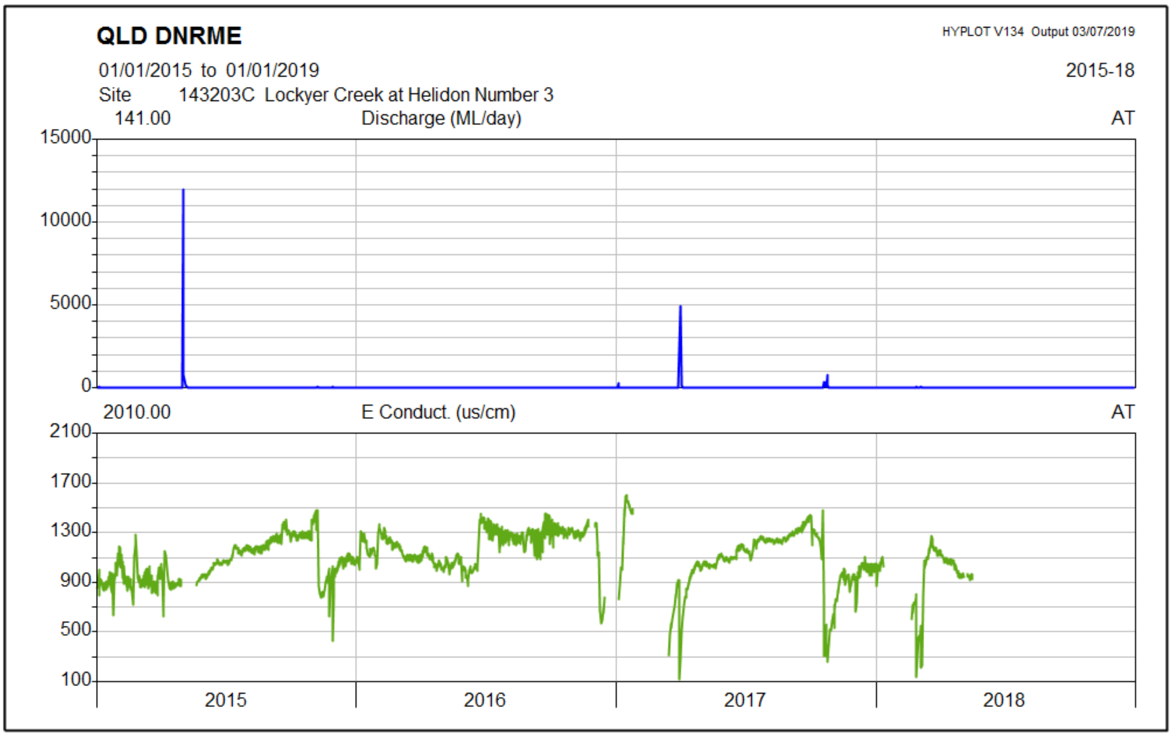


**Figure D.2** **Laidley Creek at Warrego Highway (143229A) streamflow (discharge ML/day) against electrical conductivity**

**Source:** DRDMW (formerly DNRME (2019))

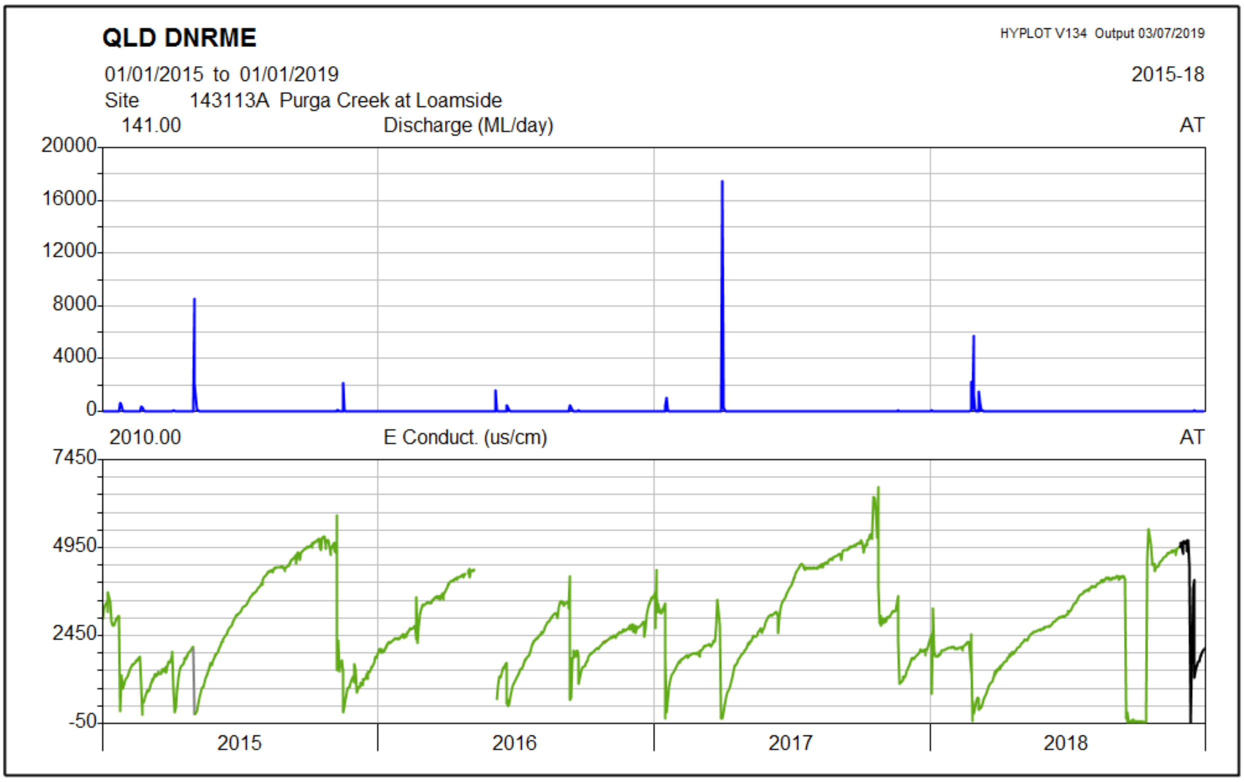


Figure D.3 **Purga Creek at Loamside (143113A) streamflow (discharge ML/day) against electrical conductivity**

**Source:** DRDMW (formerly DNRME (2019))

# APPENDIX

# L

## Surface Water Quality Technical Report

## **Appendix F** Gauging Station Seasonality Plots

**HELIDON TO CALVERT** ENVIRONMENTAL IMPACT STATEMENT

IR_1381

# Appendix F

# Gauging station seasonality plots

## Lockyer Creek at Helidon Number 3 (143203C)

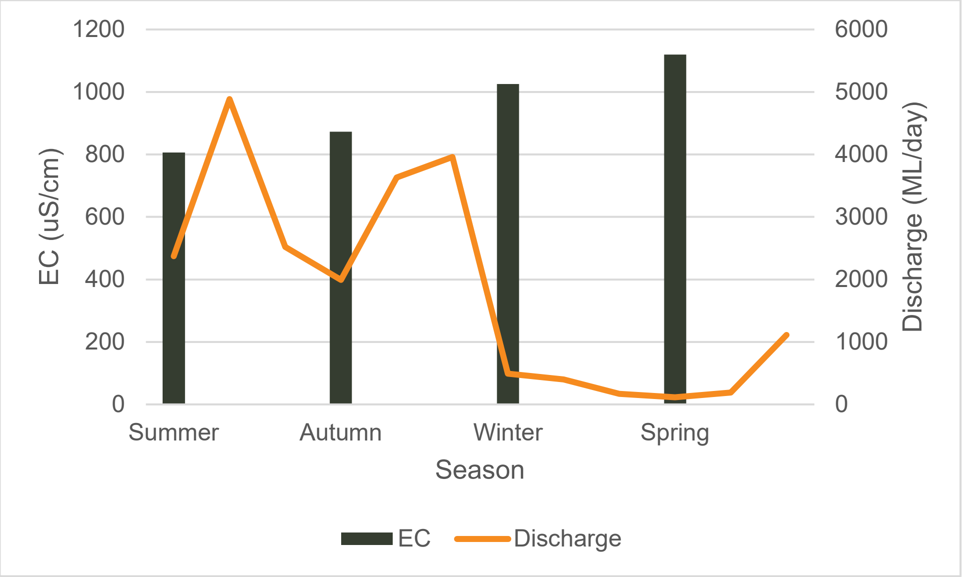


**Figure F1** Electrical conductivity (µs/cm) seasonality data (median) relative to seasonal distribution

**Figure note:**

Data available from period of 1988 – 2018

Summer (n=24), autumn (n=24), winter (n=25), spring (n=15)

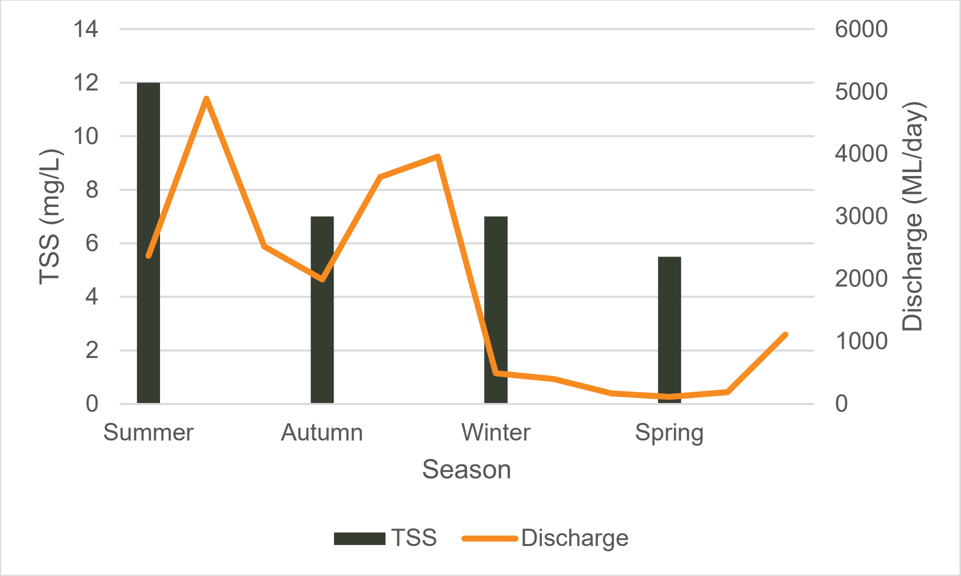


**Figure F2** Total suspended solids (mg/L) seasonality data (median) relative to seasonal distribution

**Figure note:**

Data available from period of 1988- 2018

Summer (n=26), autumn (n=21), winter (n=23), spring (n=13)

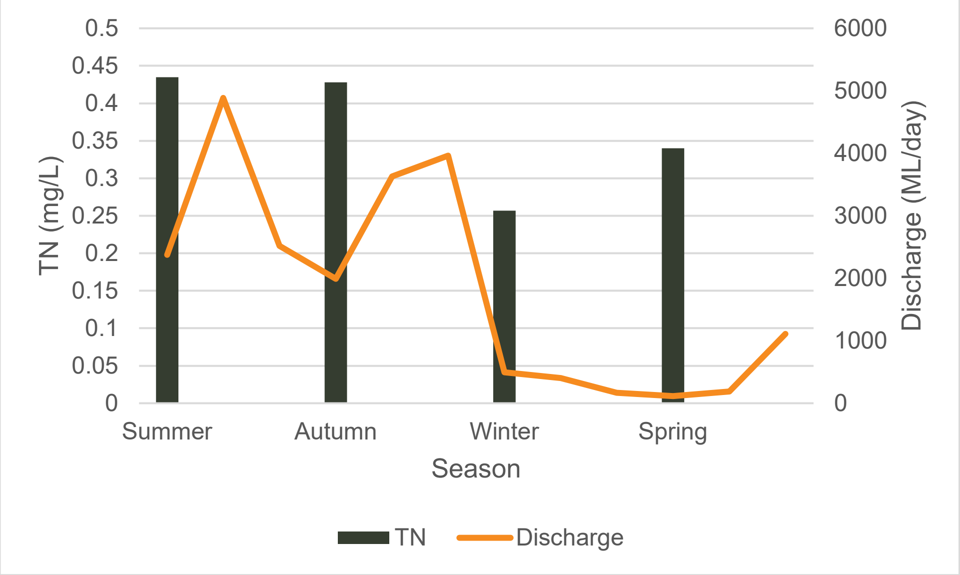


**Figure F3** Total nitrogen (mg/L) seasonality data (median) relative to seasonal distribution

**Figure note:**

Data available from period of 1988- 2018

Summer (n=16), autumn (n=18), winter (n=17), spring (n=14)

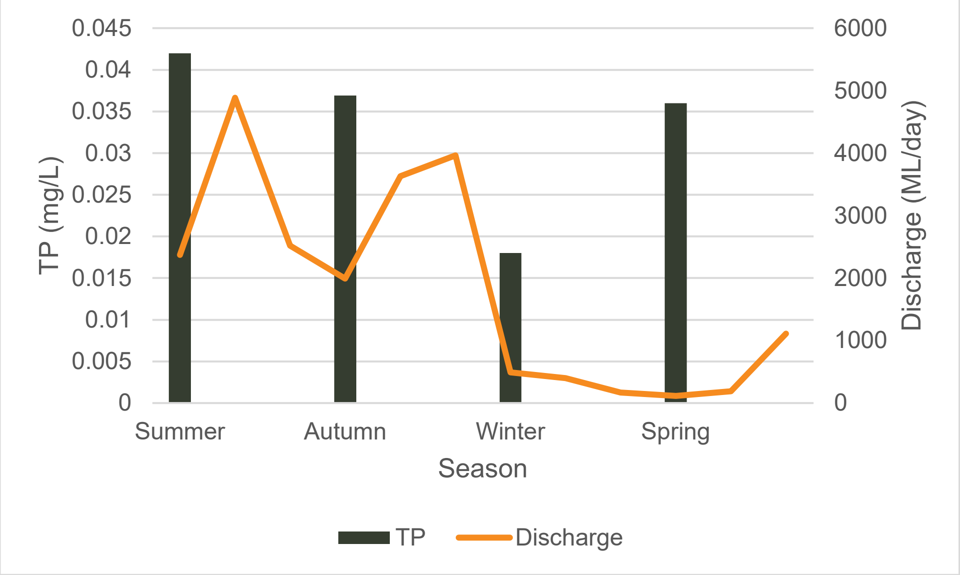


**Figure F4** Total phosphorus (mg/L) seasonality data (median) relative to seasonal distribution

**Figure note:**

Data available from period of 1988- 2018

Summer (n=20), autumn (n=21), winter (n=17), spring (n=13)

# Laidley Creek at Warrego Highway (143229A)

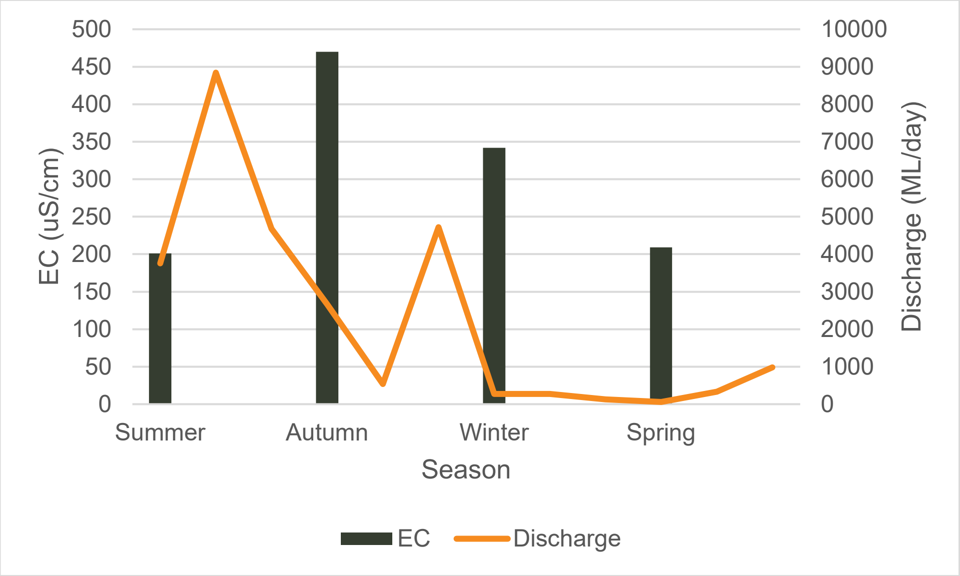


**Figure F5** Electrical conductivity (µS/cm) seasonality data (median) relative to seasonal distribution

**Figure note:**

Data available from period of 1991-2017

Summer (n=89), autumn (n=32), winter (n=29), spring (n=17)

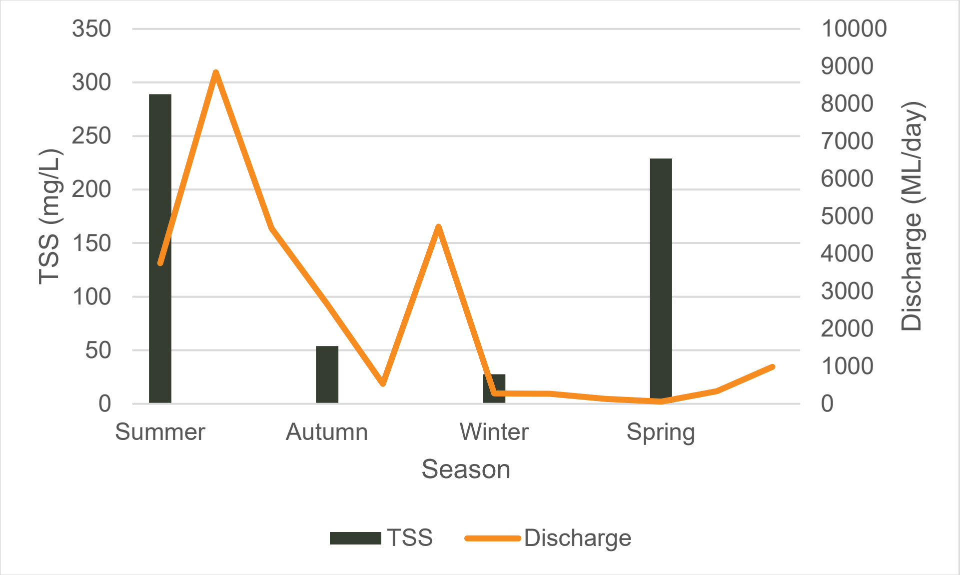


**Figure F6** Total suspended solids (mg/L) seasonality data (median) relative to seasonal distribution

**Figure note:**

Data available from period of 1991-2017

Summer (n=90), autumn (n=28), winter (n=26), spring (n=18)

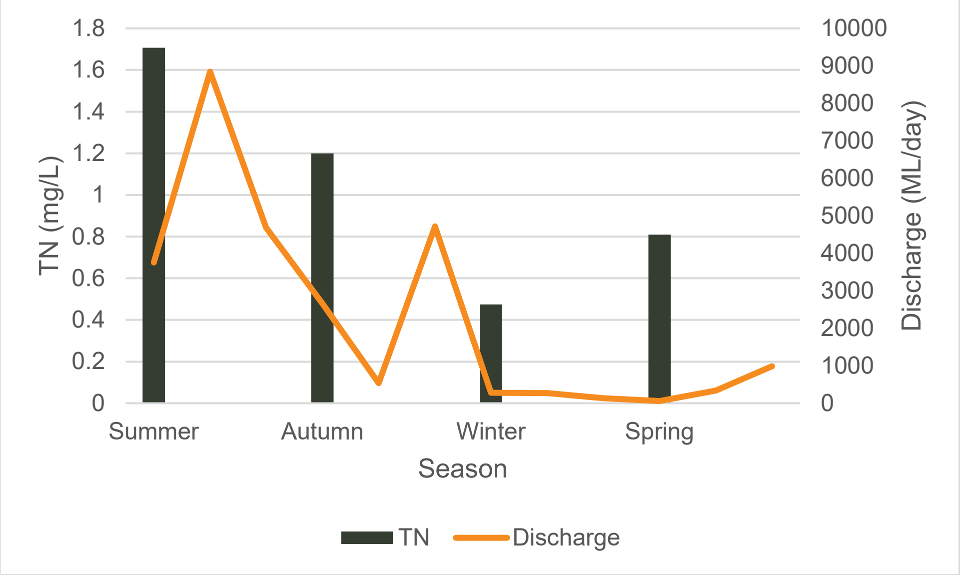


**Figure F7** **Total nitrogen (mg/L) seasonality data (median) relative to seasonal distribution**

**Figure note:**

Data available from period of 1988- 2018

Summer (n=10), autumn (n=7), winter (n=3), spring (n=3)

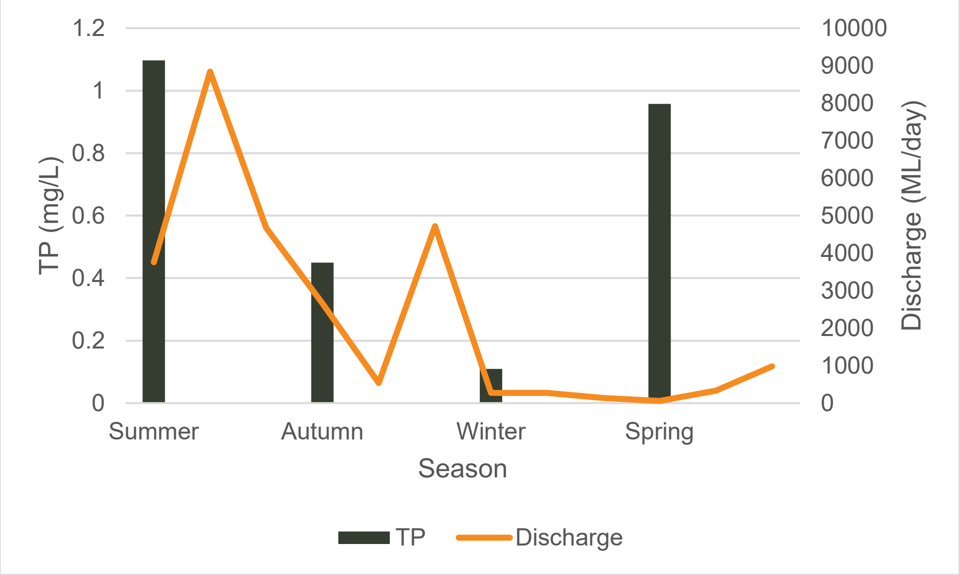


**Figure F8** **Total phosphorus (mg/L) seasonality data (median) to relative to seasonal distribution**

**Figure note:**

Data available from period of 1991-2018

Summer (n=33), autumn (n=8), winter (n=3), spring (n=16)

# Purga Creek at Loamside (143113A)

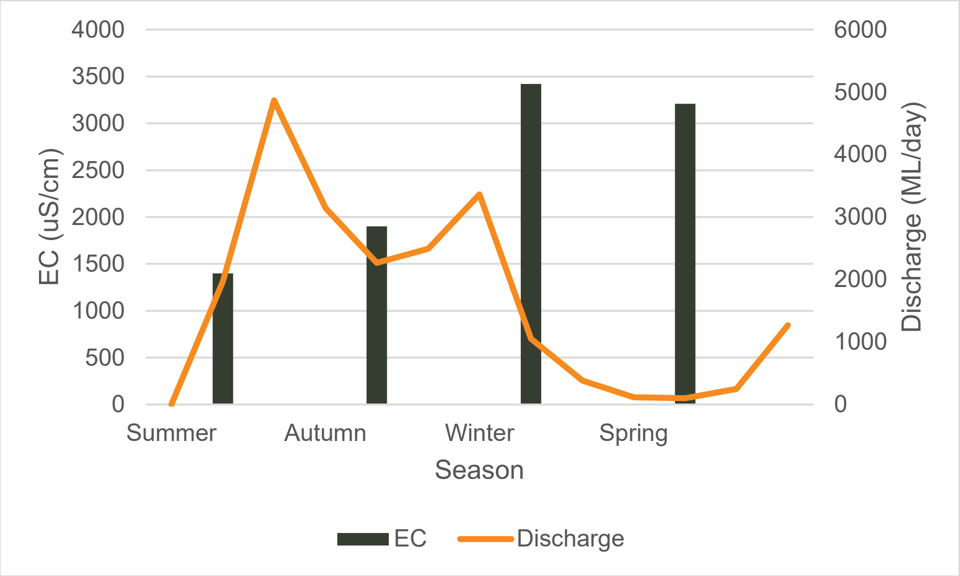


**Figure F9** Electrical conductivity (uS/cm) seasonality data (median) to relative seasonal distribution

**Figure note:**

Data available from period of 1974-2018

Summer (n=19), autumn (n=21), winter (n=17), spring (n=16)

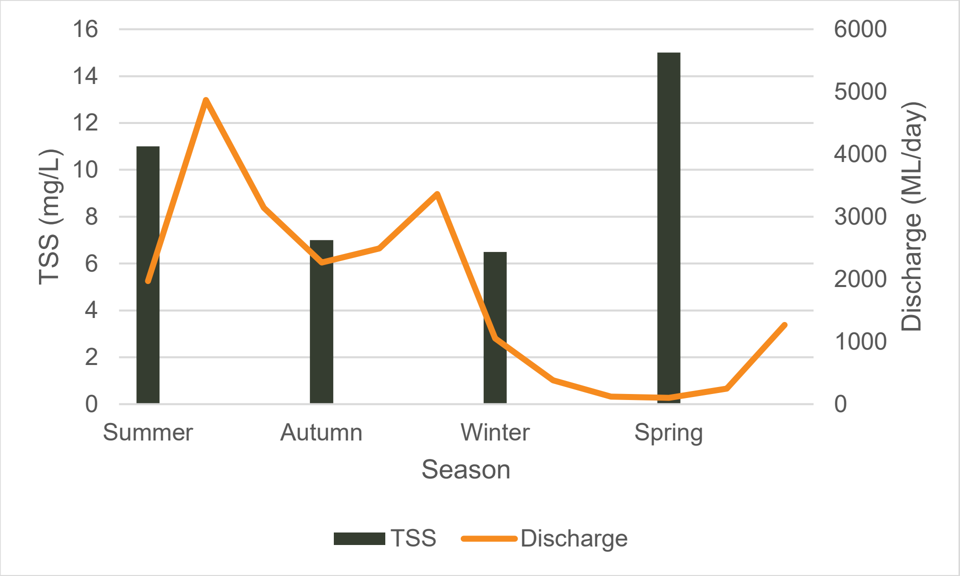


**Figure F10** Total suspended solids (mg/L) seasonality data (median) to relative seasonal distribution

**Figure note:**

Data available from period of 1974-2018

Summer (n=16), autumn (n=18), winter (n=15), spring (n=14)

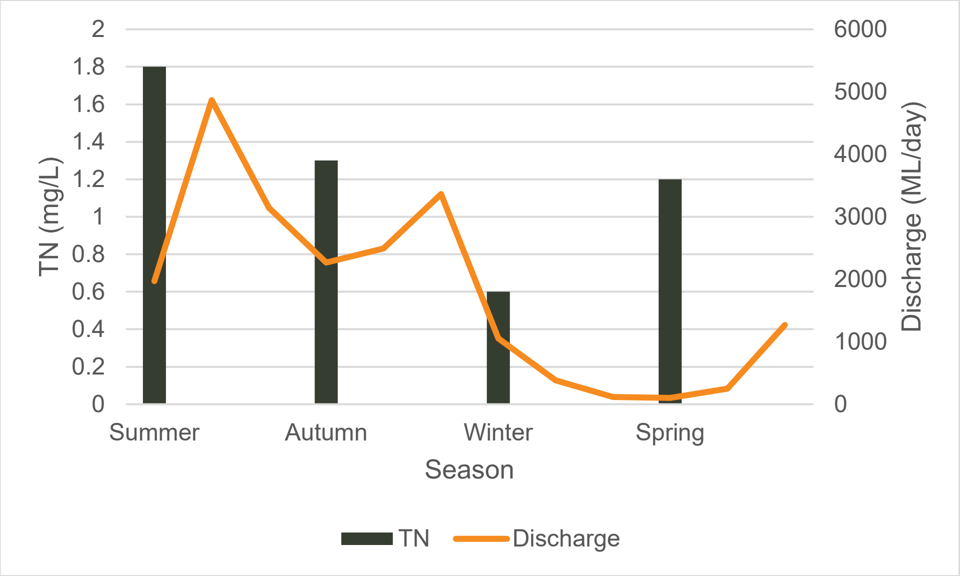


**Figure F11** Total nitrogen (mg/L) seasonality data (median) to relative seasonal distribution

**Figure note:**

Data available from period of 1974-2018

Summer (n=9), autumn (n=12), winter (n=8), spring (n=7)

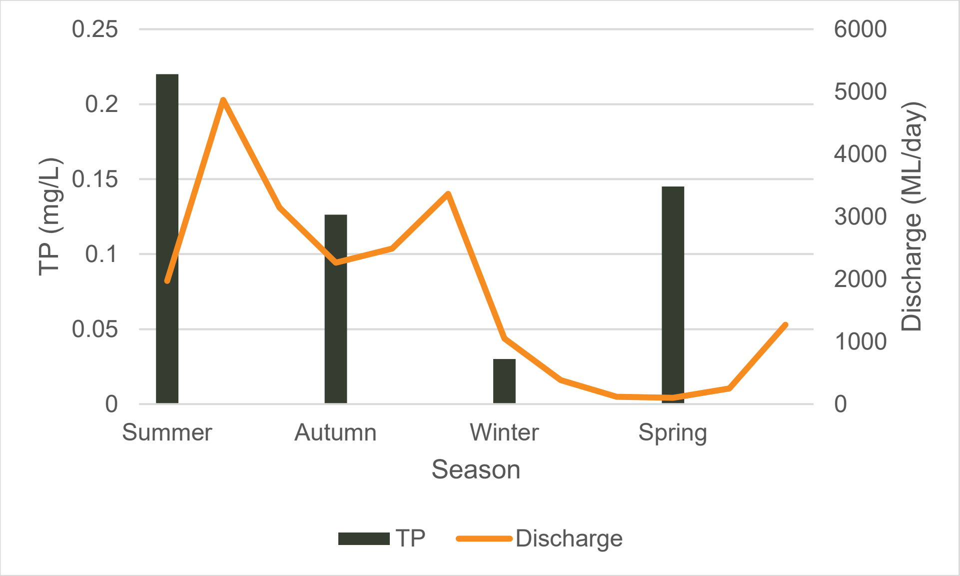


**Figure F12** Total phosphorus (mg/L) seasonality data (median) to relative seasonal distribution

**Figure note:**

Data available from period of 1974-2018

Summer (n=10), autumn (n=14), winter (n=8), spring (n=8)

# APPENDIX
# L

# Surface Water Quality Technical Report

## **Appendix G** Artificial Waterbodies

**HELIDON TO CALVERT** ENVIRONMENTAL IMPACT STATEMENT

IR_1381

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47

**Legend**

- 5 Chainage (km)
- ◉ Localities
- ┼ Existing rail
- ▬ H2C project alignment
- ― Define watercourses (Water Act 2000)
- ▬ Major roads
- ― Minor roads
- ⬚ Artificial waterbodies (approx. outline)
- ☐ EIS disturbance footprint

A3 scale: 1:3,500

0 0.025 0.05 0.075 0.1 0.125 km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 27/04/2020 Version: 0
Coordinate System: GDA 1994 MGA Zone 56

## Helidon to Calvert

## Appendix G-1(a):
## Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47

**Legend**

5 Chainage (km)
● Localities
▬ H2C project alignment
▬ Define watercourses (Water Act 2000)
▬ Major roads
▬ Minor roads
▭ Artificial waterbodies (approx. outline)
▭ EIS disturbance footprint

A3 scale: 1:3,500
0 0.025 0.05 0.075 0.1 0.125 km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 27/04/2020 Version: 0
Coordinate System: GDA 1994 MGA Zone 56

## Helidon to Calvert
## Appendix G-1(b): Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47

**Legend**

5 Chainage (km)
● Localities
▬ H2C project alignment
— Define watercourses (Water Act 2000)
▬ Major roads
— Minor roads
▭ Artificial waterbodies (approx. outline)
▭ EIS disturbance footprint

A3 scale: 1:3,500
0 0.025 0.05 0.075 0.1 0.125 km

Future Freight
Integrating Community, Environment and Engineering

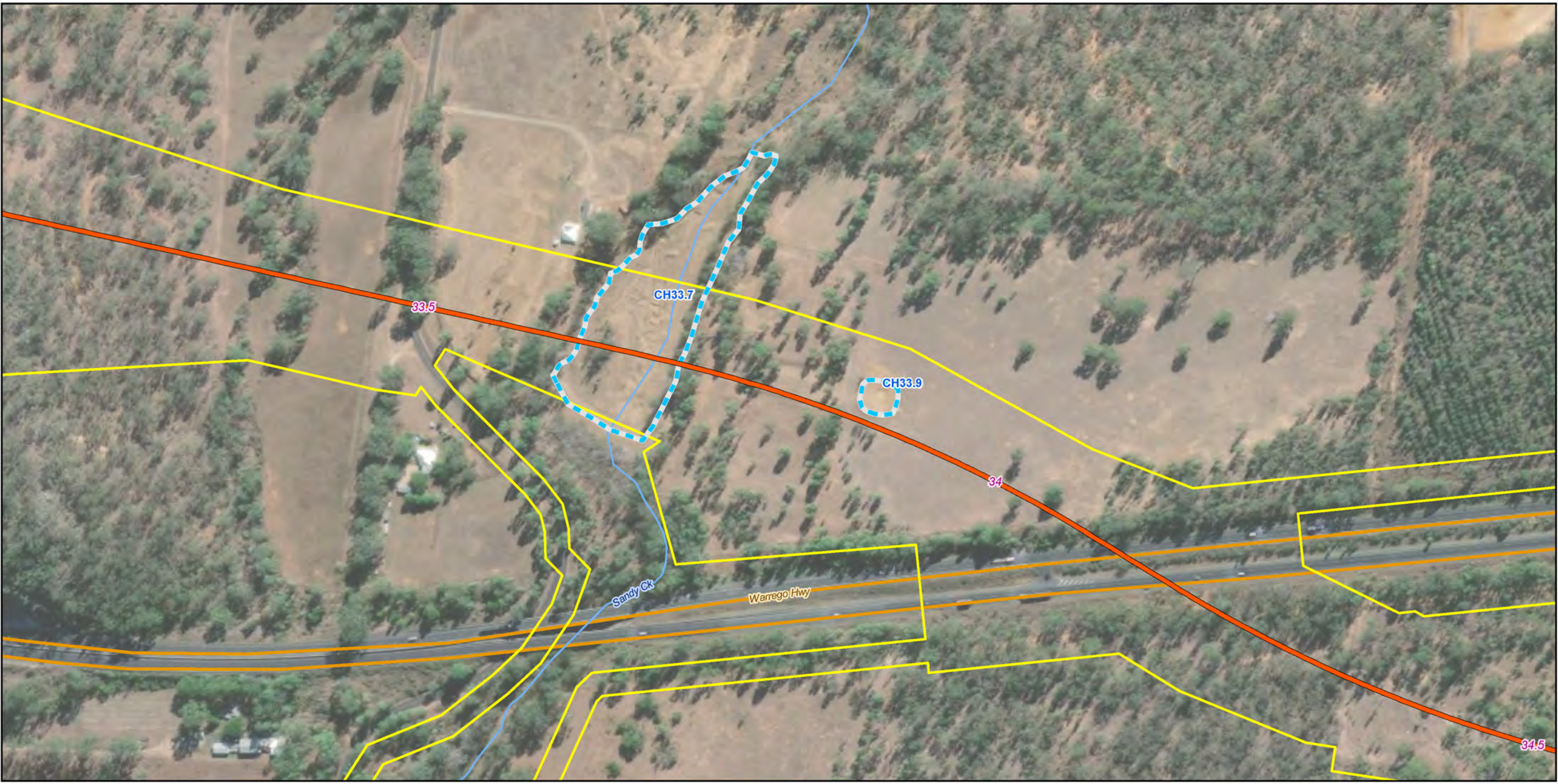
Issue date: 27/04/2020 Version: 0
Coordinate System: GDA 1994 MGA Zone 56

## Helidon to Calvert

## Appendix G-1(c): Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47



**Legend**

| | |
|---|---|
| 5 | Chainage (km) |
| ◉ | Localities |
| ▬ | H2C project alignment |
| — | Define watercourses (Water Act 2000) |
| ▬ | Major roads |
| — | Minor roads |
| ▭ | Artificial waterbodies (approx. outline) |
| ☐ | EIS disturbance footprint |

A3 scale: 1:3,500

0 0.025 0.05 0.075 0.1 0.125 km

Future Freight
Integrating Community, Environment and Engineering

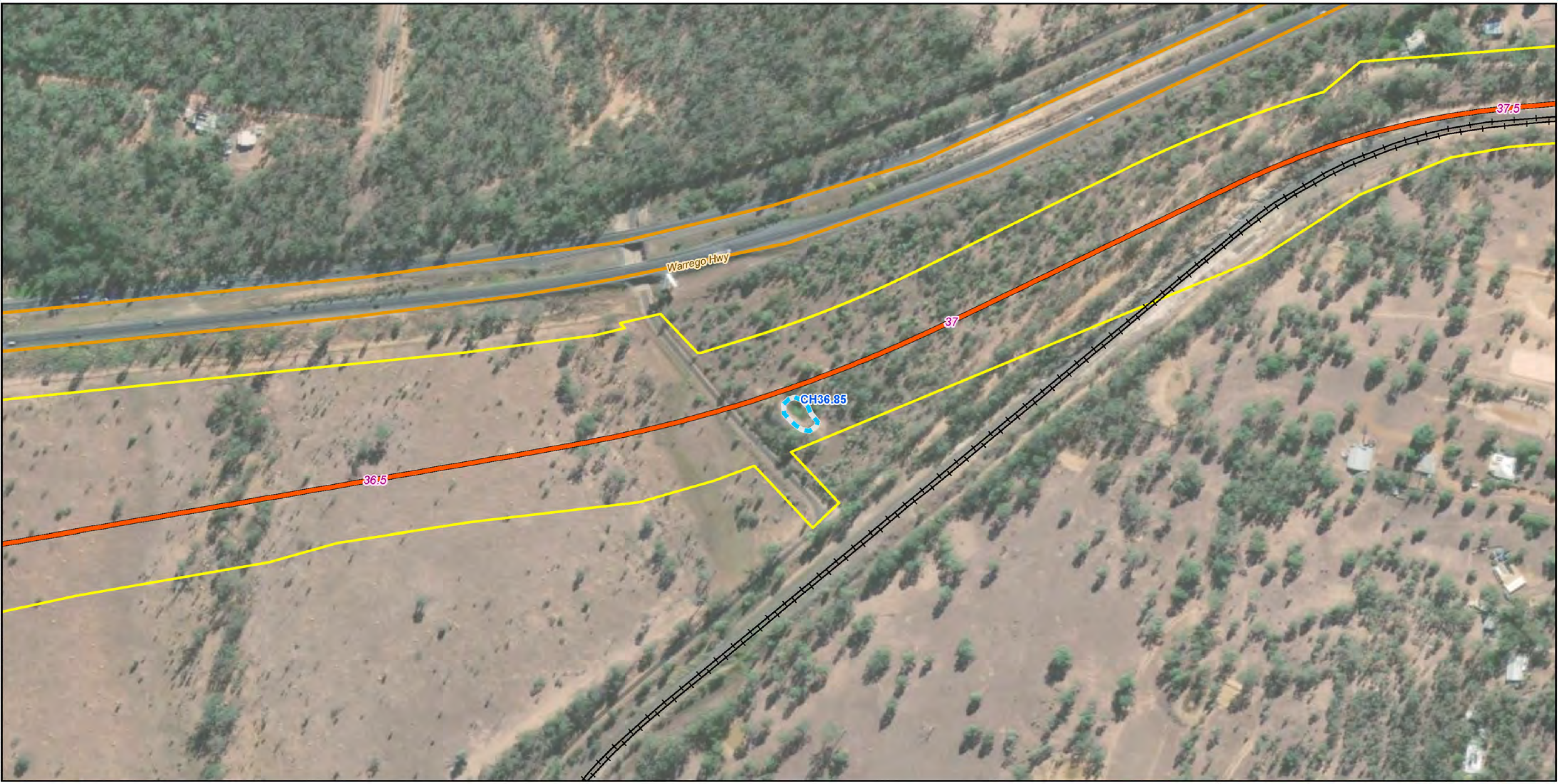
Issue date: 27/04/2020 Version: 0
Coordinate System: GDA 1994 MGA Zone 56

# Helidon to Calvert

## Appendix G-1(d):
## Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47



**Legend**

| | |
|---|---|
| 5 | Chainage (km) |
| ◉ | Localities |
| ┼ | Existing rail |
| ▬ | H2C project alignment |
| — | Define watercourses (Water Act 2000) |
| ▬ | Major roads |
| — | Minor roads |
| ⬚ | Artificial waterbodies (approx. outline) |
| ☐ | EIS disturbance footprint |

A3 scale: 1:3,500

0 0.025 0.05 0.075 0.1 0.125km

Future Freight
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Issue date: 27/04/2020 Version: 0
Coordinate System: GDA 1994 MGA Zone 56

# Helidon to Calvert
## Appendix G-1(e):
## Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47

**Legend**

- 5 Chainage (km)
- ◉ Localities
- ┼ Existing rail
- 🟥 H2C project alignment
- — Define watercourses (Water Act 2000)
- — Major roads
- — Minor roads
- ▨ Artificial waterbodies (approx. outline)
- ☐ EIS disturbance footprint

A3 scale: 1:3,500

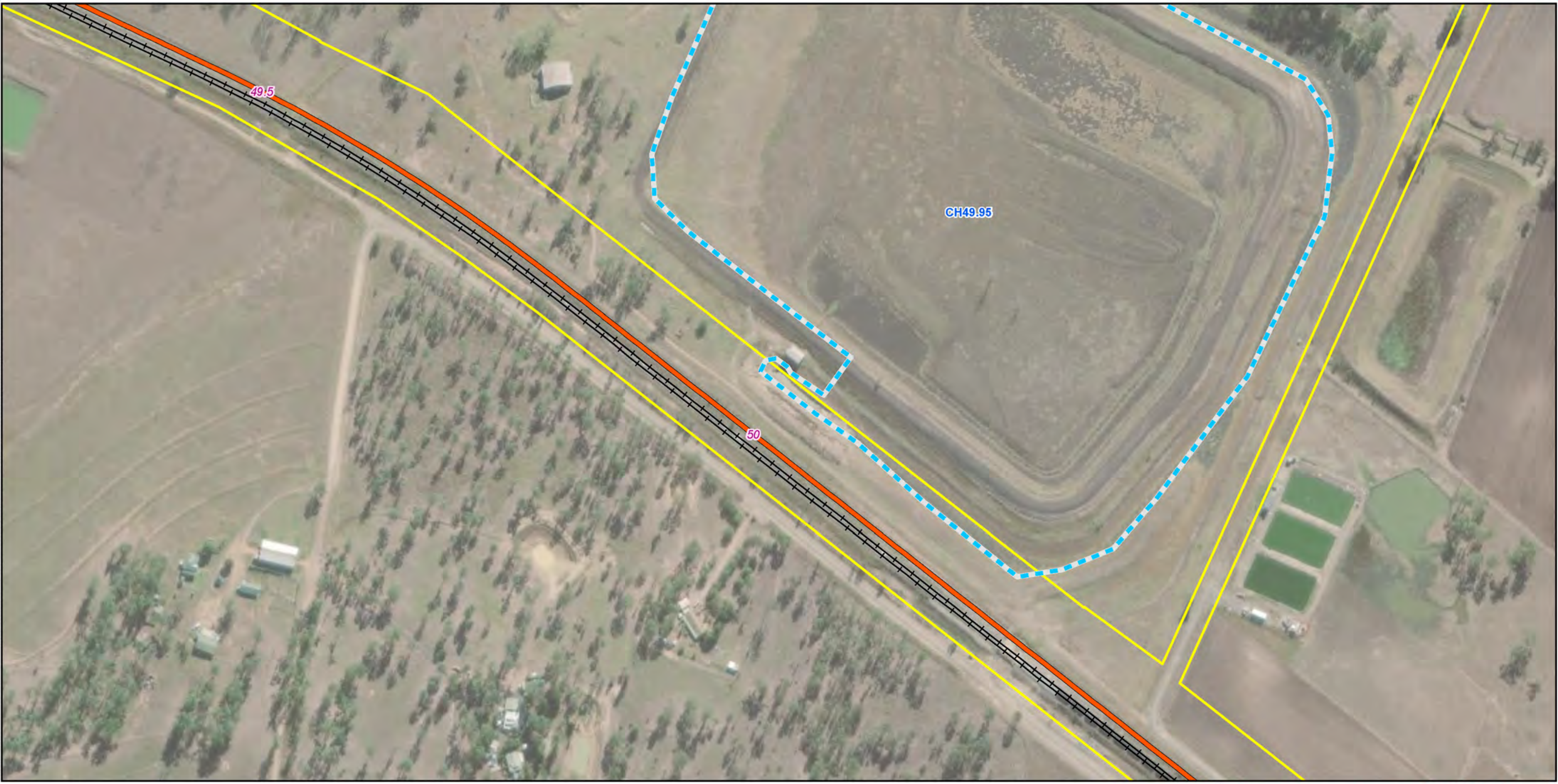
0 0.025 0.05 0.075 0.1 0.125 km

Future Freight
Integrating Community, Environment and Engineering

Issue date: 27/04/2020 Version: 0
Coordinate System: GDA 1994 MGA Zone 56

# Helidon to Calvert
## Appendix G-1(f): Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47

**Legend**

| | |
|---|---|
| 5 | Chainage (km) |
| ◉ | Localities |
| ┼ | Existing rail |
| ▬ | H2C project alignment |
| ― | Define watercourses (Water Act 2000) |
| ▬ | Major roads |
| ― | Minor roads |
| ▭ | Artificial waterbodies (approx. outline) |
| ▭ | EIS disturbance footprint |

A3 scale: 1:3,500

0 0.025 0.05 0.075 0.1 0.125km

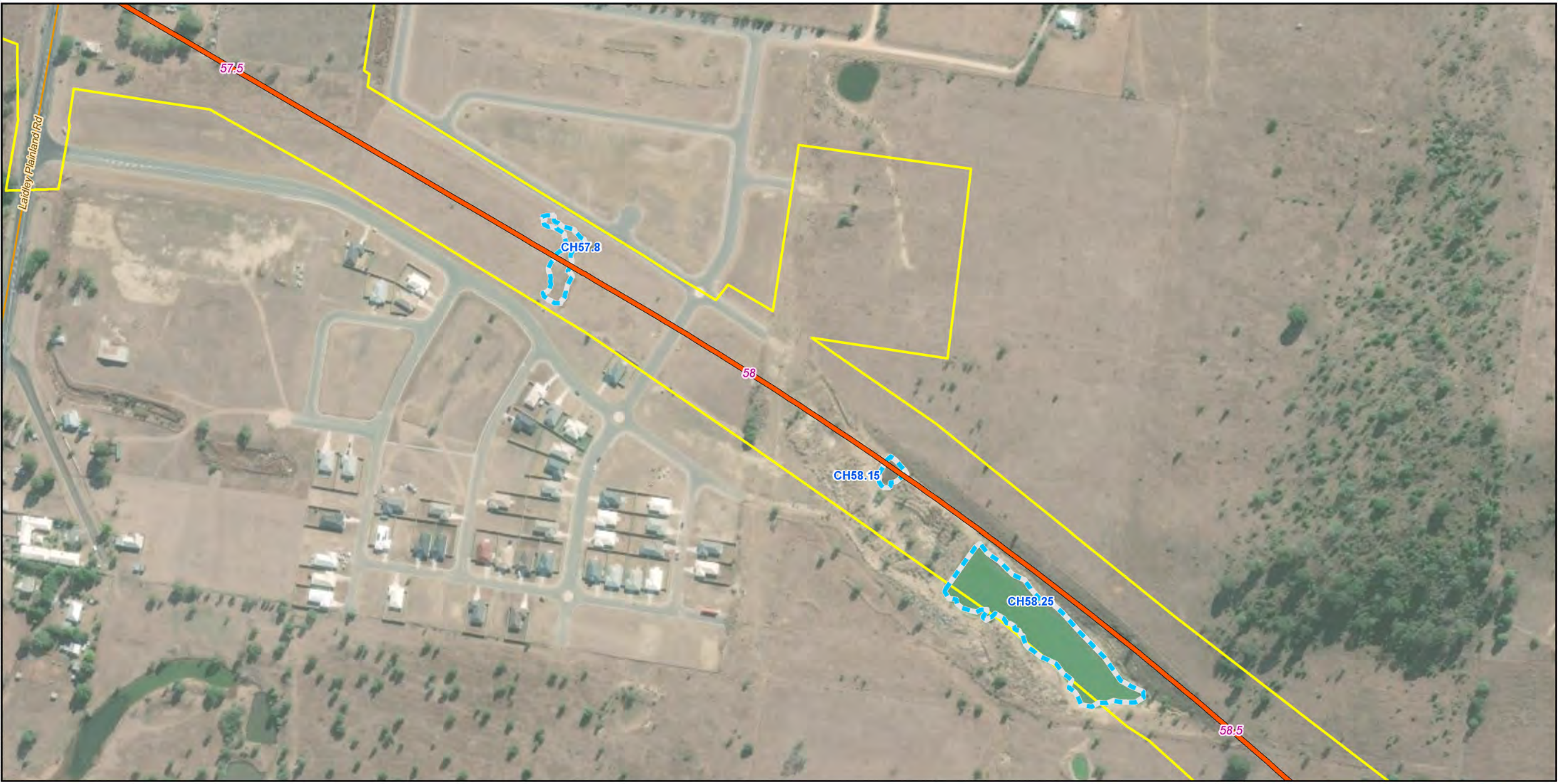
Issue date: 27/04/2020 Version: 0

Coordinate System: GDA 1994 MGA Zone 56

# Helidon to Calvert

# Appendix G-1(g): Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47

**Legend**

- 5 Chainage (km)
- ● Localities
- ▬ H2C project alignment
- ― Define watercourses (Water Act 2000)
- ▬ Major roads
- ― Minor roads
- ▭ Artificial waterbodies (approx. outline)
- ▭ EIS disturbance footprint

A3 scale: 1:3,500

0 0.025 0.05 0.075 0.1 0.125 km

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Issue date: 27/04/2020 Version: 0
Coordinate System: GDA 1994 MGA Zone 56

# Helidon to Calvert
## Appendix G-1(h): Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47

**Legend**

- 5 Chainage (km)
- ◉ Localities
- H2C project alignment
- Define watercourses (Water Act 2000)
- Major roads
- Minor roads
- Artificial waterbodies (approx. outline)
- EIS disturbance footprint

A3 scale: 1:3,500

0 0.025 0.05 0.075 0.1 0.125 km

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Coordinate System: GDA 1994 MGA Zone 56

## Helidon to Calvert

## Appendix G-1(i):
## Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47

**Legend**

| | |
|---|---|
| 5 | Chainage (km) |
| ◉ | Localities |
| ┼ | Existing rail |
| ▬ | H2C project alignment |
| ─ | Define watercourses (Water Act 2000) |
| ─ | Major roads |
| ─ | Minor roads |
| ▭ | Artificial waterbodies (approx. outline) |
| ▭ | EIS disturbance footprint |

A3 scale: 1:3,500

0 0.025 0.05 0.075 0.1 0.125 km

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Coordinate System: GDA 1994 MGA Zone 56

# Helidon to Calvert
# Appendix G-1(j):
# Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47

**Legend**

| | |
|---|---|
| 5 | Chainage (km) |
| ◉ | Localities |
| ┼ | Existing rail |
| ▬ | H2C project alignment |
| ― | Define watercourses (Water Act 2000) |
| ▬ | Major roads |
| ― | Minor roads |
| ▢ | Artificial waterbodies (approx. outline) |
| ▢ | EIS disturbance footprint |

A3 scale: 1:3,500

0 0.025 0.05 0.075 0.1 0.125 km

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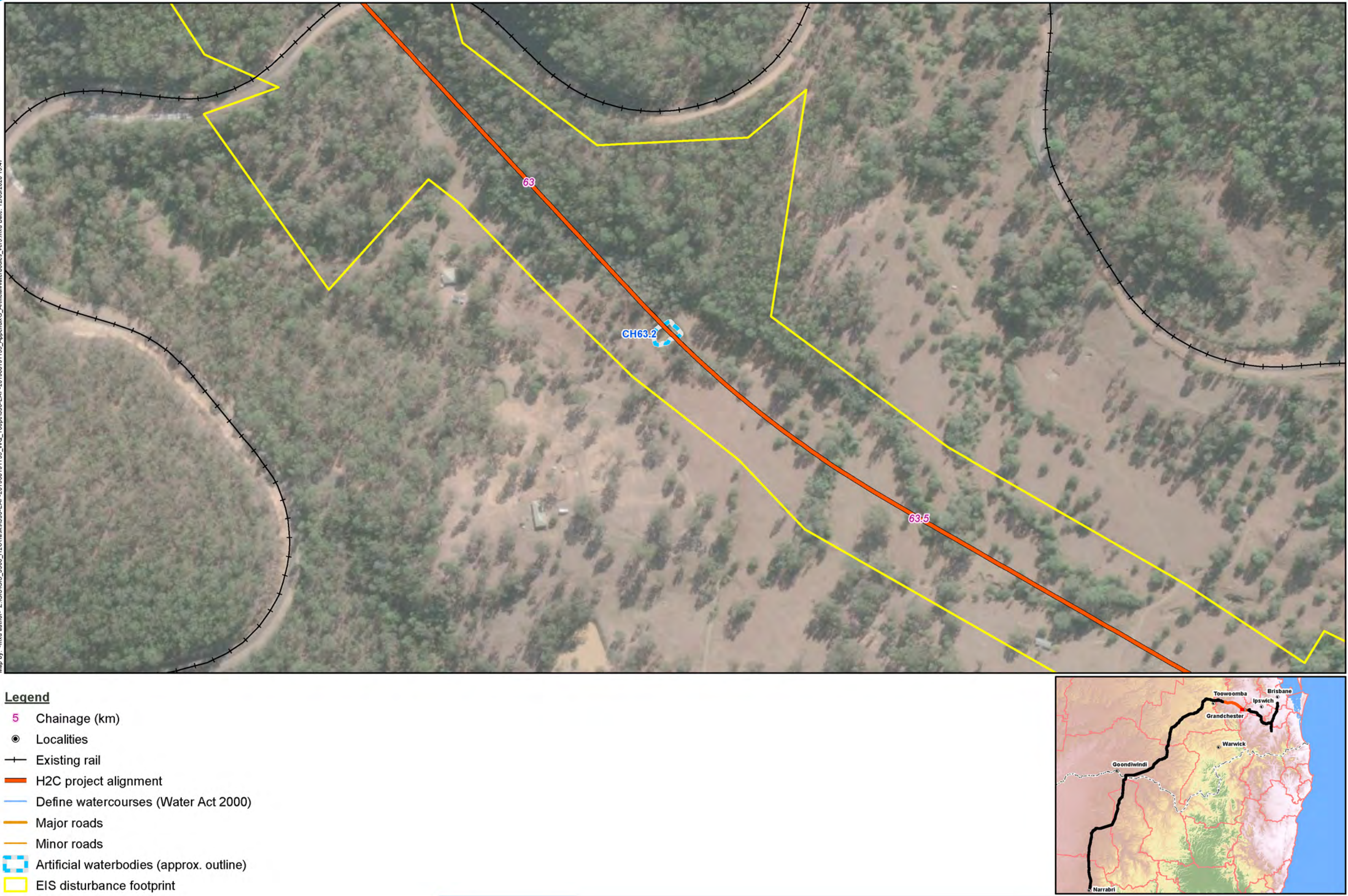
Coordinate System: GDA 1994 MGA Zone 56

## Helidon to Calvert
## Appendix G-1(k): Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47



**Legend**

- 5 Chainage (km)
- ◉ Localities
- ┼ Existing rail
- ▬ H2C project alignment
- ▬ Define watercourses (Water Act 2000)
- ▬ Major roads
- ▬ Minor roads
- ▭ Artificial waterbodies (approx. outline)
- ▭ EIS disturbance footprint

A3 scale: 1:3,500

0 0.025 0.05 0.075 0.1 0.125 km

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# Helidon to Calvert

## Appendix G-1(l): Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47

**Legend**

| | |
|---|---|
| 5 | Chainage (km) |
| ◉ | Localities |
| —+— | Existing rail |
| — | H2C project alignment |
| — | Define watercourses (Water Act 2000) |
| — | Major roads |
| — | Minor roads |
| ▭ | Artificial waterbodies (approx. outline) |
| ▭ | EIS disturbance footprint |

A3 scale: 1:3,500

0 0.025 0.05 0.075 0.1 0.125km

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Coordinate System: GDA 1994 MGA Zone 56

# Helidon to Calvert
## Appendix G-1(m): Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47

**Legend**

- 5 Chainage (km)
- ● Localities
- ┼ Existing rail
- ▬ H2C project alignment
- ─ Define watercourses (Water Act 2000)
- ▬ Major roads
- ─ Minor roads
- ▭ Artificial waterbodies (approx. outline)
- ▭ EIS disturbance footprint

A3 scale: 1:3,500

0 0.025 0.05 0.075 0.1 0.125 km

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## Helidon to Calvert
## Appendix G-1(n): Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47

**Legend**

- 5 Chainage (km)
- ◉ Localities
- ┼ Existing rail
- ━ H2C project alignment
- ─ Define watercourses (Water Act 2000)
- ━ Major roads
- ─ Minor roads
- ▭ Artificial waterbodies (approx. outline)
- ▭ EIS disturbance footprint

A3 scale: 1:3,500

0 0.025 0.05 0.075 0.1 0.125 km

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Coordinate System: GDA 1994 MGA Zone 56

# Helidon to Calvert
# Appendix G-1(o):
# Artificial/constructed waterbodies

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map by: <mxd author> Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\330-EAP-201908191155_AppendixG_ArtificialWaterbodies_ver5.mxd Date: 12/03/2020 15:47

**Legend**

- 5 Chainage (km)
- ◉ Localities
- ┼ Existing rail
- ▬ H2C project alignment
- ― Define watercourses (Water Act 2000)
- ▬ Major roads
- ― Minor roads
- ▭ Artificial waterbodies (approx. outline)
- ▭ EIS disturbance footprint

A3 scale: 1:3,500

0 0.025 0.05 0.075 0.1 0.125 km

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Coordinate System: GDA 1994 MGA Zone 56

# Helidon to Calvert
# Appendix G-1(p):
# Artificial/constructed waterbodies

# APPENDIX

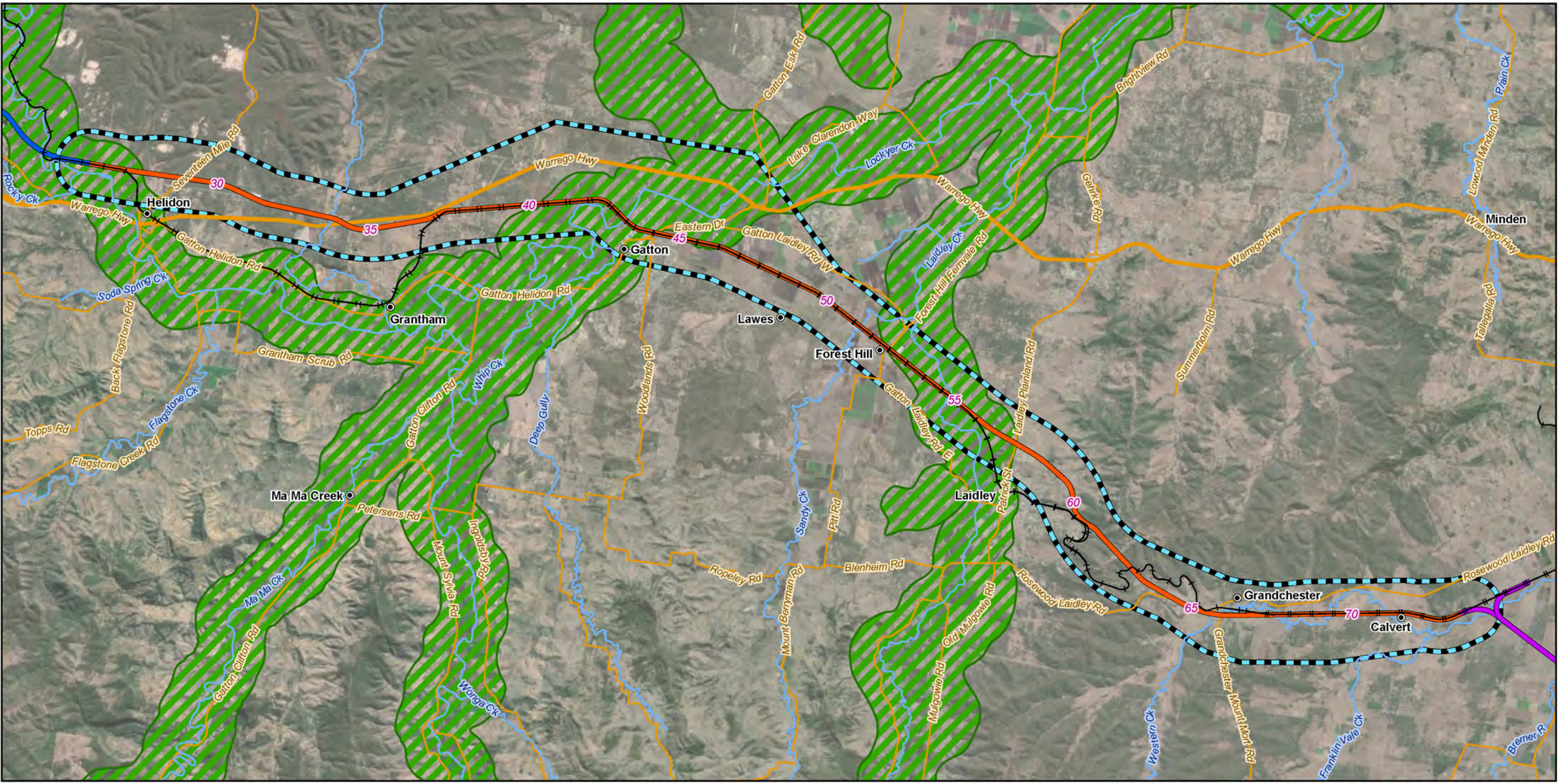
# L

# Surface Water Quality Technical Report

## **Appendix H** South East Queensland Water Supply Buffer Area

**HELIDON TO CALVERT** ENVIRONMENTAL IMPACT STATEMENT

IR_1381



Map by: NCW / DTH Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201908191155_WQ_100pc\Check\330-EAP-201908191155_Fig1.2_WaterAct_Rev1.mxd Date: 5/03/2020 10:12

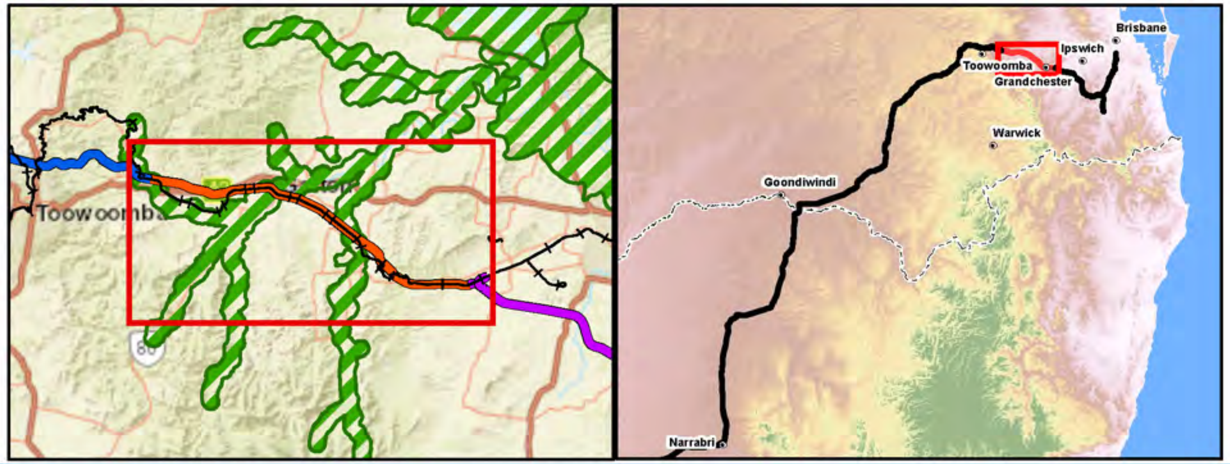
**Legend**

- 5 Chainage (km)
- ● Localities
- Existing rail
- G2H project alignment
- H2C project alignment
- C2K project alignment
- Defined watercourses (Water Act 2000)
- Major roads
- Minor roads
- Water quality study area
- ▨ Water Supply Buffer Area (SPP)

An approximation of the "Environment & Heritage > Water Quality > Water Supply Buffer Areas" layer on the publicly viewable Queensland Government State Planning Policy Interactive Mapping System viewed on 16-Jan-2020 has been superimposed for this figure.

Please refer to the interactive webmap to view the official published data.

*https://spp.dsdip.esriaustraliaonline.com.au /geoviewer/map/planmaking*



A3 scale: 1:130,000

0 1 2 3 4 5km

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Issue date: 27/02/2020 Version: 0
Coordinate System: GDA 1994 MGA Zone 56

## Helidon to Calvert

## Appendix H-1:
## Proximity of Project to water supply buffer area