Technical Paper 7 – Supplementary Water Quality and Watercourse Assessment

Newcastle Inner City Bypass
Rankin Park to Jesmond

April 2018

NSW GOVERNMENT

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Aurecon Australasia Pty Ltd

Newcastle Inner City Bypass - Rankin Park to Jesmond

Technical Paper 7 - Supplementary Water Quality and Watercourse Assessment

April 2018

Executive summary

Roads and Maritime Services (Roads and Maritime) is seeking approval to construct the fifth section of the Newcastle Inner City Bypass between Rankin Park and Jesmond (the project). The project would involve the construction of about 3.4 kilometres of new four lane divided road between Lookout Road at New Lambton Heights and Newcastle Road at Jesmond.

The approval is sought under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

In accordance with the Secretary's Environmental Assessment Requirements (SEARs) and Supplementary SEARs, an environmental impact statement (EIS) was prepared by Roads and Maritime in November 2016 (*Newcastle Inner City Bypass – Rankin Park to Jesmond Environmental Impact Statement* (Roads and Maritime Services 2016) to assess the potential impacts of the project. The EIS was exhibited by the Department of Planning and Environment (DP&E) for 30 days from 16 November 2016 to 16 December 2016.

A *Water Quality and Watercourse Assessment* (GHD 2016) was prepared in support of the EIS for the project. The objective of the assessment was to assess potential watercourse impacts and water quality issues from the project operation and construction, and where required, identify feasible and reasonable management measures.

Following exhibition of the EIS, receipt of submissions and further consultation with stakeholders a number of design refinements have been made to the project. The main design refinements are:

- The hospital Interchange would now be a full interchange with both north and south facing ramps
- Improved pedestrian and cyclist facilities including grade separation of the Jesmond Park shared path and refinement to the shared path connections to the shared path bridge over Newcastle Road
- Refinement and inclusion of additional water quality treatment measures with permanent operational water quality structures increased from five to eight
- Construction work:
  - New/adjusted construction compounds including access and utility connections
  - Refinement of the proposed extended construction hours to limit construction activities carried out during the morning.

This supplementary assessment has been prepared to assess the potential impacts of the project, including the design refinements. This supplementary assessment only includes information that has changed since the EIS and should be read in conjunction with the *Water Quality and Watercourse Assessment* (GHD 2016).

Construction of the project will be managed in accordance with a surface water strategy and controls that have been developed in accordance with the *Managing Urban Stormwater: Main road construction, Volume 2D* (DECC 2008) and *Managing Urban Stormwater: Soils and Construction* – Volume 1, 4th Edition (Landcom 2004). With the implementation of the strategy and controls construction of the project is unlikely to result in a substantial or significant impact to local or downstream receiving water quality.

The potential water quality impacts to the local receiving waters and wider catchments of the SEPP 14 and Ramsar wetlands during the operational stage of the project have been assessed via MUSIC modelling. The analysis indicates that the project is unlikely to have an appreciable impact on the water quality. This is in part due to the proposed stormwater management strategy and controls, which includes capturing most of the potentially impacted surface water and treating it via proposed operational water quality treatment structures that assist in removing TSS, TN and TP from the stormwater runoff. The modelling and assessment demonstrates that it is considered unlikely that the project would result in a substantial or significant impact on the quality of water flowing into the SEPP 14 and Ramsar wetlands, and is therefore considered to be consistent with the associated *Significant impact guidelines 1.1: Matters of National Environmental Significance* (DotE 2013).

Overall it is considered that the project is likely to result in no appreciable impacts to the water quality of the local receiving waters or the SEPP 14 and Ramsar wetlands.

Glossary and acronyms

Term / acronym	Description
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
Blue Book	*Managing Urban Stormwater, Soils and Construction, Volume 1 4th Edition, March 2004* (Landcom 2004) and *Managing Urban Stormwater, Volume 2D – Main road construction* (Department of Environment and Climate Change (DECC) 2008)
DECC	Department of Environment and Climate Change
EC	Electrical conductivity
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
mg/L	Milligrams per litre
NCC	Newcastle City Council
OEH	NSW Office of Environment and Heritage
SEARs	Secretary's Environmental Assessment Requirements
SEPP 14	State environmental planning policy no. 14 – Coastal wetlands
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids

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1. Introduction

1.1 The project

1.1.1 Overview

Roads and Maritime Services (Roads and Maritime) is seeking approval to construct the fifth section of the Newcastle Inner City Bypass between Rankin Park and Jesmond (the project). The approval is sought under Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The project would involve the construction of about 3.4 kilometres of new four lane divided road between Lookout Road at New Lambton Heights and Newcastle Road at Jesmond. The project is located in the Newcastle local government area, about 11 kilometres west of the Newcastle central business district and about 160 kilometres north of Sydney (Figure 1-1).

In accordance with the Secretary's Environmental Assessment Requirements (SEARs) and Supplementary SEARs, an environmental impact statement (EIS) was prepared by Roads and Maritime in November 2016 (*Newcastle Inner City Bypass – Rankin Park to Jesmond Environmental Impact Statement* (Roads and Maritime Services 2016) to assess the potential impacts of the project. The EIS was exhibited by the Department of Planning and Environment (DP&E) for 30 days from 16 November 2016 to 16 December 2016.

Following exhibition of the EIS, receipt of submissions and further consultation with stakeholders a number of design refinements have been made to the project.

The key features of the project (Figure 1-2) now include:

- New road with two lanes in each direction, separated by a median
- Three interchanges, consisting of:
  - Northern interchange providing access to Newcastle Road and the existing Jesmond to Shortland section of the Newcastle Inner City Bypass. The full interchange provides all movements to/from the bypass and Newcastle Road
  - Hospital interchange providing access between John Hunter Hospital precinct and the bypass. The full interchange provides all movements to/from the bypass
  - Southern interchange providing access to Lookout Road and the existing Kotara to Rankin Park section of the Newcastle Inner City Bypass. The bypass would travel under McCaffrey Drive. The half interchange provides connection in both directions on Lookout Road
- Structures along the road to allow for drainage, animal and bushwalker access
- Tie in and upgrades to connecting roads, including Lookout Road, McCaffrey Drive and Newcastle Road
- Large cut and fill embankments due to steep and undulating terrain
- Pedestrian and cycling facilities, including a shared path bridge over Newcastle Road and grade separation of the existing east-west Jesmond Park shared path at the northern interchange
- Noise barriers and/or architectural treatment, as required
- Permanent operational water quality measures

Ancillary work to facilitate construction of the project (Figure 1-3), including:

- Adjustment, relocation and/or protection of public utilities and services
- Mine subsidence treatment, as required
- Temporary construction facilities, including sedimentation basins, compounds and stockpile sites
- Temporary and permanent access tracks
- Concrete/asphalt batching plant, as required

1.1.2 Design refinements

There are two types of design refinements:

- Main design refinements
- Minor design refinements

Main design refinements

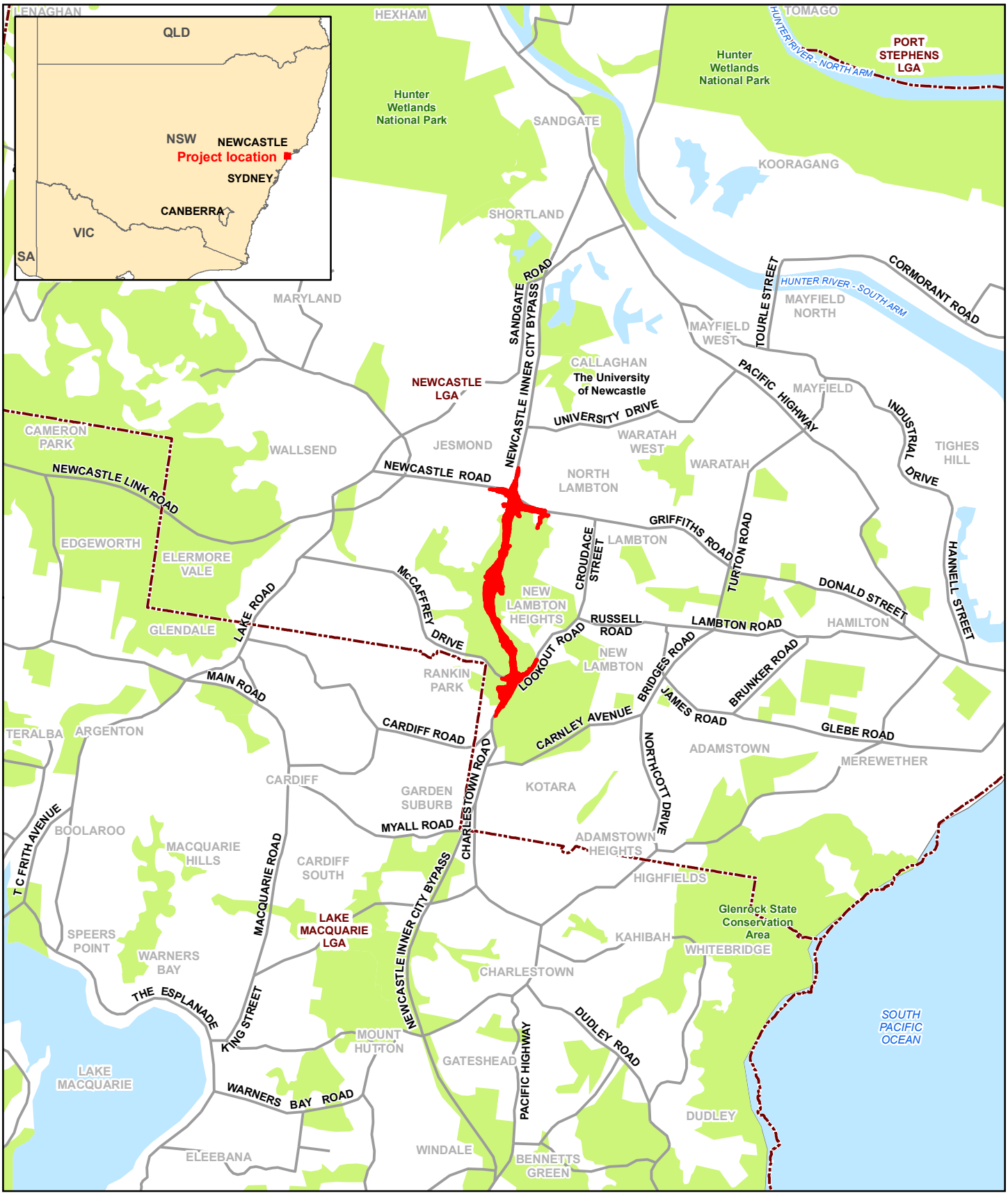
The main design refinements are:

- Hospital Interchange layout:
  - The addition of south-facing ramps results in a full interchange with both north and south facing ramps, providing access between the bypass and the hospital precinct
- Pedestrian and cyclist facilities
  - Jesmond Park shared path – an overpass bridge (Bridge 8) and underpass arrangement would now be provided at the northern interchange to provide an east-west grade separated shared path for both pedestrians and cyclists
  - Hospital interchange – the shared path crossing of the southbound off-ramp would now be controlled by traffic lights
  - Southern interchange – a new northbound cycleway connection from Lookout Road to the bypass would be provided for on-road cyclists
  - Southern interchange – a new southbound cycleway crossing controlled by traffic lights would be provided from the bypass to Lookout Road for on-road cyclists
  - McCaffrey Drive – the proposed pedestrian footpath on the northern side would now be replaced with a wider shared path for use by both pedestrians and cyclists
  - Lookout Road and McCaffrey Drive intersection – the pedestrian crossings on the left turn lane from McCaffrey Drive onto Lookout Road, and across Lookout Road would now both be shared path crossings controlled by traffic lights
  - Shared path bridge over Newcastle Road – the connections either side of the shared path bridge (Bridge 7) over Newcastle Road have been refined to improve connectivity with existing shared paths
- Water quality treatment structures:
  - Refinement and inclusion of additional treatment measures with permanent operational water quality structures increased from five to eight
- Construction work:
  - New/adjusted construction compounds including access and utility connections
  - Refinement of the proposed extended construction hours to limit construction activities carried out during the morning

Minor design refinements

The minor design refinements are mostly as a result of the main design refinements and are:

- Bridges
  - Adjustments to the cross section of Bridge 2 to allow for the McCaffrey Drive shared path
  - Widening of Bridge 3 to allow for the full hospital interchange
- Flooding and drainage:
  - Refinement of the proposed flood mitigation work near the northern interchange, to allow for the grade separation of the Jesmond Park shared path
  - Adjustments to the project drainage design to reflect other design refinements
- Cuttings and embankments:
  - Adjustments to the estimated cut and fill volumes required for the project to reflect other design refinements
- Proposed road corridor:
  - Minor adjustments to the proposed road corridor to reflect other design refinements
- Property acquisition:
  - Minor adjustments to the property acquisition requirements for the project to reflect other design refinements
- Noise mitigation work:
  - Adjustments to the preliminary operational noise mitigation scenario
- Directional signage:
  - Addition of directional signage on the surrounding road network
- Construction work:
  - Minor adjustments to the construction footprint to reflect other design refinements
  - Minor adjustments to potential construction lease areas to reflect other design refinements
  - Adjustments to earthworks, erosion and sediment control and construction materials to reflect other design refinements
  - Refinement of the early work construction activities.



LEGEND

- The Project
- Road
- Local government area
- National Parks and Wildlife Service Estate and bushland reserves
- Watercourse area

Paper Size A4

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Rankin Park to Jesmond
Supplementary Water Quality and Watercourse Assessment

Job Number 22-17656
Revision 0
Date 16 Apr 2018

Project locality

Figure 1-1

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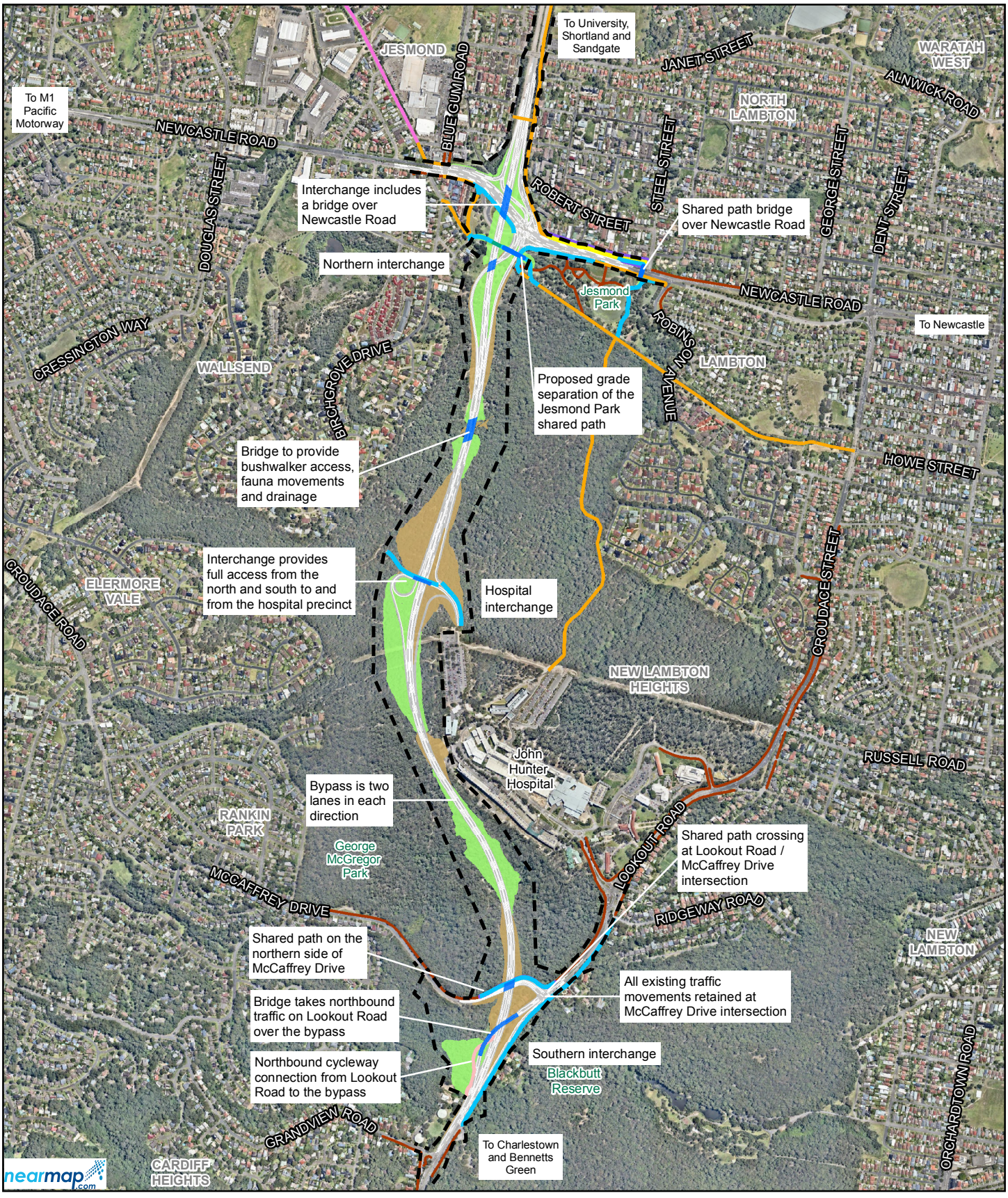
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

Data source: Geoscience Australia: 250k Topographic Series 3, 2012; Aurecon: The project, 2015; LPI: DTDB, 2006. Created by: fmackay



LEGEND

- Design
- Pavement
- Bridge
- Earthworks cut
- Earthworks fill
- Proposed road corridor
- Existing on-road cycleway
- Existing shared path
- Proposed shared path
- Proposed on-road cycleway
- Proposed shared path underpass
- Proposed northbound cycleway connection
- Existing footpath
- Proposed footpath

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Rankin Park to Jesmond Supplementary Water Quality and Watercourse Assessment

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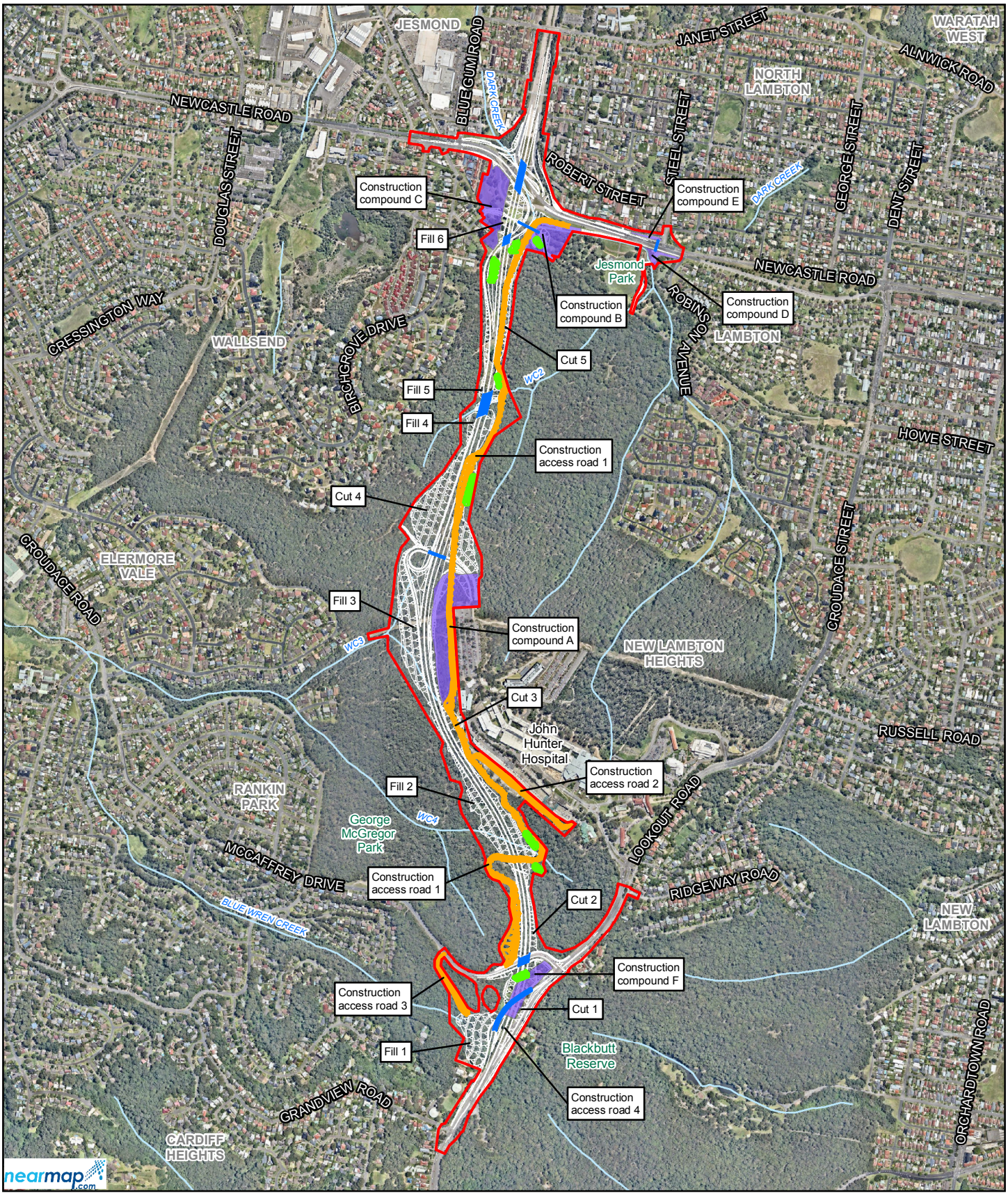
Project overview

Figure 1-2

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\17656\GIS\Maps\Deliverables\Supplementary_WaterQuality\2217656_SWQ002_ProjectOverview_0.mxd

Data source: RMS: Project corridor, 2016; Aurecon: Design / cycleways, 2016; Nearmap: Aerial Imagery, 20160331; LPI: DTDB, 2012. Created by: fmackay



LEGEND

- Construction footprint
- Construction compound
- Construction access tracks
- Construction sedimentation basin
- Design
- Bridge
- Watercourse

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Rankin Park to Jesmond Supplementary Water Quality and Watercourse Assessment

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Construction ancillary facilities

Figure 1-3

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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Data source: Nearmap: Aerial Imagery, 20160331; Aurecon: Construction footprint/ Design / Water quality structures, 2016; LPI: DTDB, 2012. Created by: tmorton, fmackay

1.2 Purpose of this report

A *Water Quality and Watercourse Assessment* (GHD 2016) was prepared in support of the EIS for the project. The objective of the assessment was to assess potential watercourse impacts and water quality issues from the project operation and construction, and where required, identify feasible and reasonable management measures. The assessment was prepared to address the Secretary's Environmental Assessment Requirements (SEARs) and Supplementary SEARs as described in Section 1.4 of the Water Quality and Watercourse Assessment (GHD 2016).

This supplementary assessment has been prepared to assess the potential impacts of the project, including the design refinements described in Section 1.1. This supplementary assessment only includes information that has changed since the EIS and should be read in conjunction with the *Water Quality and Watercourse Assessment* (GHD 2016).

1.3 Relevant legislation and guidelines

This supplementary report has been prepared with consideration of relevant legislation and guidelines detailed in *Water Quality and Watercourse Assessment* (GHD 2016) and the following:

- *NSW Water Quality and River Flow Objectives* (OEH 2006), which define agreed environmental values and long-term goals for NSW's surface waters. The values defined for the Hunter River for protection of aquatic ecosystems have been adopted for the assessment and are consistent with the framework for assessing water quality provided by ANZECC and ARMCANZ (2000a).
- Newcastle City Council *Development Control Plan* (NCC 2012) supplements the *Newcastle Local Environmental Plan 2012* and provides additional information that should be taken into account when preparing a Development Application. It should be noted that the project does not require a Development Application to be submitted and therefore the requirements of the *Development Control Plan* do not strictly apply. However, the relevant water treatment targets requirements have been considered in this supplementary assessment.

2. Existing environment

2.1 Overview

Section 2 of the *Water Quality and Watercourse Assessment* (GHD 2016) provides a detailed description of the existing environment within which the project is located including topography, catchments, surface water quality, groundwater aquifers and quality and watercourse geomorphology.

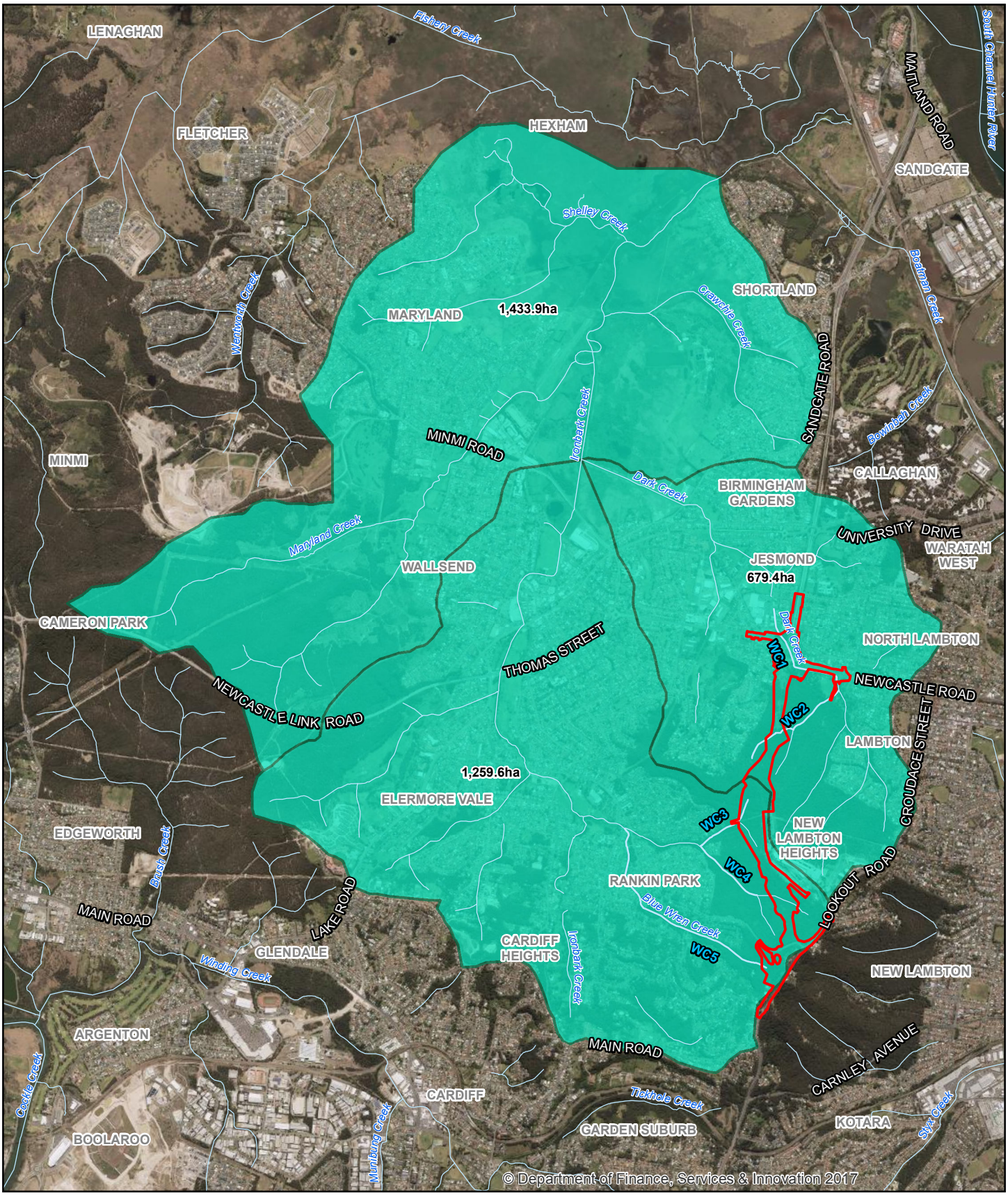
The project is located in the upper reaches of the Ironbark Creek catchment and its tributary, Dark Creek (Figure 2-1). A small portion also extends into the Styx Creek catchment on the ridgeline along which Lookout Road is located.

The lower reaches of the Ironbark Creek catchment contain extensive areas of wetlands associated with the Hunter River floodplain (Figure 2-2):

- Hunter Estuary Wetlands Ramsar site (EPBC Act) – this is comprised of the Kooragang Nature Reserve (located on the north arm of the Hunter River) and Shortland Wetlands which is located about six kilometres downstream of the project.
- Hunter Wetlands Nature Reserve (NSW *National Parks and Wildlife Act 1974*) – this site is comprised of a number of areas on the south and north arms of the Hunter River, the nearest of which is about six kilometres downstream of the project. This area is also mapped as a nationally important wetland.
- There are a number of areas mapped under *State environmental planning policy no. 14 – Coastal wetlands* (SEPP 14) on the south and north arms of the Hunter River, the nearest of which is about three kilometres downstream of the project.

These catchments are dominated by residential, commercial, industrial and agricultural land uses, which along with substantially modified channels, result in generally poor water quality.

The tributaries of Ironbark Creek and Dark Creek located in the bushland area through which the project passes are ephemeral and consist of both steep narrow channels and less defined flat sections that are exhibiting signs of scour and erosion (including gully erosion) in several locations.



LEGEND

- Construction footprint
- Watercourse
- Catchments

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Ironbark Creek catchment

Figure 2-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\17656\GIS\Maps\Deliverables\Supplementary_WaterQuality\2217656_SWQ004_IronbarkCreek_Catchment_0.mxd

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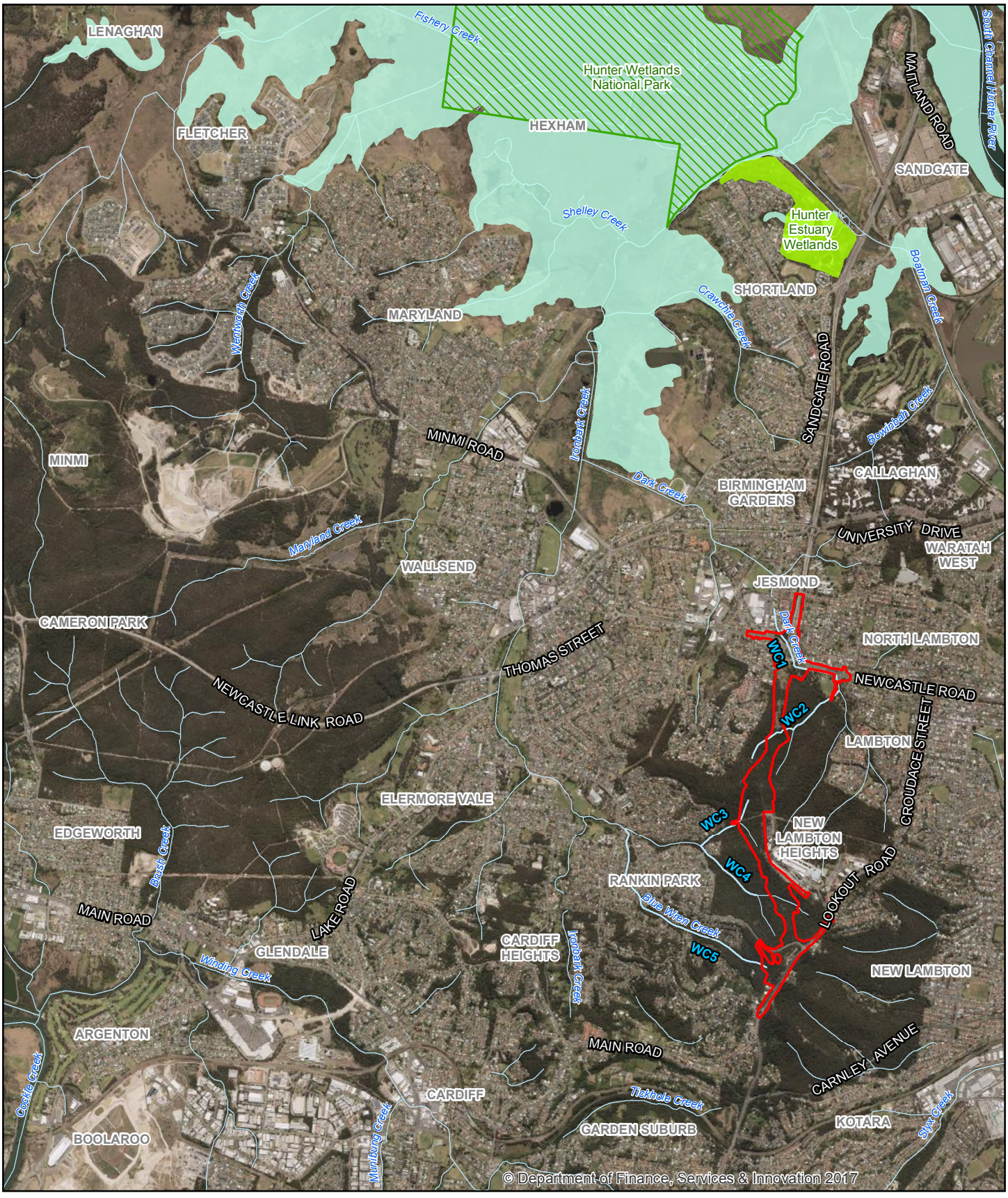

LEGEND

- Construction footprint
- Watercourse
- Hunter Estuary Wetlands - Ramsar
- State Environmental Planning Policy no. 14 - Coastal Wetlands
- Hunter Wetlands National Park

Paper Size A4

0 325 650 975 1,300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Rankin Park to Jesmond
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Study Area

Figure 2-2

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

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Data source: Geoscienece Australia: Natioanl Park, 2006; DSEWPaC: Ramsar Wetland, 2008, CANRI: SEPP14, 2008; Aurecon: Construction footprint, 2016; LPI: Aerial imagery, 2015. LPI: DCDB\DTDB, 2012. Created by: tmorton, fmackay

2.2 Water quality objectives

ANZECC and ARMCANZ (2000a) provides a method of determining local water quality triggers against which to monitor the impacts of a development or activity. In lieu of detailed existing local water quality data, ANZECC and ARMCANZ (2000a) provide default water quality triggers for a range of ecosystems, from high conservation/ecological value systems to highly disturbed ecosystems. It should be noted that trigger values are intended to be applied at the receiving waterway and not at the point of discharge from the project site. As a result, any analysis of the impacts of the development is required to consider existing development within the catchment.

The project is located within the upper catchment area of Ironbark Creek (including Dark Creek). The upper catchment areas of these watercourses are ephemeral. Out of the construction footprint and down gradient where the watercourses contain permanent water flow, they are considered to be slightly to moderately disturbed, passing through reserve areas in close proximity to residential areas. Further downstream, these watercourses are considered to be highly disturbed ecosystems, being largely concrete lined and/or maintained for flood management purposes. For slightly to moderately disturbed and highly disturbed ecosystems, ANZECC and ARMCANZ (2000a) recommends the adoption of the 95 per cent aquatic species protection level for metals and trigger values for NSW coastal rivers.

Further downstream lies Ramsar and SEPP 14 wetlands. Wetlands are considered to be high conservation/ecological values systems. For such systems, ANZECC and ARMCANZ (2000a) recommends the adoption of the 99 per cent aquatic species protection level for metals and trigger values for NSW estuaries.

Given the extensive areas of existing development between the project and the Ramsar and SEPP 14 wetlands (Figure 2-2), it is not possible to isolate the water impacts to the wetlands associated with the project from those associated with the balance of the urbanised catchment. Table 2-1 summarises the proposed water quality triggers for the creeks and wetlands downstream of the project.

Table 2-1 Default trigger values (ANZECC/ARMCANZ 2000a)

Parameter	Default trigger values (mg/L) Creeks	Default trigger values (mg/L) Wetlands
Total suspended solids (TSS)	6[(a)(b)]	6[(a)(b)]
NOx as N	0.040[(a)]	0.040[(a)]
Total nitrogen as N (TN)	0.35[(a)(b)]	0.30[(a)(b)]
Filterable reactive phosphorus as P	0.02[(a)]	0.005[(b)]
Total phosphorus as P (TP)	0.025[(a)]	0.030[(b)]
Copper	0.0014[(c)]	0.0003[(d)]
Nickel	0.011[(c)]	0.007[(d)]
Lead	0.0034[(c)]	0.0022[(d)]
Zinc	0.008[(c)]	0.007[(d)]

(a) NSW coastal rivers.

(b) NSW estuaries.

(c) 95 per cent protection, fresh. Apply to dissolved concentrations.

(d) 99 per cent protection, marine. Apply to dissolved concentrations.

In addition to the default trigger values for wetlands, the Commonwealth Department of the Environment (DotE) (now the Commonwealth Department of the Environment and Energy) provides guidance on determining the significance of impacts on Ramsar wetlands in *Significant impact guidelines 1.1: Matters of National Environmental Significance* (DotE 2013). The Commonwealth Department of the Environment (2013) specifies that for a declared Ramsar wetland, a significant impact is one which has a 'real chance of a substantial and measurable change in the water quality of the wetland'.

The NSW Water Quality Objectives define agreed environmental values and long-term goals for NSW's surface waters (OEH 2006). The values defined for the Hunter River for protection of aquatic ecosystems have been adopted for the assessment. The adopted water quality objectives for estuaries and catchments that are affected by urban development (OEH 2006) are listed in Table 2-2. Objective values have been defined for both creeks and for estuaries (wetlands). The objective values are consistent with ANZECC and ARMCANZ (2000a) default trigger values (Table 2-1).

Table 2-2 Hunter River water quality objectives for protection of aquatic ecosystems (OEH 2006)

Parameter	Numerical criteria (mg/L) Creeks	Numerical criteria (mg/L) Estuaries
Total nitrogen as N (TN)	0.35	0.30
Total phosphorus as P (TP)	0.025	0.030

While they do not directly apply to the project, consideration has also been given to Newcastle City Council *Development Control Plan* (NCC 2012) water quality targets (Table 2-3). The targets are percentage reduction to the loads expected from a development with stormwater treatment measures compared to a development without stormwater treatment measures.

Table 2-3 NCC Development Control Plan water quality targets (NCC 2012)

Parameter	Target
Total suspended solids	85% reduction in the average annual load of total suspended solids
Total nitrogen	45% reduction in the average annual load of total nitrogen
Total phosphorus	65% reduction in the average annual load of total phosphorus
Gross pollutants	90% reduction in the average annual load of gross pollutants (>5 mm)
Hydrocarbons	100% removal

3. Impact assessment

3.1 Construction impacts

The construction of the project will include the establishment of temporary construction access tracks and compound areas, demolition of existing buildings and structures, clearing and mulching of vegetation, earthworks including cutting and filling and minor realignment of a section of ephemeral creek; and construction of bridges.

Each of these construction elements has the potential to impact on water quality or watercourse geomorphology, both within and immediately downstream of the project (ie local impacts) and further downstream at the SEPP 14 / Ramsar wetlands (ie sensitive receiving environment). Potential risks and impacts of the construction elements were discussed in Section 3.1 of the *Water Quality and Watercourse Assessment* (GHD 2016) and these are still relevant for the refined design.

Water quality impacts will be managed in accordance with the management strategy outlined in Section 4, which would be further developed during detailed design. Mitigation measures in Section 5 will also be implemented to minimise the potential impacts. As such, the potential for substantial or significant impacts to the downstream environment, including the SEPP 14 and Ramsar wetlands, during construction are considered to be minimal.

3.2 Operation impacts

The project will include a sealed road surface with associated drainage infrastructure (open concrete drains, concrete pit and pipes, grass swales, etc) that collects stormwater runoff and groundwater seepage and discharges it into local ephemeral watercourses. These discharges have the potential to impact the downstream water quality as a result of the discharge of pollutants that accumulate on the road surface and associated areas and altered flows causing erosion and scouring within the downstream watercourses.

Water quality modelling has been carried out for the project, including the design refinements described in Section 1.1. Potential water quality impacts will be managed in accordance with the management strategy outlined in Section 4, which would be further developed during detailed design. Mitigation measures in Section 5 will also be implemented to minimise the potential impacts. Overall it is considered that the project is unlikely to result in a substantial or significant impact to the water quality of the local catchments and the SEPP 14 and Ramsar wetlands during operation.

3.2.1 Water quality modelling

MUSIC modelling was carried out to estimate the impact of the project on pollutant (TSS, TP and TN) concentrations within both the local catchment and the downstream sensitive receiving environment.

The changing land usages within the project area were represented using the pollutant source node types and the associated parameters (Table 3-1) from *Draft NSW MUSIC Modelling Guidelines* (BMT WBM 2010):

- Existing conditions were modelled using “forest” nodes as this was considered to be a reasonable representation of the existing conditions within the project area.
- Operational conditions were modelled using “sealed road” nodes.

Areas outside of the project were modelled as mixture of residential, commercial and industrial areas.

In addition to considering the design refinements, the modelling carried out for this supplementary assessment has been refined to provide greater definition between sealed surfaces (eg road surfaces) and vegetated areas (eg rehabilitated batters and vegetated swales) for both the project and the broader catchment. This has resulted in refinements to the existing conditions previously presented in the EIS.

Table 3-1 Average pollutant source concentrations

Land use/surface type	TSS (mg/L)	TP (mg/L)	TN (mg/L)
Base flow			
Residential	16	0.1	1.3
Commercial	16	0.1	1.3
Industrial	16	0.1	1.3
Forest	6	0.0	0.3
Sealed roads (including verge)	16	0.1	1.3
Sealed roads (excluding verge)	0 (a)	0 (a)	0 (a)
Unsealed roads	16	0.1	1.3
Storm flow			
Residential	141	0.3	2.0
Commercial	141	0.3	2.0
Industrial	141	0.3	2.0
Forest	40	0.1	0.9
Sealed roads (including verge)	269	0.5	2.2
Sealed roads (excluding verge)	141	0.3	2.0
Unsealed roads	1000	0.5	2.2

(a) no base flow from sealed roads.

Land usage influences the generation of runoff and pollutant concentrations. Within areas that are relatively undisturbed, runoff and pollutant volumes are typically lower as they are less likely to be generated and if mobilised, are more likely to be re-incorporated into the environment by existing (eg natural) infiltration and absorption processes. Developed areas include impervious areas, which typically result in a higher proportion of rainfall becoming runoff, with a higher concentration of mobilised pollutants. Once mobilised, these can be removed by existing (eg natural) or constructed (eg vegetated swales) infiltration and absorption processes.

Existing land usage within the existing Ironbark Creek catchment were estimated from aerial photography and land use information provided by Newcastle City Council (2012). Land use types were classified as either residential, commercial, grassed or vegetated (Table 3-2). The change in land usage within the SEPP 14 wetland and Ramsar wetland catchments were then estimated based on the proposed clearing and construction activities associated with the project (based on the catchment areas included in Figure 4-1). The resulting changes in land usage are summarised in Table 3-2.

Based on assumed impervious area fractions, the effective impervious area of the SEPP 14 and Ramsar wetland catchments were estimated for the existing and operational catchment conditions (Table 3-2). In Table 3-2 it can be seen that the project is estimated to increase the estimated impervious catchment area of Ironbark Creek reporting to the SEPP 14 wetland by about 0.7 per cent and to the Ramsar wetland by about 0.4 per cent.

Table 3-2 Estimated land use areas

Land Use	Existing (ha)	Operations (ha)	Assumed impervious fraction
SEPP 14 Wetland			
Residential	1181	1181	80%
Commercial	124	139	90%
Grassed	220	220	15%
Vegetation	414	399	5%
Cleared	-	-	50%
Total catchment	1939	1939	-
Impervious area	1110 (57.2 %)	1123 (57.9 %)	-
Ramsar Wetland			
Residential	1535	1535	80%
Commercial	150	165	90%
Grassed	582	582	15%
Vegetation	1106	1091	5%
Cleared	-	-	50%
Total	3373	3373	-
Impervious area	1506 (44.6 %)	1518 (45.0 %)	-

Local watercourse impacts

Average pollutant concentrations

The average modelled pollutant concentrations within Dark Creek and Ironbark Creek catchments generated during the operational stage of the project (with and without treatment as described in Sections 4 and 5) are summarised in Table 3-3.

The project would discharge to Dark Creek and Ironbark Creek via various tributaries however the results reported in Table 3-3 represent the total discharge into each creek across all discharge locations.

Table 3-3 Average modelled pollutant concentrations in local catchments

Metric	ANZECC	Existing	Operation (no treatment)	Operational (with treatment) (a)
Dark Creek				
Flow (m^3/s)	-	0.0013	0.0026	0.0026
TSS (mg/L)	6	5.74	65.9	31.4
TP (mg/L)	0.025	0.029	0.154	0.12
TN (mg/L)	0.35	0.287	1.22	1.22
Gross pollutants (kg/day)	-	0	5.54	1.25
Ironbark Creek				
Flow (m^3/s)	-	0.0017	0.0031	0.0029
TSS (mg/L)	6	5.81	65.9	12.3
TP (mg/L)	0.025	0.029	0.167	0.051
TN (mg/L)	0.35	0.289	1.29	0.771
Gross pollutants (kg/day)	-	0	5.91	0.121

(a) Refer to Sections 4 and 5 for details on treatment and mitigation

Annual pollutant loads

Modelled annual pollutant loads and percentage reduction within Dark Creek and Ironbark Creek catchments generated during the operational stage of the project (with and without treatment as described in Sections 4 and 5) are summarised in Table 3-4.

The project would discharge to Dark Creek and Ironbark Creek via various tributaries however the results reported in Table 3-4 represent the total discharge into each creek across all discharge locations.

Table 3-4 Modelled annual pollutant loads in local catchments

Metric	NCC water quality targets (NCC 2012) (% reduction)	Operational (no treatment)	Operational (with treatment) [(a)]	Achieved percentage reduction
Dark Creek				
TSS (kg/year)	85%	19200	7420	61.4%
TP (kg/year)	65%	35.4	19	46.2%
TN (kg/year)	45%	178	148	16.8%
Gross pollutants (kg/year)	90%	2030	456	77.5%
Ironbark Creek				
TSS (kg/year)	85%	21600	1840	91.5%
TP (kg/year)	65%	42.2	7.46	82.3%
TN (kg/year)	45%	211	103	51.3%
Gross pollutants (kg/year)	90%	2160	44.1	98%

(a) Refer to Sections 4 and 5 for details on treatment and mitigation

Potential impacts

Table 3-3 suggest that the modelled average pollutant concentrations generally exceed ANZECC/ARMCANZ (2000a) default trigger values within the local watercourses. These default trigger values are exceeded during operational stage while under existing conditions, TP concentration exceeds the default trigger value while TSS and TN are just below the default trigger values.

Table 3-4 indicates the modelled proposed water quality treatments achieve the Newcastle City Council water quality targets (NCC 2012) for TSS, TP, TN and gross pollutants within the Ironbark Creek catchment. While the modelled proposed water quality treatments do not achieve the Newcastle City Council water quality targets within the Dark Creek catchment the proposed treatments result in a substantial reduction compared with the no treatment scenario. Hydrocarbons, either from the perched groundwater or from road runoff, would be partially volatised by agitation within the open channels that drain towards the operational water quality structures.

As discussed in Section 4.3.1, a number of construction sedimentation basins and vegetated swales have been identified as potentially being retained or constructed as part of operational conditions. While these water treatment structures do not reduce pollutant concentrations or loads below the default trigger values or in the case of Dark Creek, the Newcastle City Council targets, they do reduce pollutants from the project (compared to a no treatment scenario). The proposed options for operational treatments are practical controls that exceed those within the surrounding road network and have been selected on balance to limit permanent vegetation clearance and need for further in-stream construction work.

Dark Creek is a heavily modified environment (consisting of concrete lined and artificial channels to mitigate local flooding impacts). Following the reduction of contaminants by the measures outlined in Sections 4 and 5 and the mixing with other surface run off water sources in the surrounding residential/commercial catchment, it is considered that the impact to Dark Creek water quality is unlikely to be substantial or significant. Water quality treatment by the project is modelled to reduce average pollutant concentrations by up to 52 per cent, annual pollutant loads by up to 61 per cent and substantially reduce gross pollutants compared to a no treatment scenario. As Dark Creek presents limited habitat for aquatic flora or fauna due to its heavily modified condition, it is considered that the changes to water quality would not result in a significant impact to the local environment or any potentially occurring aquatic flora or fauna in this watercourse.

Ironbark Creek presents a less modified environment in comparison to Dark Creek. Water quality treatment by the project is modelled to reduce average pollutant concentrations by up to 81 per cent, annual pollutant loads by up to 91 per cent and significantly reduce gross pollutants compared to a no treatment scenario. The condition of Ironbark Creek presents more opportunity for natural attenuation of nutrients and solids sourced from the project and surrounding land uses and as such, is unlikely to present a substantial or significant impact to existing water quality. Due to negligible impacts to surface water quality, impacts to aquatic flora or fauna are unlikely to be substantial or significant.

The proposed operational water quality treatment measures (Section 4) are designed to capture the “first flush” flows from each rainfall event, which typically include higher concentrations of pollutants. In addition, the modelling does not include any water quality attenuation that would be provided by the typically ephemeral natural watercourses immediately downstream of the project that can readily absorb nutrients and contain negligible aquatic biodiversity.

As such, the model provides an “upper estimate” of the potential increases to pollutants reporting to the local watercourses as a result of the project. As water from the local watercourses is interspersed with the water sourced from the surrounding catchment within its perennial flows, it is considered that potential water quality impacts such as sedimentation, eutrophication and changes in available light or oxygen would be negligible. It is anticipated that any locally occurring aquatic flora and fauna have habituated to this urban water quality and as a result it is unlikely to result in a significant impact to the environment or any potentially occurring aquatic flora or fauna.

Sensitive receiving environment impacts

The average modelled pollutant concentrations within the sensitive receiving environment (Ramsar and SEPP 14 wetlands) generated during the operational stage of the project are summarised in Table 3-5. Table 3-5 presents average modelled pollutant concentrations for the operational stage both with and without the water quality treatment described in Sections 4 and 5.

The modelling completed for the sensitive receiving environment indicates that under both existing and operational conditions (with and without treatment), the modelled average concentrations of TSS, TP and TN are all above the default trigger values. The proposed water quality treatment measures assist in managing the TSS, TP, TN and gross pollutants reporting to the SEPP 14 and Ramsar wetlands and maintaining existing water quality.

Table 3-5 highlights that the impacts from the project would not result in an appreciable change to water quality in the sensitive receiving environment. In addition, and as per the modelling for the local scale, the catchment scale modelling does not include any water quality attenuation that would be provided by the ephemeral natural watercourses immediately downstream of the project. As such, the model provides an "upper estimate" of the potential increases to pollutant concentrations reporting to the wetlands as a result of the project.

It is anticipated that aquatic flora and fauna in the broader sensitive catchment have habituated to urban water quality environment and as a result, the project is unlikely to result in a substantial or significant impact to the environment, flora or fauna.

Table 3-5 Average modelled pollutant concentrations – catchment scale - wetlands

Metric	ANZECC [(a)]	Existing	Operational (without treatment)	Operational (with treatment)
SEPP 14 wetland				
Flow (m^3/s)	-	0.320	0.323	0.322
TSS (mg/L)	6.0	46.9	49.5	47.1
TP(mg/L)	0.03	0.171	0.176	0.165
TN (mg/L)	0.30	1.41	1.49	1.41
Gross pollutants (kg/day)	-	751	762	752
Ramsar wetland				
Flow (m^3/s)	-	0.492	0.495	0.495
TSS (mg/L)	6.0	46.1	48.0	46.7
TP(mg/L)	0.03	0.172	0.176	0.166
TN (mg/L)	0.30	1.42	1.48	1.45
Gross pollutants (kg/day)	-	1070	1080	1070

(a) ANZECC/ARMCANZ (2000a) - NSW estuaries.

3.2.2 Watercourse geomorphology

Due to the design refinements there has been adjustment of the required cut and fill volumes for the project. This would require a minor widening (about five metres) of the fill in the upper reaches of Blue Wren Creek (watercourse 5). This minor widening would not result in any noticeable additional impacts to this watercourse.

Updated hydraulic modelling carried out for the project (including the design refinements) (Aurecon 2018) indicates the predicted changes in peak flows, flow velocities and water depths are consistent with those identified in the EIS and as such, no additional impacts are expected.

4. Soil and water management

4.1 Strategy

During construction and operational stages, the strategy for the water management system is to intercept, capture and manage surface water, including groundwater seepages, generated within the site. Depending on the stage of the project, intercepted water may be treated using various controls and discharged into the existing downstream ephemeral and modified watercourses. In this manner, discharges from the project would be contained within existing drainage lines, and not result in uncontained overland flows, thereby minimising the risk of increasing soil erosion and scouring.

4.2 Construction

The strategy for the water management system during construction is detailed in Section 4.2 of the *Water Quality and Watercourse Assessment* (GHD 2016) and is still relevant for the refined design. Due to project design refinements there has been a refinement to the proposed construction phase sedimentation basins.

A soil conservation specialist was engaged during concept design of the project to carry out a preliminary design of the construction phase water management system. The result of this planning is a system that is proposed to include sedimentation basins designed to capture runoff generated by the 80th percentile five day rainfall event. The proposed sedimentation basins have been positioned to ensure treatment of the majority of runoff from the construction footprint while minimising environmental impacts including additional permanent vegetation clearing. The sedimentation basins have been sized in accordance with the Blue Book Volume 1 (Landcom 2004) and Volume 2D (DECC 2008) using the revised universal soil loss equation and based on a construction duration of greater than 12 months and a standard receiving environment.

The preliminary proposed construction sedimentation basins are shown on Figure 1-3 and detailed in Table 4-1. These are preliminary only and will be refined during the detailed design stage in consultation with the EPA as part of the Environment Protection Licence (EPL) application process.

Table 4-1 Preliminary proposed construction sedimentation basins

Basin	Catchment area (ha)	Volume (m^3)
B7500N	2.3	432
B7600	2.0	348
B8000N	1.7	385
EWB8000S	0.9	204
B8100S	1.9	564
B8150N	1.5	341
B8250N	1.6	363
B8400N	1.8	471
B8700S	6.6	1330
B8800N	5.6	1466
B9300S	2.9	759
B9600S	4.3	1126
EWB9700S	0.6	178
B10000N	2.5	567
B10100S	0.8	161
B10150S	0.5	101

4.3 Operation

The project includes a stormwater management system that is typical of dual carriageway roads. The stormwater runoff from the road surface and captured groundwater seepage would be managed by a system of surface drains and stormwater inlet pits that connect to sub-surface reinforced concrete pipes (RCPs). The RCPs discharge into energy dissipaters and scour protection, and as relevant into operational water quality measures, which then outlet to downstream watercourses.

Fill batter slopes would include cross drains to intercept runoff from the batter surface. The cross drains would convey runoff to a toe drain flowing to stabilised discharge points.

All operational stormwater management controls are indicative only and will be refined during the detailed design stage.

4.3.1 Operational water quality treatment

To assist with ongoing water quality control during operation of the project it is proposed to retain and modify some of the construction sedimentation basins as operational water quality treatment structures.

Vegetated swales are proposed to be constructed along batters and cuttings as first stage operational water quality treatment structures that assist with the retention of nutrient and sediment on site. Vegetated swales are proposed to be constructed where batter grades are suitable (where batter grades are between one and five per cent). The vegetated swales would provide pre-treatment of water prior to it entering the operational water quality treatment structures (modified construction sedimentation basins). These operational water quality treatment structures would provide further bio-retention and are the main feature to reduce potential pollutants from entering the adjacent ephemeral watercourses and downstream sensitive receiving environments. Outlets of the water quality structures may include scour protection measures. The practice of combining various control options into a sequential treatment train improves the effectiveness of the operational water quality treatment structures and process resulting in increased performance outcomes.

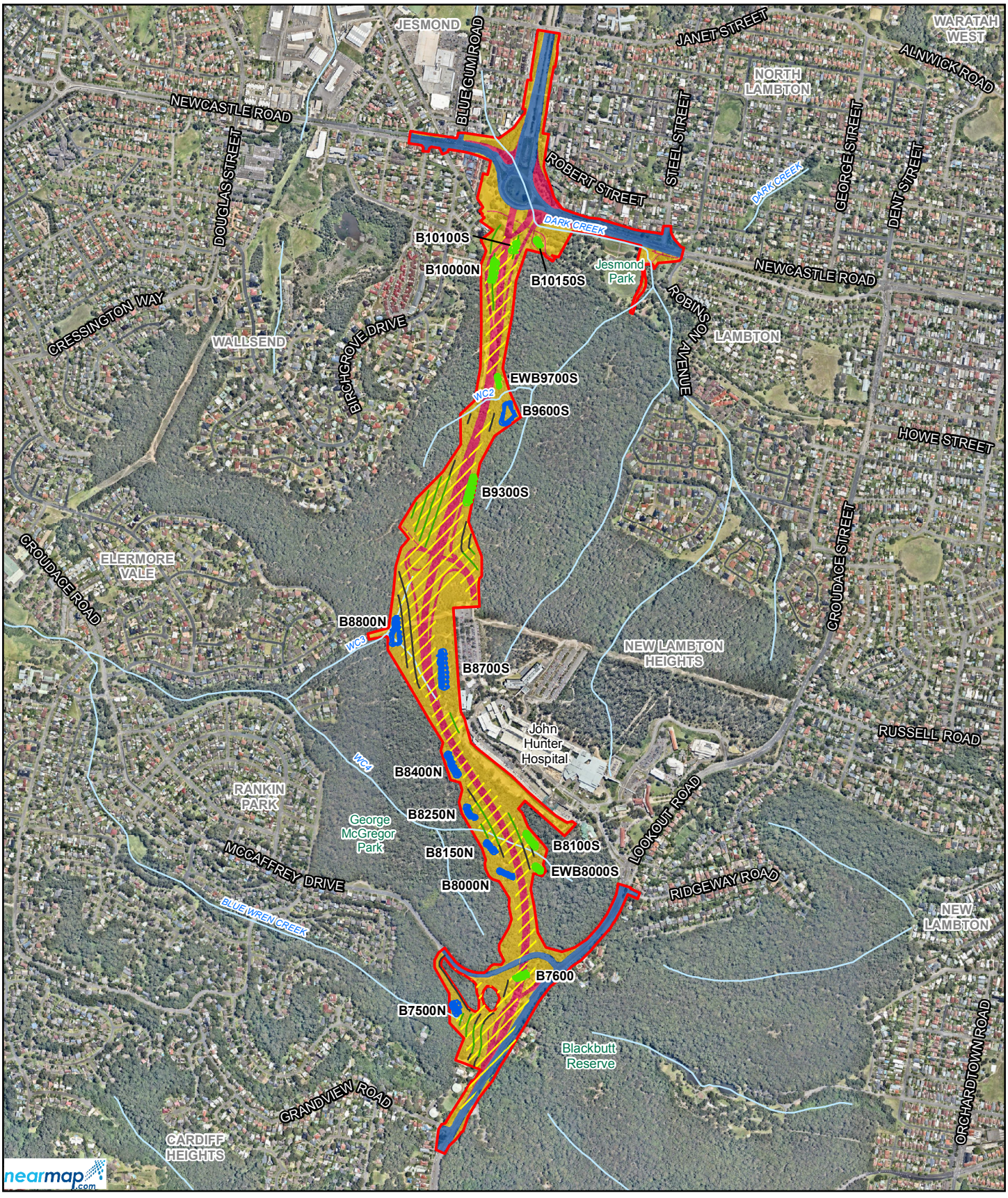
The operational water quality treatment structures would be adequately sized and located to maximise the settling out of sediment and other suspended materials and pollutants. Vegetation to be installed in the operational water quality structures and vegetated swales would be selected to preferentially address the pollutants identified in this report and maximise the absorption of TN and TP from the stormwater. Hydrocarbons, either from the perched groundwater or from road runoff, would be partially volatised by agitation within the open channels that drain towards the operational water quality structures.

A review of the location of the proposed 16 construction sedimentation basins (Section 4.2) identified eight that could be retained and modified to provide ongoing stormwater quality improvement as operational water quality treatment structures. This is an increase from the five sediment basins identified as being retained in Section 4.3.1 of the *Water Quality and Watercourse Assessment* (GHD 2016). As per the requirements of the receiving environment, seven of these are within the Ironbark Creek catchment and one is within the Dark Creek catchment (Figure 4-1). The operational catchment area for each of the operational water quality treatment structures was estimated (Table 4-2), based on the final landform design and the location of the proposed discharge channels. Additional low flow channels may be required to ensure that flows from these catchment areas is conveyed to the operational water quality structures in a controlled manner and where grades permit, additional vegetated swales may be used. This would be further refined during detailed design.

Table 4-2 Operational water quality treatment structures

Treatment structure	Operational catchment area (ha)
B7500N	4.1
B8000N	2.4
B8150N	0.9
B8250N	2.6
B8400N	1.0
B8700S	1.4
B8800N	3.9
B9600S	1.8
Vegetated swales	7.7

Stormwater discharges (including groundwater inflows captured in cuttings) from the project would be intercepted at the discharge points from the road drainage infrastructure (where practical) by a low flow/high flow bypass structure. The bypass structure allows low flows to be diverted towards the operational water quality structures, with high flows (ie major storm events) being discharged directly to the drainage line. This is intended to minimise damage to the operational water quality structures by scouring during large storm events, while maximising the capture and potential improvement to stormwater quality during low flow events “first flush” flows, which typically include higher concentrations of pollutants.



LEGEND

- Construction footprint
- Cleared area
- Existing road
- Proposed pavement area
- Watercourse
- Operational water quality structure
- Temporary sedimentation basin
- Concrete lined swale
- Vegetated lined swale
- Water quality treatment structure catchment area

B8100S Temporary sedimentation basin / operational water quality structure name

Paper Size A4

0 62.5 125 250 375 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Rankin Park to Jesmond Supplementary Water Quality and Watercourse Assessment

Proposed operational water quality treatment structures

Job Number	22-17656
Revision	0
Date	16 Apr 2018

Figure 4-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

G:\22\17656\GIS\Maps\Deliverables\Supplementary_WaterQuality\2217656_SWQ006_ConstructionFootprint_Catchments_0.mxd

Data source: Nearmap: Aerial Imagery, 20160331; Aurecon: Construction footprint, Water quality structures, 2016; LPI: DTDB, 2012. Created by: tmorton, fmackay

It is proposed to modify the retained construction sedimentation basins as follows (Figure 4-2):

- Lowering of basin walls and filling of basins to provide about 0.5 metres of storage depth.
- Placement of a 100 millimetre layer of topsoil within the base of the basin and planting with a mix of native grasses that are selected to maximise the absorption of TN and TP from the discharge water. This lining should be extended to cover the internal batters and basin walls.
- An open channel is to carry low flows from the stormwater discharge points into the basin. This channel should be, as far as practical, constructed with a longitudinal grade less than 0.5 per cent to minimise inflow velocities. Scour protection, in the form of rock rip-rap, may be required at intervals within the channel and at the entrance to the basin.
- The low-flow bypass should be capable of diverting stormwater discharges generated for design storms up to the three month ARI critical duration design storm event. The low-flow bypass should be self-cleansing to prevent blockage and reduce the requirement for inspection and maintenance.
- An emergency spillway is to be included within the basin to allow excess stormwater to discharge from the basin safely.

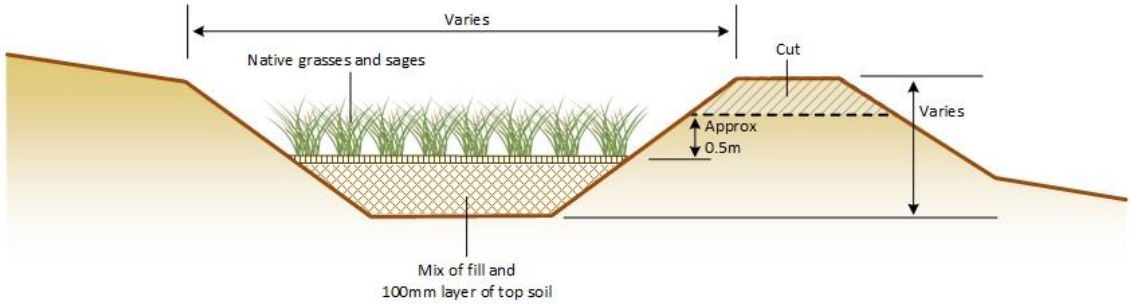


Figure 4-2 Concept design operational water quality treatment structures

5. Mitigation and management measures

Management measures will be implemented during the construction and operational phases of the project to minimise the potential for pollutants to be released into the downstream catchment. These mitigation measures are detailed in Section 5 of the *Water Quality and Watercourse Assessment* (GHD 2016) and these are still relevant for the refined design.

No additional management measures are required.

6. Conclusion

The project lies primarily within the Ironbark Creek catchment. Construction of the project would require clearing, earthworks, construction of temporary access roads, watercourse crossings, pavement, and revegetation work.

The potential impacts of the project have been considered in the *Water Quality and Watercourse Assessment* (GHD 2016) and this supplementary assessment.

There are a number of potential pollutants associated with the construction of the project, including naturally occurring hydrocarbons in intercepted groundwater, contaminated soils, fuels from machinery, tannins from cleared and mulched vegetation and sediment laden runoff. Each of these pollutants has the potential to impact on the water quality and geomorphology of the downstream environment, including local catchments and the sensitive SEPP 14 and Ramsar wetlands. The risks associated with each of these potential sources of pollution have been considered and assessed against the relevant guidelines.

With the implementation of the proposed management and control measures, construction of the project is unlikely to have a substantial or significant impact on downstream water quality.

Potential water quality impacts to the local catchments and wider catchments of the SEPP 14 and Ramsar wetlands during the operation phase of the project have been assessed using MUSIC modelling, with consideration of the proposed operational water management strategy and controls. The implementation of pre-treatment vegetated swales and operational water quality treatment structures will minimise TSS, TN and TP in the stormwater runoff from the project and reduce the potential operational impacts of the project on water quality. The modelling and assessment indicates that the project is unlikely to have a substantial or significant impact on the water quality reporting to the SEPP 14 and Ramsar wetlands located downstream.

Much of Ironbark Creek and its tributaries downstream of the project pass through residential, commercial and industrial areas and has been modified, maintained or concrete lined. The catchment area of the SEPP 14 and Ramsar wetlands is therefore highly urbanised, with estimated impervious areas of about 57 per cent and 45 percent respectively. The highly developed nature of the Ironbark Creek catchment results in flows into the wetlands that have relatively high pollutant concentrations demonstrated by the modelled existing exceedances of water quality targets. The project is estimated to result in a small increase in the impervious area of the SEPP 14 and Ramsar wetland catchments (about 0.7 per cent and 0.4 per cent respectively). The MUSIC modelling indicates that the project does not result in an appreciable change in pollutant concentrations reporting to the SEPP 14 and Ramsar wetlands.

As a result, it is considered unlikely that the project would result in a substantial or significant impact on the quality of water flowing into the SEPP 14 and Ramsar wetlands, and is therefore considered to be consistent with *Significant impact guidelines 1.1: Matters of National Environmental Significance* (DotE 2013). Overall it is considered that the project is likely to result in no appreciable impacts to the water quality of the local catchments and the SEPP 14 and Ramsar wetlands.

7. References

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GHD

Level 3 GHD Tower 24 Honeysuckle Drive Newcastle NSW 2300
PO Box 5403 Hunter Region Mail Centre NSW 2310
T: (02) 4979 9999 F: (02) 4979 9988 E: ntlmail@ghd.com

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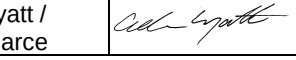
CRV01	I Gilmore	A Wyatt / S Pearce		G Wood		17/04/2018

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