



WestConnex M4-M5 Link

Mainline Tunnel

Modification report

Appendix E

Surface water and flooding report





Transport
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WESTCONNEX M4-M5 LINK

Mainline Tunnel – Modification report

Appendix E Surface water and flooding report

SEPTEMBER 2018

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Appendix E Surface water and flooding report

September 2018

Prepared for

Roads and Maritime Services

Prepared by

AECOM Australia

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Glossary of terms and abbreviations

Term	Definition
A	
AEP	Annual exceedance probability. The probability of a rainfall or flood event exceeding a nominated level in a year. For example, a one per cent AEP is the probability of an event exceeding a nominated level in 100 years.
Afflux	An increase in water level resulting from obstacles in the flow path.
AHD	Australian Height Datum. The standard reference level used to express the relative height of various features. A height given in metres AHD is the height above sea level. Mean sea level is set as zero metres elevation.
ANZECC	Australian and New Zealand Environment and Conservation Council.
Aquifer	A groundwater bearing formation sufficiently permeable to transmit and yield groundwater or water bearing rock.
AR&R	Australian Rainfall & Runoff.
ARI	Average recurrence interval. An indicator used to describe the frequency of floods. The average period in years between the occurrence of a flood of a particular magnitude or greater. In a long period of say 1,000 years, a flood equivalent to or greater than a 100 year ARI event would occur 10 times. The 100 year ARI flood has a one per cent chance (i.e. a one-in-100 chance) of occurrence in any one year. Floods generated by runoff from the study catchments are referred to in terms of their ARI, for example the 100 year ARI flood.
B	
Batter	The constructed side slope of road embankments and cuttings usually expressed as a ratio of horizontal distance to a vertical height value of one eg 2H: 1V. A fill batter is where the road is above the existing surface on a filled embankment and refers to the sloping sides of the embankment. A cut batter is where the road is below the existing surface.
BBWQIP	Botany Bay and Catchment Water Quality Improvement Program.
Bedrock	Rock of a substantial thickness and extent underlying a relatively soft and variable surface.
Bioretention	Treatment process involving retention and filtration of stormwater through a filter media to remove contaminants and sediments.
Biota	All organisms in a given area (including flora and fauna), considered as a unit.
BOD	Biological Oxygen Demand.
BoM	Bureau of Meteorology.
Box culvert	A culvert of rectangular cross section.
Bund	A small embankment designed to retain water.
BTEX	Benzene, toluene, ethylbenzene and xylenes.
C	
Campbell Road motorway operations complex	A construction ancillary facility for the New M5 and M4-M5 Link projects which forms part of the St Peters interchange and which is approved as part of the New M5 project.
Campbell Road ventilation facility	A ventilation facility for the M4-M5 Link project located to the south of Campbell Road, which forms part of the St Peters interchange and which is approved as part of the New M5 project.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
CBD	Central business district.

Term	Definition
CEMP	Construction Environmental Management Plan. A site specific plan developed for the construction phase of the project to ensure that all contractors and sub-contractors comply with the environmental conditions of approval for the project and that the environmental risks are properly managed.
Climate change	A change in the state of the climate that can be identified (eg by statistical tests) by changes in the mean and/or variability of its properties, and that persists for an extended period of time, typically decades or longer (CSIRO and BoM 2015).
Climate projection	A climate projection is the simulated response of the climate system to a scenario of future emission or concentration of greenhouse gases and aerosols, generally derived using climate models. Climate projections are distinguished from climate predictions by their dependence on the emission/concentration/radiative forcing scenario used, which in turn is based on assumptions concerning, for example, future socio-economic and technological developments that may or may not be realised (CSIRO and BoM 2015).
CMA	Catchment Management Authority.
Concept design	Initial functional layout of a road/road system or other infrastructure. Used to facilitate understanding of a project, establish feasibility and provide basis for estimating and to determine further investigations needed for detailed design.
Confluence	A point at which streams combine.
Construction ancillary facilities	Temporary facilities during construction that include, but are not limited to construction sites (civil and tunnel), sediment basins, temporary water treatment plants, pre-cast yards and material stockpiles, laydown areas, parking, maintenance workshops and offices.
CDS	CPB Contractors, Dragados, Samsung Joint Venture (CDS). Contractor responsible for the New M5 Project.
CSJ	CPB Contractors, Samsung, John Holland Joint Venture (CSJ). Contractor responsible for the M4 East Project.
CSWMP	Construction Soil and Water Management Plan
CRC	Cooks River catchment.
Cul-de-sac	A street or road that is open for vehicular traffic at one end only.
Culvert	An enclosed channel for conveying water below a road.
Cumulative impacts	Impacts that, when considered together, have different and/or more substantial impacts than a single impact assessed on its own.
Cut-and-cover	A method of tunnel construction whereby the structure is built in an open excavation and subsequently covered.
Cutting	Formation resulting from the construction of the road below existing ground level, the material is cut out or excavated.
D	
Darley Road civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located between City West Link to the north and Darley Road to the south at Leichhardt.
DCP	Development Control Plan
DEC	NSW Department of Environment and Conservation (now OEH and the NSW EPA)
DECC	NSW Department of Environment and Climate Change (now OEH and NSW EPA).
DECCW	NSW Department of Environment, Climate Change and Water (now OEH and the NSW EPA).
Detailed design	The phase of the project following concept design where the design is refined, and plans, specifications and estimates are produced. These typically include two dimensional and three dimensional models.
Dewatering	The removal of water from solid material or soil by wet classification, centrifugation, filtration or similar solid-liquid separation processes.

Term	Definition
Discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m ³ /s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving (eg metres per second [m/s]).
DLWC	NSW Department of Land and Water Conservation (now part of DPI).
DoP	NSW Department of Planning (now NSW Department of Planning and Environment).
DP&E	NSW Department of Planning and Environment.
DP&I	NSW Department of Planning and Infrastructure (now NSW Department of Planning and Environment).
DPI	NSW Department of Primary Industries.
DPI (Water)	NSW Department of Primary Industries (Water), formerly the NSW Office of Water.
DPWS	NSW Department of Public Works and Services.
Drainage	Natural or artificial means for the interception and removal of surface or subsurface water.
Drawdown	Reduction in the height of the water table caused by changes in the local environment.
DRAINS	A stormwater drainage system design and analysis program for estimating water flows. It is a successor to the ILSAX program which has been widely used for urban stormwater system design and analysis.
E	
Earthworks	All operations involved in loosening, excavating, placing, shaping and compacting soil or rock.
Ecosystem	A functional unit of energy transfer and nutrient cycling in a given place. It includes all relationships within the biotic community and between the biotic components of the system.
EIA	Effective Impervious Area.
EIS	Environmental Impact Statement.
Electrical conductivity	The measure of a material's ability to accommodate the transport of an electric charge.
Embankment	An earthen structure where the road (or other infrastructure) subgrade level is above the natural surface.
Enabling works	Works which are required to enable the commencement of the main construction works.
Erosion	A natural process where wind or water detaches a soil particle and provides energy to move the particle.
Environmental assessment (process)	A specialised part of the decision-making process, where the environmental impact of a development or proposal or activity is considered in detail, together with other aspects of the development.
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i> NSW
EP&A Regulation	Environmental Planning and Assessment Regulation 2000 (NSW).
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth).
Ephemeral creek	A creek that only exists for a short duration of time following rainfall.
EPL	Environment Protection Licence under the <i>Protection of the Environment Operations Act 1997</i> (NSW).
ESCP	Erosion and Sedimentation Control Plan.
Extreme rainfall	There is no consistent global definition for extreme rainfall. It can be defined by either relative rainfall at a location (amount relative to averages), or absolute rainfall amounts (eg over 100 millimetres in a single day). In this report, an extreme rainfall event is defined as the wettest day in 20 years.

Term	Definition
F	
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. 'Feasible' relates to engineering considerations and what is practical to build. 'Reasonable' relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community expectations and nature and extent of potential improvements.
Fill	The material placed in an embankment.
Flash flooding	Flooding which is sudden and unexpected. It is often caused by sudden local or nearby heavy rainfall. It is often defined as flooding which peaks within six hours of the rain event.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunamis.
Flood immunity	Relates to the level at which a particular structure would be clear of a certain flood event.
Flood planning level (FPL)	The combinations of flood levels and freeboards selected for floodplain risk management purposes, as determined in flood studies and floodplain risk management studies and plans.
Flood prone land	Land susceptible to flooding by the probable maximum flood. Note that the flood prone land is also known as flood liable land.
Flood storage area	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. It is necessary to investigate a range of flood sizes before defining flood storage areas.
Floodplain	Area of land which is inundated by floods up to and including the probable maximum flood event (ie flood prone land).
FMS	Flood mitigation strategy.
Floodplain Risk Management Plan	A management plan developed in accordance with the principles and guidelines in the NSW Floodplain development manual (NSW Department of Infrastructure, Planning and Natural Resources 2005). Usually includes both written and diagrammatic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives.
FM Act	<i>Fisheries Management Act 1994</i> (NSW).
Footprint	The extent of direct impact that a development makes on the land.
FBA	Framework for Biodiversity Assessment
Freeboard	A factor of safety typically used in relation to the setting of floor levels, levee or crest levels. It is usually expressed as the difference in height between the adopted FPL and the peak height of the flood used to determine the flood planning level. Freeboard provides a factor of safety to compensate for uncertainties in the estimation of flood levels across the floodplain, such as wave action, localised hydraulic behaviour and impacts that are specific event related, such as levee and embankment settlement, and other effects such as 'greenhouse' and climate change. Freeboard is included in the Flood Planning Level.
G	
Geomorphology	The study of shaping of the landscape by water, wind and other processes. Commonly used to describe the condition of streams as they are shaped by erosion and/or accretion of sediments.
GIS	Geographical Information System.

Term	Definition
GPT	Gross pollutant trap.
Grade	Rate of longitudinal rise (or fall) with respect to the horizontal expressed as a percentage or ratio.
Groundwater	Water that is held in the rocks and soil beneath the earth's surface.
Groundwater dependent ecosystem (GDE)	Refers to communities of plants, animals and other organisms whose extent and life process are dependent on groundwater, such as wetlands and vegetation on coastal sand dunes.
H	
ha	Hectare(s).
Hazard	A source of potential harm or a situation with a potential to cause loss of human life or damage to physical assets.
Habitat	The place where a species, population or ecological community lives (whether permanently, periodically or occasionally). Habitats are measurable and can be described by their flora and physical components.
Hydrology	The study of rainfall and surface water runoff processes.
I	
J	
IFD	Intensity-Frequency-Duration.
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
Infiltration	The downward movement of water into soil and rock. It is largely governed by the structural condition of the soil, the nature of the soil surface (including presence of vegetation) and the antecedent moisture content of the soil.
Interchange	A grade separation of two or more roads with one or more interconnecting carriageways.
Iron Cove Link	A component of the M4-M5 Link project, comprising a one kilometre tunnel between the Rozelle interchange and Victoria Road at Rozelle, south of the Iron Cove Bridge.
IPCC	Intergovernmental Panel on Climate Change.
K	
kL	Kilolitres.
kL/day	Kilolitres per day.
L	
L/s/km	Litres per second per kilometre.
Leachate	Liquid that 'leaches' (drains) from a landfill.
LGA	Local government area.
LiDAR	Light Detection and Ranging.
LLS	Local Land Services.
Localised flooding	Localised flooding occurs when components of the drainage system are undersized or blocked and cannot accommodate the incoming overland surface flows, resulting in the flooding of a localised area.
M	
M	Metres
m/day	Metres per day
m ²	Square metres
m ³	Cubic metres
mg/L	Milligrams per litre
ML	Megalitres
ML/day	Megalitres per day
ML/year	Megalitres per year
M4 East	A component of the WestConnex program of works. Located from Homebush Bay Drive, Homebush to Parramatta Road and City West Link (Wattle Street) at Haberfield (under construction).

Term	Definition
M4 East mainline tunnel stubs	Eastbound and westbound extensions of the M4 East mainline tunnel built as part of the M4 East project (to connect with the M4-M5 Link).
M4 East mainline connection	The location where the M4-M5 Link mainline tunnels and the M4 East mainline tunnel stubs connect underground.
M4-M5 Link	A component of the WestConnex program of works to be delivered in two stages.
M5 East Motorway	Part of the M5 Motorway corridor. Located between Beverly Hills and Sydney Airport (General Holmes Drive).
M5 Motorway corridor	The M5 East Motorway and the M5 South West Motorway.
M5 South West Motorway	Part of the M5 Motorway corridor. Located between Prestons and Beverly Hills.
Mainline tunnels	The M4-M5 Link twin mainline tunnels, with an M4 East mainline tunnel connection at Haberfield and a New M5 mainline tunnel connection at St Peters.
Mainstream flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.
MUS	Managing urban stormwater
Mean rainfall	The arithmetically averaged total amount of precipitation recorded during a calendar month or year.
Median	The central reservation which separates carriageways from traffic travelling in the opposite direction.
Methodology	The method for analysis and evaluation of the relevant subject matter.
microSiemens per centimetre (mS/cm)	A measure of electrical conductivity. Commonly used to measure the salinity of water.
Motorway	Fast, high volume controlled access roads. May be tolled or untolled.
MUSIC	Model for Urban Stormwater Improvement Conceptualisation.
N	
New M5	A component of the WestConnex program of works. Located from Kingsgrove to St Peters (under construction).
New M5 mainline tunnel stubs	Extensions of the New M5 mainline tunnel to a point underground around Canal Road at St Peters, being built as part of the New M5 project (to connect with the M4-M5 Link).
New M5 mainline connection	The location where the M4-M5 Link mainline tunnels and the New M5 mainline tunnel stubs connect underground.
Northcote Street civil and tunnel site	A construction ancillary facility for the M4 East and M4-M5 Link projects located on the northern side of Parramatta Road generally between Wolseley Street and Wattle Street at Haberfield.
NSW EPA	NSW Environment Protection Authority.
NSW State Flood Plan	A plan that deals specifically with flooding and is a sub-plan of an EMPLAN. Flood Sub Plans describe agreed roles, responsibilities, functions, actions and management arrangements for the conduct of flood operations and for preparing for them. They are prepared at State, Region and Local Government levels.
NSW Water Quality and River Flow Objectives	The NSW Water Quality and River Flow Objectives (DECCW 2006) are consistent with the agreed national framework of the ANZECC Water Quality Guidelines and are primarily aimed at maintaining and improving water quality, for the purposes of supporting aquatic ecosystems, recreation and where applicable water supply and the production of aquatic foods suitable for consumption and aquaculture activities.
NSW WQOs	NSW Water Quality Objectives. See also NSW Water Quality and River Flow Objectives.
NWQMS	National Water Quality Management Strategy.
O	
OEH	NSW Office of Environment and Heritage (formerly DECCW).
OEMP	Operational Environmental Management Plan

Term	Definition
Off-ramp	A ramp by which one exits a limited-access highway/tunnel.
On-ramp	A ramp by which one enters a limited-access highway/tunnel.
Operational footprint	Areas to be directly impacted by the operational components of the project such as roadways, tunnels and associated facilities (eg motorway operations complex and ventilation facilities).
Outside shoulder	The area of pavement outside the traffic lanes that is closest to the 'slow' lane.
Overbridge	Bridge which conveys another road, rail or pedestrians over the described road.
Overland flooding	Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.
P	
Parcel of land	Refers to an individual lot number (lot) and deposited plan (DP).
Parramatta Road corridor	The Parramatta Road corridor is the area from Parramatta CBD to Sydney CBD, generally between the Main Western Rail Line in the south and the Parramatta River to the north.
Parramatta Road East civil site	A construction ancillary facility for the M4-M5 Link project located to the east of Parramatta Road between Bland Street and Alt Street
Parramatta Road interchange	An interchange constructed as part of the M4 East project to connect Parramatta Road in Ashfield/Haberfield with the M4 East tunnels.
Parramatta Road ventilation facility	A ventilation facility site located on the south-eastern corner of the Parramatta Road/Wattle Street intersection and adjacent to the Eastern ventilation facility for the M4E project. The facility only requires mechanical and electric fit-out works as it was approved as part of the M4 E project.
Parramatta Road West civil site	A construction ancillary facility for the M4-M5 Link project located to the west of Parramatta Road between Bland Street and Alt Street.
Pavement	The portion of a carriageway placed above the subgrade for the support of, and to form a running surface for vehicular traffic.
Peak discharge	The maximum discharge occurring during a flood event.
Peak flood level	The maximum water level occurring during a flood event.
pH	Numeric scale ranging from zero to 14 used to specify the acidity or alkalinity of an aqueous solution. Solutions with a pH less than seven are acidic and solutions with a pH greater than seven are alkaline. Pure water has a pH of seven and is neutral.
POEO Act	<i>Protection of the Environment Operations Act 1997</i> (NSW)
Pollutant	Any measured concentration of solid or liquid matter that is not naturally present in the environment.
Portals	The locations where a tunnel meets a surface road.
Probability	A statistical measure of the expected chance or likelihood of occurrence.
PMF	Probable Maximum Flood. The flood that occur as a result of the probable maximum precipitation on a study catchment. The probable maximum flood is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The probable maximum flood defines the extent of flood prone land (ie the floodplain).
Project	The M4-M5 Link project would comprise a new multi-lane road link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters. The project would also include an interchange at Lilyfield and Rozelle (the Rozelle interchange) which includes construction of tunnels, ramps and associated infrastructure to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project and a tunnel connection to the Iron Cove Bridge (Iron Cove Link).

Term	Definition
Project footprint	The land required to construct and operate the project. This includes permanent operational infrastructure (including the tunnels), and land required temporarily for construction.
Proprietary stormwater treatment device	Pre-fabricated device designed for removal of pollutants from stormwater. These are usually installed underground and connected to the pipe drainage network.
Publicly available	Available for inspection in hard copy and/or electronic format by a member of the general public (for example available on the project website).
Pymont Bridge Road tunnel site	A construction ancillary facility for the M4-M5 Link project located between Parramatta Road and Pymont Bridge Road at Annandale.
Q	
R	
RCBC	Reinforced concrete box culvert.
Revegetation	To revegetate an area by direct seeding with non-native species or cover crops and / or native species using manual or mechanical means such as hydromulching, straw mulching and tractor seeding.
Riparian	The part of the landscape adjoining rivers and streams that has a direct influence on the water and aquatic ecosystems within them.
Rising main	A pipe through which water from a pump is delivered to an elevated location.
Roads and Maritime	NSW Roads and Maritime Services.
RTA	NSW Roads and Traffic Authority. Now NSW Roads and Maritime Services.
Runoff	The part of the rainfall on a catchment which flows as surface discharge past a specified point.
S	
Scour	The erosion of material by the action of flowing water.
Secretary's Environmental Assessment Requirements (SEARs)	Requirements and specifications for an environmental assessment prepared by the Secretary of the NSW Department of Planning and Environment under section 5.16 of the <i>Environmental Planning and Assessment Act 1979</i> (NSW).
Sediment	Material, both mineral and organic, that is being or has been moved from its site of origin by the action of wind, water or gravity and comes to rest either above or below water level.
Sensitive receptor/ receiver – biophysical	Refers to land uses, landforms and biological organisms that are less resilient (ie cannot easily adapt to change) to impacts including vulnerable ecological communities, threatened species and habitats.
Sensitive receptor/ receiver – socio-economic	Refers to land uses that are less resilient to impacts (ie cannot easily adapt to change) including educational, religious or health care facilities such as (not exclusive) childcare, day care, schools, tertiary education facilities (TAFE, college or university); churches, mosques, temples; aged care facilities, hospitals, and clinics (excludes commercial pharmacies).
Sedimentation	Deposition of sediment usually by water.
Sedimentation basins	A stormwater detention system that promotes the settling of sediments through the reduction of flow velocities and temporary detention. Key elements include purpose designed inlet and outlet structures, settling pond and high flow, overflow structures.
SES	NSW State Emergency Service
SHPRC	Sydney Harbour and Parramatta River Catchment.
SHWQIP	Sydney Harbour Water Quality Improvement Plan.
SMC	Sydney Motorway Corporation.
SMCMA	Sydney Metropolitan Catchment Management Authority.
Socio-economic	Involving combination of social and economic matters.
Spoil	Surplus excavated material.

Term	Definition
St Peters interchange	A component of the New M5 project, to be located at the former Alexandria Landfill site at St Peters. In its ultimate configuration (ie in the event the entire WestConnex program of works is completed) it would connect the New M5, the M4-M5 Link and the proposed future Sydney Gateway project with Euston Road, Gardeners Road and Sydney Airport and Port Botany precinct.
St Peters motorway operations complex	New M5 motorway operations complex located near the western corner of the St Peters interchange, adjacent to the Prince Highway/Canal Road intersection. Contains operational ancillary infrastructure that is required for operation of the project.
Staging	Refers to the division of the project into multiple contract packages for construction purposes, and/or the construction or operation of the overall project in discrete sections.
Stockpile	Temporarily stored materials such as soil, sand, gravel and spoil/waste.
Strahler stream ordering process	A stream classification system where waterways are given an 'order' according to the number of additional tributaries associated with each waterway. This is used as a measure of system complexity and therefore the potential for fish habitat to be present. Flow paths at the top of a catchment are assigned the number one.
Strata	Geological layers below the ground surface.
Stream order	A classification system which assigns an 'order' to waterways according to the number of additional tributaries associated with each waterway, to provide a measure of system complexity.
Study Area	The area of investigation determined by each of the technical specialist disciplines for the individual modification assessments. It may include part, or all, of the project footprint, with possible additional buffer zones.
Surface water	Water flowing or held in streams, rivers and other wetlands in the landscape.
Swale	A shallow, grass-lined drainage channel.
T	
Terrestrial	Living or growing on land (i.e. terrestrial flora or fauna).
Thalweg	The lowest point along the length of a stream bed.
The Blue Book	<i>Managing Urban Stormwater – Soils and Construction</i> Volumes 1 and 2, NSW Government 2004 and 2006.
Threatened	As defined under the <i>Threatened Species Conservation Act 1995</i> (NSW), a species, population or ecological community that is likely to become extinct or is in immediate danger of extinction.
Toxicity	The degree of danger posed by a substance to human, animal or plant life.
TPH	Total Petroleum Hydrocarbon.
Transverse drainage	Existing drainage lines (typically) that cross linear infrastructure such as roads. Synonym: cross drainage.
Tributary	A river or stream flowing into a larger river or lake.
TRH	Total recoverable hydrocarbons.
TSS	Total Suspended Solids.
TUFLOW	A 1D/2D finite difference numerical model that simulates hydrodynamic behaviour in rivers, floodplain and urban drainage environments.
Tunnel portal	The entrance/exit to the tunnel.
Tunnel stub	Driven tunnels constructed to connect to potential future motorway links.
Turbidity	A measure of light penetration through a water column containing particles of matter in suspension.
U	
Urban design	The process and product of designing human settlements, and their supporting infrastructure, in urban and rural environments.

Term	Definition
V	
Ventilation facility	Facility for the mechanical removal of air from the mainline tunnels, or mechanical introduction of air into the tunnels.
W	
WAL	Water access licence.
Water Act 1912	<i>Water Act 1912</i> (NSW)
WM Act	<i>Water Management Act 2000</i> (NSW).
Waterway	Any flowing stream of water, whether natural or artificially regulated (not necessarily permanent).
Wattle Street civil and tunnel site	A construction ancillary facility for the M4 East and M4-M5 Link projects located on the eastern side of Wattle Street and extending north to Wolseley Street at Haberfield. It includes some properties in Walker Avenue.
Wattle Street interchange	An interchange to connect Wattle Street (City West Link) with the M4 East and the M4-M5 Link tunnels. Approved and to be constructed as part of the M4 East project, with minor construction works associated with the M4-M5 Link project.
WestConnex program of works	A 33 kilometre motorway linking Sydney's west and south-west with Sydney Airport and the Port Botany precinct. It includes the M4 Widening, King Georges Road Interchange Upgrade, M4 East, New M5 and the M4-M5 Link projects.
Western Harbour Tunnel	A future road transport crossing of Sydney Harbour to the west of Sydney Harbour Bridge which, together with WestConnex, will act as a western bypass of the CBD and reduce pressure on the Sydney Harbour Bridge and Sydney Harbour Tunnel. The project is being delivered by NSW Roads and Maritime Services and would be subject to separate planning approval.
Wetland	Wetlands are areas of land that are wet by surface water or groundwater, or both, for long enough periods that the plants and animals in them are adapted to, and depend on, moist conditions for at least part of their lifecycle. They include areas that are inundated cyclically, intermittently or permanently with fresh, brackish or saline water, which is generally still or slow moving except in distributary channels such as tidal creeks which may have higher peak flows. Wetlands may be constructed for the purposes of removing pollutants from runoff.
WQIP	Water Quality Improvement Plan.
WQPMP	Water Quality Plan and Monitoring Program.
WSUD	Water sensitive urban design.
WTP	Water treatment plant.
X	
Y	
Z	

Executive summary

Construction design and planning for the M4-M5 Link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters has progressed since the assessment in the M4-M5 Link Environmental Impact Statement (EIS) and the Submissions and Preferred Infrastructure Report (SPIR). A review of the concept design for the approved project has also occurred and, as a result, the proponent has further optimised the construction site arrangements assessed in the EIS and SPIR.

Proposed modifications

The proposed modification relates to Stage 1 of the approved project. The following points provide an overview of the proposed modification:

- The Northcote Street civil site (C3a) would become a civil and tunnel site. This would result in 24 hours, seven days a week tunnelling works being carried out from this location within an existing acoustic shed. The Northcote Street site is being used for tunnelling as part of the M4 East project. A construction access tunnel is to be provided from the Northcote Street site that utilises part of the existing access tunnel for the M4 East project. Proposed spoil haulage routes to and from this site are identified in this traffic and transport assessment. Relevant conditions of the project approval would apply to the use of this site for tunnelling and civil works to ensure potential impacts are managed consistently with the project approval
- The Parramatta Road West and Parramatta Road East civil sites (C1b and C3b) would be used as civil sites in accordance with condition of approval C19 and other conditions of the project approval. The sites would be used for site offices, light and heavy vehicle car parking, shuttle bus services, workshop and storage of equipment, materials and construction machinery. Both sites would operate 24 hours a day, 7 days a week in accordance with the conditions of the project approval. No tunnelling, tunnel spoil handling or tunnel spoil stockpiling and haulage would occur at these sites
- A temporary pedestrian walkway would be constructed above Parramatta Road to connect the Parramatta Road East and Parramatta Road West civil sites. The pedestrian walkway would only be available for use by project staff during the construction phase of the project and would not be available for public use. The pedestrian walkway would be demobilised upon completion of the construction phase of the project
- Removal of the Darley Road civil and tunnel site (C4) from the project. No construction activities or permanent operational infrastructure would be provided at this location. The EIS provided for construction spoil to be removed from the Darley Road site. This spoil would now be removed from other tunnelling sites
- The relocation of the operational water treatment plant from the Darley Road motorway operations complex (as described in the EIS) to the Campbell Road motorway operations complex at the St Peters interchange.

These modifications would result in a small change in construction traffic volumes across the road network relative to that identified in the M4-M5 Link SPIR.

The purpose of this surface water and flooding assessment is to support the environmental assessment for the modification by assessing and reporting potential construction and operational impacts in relation to surface water hydrology, surface water quality and flooding. Additional management and mitigation measures have also been considered and recommended for implementation where appropriate.

The potential flood risk and localised drainage impacts associated with the modification are considered to be acceptable based on the mitigation measures identified and the controls set out in the M4-M5 Link conditions of approval. The assessment of flood risk and mitigation measures identified will need to be refined as part of the future detailed design process.

Water quality impacts associated with construction phase discharges from the Northcote Street civil and tunnel site, Parramatta Road West and Parramatta Road East civil sites, the Pyrmont Bridge

Road tunnel site and from the Campbell Road civil and tunnel site have been assessed as well as treated discharges from the proposed operational WTP at the Campbell Road motorway operations complex. Potential impacts on surface water quality during construction and operation of the modification are considered to be minor and manageable with the application of the proposed mitigation measures and relevant conditions of approval.

Potential scour and erosion impacts associated with releases to Dobroyd Canal, Alexandra Canal and Johnstons Creek are considered to be negligible. As potential scour impacts at Alexandra Canal are considered to be negligible, impacts on contaminated sediments in Alexandra Canal are also considered to be negligible beyond those assessed and approved as part of the New M5 project.

A summary of the key EIS mitigation measures and conditions of approval that would manage impacts associated with flooding and surface water during construction and operation is provided below:

- Preparation of a Flood Mitigation Strategy
- The project must be designed so that relevant flooding characteristics are not exceeded on adjacent lands / properties (refer to condition of approval E151)
- All reasonably practicable erosion and sediment controls must be installed and appropriately maintained to minimise any water pollution. When implementing such controls, any relevant guidance in the Managing Urban Stormwater series must be considered
- The project construction water treatment plant discharge criteria must comply with the ANZECC (2000) 90 per cent species protection level unless an Environment Protection Licence (EPL) is in force in respect to the project. Discharge criteria for iron during construction must comply with the ANZECC (2000) recreational water quality criteria (refer to condition of approval E186)
- The project operational water treatment plant discharge criteria must comply with the ANZECC (2000) 95 per cent species protection level and a 99 per cent protection level for contaminants that bioaccumulate unless other discharge criteria are agreed in consultation with relevant stakeholders including EPA, DPI Water and Sydney Water. Discharge criteria for iron during operation must comply with the ANZECC (2000) recreational water quality criteria (refer to condition of approval E187)
- Works on waterfront land must be undertaken in accordance with NSW Department of Primary Industries (DPI) controlled activity guidelines (refer to condition of approval E189)
- Further hydrological and hydraulic modelling based on the detailed design of the project must be carried out to determine the ability of the receiving drainage systems to effectively convey pavement drainage from the project. The modelling must be undertaken in consultation with the relevant council(s) and Sydney Water and the outcomes documented in the Stormwater Drainage Report (refer to condition of approval E195)
- The Stormwater Drainage Report must be prepared at least one (1) month prior to the commencement of any new drainage works, modifications or connections to existing drainage works, or construction of hard surfaces that are associated with the operation of the project and would result in runoff to existing stormwater drainage systems (refer to condition of approval E196)
- Appropriate design of all new or modified drainage systems (refer to condition of approval E197).

1 Introduction

Approval for the construction and operation of the project was granted on 17 April 2018 by the NSW Minister for Planning (application number SSI 7485).

Construction design and planning has progressed since the assessment contained in the Environmental Impact Statement (EIS) and Submissions and Preferred Infrastructure Report (SPIR) and a review of the concept design for the approved project has occurred. As a result, the proponent has further optimised the construction site arrangements assessed in the EIS and SPIR to reduce community impacts and to decrease the overall number of construction sites required for Stage 1 of the project. The main changes include the removal of the Darley Road civil and tunnel site from the project and changes to some of the construction ancillary facilities proposed at Haberfield and Ashfield as summarised in **Table 1-1** and described in **Chapter 2** below.

Table 1-1 Change to construction ancillary facilities at Haberfield, Ashfield and Leichhardt

EIS and SPIR	Proposed modification
Wattle Street civil and tunnel site (C1a)	No change
Haberfield civil site (C2a/C2b) ¹	No change
Northcote Street civil site (C3a)	Northcote Street civil and tunnel site Includes tunnelling, spoil handling and spoil haulage from this site
Parramatta Road West civil and tunnel site (C1b)	Parramatta Road West civil site ² Inclusion of a temporary pedestrian walkway above Parramatta Road to link to the Parramatta Road East civil site.
Parramatta Road East civil site (C3b)	Parramatta Road East civil site ² Inclusion of a temporary pedestrian walkway above Parramatta Road to link to the Parramatta Road West civil site.
Darley Road civil and tunnel site (C4)	Removal of site

Notes

1. The use and footprint of this site was amended in sections B11.6.8 and C6.1.3 of the SPIR to be as per the arrangement for the Haberfield civil site (C2b).
2. Condition C19 allowed use of the site for parking and other works that do not exceed the 'noise affected' Noise Management Levels as identified in the ICNG.

Not all of the changes proposed can be accommodated within the existing project approval. As such it is necessary to seek a modification to the project approval in accordance with Section 5.25 of the EP&A Act.

1.1 Overview of M4-M5 Link project

The project approval provides for the construction and operation of the WestConnex M4-M5 Link project.

The approved project describes construction and operation of the M4-M5 Link in two stages:

Stage 1¹, as detailed in the EIS included:

- Construction of the mainline tunnels between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters, stub tunnels to the Rozelle interchange (at the Inner West subsurface interchange) and ancillary infrastructure at the Darley Road motorway operations complex (MOC1) and Campbell Road motorway operations complex (MOC5)
- These works are anticipated to commence in 2018 with the mainline tunnel opening to traffic in 2022.

Stage 2², as detailed in the EIS, included:

- Construction of the Rozelle interchange and Iron Cove Link including connection to the stub tunnels at the Inner West subsurface interchange, connection to the surface road network at Lilyfield and Rozelle, and construction of tunnels, ramps and associated infrastructure as part of the Rozelle interchange to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project. Ancillary infrastructure will be provided at Rozelle West motorway operations complex (MOC2), Rozelle East motorway operations complex (MOC3) and Iron Cove Link motorway operations complex (MOC4)
- Stage 2 works are expected to commence in 2019 with these components of the project opening to traffic in 2023.

The M4-M5 Link project is part of the WestConnex program of works that, together with the proposed future Sydney Gateway, would facilitate improved connections between western Sydney, Sydney Airport and Port Botany and south and south-west Sydney, as well as better connectivity between the important economic centres along Sydney's Global Economic Corridor and through local communities.

A more comprehensive overview of the M4-M5 Link project, as well as other aspects of the WestConnex program of works is provided within the EIS.

¹ M4-M5 Link Stage 1 (the mainline tunnels) is also commonly referred to as Stage 3A of the WestConnex program of works

² M4-M5 Link Stage 2 (the Rozelle interchange and Iron Cove Link) is also commonly referred to as Stage 3B of the WestConnex program of works

1.2 Overview of modification

The proposed modification relates to Stage 1 of the approved project. The following points provide an overview of the proposed modification:

- The Northcote Street civil site (C3a) would become a civil and tunnel site. This would result in 24 hours, seven days a week tunnelling works being carried out from this location within an existing acoustic shed. The Northcote Street site is being used for tunnelling as part of the M4 East project. A construction access tunnel is to be provided from the Northcote Street site that utilises part of the existing access tunnel for the M4 East project. Proposed spoil haulage routes to and from this site are identified in this modification report. Relevant conditions of the project approval would apply to the use of this site for tunnelling and civil works to ensure potential impacts are managed consistently with the project approval
- The Parramatta Road West and Parramatta Road East civil sites (C1b and C3b) would be used as civil sites in accordance with condition of approval C19 and other conditions of the project approval. The sites would be used for site offices, light and heavy vehicle car parking, shuttle bus services, workshop and storage of equipment, materials and construction machinery. Both sites would operate 24 hours a day, 7 days a week in accordance with the conditions of the project approval. No tunnelling, tunnel spoil handling or tunnel spoil stockpiling and haulage would occur at these sites
- A temporary pedestrian walkway would be constructed above Parramatta Road to connect the Parramatta Road East and Parramatta Road West civil sites. The pedestrian walkway would only be available for use by project staff during the construction phase of the project and would not be available for public use. The pedestrian walkway would be demobilised upon completion of the construction phase of the project
- Removal of the Darley Road civil and tunnel site (C4) from the project. No construction activities or permanent operational infrastructure would be provided at this location. The EIS provided for construction spoil to be removed from the Darley Road site. This spoil would now be removed from other tunnelling sites
- The relocation of the operational water treatment plant from the Darley Road motorway operations complex (as described in the EIS) to the Campbell Road motorway operations complex at the St Peters interchange.

Key aspects of the proposed modification relevant to the assessment of potential noise and vibration impacts are described in further detail in **Chapter 2**. Chapter 4 (Proposed modification) of the modification report provides a detailed description of the proposed modification.

The proposed modification would require changes to the conditions of the project approval. Proposed changes to the project approval are detailed in Chapter 7 (Conditions of approval) of the modification report.

Site establishment works (in accordance with an approved Site Establishment Management Plan) and/or construction works (in accordance with an approved Construction Environmental Management Plan) are proposed at a number of the project construction sites and will be carried out in accordance with the existing conditions of approval for the project.

1.3 Purpose of this report

The purpose of surface water and flooding assessment is to support the environmental assessment for the proposed modification by assessing and reporting existing conditions and potential impacts relating to surface water hydrology, surface water quality and flooding. Specifically, the assessment was undertaken on the aspects of the modification which have the potential to result in adverse surface water and flooding impacts including:

- Potential flooding, localised drainage and water quality impacts during construction associated with the change in construction activities at Northcote Street civil and tunnel site, This includes assessment of the reinstatement and use of the 'G-loop' at Haberfield for trucks egressing from the Northcote Street civil and tunnel site

- Potential flooding, localised drainage and water quality impacts during construction associated with the change in construction activities at the Parramatta Road West and Parramatta Road East civil sites
- Potential localised drainage and water quality impacts during construction associated with additional tunnel water (formally pumped to the Darley Road civil and tunnel site) being treated and discharged at the Northcote Street civil and tunnel site and the Pyrmont Bridge Road tunnel site during construction
- Potential flooding, drainage and water quality impacts during construction and operation associated with the relocation of the mainline tunnel operational WTP to the Campbell Road motorway operations complex (MOC5) at the St Peters interchange.

1.4 Structure of this report

This report has been structured as follows:

- **Chapter 2** presents an overview of the modification to the approved project
- **Chapter 3** presents the assessment methodology that was used
- **Chapter 4** considers the potential impacts associated with construction activities
- **Chapter 5** considers the potential impacts associated with operational activities
- **Chapter 6** documents management measures that are proposed to mitigate impacts
- **Chapter 7** provides a conclusion to the assessment.

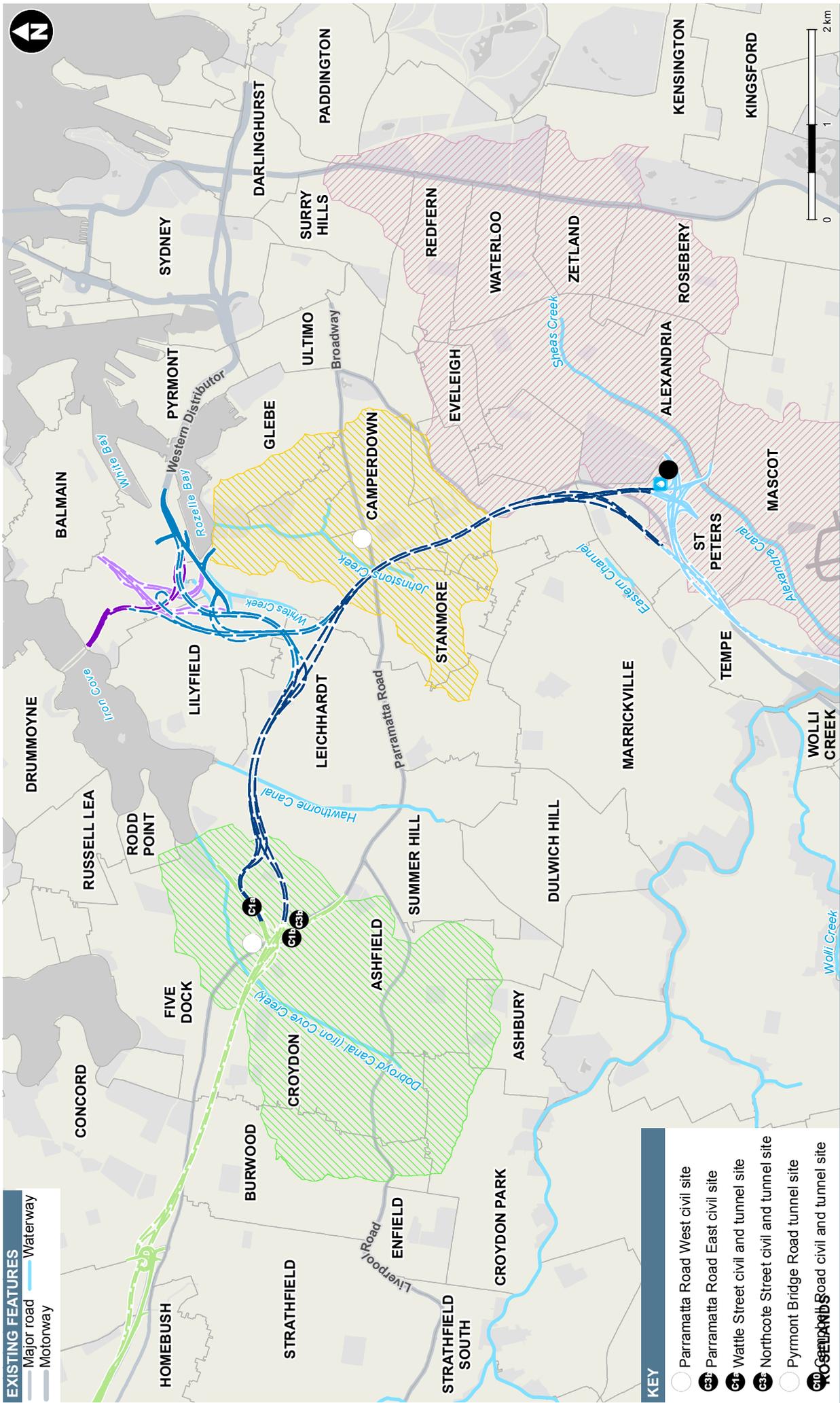
Annexure A of this report summarises the Box model used to assess the impact of treated tunnel water discharges to Alexandra Canal.

1.5 Study area

The study area for the surface water and flooding assessment is shown in **Figure 1-1** and includes the relevant construction ancillary facilities at Haberfield and Ashfield and the Campbell Road motorway operations complex (MOC5) operational WTP, as well as areas where potential surface water and flooding impacts could occur as a result of construction or operation of the proposed modification.

All activities associated with the proposed modification would lie within the following sub-catchments which form part of the larger Parramatta River and Cooks River catchments:

- Dobroyd Canal (Iron Cove Creek) – this catchment includes the Northcote Street civil and tunnel site and Parramatta Road East and West civil sites
- Alexandra Canal – this catchment includes the operational WTP at the Campbell Road motorway operations complex
- Johnstons Creek – this catchment includes the Pyrmont Bridge Road tunnel site.



EXISTING FEATURES

- Major road
- Motorway
- Waterway

KEY

- Parramatta Road West civil site
- Parramatta Road East civil site
- Wattle Street civil and tunnel site
- Northcote Street civil and tunnel site
- Pymont Bridge Road tunnel site
- Wentworth Road civil and tunnel site

LEGEND

New M5

- Surface road
- Tunnel

Mainline

- Surface road
- Tunnel

M4 East

- Surface road
- Tunnel

Project features

- Proposed operational water treatment

Rozelle interchange

- Surface road
- Tunnel

Iron Cove Link

- Surface road
- Tunnel

Proposed future WHTBL connections (civil construction only)

- Surface road
- Tunnel

Sydney Harbour and Parramatta River catchment

- Johnstons Creek subcatchment
- Dobroyd Canal subcatchment

Cooks River catchment

- Alexandra Canal subcatchment

Scale: 0, 1, 2 km

Figure 1-1 Surface water and flooding study area

2 Key aspects of the proposed modification relevant to this assessment

2.1 Northcote Street civil and tunnel site

2.1.1 Site layout

The construction footprint for the project around Haberfield and Ashfield is shown in **Figure 2-1**. The proposed indicative layout for the Northcote Street civil and tunnel site is provided in **Figure 2-2**. Key elements that would be consistent with the existing layout for the M4 East project include the vehicle entry and exit locations, the acoustic shed and the entry to the temporary access tunnel. Infrastructure not required for construction of the M4-M5 Link project would be removed from the site. The final layout for this site would be confirmed during detailed design and detailed in the approved Site Establishment Management Plan (SEMP) and/or approved Construction Environmental Management Plan (CEMP).

The existing acoustic shed is located in the middle of the site with associated tunnelling activities being undertaken inside the shed. The acoustic shed would be used to enclose noise-generating and dust-generating activities associated with tunnelling works. Within the acoustic shed, the main construction activities proposed are spoil handling, stockpiling of spoil material along with the loading of spoil material onto haulage vehicles for transportation to designated landfill or reuse sites.

2.1.2 Construction access tunnel

The existing construction access tunnel located at the northern end of the site would be altered to meet the needs of the M4-M5 Link project. The indicative alignment of the construction access tunnel is shown in **Figure 2-3**. For the M4-M5 Link project, the new construction access tunnel would head generally in a south eastern direction beneath Wattle Street, to the north of the Haberfield civil site and beneath a small number of residential properties in Walker Avenue and Alt Street to connect with the M4-M5 Link mainline tunnels. This route has been selected as it would provide the most direct route from the access tunnel to the M4-M5 Link mainline tunnels. Access to the M4 East access tunnel at the alignment of Parramatta Road would be blocked off on completion of the M4 East project.

The access tunnel would have an average grade of around 14 per cent with a maximum depth of around 50 metres and will be around 430 metres in length. The access tunnel would have an average width of 12 metres to allow two heavy construction vehicles to comfortably travel side by side in the access tunnel.

For the construction of the access tunnel, roadheaders would be used to cut the top heading with a roadheader, surface miner or excavators with breakers used to excavate the bench. To support the access tunnel, steel rock bolts, mesh and shotcrete would be used. Spoil would be removed by off road articulated trucks to the surface where it would be stockpiled in the acoustic shed until transported to a disposal or reuse site. Construction of the access tunnel would take around six months. Once construction works are complete the construction access tunnel would be backfilled.

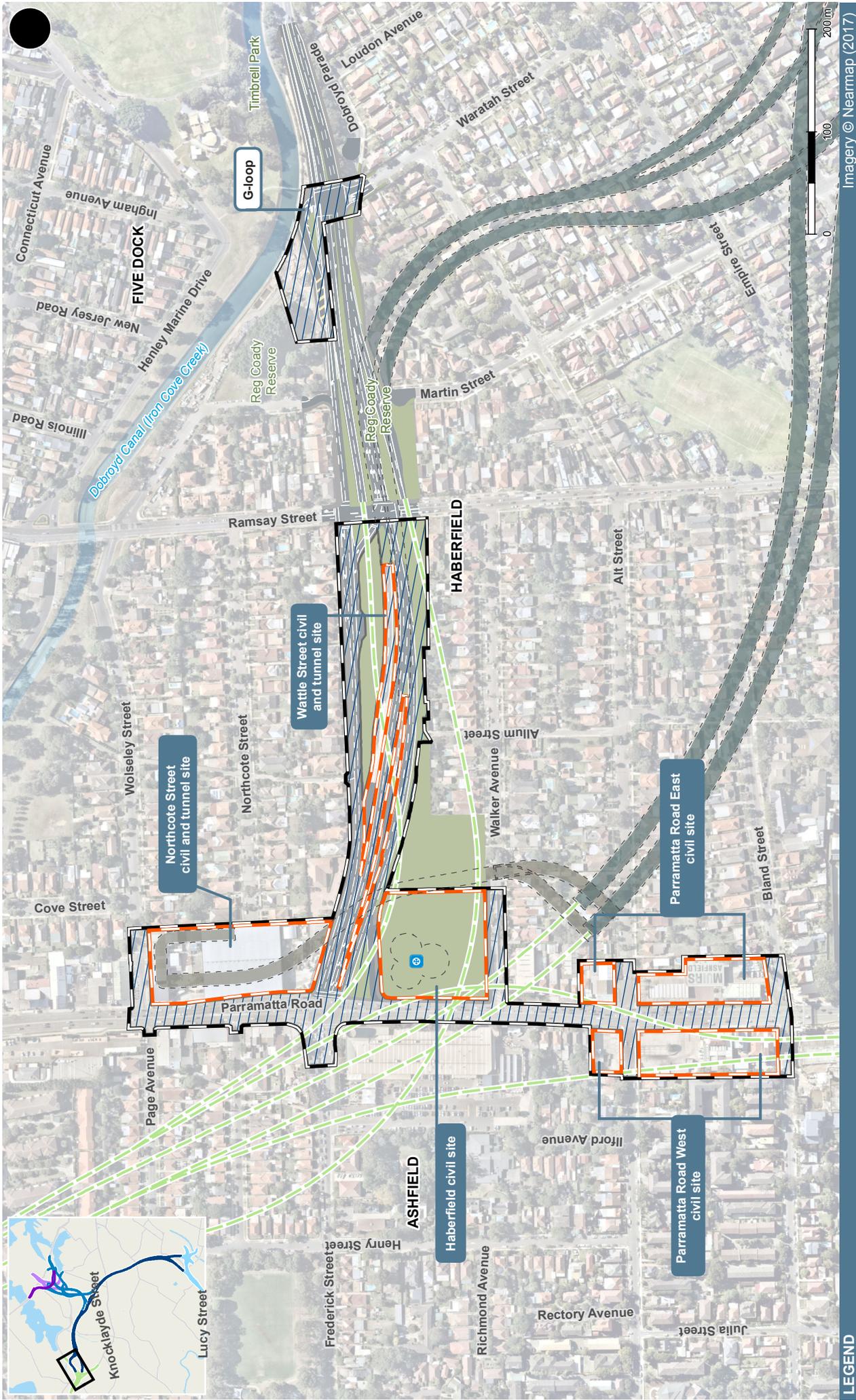


Figure 2-1 Construction project footprint at Haberfield/ Ashfield

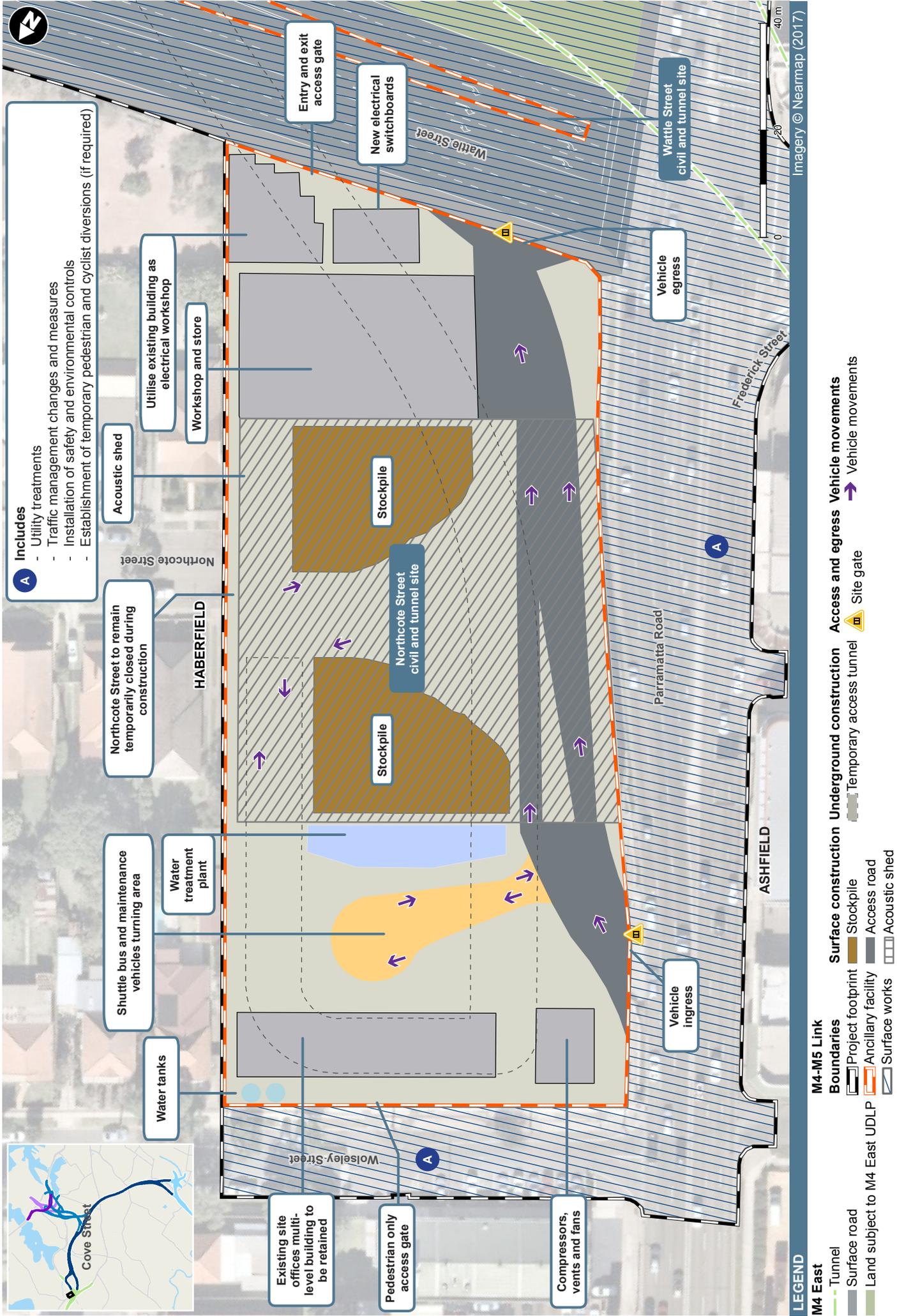


Figure 2-2 Indicative Northcote Street civil and tunnel site layout



Imagery © Nearmap (2017)

- LEGEND**
- M4 East**
 - Tunnel
 - M4-M5 Link**
 - Boundaries**
 - Underground construction**
 - Mainline tunnel
 - Ancillary facility
 - Temporary access tunnel
 - Surface works
 - Project features**
 - Ventilation facility

Figure 2-3 Indicative alignment of construction access tunnel

2.1.3 Program

An indicative program of works for the Northcote Street civil and tunnel site is shown in **Table 2-2**. The program shows that the construction activity at the Northcote Street site commences in Q2 2019, and continues through to end of Q1 2023. Once construction works are complete, construction facilities would be demobilised and the site would be rehabilitated in accordance with the M4 East Residual Land Management Plan. It is expected that Northcote Street would be reinstated, as provided for under the M4 East project approval.

Table 2-1 Indicative program of works – Northcote Street civil and tunnel site

Construction Activity	Indicative construction timeframe																				
	2018			2019			2020			2021			2022			2023					
Refurbishment and traffic management																					
Site establishment																					
Construct temporary access tunnel																					
Tunnelling																					
Civil and mechanical fitout																					
Testing and commissioning																					
Site demobilisation and rehabilitation																					

2.2 Parramatta Road West and Parramatta Road East civil sites

The Parramatta Road West and East civil sites are located on the western and eastern sides of Parramatta Road between around Alt Street and Bland Street at Ashfield and Haberfield.

The Parramatta Road West and Parramatta Road East civil sites would be used in accordance with condition of approval C19 and other conditions of the project approval. The sites would be used for parking and other works that do not exceed the 'noise affected' Noise Management Levels as identified in the ICNG.

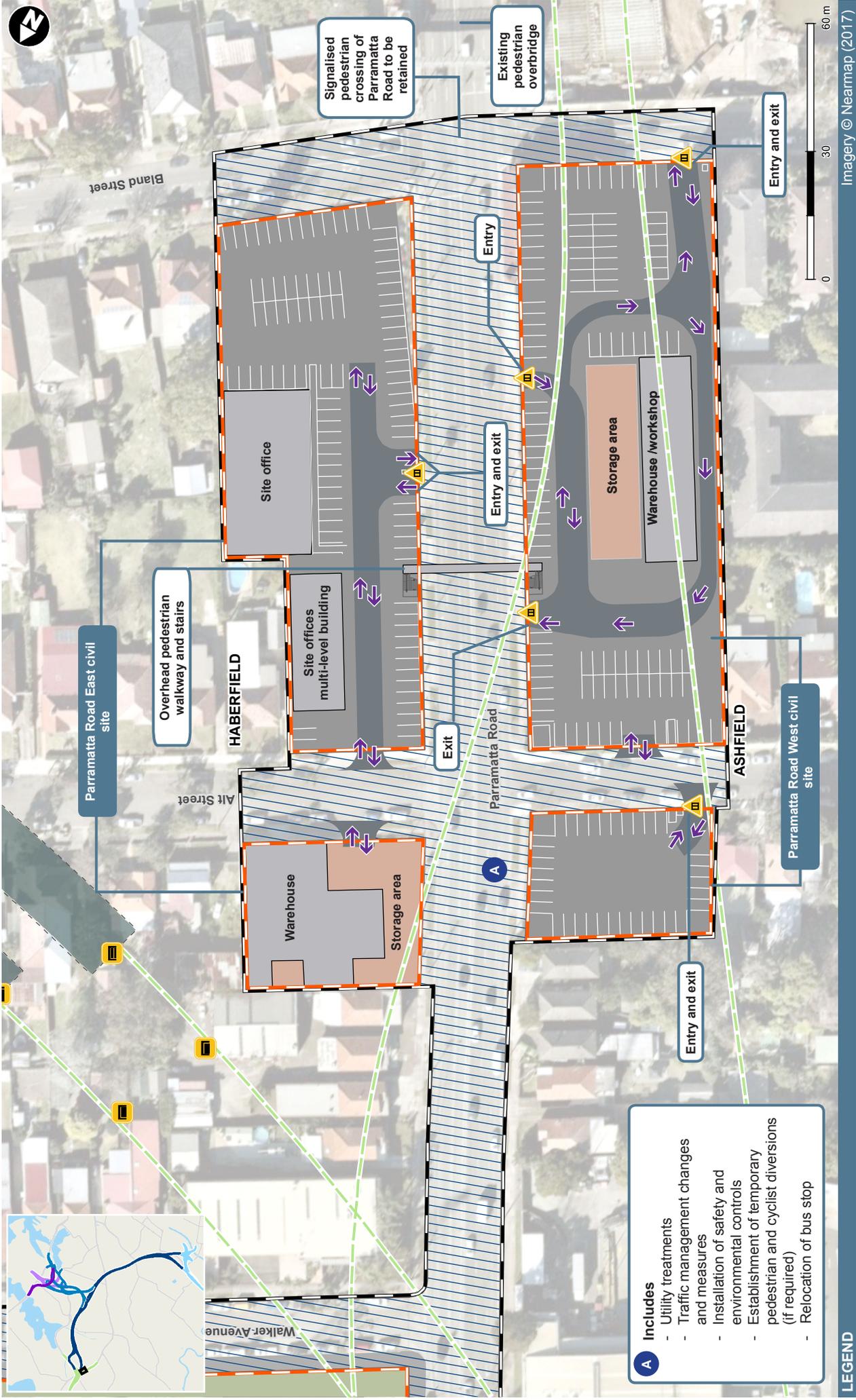
The sites would be used for site offices, light and heavy vehicle car parking, shuttle bus services, workshop and storage of equipment, materials and construction vehicles. Both sites would operate 24 hours a day, 7 days a week in accordance with the conditions of the project approval.

The sites would be used to support civil and tunnelling construction activities at other project construction sites, primarily within the Haberfield and Ashfield area. No tunnelling, tunnel spoil stockpiling and handling or tunnel spoil haulage would occur at these sites.

2.2.1 Site layout

The proposed indicative site layout for Parramatta Road West and Parramatta Road East civil sites is provided in **Figure 2-4**. The layout for the sites would be confirmed during detailed design and in the approved Site Establishment Management Plan (SEMP) and/or approved Construction Environmental Management Plan (CEMP).

Vehicle access points are provided for Parramatta Road West civil site from Parramatta Road, Bland Street (west of Parramatta Road) and Alt Street. The entry along Parramatta Road would only be accessible for westbound traffic with a left turn into the site. Exit onto Parramatta Road would be left turn out to travel westbound. Entry and exit points are proposed on Bland Street, west of Parramatta Road, and Alt Street to allow traffic to access between the sites or onto Parramatta Road as shown in **Figure 2-4**.



A Includes

- Utility treatments and measures
- Traffic management changes and measures
- Installation of safety and environmental controls
- Establishment of temporary pedestrian and cyclist diversions (if required)
- Relocation of bus stop

LEGEND

M4 East	Tunnel	Surface construction	Underground construction	Vehicle movements	Access and egress
Surface road	Project footprint	Building	Mainline tunnel	Vehicle movements	Site gate
Land subject to M4 East UDLP	Ancillary facility	Access road		Roller door (below ground)	
	Surface works	Laydown and storage area			

Figure 2-4 Indicative Parramatta Road West and Parramatta Road East sites layouts

2.2.2 Program

An indicative program of works for Parramatta Road West and Parramatta Road East civil sites is provided in **Table 2-2**. The construction program shows construction activities commencing in Q3 2018 and continuing through to the end of Q1 2023. Once construction activities are complete, construction facilities would be removed and the site would be rehabilitated in accordance with the Residual Land Management Plan for the project.

Table 2-2 Indicative program of works - Parramatta Road West and Parramatta Road East civil sites

Construction Activity	Indicative construction timeframe																				
	2018			2019			2020			2021			2022			2023					
Site establishment and utility works																					
Site operations – offices, warehouse/storage, workshop and parking																					
Site demobilisation and rehabilitation																					

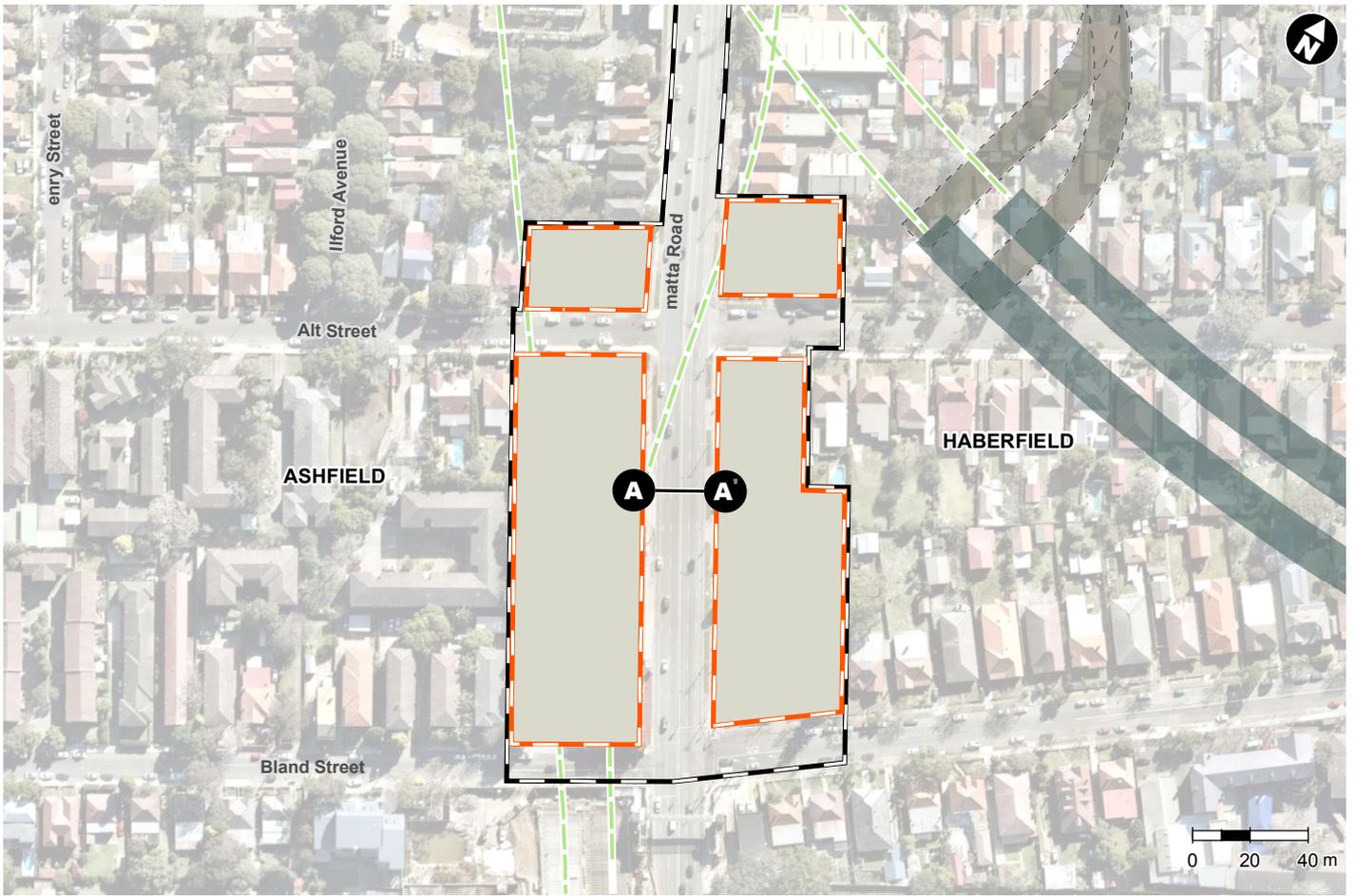
2.3 Parramatta Road West and Parramatta Road East civil sites – pedestrian walkway

This modification proposes to link the Parramatta Road West and Parramatta Road East civil sites with a temporary overhead pedestrian walkway above Parramatta Road which would only be used by the construction workforce and would not be available for public use. Access to the walkway would be via stairs at either end located within the work sites. The pedestrian walkway is provided to allow the construction workforce to easily move between the two sites without the need to use the existing at-grade pedestrian crossing on Parramatta Road at the traffic signals.

The structure would provide sufficient clearance for vehicles travelling along Parramatta Road with the base of the walkway being around six metres above Parramatta Road. The overall height of the walkway structure would extend to around 10 metres above Parramatta Road. Both the walkway and access towers would be enclosed to provide weather protection for users and enable use 24 hours a day, seven days a week. Lighting would be provided to allow the walkway to be used after daylight hours.

The bridge structure would be fabricated offsite in sections that are of suitable size for transportation to the site. The sections would be welded or bolted together at the Parramatta Road sites. The supporting steel towers would be assembled on site and mounted on concrete foundations to support the pedestrian walkway. The bridge would be a single span and would be lifted into position by a crane. Installation of the span would be carried out at night with full road closure of Parramatta Road and traffic detours provided. A Road Occupancy Licence from the Transport for NSW Traffic Management Centre would be required for the installation of the pedestrian walkway, allowing for the temporary closure of Parramatta Road. Once the walkway span is in place the roof and deck would be installed.

The pedestrian walkway is expected to be in place from around late 2018 to end of Q1 in 2023. Once construction works are complete, the pedestrian walkway would be removed following a similar process to that described above, but in reverse. A site layout showing the location of the walkway and elevation plan of the pedestrian walkway are provided in **Figure 2-5**.



Imagery © Nearmap (2017)

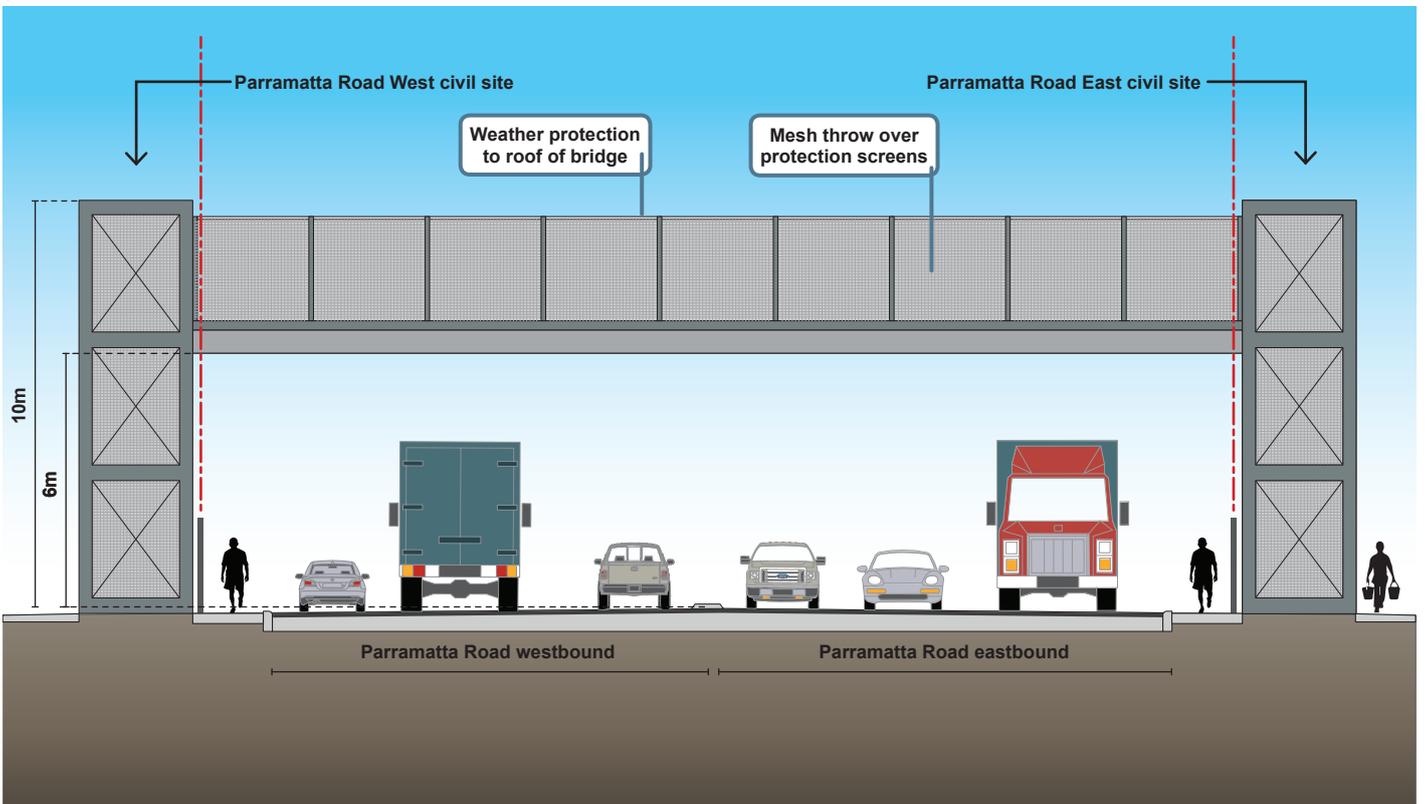


Figure 2-5 indicative location and design of Parramatta Road West and Parramatta Road East overhead pedestrian walkway

2.4 Removal of Darley Road site from project

The EIS identified the site as the Darley Road civil and tunnel site (C4) for the construction of the project and as the Darley Road motorway operations complex (MOC1) for the operation of the project.

Ongoing construction design and planning has determined that the Darley Road site is no longer required to support the construction and operation of the project.

2.4.1 Relocation of construction activities

Construction activities would not be carried out at the Darley Road civil and tunnel site. The construction activities proposed for Darley Road civil and tunnel site as described in the EIS would be accommodated at other project construction sites.

The approved project involved the removal and transportation of around 550,300 cubic metres of tunnel spoil from the Darley Road civil and tunnel site as described in section 23.3.2 of the EIS. Given that the length of the mainline tunnel would not change for the proposed modification, this spoil volume would be required to be removed from other tunnelling sites.

The overall intensity (rate) of spoil removal at approved tunnelling sites is not expected to change, however the additional spoil to be removed would require the extension of the tunnelling component of the overall construction program by around six months.

2.4.2 Relocation of operational ancillary infrastructure

The EIS described that an operational water treatment plant and substation would be located at the Darley Road motorway operations complex. The removal of the Darley Road site from the project would result in the relocation of the operational water treatment plant to the Campbell Road motorway operations complex at St Peters interchange. The relocation of the operational water treatment plant is described in **section 2.5** below.

The removal of the motorway operation complex from Darley Road would result in no permanent infrastructure for the project being located at this location.

2.5 Relocation of operational water treatment plant to St Peters

The proposed relocation of the operational water treatment plant to the Campbell Road motorway operations complex would result in the operational footprint of the motorway operations complex at St Peters being increased.

Figure 2-6 provides an indicative site layout for the Campbell Road motorway operations complex at St Peters interchange which includes an indicative location for the operational water treatment plant. The motorway operation complex is located on the cut and cover structure above the M4-M5 Link ramps at the St Peters interchange which is being constructed by the New M5 project and on land to the immediate east. The motorway operations complex as described in the EIS includes ventilation facilities and a substation. Additional land adjacent to, and to the immediate south east of the motorway operations complex would be required to accommodate the operational water treatment plant.

The increase in footprint of the motorway operations complex would have only a minimal impact on the total area of proposed open space on the southern side of Campbell Road at the St Peters interchange that is being delivered as part of the New M5 project. The increase in footprint will also have some impact on the proposed landscaping area for the St Peters interchange to be provided in this location.

The overall design, capacity and discharge rate of the water treatment plant would remain similar to the proposed water treatment plant to be located at Darley Road (as detailed in section 2.4.2 of Appendix Q (Surface water and flooding) of the EIS). The water treatment plant would be designed so that discharge would be in accordance with the condition of approval E187. The final design for the water treatment plant would be confirmed during detailed design and would be subject to the relevant M4-M5 Link Urban Design and Landscape Plan for the project.

For the proposed modification three options would be considered for the discharge of treated wastewater from the mainline tunnel drainage system:

- Option 1: Wastewater would be pumped to the water treatment plant at the Campbell Road motorway operations complex. Treated water would discharge to the stormwater basin and/or drainage network within the St Peters interchange site being constructed by the New M5 project. This drainage network would then discharge to Alexandra Canal
- Option 2: Wastewater would be pumped to the water treatment plant at the Campbell Road motorway operations complex. Treated water would be discharged to the existing drainage network and then to Alexandra Canal
- Option 3: Wastewater would be discharged to Sydney Water's sewage system in accordance with a Trade Waste Agreement.

The detailed design for the water treatment plant may include a combination of the above options.

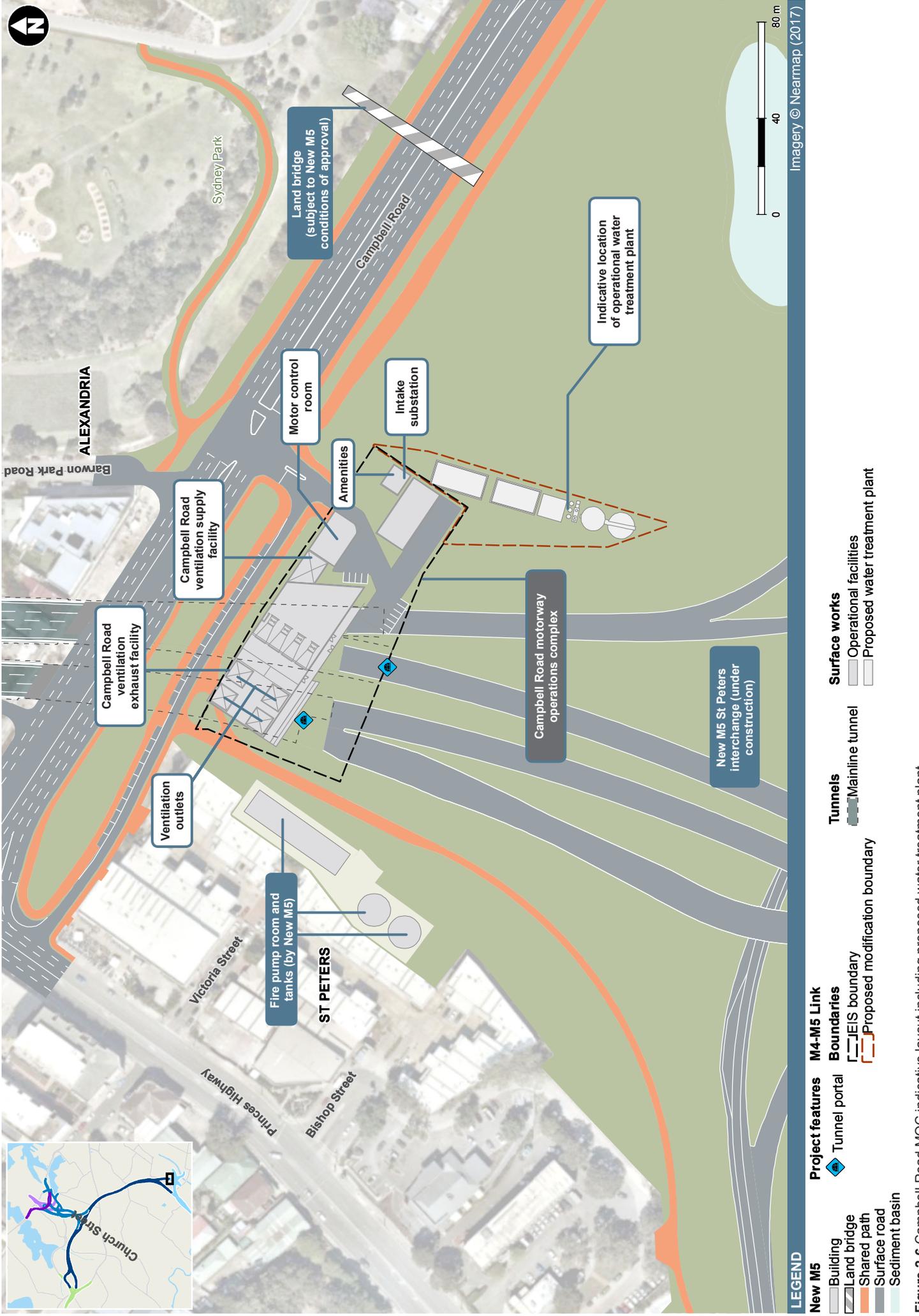


Figure 2-6 Campbell Road MOC indicative layout including proposed water treatment plant

3 Assessment methodology

3.1 Relevant legislation and guidelines

Key relevant legislation that applies to this assessment includes:

- *Water Act 1912* (NSW)
- *Water Management Act 2000* (NSW).

Key relevant guidelines and policies that apply to this assessment include:

- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC/ARMCANZ 2000)
- *NSW Water Quality and River Flow Objectives* (Department of Environment and Climate Change and Water (DECCW), 2006)
- *Managing Urban Stormwater – Soils and Construction, Volume 1, 4th Edition* (Landcom, 2004)
- *Managing Urban Stormwater – Soils and Construction, Volume 2D, Main Road Construction* (Department of Environment and Climate Change (DECC), 2008)
- *Botany Bay and Catchment Water Quality Improvement Plan* (Sydney Metropolitan Catchment Management Authority (SMCMA), 2011)
- *Floodplain Development Manual* (NSW Government 2005)
- *Planning circular PS 07-003 New guideline and changes to section 117 direction and Environmental Planning and Assessment Regulation on flood prone land* (Department of Planning and Environment (DPE), 2007)
- *Floodplain Risk Management Guideline – Practical Consideration of Climate Change* (DECC, 2007).

Further details on how the above guidelines and policies apply to the assessment of surface water and flooding and additional relevant policies and guidelines are provided within the M4-M5 Link EIS Appendix Q (Technical Working Paper: Surface water and flooding (August, 2017)).

3.2 Key assumptions

It was assumed that the following aspects of the proposed modification have the potential to result in adverse flooding or surface water impacts:

- Change of use of the Northcote Street civil and tunnel site and the Parramatta Road West and Parramatta Road East civil sites

Relocation of the mainline tunnel operational WTP to the Campbell Road motorway operations complex (MOC5) at St Peters

- Changes in the volume of treated wastewater at the Northcote Street civil and tunnel site and the Pyrmont Bridge Road tunnel site due to the removal of the Darley Road civil and tunnel site from the project. Indicative daily construction wastewater discharge volumes from the construction water treatment plants were assumed for the purposes of this assessment to be:
 - 13 litres per second (L/s) at the Northcote Street civil and tunnel site
 - 16 L/s at the Pyrmont Bridge Road tunnel site.

- The extended duration of the tunnelling component of the overall construction program by around six months compared to the M4-M5 Link EIS and M4-M5 Link SPIR associated with the changes to the construction methodology presented in the proposed modification would result in a similar increase in duration of discharges from the construction WTPs and run-off from construction ancillary facilities and other sites. These changes are expected to result in negligible impacts on drainage infrastructure or water quality of the receiving environments compared to the impacts assessed in the M4-M5 Link EIS and M4-M5 Link SPIR. No material change in flow volumes or rates is predicted and the impacts would continue to be adequately managed through the implementation of the environmental management measures set out in the M4-M5 Link EIS, M4-M5 Link SPIR and the conditions of approval
- The assessment of potential surface water and flooding impacts associated with the proposed modification has assumed that the existing environment conditions at each of the assessed locations are consistent with those set out in the M4-M5 Link EIS Appendix Q (Technical Working Paper: Surface water and flooding (August, 2017)).

3.3 Methodology

3.3.1 Construction assessment

The assessment of potential surface water and flooding impacts during construction associated with the proposed modification was limited to a qualitative flooding assessment. This included:

- An assessment of flooding conditions and potential impacts based on a review of the relevant sections of the M4-M5 Link EIS, New M5 EIS and M4 East EIS. New M5 will provide the construction platform within St Peters interchange which will be handed over to the M4-M5 Link contractor, who will then refine the construction site platform (and associated flood management measures) as required. As such, the New M5 flood mapping was used to inform the assessment of the construction of the operational WTP. Flood mapping developed as part of the M4 East EIS was used to assess flooding within the sites which formed part of the M4 East project including Northcote Street civil and tunnel site, Parramatta Road West and Parramatta Road East civil sites and the use of the G-loop at Haberfield.
- An assessment of whether surface water can be adequately managed by the environmental management measures stipulated within the M4-M5 Link EIS and M4-M5 Link SPIR when considering the:
 - Change in construction activities at Northcote Street civil and tunnel site and the Parramatta Road West and Parramatta Road East civil sites
 - Change in wastewater volumes at the Northcote Street civil and tunnel site and Pyrmont Bridge Road tunnel site due to the proposed removal of the Darley Road civil and tunnel site from the project
 - Proposed reinstatement and use of the G-loop at Haberfield by spoil haulage and other project-related heavy vehicles during construction.

The assessment of the operational WTP at the Campbell Road motorway operations complex (MOC5) included a qualitative flooding and drainage assessment. This included:

- An assessment of flooding conditions and potential impacts using the assessment carried out for the New M5 EIS and available New M5 detailed design for the St Peters interchange site
- An assessment of whether surface water can be adequately managed by the environmental management measures stipulated within the M4-M5 Link EIS and M4-M5 Link SPIR when considering the additional construction activities associated with the operational WTP.

3.3.2 Operational assessment

The methodology for the assessment of the operational WTP at the Campbell Road motorway operations complex (MOC5) included an assessment of potential water quality impacts and scour impacts associated with the treated discharges from the operational WTP and a qualitative flooding assessment based on a review of the WestConnex New M5 EIS.

A “box model” was developed to assess how the quality and quantity of pollutants associated with treated releases from the operational WTP would impact Alexandra Canal. A box model simulates the average state of a system through mass balancing and is used to evaluate heterogeneities in the system, in this instance changes in water quality.

The key inputs and assumptions applied during the box modelling assessment (see **section 3.3**) include:

- The tidal prism was calculated using mean high tide and mean low tide values for Tempe Bridge
- Tidal heights were obtained from Manly Hydraulics Lab (2012)
- Bathymetric data was used to estimate the flood and ebb tide volumes
- Untreated tunnel water quality was assumed to be equivalent to average groundwater quality based on a review of relevant monitoring well data for the mainline tunnel
- Treated tunnel discharges were assessed assuming a discharge quality consistent with the M4-M5 Link approval condition E187 (condition of approval E187 sets the operational water treatment plant discharge criteria for the project)
- The mainline tunnel groundwater flow rate to the WTP was assumed to be 23 litres per second which is the same flow rate assumed for the mainline tunnels within the M4-M5-Link EIS. This was based on one litre per second per kilometre of tunnel and is consistent with the requirement set out in condition E190 of the conditions of approval for the project
- Surface water quality for Alexandra Canal was based on median values of the New M5 surface water quality monitoring for Alexandra Canal (see **Table 5-1**)
- Following initial interrogation of the box model, stormwater inflows to Alexandra Canal were omitted from the box model for the purposes of this assessment. This enabled treated tunnel discharge impacts to be more readily identified and is considered to be a conservative approach (ie the box model assumes dry conditions)
- Groundwater inflows into Alexandra Canal from the surrounding catchment were assumed to be negligible for the purposes of this assessment as they are minor compared to tidal inflows, are likely to remain relatively constant and are already accounted for in terms of their effect on water quality (eg Alexandra Canal surface water quality monitoring).

A full description of the methodology and assumptions adopted for the box model are provided in **Annexure A**.

4 Potential impacts – construction

4.1 Northcote Street civil and tunnel site

The Northcote Street civil and tunnel site is located within the Dobroyd Canal catchment (see **Figure 1-1**). Construction discharges would ultimately drain to Dobroyd Canal.

The Dobroyd Canal catchment is fully urbanised with an area of around 800 hectares. The canal comprises an open channel between Iron Cove and the intersection of Carshalton and Norton Streets with underground branches extending upstream.

4.1.1 Flooding

Due to the interface of the M4-M5 Link project with the M4 East project and timing for completion of construction of these projects, the 'existing' flood conditions at the Northcote Street civil and tunnel site has been taken to be represented by the post-construction situation for the M4 East project.

Given the Northcote Street civil and tunnel site and the tunnel dive are located outside the Probable Maximum Flood (PMF) extent for mainstream flooding and overland flow, no flood impacts on adjacent properties are anticipated and the entrance to the tunnel dive would be suitably located outside the PMF flood extent. An extract from the flood maps produced for the M4 East EIS are provided in **Annexure B**. No additional flood mitigation measures to those stipulated within the M4-M5 Link EIS, M4-M5 Link SPIR and conditions of approval for the project are necessary at this location.

The Route B spoil haulage route for the Northcote Street civil and tunnel site includes a section of construction only road known as the G-loop at the intersection of Dobroyd Parade and Waratah Street. This location is affected by flooding during a 100 year ARI event. The G-loop was assessed during the M4 East EIS to potentially cause localised increases of up to 200 millimetres in the depth of inundation in Dobroyd Parade at Martin Street. Increases in the range of 10 to 20 millimetres were also assessed to extend into the Sydney Water pump station on the corner of Dobroyd Parade and Martin Street. The M4 East EIS identified that impacts could be mitigated by the provision of local bunding to direct overland flow along the G-loop road and around the Sydney Water pump station.

The temporary flood mitigation measures and temporary drainage associated with the G-loop would be reinstated in generally the same form. . At the end of construction the G-loop would be decommissioned and adjoining roads would be reinstated in accordance with the M4 East detailed design. As such, no worsening of existing flooding conditions is likely to occur, however any temporary residual impacts would be prolonged for the duration of construction. These potential impacts would be further considered during detailed design and construction planning phases in accordance with the mitigation measures set out in the M4-M5 Link EIS, M4-M5 Link SPIR and conditions of approval, including the preparation of a Flood Mitigation Strategy (as described in the M4-M5 link EIS) which would include details and procedures to manage the risk of adverse flood impacts on surrounding properties.

4.1.2 Localised drainage

All construction works would have the potential to impact local overland flow paths and existing minor drainage paths. Disruption of existing flow mechanisms, both of constructed drainage systems or those of overland flow paths, could occur as a consequence of the various construction activities and facilities. Specific causes of these impacts could include:

- Disruption of existing drainage networks during decommissioning, upgrade or replacement of drainage pits and pipes
- Interruption of overland flow paths by installation of temporary ancillary construction facilities
- Sediment entering into drainage assets and causing blockages
- Overloading the capacity of the local drainage system due to the generation of additional runoff.

These are typical impacts faced on most construction projects and can be addressed by adopting industry standard mitigation measures. Consideration of these impacts would be included during future detailed design and construction planning phases, along with consideration of the typical mitigation measures described in the M4-M5 Link EIS, M4-M5 Link SPIR and conditions of approval.

4.1.3 Water quality and geomorphology

Construction wastewater (including groundwater ingress, rainfall runoff in tunnel portals and ventilation shafts, heat and dust suppression water and wash down runoff) discharges from the Northcote civil and tunnel site would be approximately 1,100 kilolitres per day. This discharge would be predominantly associated with tunnel groundwater ingress which would be treated at the construction WTP to be located at the Northcote Street civil and tunnel site. Intermittent surface water (surface water runoff from roof/paved surfaces) discharges would also occur, which would be consistent with the flows assumed during the M4-M5 Link EIS to be generated by the Northcote Street civil and tunnel site. Given the minor discharge volumes occurring in the context of the overall catchment and concrete channel receiving environment of Dobroyd Canal, the potential for scour and erosion to occur is considered to be negligible.

Surface water and construction wastewater would be managed in accordance with the environmental management measures presented in the M4-M5 Link EIS, M4-M5 Link SPIR, conditions of approval and EPL including implementation of erosion and sediment controls and discharge criteria for construction discharges. With the proposed environmental management measures in place, impacts on water quality are considered to be negligible.

4.2 Parramatta Road West and Parramatta Road East civil sites

The Parramatta Road West and Parramatta Road East civil sites are located within the Dobroyd Canal catchment (see **Figure 1-1**). Construction discharges would ultimately drain to Dobroyd Canal. The Dobroyd Canal catchment is described in **section 4.1**.

4.2.1 Flooding

Due to the interface of the M4-M5 Link project with the M4 East project, the 'existing' flood conditions at the Parramatta Road West and Parramatta Road East civil sites has assumed that the the M4 East project is completed.

The Parramatta Road East civil site is located outside the PMF flood extent and the Parramatta Road West civil site is located on the fringe of the PMF flood extent with no overland flow paths occurring through the site. An extract from the flood maps produced for the M4 East EIS is provided in **Annexure B**. No topographic changes are proposed for Parramatta Road, Bland Street or Alt Street which abut the Parramatta Road West and Parramatta Road East civil sites. Therefore no flood impacts on adjacent properties are anticipated and no additional flood mitigation measures to those stipulated within the M4-M5 Link EIS, M4-M5 Link SPIR and conditions of approval are necessary at the Parramatta Road East and Parramatta Road West civil sites.

4.2.2 Localised drainage

All construction works would have the potential to impact local overland flow paths and existing minor drainage paths. Disruption of existing flow mechanisms, both of constructed drainage systems or those of overland flow paths, could occur as a consequence of the various construction activities and facilities. Specific causes of these impacts could include:

- Disruption of existing drainage networks during decommissioning, upgrade or replacement of drainage pits and pipes
- Interruption of overland flow paths by installation of temporary ancillary construction facilities
- Sediment entering into drainage assets and causing blockages
- Overloading the capacity of the local drainage system due to the generation of additional runoff.

These are typical issues faced on most construction sites and can be adequately managed by adopting industry standard mitigation measures. Consideration of these impacts would be included during future detailed design and construction planning phases, along with consideration of the typical mitigation measures described in the M4-M5 Link EIS, M4-M5 Link SPIR and CoA.

4.2.3 Water quality and geomorphology

No tunnel dive is proposed for the Parramatta Road West and Parramatta Road East civil sites, therefore a construction WTP is not proposed at these sites. Tunnel water pumped to Parramatta Road West civil and tunnel site as set out in the M4-M5 Link EIS would now be pumped to the Northcote Street civil and tunnel site which will discharge to Dobroyd Canal and the Pyrmont Bridge Road tunnel site which will discharge to Johnstons Creek.

Discharges from the Parramatta Road West and Parramatta Road East civil sites will only relate to surface water (surface runoff from roofs and paved surfaces). The total discharge volume will vary depending on rainfall conditions but is likely to be similar to existing conditions as both sites are almost totally covered by buildings and paved areas.

Surface water would be managed in accordance with the environmental management measures presented in the M4-M5 Link EIS, M4-M5 Link SPIR, conditions of approval and EPL including implementation of erosion and sediment controls and construction discharge criteria. With the proposed environmental management measures in place and given the overall discharge to Dobroyd Canal from the Parramatta Road West and Parramatta Road East civil sites, impacts on water quality and scour and erosion impacts due to the proposed modification are considered to be negligible.

Potential impacts on Johnston Creek as a result of the additional discharge via the Pyrmont Bridge Road tunnel site are discussed in **section 4.4**.

4.3 Construction of the water treatment plant at Campbell Road motorway operations complex

The Campbell Road motorway operations complex (MOC5) is located within the Alexandra Canal catchment (see **Figure 1-1**) with construction discharges ultimately discharging to Alexandra Canal.

Alexandra Canal is a constructed canal, originally a natural watercourse named Sheas Creek. It flows into the Cooks River near the north-western corner of Sydney Airport. As it was originally built for navigation by boat for transportation purposes, it is much larger than technically required to convey stormwater from the catchment area draining to it. Due to its size, in relation to its inflows as well as tidal action, the canal accumulates sediment. The sediments within the canal have been assessed to be contaminated and have been declared a remediation site by the NSW EPA.

A review of known water quality data for Alexandra Canal was undertaken as part of the M4-M5 Link EIS. The monitoring results were compared with the slightly to moderately disturbed trigger values for marine waters or estuarine waters in the case of nutrients, which correspond with the NSW Water Quality Objectives for aquatic ecosystems in the Cooks River catchment. Elevated levels of metals (chromium (III+VI), copper, lead, nickel (Sheas Creek only) and zinc) and nutrients (nitrogen, phosphorus and reactive phosphorus) were recorded in Alexandra Canal and Sheas Creek. The results are indicative of waterways within an urbanised catchment.

4.3.1 Flooding

The additional land for the water treatment plant would be sited outside the PMF flood extent for existing conditions mainstream flooding and would not be located within an existing major overland flow path. An extract from the existing conditions and proposed impact main stream flood maps produced for the New M5 EIS are provided in **Annexure B**.

The New M5 project is providing the construction site platform within the St Peters interchange. When the additional land for the water treatment plant is handed over to the M4-M5 Link contractor, the contractor will refine the construction site platform (if appropriate) to manage local overland flows as described in **section 4.3.2**.

Therefore, construction of the operational WTP is considered to pose a negligible risk of flooding impacts on adjacent properties.

4.3.2 Localised drainage

The potential for construction works to impact on local overland flow paths, existing minor drainage paths and drainage networks, as discussed in **section 4.1.2**, also applies to the construction activities associated with the operational WTP at the Campbell Road motorway operations complex (MOC5). Consideration of these impacts would be included during detailed design and construction planning phases, along with consideration of the typical mitigation measures described in the M4-M5 Link EIS, M4-M5 Link SPIR and conditions of approval.

4.3.3 Water quality and geomorphology

Surface water and construction wastewater within the extended portion of the Campbell Road motorway operations complex (MOC5) would be managed in accordance with the proposed environmental management measures presented in the M4-M5 Link EIS, M4-M5 Link SPIR and the conditions of approval. There would be a slight increase in the volume of construction surface water and construction wastewater as a result of the proposed construction activities associated with the operational WTP. With the proposed environmental management measures in place, impacts on water quality are considered to be negligible.

4.4 Pymont Bridge Road tunnel site

The Pymont Bridge Road tunnel site is located within the Johnstons Creek catchment (see **Figure 1-1**) with construction discharges ultimately discharging to Johnstons Creek.

Johnston Creek catchment is heavily urbanised. Originally a natural watercourse discharging to Rozelle Bay, Johnstons Creek was converted into a stormwater channel in the 1890s. The channel consists of a wide open concrete section at the Rozelle Bay end and brick walls further upstream.

A review of known water quality data for Johnstons Creek was undertaken as part of the M4-M5 EIS. Elevated levels of heavy metals (cadmium, copper, chromium, lead, nickel and zinc), phosphorus, nitrogen and nitrate were recorded. On some occasions the pH was also outside guideline levels and the turbidity exceeded guideline levels. The electrical conductivity indicated brackish conditions on occasion in the assumed non-tidal sampling location which indicate this location may be tidally influenced. Total recoverable hydrocarbons were also detected in the non-tidal sampling location.

Construction wastewater discharges from the Pymont Bridge Road tunnel site would increase to around 1,400 kilolitres per day. This is an increase of around 15 per cent compared to the daily discharge volume assumed within the M4-M5 Link EIS.

This discharge would be predominantly associated with tunnel groundwater ingress which would be treated at the construction WTP to be located at the Pymont Bridge Road tunnel site. Given the increase in discharge volume is minor from that assessed in the M4-M5 Link EIS and the receiving environment is the tidally influenced concrete channel of Johnstons Creek, the potential for scour and erosion to occur is negligible. There would also be negligible increase in the risk of scour downstream in Rozelle Bay given the flow rates are negligible compared to typical stormflows within Johnstons Creek and the estuarine bay would readily dissipate the minor flow rates during dry conditions. Downstream scour protection measures are therefore not required.

Construction wastewater would be managed in accordance with the environmental management measures presented in the M4-M5 Link EIS, M4-M5 Link SPIR and conditions of approval. With the proposed environmental management measures in place, impacts on water quality are considered to be negligible.

5 Potential impacts - operation

5.1 Water treatment plant at Campbell Road motorway operations complex (MOC5)

The Campbell Road motorway operations complex (MOC5) is located within the Alexandra Canal catchment (see **Figure 1-1**) with treated flows from the operational WTP ultimately discharging to Alexandra Canal. There are a range of potential discharge options as described in **section 5.1.1** and shown in **Figure 5-1**. The Alexandra Canal catchment is described in **section 4.3**.

5.1.1 Flooding and drainage

The operational WTP would be sited outside the PMF flood extent for mainstream flooding (refer **Annexure B**) and would be designed with consideration to potential local overland flow impacts and flood mitigation measures stipulated within the M4-M5 Link EIS, M4-M5 Link SPIR and conditions of approval. Therefore, the operational WTP is not likely to cause flooding impacts on adjacent properties. No additional flood mitigation measures to those stipulated within the M4-M5 Link EIS, M4-M5 Link SPIR and conditions of approval are considered to be necessary at this location.

Runoff generated from the operational WTP site will either be discharged to the St Peters interchange stormwater management system being constructed as part of the New M5 project or directly to the local drainage system.

Further hydrological and hydraulic modelling will be undertaken as part of detailed design to determine the ability of the receiving drainage systems to effectively convey drainage discharges from the operational WTP at this location.

Any potentially contaminated runoff (eg wash bay or a bunded chemical storage area without a roof) would be captured and disposed to sewer via a trade waste agreement or removed by a liquid waste contractor and disposed of offsite at a licenced facility.

5.1.2 Tunnel drainage streams

The M4-M5-Link EIS provides a description of the two tunnel drainage streams which will be managed separately including tunnel groundwater and tunnel surface water (stormwater ingress at portals, spills, maintenance washdown water, fire suppressant deluge and other potential water ingress events). As discussed in the M4-M5-Link EIS, given tunnel surface water discharges would be intermittent and the quality would be consistent with the approved discharge criteria, impacts associated with tunnel surface water are considered to be negligible.

The operational WTP would discharge on average around 23 litres per second of treated flow. For the proposed modification three options would be considered for the discharge of treated wastewater from the mainline tunnel drainage system:

- Option 1: Wastewater would be pumped to the water treatment plant at the Campbell Road motorway operations complex. Treated water would discharge to the stormwater basin and/or drainage network within the St Peters interchange site being constructed by the New M5 project. This drainage network would then discharge to Alexandra Canal
- Option 2: Wastewater would be pumped to the water treatment plant at the Campbell Road motorway operations complex. Treated water would be discharged to the existing drainage network and then to Alexandra Canal
- Option 3: Wastewater would be discharged to Sydney Water's sewage system in accordance with a Trade Waste Agreement.

The detailed design for the water treatment plant may include a combination of the above options.

The indicative location of the discharge outlets to Alexandra Canal being provided as part of the New M5 project works are shown on **Figure 5-1**. The location of these outlets will be confirmed as part of New M5 detailed design.

The strategy for treated tunnel discharges would be confirmed during detailed design and supported by hydrological and hydraulic modelling to assess the capacity of the drainage network to accept the additional flows. Where the above options for discharge of treated tunnel water are not feasible or an alternative discharge option is identified during detailed design, further assessment would need to be carried out.

An assessment of treated tunnel groundwater discharges is provided in **section 5.1.3** and **section 5.1.4** assuming treated flows are ultimately discharged to Alexandra Canal. No assessment was undertaken for discharges to the sewer system as environmental impacts are considered to be negligible.

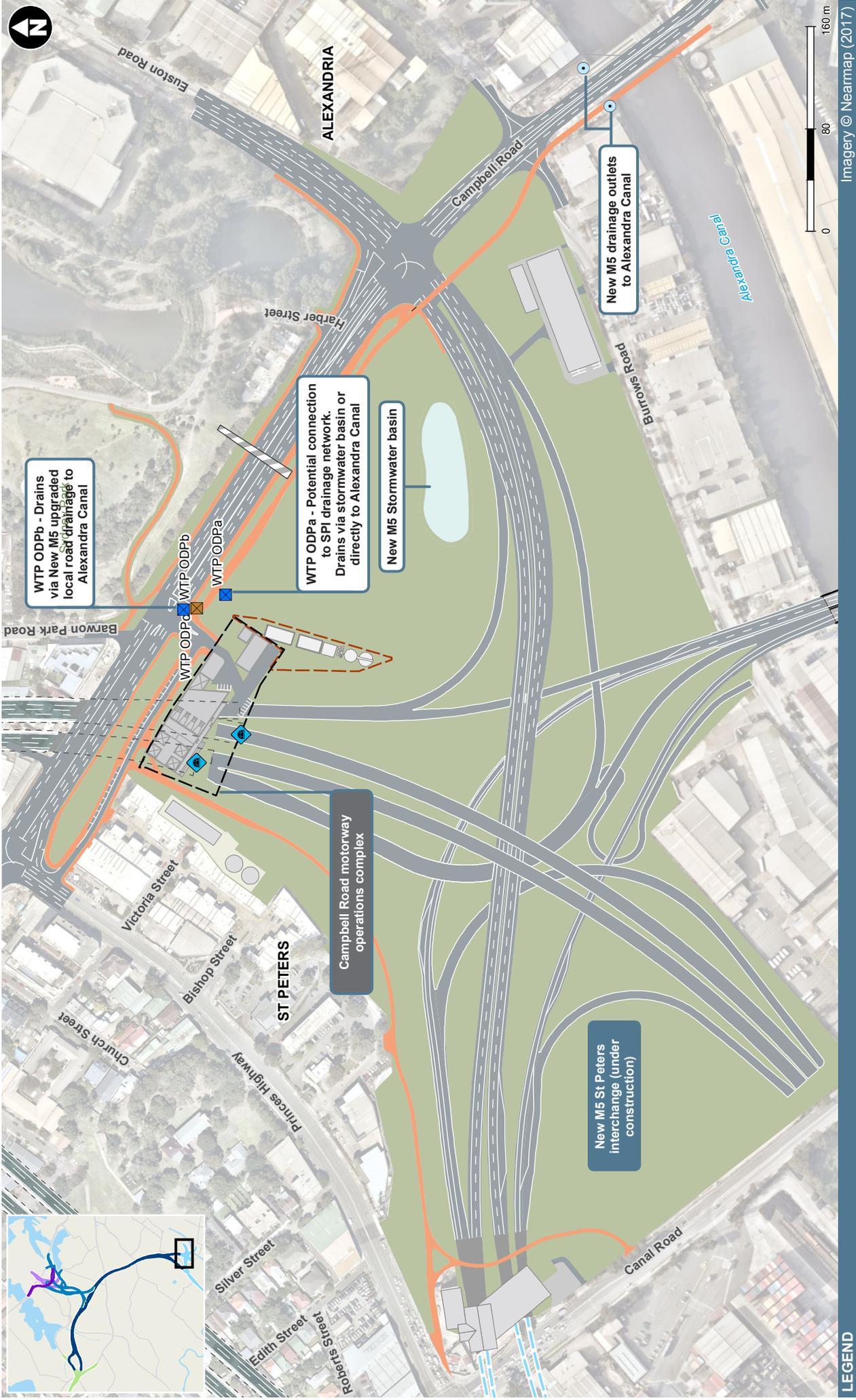


Figure 5-1 Indicative outlet locations for the operational water treatment plant at the Campbell Road motorway operations complex

5.1.3 Discharge quality

For the purposes of this assessment, tunnel groundwater quality is assumed to be equivalent to average groundwater quality recorded across monitoring wells in proximity to the mainline tunnel. Tunnel groundwater characterisation undertaken as part of the M4-M5 Link EIS was updated to incorporate the latest available groundwater monitoring data.

Groundwater quality monitoring data recorded between June 2016 and June 2018 was reviewed for wells relevant to the mainline tunnel route. The mean groundwater quality across all wells was determined following removal of significant anomalies. The groundwater quality is considered to be indicative of typical groundwater quality in the Hawkesbury Sandstone aquifer. This is presented as 'tunnel groundwater quality' in **Table 5-1**.

The proposed discharge criteria for the operational WTP are based on condition of approval E187 which states:

- *The CSSI operational water treatment plant discharge criteria must comply with the ANZECC (2000) 95 per cent species protection level and a 99 per cent protection level for contaminants that bioaccumulate unless other discharge criteria are agreed in consultation with relevant stakeholders including EPA, DPI Water and Sydney Water. Discharge criteria for iron during operation must comply with the ANZECC (2000) recreational water quality criteria.*

Discharges from the operational WTP at the Campbell Road motorway operations complex would be to the estuarine environment of Alexandra Canal. Therefore, the marine water quality trigger values were adopted as the discharge criteria. The freshwater trigger value was adopted for manganese consistent with the M4-M5 Link EIS. No nutrient discharge criteria were adopted in the absence of a 95 per cent species protection level for nutrients. The adopted operational WTP discharge criteria are presented in **Table 5-1**.

The review of average groundwater quality conditions indicates that chromium (III+VI), copper, iron and zinc were elevated in comparison to the approved discharge criteria.

- Iron: 24 milligrams per litre (mg/L) above the discharge criteria
- Chromium (III+VI): 0.0004mg/L above the discharge criteria
- Copper: 0.0013 mg/L above discharge criteria
- Zinc: 0.009 mg/L above discharge criteria

While iron concentrations were significantly above the discharge criteria, the concentration of chromium, copper and zinc only slightly exceeded the discharge criteria. It is noted that the average chromium (III+VI) concentration only exceeded the chromium (VI) 95 per cent species protection level and was below the chromium (III) 95 per cent species protection level.

5.1.4 Water quality impacts

A box model assessment was undertaken to assess impacts associated with treated tunnel water discharges. This assessment was limited to the assessment of treated tunnel groundwater flows. Refer to **section 3.2** and **section 3.3** for the assessment methodology and assumptions. The results of the box model assessment are provided in **Table 5-1**.

The box model assessment results indicate that:

- Treated discharges would result in a negligible impact on water quality within Alexandra Canal
- The number of constituents that currently exceeds the NSW Water Quality Objectives for aquatic ecosystems in marine / estuarine waters within Alexandra Canal (i.e. copper, lead, zinc, nitrogen and phosphorus) would not change as a result of the project.

On the basis that minor increases in nutrient loading were assessed to pose a negligible impact to Alexandra Canal, nutrient removal processes within the WTP are not considered to be required.

Table 5-1 Box model assessment results

Pollutants	Baseline Alexandria Canal water quality (mg/L)	Tunnel groundwater quality (mg/L)	WTP discharge criteria ¹ (mg/L)	Assumed WTP discharge quality (mg/L) ⁵	Final Alexandria Canal water quality (mg/L)	Impact (%)
Arsenic	0.003	0.0009	-	0.0009	0.003	-0.3
Cadmium	0.00005	0.00006	0.0007	0.00006	0.00005	0.0
Chromium (III+VI)	0.002	0.0048	0.0044 ³	0.0044	0.002	0.5
Copper	0.0050	0.0047	0.0013	0.0013	0.0050	-0.3
Iron	0.29	24.34	0.3	0.3	0.29	0.0
Lead	0.0050	0.0013	0.0044	0.0013	0.005	-0.3
Manganese	0.031	0.69	1.9 ²	0.69	0.034	9.5
Mercury	0.00005	0.00005	0.00010	0.00005	0.00005	0.0
Nickel	0.002	0.007	0.007	0.007	0.002	1.1
Zinc	0.046	0.024	0.015	0.015	0.046	-0.3
Nitrogen (Total)	0.9	1.64	- ⁴	1.64	0.90	0.4
Nitrate	0.2	0.09	- ⁴	0.09	0.20	-0.2
Ammonia	0.38	0.56	0.91	0.56	0.381	0.2
Phosphorus (Total)	0.09	0.41	- ⁴	0.41	0.091	1.6
Reactive Phosphorus as P	0.010	0.013	- ⁴	0.013	0.010	0.1

1. Adopted discharge criteria based on marine water 95 per cent or 99 per cent (for contaminants that bioaccumulate) species protection level (ANZECC, 2000)
2. Freshwater 95 per cent species protection level adopted for manganese
3. Based on chromium (VI) marine water 95 per cent species protection level
4. No ANZECC (2000) 95 per cent or 99 per cent species protection level
5. Lower value of tunnel groundwater quality and WTP discharge criteria. Bold values indicate where the discharge criteria were adopted as the discharge quality indicating some treatment may be required

Shaded values indicate Alexandria Canal constituent exceeds NSW Water Quality Objective (WQO) for aquatic ecosystems in marine / estuarine waters.

5.1.5 Geomorphic impacts

The operational WTP would increase discharge volumes to Alexandria Canal on average by around 23 litres per second with a negligible increase in runoff rates also occurring associated with the minor increase in impervious surface. Potential discharge strategies to Alexandria Canal are described in **section 5.1.2**. The final design of the stormwater infrastructure would be confirmed during detailed design.

There is potential to disturb contaminated sediments within Alexandria Canal (AECOM 2015) through increases in concentrated flow and velocities at an existing outlet where insufficient dissipation / scour protection is provided. There is also potential for sediment to be disturbed if flow rates within the wider canal are significantly increased. The disturbance of contaminated sediments could affect local water quality. As discussed in **section 4.3**, there is a current EPA Remediation Order for the contaminated sediments in the canal.

The treated tunnel discharge rate (around 23 litres per second) would be minor compared to flow rates and velocities from intermittent stormwater discharges at the outlet (likely to be greater than 1000 L/s). The minor increase in impervious surface associated with the operational WTP facility would result in a negligible increase in runoff volume to the existing stormwater outlet in the context of the overall catchment.

The highest risk of scour impacts occurring at an existing outlet is where flow velocities are greatest (when the outlet is at full capacity) during stormwater flow conditions. Providing appropriate dissipation / scour protection is in place at the existing outlet to cater for stormwater flows, the newly introduced continuous flow is unlikely to increase the risk of scour occurring during dry conditions. The suitability of the existing dissipation / scour protection to cater for the additional flow during design storm conditions would be confirmed during detailed design and supported by drainage modelling.

A comparison between the assumed discharge rate from the operational WTP and the one year ARI flow in Alexandra Canal, as defined in Appendix N of the New M5 EIS (Technical working paper: Surface water) (AECOM 2015) was undertaken to understand whether the operational WTP discharge is likely to create flow conditions that are rare or uncommon in Alexandra Canal. Flows from the operational WTP site are negligible compared to the one year ARI flow rate (refer to **Table 5-2**). The additional flow to Alexandra Canal is therefore considered to pose a negligible impact on flow velocities and flow energy within Alexandra Canal and as such, the potential for mobilisation of contaminated sediments is negligible.

Table 5-2 Estimated Alexandra Canal vs WTP discharge flow

Flow	Flow rate
1 year ARI flow in Alexandra Canal	83,900 litres per second
Average daily WTP discharge to Alexandra Canal	23 litres per second

6 Management of impacts

Based on the assumptions described in **section 3.2** and assessment of potential surface water and flooding impacts associated with the proposed modification, no further additional surface water or flooding environmental management measures are deemed necessary beyond those set out in the M4-M5 Link EIS, M4-M5 Link SPIR and conditions of approval.

A summary of the key mitigation measures and conditions of approval that would manage impacts associated with flooding and surface water during construction and operation is provided below:

- Preparation of a Flood Mitigation Strategy
- The project must be designed so that relevant flooding characteristics are not exceeded on adjacent lands / properties (refer to condition of approval E151)
- All reasonably practicable erosion and sediment controls must be installed and appropriately maintained to minimise any water pollution. When implementing such controls, any relevant guidance in the Managing Urban Stormwater series must be considered
- The project construction water treatment plant discharge criteria must comply with the ANZECC (2000) 90 per cent species protection level unless an EPL is in force in respect to the CSSI. Discharge criteria for iron during construction must comply with the ANZECC (2000) recreational water quality criteria (refer to condition of approval E186)
- The project operational water treatment plant discharge criteria must comply with the ANZECC (2000) 95 per cent species protection level and a 99 per cent protection level for contaminants that bioaccumulate unless other discharge criteria are agreed in consultation with relevant stakeholders including EPA, DPI Water and Sydney Water. Discharge criteria for iron during operation must comply with the ANZECC (2000) recreational water quality criteria (refer to condition of approval E187)
- Works on waterfront land must be undertaken in accordance with DPI controlled activity guidelines (refer to condition of approval E189)
- Further hydrological and hydraulic modelling based on the detailed design of the project must be carried out to determine the ability of the receiving drainage systems to effectively convey pavement drainage from the project. The modelling must be undertaken in consultation with the relevant council(s) and Sydney Water and the outcomes documented in the Stormwater Drainage Report (refer to condition of approval E195)
- The Stormwater Drainage Report must be prepared at least one (1) month prior to the commencement of any new drainage works, modifications or connections to existing drainage works, or construction of hard surfaces that are associated with the operation of the project and would result in runoff to existing stormwater drainage systems (refer to condition of approval E196)
- Appropriate design of new or modified drainage systems (refer to condition of approval E197).

If during detailed design a different strategy for the discharge of treated water from the operational WTP at the Campbell Road motorway operations complex (MOC5) is required, separate environmental assessment and hydrologic and hydraulic modelling would be carried out.

7 Conclusion

7.1 Flooding and drainage impacts

The risk of flooding and local drainage flows to the surface features of the modification has been assessed, as well as the potential impact that the modification might have on surrounding properties.

The potential flood risk and localised drainage impacts associated with the proposed modification are considered to be acceptable where the management and mitigation measures identified in the M4-M5 Link EIS, M4-M5 Link SPIR and conditions of approval are implemented. The assessment of flood risk and mitigation measures identified will need to be refined throughout the detailed design process.

7.2 Water quality impacts

Water quality impacts associated with construction phase discharges from the Northcote civil and tunnel site, Parramatta Road West and Parramatta Road East civil sites, the Pyrmont Bridge Road tunnel site and from the Campbell Road motorway operations complex were assessed as well as treated discharges from the operational WTP at the Campbell Road motorway operations complex.

Potential impacts on surface water quality during construction and operation of the modification are considered to be minor and manageable with the application of the proposed mitigation measures as set out in the M4-M5 Link EIS, M4-M5 Link SPIR, conditions of approval and EPL.

7.3 Geomorphology

Potential scour and erosion impacts associated with releases to Dobroyd Canal, Alexandra Canal and Johnstons Creek are considered to be negligible with the application of proposed management measures. As scour and erosion impacts to Alexandra Canal are considered to be negligible, disturbance of contaminated sediments and associated potential water quality impacts are considered to be negligible.

8 References

Lyall and Associates, WestConnex M4 East EIS, Surface Water: Flooding and Drainage. Prepared for NSW Roads and Maritime Services, September 2015

Lyall and Associates, WestConnex New M5 EIS, Appendix P, Technical working paper: Flooding. Prepared for Roads and Maritime Services, November, 2015

OEH NSW Tidal Planes Analysis, 1990-2010 Harmonic Analysis, (for NSW Office of Environment and Heritage), October 2012

AECOM, 2017, WestConnex M4-M5 Link Environment Impact Statement. Prepared for NSW Roads and Maritime Services, August, 2017

Annexure A – Box Model

Approach

A box model of Alexandra Canal was developed to assess the impact of treated tunnel water discharges to Alexandra Canal with consideration to the proposed treatment plant and dilution and mixing which would occur upon release.

In this model, Alexandra Canal has been schematised into one control volume whereby the main process of mixing is tidal exchange. This mixing is assumed to be uniform and effective. Tidal flows and treated tunnel water concentrations have been averaged over time, with Cooks River having constant water quality as a boundary condition. With these assumptions, an iterative scheme over many tidal cycles has been created to estimate the final water body concentrations at Alexandra Canal for a selection of analytes.

The inputs to the box model are described as follows. The results are presented in **section 5**.

Box model

A box model simulates the average state of a system through mass balancing and is used to evaluate heterogeneities in the system. A summary of the water balance and mass balance components of the model is provided below.

The box consists of a flood (V_{ft}) and ebb (V_{et}) component. As a whole, the water balance of Alexandra Canal is determined using a simple box model and is expressed in discrete time steps:

$$\frac{dV}{dt} = V_{MLW} + V_{ft} + V_{gw} - V_{et} = 0 \text{ (over many tidal cycles)}$$
$$V_{et} = V_{ft} + V_{gw}$$

As the main exchange of mixing is tidal exchange, the tidal prism (V_{ft}) is calculated using mean high tide (MHW) and mean low tide (MLW) values with (V_{MLW}) representing the volume of the box at mean low water. Tidal heights were obtained from Manly Hydraulics Lab (2012), and using bathymetric data the flood tide volumes were calculated as follows:

$$V_{ft} = V_{MHW} - V_{MLW}$$

Since the change in volume over time is assumed to reach zero, change in concentration can be calculated through mass balance equations. The Canal concentration (C_{canal}) is evaluated after each tidal cycle and is used to calculate the total mass of a selected analyte during the ebb tide (M_{et}) as well as the residual concentration during low tide (M_0). These have been calculated using the mass balance equations in **Figure A-1**. The extent of the model and process of tidal exchange is schematised in **Figure A-2** and **Figure A-3** respectively.

$$M_{FT} = C_{river} \times V_{ft}$$
$$M_{ET} = C_{canal} \times V_{et}$$
$$M_{gw} = V_{gw} \times C_{gw}$$
$$M_0 = C_{canal} \times V_{MLW}$$
$$C_{canal} = \frac{M_0 + M_{gw} + M_{ft} - M_{et}}{V_{MLW}}$$

Figure A-1 Mass balance calculations for the flood and ebb components of each box



Figure A-2 Box Model Extent

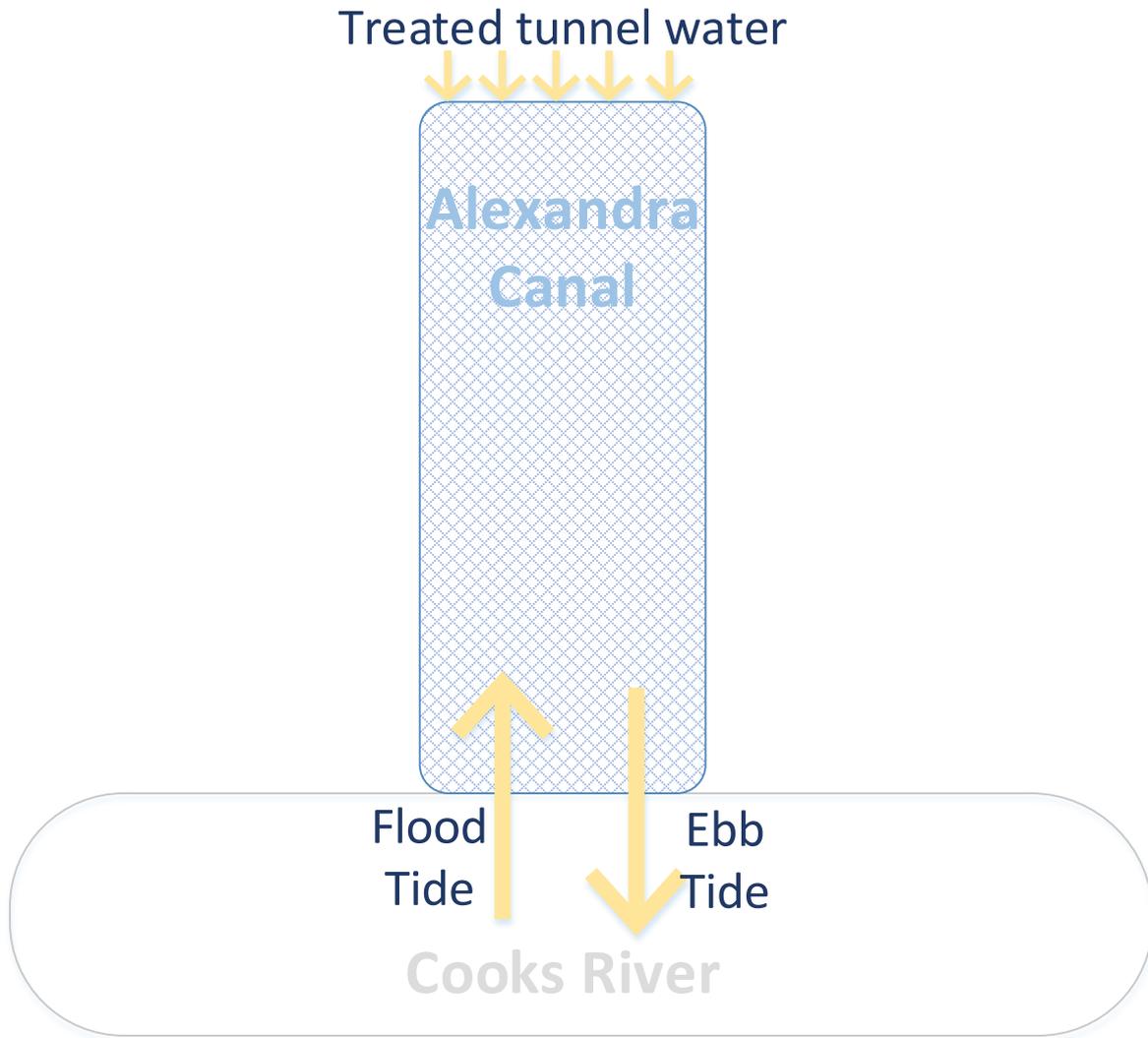
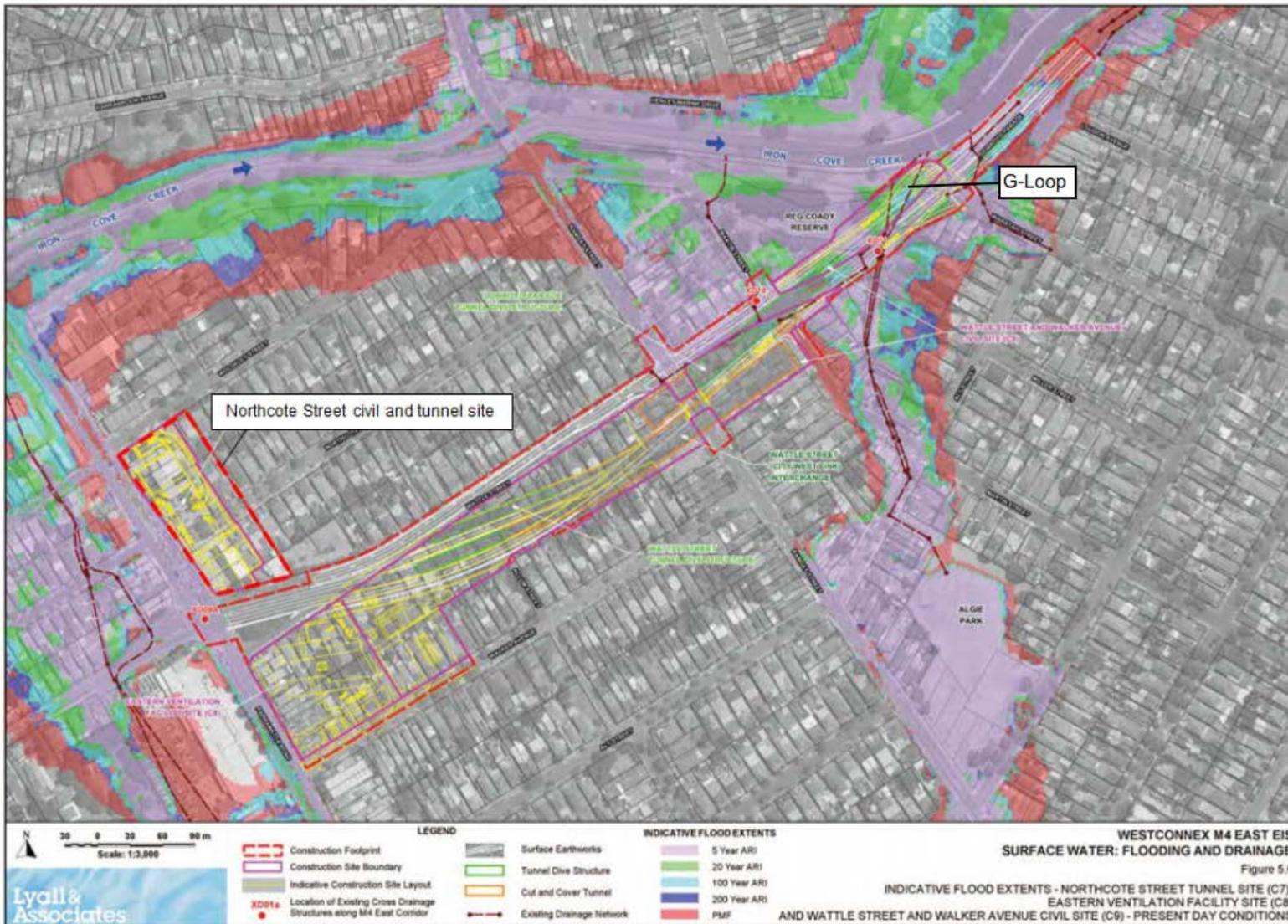
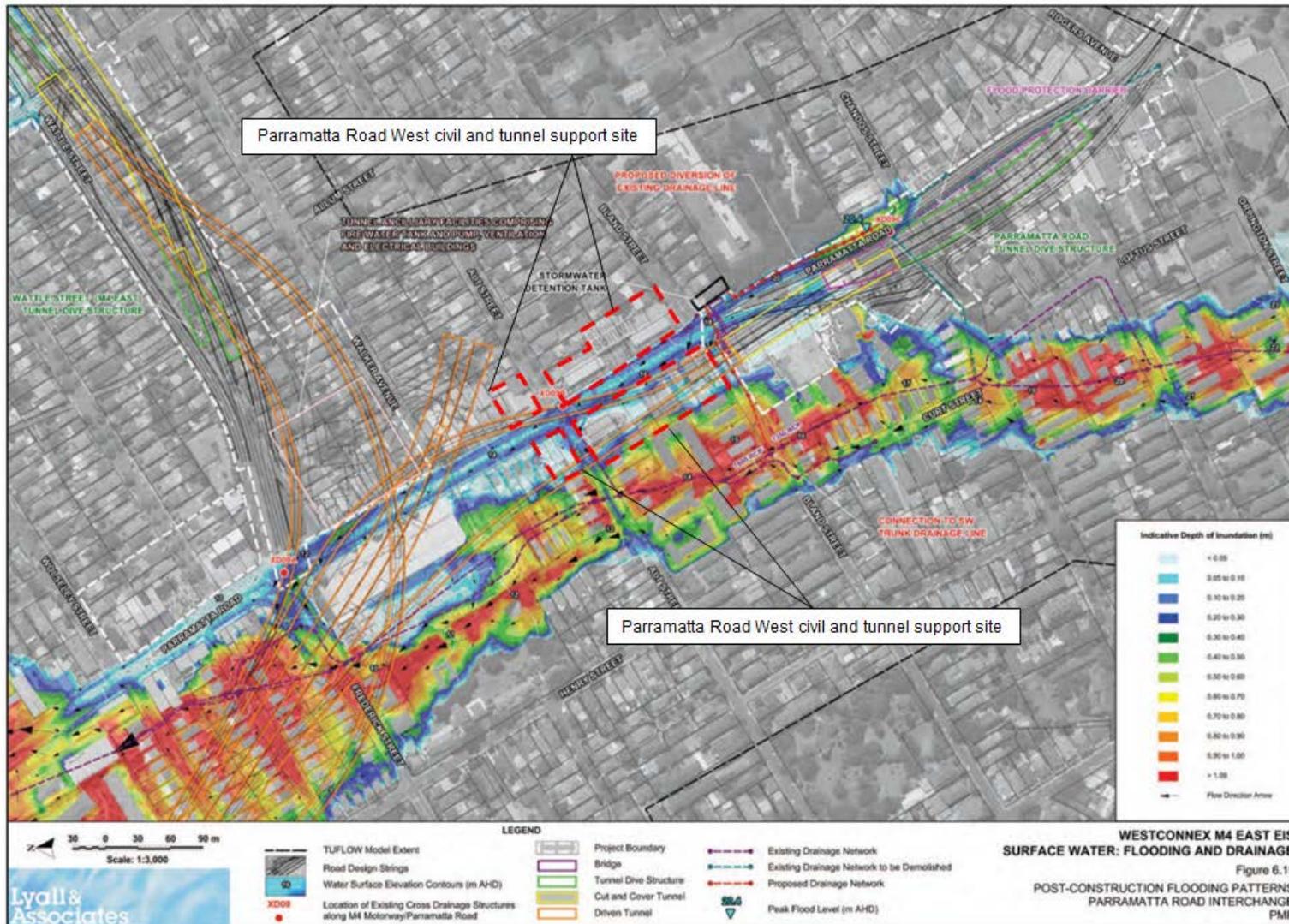


Figure A-3 Schematisation of Alexandra Canal Box Model

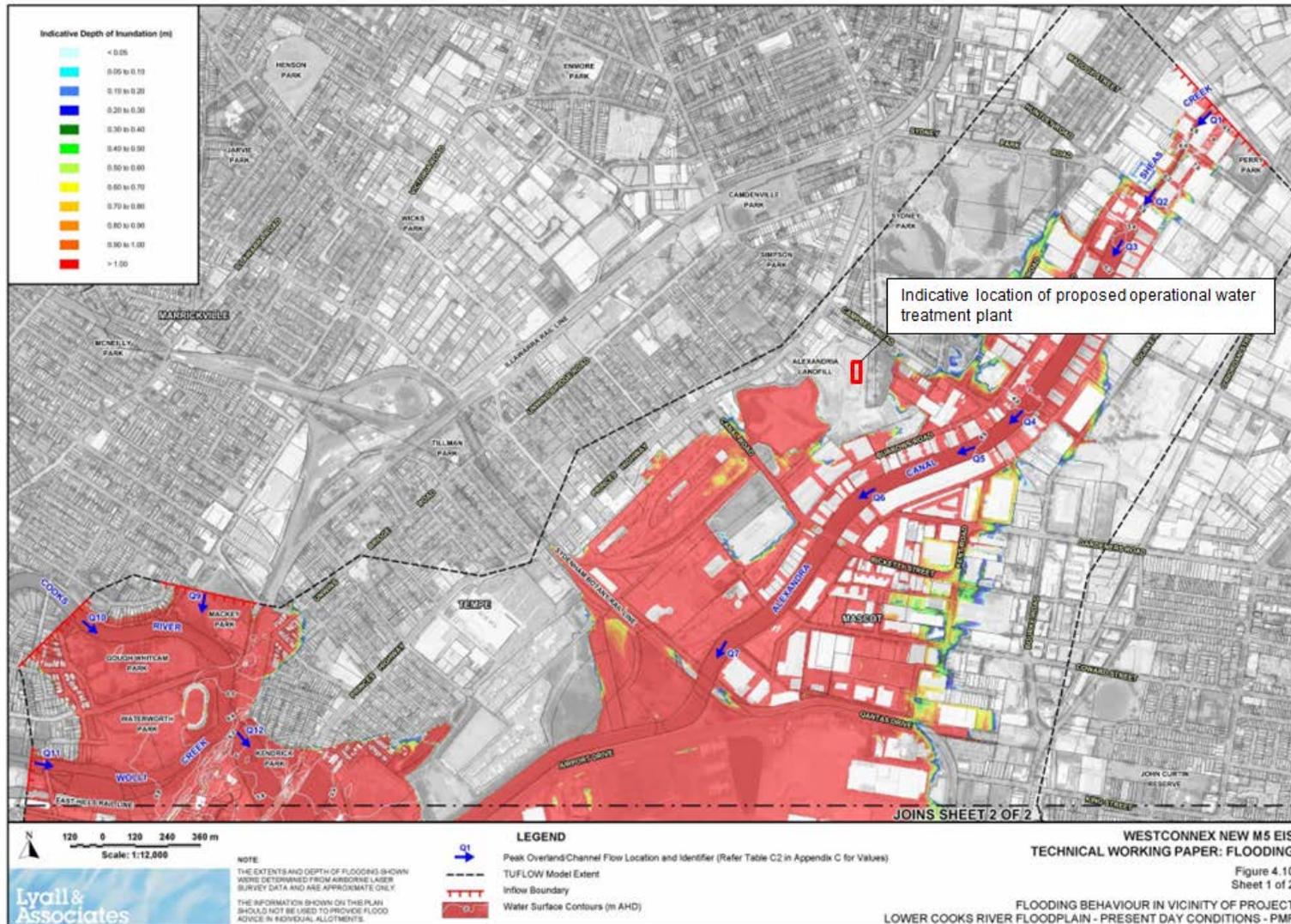
Annexure B – Flood map extracts



Edited extract from M4 East EIS Surface Water: Flooding and Drainage technical report (Lyall and Associates 2015) to show existing flooding conditions within vicinity of the Northcote Street civil and tunnel site



Edited extract from M4 East EIS Surface Water: Flooding and Drainage technical report (Lyall and Associates 2015) to show post M4 East construction flooding conditions within vicinity of the Parramatta Road West and Parramatta Road East civil sites



Edited extract from New M5 EIS Flooding technical report (Lyall and Associates 2015) to show existing mainstream flooding conditions adjacent to the Campbell Road civil and tunnel site