4. Proposed drainage works

4.1 Sydney Metro design criteria

The design criteria for the project in relation to drainage and flooding was developed as part of the reference design

The reference design on which the impact assessment has been based would be refined during future design stages and the below requirements would be further addressed as necessary at that stage.

Proposed flood immunity criteria for various types of infrastructure are summarised in Table 4-1.

Table 4-1 Minimum flood immunity of metro infrastructure

Infrastructure	Minimum flood immunity	Comment
Above-ground track	1 % AEP climate change event	For mainstream flooding when measured to track formation at the edge of ballast
Above ground rail system facilities	500 mm above the 1 % AEP climate change event	Except where facilities are identified as being critical for emergency management, in which case they must be set at a minimum of the PMF
Above ground stations	1 % AEP climate change event	Subject to site specific flood risk assessment to determine impacts and emergency management in the PMF

Note: A 10 per cent increase in rainfall intensity above the one per cent AEP rainfall intensity has been included to make allowance for the future effects of climate change.

Adopted design criteria for the proposed drainage system are summarised in Table 4-2. Proposed design criteria in relation to flood impacts are provided in Table 4-3.

Table 4-2 Drainage system design criteria

Infrastructure	Design criteria	Comment
Track drainage	Capacity up to 1 % AEP climate change event where subject to overland flooding 2 % AEP + 10 % increase in rainfall intensity elsewhere, except in the Campsie and Marrickville areas, where only 5 % AEP is achievable due to existing track immunity	The existing track immunity is low in these areas due to flooding from the surrounding catchments. Achieving greater flood immunity in these areas has the potential to require major drainage upgrade works, which may alleviate flooding in the rail corridor but exacerbate downstream impacts.
	No net increase in discharge rates to downstream systems for all events up to and including the 1 % AEP event	On site detention to be provided as required.
On-site detention basin spillways	Designed to provide controlled discharge of flows for events up to and including the 1 % AEP climate change event	N/A

Infrastructure	Design criteria	Comment
Stormwater outlets	Prevention of scour up to 2 % AEP + 10 % increase in rainfall intensity	Impacts to be checked for events up to the 1 % AEP climate change event.
Stormwater inlets	Allowance in design for partial blockage	Industry practice to be adopted.
Car park drainage	Applicable council standards Effective drainage to prevent ponding of water	N/A

Table 4-3 Design criteria for flood impacts on adjoining lands

Flooding characteristic	Proposed criteria for flooding on adjoining lands
Duration of flooding	Maximum increase in time of inundation of one hour in a 1 % AEP event.
Maximum increase in flood level at properties where floor levels are already exceeded in a 1 % AEP event	10 mm
Maximum increase in flood level at properties where floor levels are not exceeded in a 1 % AEP event	50 mm
Increase in flood velocities	Identification of measures to be implemented to minimise scour and dissipate energy at locations where flood velocities are predicted to increase.

Note: Of the above criteria, only increases in flood levels and velocities have been modelled at this stage. Floor levels were not available therefore it was not possible to report against these criteria in the EIS.

Where it is not reasonable or feasible to achieve the outcomes in Table 4-3, further analysis would be undertaken at the detailed design stage to determine an acceptable flood impact for individual locations.

Proposed water quality and re-use criteria are provided in Table 4-4 and are based on the *Water Sensitive Urban Design Guideline* (Roads and Maritime Services, 2016). These guidelines were found to be more stringent than the Council guidelines reviewed which included those documented in the former Marrickville Council Development Control Plan 2011 and the Botany Bay and Catchment Water Quality Improvement Plan (Sydney Metropolitan Catchment Management Authority 2011). Relevant Sydney Water standards were also adopted where required.

It is noted that ANZECC guidelines were not adopted for the purposes of this design. However, it is intended that they will be incorporated at a later stage of the project during detailed design.

Table 4-4 Water quality design criteria

Pollutant	Pollutant reduction criteria
Suspended solids	85 % retention of the average annual load (6 months ARI)
Total Phosphorous	65 % retention of the average annual load (6 months ARI)
Total Nitrogen	45 % retention of the average annual load (6 months ARI)
Litter	Retention of litter greater than 50mm for flows up to 25 % of the 63 % AEP (1 year ARI) peak flow

Pollutant	Pollutant reduction criteria
Course sediment	Retention of sediment courser than 0.125 mm for flows up to 25 % of the 63 % AEP (1 year ARI) peak flow
Oil and grease (hydrocarbons)	In areas with concentrated hydrocarbon deposition, no visible oils for flows up to 25 % of the 63 % AEP (1 year ARI) peak flow

4.2 Drainage infrastructure

Major changes to drainage at key locations are discussed below. Numerous other amendments to track drainage and cross drainage are also proposed and are discussed in later sections. In general, changes to existing drainage in the project area would be undertaken to:

- Replace assets in poor condition
- Provide new track drainage to cater to the realigned track
- Provide new track drainage to improve existing capacity issues
- Provide new cross drainage to manage overland flooding issues
- Mitigate increases in flow rates by provision of detention basins

The proposed works include the following:

- Around 14 kilometres of new track drainage
- Six new cross drainage structures to replace assets in poor condition
- Three new cross drainage structures
- Four new detention basins of sizes between 800 cubic metres and 8,000 metres cubed
- Several new inlet structures and open channels to manage runoff from the track formation and upstream areas
- Provision of a number of water quality treatment devices along the corridor to meet water quality objectives

The proposed works are summarised in section 4.2.1 for Marrickville Station, and in section 4.2.2 for stations between Dulwich Hill and Bankstown. The locations of the proposed detention basins are shown in Figure 4-1.

4.2.1 Marrickville Station

To alleviate existing flooding of the rail corridor for events up to the five per cent AEP event, the following is proposed in the vicinity of Marrickville Station to improve collection and conveyance of stormwater runoff.

Drainage to manage stormwater from the north

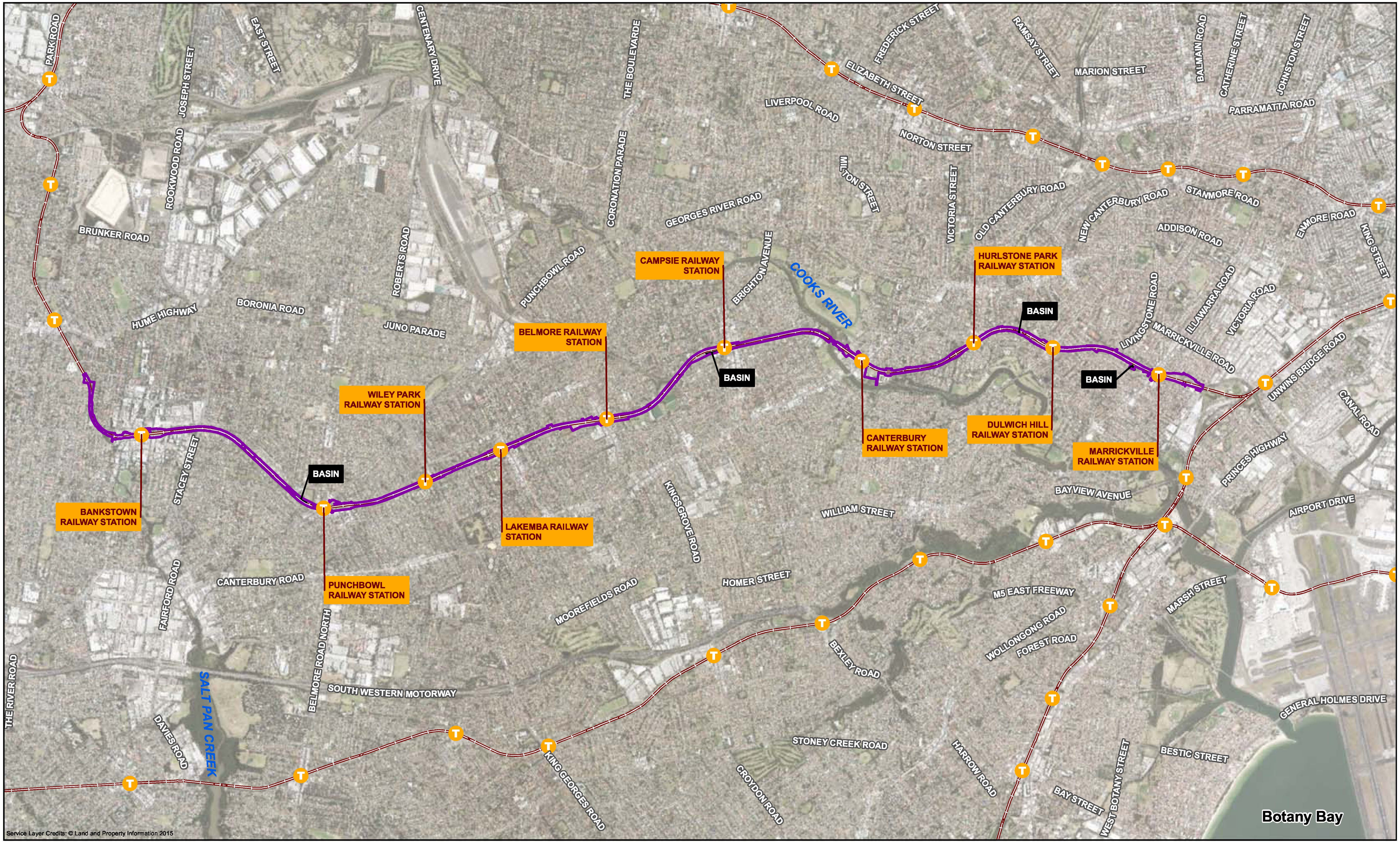
The following is proposed:

- 8,000 metres cubed underground detention basin system in McNeilly Park
- New trafficable grated inlet drains in Hollands Avenue and Livingstone Road
- Trafficable grated inlet drains in Livingstone Road and Marrickville Avenue
- New large diameter (1350 millimetre to 1650 millimetre) buried trunk stormwater system in Livingstone Road and Marrickville Avenue
- Inlet stormwater chamber in Marrickville Avenue adjacent to the rail corridor boundary

The new stormwater system external to the rail corridor would follow an alignment from the Hollands Avenue/ Livingstone Road intersection north of the rail corridor and cross beneath the rail corridor via a large inlet chamber to the north. This stormwater system would continue in an easterly direction, parallel to the cess drainage on the south side of the rail corridor in twin buried pipes placed side by side.

The most southerly of the twin pipe system will be diverted to a new 8,000 metres cubed underground detention system in McNeilly Park on the south side of the rail corridor. This detention basin manages the peak flows and discharges into the existing Malakoff Street stormwater tunnel which passes beneath McNeilly Park.

The remainder of the stormwater system from Livingstone Road continues past the proposed detention basin in McNeilly Park and is conveyed beneath Illawarra Road bridge under existing rail tracks in a large diameter buried pipe system and then diverts to the south beneath the station platform alignment.



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Metres

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

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LEGEND

- Project area
- Train station
- Railway
- Proposed Basin Location

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Revision	A
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Proposed Basin Locations

Figure 4-1

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This system then crosses beneath the existing rail tracks in a northerly direction and discharges into the existing open channel adjacent to Victoria Road. The system then enters the existing closed stormwater system beneath Meeks Road bridge before finally discharging into the Western Channel which outfalls into the Cooks River.

Drainage to manage stormwater from the south

The following is proposed:

- New trafficable drains adjacent to Illawarra Road and parallel to Marrickville Station platforms.
- New drainage culverts to convey flows beneath the Marrickville Station platform.
- A series of new large stormwater drainage pipes in Station Street, conveying flows towards McNeilly Park.

4.2.2 Dulwich Hill to Bankstown

A range of drainage works are proposed in the rail corridor between Dulwich Hill and Bankstown stations. This includes detention basins and upgrades to cross drainage culverts, slotted pipe inter-track drainage, stormwater inlet pits, junction pits, cess drainage, headwalls, and other associated works.

An overview of the proposed drainage works along the alignment from Dulwich Hill to Bankstown is provided in Table 4-5.

Table 4-5 Summary of proposed drainage works from Dulwich Hill to Bankstown

Location*	Summary of existing flooding and drainage issues	Proposed drainage works
Dulwich Hill Station to Canterbury Station	• Surface water flows from north to south beneath rail corridor. • Some locations of overland flooding into the rail corridor when the existing cross drainage capacity is exceeded (refer figures). • Substantial overland flooding east of Canterbury Station (high flood hazard area) due to insufficient track and cross drainage. • Minor overland flooding potential west of Canterbury Station (low flood hazard area).	• Culvert upgrades near Dulwich station. • New track drainage and local drainage upgrades. • 800 m^3 underground detention basin between Dulwich Hill and Hurlstone Park stations to mitigate increases in flow. • Culvert upgrades near Canterbury Station and provision of new 750 mm pipe to Cooks River.

Location*	Summary of existing flooding and drainage issues	Proposed drainage works
Campsie Station	• Surface water flows from south to north beneath rail corridor. • Overflows from local drainage overtop the rail corridor and flow east along rail corridor towards Campsie Station in events greater than the 10 % AEP. • West of Campsie Station is a high flood hazard area. • Overflows from local drainage into rail corridor near Belmore triangle area in events greater than 39 % AEP. • Because of the existing flooding in the rail corridor, and extensive works that would be required outside the project site to alleviate these, it is not considered practical to provide flood immunity in this area up to the 1 % event.	• New inter-track drainage. • New concrete-lined open channel to intercept overland flow from upstream. • 2,500 m^3 detention basin. • Provision of drainage standard and flood immunity to 5 % AEP level only. • New culvert to be provided in Belmore Triangle area to alleviate existing flooding.
Belmore Station	• Surface water flows from south to north beneath rail corridor. • Local drainage capacity constraints outside the rail corridor. • Rail corridor in fill and no predicted overland flow issues within the rail corridor.	• No measures proposed.
Lakemba Station	• Surface water flows from south to north beneath rail corridor. • East of station, risk of flooding in rail corridor for 5 % AEP and greater. • West of station, limited cross drainage capacity however rail corridor is in fill.	• New concrete lined cess drain to be provided. • New track drainage proposed.
Wiley Park Station	• Surface water flows from south to north beneath rail corridor. • Limited cross drainage capacity however rail corridor is mostly in fill.	• New track drainage proposed.
Punchbowl Station	• Surface water flows from south to north beneath rail corridor. • East of the station there are a number of culvert crossings present with varying capacities. • Potential for overflows into the rail corridor. • West of the station drainage modelling indicates overflows into the rail corridor at a number of locations for 1 % AEP climate change event.	• New cess drain and track drainage in this area. • 1,700 m^3 underground detention basin underneath the Up cess area.

Location*	Summary of existing flooding and drainage issues	Proposed drainage works
Bankstown Station	• Rail corridor mostly in fill with limited potential for flooding of tracks except in large (infrequent) events. • An area of medium flood risk hazard to the east of the station.	• New track drainage proposed.

Note: For simplicity, locations are described with reference to the nearest station

4.3 Water quality

Water quality treatment measures have been proposed to satisfy the adopted design criteria outlined in Table 1-3. The proposed measures have been modelled in MUSIC for Punchbowl Station as a test site, and extrapolated for the other stations using the results for Punchbowl as the reference. Punchbowl was adopted as the test site on the basis that it has the largest extent of proposed impervious areas.

The proposed water quality measures are summarised in Table 6-4, and consist of:

- GPTs for the treatment of litter and debris. A total of 12 GPTs (2 each for Lakemba and Wiley Park stations, and 1 each for the remaining stations).
- Rain gardens for the treatment of total phosphorus, total nitrogen and suspended solids. Rain gardens are provided for each of the stations, except for Marrickville, where it is not required.

4.4 Construction

Construction of the project would commence once all necessary approvals are obtained, and the detailed design is complete. Where possible, construction and drainage activities would be planned considering the upcoming weather forecast to minimise the risks of potential heavy rainfall and major surface runoff events.

Although planning of activities in this manner would not prevent construction during periods of potentially heavy rainfall, the risk of having disturbed construction areas or unpreparedness during heavy rainfall periods would be reduced.

4.4.1 Pre-construction works

During the early stages of construction, various preparatory works would be undertaken such as site establishment works and construction access provision. Early stage works would also include:

- Installation of environmental controls, including sediment and erosion controls
- Stormwater drainage channel protection and diversion works
- Any necessary flood mitigation measures to manage overland flows

4.4.2 Construction and maintenance access

Construction access to the rail corridor would be carefully controlled and co-ordinated to minimise disturbance and inconvenience to landholders. Access to the project area would be via existing gates along the rail corridor and from major roads, where possible.

Any new access along the corridor would be formed and stabilised. Where access crosses drainage flow paths, drainage culverts of adequate capacity would be provided across the access track to keep vehicle tyres out of the water whilst facilitating drainage.

4.4.3 Construction compounds and worksites

Construction compounds and worksites would be located both within the rail corridor and in external locations. They would be located:

- At least 50 metres from watercourses or major drainage structures unless a detailed site specific erosion and sediment control plan is implemented.
- Above the five per cent AEP flood level (1 in 20 year ARI flood level) where possible.

Indicative locations for the construction compounds are shown in Figure 4-2. Some of these are within areas identified as existing flood hazard areas. Worksite information and potential construction stage impacts resulting from these are discussed in section 5.2.2. The final construction compound and worksite locations would be selected by the construction contractor and will be included in the Construction Environmental Management Plan (CEMP) or relevant subplan.

4.4.4 Stockpiles

Stockpiles of raw materials or spoil would be located as close as practical to the work area where they are proposed to be used and to permit drainage away from the track to reduce potential flooding impacts.

4.4.5 Surface water flows

A number of proposed improvements to cross corridor drainage would occur as part of the overall construction process. In general, where new cross drainage is proposed, the new infrastructure would be installed first before decommissioning the existing infrastructure. This would minimise the potential for uncontrolled water passage through the site and into adjacent areas.

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Map Projection: Transverse Mercator
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LEGEND

- Project area
- Compound Locations
- Train station
- Railway

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Figure 4-2

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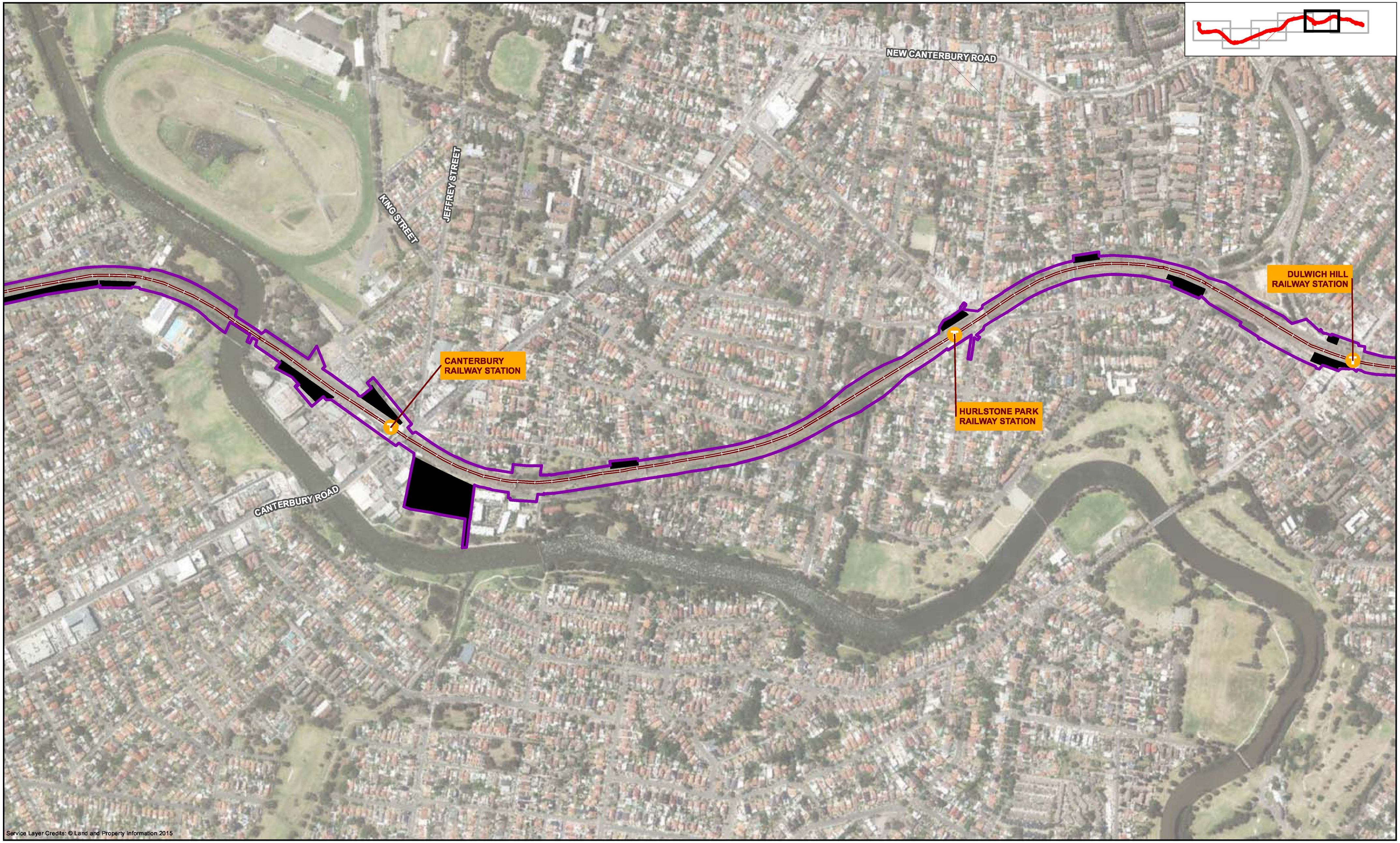

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LEGEND

- Project area
- Compound Locations
- Train station
- Railway

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Figure 4-3

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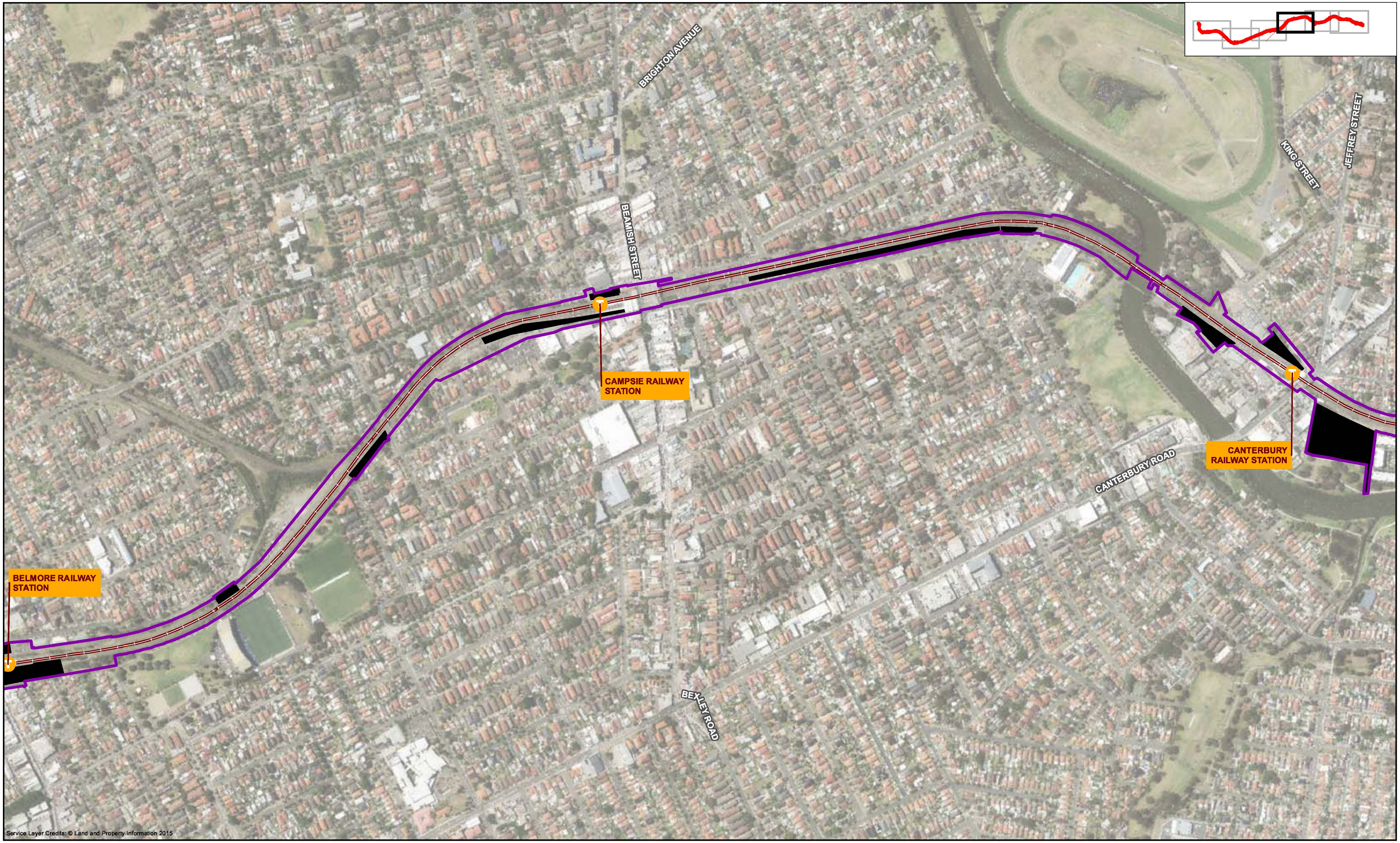

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LEGEND

- Project area
- Compound Locations
- Train station
- Railway

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Figure 4-4

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LEGEND

- Project area
- Train station
- Railway
- Compound Locations

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Figure 4-5

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LEGEND

Project area

Compound Locations

Train station

Railway

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Figure 4-6

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Map Projection: Transverse Mercator
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LEGEND

- Project area
- Compound Locations
- Train station
- Railway

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Figure 4-7

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