Chapter 7. Description of the project

The description of the project included in this chapter is based on a level of design that is indicative only, and would be subject to further planning and development based on the outcomes of the environmental assessment process.

7.1 Overview of the project and key features

The project would be a dual track, electrified railway line, approximately 23 kilometres long, between Epping Station and the proposed train stabling facility at Rouse Hill.

Six stations are proposed at Franklin Road, Castle Hill, Hills Centre, Norwest Business Park, Burns Road, and Rouse Hill. Park and ride facilities are proposed at Franklin Road, Hills Centre and Burns Road Stations. Interchanges with the North West Transitway would feature at Burns Road and Rouse Hill Stations, whilst local bus services would connect at the Franklin Road, Castle Hill and Norwest Stations.

A train stabling facility for eight eight-car trains is proposed at Rouse Hill.

Key features of the project are summarised in Table 7.1 and the proposed alignment is shown in Figures 7.1 to 7.7.

Table 7.1 Key features of the project – described from east to northwest

Feature	Summary
Total length (approx)	23 km (approximately 16 km below ground, 7 km at surface level or on viaduct)
Quadruplication	Amplification of the existing twin track between Epping and Beecroft Stations to four tracks (approximately 2.5 km). Cheltenham Station would be upgraded.
Dive structures	Two dive structures incorporating 0.2 km tunnel portals branching off the Northern Line between Cheltenham Station and Beecroft Station, to connect with the twin bored tunnels.
Twin bored tunnel section	A twin bored tunnel section (13 km) running from the Northern Line to a tunnel portal to the north of Celebration Drive (south of Burns Road Station). Incorporates new underground stations at Franklin Road, Castle Hill, Hills Centre and Norwest.
Cut and cover tunnel sections	Approximately 3 km of cut and cover tunnel sections: » 1.2 km cut-and-cover tunnel section from the north of Celebration Drive to north of Burns Road Station. Incorporates a new underground station at Burns Road. » 1.4 km cut-and-cover section from north of the Windsor Road/Old Windsor Road intersection to north of Commercial Road, incorporating a new underground station at Rouse Hill.
Surface sections (embankment/cutting, viaduct)	The above ground sections are approximately 4 km long, including: » Approximately 1 km on viaduct across the Elizabeth Macarthur/Caddies Creek floodplain, from Samantha Riley Drive and over the Windsor

Feature	Summary
	Road/Old Windsor Road intersection. » The remaining sections above ground including areas in embankment or cutting. This area incorporates the stabling facility to the north of Rouse Hill Station.
Train stabling facility	Located west of Windsor Road at Rouse Hill, with facilities for cleaning and maintenance of eight eight-car trains
Stations	» Franklin Road » Castle Hill » Hills Centre » Norwest » Burns Road » Rouse Hill
Park and ride	Facilities are proposed at Franklin Road, Hill Centre and Burns Road Stations – refer Table 7.2.
Ancillary facilities	Includes power supply, sectioning huts, signalling structures, access roads and other infrastructure required for the operation and maintenance of rail services and infrastructure.
Construction work sites	» Epping to Beecroft quadruplication (linear construction zone); » Cheltenham Station upgrade; » Cheltenham dive site; » Underground station sites (Franklin Road, Castle Hill, Norwest); » A site In the Balmoral Road release area; » A site at the Hills Centre station area; » Above ground construction areas and viaduct construction (between Burns Road and Rouse Hill); » Ancillary tunnel support site (in the vicinity of Pennant Hills Road); » Cut and cover works at Rouse Hill and Windsor Road; and » Rouse Hill stabling area.

The concept plan detailed in chapter 11 describes what the proponent is seeking approval for from the Minister for Planning. The concept plan seeks approval for the project generally within a 60 metre wide corridor for the tunnel sections and the interim stabling facility and a 40 metre wide corridor in remaining areas. These corridor widths in some cases would be wider than that required for the physical infrastructure and therefore allows for some flexibility during design development.

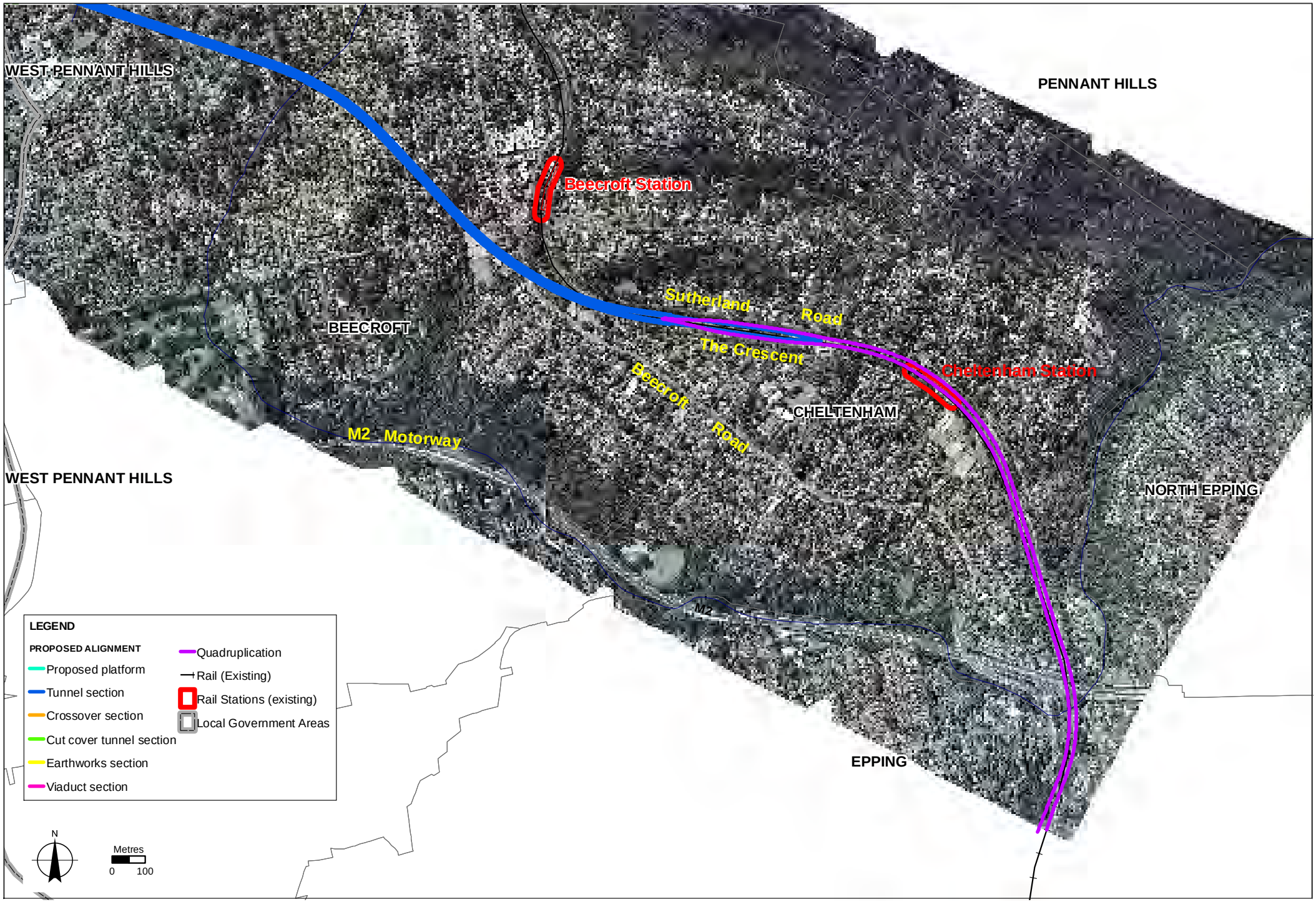

Figure 7.1 Proposed alignment - Epping to Thompsons Corner

Figure 7.2 Proposed alignment - Thompsons Corner to Rogans Hill Reservoir

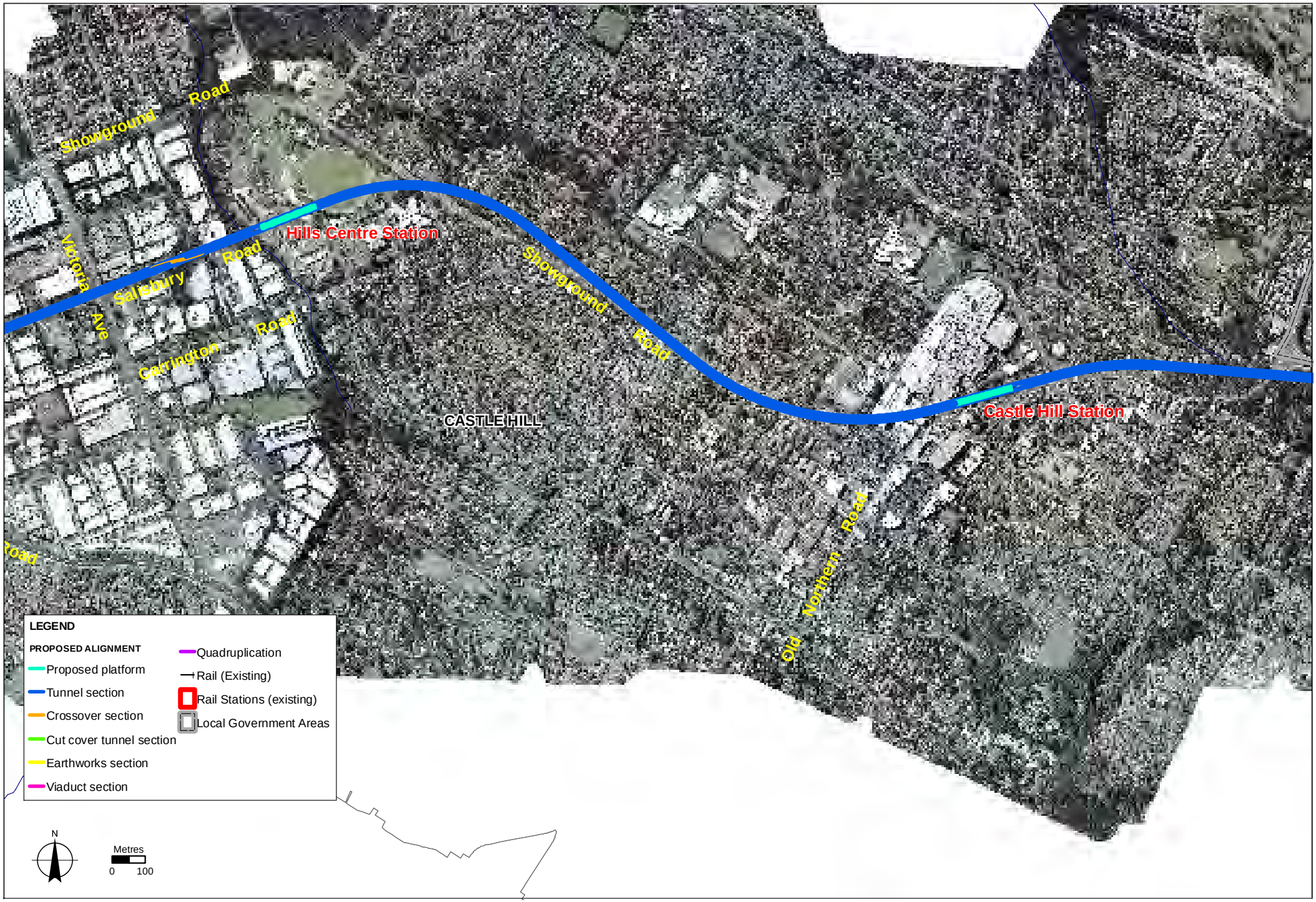

Figure 7.3 Proposed alignment - Rogans Hill Reservoir to Hills Centre Station

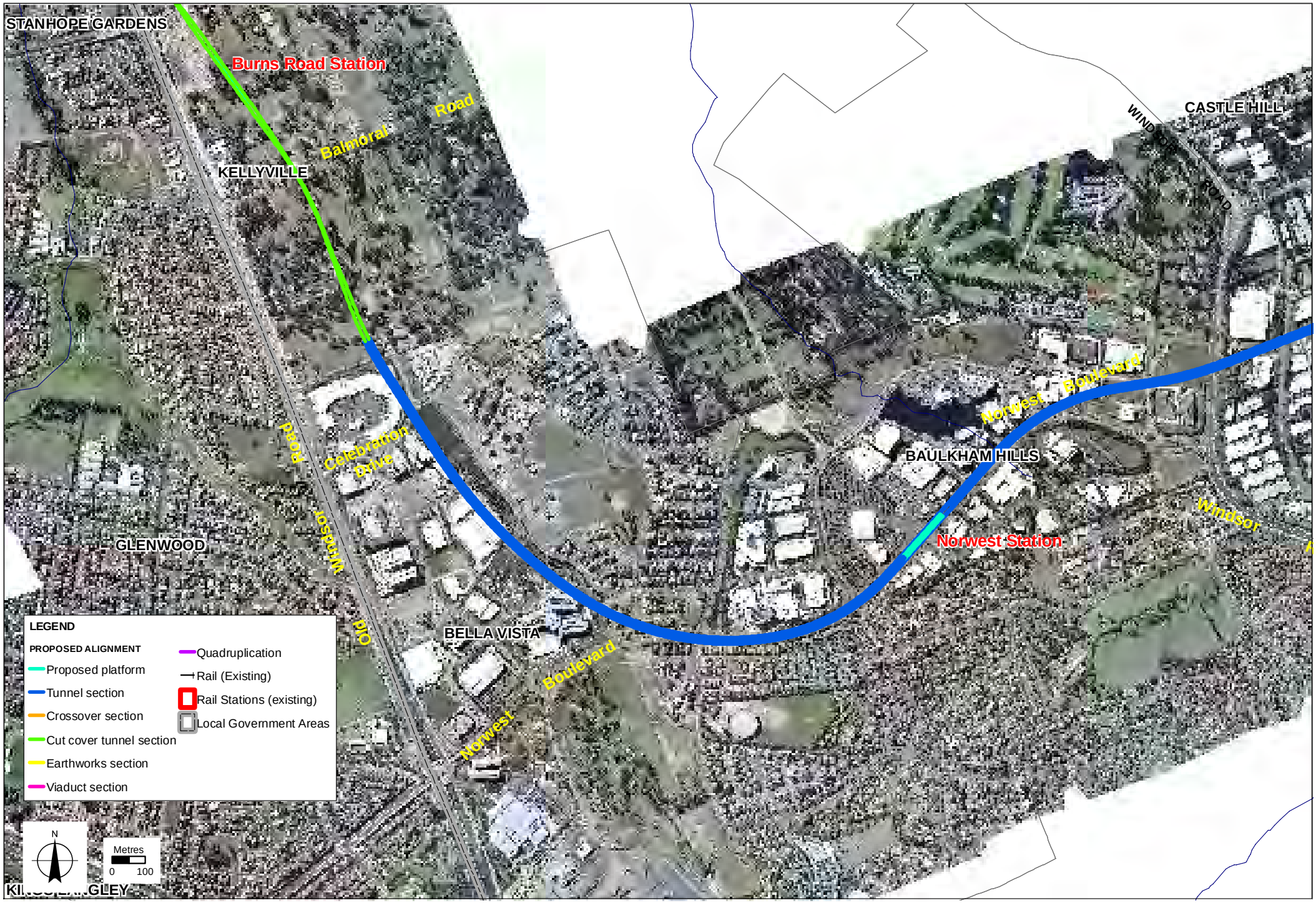

Figure 7.4 Proposed alignment - Hills Centre Station to Burns Road Station

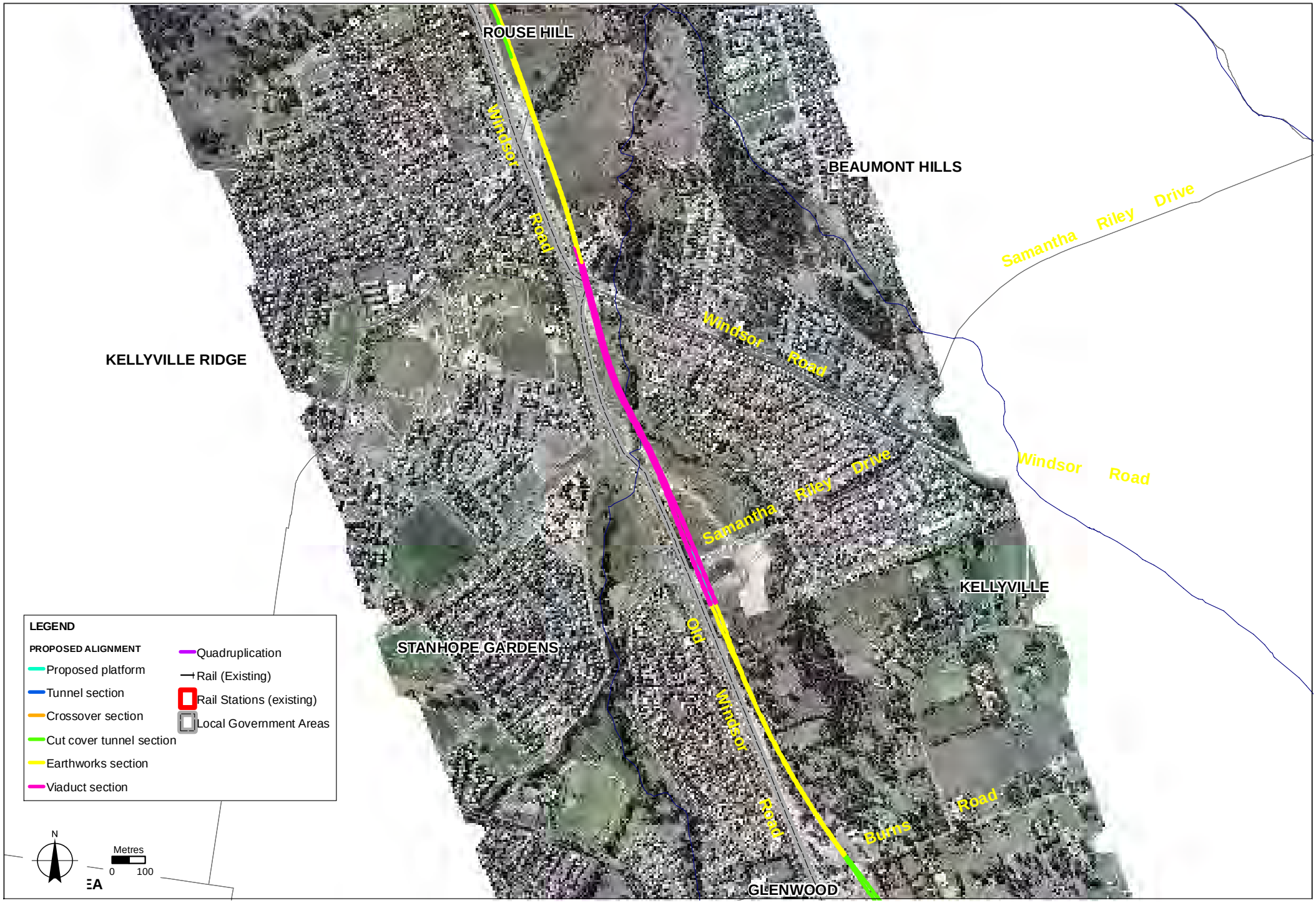

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Figure 7.5 Proposed alignment - Burns Road Station to Old Windsor Road/Windsor Road intersection

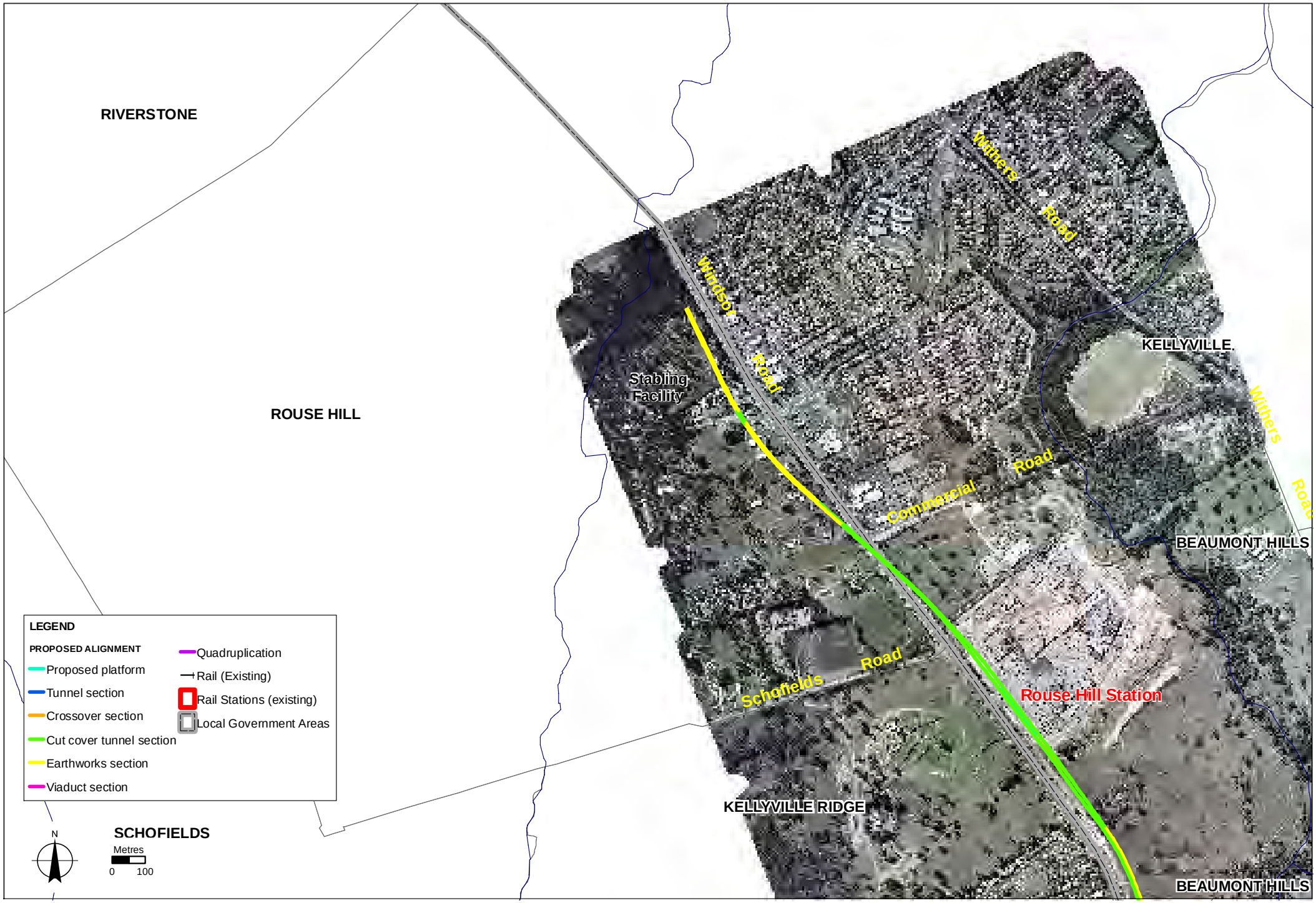

Figure 7.6 Proposed alignment - Old Windsor Road/Windsor Road intersection to Rouse Hill stabling facility

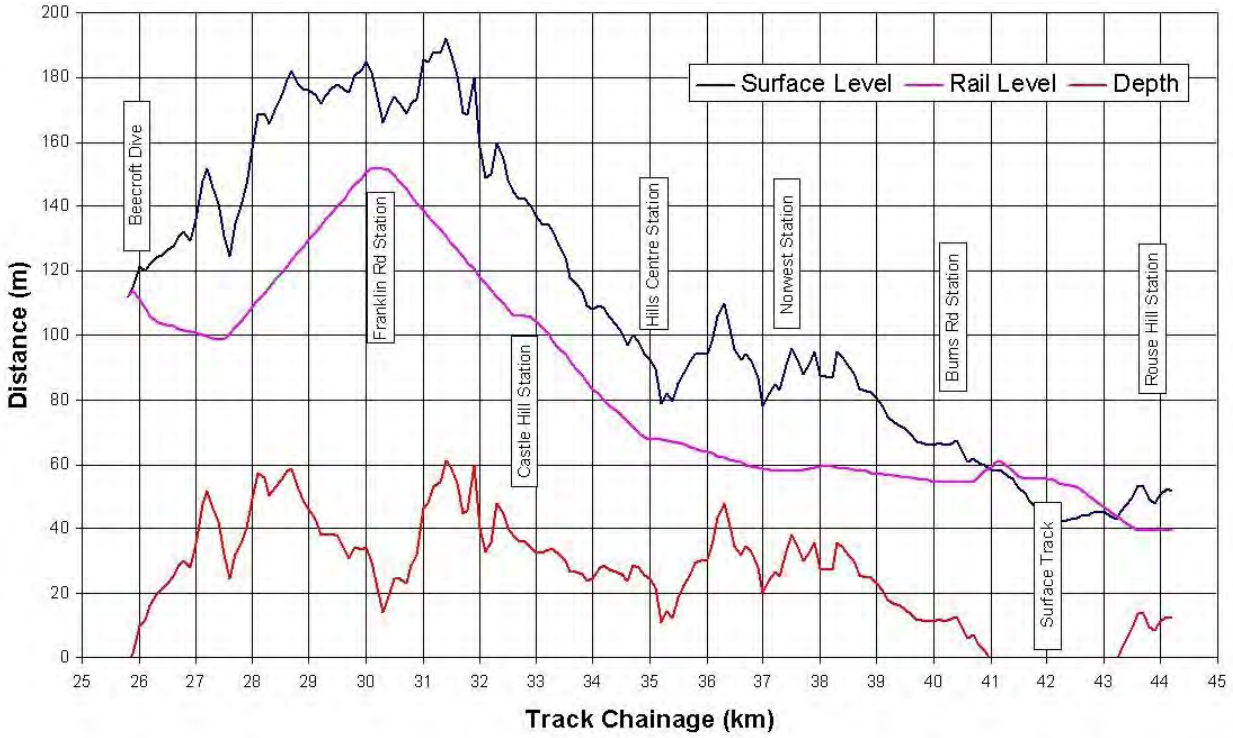

Figure 7.7 Indicative vertical alignment

7.2 Alignment design and proposed works

The project is described in sections from east to west.

7.2.1 Epping Station to Beecroft tunnel portal (quadruplication works)

The project commences at Epping with an approximately 2.5 km surface quadruplication of the Northern Line between Epping and Beecroft (refer Figure 7.1). As part of the quadruplication works, a new rail bridge over the M2 and upgrades to Cheltenham Station would be required. It is anticipated that the quadruplication works would remain within the rail corridor, with the exception of the rail bridge over the M2.

The quadruplication works would involve significant construction within the existing rail corridor, including works during track possessions (that is, when the operating rail is not running). The corridor would largely be cleared of vegetation and cuttings would be widened to accommodate the additional tracks and associated structures including retaining walls, track formation and new overhead wiring. An indicative example of the scale of works is shown in the cross section in Figure 7.8.

Figure 7.8 Example cross section for the proposed quadruplication within the existing rail corridor

Note: Figure shows the four track arrangement (red), the existing ground level (grey) and new ground level (green) that would be required.

The existing Cheltenham Station consists of two side platforms to support the up and down main lines, with small buildings to each platform. The existing station facilities and ticket office are located on the up main line or Sutherland Road side, while the down main line or The Crescent road side has a small building providing an undercover waiting area.

The proposed addition of two lines through Cheltenham would create a pair of island platforms out of the existing. With island platforms an overhead concourse would be added to allow for ease of access to the platforms. This would include the installation of lift access. The new tracks would involve the demolition of the existing station buildings. Ticketing and staff amenity facilities would need to be relocated to a new facility.

Two commuter car parking areas within the rail corridor currently provide 81 spaces (including 5 disabled spaces) at Cheltenham Station. The proposed quadruplication would utilise a significant area within the rail corridor necessitating impacts on the existing car parking area. Additionally construction related activities are likely to temporarily impact on further areas of car parking.

At this stage the precise construction or permanent impacts on car parking numbers are not known. Figure 7.9 shows an indicative conceptual design for Cheltenham Station that would retain 44 car parking spaces. The actual configuration and impacts on car parking spaces at Cheltenham would be subject to further design and assessment.

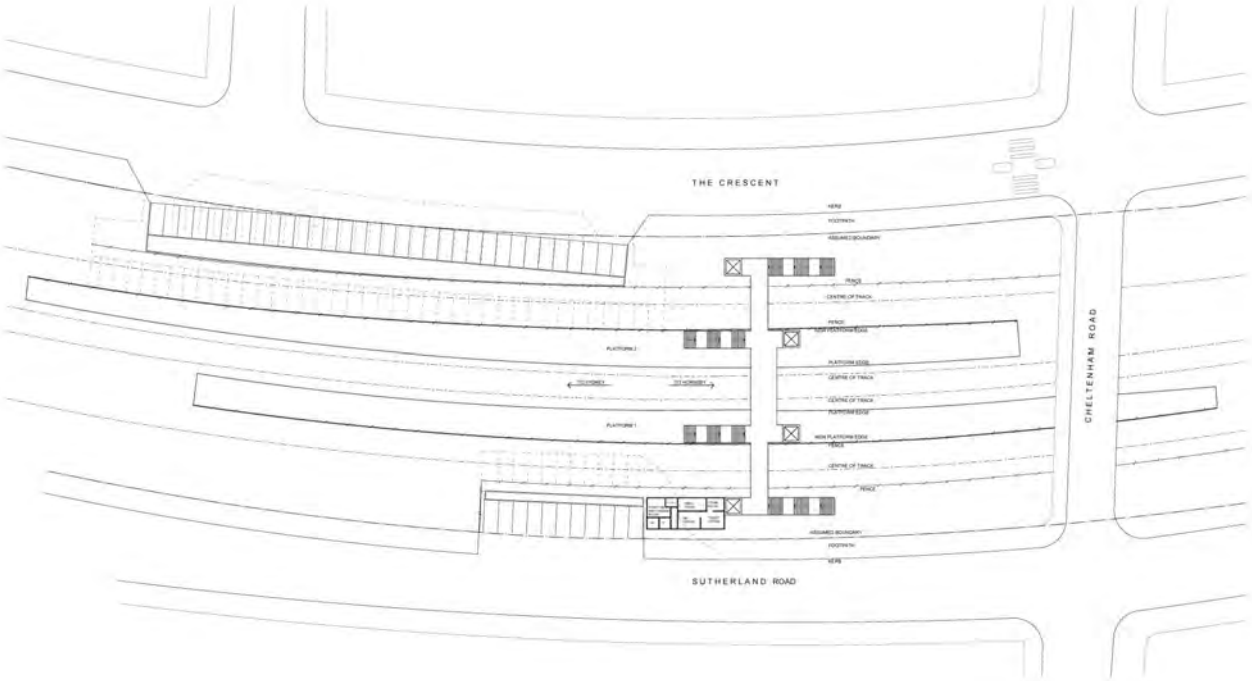

Figure 7.9 Indicative layout for the upgraded Cheltenham Station

Source: Hassell, 2006

The project would diverge from the Northern Line north of Cheltenham Station, via the Beecroft tunnel portals. The dives to the portals would be over a distance of approximately 0.2 km and in this section two new tracks and two new dive structures would be constructed within the rail corridor.

This configuration is proposed to provide full operational flexibility, enabling trains on the North West Rail Link to proceed on the Northern Line or on the Epping to Chatswood Rail Line, and to ensure that there is no conflict between trains travelling on the Northern Line from Hornsby and trains travelling on the North West Rail Link. This configuration requires a total of four tracks plus two dive structures in this 200 metre section, as shown diagrammatically in Figure 7.10.

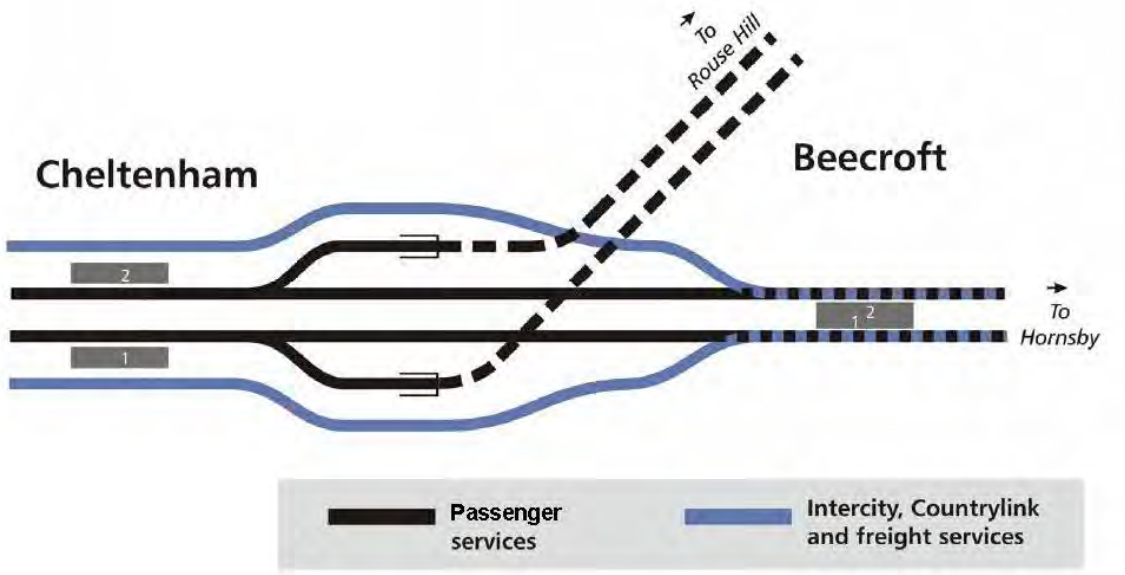

Figure 7.10 Dive structure arrangement

Source: TIDC

This configuration means that passenger services on the North West Rail Link would not have to wait for intercity or freight services on the Northern Line to pass before joining the Northern Line.

Amplification of the existing rail lines would be required within this section of the proposed alignment to allow for the track quadruplication. Retaining walls along either side of the corridor would be required to support the embankment. The major existing structures that would require modification for the additional outer tracks would include:

» M2 Motorway bus underpass;

» M2 Motorway rail overbridge; and

» Cheltenham Road rail overbridge.

The quadruplication would benefit passenger services in this section by separating these trains from freight and intercity trains.

7.2.2 Beecroft tunnel portal to Hills Centre Station

The project would branch off the Northern Line between Cheltenham Station and Beecroft Station. The tunnel portal, which would establish the commencement of the underground section of the railway, would be located within the existing rail corridor, south-east of the tennis courts adjacent to The Crescent at Beecroft.

Excavations to the tunnel portals would be required. These would involve open cut excavation and a combination of battered slopes protected from surface erosion, and retaining walls with suitable drainage.

The proposed alignment would pass beneath Beecroft Village Green and Devlins Creek, head west towards Thompsons Corner and then proceed to the first proposed station at Franklin Road, Cherrybrook near the intersection of Franklin Road and Castle Hill Road.

From Franklin Road the proposed alignment continues underground in a north-westerly direction, generally following the proposed alignment of Castle Hill Road to Castle Hill Station. The new station would be located under the Castle Hill Town Centre at the corner of Old Northern Road and Castle Hill Road.

Beyond Castle Hill, the proposed alignment curves beneath the Castle Towers Shopping Centre, then follows the proposed alignment of Showground Road to the proposed Hills Centre Station. Hills Centre Station would be located underground, adjacent to the Council depot.

7.2.3 Hills Centre Station to Burns Road Station

The proposed alignment would pass beneath Cattai Creek and follow Salisbury Road until the junction with Windsor Road, before continuing under Norwest Boulevard to Norwest Station, within Norwest Business Park.

From Norwest Station, the proposed alignment would continue beneath Norwest Boulevard towards Old Windsor Road before curving to the north to pass beneath Northridge Avenue. The proposed alignment then continues in bored tunnel to a tunnel portal located just to the north of Celebration Drive (described below). From there, the proposed alignment would continue in a cut and cover tunnel beneath Balmoral Road to the southern end of Burns Road Station. Subject to further technical review and design development, temporary realignment of Elizabeth Macarthur Creek may be required during construction of the cut and cover tunnel. This section is shown in Figure 7.4.

Celebration Drive tunnel portal and transition structure

The tunnel would be cut and cover rather than bored between Celebration Drive and north of Burns Road Station.

Excavation for the portal and the start of the cut and cover section at Celebration Drive would involve an open cut excavation and battered slopes that are protected from surface erosion. The exit portal would be approximately 13 metres below ground level.

The Balmoral Road Release Area is proposed as the major construction site for underground tunnelling and spoil removal. As a result, it is anticipated that the actual size of the excavation could be greater than that required just for portal and transition structure construction.

The majority of the cut and cover tunnel section would be close to, or just below, the watertable. A range of tunnel lining options to prevent inflow and seepage would be considered during design development.

In the vicinity of Burns Road Station, the tunnel conditions are likely to pass through the interface between shale and sandstone. Further geotechnical and utilities investigations would need to be carried out as part of the detailed design in this area. Burns Road would be reconstructed as a bridge on its current alignment, with the railway passing underneath in a retained cutting.

7.2.4 Burns Road Station to Rouse Hill train stabling facility

After Burns Road Station, the proposed alignment would pass beneath Burns Road and continue in open cut or on an embankment before proceeding onto a viaduct over Samantha Riley Drive (refer Figure 7.5). The proposed alignment would continue on viaduct from Samantha Riley Drive over the intersection of Windsor Road and Old Windsor Road to minimise impacts on the intersection and the Elizabeth Macarthur/Caddies Creek floodplain. The viaduct would be located adjacent to the route of Old Windsor Road and the Parramatta to Rouse Hill section of the North West Transitway.

From the overbridge at the intersection of Windsor Road and Old Windsor Road, the proposed alignment would be in a cut and cover tunnel. It would then follow Windsor Road and the proposed alignment of the North West Transitway to Rouse Hill Station in the proposed Rouse Hill Regional Centre. After Rouse Hill Station, the proposed alignment would pass beneath the dual carriageway of Windsor Road in cut and cover tunnel, to the proposed stabling facility located in cutting west of, and roughly parallel to, Windsor Road.

The proposed alignment is shown in Figures 7.5 and 7.6.

7.2.5 Tunnels

The tunnel would comprise twin bored, 7 metres diameter tunnels. A typical cross section of the tunnel component of the project can be seen in Figure 7.11.

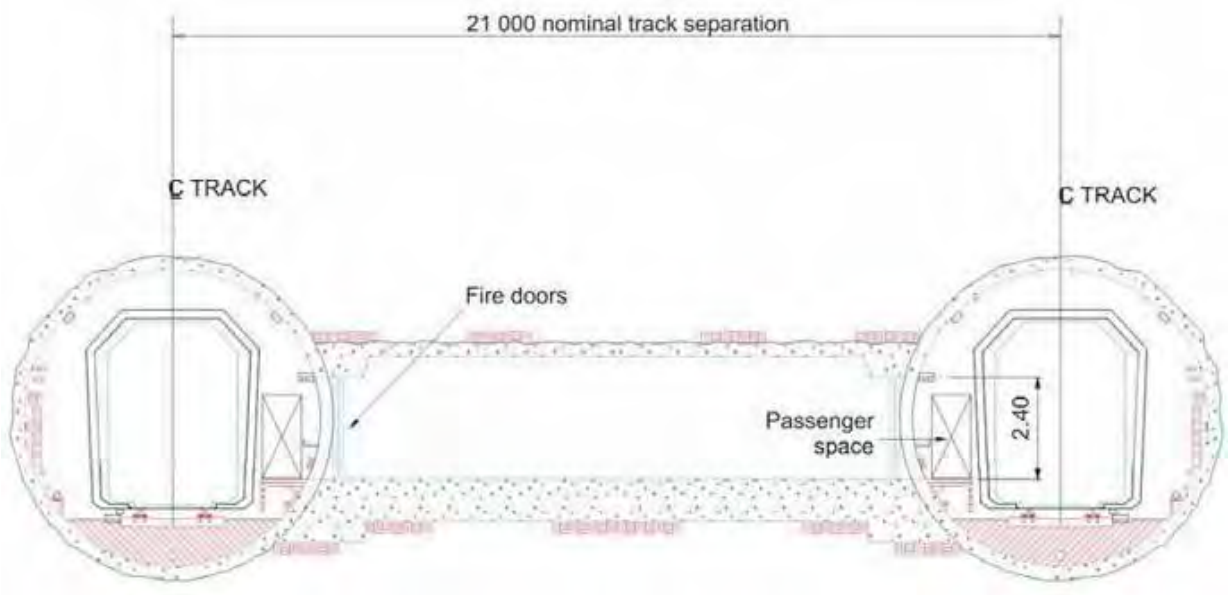

Figure 7.11 Typical twin tunnels cross section

In accordance with the National Fire Protection Association Standard for Fixed Guideway Transit and Passenger Rail Systems, NFPA 130 (latest version 2003), cross passages for emergency egress to the opposite tunnel would be located 533 metres from each station, followed by spacings no greater than 243 metres apart. Draught relief and ventilation structures would be incorporated into the station structures, along with associated equipment.

Construction of twin tunnels is preferred, as there is considered to be a higher risk associated with tunnelling a single tunnel by a larger tunnel boring machine through shale with shotcrete and rock bolts as initial support. Twin tunnels also provide enhanced safety in the event of a train derailment, or fire in a tunnel to escape to a separate air cavity via emergency cross passages.

Cover to tunnel

In accordance with recommendations of the Arup (2001) North West Rail Link – Rail Infrastructure Study, a minimum cover of two tunnel diameters was adopted as the design parameter for cover between the top of the tunnel and the ground level/level of footings (if known) in the design to date. There may be potential to review and reduce this clearance if required, subsequent to further geotechnical field investigations.

Particular attention would need to be made where the tunnel crosses under Devlins Creek, Elizabeth Macarthur Creek, and Caddies Creek tributary 3 (where clearance under both creeks is less than 3 metres) and a proposed development in Castle Hill (current development application) that includes underground parking.

Tunnel spacing

Previous design reports show the twin bored tunnels at 21 metres centres, or approximately three tunnel diameters. Common practice in this regard is for parallel tunnels to be spaced at two tunnel diameters, or approximately 14 metres centres, with a possible increase in that dimension at the approaches to island platforms. The larger centres proposed in the previous design reports have been adopted at this stage, recognising the limited geotechnical investigations to date, and the assumption that shale quality could be lower than that encountered on the Epping to Chatswood Rail Link. Further geotechnical investigations would increase knowledge of ground conditions and provide confidence to reduce tunnel centres.

Spoil

Information on spoil generation and management is provided in section 9.5.

Underground stations

Four underground stations are proposed in the bored tunnel section at depths of up to approximately 40 metres below surface level. Further information is provided in section 7.2.8.

7.2.6 Above ground section

Proposed design concepts for the above ground section are generally straight forward. However, complexities could arise regarding the adjacent road, Transitway and utilities enhancements along the Windsor Road corridor, associated with the rapid urban development in this area.

The crossing of the Elizabeth Macarthur/Caddies Creek floodplain requires particular attention in the selection of design and construction methodologies to minimise impacts to this area. Principal watercourses flowing across the proposed alignment include Caddies Creek, Elizabeth Macarthur Creek and Second Ponds Creek. Caddies Creek tributary 3, and a further unnamed tributary, pass beneath Windsor Road immediately south and north of the proposed Rouse Hill Station respectively. A range of appropriate sediment controls and other design treatments, such as energy dissipaters at culverts, would be necessary to minimise environmental impacts and reduce channel scouring.

An approximately 1 km long viaduct, up to 10 metres above surface level is proposed to keep the rail line above the 1 in 100 year flood level, where the proposed alignment crosses Caddies Creek. Indicative information on a possible design of the viaduct structure is provided below.

A rail overbridge is proposed at the grade-separated junction between Windsor Road and Old Windsor Road. The structure would permit the Transitway to pass underneath the rail overbridge at grade, and the elevated rail alignment to pass over the intersection and tie in with the viaduct to the south and embankment to the north. There could be opportunities for co-location of the transitway with the rail overbridge. This would be investigated in further design studies in consultation with the RTA. The resultant structure would be complex and costly, and further investigation of options to resolve design issues is required. These issues include the need for construction to take into account traffic management issues at a very busy intersection, geometric constraints, and rapid construction to minimise traffic impacts and service disruptions. Integration of the design with RTA requirements is particularly important.

Viaduct design

An indicative impression of the viaduct is shown in Figure 7.12. The following description is based on this indicative design. The design of the viaduct would incorporate measures to minimise wheel rail noise.

The design comprises a transparent, light weight, steel ribbed structure supported by a series of concrete columns. The aerodynamic profile emphasises the movement of the trains within an implied tube structure and at the same time reduces the bulk of enveloping the viaduct to provide both visual and acoustic isolation.

The overall cross section of the viaduct is elliptical in shape and consists of two principle elements; the concrete column and track supporting structure, and the steel portals forming a ribbed enclosure. The structure and envelope have been designed to be flexible, enabling appropriate responses to the variety of topographical and development typology along its length. The span for column supports may vary from 24m to 48m in response to existing structure and road layouts.

The curved and taper pre-cast base would act as permanent formwork to the track slab and would be supported by tapered blade columns with rounded edges to provide an elegant vertical element that compliments the horizontal elliptical tube above. The curved profile of the track structure has been minimised at the edge and provides a thin floating appearance for the concrete base.

The elliptical tube is proposed to be a lightweight steel frame that supports both the overhead wires and a system of screening components. The cladding material proposed could be

transparent or translucent poly-carbonate, or smooth or profiled metal cladding fixed to the steel framing system. The cladding could be installed in a variety of combinations at various points along the line to address specific acoustic or visual requirements.

Windsor Road cut and cover structures

The proposed alignment would pass at a flat, skewed angle under Windsor Road north of Rouse Hill Station.

There are a number of projects under consideration for widening Windsor Road and the Schofields Road/Windsor Road intersection. However, all options appear to have Windsor Road at grade in this area; therefore, the proposed alignment would pass under the road in a cut and cover tunnel section, which would need to be constructed in stages to permit maintenance of traffic flows.

Figure 7.12 Rail viaduct cross section

Source: Cox Architects, 2006

7.2.7 Train stabling at Rouse Hill

From Rouse Hill Station the proposed alignment would pass beneath the dual carriageway of Windsor Road in a cut and cover tunnel to the proposed Rouse Hill train stabling facility to the west of, and approximately parallel, to Windsor Road. The crossing under Windsor Road would require careful design to ensure traffic impacts are minimised. This would be done in consultation with the RTA.

The required stabling facility at Rouse Hill would be an interim facility designed for eight by eight-car train sets. This arrangement would facilitate any future extension of the project.

The stabling facility would cover an area of approximately 700 metres long by 60 metres wide, in a cutting, which would assist in providing a natural noise and visual barrier. Some facilities, such as staff amenities, may be outside of this nominated area. Noise and visual attenuation measures at this location are discussed in section 9.3.7 and 9.10.4.

A decision on the precise arrangement of the facility would be made during the further design stage.

Additional facilities in the yard would include cleaning/light maintenance facilities, ablutions, administration offices and staff car parking. The facility would be lit by floodlights and fenced for security.

Controls for waste from the facility, including wastewater, are discussed further in Chapter 10. Train crews would have to walk to and from trains stabled at the sidings at the commencement of each shift, or on completion of the operations for each train. The access track walkways for train crews would be designed to meet occupational health and safety requirements for safe access (for example, warning lights, trip-free walking surfaces, adequate lighting, the provision of safe places, etc). Staff amenities would be provided to meet RailCorp occupational health and safety obligations and standard requirements.

The amenities building would comprise a meal room and appropriate amenities for staff (male and female). The stabling facility is proposed to become a Train Crew Sign-On Depot, meaning that the following additional facilities would be required:

» An inspectors office with room for desk, furniture and computer system;

» A sign-on location with suitable area for notice boards, safety and other documentation to be issued;

» Locker rooms with toilets, male and female;

» Appropriate security arrangements for all facilities (including closed circuit television coverage); and

» Car parking.

Interim stabling facilities (staged delivery)

Under staged delivery the project between Epping and Hills Centre Station would be operational by 2015. Therefore, interim stabling facilities would be required at this time. These facilities would utilise the future rail tunnel beneath Salisbury Road until Stage 2 was constructed and operational.

The interim stabling facility associated with Stage 1 would be designed for eight by eight-car train sets within the rail tunnel. Access arrangements and amenity facilities would be within the industrial area and would be subject to further planning during the next design phase.

An interim train stabling facility at Rouse Hill would be constructed and implemented with the remainder of the project (Stage 2) to Rouse Hill by 2017 as described above.

7.2.8 Stations

Schematic designs have been developed for the six proposed underground stations. The Franklin Road, Castle Hill, Hills Centre, Norwest and Burns Road Stations are proposed to have two platforms on a central island. Rouse Hill Station is proposed to have provision for four platforms on two central islands.

Park-and-ride facilities would be provided at Franklin Road, Hills Centre and Burns Road. Transitway bus services would operate to Rouse Hill and Burns Road. The stations would be designed with easy and safe connections between buses and the station platforms, and kiss-and-ride points would be proposed at all the stations.

The lack of available sites for parking in close proximity to the proposed Norwest Station would prevent the provision of exclusive commuter parking. Complementary use of parking spaces would be investigated at that location.

There is also the potential to provide a station near Samantha Riley Drive. A station in this location is not proposed as part of the project, however the design does not preclude the provision of a station in this location in the future.

The stations are described below. A summary of the proposed features of each station is provided in Table 7.2.

Table 7.2 Summary of proposed station features

Feature	Franklin Road Station	Castle Hill Station	Hills Centre Station	Norwest Station	Burns Road Station	Rouse Hill Station
Configuration	20 metres underground 2 platforms on central island	37 metres underground 2 platforms on central island	21 metres underground 2 platforms on central island	29 metres underground 2 platforms on central island	11 metres underground 'sunken' 2 platforms on central island	13 metres underground 4 platforms on 2 central islands
Primary role	Capture	Capture and destination	Capture	Capture and destination	Capture	Capture and destination
Pedestrian access	ü	ü	ü	ü	ü	ü
Commuter parking target (see section 7.2.9)	500 spaces	Investigate opportunities for comple-mentary parking	1,000–1,200 spaces	Investigate opportunities for comple-mentary parking	Up to 1,200 spaces	None
Transport interchange	Bus and kiss-and-ride	Bus interchange	Kiss-and-ride	Bus and kiss-and-ride	Transitway interchange and kiss-and-ride	Transitway interchange and kiss-and-ride
Local features	Residential Schools	Castle Towers Shopping Centre	Showground Hills Centre Baulkham Hills Shire Council	Business Park Hillsong Church	Balmoral Road Release Area	Rouse Hill Regional Centre

Franklin Road Station

An indicative cross section for Franklin Road station is provided in Figure 7.13. The surrounding land uses including surface buildings and car parking are indicative only and would be subject to extensive planning by relevant stakeholders.

Franklin Road Station would be an underground station, located to the north of Castle Hill Road in Cherrybrook (near the boundary with West Pennant Hills), west of Franklin Road and east of Robert Road. This station would service the population catchments of Cherrybrook and West Pennant Hills. The station in this area represents an opportunity to provide convenient bus access and potential park-and-ride facilities for the population.

The site was chosen because of the large available land area and proximity to a main road and catchment area. It would have a large catchment area for walking, buses and kiss and ride, and a park and ride facility (target of 500 spaces).

Due to the vertical height of the site, the station would be approximately 20 metres deep below surface level, to minimise the gradient of the rail vertical alignment Up from Beecroft and Down to Castle Hill Station.

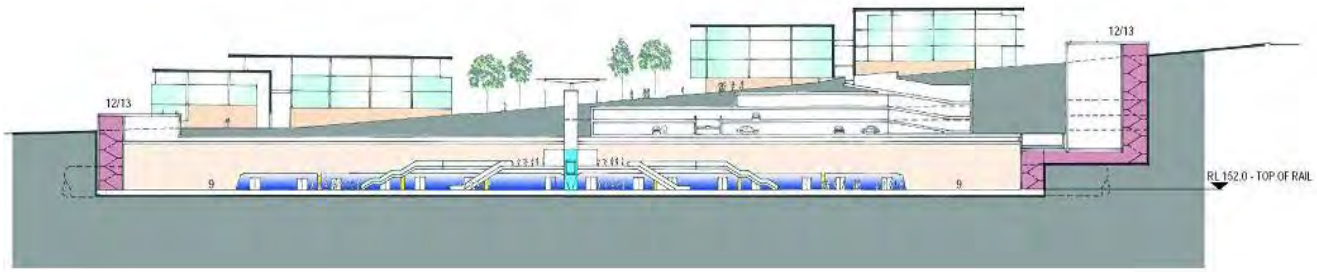

Figure 7.13 Indicative cross section for Franklin Road Station

Source: Hassell, 2006
Note: The surrounding land uses, including surface buildings and car parking, are indicative only and would be subject to extensive planning by relevant stakeholders

Castle Hill Station

Castle Hill Station would be an underground station, located within the town centre beneath Arthur Whitling Park (bounded by Northern Road, Old Castle Hill Road and McMullen Avenue). An example of an underground station concourse is shown in Figure 7.14. The station entrances, ventilation building and emergency egress at both ends of the underground platform would be located in Arthur Whitling Park. The station entrances, ventilation building and emergency egress at both ends of the underground platform would be located in Arthur Castle Towers Shopping Centre is located immediately to the northwest of the station location. The

opportunity exists to provide underground walkways for direct access into the shopping centre and the south side of Old Northern Road.

Castle Hill Station would be a central hub for feeder bus services including local bus services. It is proposed that bus services using the Blacktown to Castle Hill section of the North West. Commuter parking facilities would not be provided at this station.

The station would be approximately 37 metres below the surface and could be accessed by escalators from the street level onto an intermediate concourse, which could also be accessible from the shopping centre.

Figure 7.14 An example of an underground station concourse

Source: TIDC

Hills Centre Station

An indicative cross section for Hills Centre Station is provided in Figure 7.15. The station would be approximately 21 metres underground, and would be located between the Hills Centre and the Castle Hill Showground. The station is proposed to be constructed at the site adjacent to the existing works depot adjacent to the Hills Centre on Carrington Road, in the vicinity of the Castle Hill Showground and the Baulkham Hills Shire Council buildings. The station is expected to serve predominantly as a capture point for daily commuters, with a focus on commuters

travelling to the station by car. It would include a park and ride facility with a target of 1,000 – 1,200 spaces.

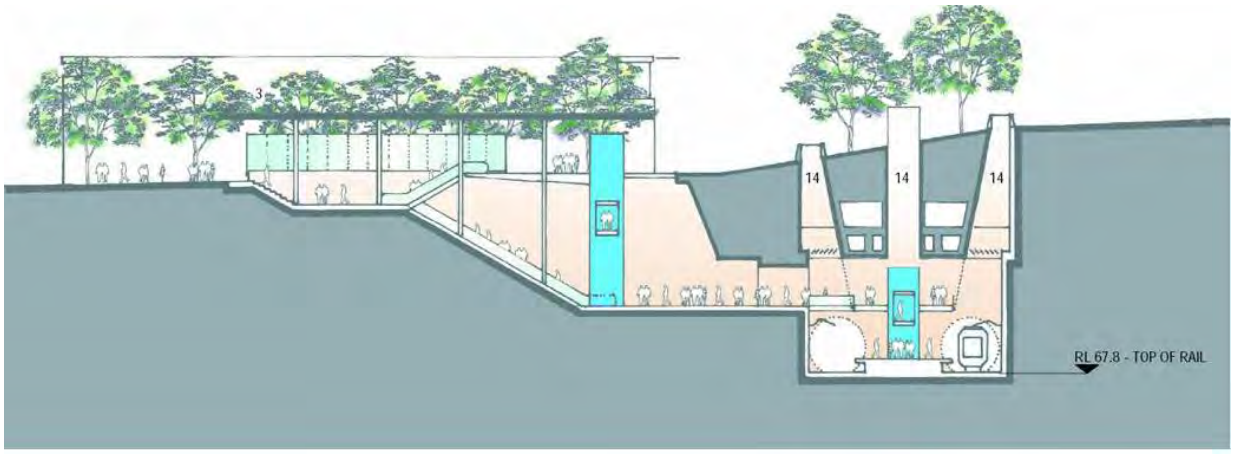

Figure 7.15 Indicative cross section for Hills Centre Station

Source: Hassell, 2006

Norwest Station

An indicative example of an underground station is provided in Figure 7.16. The proposed location for the station is under a busy intersection of Norwest Boulevard and the entrance to the Norwest retail development and Hillsong Church car parking. Major uses in the area with the potential to attract rail patronage included the Norwest Business Park, the retail development, the Woolworths Centre, and the Hillsong Church and Christian Centre. In addition, commuters could interchange on to the bus distributor service provided nearby.

The station would be approximately 29 metres deep, with easy access facilities, emergency egress and ventilation structures at the surface.

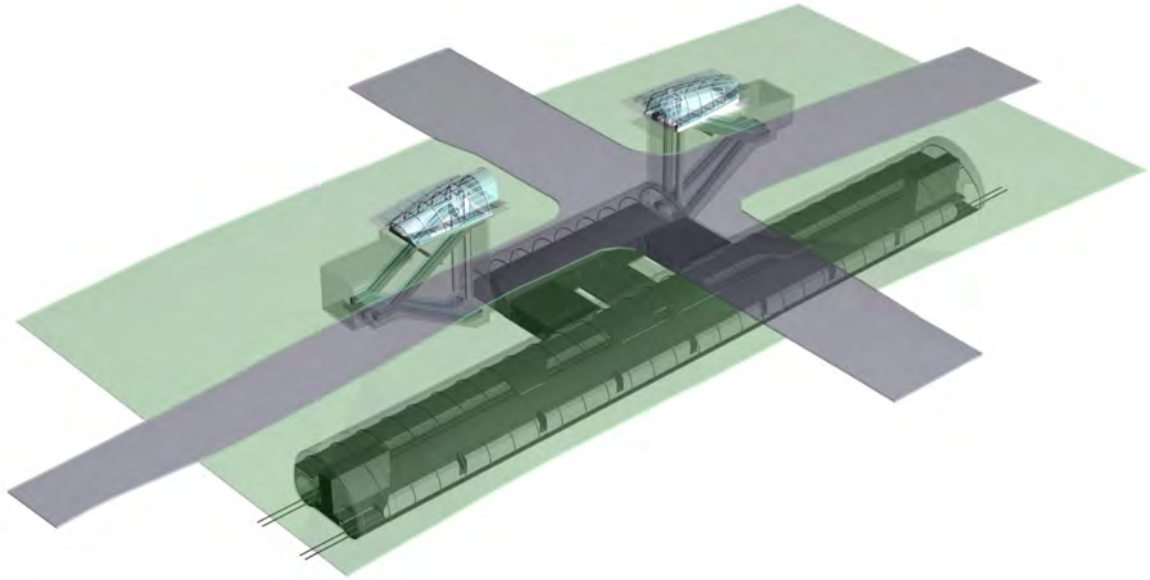

Figure 7.16 An indicative example of an underground station showing two surface entrances and the underground platforms

Source: Hassell, 2006
Note: Norwest Station is proposed to have three or four entrances

Burns Road Station

The proposed site for the Burns Road Station is located to the east of Windsor Road and to the south of Burns Road, within the Balmoral Road Release Area. A station location is provided for in the Local Environmental Plan for the Balmoral Road Release Area.

Burns Road Station is proposed as a partial cut and cover station, approximately 11 metres below ground level. The station design would also need to incorporate site drainage, car parking and circulation roads.

The station would be a commuter station, which would draw on commuters from Stanhope Gardens, Glenmore Park, Parklea, and the Balmoral Road Release Area. The station would form a major transport interchange for the project with the North West Transitway connecting Blacktown to Castle Hill and Parramatta to Rouse Hill.

A park and ride facility would be provided (with a target of up to 1,200 spaces), together with an interchange to the Transitway. A public square would link the residential and commercial developments to the east of the station, and the Transitway on the northwest side. Further urban design work is required at this station to ensure that it integrates effectively with the bus transitways and surrounding land use.

Rouse Hill Station

Rouse Hill Station would be the most northwesterly station and is proposed to be a major interchange station linked to the Transitway terminus serving the Rouse Hill Regional Centre,

which is expected to become a major destination. The project provides for an underground station parallel to Windsor Road, situated within an area that will be the focus of the new Rouse Hill Regional Centre. Figure 7.17 provides an indicative image of the Rouse Hill Regional Centre, based on the approved master plan for the area.

A cut and cover structure is proposed, constructed to a maximum depth of approximately 13 metres below surface level. The station would ultimately have four train platforms on two main islands.

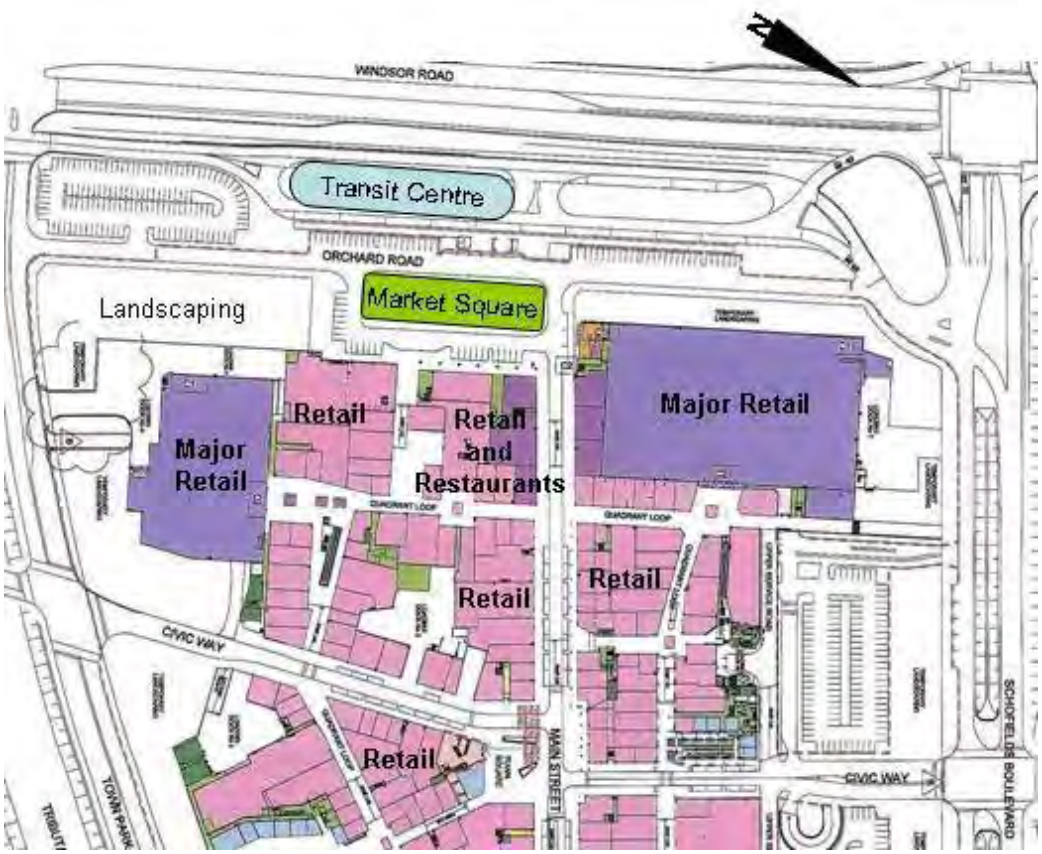

Figure 7.17 Extract from the approved Development Plan for Rouse Hill Regional Centre

Source: Baulkham Hills Shire Council

7.2.9 Commuter parking

Provision of commuter parking would be subject to the outcomes of strategies currently being prepared by the Department of Planning. The Metropolitan Parking Policy is a key action from the NSW Government's Metropolitan Strategy. However, based on predicted demand and opportunities/constraints around each proposed station location, the following park and ride facilities would be investigated. The estimated numbers are based on PB 2006b, and further investigation is required to confirm the amount of parking required.

» Franklin Road:
  – High demand from commuters in Cherrybrook and West Pennant Hills.
  – A target of about 500 spaces would be investigated noting that this precinct has some road network access constraints.
» Castle Hill:
  – No commuter parking is proposed. However, opportunities for shared use arrangements with commercial properties would be investigated.
» Hills Centre:
  – High demand, therefore commuter parking would be maximised.
  – A target of between 1,000 and 1,200 spaces would be investigated noting the attractive park-and-ride location for commuters in Kellyville, Baulkham Hills and Castle Hill combined with good regional access (eg, Showground Road).
  – Space constraints may limit the ability to achieve this target.
» Norwest:
  – Commuter parking would be desirable at this location to serve commuters from Blacktown and Kellyville. However, access and space constraints limit the ability to provide parking facilities. Therefore, no commuter parking is proposed. However, opportunities for shared use arrangements with adjacent properties would be investigated.
» Burns Road:
  – High demand from Blacktown and Kellyville would be expected, particularly if parking opportunities were not provided at Norwest.
  – A target of up to 1,200 spaces would be initially investigated. However, this would be subject to review based on patronage associated with the North West Transitway and potential surrounding development.
» Rouse Hill:
  – Demand for parking would occur at Rouse Hill, particularly as areas north and west of Rouse Hill develop. However, consistent with the Rouse Hill Regional Centre Master Plan, the provision of commuter parking is not proposed as part of the project.

7.2.10 Potential future extension

The design and location of the project, including the interim Rouse Hill stabling facility, would not preclude the potential extension to the Richmond Line. The precise location of the extension and any future terminus would be determined by operational needs and patterns of future development. The extension would include permanent stabling facilities that would replace the interim facilities at Rouse Hill. Any future extension is not part of the current project and would be subject to a separate environmental assessment and approvals process.

7.3 Other facilities

7.3.1 Signalling, communications and train control

Associated facilities and systems need to be provided in order to deliver a rail system that enables safe and efficient operation of trains. These systems, which include signalling, communications, train control, automatic fare collection, ticket vending machines and power distribution control would be integrated into the existing Sydney network.

Signalling and train control

The signalling system would be designed to allow trains to run to full design line speed (100–130 km hour) at three minute headways, and to integrate with existing systems on the Epping to Chatswood Rail Line and Northern Line at the Epping interface area.

At Rouse Hill, a local control panel would be necessary for the operation of the service termination and train stabling facilities, in the event that the remote control at Strathfield fails. A local control facility would also be required for any 'in section' crossovers.

7.3.2 Traction power

Traction would be implemented via standard 1,500V DC overhead wiring. It is assumed this would be to a similar specification and integrate with the existing overhead system on existing lines.

It is envisaged that four 10–15 megawatt DC substations would be required to supply approximately 12 trains running at any one time on the North West Rail Link.

A DC substation is currently being constructed to the north of Cheltenham Station. Physical space has been allowed for the upgrade of the substation with additional switchgear to cater for part of the power requirements project. At least a further three additional sites for the North West Rail Link would need to be identified, together with high voltage connections. It is likely that these sites would be in the vicinity of existing or planned substations required for other development at Rouse Hill, in the Balmoral Road Release Area, and at the (existing) Hills Centre.

7.3.3 Power supply

An 11 kilovolt power supply, derived from an Integral Energy supply point would be required to provide power to stations and infrastructure. Tunnel lighting, emergency evacuation systems, pumping facilities and tunnel ventilation power requirements also need to be considered for power loadings.

7.3.4 Tunnel and station support systems

Tunnel and station support systems for the project would have a similar specification to those used on the Epping to Chatswood Rail Line. Macquarie Park Station would be used as a model for the station support systems.

DC traction substations are required every 2.5 to 3 km.

Wastewater treatment facilities for treatment of the tunnel seepage draining system are required to meet DEC quality limits, particularly in regard to the high iron and magnesium content of the groundwater. Several pumping stations would be required, with vertical risings to two treatment facilities. These sites are yet to be identified. Section 9.8 notes some considerations with regard to seepage.

A vent shaft and emergency egress facility would be required between Epping and Franklin Road Stations. A site adjacent/above the tunnel on Pennant Hills Road would be the likely location of this facility.

7.4 Construction activities

The construction of the project is divided into three distinct construction methodologies:

» Construction of the tunnels and underground stations;

» Construction of dive structures and cut and cover tunnel sections including stations; and

» Construction of the surface works.

The following sections briefly describe the anticipated construction methodologies.

7.4.1 Tunnel and station construction

The preferred excavation method for tunnels and stations is largely driven by the geology and ground conditions encountered during construction. It is anticipated that for this project the tunnels would be bored using a tunnel boring machine due to the fast rate of advance that can be achieved. Road headers and rock breakers would be required for other underground construction activities such as station excavation, tunnel boring machine access shafts, ventilation tunnels and cross passages. If the geology of the sites is such that rock is too hard to break, then limited blasting may be required.

Construction is assumed to be with a minimum of two tunnel boring machines, with the main tunnel boring machine launch site at the western portal near in the Balmoral Road Release Area. From there, tunnelling would be directly through to the Cheltenham dive site.

Under staged delivery the project between Epping and Hills Centre Station would be operational by 2015. Therefore, the Hills Centre site would be required for launching the tunnel boring machines. Spoil removal from the tunnel up to this point (approximately 11 km in length) and two underground stations (Franklin Road and Castle Hill) would also be from the Hills Centre site.

It is proposed that the stations be largely mined, that is construction would occur from inside rather than from the surface, although access shafts to the stations would be sunk from the surface.

Whilst the tunnels would not need to be lined in all locations for structural stability, lining the tunnels with concrete is likely to be required to minimise seepage into the tunnel. Lining would be either undertaken using precast concrete segmental units, placed immediately behind the tunnel boring machine, or by the use of travelling forms after excavation is completed along the length of the tunnel.

Station caverns would be lined with concrete, largely by use of shotcrete sprayed by specialised shotcreting equipment. Station platforms and concourses would be constructed insitu with concrete or with precast elements.

Station service buildings would be excavated from the surface down and the various levels would be constructed either insitu or using precast components.

Track slabs and tracks would be constructed at the completion of tunnel excavation and lining works. Following the installation of tracks, tunnel services would be installed.

7.4.2 Dives, cut and cover station construction

The dives, cut and cover tunnels and stations would be constructed using similar methods namely:

» Clearing of the sites;

» Piling to support the limits of excavation;

» Excavation carried out using rock breakers, conventional excavators or a combination of methods depending on the site geology;

» Base slabs poured upon the completion of excavation; and

» Roof slabs constructed following excavation.

7.4.3 Above ground construction

Construction methodologies for at grade and above ground sections of the track would involve:

» Clearing of the sites;

» Undertake bulk earthworks and drainage to level ground and provide a stable work platform;

» Construct capping layer, lay ballast and tracks, drainage and other services;

» Place concrete foundations for buildings, platforms and bridges;

» Construct platforms and buildings using conventional building methods; and

» Construct bridges/viaducts.

7.5 Construction sites

The following construction sites are proposed:

- Epping to Beecroft quadruplication (linear construction zone);
- Cheltenham Station upgrade;
- Cheltenham dive site;
- Underground station sites (Franklin Road site, Castle Hill Station site and Norwest Station site);
- Ancillary tunnel support site (in the vicinity of Pennant Hills Road);
- Balmoral Road construction site;
- Hills Centre Station construction site;
- Above ground construction areas and viaduct construction (between Burns Road and Rouse Hill);
- Cut and cover works at Rouse Hill and Windsor Road; and
- Rouse Hill stabling area.

The general location of work sites is indicated in Figure 7.18. The amount of work required at each location and the duration of this work would vary significantly as a result of the adopted construction methodology. Indicative activities at each construction site are described below.

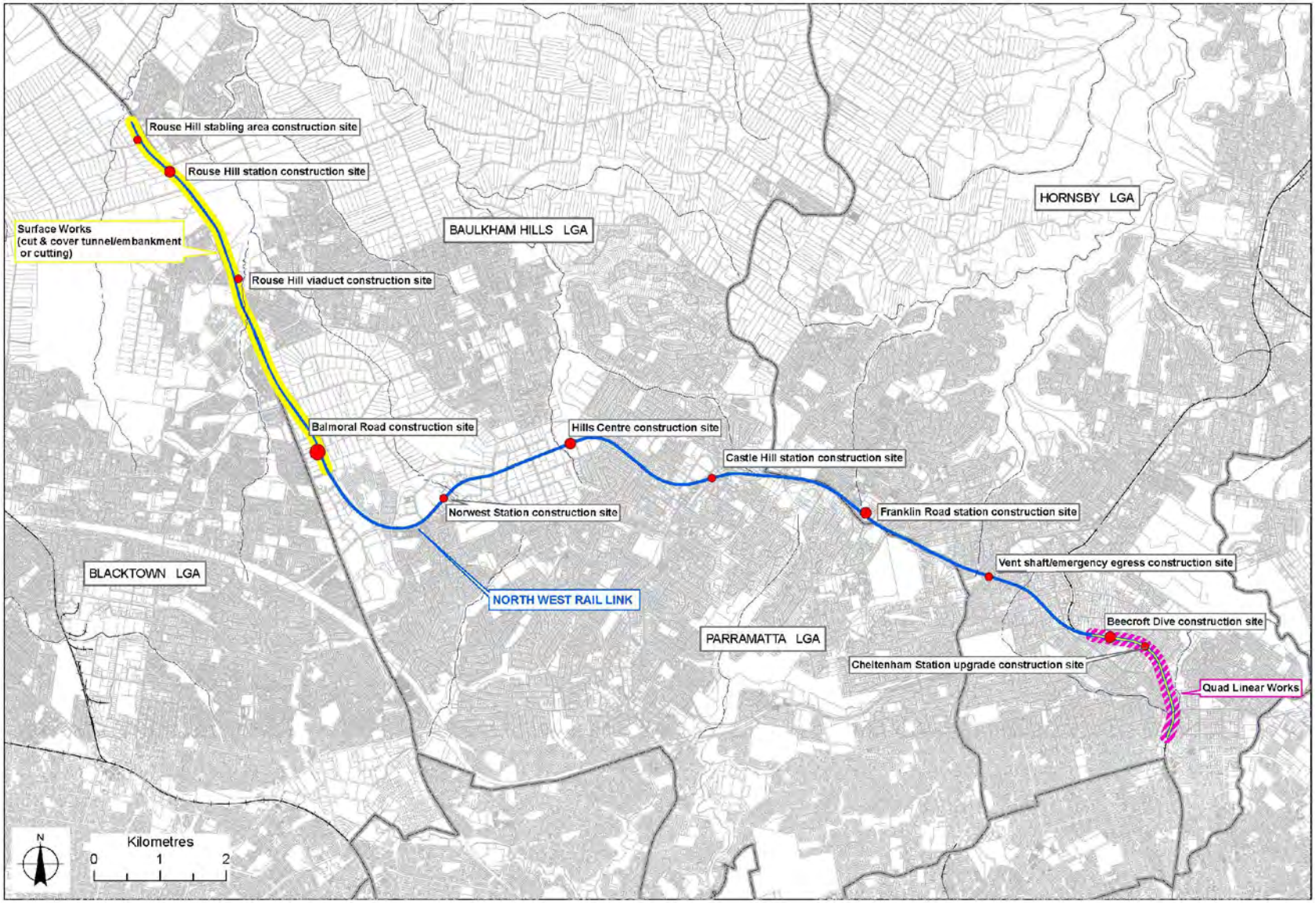

Figure 7.18 Proposed construction site locations

7.5.1 Epping to Beecroft quadruplication (linear construction zone)

The above ground quadruplication between north of Epping Station and the Cheltenham dive would require the establishment of linear construction zone that would stretch for approximately 2.5 km. Much of the construction for the quadruplication would need to be undertaken during track possessions (that is, when the operating rail is shut down).

The expected construction activities are as follows:

» Establishment of a central site compound containing site offices, crib rooms and equipment storage areas;

» Clearing of the corridor;

» Widening of cuttings;

» Construction of retaining walls to support widening of the corridor as required;

» Earthworks to widen the existing track formation;

» Laying of track;

» Construction of new overhead wiring for the additional tracks;

» Construction of a new bridge over the M2 Motorway;

» Construction of new platforms, buildings and elevated walkway at Cheltenham station.

» Modifications to existing signalling system; and

» Landscaping.

Construction access is discussed in section 9.2.2.

7.5.2 Cheltenham Station upgrade

Works to upgrade Cheltenham Station would occur concurrently with the quadruplication of the Northern Line. During construction passenger access would be maintained at all times except during track possessions. The associated station buildings would be removed and replaced with temporary facilities whilst the new facilities are built.

The existing two side platforms would be converted into a pair of island platforms (although the station would continue to operate with two passenger platforms). An overbridge would be constructed.

The majority of commuter carparking would be removed during construction.

7.5.3 Cheltenham dive site

The following activities are expected to occur at the Cheltenham dive site:

» Site sheds and crib rooms;

» Site clearing;

» Piling to support excavations;

» Excavation of dives;

» Construction of slabs along base of dives and tunnels;

» Lining of dive walls;

» Construction of roof slabs;

» Laying of rails and track slabs;

» Installation of services including overhead wiring;

» Construction of stormwater diversions to keep water out of dives; and

» Landscaping.

At the Cheltenham dive site, the tunnel boring machines may be disassembled and removed from the tunnel.

Property within the rail corridor would be required on the east side of Beecroft Road for permanent works and a work site associated with the tunnel dive structures. Cut and cover construction would occur adjacent to The Crescent resulting in demolition of the existing Scout Hall building. The scout facilities would be relocated or replaced.

At this stage of design it is envisaged that some temporary work during construction such as an access road, staff/worker accommodation and the storage of plant may encroach outside of the rail corridor into the road corridor of The Crescent and/or into Beecroft Village Green. This could result in removal of mature trees within the Beecroft Village Green. The extent of this possible encroachment would be clarified during future design work and would be planned to maintain access along The Crescent, protect the Tennis Courts and minimise impacts on the Beecroft Village Green.

7.5.4 Underground station sites

Whilst the majority of the station construction works would be undertaken from underground (with access and spoil removal from Balmoral Road or Hills Centre (under staged delivery)) there would still need to be works undertaken aboveground at the various station sites. The following works are anticipated at each station site:

» Site sheds, offices and crib rooms;

» Piling to support excavations;

» Excavation of access shafts (for lifts, stairs and escalators);

» Excavation of service shafts;

» Tunnel ventilation (intermediate ventilation points required due to the length of tunnel)

» Lining of shafts;

» Construction of slabs;

» Installation of and connection to services; and

» Surface works (including paths, roofs and awnings, landscaping, carparks and road changes).

Station-specific construction issues are noted in Table 7.3.

Table 7.3 Station specific construction issues

Station	Construction issues
Franklin Road Station site	The area around the station would be potentially cleared of vegetation. However, trees around the boundary would be kept to screen the site (unless directly obstructing access or critical construction activities). Activities undertaken at this location include construction of the station (the station cavern is likely to be mined from below, with access and ventilations shafts excavated from the surface).
Castle Hill Station site	The construction site would use areas of Arthur Whitling Park. Site boundaries would be clarified and refined during future design work to maintain pedestrian access and protect important features/structure of the Park. Construction would be managed to minimise impacts on events in the park. Affected areas of the park would be restored in consultation with Council, local community and other stakeholders.
Hills Centre Station site	The construction site would use an area to the south west of the Castle Hill Showground. This area is currently occupied by showground buildings, which would be relocated. Use of the Council Depot site would be considered in consultation with Baulkham Hills Council. Street trees would be removed. However, trees around the boundary would be maintained to screen site if practicable. It is likely that cut and cover construction would be required across Cattai Creek, which would result in vegetation removal within a corridor approximately 50 metres. Temporary coffer dams would be installed within the creek. Construction activities would be carefully planned to avoid impacts on major events at the Hills Centre and the showground. There is the potential that this site could be used to launch tunnel boring machines and for spoil removal – see section 7.5.7.
Norwest Station site	A surface site would be required adjacent to Norwest Boulevard. Traffic impacts would be experienced in the vicinity of this site.
Rouse Hill Station	Construction would occur within the future Rouse Hill Town Centre. Considerable construction planning would be required for works which would occur within an operating and growing town centre.

The work activities at the station sites are generally anticipated to only occur during normal working hours, with the exception of the ventilation systems and underground works, which would be required to operate 24 hours per day.

7.5.5 Ancillary tunnel support site (in the vicinity of Pennant Hills Road)

Construction of a vent shaft and emergency egress would be required. This would be located between Cheltenham and Franklin Road Stations. This site would be located adjacent/above the tunnel in the vicinity of Pennant Hills Road. The location would be determined during detailed design to avoid impacting on remnant vegetation or sensitive land uses.

7.5.6 Balmoral Road construction site

The Balmoral Road site (in the Balmoral Road Release Area) is anticipated to be the major construction site for the project due to the available land at Balmoral Road and constraints at any other sites. As there are no intermediate tunnelling sites, a significant amount of equipment would need to be stored on the site. The site boundaries are shown in Figure 7.19.

Figure 7.19 Balmoral Road construction site

It is proposed that the tunnel boring machines would be launched from Balmoral Road heading east. As a result, the majority of spoil would be removed from this location. In addition, as the underground stations would be excavated from within, the spoil from these stations would also be removed through the Balmoral Road site. Conveyor belts and spoil handling equipment would need to be sized to convey spoil from all sites concurrently. Concrete lining sections for the tunnel, along with concrete for track slabs, would also be sourced through the Balmoral Road construction site.

The following activities are anticipated to occur at the Balmoral Road construction site:

» Site offices, design offices and crib rooms;

» Tunnel boring machine assembly and launch;

» Tunnel boring machine and station spoil extraction, storage and dispatch;

» Tunnel construction water treatment plant;

» Tunnel air ventilation, extraction and scrubbing;

» Road header access;

» Spoil stockpiling and removal;

» Aggregate and cement delivery;

» Concrete batch plant;

» Storage of tunnel construction equipment i.e. vehicles, conveyor belt parts, pipes, ventilation ducts, inverts, rail and cabling;

» Electrical transformers; and

» Truck and vehicle wash.

It is also likely that if space is available on site then a precast segmental lining facility would also be established. Should space not be available then a storage area on site would be required to store sufficient units so that construction could continue uninterrupted with deliveries limited to normal working hours.

Hours of operation

Tunnelling is expected to occur 24 hours a day and as a result it is likely that some of the activities at the site would continue 24 hours a day. Activities expected to occur around the clock would include:

» Spoil removal from the tunnel. Spoil would be conveyed out of the tunnel 24 hours a day to stockpile areas using conveyors and stackers;

» Tunnel water treatment. The water treatment plant would operate 24 hours a day as water cannot be stored in the tunnels without affecting the construction program. The period of plant operations would depend upon how much water is produced in the tunnel. The plant would be designed and located to minimise noise;

» Tunnel ventilation – Tunnel ventilation would be in operation 24 hours a day. As a result some noise would be generated on site by the air scrubber machines located near the tunnel portals;

» Concrete batch plant – Concrete would be required in the tunnel and stations 24 hours a day so the concrete batch plant is likely to be operational at all hours. The delivery of cement and aggregate would only occur during normal operational hours. Associated with the batch plant would be concrete agitator truck operations into and out of the tunnel;

» Retrieval of stored equipment – It may be required at times to take stored equipment from storage areas at the construction compound into the tunnels; and

» Deliveries of over size loads to the site may need to occur late at night depending upon RTA requirements.

7.5.7 Hills Centre construction site (staged delivery)

Under staged delivery, the project between Epping and Hills Centre Station would be operational by 2015. Therefore, the Hills Centre site would be required for launching the tunnel boring machines. Spoil removal for the tunnel up to this point (approximately 11 km in length)

and two underground stations (Franklin Road and Castle Hill) would also be from the Hills Centre site.

Conveyor belts and spoil handling equipment would need to be sized to convey spoil from tunnelling, Franklin Road and Castle Hill stations concurrently. Concrete lining sections for the tunnel, along with concrete for track slabs, would also be sourced through the Hills Centre construction site.

Activities consistent with those described in section 7.5.6 (Balmoral Road construction site) would be required within the Hills Centre site. However, this site does have additional constraints not associated with the Balmoral Road construction site, including Cattai creek and the Castle Hill showground.

Notwithstanding these constraints, preliminary specialist advice suggests that there would be adequate space at the Hills Centre site to undertake the activities associated with launching tunnel boring machines and spoil removal. The site boundaries are shown in Figure 7.20, which nominates the Council Depot and areas to the north around the station box. Under this design scenario, Cattai Creek would require temporary diversion during construction activities. Spoil removal would likely be via direct access to Showground Road.

Figure 7.20 Potential Hills Centre construction site

Under the staged delivery scenario, the following activities would be anticipated to occur at the Hills Centre construction site:

» Site offices, design offices and crib rooms;

» Tunnel boring machine assembly and launch;

» Tunnel boring machine and station spoil extraction, storage and dispatch;

» Tunnel construction water treatment plant;

» Tunnel air ventilation, extraction and scrubbing;

» Road header access;

» Spoil stockpiling and removal;

» Aggregate and cement delivery;

» Storage of tunnel construction equipment i.e. vehicles, conveyor belt parts, pipes, ventilation ducts, inverts, rail and cabling;

» Electrical transformers; and

» Truck and vehicle wash.

A storage area for precast segmental lining would also be required.

Hours of operation

Tunnelling is expected to occur 24 hours a day and as a result it is likely that some of the activities at the site would continue 24 hours a day, including:

» Spoil removal from the tunnel – spoil would be conveyed out of the tunnel 24 hours a day to stockpile areas using conveyors and stackers;

» Tunnel water treatment – the water treatment plant would operate 24 hours a day as water cannot be stored in the tunnels without affecting the construction program. The period of plant operations would depend upon how much water is produced in the tunnel. The plant would be designed and located to minimise noise;

» Tunnel ventilation – tunnel ventilation would be in operation 24 hours a day. As a result some noise would be generated on site by the air scrubber machines located near the tunnel portals;

» Retrieval of stored equipment – It may be required at times to take stored equipment from storage areas at the construction compound into the tunnels; and

» Deliveries of over size loads to the site may need to occur late at night depending upon RTA requirements.

7.5.8 Above ground construction areas and viaduct construction (between Burns Road and Rouse Hill)

The above ground sections of the route (between Burns Road and Rouse Hill) would require the establishment of linear construction sites that would each stretch for several kilometres, including on either site of Windsor Road where it intersects with Old Windsor Road.

The expected construction activities are as follows:

- Establishment of a central site compound containing site offices, crib rooms and equipment storage areas;
- Site clearing;
- Bulk earthworks;
- Piling for viaduct footings;
- Construction of viaduct piers;
- Delivery to site and placement of viaduct segments;
- Laying of track and ballast;
- Construction of new overhead wiring for the new tracks;
- Installation of signalling systems; and
- Landscaping.

7.5.9 Cut and cover works at Rouse Hill and Windsor Road

Construction sites would be located on either side of Windsor Road. Traffic impacts would be experienced during road diversions for the cut and cover construction across Windsor Road.

7.5.10 Rouse Hill stabling area

Acquired properties (rural residential) would be used as a construction site to the west of the proposed stabling facility. This would result in removal of scattered trees, which are representative of Cumberland Plain Woodland, other isolated paddock trees and vegetation associated with farm dams. However, the site would not encroach into vegetation within the Regional Parkland to the north. Cut and cover construction would be required across Rouse Road.

7.6 Construction timing

7.6.1 Proposed construction program

It was initially estimated that construction of the project could take approximately 6 years and 9 months. This period includes civil construction activities, which would take approximately 5 years and 2 months, an 8 month contingency period, and 11 months for testing, commissioning and handover.

Staged delivery would involve an accelerated program. Under staged delivery, the project between Epping and Hills Centre Station would be operational by 2015, with the remainder of the project to Rouse Hill operational by 2017.

The final timing and staging of construction works would be subject to significant detailed design and construction planning to be undertaken as part of the next stage of the project.

In general, construction sites would be occupied for the full duration of project construction.

7.6.2 Construction hours

Surface works would in general be carried out between:

» 7.00 am and 6.00 pm Monday to Friday; and

» 8.00 am and 1.00 pm Saturdays.

To minimise disruption of the community, it would be necessary for some works to be undertaken outside these hours. This includes works affecting:

» Arterial roads, where partial closures can only occur outside these hours;

» Existing rail links, where track possessions need to be undertaken out of peak commuting hours; and

» Trunk infrastructure and utilities, where shutdowns would cause an interruption/inconvenience over a wide area.

The community would be informed of any out of hours work, with the exception of unscheduled work required for safety or emergency reasons.

Underground tunnelling work and support activities at the Balmoral Road construction site or the Hills Centre construction site would normally proceed on a 7 day, 24 hours basis.

7.7 Operation requirements

Upon opening, train services are anticipated to operate every five to 10 minutes in peak periods and every 15 minutes during off-peak periods. Services would travel to Chatswood and the City via the Epping to Chatswood Rail Link or via the Northern Line through Strathfield. The mix of routes would depend on the progress of the CBD Rail Link.

Operating parameters

Stopping patterns

The stopping patterns would be linked to the operation of the CBD Rail Link and South West Rail Link services. Services from Rouse Hill would stop at all North West Rail Link stations to Epping. From Epping, the services would continue on the Epping to Chatswood Rail Link, stopping at Macquarie University, Macquarie Park, Delhi Road, and Chatswood. The services would then continue on the CBD Rail Link, stopping at St Leonards, Mount Street (North Sydney), and the new CBD Stations. From Central Station, trains would either run via the Airport Rail Line or Sydenham. The service would then continue south via Wolli Creek. Services travelling northwards would follow the same sequence, but in reverse.

Network integration

The project is designed to be incorporated into the existing rail network. This would be limited to CityRail suburban services, where four services per hour on the down line (away from the City) would depart the Epping to Chatswood Rail Link on to the Northern Line, instead of following the normal service from the Epping to Chatswood Rail Link onto the North West Rail Link.

Rolling stock

New trains would be double-deck eight-car sets, with one driving car at each end. Dimensions would be compatible with fourth generation trains like Millennium, and those being provided as part of the rolling stock public private partnership project. Trains would contain 900 seats, with room for another 300 passengers to stand comfortably.

Trains with eight cars have a length of 163 metres. Design of the horizontal and vertical alignments through the new stations would permit future operation of ten-car sets on the new sector, through extension of station platforms.