7 Construction of the Proposal

Chapter 7 contains an indicative construction plan and method. A detailed construction staging plan and method would be established prior to start of the works. This plan would be consistent with all relevant conditions of approval and other statutory requirements including occupational health and safety. The construction method and staging chosen may vary from the description included in this chapter as a result of detailed design changes and community consultation.

7.1 Construction along the corridor

7.1.1 Outline of construction sequence

Construction of the Proposal is expected to start in mid-2008 and would be carried out in three main phases:

- A preliminary establishment phase to isolate the construction zone from the operating RailCorp rail tracks and relocate or protect existing services and utilities.
- The major civil works phase when the earthworks, culverts and bridges would be constructed.
- A final phase of track construction and installation of signalling and communication facilities. This would include installation of all connections to the existing RailCorp tracks, testing and commissioning.

The construction program is expected to take up to 32 months. The Project is likely to be split into a number of separate work sections operating simultaneously and working at different rates along the corridor. This has been taken into account in the assessment of impacts during construction.

Over this period, the construction zone would be separated from the operating railway by a temporary barrier where practical and the only effects on existing rail operations would be a number of scheduled track possessions and possibly, reductions in train speeds when approaching some of the major work sites.

An indicative construction program has been prepared and is shown in **Table 7.1**. This program is indicative only and would be amended once detailed design and associated construction planning is completed.

Table 7.1 Preliminary indicative construction program

Stage	Activity	Indicative Timing
Site Establishment	General establishment works including vegetation clearing, establishment of temporary site compound areas, service relocations/diversions, traffic management arrangements, installation of environmental controls and isolation of construction work areas from the live rail corridor (placement of jersey kerbs), property adjustments and land acquisition	April – August 2008
Construction	Bulk earthworks, construction of retaining walls and construction of noise walls Station works Bridge works including works at King Georges Road overbridge, Broad Arrow Road underbridge, Bonds Road underbridge, Belmore Road overbridge, Webb Street underbridge, Salt Pan Creek overbridge, Davies Road overbridge, Memorial Drive overbridge and Doyle Road overbridge Other structures including: ■ temporary works structures as required ■ modification of commercial premises at Narwee ■ drainage works (including construction of bridges over stormwater culverts), ■ replacement of commuter parking/modifications to existing commuter parking ■ demolition of sectioning huts and construction of new traction supply substation at Revesby ■ demolition of RailCorp signalling maintenance depot at Riverwood and relocation to Revesby or another appropriate location ■ Revesby Station concourse works and pedestrian overpass ■ extension to pedestrian underpass at Narwee Station Service relocation/modifications/diversions, formation and trackworks, overhead wiring, power works, signalling works	August 2008 – December 2010
Demobilisation	Removal of temporary construction facilities, landscaping and rehabilitation of worksites and affected areas Removal of environmental controls once areas are established	Late 2010 – early 2011
Testing and commissioning	Testing and commissioning of railway systems and signals	Ongoing throughout construction as works are completed.

Rail or track possessions are planned closedowns of sections of the rail system to allow construction or maintenance works to occur. The current 48 hour planned possessions which are applicable to the Proposal are shown in **Table 7.2.** These are subject to amendment by RailCorp throughout the construction stage. In addition to the possessions listed in the table, there is the possibility of a month long possession to occur late in the construction period (late 2010/early 2011) to allow final testing and commissioning to take place prior to operation of the Proposal.

Table 7.2 Planned rail track possessions

Number	Possession[1]	
	Start	Finish
1	15.03.08	17.03.08
2	09.08.08	11.08.08
3	25.10.08	27.10.08
4	14.02.09	16.02.09
5	02.05.09	04.05.09
6	05.09.09	07.09.09
7	24.10.09	26.10.09
8	27.02.10	01.03.10
9	17.04.10	19.04.10
10	26.06.10	28.06.10
11	18.09.10	20.09.10
12	11.12.10	13.12.10

Note 1: Rail track possessions normally take place between midnight on Friday and 04.00 hours on Monday, a duration of 52 hours. However, they are known as 48 hour possessions.

Weekend possessions in addition to those listed in **Table 7.2** may be sought through RailCorp throughout the construction period. In addition to the planned possessions, midweek engineering hours would also be used. These midweek engineering hours relate to works which can be undertaken overnight when no trains are running. Although there are some preliminary scheduled dates for these works, they are subject to confirmation by RailCorp.

The local community and businesses would be notified in advance of any out-of-hours works likely to be audible at adjacent sensitive receivers, including midweek engineering hours and possessions.

7.1.2 Site establishment works

Relocation and protection of services and utilities

Relocation of existing utilities in the corridor but outside the active rail zone would be carried out outside possessions. In general, the aim would be to clear the site for bulk earthworks by relocating the affected utilities. There are a number of telecommunication cables on the approaches to Beverly Hills Station, at and adjacent to Narwee Station, Padstow Station and in the vicinity of Doyle Road that need relocation, mainly undertaken outside possessions.

Services crossing the corridor, such as gas mains, power lines, water mains and sewers, are located within undertrack crossing structures. Those crossings located in embankment fill areas would be extended during possessions following erection of jersey barriers. Crossings in areas of cuttings would be extended following completion of the earthworks. During excavation, services currently supported on the slope would be temporarily supported and protected.

RailCorp signalling, power and communication cables and other electrical and signalling equipment within the alignment of the Proposal would be relocated where necessary to the boundary of the rail corridor as the first major item of work for the Project carried out during early available possessions. A combined services route (CSR), or sections of it, would be constructed along the corridor where possible.

Future services required by RailCorp are likely to be located in the CSR running along the alignment and typically located along the perimeter of the rail corridor. Existing buried services running along the corridor would either be protected or be relocated to the boundary subject to agreement with RailCorp.

Other in-corridor services, such as gas pipelines, stormwater pipes, water mains, optical fibre and other telecommunications cables and underground or aerial power lines would need to be surveyed, potholed and relocated as necessary well before the start of earthworks and related works.

The utilities located outside the corridor that need relocation, include water, gas, stormwater pipes, underground and aerial power cables and Telstra equipment. These utilities are located across the roads at the abutment piling work sites and along the overbridges. The services need to be relocated or removed prior to construction of the piling and related activities. Utilities crossing the corridor on the existing bridges would be temporarily relocated to a temporary structure spanning the width of the four-track corridor well in advance of piling and bridgeworks.

Special consideration would be given to the high pressure ethane gas pipeline. The alignment of the pipeline would be identified by survey and be clearly marked. There are six locations where the pipeline crosses the rail corridor. Here, its depth would be established before the start of the earthworks and, where necessary, it would be permanently protected using a method acceptable to its maintainer (Alinta) and its owner (Gorodok) to carry any additional embankment and/or railway loads. The design of the Proposal would be modified so that there are no impacts on the pipeline.

Isolation of the construction zone from the operating rail tracks

The construction zone for the Proposal must be isolated from the operating railway for safety and operational reasons. Separation would be achieved using a variety of methods, depending on available corridor width for construction activities. Where width is limited, it is possible that temporary construction barrier units incorporating a wire mesh fence would have to be used to achieve the necessary separation from the operating railway.

Construction sequencing would be planned to ensure that access to the site does not require a crossing of the operating rail tracks. The earthworks would also be configured so that work is not necessary on the operational side of the barrier. The work site would be narrow with limited access points along most of the rail corridor.

7.1.3 Main civil construction works

All civil works shown in the figures and described in the text are indicative and subject to detailed design and construction planning.

Earthworks and retaining walls

Widening of the corridor would require excavation within existing cuttings and the extension of existing embankments supported either by engineered batters or retaining walls. An assessment of earthworks quantities indicates that there would be a total of some 290,200 cubic metres of material to be excavated as summarised in **Table 7.3.** This quantity includes bulk earthworks in addition to material to be excavated for drainage works, track formation and services diversions.

Table 7.3 Estimate of quantities of excavated material

Location[1] (kilometres)	Volume of material to be excavated (cubic metres)
14.120 – 14.930	54,200
14.930 – 16.000	26,000
16.000 – 18.175	52,500
18.175 – 18.671	2,000
18.671 – 21.680	155,500

Note 1: Locations are defined in relation to the distance in kilometres from Central Station

Fill material would be required for backfilling, access roads and retaining wall construction. The estimated fill requirements are listed in **Table 7.4**.

Table 7.4 Fill requirements for embankment works

Location[1] (kilometres)	Volume of fill material to be imported (cubic metres)
14.120 – 14.930	28,600
14.930 – 16.000	41,600
16.000 – 18.175	53,500
18.175 – 18.671	26,000
18.671 – 21.680	98,200

Note 1: Locations are defined in relation to the distance in kilometres from Central Station

The material generated from excavation works may not be suitable for fill behind retaining walls and hence material may need to be imported. Further detailed geotechnical investigations would confirm this. In addition, structural fill, drainage material, ballast, concrete and material for backfill of trenches would be imported throughout the construction period. This material would total approximately 250,000 cubic metres. Fill may have to be imported if the in-situ material does not comply with the specification for structural fill and surplus material would need to be exported for reuse on other sites or for disposal.

Retaining walls

The widening of the active rail corridor would require the extensive use of retaining walls. The type of wall required in the widened formation would vary depending on ground conditions, height of the cut/fill and proximity to the rail boundary/adjacent structures. Retaining walls can usually be constructed outside possessions once the work zone has been made safe using jersey barriers which are generally located three metres from the centre line of the live tracks.

Ground conditions along the route are typically residual clay over weathered rock. The rock on the cutting walls is generally Ashfield Shale with a covering of residual clay expected to be approximately three metres deep. These are generally good conditions for bored pile construction. The piles are required to support ground pressure from the retained soil, residual clay and rock.

Pile walls are often constructed with spaced piles infilled with a shotcrete arch. A capping beam is normally constructed along the top of the pile wall to ensure that any deflection is regular. The beam also provides support to any granular fill which may be found.

Where geotechnical conditions and space permit, the design would include embankment slopes rather than retaining walls. Depending on slope, these embankments may require soil nailing and the application of shotcrete. If no horizontal clearance is available for a cut slope, the pile wall would be located on the boundary of the railway corridor. Pile diameters and spacing would vary depending on the ground conditions and height of the cutting.

Where there is insufficient space for the embankment slope, a reinforced soil wall or insitu concrete or masonry wall would be constructed. The final wall type would depend on geotechnical conditions encountered and the presence of services including the ethane gas pipeline. Walls would be located at the base of the batter slope or if clearance is limited, at the edge of the formation.

Some car parking spaces would be temporarily affected during construction of retaining walls and earthworks which are undertaken adjacent to commuter parking areas. This is expected to occur at Beverly Hills, Narwee, Riverwood and Padstow.

Drainage works
Stormwater drainage works would include:

- surface, subsoil and underground track drainage along the corridor including water quality treatment devices connecting into council systems;
- culvert adjustments and extensions;
- minor culvert adjustments at chainages 17.56 kilometres and 18.70 kilometres;
- relocation of some existing council drainage;
- adjustment and/or relocation of existing car park drainage at Beverly Hills, Narwee, Padstow and Revesby Stations;
- flooding mitigation works at Morgan Street, Beverly Hills; Beverly Hills Girls High School and Riverwood undertrack culvert crossings; and
- drainage systems for all retaining walls.

Overbridges
Many of the bridge works would need to be undertaken outside normal work hours to reduce impacts on road traffic and train operations. All such activities are constrained by the availability of rail possessions and restrictions on the closure of public roads. It will therefore be necessary to minimise the number of track possessions and road closure periods by the use of appropriate design concepts and construction methods. The construction methods described in the following section are based on the concept design and may be modified during the detailed design phase.

King Georges Road overbridge
The existing structure at King Georges Road consists of two bridges abutting each other. The bridge carrying the southbound lanes would need to be demolished and replaced; the northbound bridge would require additional strengthening to comply with current engineering standards and loading requirements.

The Memorial Drive overbridge would be closed at the same time as the southbound bridge.

Southbound bridge
Prior to closure and demolition of the bridge, pedestrian bridges would be erected across the rail corridor to maintain pedestrian access to Beverly Hills Station and carry utilities

currently supported on the existing bridge. The footings of this bridge would be constructed before a rail possession with the erection of the bridge undertaken during the possession. Some night works (see **Table 7.7**) are likely to be required for the footings of the pedestrian bridge which are located around the existing concourse. The footings adjacent to the roadway are expected to be completed during normal working hours subject to the maintenance of safe pedestrian access..

Temporary structures would be installed beneath the bridge to protect the tracks from debris possibly generated during the cutting of the deck into manageable sections for lifting during demolition. The rail traction cables would also need protection to avoid accidental contact with mobile equipment used during the demolition and reconstruction works.

The piled abutment and headstocks would be constructed at night to minimise disruptions to traffic. Construction or modification of the intermediate bridge piers would also take place either during possessions or at night. Construction activities would include:

- installation of new piles beside the existing central pier, installing reinforcement and concrete; and
- installation of formwork and reinforcement over new piers and pour new wall abutting the existing wall.

The southbound section of the bridge would be closed for about six months. Following the bridge works, road works including regrading of the roadway, kerb and guttering, and footpath works would be undertaken. These would be completed during night works (refer to **Table 7.7**).

Northbound bridge

The abutments at the ends of the existing northbound bridge require underpinning and staged excavation to accommodate the new Up and Down tracks. Prior to the start of underpinning, a sheet pile wall parallel to the abutment would be installed to prevent undermining King Georges Road behind the abutment. Sheet piling works would be undertaken during night time lane closures.

Following construction of the sheet pile wall, the abutment would be underpinned. This would take place in stages and involve excavation beneath the existing deck, rock bolting the face of the excavation followed by the application of shotcrete. Consideration would be given to closing the bridge to traffic for safety reasons during this operation.

An option under consideration involves the existing piers adjacent to the rail track being encased in concrete forming a blade wall to a height of 2.5 metres above the rail top. The existing isolated pad footings would either be strengthened by installation of rock anchors or new piles would be constructed between the existing pads and the new blade wall. The existing column pier and pad footing on the station platform would remain without modification. This option would only be considered subject to favourable geotechnical conditions.

Construction of the intermediate bridge piers and strengthening the existing ones would be carried out during a rail possession due to the proximity of the work sites to the operating tracks.

Belmore Road overbridge

The existing structure at Belmore Road consists of two bridges abutting each other accommodating two lanes of traffic in each direction. The existing southbound structure is a two-span concrete structure supported on brick abutments with a central brick pier. The northbound structure is a two span concrete plank bridge supported on a central concrete blade wall with reinforced concrete abutments.

The existing structures of both bridges would need to be demolished and replaced due to the clearances required for the new Up and Down East Hills Main tracks as specified in current engineering standards and loading requirements. The existing central support is located on the island platform at Riverwood Station. Demolition and construction operations would be carried out during rail possessions following removal of the deck.

Construction issues related to the bridge are similar to those for the King Georges Road southbound overbridge. Roadworks including regrading of the roadway, kerb and guttering, and footpath works would be undertaken on completion of the bridge works. Some night works would be required during demolition/construction of the bridge. Details of proposed night works are provided in **Table 7.7**.

Davies Road overbridge

The existing structure at Davies Road consists of two bridges abutting each other accommodating two lanes of traffic in each direction, a turning lane, wide median and pedestrian footpaths on both sides. The existing southbound structure is single span supported on brick abutments. The northbound structure is a single span concrete plank bridge supported on blade wall piers acting as abutments that allow for future widening.

The existing northbound structure would need to be demolished and replaced due to the clearances required, current engineering standards and loading requirements. The existing southbound structure would remain being extended to the south to accommodate the widening of the rail corridor.

Staging would entail reconfiguration of the lane markings on Davies Road and keeping three lanes of traffic open at all times during construction.

The bridge closure would coincide with that of the Doyle Road overbridge.

Due to the proximity of the running tracks, demolition of the brick abutments and construction of the bridge deck and abutments of the northbound bridge would need to be completed during rail possessions. The excavations would also need to be shored to prevent any track movement. A temporary track protection structure would be required to allow the new reinforced concrete pier to be constructed outside possessions. The bridge beams forming the main deck would be lifted into position during midweek possessions although then use of a second weekend possession may be required.

The construction process would be similar to that for the King Georges Road overbridge. Roadworks including regrading of the roadway, kerb and guttering, and footpath works

would be undertaken on completion of the bridge works. Some night works would be required during demolition/construction of the bridge. Details of proposed night works are provided in **Table 7.7**.

Memorial Drive/Cahors Road overbridge

The existing overbridge accommodates two lanes of traffic and a pedestrian footpath on each side. The existing structure at Memorial Drive consists of a two-span concrete bridge supported by a central brick pier and brick abutments. The pier is located on the platform of Padstow Station. A new overhead concourse abuts the existing overbridge and spans the tracks. A reinforced concrete retaining wall would be constructed in front of the existing concourse pier supports. Alternatively, the piers could be encased in concrete to provide appropriate protection.

The existing structure would need to be demolished and replaced due to the clearances required in current engineering standards and loading requirements.

The bridge would be constructed in several stages. The new piled abutments could be constructed outside rail possessions but temporary lane closures and night work at road level would be required. The demolition of the existing intermediate pier, if required, and construction of a new pier would be undertaken outside rail possessions on the platform during times avoiding peak hours.

Completion of the abutments, earthworks and demolition of the brick wing walls would require closure of the road to traffic. During this time and within a rail possession, the existing brick abutment walls would be removed and the new bridge beams placed. These activities would take place at the same time as the closure of the King Georges Road southbound overbridge.

The existing structures would need to be demolished and replaced due to the clearances required in current engineering standards and loading requirements. Roadworks including regrading of the roadway, kerb and guttering, and footpath works would be undertaken on completion of the bridge works. Some night works would be required during demolition/construction of the bridge. Details of proposed night works are provided in **Table 7.7**.

Doyle Road overbridge

The existing overbridge accommodates two lanes of traffic and a pedestrian footpath on both sides. The bridge consists of a single span concrete structure supported by brick abutments and wing walls.

The existing structures would need to be demolished and replaced due to the clearances required in current engineering standards and loading requirements. Demolition of the existing bridge would need to take place during one of the possessions. Roadworks including regrading of the roadway, kerb and guttering, and footpath works would be undertaken on completion of the bridge works.

The works at all underbridges would be completed by the regrading of the roadway and resheeting of the adjacent roads to integrate surface levels with the surroundings. In some cases, these activities would extend into the surrounding roads to achieve the necessary

transition. Some night works would be required during demolition/construction of the bridge. Details of proposed night works are provided in **Table 7.7**.

Underbridges

The underbridges would generally be constructed in normal working hours, although, installation of the deck would take place during possessions. The piled foundations and headstocks together with erection of the superstructures would be undertaken outside possessions and closely follow the completion of the earth embankments and retaining walls. Some night works would be required leading up to possessions to prepare for demolition and deck installation to be undertaken during the possessions.

Canal crossing underbridges

The structures of these bridges would comprise precast concrete girders over a single span. They would be supported by concrete abutment headstocks each founded on two cast in-situ concrete bored piles. These would be bored so that the edge of the pile is beyond either side of the canal to avoid damaging the canal wall. Small wing walls would extend outwards to retain the ballast formation.

Broad Arrow Road underbridges

The new underbridges over Broad Arrow Road would be located on either side of the existing underbridge each providing for a ballast top single track and maintenance walkway on the Down side.

The wing walls of the existing bridge would remain with new abutments located beyond them. A new retaining wall would be required on the outer edge of each bridge aligned parallel to the new Up and Down East Hills Main tracks. The existing walls retaining the batter would remain allowing a retaining wall to be constructed behind.

Narwee Station underbridge and pedestrian subway lengthening

The existing pedestrian subway would require a culvert extension on the Down side and a new underbridge on the Up side to accommodate the new tracks.

The retaining walls for the underbridge abutments would be constructed together with the earthworks although their completion would be delayed until bulk earthworks, drainage and demolition activities elsewhere are completed. This would allow the work site to remain ramped to provide access to the rail corridor.

Once the retaining walls for the abutments are completed, the bridge supports would be piled and the headstocks completed. Most of the work would take place outside possessions although some night works or possession works are likely to be required for piling in the proximity of the live rail and the tie-in of the structures. Pedestrian access during construction is described in **Section 12.2.4**.

Bonds Road underbridges

The works at Bonds Road would initially comprise the replacement of the existing structure under the twin tracks with a new ballasted concrete deck supported on the existing brick abutments. This work would be undertaken during a weekend track possession. New bridge structures with ballasted concrete decks, would then be constructed off an extension to the strengthening works to the existing abutments and wing walls to support each of the new Main lines.

Webb Street underbridge

The proposed new underbridge over Webb Street would be located on the Down side of the existing bridge. The wing walls of the existing bridge would remain with the new abutments located behind. Although most works at this site would be completed during normal working hours, some night works and work during possessions are likely to be required for piling in the proximity of the live rail and the tie-in of the structures.

Salt Pan Creek underbridge

The Salt Pan Creek underbridge is subject to specific constraints imposed by the need to minimise impacts on the mangroves and other native vegetation along the foreshores of the creek. It would be constructed in a number of stages:

- The access road into the site would be constructed from Meagher Avenue.
- The rail corridor would be widened on the southern side of the existing embankment on the western side of Salt Pan Creek by the installation of piles or another construction method for soil improvement. The embankment would be retained by reinforced concrete walled structures or similar constructed from Salt Pan Creek towards the west.
- The deck and parapet would be constructed using precast concrete beams which would be located on the headstocks using a crane or a launching truss. The deck works would then be completed.
- All temporary works, including the construction platforms would be removed and adjacent vegetated areas reinstated.

It is also proposed to install interpretive signage on each side of Salt Pan Creek outlining the significance of mangrove habitats, the history of the area and other issues of community relevance. The displays would provide the local community and visitors with information about the importance of the local ecosystems and describe the benefits they provide. The proposed signage boards would be developed in consultation with Bankstown and Hurstville Councils.

Impacts on pedestrian use of the existing bridge and walkway at salt Pan Creek are described in **Section 12.2.6**.

Road closures

A summary of proposed road closures due to bridge construction is provided in **Table 7.5**. These closures would be subject to approval by the RTA and relevant local council. If full closures are not available, their duration will need to be reviewed.

Table 7.5 Duration of full road closures

Bridge Location	Duration of closure	Roads to remain open during bridge closure
King Georges Road (southbound only)	Six months	Kingsgrove Road Davies Road Broad Arrow Road Bonds Road
Broad Arrow Road	Two weekend track possessions	King Georges Road Bonds Road
Pedestrian underpass at Narwee Station	Two weekend track possessions	Broad Arrow Road
Bonds Road	Six weeks	Belmore Road Broad Arrow Road King Georges Road
Belmore Road-southbound -northbound	Six months Six months	Davies Road Bonds Road Webb Street
Webb Street	Six months	Belmore Road
Salt Pan Creek	None required	-
Davies Road-southbound	Ten weeks – one lane closed, 2/1 tidal flow arrangement in operation.	King Georges Road Belmore Road Memorial Drive Padstow Parade The River Road
Davies Road-northbound	Twelve months with two weekend track possessions-two lanes maintained for each direction of travel.	-
Memorial Drive	Seven months with two weekend possessions if the central pier is removed	Davies Road Doyle Road The River Road
Doyle Road	Nine months with two weekend possessions	Memorial Drive Davies Road The River Road

7.1.4 Trackwork, testing and commissioning

Ballasted track installation

The works would involve the construction of two new operational tracks along the corridor with point and crossing layouts (specialised track allowing trains to transfer between adjacent tracks) at either end to integrate the new system with the existing railway.

The track base would comprise a formation bed of suitable fill material with in-built track drainage, as required by the local track geometry, to allow efficient drainage of surface

water. Foundations for the overhead traction wiring structures would be installed at regular intervals (nominally every 40 metres). These would consist of insitu cast reinforced concrete footing or piles.

The finished track structure would comprise parallel continuously welded steel rails tied together by reinforced concrete sleepers, supported and retained by a bed of stone ballast.

Materials for trackwork would be delivered using the same access and egress points as for civil construction works. Track construction would require delivery of approximately one hundred, 25 tonne loads of materials per linear kilometre of track, totalling approximately 1,500 for the proposed scope of works. Intermediate stockpiles of materials such as ballast and sleepers would be established at regular intervals along the corridor as dictated by the available trackside space and access/environmental constraints.

Overhead wiring

Overhead wiring for the Proposal would comprise:

- new single mast cantilevers;
- modification of existing portals by the addition of cantilever arms for the new tracks; and
- new portals spanning the four tracks and removal of the portals or masts made redundant by the new structures.

All overhead wiring structures would be constructed before the tracks are laid.

The new single mast structures could be constructed outside possessions as they would be located 3.2 metres from the centre line of the running tracks. As the jersey barrier would be located three metres from the centre line, it would be necessary to provide sufficient space to construct the footings and erect the steelwork outside possessions. Existing structures would be analysed for both loading and clearance from both existing and new tracks to determine the final configuration and installation requirements for the overhead wiring structures. Modification of existing portals and the erection of new portals would take place during possessions.

Overhead wiring for the new tracks would be assembled outside possessions while wiring for turnouts and crossovers would be carried out during possessions following completion of the trackwork.

Signalling equipment

New signalling equipment would be erected both within and outside possessions.

Early activities following completion of the safety barriers would comprise the construction of a new cable route outside the work area to replace the existing route affected by construction and relocating any signalling equipment likely to be affected by the earthworks. Connections to the existing equipment would be undertaken progressively during possessions before bulk earthworks are started.

Work undertaken during possessions would include the installation of points, emergency operating locks, train stops, telephones and signals close to the operating tracks. Other works to be completed during possessions include the relocation of existing equipment likely to have substandard clearance from the new tracks and modifications to the ATRICS and Microlok systems, upgrading of signalling power supply and relocation of equipment huts.

The remainder of the signalling infrastructure relating to the new trackwork, including additional power supply would be completed outside possessions.

Testing and commissioning

The testing and commissioning of the Proposal would involve testing the operation of all aspects of the Project, including signalling and communication facilities, train control, the new tracks and the interfaces with the existing network. It would be undertaken during a final possession.

7.2 Plant and equipment

The plant and equipment likely to be used for the construction of the Proposal is listed in **Table 7.6.**

Table 7.6 Typical plant and equipment required for construction activities

Construction activities	Typical plant and equipment
Earthworks	Excavator, shoring equipment, rock breaker, heavy duty jack hammers mounted on excavators, dump trucks, piling rig, soil compactors including 5 and 10 tonne vibrating rollers and sheepsfoot compactors, graders, dewatering pumps, and water cart
Bridges and building works	Pile boring equipment including large diameter percussion drills and continuous flight augers, mobile cranes, 400, 200 and 150 tonne and smaller cranes, concrete mixer trucks, concrete pump, flat bed truck, skidster loader, concrete cutter, semi-trailers, generators and flood lights, temporary noise barriers, cherry pickers and demolition equipment such as a concrete breaker and jack hammers
Trackwork	Work train for supply of ballast, sleepers and rail, track laying and tamping equipment, rail cutting, welding and grinding equipment, laser equipment for control of gauge and switch opening, track recording car, generators, temporary lighting towers, regulator, mobile cranes, water cart and trucks/rail dump carts for placing ballast

7.3 Construction traffic and access

Construction vehicle traffic would be greatest during the main earthworks and civil construction including:

- access to work areas would be provided by the existing vehicle gates along the rail corridor. Some additional access gates may be added where streets or reserves adjoin the rail corridor or some existing gates could be relocated;
- construction materials such as concrete, steel reinforcement and precast components would be transported to the work areas using trucks, concrete mixers and excavators;
- during bulk earthworks, the expected number of truck movements would be approximately 40 trucks (80 movements) per day at each work area (maximum). It would be expected that several work areas would be operating simultaneously;
- construction traffic would generally travel by the most direct route, although consideration would be given to RTA vehicle weight restrictions, bridge height clearances and sensitive uses such as schools and shopping centres; and
- the workforce would travel to and from the work sites by car and park at or adjacent to that location. Related traffic movements would be limited to personal use and local trips.

Chapter 12 and **Technical Paper 5** in Volume Two provide details on the extent of construction traffic and access requirements for the Proposal.

Site-specific Traffic Management Plans would be developed for the complex construction traffic and transport arrangements during the construction of the bridges along the rail corridor. The proposed Traffic Management Plans would include the following:

- a description or detailed plan of the proposed works;
- identification and assessment of the expected traffic impacts of the proposed works;
- an assessment of impacts on any affected public transport services;
- details of all provisions made for emergency vehicles, heavy vehicles, cyclists and pedestrians; and
- measures to ameliorate expected impacts including those on the local community.

The potential for cumulative effects of construction activities taking place simultaneously at a number of sites along the rail corridor would also be considered during the preparation of the Traffic Management Plans.

Traffic Control Plans would also be prepared for all works that would take place in the road or would affect trafficable areas. These would be completed in accordance with the requirements of *Traffic Control at Work Sites* (Roads and Traffic Authority 2003) and the

Australian Standard 1742.3 – 2002 Manual of uniform traffic control devices, Part 3: Traffic Control Devices for Works on Roads.

7.4 Workforce and working hours

Construction of the Project is expected to require a construction workforce of approximately 450 during periods of peak activity, supplemented during weekend possessions. A typical bridge would involve a construction team of between 10 and 12 persons. Large structures would not be worked on continuously as the construction team moves to other locations while waiting for the completion of specialised activities or for concrete pours to gain strength.

Construction works would generally be carried out during standard construction hours:

- Monday to Friday: 07.00 hours to 18.00 hours;
- Saturday: 08.00 hours to 13.00 hours; and
- No work on Sundays or public holidays.

Exemptions would be necessary in the following circumstances:

- works on major road bridges (including pilling works and pier strengthening) which the RTA or RailCorp would not permit during normal working hours due to traffic impacts or rail operation;
- works required by service providers or where impacts to services cannot be reasonably managed;
- for oversize deliveries/unloading of machinery which can only travel between hours specified by police or RTA;
- where works can be undertaken so as to be inaudible at the nearest residential receivers;
- as otherwise be agreed with the Department of Environment and Climate Change (DECC) in the issuing of an environmental protection licence;
- if any bridge works need to be undertaken at night to public road crossings of the rail corridor, for example if bridge decks or rail bridge girders need to be transported to the site requiring local road closures; and
- where works require power shut down and/or the cessation of train operations for worker and/or public safety reasons.

A preliminary review of out-of-hours works required for the construction of the Proposal has been undertaken, including those works which are required in the lead up to and immediately following a scheduled rail possession. While the requirements for night works are listed under each of the specific sections relating to bridge construction, a summary of these out-of-hours works is also provided.

Typical pre-possession works critical for completion prior to the scheduled rail possession include:

- installation of new or temporary signalling equipment and overhead electrification infrastructure to allow track slewing to occur for required staging of works. These works are likely to be undertaken during mid-week engineering hours leading up to a rail possession; and
- installation of new or temporary pedestrian bridges at several of the overbridges including Doyle Road, Davies Road, Belmore Road and Tooronga Terrace/Morgan Street. In some cases the footings may be constructed during standard daytime hours, although where works are required close to the live rail or where pedestrian bridge decks are required to be lifted and installed over the rail line, out-of-hours weekend works or engineering hours would be required.

At least two to three weeks before commencing the demolition of the overbridges, some enabling works would be required to prepare the bridges. These works would include cutting up bridge decks and abutment walls, disconnecting overhead wiring and services. These works would be undertaken out-of-hours due to potential traffic impacts and the proximity of the live rail.

Post-possession works would be minimal although there is the potential for critical works such as survey, ballast works and minor adjustments to rail to be completed following scheduled rail possessions.

Table 7.7 provides a summary of the preliminary review of out-of-hours works and their expected duration. The table also indicates the reasoning behind the requirement for these works. The duration of works is approximate and subject to refinement throughout the detailed design process as detailed survey (including geotechnical investigations) and services searches have not yet been completed.

Table 7.7: Preliminary summary of out-of-hours works

Description of works	Indicative duration	Reason for out-of-hours works
Vegetation removal within rail corridor	Two weekend possessions (daytime hours)	Proximity of the live tracks
Delivery of ballast, sleepers and rail	All possessions through the construction period	The top ballast would be delivered to the work areas by trains which can only use the rail line during mid-week engineering hours or during rail possessions. These works would be undertaken during daytime possessions where scheduling and resources allow. However, there is likely to be some night-time possession works for ballast delivery.

Description of works	Indicative duration	Reason for out-of-hours works
		Delivery of plain line rail tracks would also be by train (110 metre lengths). These works would be undertaken during daytime possessions where scheduling and resources allow although there is likely to be some night-time possession works for track delivery
Construction of turnouts and normal track (plain line)	All possessions throughout the construction period	There are several turnouts located at Revesby and Kingsgrove to be installed during the Project. These would be pre-assembled during mid-week engineering hours and installed during weekend possession periods due to the interface requirements with the live rail Majority of the plain line track would be installed during normal working hours expect in those areas which are close to live rail (and not delineated by fencing). These works would generally be undertaken during daytime weekend possession periods
Survey, marking and protection works associated with the ethane gas pipeline	Four weeks of night-time works	There are several locations where the ethane gas pipeline crosses beneath the rail corridor via underbore. In these areas, the survey marking and protection works would need to be undertaken at night when no trains are operating
Removal of advertising hoardings within the rail corridor	Two weeks of night-time works	Advertising hoardings from Kingsgrove to Revesby would be removed during possession works of which most could be daytime hours. However some night works would be necessary due to scheduling of RailCorp possessions
Installation/modification of 33kv high voltage cables along the alignment	All possessions through the construction period	The installation and/or modification of the 33kV power supply requires all power to be switched off to the rail system. These works can only be undertaken during rail possessions or scheduled mid-week engineering hours

Description of works	Indicative duration	Reason for out-of-hours works
Barrier placement/Fencing/Delineation of work zone	Three weekend possessions and up to two weeks of Engineering Hours (same duration also applies for removal of barriers and fencing)	Delineation of the work zone requires fencing/jersey kerbs to be placed approximately 3m from the rail. These works must be completed when no trains are operating. Initial possessions would be used to assist in facilitating daytime works as readily as possible
Installation and removal of overhead portal frames for signalling structures.	All possessions through the construction period	Safe working distance requirements. Some mid-week engineering hours are likely to be required where footings for the overhead frames are close to the live rail
Testing and commissioning	All possessions through the construction period	Testing and commissioning of the rail system would be undertaken as works are progressively completed and all rail possessions would be utilised
Services works including water/drainage, communications, signalling, power/power feeders, gas mains	The duration of these works cannot be estimated until detailed survey and services searches have been completed (Nov 2007)	Out-of-hours works would only be undertaken where works are close to the rail/require a power outage/result in significant traffic impacts as determined with RTA/Council or where required by service and utility providers
Road works associated with realignment/milling/resheeting/asphalting following completion of bridge works. Some minor scabbling of lines and re-line marking for parking areas would also be required	Four to five nights per bridge (King Georges Road, Broad Arrow Road, Bond Road, Belmore Road, Webb Street, Davies Road, Memorial Avenue, and Doyle Road) Two to five nights for line marking of parking areas	These works must be undertaken at night due to heavy traffic impacts during the day. It is expected that works at Webb Street and Doyle Road could be undertaken during normal working hours
Median removal and traffic switching arrangements at Davies Road and King Georges Road	Five to six nights per bridge (King Georges Road, and Davies Road)	These works must be undertaken at night due to heavy traffic impacts during the day. These works are required to implement traffic switches at these two locations to allow daytime bridge works to be facilitated

Description of works	Indicative duration	Reason for out-of-hours works
Memorial Road Bridge		
Abutment piling works	Ten nights of piling	Works associated with the abutment would result in the need to close Memorial Road while piling works are undertaken across the road to minimise traffic impact
Demolition and reconstruction of central piers/tying of struts	Eight nights of pre-possession works and 12 nights of post-possession night works as well as bridge demolition works during rail possessions	Advance works associated with bridge demolition and reconstruction (such as typing of struts, saw-cutting) must be completed prior to the designated rail possessions to allow the complete demolition of the bridge to occur within a 48 hour rail possession
Doyle Road bridge		
Abutment piling works	Maximum of 10 nights of piling	Works associated with the abutment would result in the need to close Doyle Road while piling works are undertaken across the road to minimise traffic impacts
Demolition and reconstruction of central piers/tying of struts	Eight nights of pre-possession works and 12 nights of post-possession night works as well as bridge demolition works during rail possessions	Advance works associated with the bridge demolition and reconstruction (such as typing of struts, saw-cutting, etc) must be completed prior to the designated rail possessions to allow the complete demolition of the bridge to occur within a 48 hour rail possession
Davies Road Bridge		
Removal of centre median and traffic switches	Eight to ten nights of road works	Heavy traffic impacts during the day. The works are required to implement the traffic configurations at this location to allow daytime bridge works to be facilitated
Abutment piling works	16 nights of piling	Some piling works would result in night works to minimise traffic impacts
Installation of parapet sections at night under lane closure and when no trains are operating.	One week of engineering hours (night works) or one to two weekend possession(s)	The parapet sections are installed over the rail line and, must be completed either during rail possessions or engineering hours when no trains are operating

Description of works	Indicative duration	Reason for out-of-hours works
Demolition and reconstruction of central piers/tying of struts	Eight nights of pre-possession works and 12 nights of post-possession night works as well as bridge demolition works during rail possessions (one bridge per one to two weekend possessions)	Advance works associated with the bridge demolition and reconstruction (such as typing of struts, saw-cutting) must be completed prior to the designated rail possessions to allow the complete demolition of the bridge to occur within a 48 hour rail possession
Revesby Station Works on the platform	Three to four weeks of night works	The works would generally be undertaken during rail possessions due to disruption to passengers. However some of these works may be undertaken during engineering hours where works are close to rail
Pedestrian bridge works at: Revesby (extension of the existing pedestrian overpass built as part of the Turnback project) Doyle Road overbridge (bridge required during construction works) Davies Road overbridge (bridge required during construction works) Belmore Road overbridge (bridge required during construction works) Morgan Street/Tooronga Terrace at Beverly Hills (bridge required during construction works)	Five nights per pedestrian bridge	These works are required to be undertaken out-of-hours due to the need to construct footings and lift the pedestrian bridge over the rail corridor, This must be undertaken when no trains are operating. In addition, revised pedestrian arrangements need to be in place prior to bridge works commencing
Under track drainage works at Revesby	15 nights	These works cannot be undertaken while trains are operating. While there is potential for them to be undertaken during a possession this would depend on the detailed possession planning to be undertaken (there may not be sufficient work area for these works to occur during a possession)
Commissioning of the new electrical substation west of Revesby Station and removal of existing sectioning hut	One weekend possession	The works associated with the substation must be undertaken when there is a power-out within the rail corridor

Description of works	Indicative duration	Reason for out-of-hours works
Webb Street bridge:		
Piling for abutments	Two weeks of night works	Both the piling works for the abutment and tying in of the precast units on the southern side of Webb Street must be undertaken when no trains are operating due to the proximity of the track in this location
Tying in of precast units	Three to four nights	
Salt Pan Creek Bridge		
Installation of new bridge decks	Two to three weekend possessions	Proximity of the live rail. Some mid-week engineering hours would be utilised in lead up and immediately following the major rail possessions when the bridge decks are lifted into position. This location has added difficulties with working over water. Further detailed staging to be undertaken
Embankment stabilisation/piling and ground improvement works	Periodically (overall duration six to eight weeks)	
Belmore Road Bridge		
Piling for bridge abutment works	Three weeks of night works.	Piling works must be undertaken at night due to the significant traffic impacts. RTA has requested that steel plates are placed over the roadway during the day
Demolition and reconstruction of central piers	16 nights	Advance works associated with the bridge demolition and reconstruction (such as tying of struts and saw-cutting) must be completed prior to the designated rail possessions to allow the complete demolition of the bridge to occur within a 48 hour rail possession
Demolition and construction of new bridges on both sides of Belmore Road	Eight nights of pre-possession works and 12 nights of post-possession night works as well as bridge demolition/reconstruction works during two rail possessions	

Description of works	Indicative duration	Reason for out-of-hours works
Bonds Road bridge and Broad Arrow bridge:		
Piling for bridge abutments	Two weeks of night works per bridge	These works must be undertaken when no trains are operating due to the interface with the rail operations including the overhead wiring structures and associated track work
Erection of new structures	Two weekend possessions per bridge	
Narwee pedestrian underpass extension:		
Piling for abutments	Two weeks of night works	Both the piling works for the abutment and tying in of the precast units must be undertaken when no trains are operating due to the proximity of the track as well as to manage any pedestrian impacts. Only one side of the underpass (northern followed by southern) would be closed at any one time
Tying in of precast units	Three to four nights	
Demolition of commercial building on northern side of Narwee Station	Two weekend possessions	The demolition works must be undertaken during a rail possession due to the proximity of the building to the rail corridor and to ensure public safety for pedestrians/motorists adjacent to Hannans Road
King Georges Road bridge:		
Establishment of site access on north west corner of King Georges Road (must be completed prior to traffic staging) Trenched road crossing of King Georges Road Concourse modifications associated with pedestrian bridge Investigation works associated with central bridge pier Piling and headstocks for new southbound bridge and northbound Deck works including parapets, footpaths, traffic loops Substructure concreting works	Six months for bridge works. During this time two major rail possessions would be utilised as well as approximately three to four weeks of night works leading up to and immediately following each of the possessions	King Georges Road is a major arterial road in the Sydney road network. Enabling works including establishing access, piling for bridge abutments, road works and investigation works would need to be undertaken at night prior to the traffic staging being implemented. Night works are required due to the significant traffic impacts which would occur as a result of daytime works. Further discussions would be ongoing with the RTA throughout detailed design to ensure that the extent of night works is minimised

Description of works	Indicative duration	Reason for out-of-hours works
Installation of precast planks over stormwater canals in Morgan Street and Tooronga Terrace	Eight nights work (two nights per side of each bridge, two stormwater canals to be constructed)	These works are required to be undertaken at night due to the requirement to lift the precast planks over the rail corridor. This can only be undertaken when no trains are operating

7.5 Ancillary construction facilities

Construction work sites would be required at a number of locations along the rail corridor. These would need to take account of the limited space available in and adjacent to the corridor, access from adjoining roads and the need to gain access from both sides. There are numerous points of access to the corridor but very limited space within it and little adjacent open space with the potential for use as a work site. The following sites have been identified as suitable for temporary construction compounds:

- Edgbaston Street car park, Beverly Hills (subject to council approval);
- reserve between Nirimba Avenue and Nanowie Steet, Narwee (chainage 15.84 kilometres to15.96 kilometres Up side);
- existing RailCorp facility, Narwee (chainage 16.55 kilometres to 16.63 kilometres Down side);
- reserve area, end of Lillian Road (Up side) and laydown area at the end of Webb Street (Down side) adjacent to Salt Pan Creek, Riverwood;
- area of land within rail corridor, Padstow (chainage 19.10 to 19.20 kilometres Up side);
- area of land within the rail corridor, Wilberforce Road, Revesby (approximate chainage. 20.30 kilometres Down side) and an additional area adjacent to Revesby Station at approximate chainage 21.00 kilometres Up side.

The general location of the compounds is shown on **Figures 12.4a** to **12.4g.** Their location would be confirmed during detailed design and construction planning. These sites would accommodate demountable offices, meal rooms, toilets/showers and parking facilities (where possible). Additional sites would be required and used to store plant and equipment involved in the construction activities and stockpiles of materials required for the civil works. The compounds would be removed when construction is complete and returned to their previous condition. The location, size and configuration of each site would be determined at the detailed design stage.

In addition to the proposed compound areas, training and logistics areas outside of the rail corridor would be established to enable competency training to be undertaken prior to the start of works within the rail corridor. This logistics area would also be used for bulk storage of materials throughout the Project. The location, size and configuration of the logistics area would be determined at the detailed design stage.

7.6 Activities during rail track possessions

Possessions are required where works cannot be safely undertaken due to their proximity to the existing rail lines or where there would be a risk that the works may adversely affect the existing operating lines. These activities are outlined in **Table 7.7** and would include:

- erection of safety barriers and fences to isolate the working areas from the live track;
- relocation, extension or reinforcement of in-corridor utilities in the Revesby Station area;
- survey, marking and protection of the high pressure ethane gas pipeline;
- vegetation clearance;
- removal of advertising hoardings at various locations along the Project alignment;
- installation of bridge decks for four bridges over stormwater canals east of King Georges Road;
- central pier strengthening works and demolition of existing abutments, demolition of bridge deck and instillation of new deck on King Georges Road bridge, southbound;
- underpinning works and construction of blade walls on King Georges Road bridge northbound including blade wall construction;
- erection of new superstructure at Broad Arrow Road bridge;
- installation of new structures at Narwee Station underpass (both sides) including demolition of existing commercial building;
- erection of new structures at Bonds Road bridge;
- demolition, strengthening and construction of new bridges (both sides) at Belmore Road;
- installation of new superstructure at Webb Street underpass;
- construction and installation of new bridge decks at Salt Plan Creek;
- demolition of existing bridges and construction of new bridges at Davies Road, Memorial Drive, and Doyle Road;
- installation and then removal of pedestrian bridges at King Georges Road Beverly Hills, Belmore Road, Riverwood and at Revesby Station (removal not required);

- construction of footings in close proximity to the existing rail lines for the new overhead wiring structure;
- removal of existing overhead power lines and installation of new overhead wiring structures;
- construction, testing and commissioning of the new sub station and upgrading of other sub stations;
- temporary installation of signalling cables and installation of new signalling;
- conversion of existing turnouts, installation of new turnouts, adjustments to overhead wiring and installation of new overhead wiring at Revesby and Kingsgrove;
- installation of new high voltage cables at various locations along the alignment where the new cables are close to the existing rail line;
- removal of safety barriers and fencing; and
- testing and commissioning of the new system.

Where feasible, some of these activities would be undertaken during midweek engineering hours when trains are not running. Although there are some preliminary scheduled dates for these works, they are subject to approval and change by RailCorp.