Airport Link

Phase 2 – Detailed Feasibility Study

CHAPTER 4

PROJECT DESCRIPTION

- October 2006

Contents

4. Project Description

This chapter addresses Section 3 of the Terms of Reference. It provides a description of the project through all of its phases, namely planning, construction, decommissioning of the construction sites and the long term operation of the tunnel.

A detailed description is provided for:

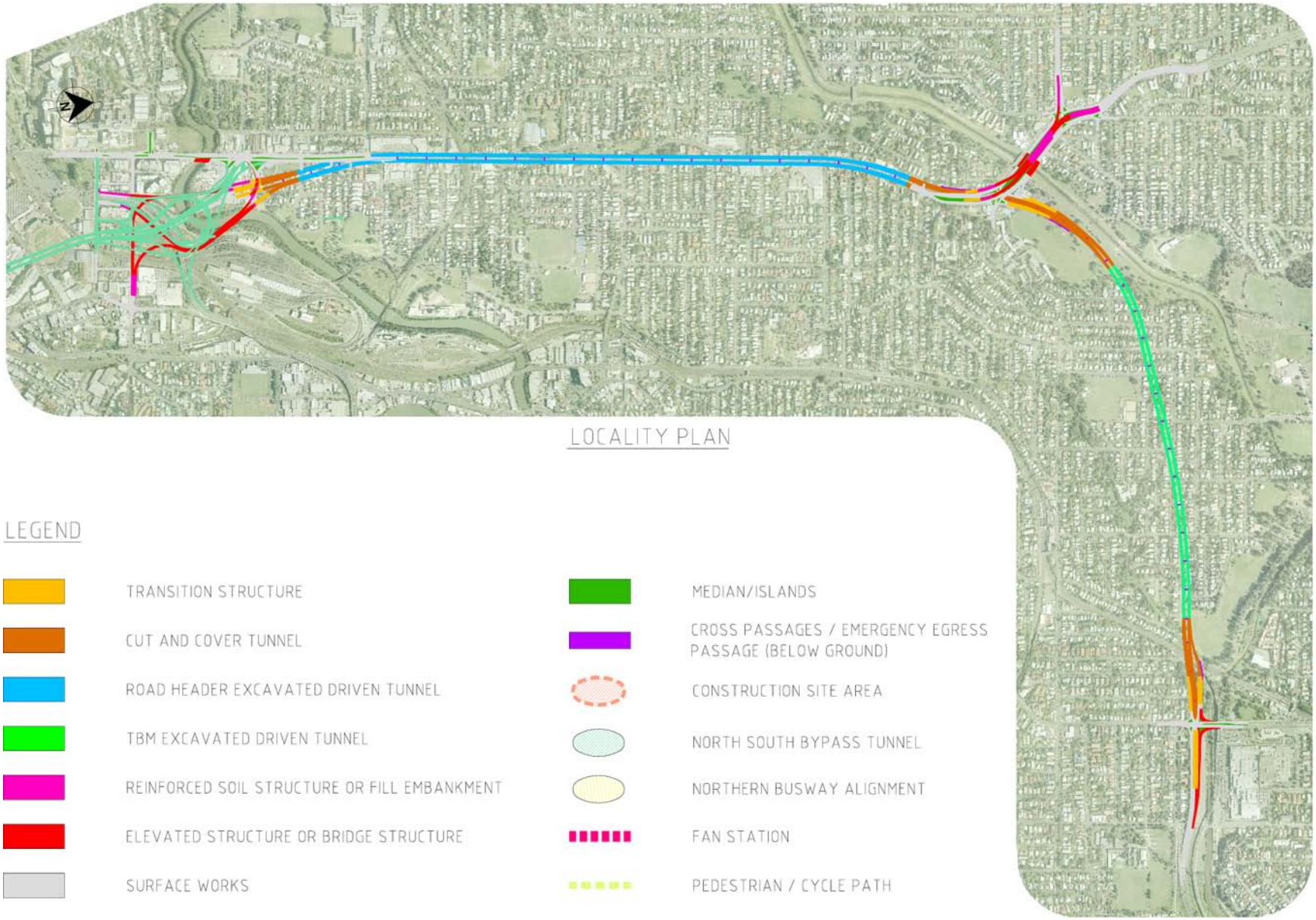
- *The finished project, including design criteria, the preferred corridor and its elements, access points and requirements. Land acquisition and tenure are addressed in Chapter 12;*
- *Construction arrangements, including a program and timing of activities, options for construction work areas and their decommissioning, access and traffic arrangements, spoil management arrangements such as transport routes and disposal locations. Information on impacts on the road network is provided here and in Chapter 5, while details on hazardous and dangerous material likely to be transported to and from the site are outlined in Chapter 17;*
- *Other infrastructure requirements, including effects on utilities and their users;*
- *Permits and licences required and the environmental or other authorities responsible; and*
- *Strategies and methods for progressive and final rehabilitation of the environment disturbed during construction.*

4.1 General Description of Airport Link Project

The proposed Airport Link Project is approximately 6.7km in length overall, with approximately 5.7km of that constructed as tunnel, mainly in rock below Lutwyche Road through Windsor, Lutwyche and Kedron, and beneath Brook Road, Lodge Road and Lewis Street through Wooloowin and Kalinga. It will link the North-South Bypass Tunnel (NSBT), the Inner City Bypass (ICB) and Lutwyche Road in Windsor/Bowen Hills to the south with Sandgate Road and the East-West Arterial at Clayfield in the north-east. At Kedron the mainline tunnels will be close to the surface to allow connections with Stafford Road and Gympie Road on elevated structures across Kedron Brook. The general plan of the project, within the study corridor identified in the Terms of Reference (ToR) for this EIS, is shown in **Figure 4-1** and the indicative longitudinal section of the alignment is shown in **Figure 4-2**.

The proposed Airport Link Project would include:

- Two separate parallel road tunnels, one for north/eastbound traffic and one for west/southbound traffic;
- Tunnel portals (openings to the surface) at Bowen Hills, Kedron and Clayfield;
- Three lanes in each direction between the southern connection and the north-western connection;
- Two lanes in each direction between the north-western connection and the north-eastern connection;
- Safety systems including safety exits, fire protection and monitoring systems;
- A ducted ventilation system to manage air quality in the tunnel and near portals, including elevated outlets near the portals in Windsor, Kedron and Clayfield;
- Surface road changes to connect the tunnels into the existing road network;
- Traffic management systems including signage, lighting, CCTV and radio/mobile re-broadcast capability; and
- Electronic tolling, plant monitoring and control systems.

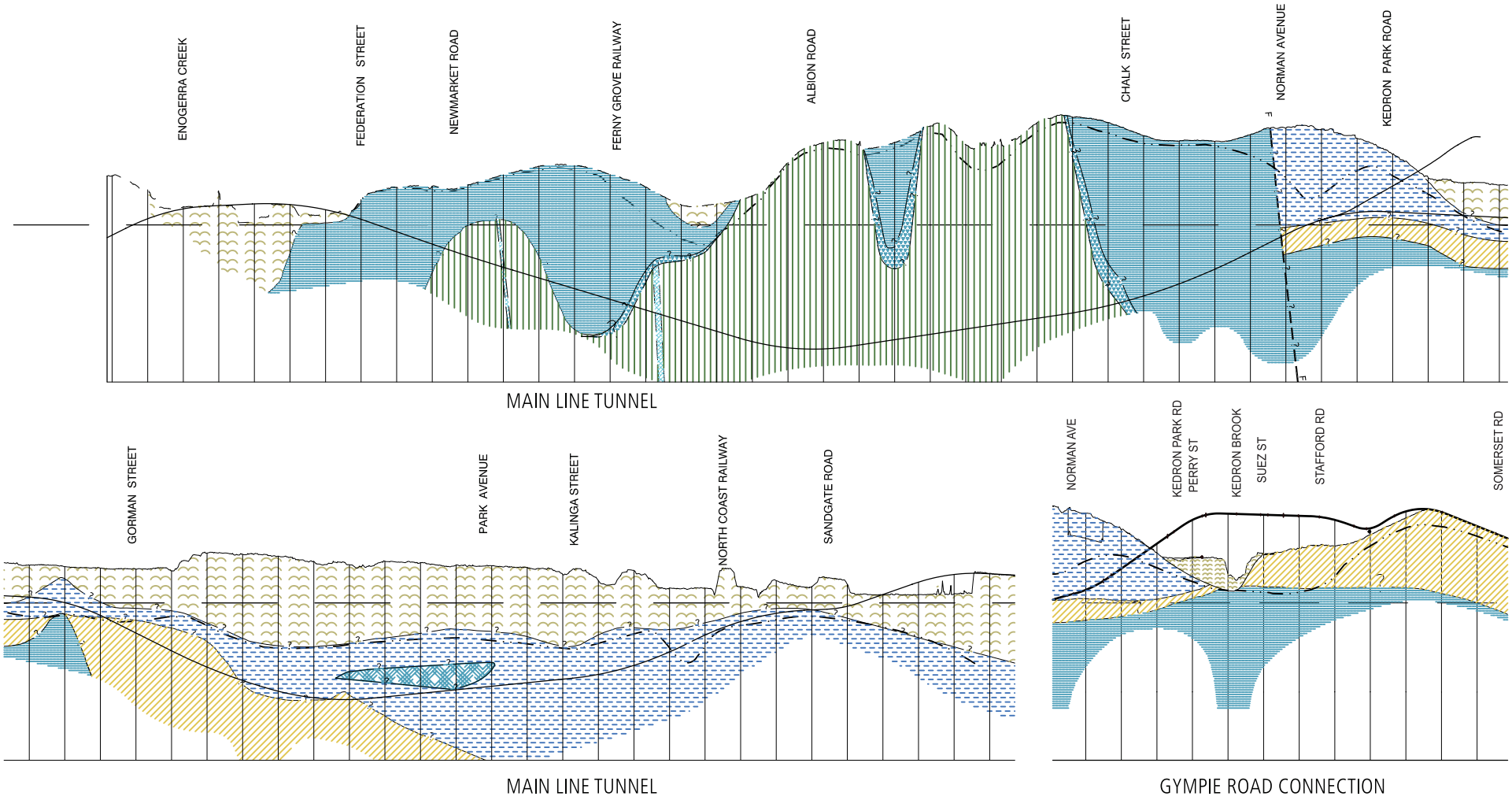


AIRPORT LINK - Figure 4-1

Tunnel Alignment

Airport Link

SKM Connell Wagner JOINT VENTURE



AIRPORT LINK - Figure 4-2

Indicative Long Section

Airport Link

SKM Connell Wagner JOINT VENTURE

4.2 Project Design

4.2.1 Design Standards and Criteria

There are no Australian design standards in use which are directly relevant to road tunnels, nor is there unified consistency amongst international standards (PIARC 2001), with projects using a mix of performance and prescriptive approaches, international codes, international and national practice and benchmarking to achieve consensus on design issues. There have been significant developments in international codes of practice and standards since the occurrence of tunnel fires in Europe (Mont Blanc, Tauern, Saint Gotthard). Such codes and standards include a mixture of prescriptive design parameters and performance based parameters supported by appropriate quantitative risk analysis (PIARC 2001, 2004).

The design objective for the mainline tunnels is to achieve a 90km/h design speed for a signposted speed of 80km/h. This would be consistent with the rest of the Brisbane urban road network and is a speed that is commonly adopted for urban road tunnels elsewhere in Australia and overseas.

The vertical grade of a road has impacts upon vehicle speeds and the quantity of vehicle emissions, with the effects increasing with steepening grades. Steep uphill grades result in slowing of heavy vehicles and potential traffic delays, and increased vehicle emissions, and the need for additional ventilation. Once the gradient relative to road length exceeds a certain value, an additional climbing lane is required to address such effects. High downgrades also can create delays, particularly in a speed-monitored environment, as “tailbacks” can form due to breaking effects as vehicles strive to keep to the speed limit. Based upon these considerations, desirable maximum grades of 5% up and 7% down were adopted for the Airport Link Project. Due to surface constraints it was necessary to exceed these grades in certain areas of the ramps outside of tunnel areas. A minimum grade in the tunnel of 0.5% was adopted to ensure adequate performance of the longitudinal drainage system. This minimum grade ensures that minor inflows to the tunnel drain to “sag points” within the tunnel from where water is collected and transferred via a piped drainage system.

Design life in Airport Link Project is taken to mean the time before first major maintenance. Different components of the project have different design lives and these have been summarised in **Table 4-1** below.

4.2.2 Flood Immunity/Drainage

Each of the tunnel ramps at the three connections has been designed to provide flood immunity to a 10,000 year ARI storm event. This criterion was adopted after considering:

- The likelihood of encountering a flood event of this magnitude within the design life of the tunnel;
- The consequences of encountering such an event; and
- The infrastructure that would be required to provide the design flood immunity.

Assuming a tunnel design life of 100 years, the likelihood of encountering a flood event greater than this magnitude is approximately 1% in that period.

Where appropriate, the hydraulic impacts of the proposed tunnel ramps, bridge structures and other new works under a 100 year ARI design event have been determined. Where the works were found to create adverse hydraulic impacts upon external properties under this design event, mitigation measures were developed and assessed.

Table 4-1 Design Life for Project Components

Component	Design Life
Bridge and roadway support structures Tunnel structures, underpasses, supports and structural linings Retaining walls including reinforced soil walls Reinforced embankments; Inaccessible drainage elements New local road pavement support structures	100 years
Buildings	50 years
Sign support structures and other roadside furniture Noise barriers Tunnel rigid pavements Tunnel architectural panels	40 years
Reconstructed local road pavements (excluding wearing courses and resurfacing) Drainage elements that are accessible for refurbishment including building drainage Lighting Mechanical and electrical equipment including fire protection systems Traffic management and control systems	20 years
Fixed sign faces Local road wearing courses	10 years

4.2.3 Tunnel Alignment

The main roadway alignment for both the northbound and southbound routes would connect with the ICB westbound, the city road network via O'Connell Terrace and Campbell Street and the NSBT Project at Bowen Hills and Windsor. It would enter the two tunnels through twin southern portals in the vicinity of Federation Street and remain directly beneath Lutwyche Road, with the deepest point approximately 50m below ground. The mainline tunnels would emerge through the north-western portals in Lutwyche Road to provide connections with Gympie Road and Stafford Road via elevated structures across Kedron Brook. The mainline tunnels would continue on beneath the Lutwyche Road/Kedron Park Road intersection, running north-east and generally parallel to Kedron Brook. The mainline tunnels would pass underneath Wooloowin, near Kedron State High School, and continue to curve to the east beneath Lodge Road and Lewis Street, with the deepest point approximately 30 metres below ground. At the eastern end of Lewis Street, the mainline tunnels continue beneath the North Coast Railway embankment and Airtrain viaducts, then rise close to the surface to provide connections with Sandgate Road. The mainline tunnels pass underneath Sandgate Road within transition structures to connect directly with the East-West Arterial, west of Widdop Street.

The alignment for the mainline tunnels has been based on a number of factors, including:

- Road geometry based on design speed, sight distance, vertical alignments;
- Geotechnical conditions, including groundwater conditions;
- Potential obstructions above and below the surface; and
- Accommodation within the design for the proposed Northern Busway.

4.2.4 Tunnel Configuration

The Reference Project design provides for two parallel tunnels, with the western tunnel dedicated to northbound and eastbound traffic and the eastern tunnel to westbound and southbound traffic. The two tunnels would be

aligned next to each other, with minimum separation of at least 10m in the driven tunnel sections. As discussed below, cross-passages would connect the two tunnels at regular intervals along the route.

Lane widths, separations and shoulders are to accord with Queensland Department of Main Roads planning and design standards for road planning and construction. The north-south tunnels would each have three running lanes, with two 3.5m wide outside lanes and a 3.7m wide central lane with a 1m wide shoulder on the left hand side and 0.5m on the right. The north-western cut and cover tunnel connection would have two running lanes in each direction separated by a structural central wall. Each tunnel would have two running lanes 3.5m wide with varying shoulder widths on both sides to accommodate sight distance requirements. The east-west tunnels would each have two running lanes 3.5m wide with a 1m wide shoulder on the left hand side and 0.5m on the right. Typical cross sections for all tunnels are shown in **Figure 4-3**.

Dedicated break down bays would not be provided within the tunnels, as there would be sufficient room to pass a stationary vehicle safely, at an appropriate speed, with the configuration proposed. The posted height clearance is 4.6m, providing a vehicle envelope of 4.9m, above which 0.7m of space would be allowed for ducts, lighting and signage.

Outbound Traffic

For north/eastbound traffic, entry to the tunnel at the southern connection would be gained from the NSBT Project, ICB, eastbound O'Connell Terrace or westbound Campbell Street. At Kedron, entry from the north-west (Gympie Road/Stafford Road) and from Lutwyche Road would provide access to the northeast. Northbound traffic would be able to leave the tunnel at Kedron onto Gympie and Stafford Roads. At Clayfield eastbound traffic could continue on the East-West Arterial, or connect to the local street system via Sandgate Road to the north and to the south.

Inbound Traffic

For west/southbound traffic, entry to the tunnel at Clayfield would be gained from Sandgate Road and the East-West Arterial and at Kedron from Gympie and Stafford Roads. Westbound traffic from Clayfield and Toombul would be able to exit at Kedron onto Gympie Road, Stafford Road or Lutwyche Road. At the southern connection southbound traffic could continue into the NSBT Project towards Kangaroo Point or Woolloongabba, connect to the ICB westbound or gain access to the local street system via O'Connell Terrace or Campbell Street.

4.2.5 Surface Roads

Design of the connections of the tunnel roads to the existing surface road network satisfies engineering requirements and constraints, takes advantage of urban design opportunities and avoids or minimises impacts on natural and social environments. Options for surface connections were considered and a concept developed to allow a level of impact assessment consistent with the ToR to be undertaken. It is possible that the conceptual arrangements of the surface connections may change when the project is subject to detailed design.

Surface Roads at Southern Connection

The proposed surface roads at the southern connection are shown in **Figure 4-4**.

The southern connection concept contains both new works and proposed works associated with the northern connection of the NSBT Project. Airport Link's primary design criteria for this connection are:

- To provide connectivity with NSBT mainline road carriageways and maintain NSBT's proposed connections with the local traffic network;

- To provide road connections to and from the ICB westbound; and
- To provide road connection with the local road network via O'Connell Terrace and Campbell Street.

Southbound traffic emerging from the Airport Link tunnel at Windsor would be in four lanes. The two left-hand lanes would separate within the cut and cover tunnel, ramping up to cross Enoggera Creek on an elevated structure. The left-hand lane would then diverge to the east onto Campbell Street and the right-hand lane merge with traffic from Lutwyche Road. These two lanes of merged traffic would continue on elevated structure into single lanes. One lane would connect with O'Connell Terrace and the other with the proposed ICB westbound ramp of the NSBT Project. Airport Link would construct the widening of the proposed NSBT structure required for these connections. Airport Link would not provide access eastbound on ICB or O'Connell Terrace, or westbound on Campbell Street.

The two remaining right-hand lanes for southbound traffic emerging from the Airport Link tunnel would merge with traffic from Lutwyche Road and connect into the NSBT mainline carriageway near Enoggera Creek. Two lanes of northbound traffic from the NSBT mainline carriageway would connect into Airport Link mainline carriageway near Enoggera Creek. The off ramp from ICB eastbound, that in the NSBT Project connects to Lutwyche Road, would diverge near Horace Street as elevated structure with the two right hand lanes merging, before descending into the Airport Link tunnel and merging with the two lanes of NSBT mainline tunnel traffic.

Local traffic would enter the Airport Link westbound from Campbell Street and eastbound from O'Connell Terrace. The two local traffic connections would be single lanes, ramping up to merge at an elevated connection. The two lane elevated structure would be constructed by Airport Link above the NSBT bridge across Enoggera Creek and would therefore be a second-level elevated structure situated adjacent to The Mews apartments in Campbell Street. The two lanes would then merge into a single lane ramp down, finally merging with the three lanes from NSBT and ICB to enter the Airport Link tunnel.

Alterations to the local traffic network are as follows:

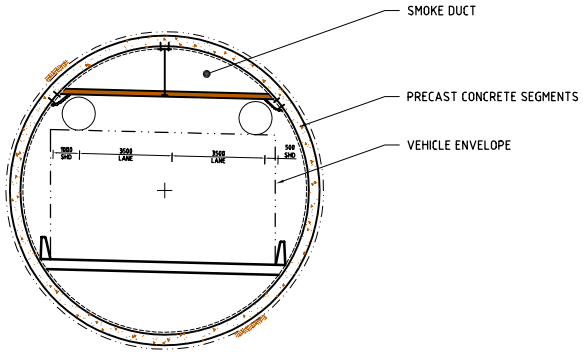
- The Campbell Street/Mayne Road intersection would be reconfigured to accommodate the Campbell Street ramps and allow for a single lane of local access traffic on Campbell Street.
- The Lutwyche Road/Northey Street intersection would have minor line marking changes to accommodate the lateral shift of the Y-junction that provides access to NSBT and the ICB westbound.
- O'Connell Terrace would have a single lane eastbound to provide access to the O'Connell Terrace on ramp.

Possible landscaping and urban design elements are discussed in Chapter 15.

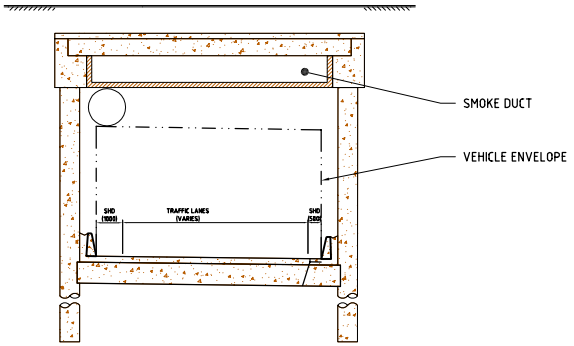
Surface Roads at North-western Connection

The proposed surface roads at the north-western connection are shown in **Figure 4-5**. The north-western connection would provide road connections:

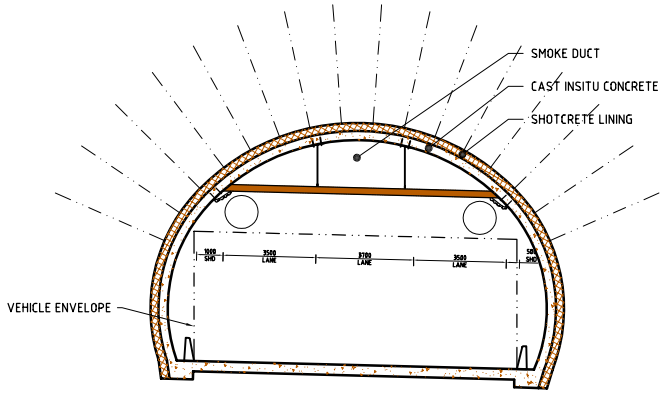
- Between Gympie Road and Stafford Road at Kedron and Bowen Hills, through the north to south tunnels;
- Between Gympie Road and Stafford Road at Kedron and Clayfield, through the east to west tunnels.



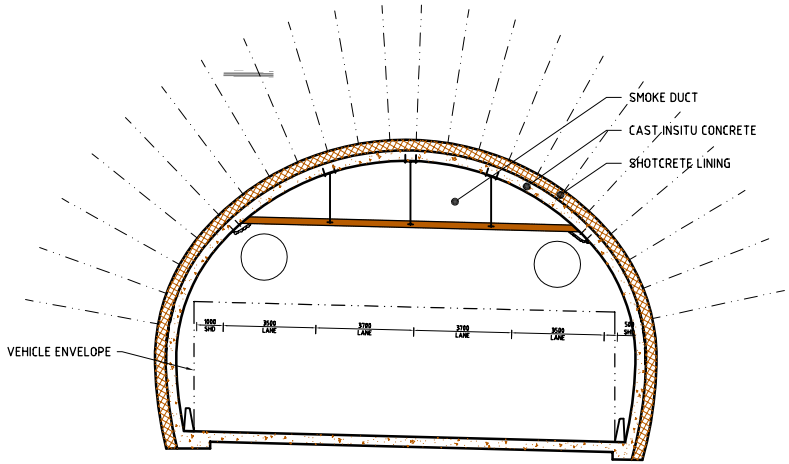
STANDARD TWO LANE TBM TUNNEL SECTION



STANDARD CUT AND COVER TUNNEL SECTION



STANDARD THREE LANE ROADHEADER TUNNEL SECTION



STANDARD FOUR LANE ROADHEADER TUNNEL SECTION

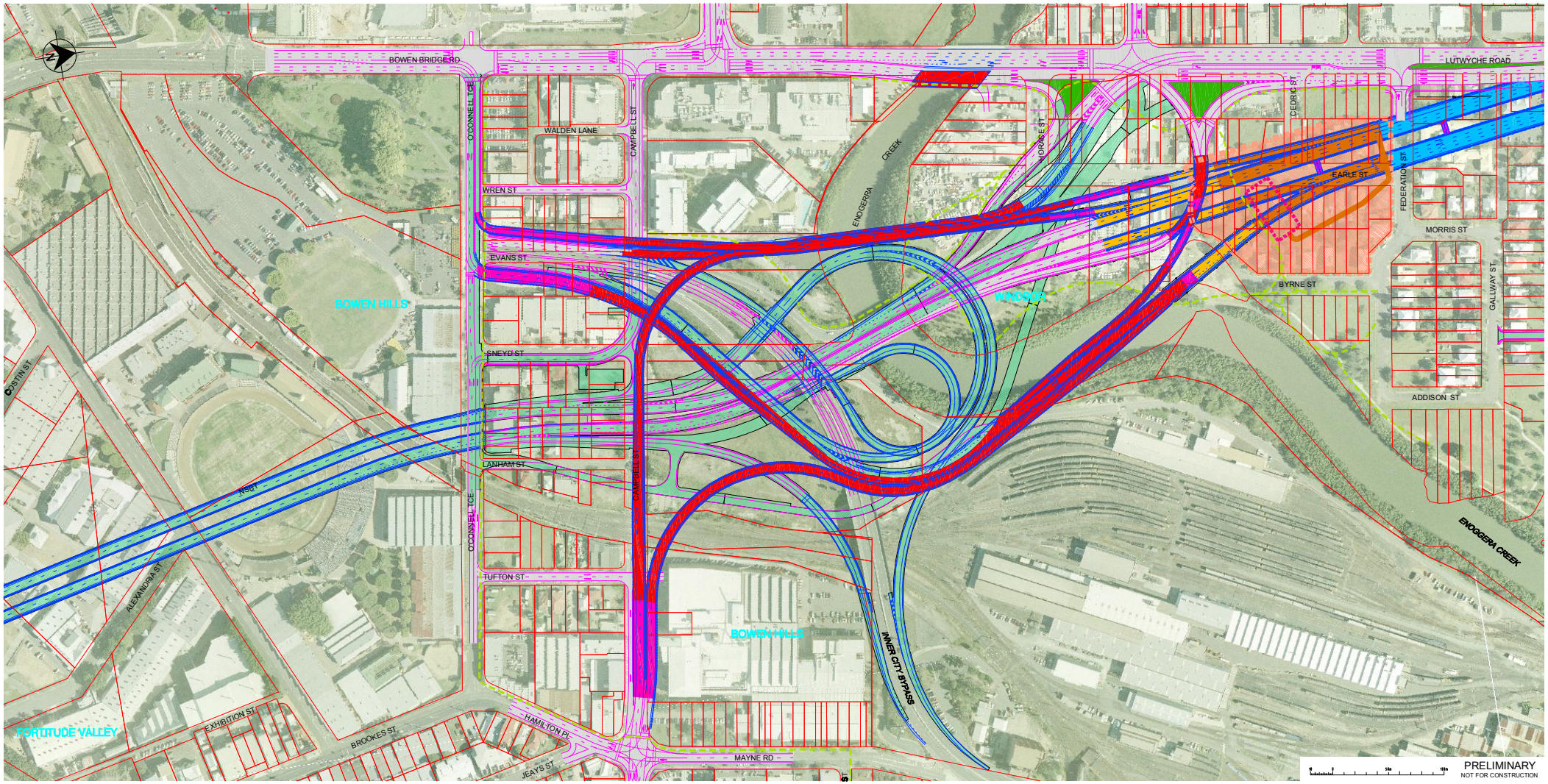
AIRPORT LINK - Figure 4-3

Typical Cross Sections

SCALE 1:100

AirportLink

SKM Connell Wagner JOINT VENTURE



LEGEND

- TRANSITION STRUCTURE
- CUT AND COVER TUNNEL
- ROAD HEADER EXCAVATED DRIVEN TUNNEL
- TBM EXCAVATED DRIVEN TUNNEL
- SURFACE WORKS
- REINFORCED EARTH STRUCTURE OR FILL EMBANKMENT
- ELEVATED STRUCTURE OR BRIDGE STRUCTURE
- MEDIAN/ISLANDS
- CROSS PASSAGES / EMERGENCY EGRESS PASSAGE (BELOW GROUND)
- NORTHERN BUSWAY ALIGNMENT
- NORTH SOUTH BYPASS TUNNEL TENDER DESIGN
- PROPOSED CONSTRUCTION WORK SITES
- PEDESTRIAN AND CYCLE ACCESS
- FAN STATION

AIRPORT LINK - Figure 4-4

Southern Connection

0 100m 200m

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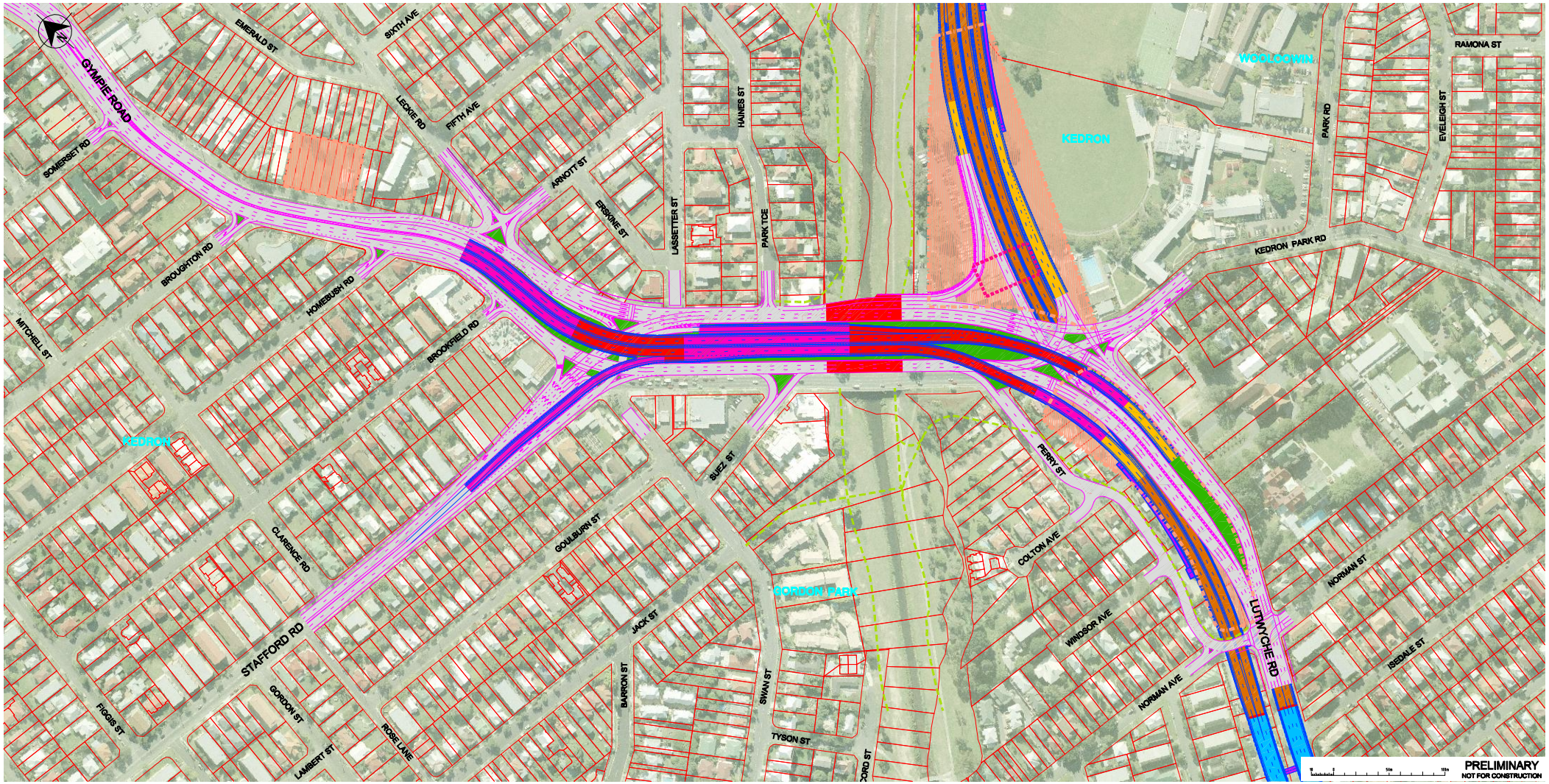
SKM Connell Wagner JOINT VENTURE



LEGEND

- TRANSITION STRUCTURE
- CUT AND COVER TUNNEL
- ROAD HEADER EXCAVATED DRIVEN TUNNEL
- TBM EXCAVATED DRIVEN TUNNEL
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- ELEVATED STRUCTURE OR BRIDGE STRUCTURE
- MEDIAN/ISLANDS
- CROSS PASSAGES / EMERGENCY EGRESS PASSAGE (BELOW GROUND)
- NORTHERN BUSWAY ALIGNMENT
- NORTH SOUTH BYPASS TUNNEL TENDER DESIGN
- PROPOSED CONSTRUCTION WORK SITES
- PEDESTRIAN AND CYCLE ACCESS
- FAN STATION

AIRPORT LINK - Figure 4-5

North Western Connection

0 100m 200m

Airport Link

SKM Connell Wagner JOINT VENTURE

Surface Connections with North-South Tunnels

Traffic emerging from the northbound tunnel at Kedron would separate into four lanes. The two left hand lanes would separate within the cut and cover tunnel, and ramp up to elevated structure that would cross the new Lutwyche Road works and continue as elevated structure across Kedron Book, above the level of the Kedron Brook bridges. The bridge would develop an additional left-hand lane that would separate and move to the left, descending to connect to Stafford Road westbound. The two right-hand lanes continuing north would ramp down and connect with Gympie Road northbound.

The two right-hand lanes of the tunnels continue through from the northbound tunnel as the mainline tunnel that passes underneath the Lutwyche Road/Kedron Park Road intersection and continues into the east-west tunnel.

Local traffic would gain access to the north-south tunnels from Kedron via Gympie Road and Stafford Road. Gympie Road traffic would access the elevated structure in two lanes via a ramp located north of the Gympie Road/Stafford Road intersection. Stafford Road traffic would turn right through the Gympie Road/Stafford Road intersection into a ramp on Gympie Road that merges into the two lanes of elevated traffic. This ramp, south of the Gympie Road/Stafford Road intersection, would be separated from Gympie Road through traffic and would only be accessible from Stafford Road. These three lanes merge into two lanes and continue on elevated structure over the Lutwyche Road/Kedron Park Road intersection before ramping down into the north-south tunnels. These two lanes of traffic would merge with the two lanes of westbound traffic, from the east-west tunnels, and enter as four lanes into the north-south tunnel.

Surface Connections with East to West Tunnels

Traffic emerging from the westbound driven tunnel would separate into two lanes. A diverge on the left-hand lane would allow for traffic to either exit the tunnel at Kedron or continue through to the north-south tunnel. The left-hand exit lane would transition from one lane to three lanes before the Lutwyche Road/Kedron Park Road intersection. Access to the local road network from the transition structure would have a single lane that would be able to turn left onto Lutwyche Road and two lanes that could turn right on Lutwyche Road and then enter either Stafford Road or Gympie Road.

The two lanes exiting the west-east driven tunnel would be able to continue through to the southbound lane of the north-south tunnel. The mainline tunnel would be continued as a tunnel that passes underneath the Lutwyche Road/Kedron Park Road intersection and continues into the north-south tunnel.

Local traffic would enter the east-west tunnels from Kedron via Lutwyche, Gympie and Stafford Roads. Lutwyche Road traffic would gain access to the east-west tunnel through two dedicated right-hand turn lanes that would be separated from Lutwyche Road through traffic. These two lanes would merge into a single lane that would descend into the east-west tunnel. Gympie Road and Stafford Road traffic would enter the east-west tunnel through a dedicated left-hand lane that would be developed south of the Gympie Road/Stafford Road intersection. This lane would move left and ramp down to merge with the single lane of traffic from Lutwyche Road. These two lanes of traffic would merge into a single lane. The single lane of local traffic would then merge with the two lanes of through traffic entering the eastbound tunnel as two lanes of traffic.

Local Traffic

Construction of the Airport Link project would result in new works and alterations to local traffic movements in the Kedron area. In particular the reconfiguration of the new intersections at Gympie Road/Stafford Road and Lutwyche Road/Kedron Park Road would include new works.

Proposed alterations to Lutwyche Road are:

- Widening of the pavement of Lutwyche Road between Norman Avenue and Kedron Brook. This would maintain the existing six lanes, three in each direction, of traffic on Lutwyche Road and would provide two right-hand turn lanes on to the east-west tunnel. The four lanes of transition structures, ramps and bridges that would provide access between the north-south tunnels and Gympie and Stafford Roads would also be incorporated in this road widening; and
- Local access from Lutwyche Road onto Windsor Avenue, Colton Avenue and Perry Street would be removed, with Perry Street maintaining a left out onto Lutwyche Road. The local access into Windsor Avenue, Colton Avenue and Perry Street would be provided via a service road across a signalised intersection on Norman Avenue.

The Lutwyche Road/Kedron Park Road intersection would have new surface works that would allow for the additional movements of Airport Link. Lutwyche Road traffic travelling northbound would have three lanes of through traffic and provide two lanes for turning right into the east-west tunnel. Lutwyche Road traffic travelling southbound would have three lanes of through traffic and two left hand turn lanes onto Kedron Park Road. There would be three lanes of traffic exiting the east-west tunnel with two lanes turning north and one turning south onto Lutwyche Road. Kedron Park Road would have two lanes turning right onto northbound Lutwyche Road and would provide a single lane left hand turn onto southbound Lutwyche Road.

Proposed alterations that would be made to Gympie Road are:

- Widening of the pavement of Gympie Road between Kedron Brook and Broughton Road. The road widening would allow for the northbound and southbound Gympie Road traffic that varies between four and eight lanes, the five lanes of ramps and elevated structure that would connect Stafford Road and Gympie Road with the north-south tunnel and the dedicated lane that would provide access to the east-west tunnel from Gympie Road southbound;
- Northbound Gympie Road would consist of three lanes of traffic from Kedron Brook through the Gympie Road/Stafford Road intersection merging to two lanes after Brookfield Road. These two lanes would merge into a single lane after Homebush Road where they would also merge with the two lanes of Airport Link traffic that would be descending from the elevated structure. Gympie Road northbound traffic would then be three lanes wide by Broughton Road; and
- Southbound Gympie Road traffic would be three lanes wide at Broughton Road with the two lanes, the central and right-hand lanes, continuing onto the elevated structure that accesses Airport Link and two lanes, the central and left hand lanes, would continue southbound along Gympie Road. The two lanes of southbound Gympie Road widen to four lanes of through traffic and a right hand turn lane would be developed for the Gympie Road/Stafford Road intersection. The left hand lane is separated into a dedicated lane to access the east-west tunnel with three lanes continuing southbound. Two additional left hand turn lanes would be developed from the southbound Gympie Road traffic between Park Terrace and Kedron Brook.

Swan Street would no longer have a left turn in from Stafford Road and would now be a cul-de-sac. Lasseter Street would no longer have a left in/left out access to Gympie Road and would be replaced with a dead end. Leckie Road/Gympie Road intersection would be constructed as new works. The intersection would provide for a left hand turn into Leckie Road and Arnott Road from Gympie Road, although trucks would be unable to turn onto Leckie Road. Traffic from Leckie Road would be able to turn left onto Arnott Road or continue through onto Gympie Road. Arnott Road traffic would be allowed to turn left onto Gympie Road.

Gympie Road/Stafford Road intersection would have new surface works that would allow for the additional movements generated by Airport Link. Gympie Road traffic travelling northbound would have three lanes of through traffic with the left-hand lane allowing for left turn into Stafford Road. Gympie Road traffic travelling southbound would have four lanes of through traffic with the left-hand lane separating into a dedicated access to the east-west tunnel and a right hand turning lane onto Stafford Road. Southbound traffic on Stafford Road would have three lanes turning right onto Gympie Road southbound and would develop a left-hand slip road that turned left onto Gympie Road northbound.

Proposed alterations for Stafford Road are:

- Widening of the pavement of Stafford Road between Gympie Road/Stafford Road intersection and Clarence Road. The road widening would allow for two lanes of northbound local traffic, a single lane exit ramp from Airport link, and up to five lanes of southbound Stafford Road traffic near the intersection; and
- A U-turn bay would be provided prior to the Gympie Road/Stafford Road intersection for local access to the southern side of Stafford Road.

The crossing of Kedron Brook with thirteen lanes of traffic would require new bridges to be constructed across the brook. Five of these lanes of traffic, i.e. the connection between Gympie and Stafford Roads and Airport Link, would be elevated above the Kedron Brook bridges. Landscaping and urban design elements are discussed in Chapter 15.

Surface Roads at North-eastern Connection

The proposed layout of the north-eastern connection is shown in **Figure 4-6**. The north-eastern connection would provide access from the east-west tunnel to both the East-West Arterial and Sandgate Road. The tunnel portals would be located in Kalinga Park west of Sandgate Road and in the existing corridor of the East-West Arterial. Surface works would be predominantly new works and include the cut and cover tunnel and transition structure from the driven portals to reach the surface of the East-West Arterial Road east of Sandgate Road and widening of the East-West Arterial. The Sandgate Road to East-West Arterial intersection will be reconfigured into a fast diamond so that opposing right-hand turns can be made simultaneously through only one set of traffic lights.

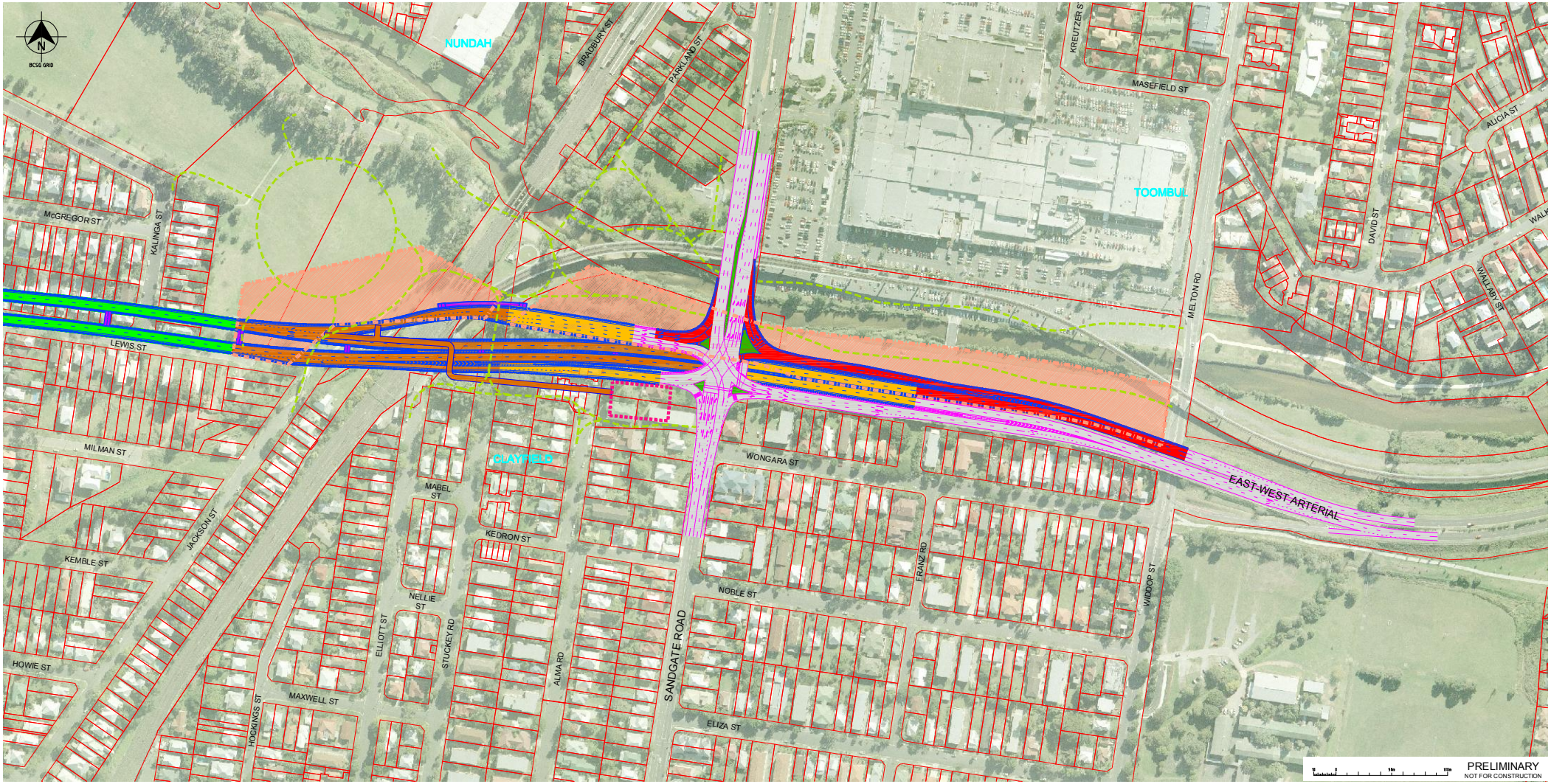
Eastbound tunnel traffic would be able to exit the tunnel either onto the Sandgate Road or continue east onto the East-West Arterial. Two lanes of traffic would leave the tunnel and develop a third and fourth lane prior to reaching the Sandgate Road intersection, where two lanes would be able to turn north and two lanes south onto Sandgate Road. The two lanes that continue on the East-West Arterial continue east, merging with traffic that originates from Sandgate Road. Access to the east-west tunnel would be via the two right-hand lanes of the westbound East-West Arterial or via Sandgate Road either from the two right-hand turn lanes southbound or the single left-hand turn lane northbound.

The major surface work at the intersection allows for:

- Four lanes of eastbound tunnel traffic to enter Sandgate Road, two travelling northbound and two southbound;
- Five lanes of northbound Sandgate Road traffic, with one lane turning left into the Airport Link tunnels, three lanes of traffic continuing northbound along Sandgate Road, and one lane turning right onto the East-West Arterial;
- Three lanes of westbound East-West Arterial traffic entering Sandgate Road with two lanes turning right to travel north and one lane turning left to go south;

- Four lanes of southbound Sandgate Road traffic, that would have one lane turning left onto the East-West Arterial, two lanes continuing south along Sandgate Road, and two lanes turning right to enter Airport Link.

Landscaping and urban design elements are discussed in Chapter 15.



LEGEND

- TRANSITION STRUCTURE
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AIRPORT LINK - Figure 4-6

North Western Connection

0 100m 200m

Airport Link

SKM Connell Wagner JOINT VENTURE

4.2.6 Ventilation System

A description of the proposed ventilation system for the tunnels is provided in Section 4.4.2 of this Chapter. This description also addresses the operational requirements for the ventilation system in terms of in-tunnel air quality criteria, energy requirements and filtration.

From the design development phase, described in Chapter 3 – Project Development, three preferred sites for ventilation outlets have been identified for the purpose of assessment for this EIS. The investigations have also determined that, for the reference design presented in this EIS, it is likely that three ventilation outlets will be required. The preferred sites for the ventilation stations and the ventilation outlets are:

- Southern station and outlet – in the vicinity of Earle Street, Windsor;
- North-western station and outlet – in the vicinity of the existing Kedron Brook Building on the Department of Emergency Services land; and
- North-eastern station and outlet – in the vicinity of the south-west corner where Sandgate Road intersects with the Airport Link entry ramp, and immediately south of the Sandgate Road entry ramp to the tunnel system.

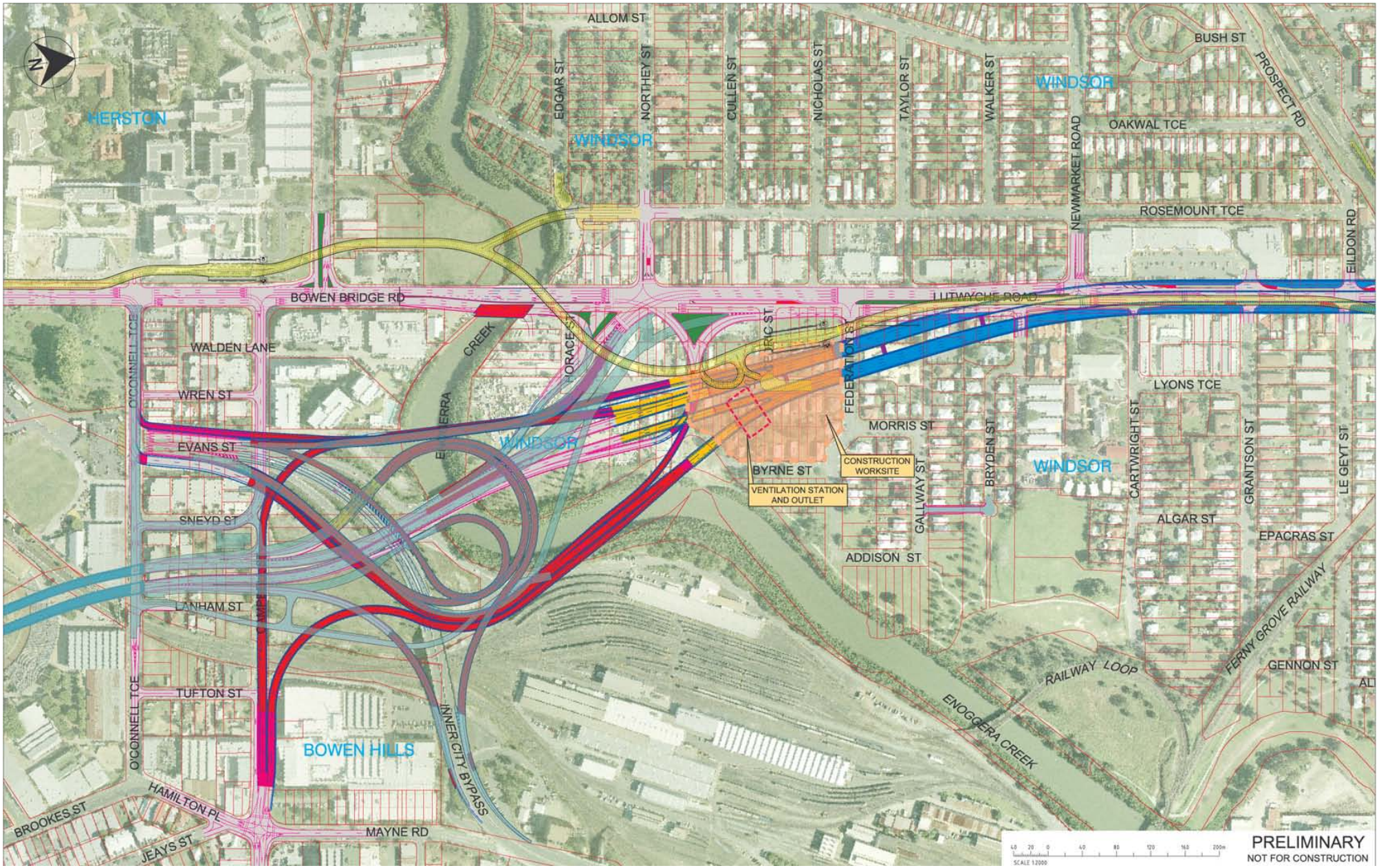
The preferred locations of each of the ventilation stations and outlets is indicated on **Figure 4-7**, **Figure 4-8** and **Figure 4-9** for the southern, north-western and north-eastern sites respectively.

The southern ventilation station and outlet would be located above the southbound cut and cover exits in the southern worksite south of Federation Street in Windsor. The mechanical and electrical equipment including the fans for the southern ventilation facility would also be located in this facility. The ventilation station, including the ventilation outlet, would be approximately 25m wide, 45m long and up to 15m high. The ventilation outlet, which would stand as part of the ventilation station, would reach a height of at least 30m and would have a cross-sectional area of at least $50m^2$. To mitigate the visual impact of this large building, the design of the buildings, including the ventilation outlet would need to address the character and context of the locality in terms of scale, bulk, lighting, materials and colours.

The north-western ventilation station and outlet would be located in the DES site near Lutwyche Road. The fan and electrical equipment would be located within a purpose-built structure that would also incorporate the ventilation outlet. This structure would connect into the ventilation tunnels from both the east-west and north-south tunnels. The dimensions of the north-western ventilation station would be approximately 45m by 18m, and up to 15m high. The ventilation outlet would be at least 30m high and would have a cross-sectional area of approximately $90m^2$. Owing to the prominent location adjacent to Gympie Road, the building would need to be designed to mitigate visual impact in terms of scale, bulk, articulation of facades, lighting and the use of materials and colours. An architectural approach, integrated with comprehensive, thematic landscaping is preferred.

The north-eastern ventilation outlet will be located on two allotments situated immediately to the south of the entry ramp and between Sandgate Road and Alma Road. The ventilation buildings would require a building envelope approximately 45m long, 20m wide and up to 15m high. The ventilation outlet would sit within this envelope but would be at least 30m high and would have a cross-sectional area of approximately $40m^2$. Owing to the location immediately adjacent to residential properties, the design and siting of the ventilation station needs to be carefully and sensitively treated. A comprehensive and integrated architectural and landscaping approach is required to mitigate the scale and bulk of the buildings and the ventilation outlet. The choice of materials and colours will be important in mitigating the visual impact of the ventilation station and ventilation outlet.

Space will be provided at each of the sites for the possible future installation of filtration equipment. Filtration equipment is large and will require a large building or structure to house it and link it within the ventilation station.

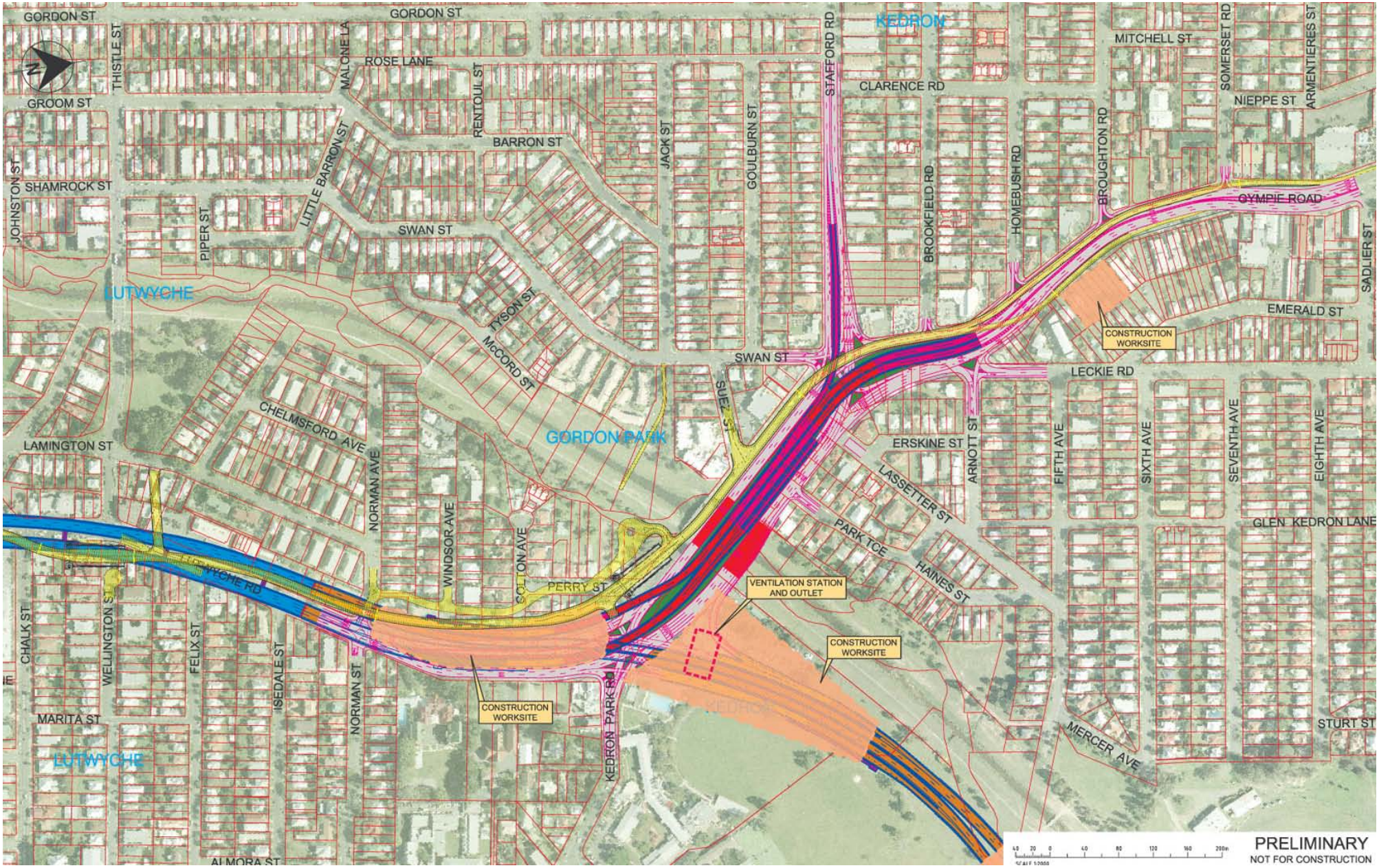


AIRPORT LINK - Figure 4-7

Southern Ventilation Station and Ventilation Outlet

Airport Link

SKM Connell Wagner JOINT VENTURE



AIRPORT LINK - Figure 4-8

NorthWestern Ventilation Station and Ventilation Outlet

Airport Link

SKM Connell Wagner JOINT VENTURE

AIRPORT LINK - Figure 4-9

NorthEastern Ventilation Station and Ventilation Outlet

Airport Link

SKM Connell Wagner JOINT VENTURE

4.3 Project Delivery Mode

4.3.1 Program and Responsibilities

A preliminary, generalised works program for the project is shown in **Figure 4-10**. Construction of the project is assumed to commence in 2008, subject to the approval of the EIS and receipt of all necessary approvals. The overall design and construction would take approximately 4 years, with the tunnel open to traffic by mid 2012.

The construction of the proposed works would involve three key phases, namely:

- Pre-construction activities such as design and site establishment;
- Construction of project works; and
- Commissioning.

The major components of work for the project are discussed below.

4.3.2 Establishment and Preliminary Works

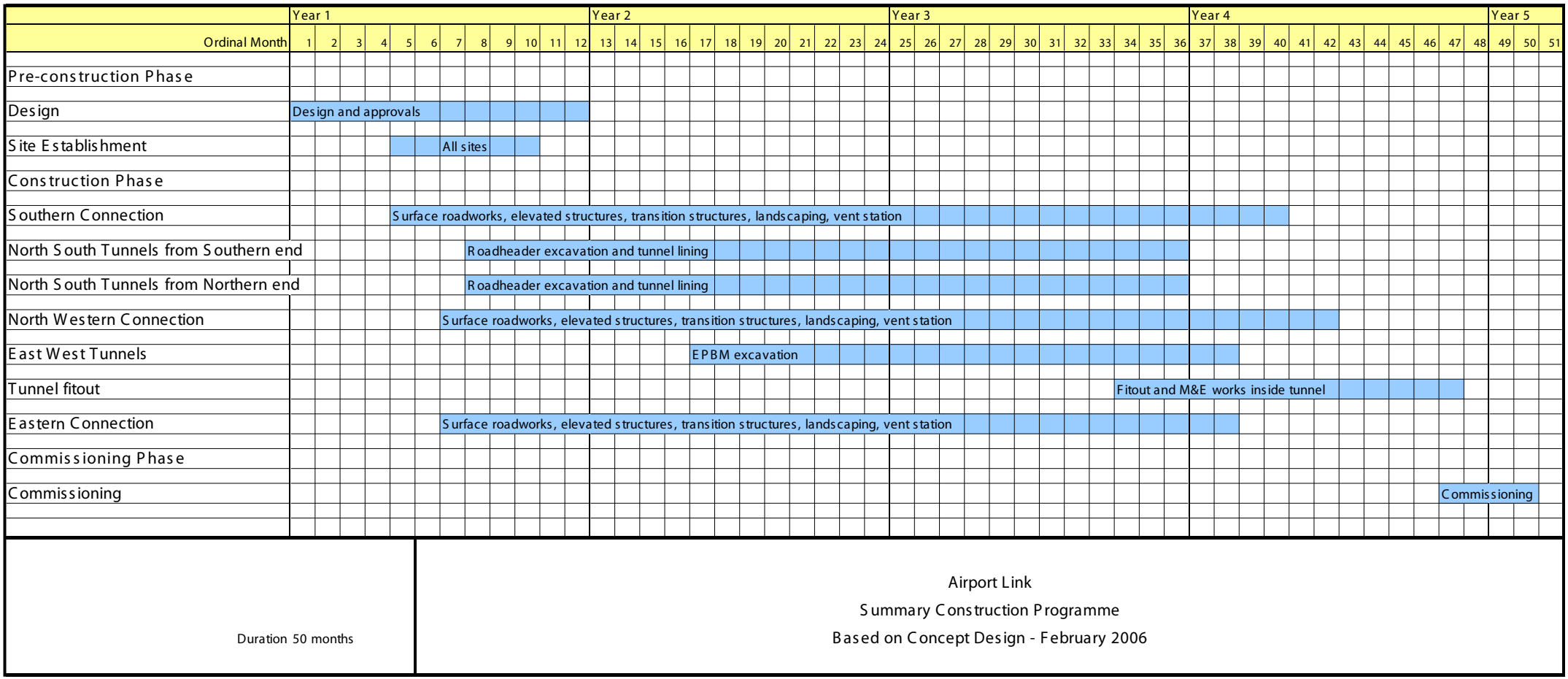
The main site offices for the project would be set up at a central location, possibly in Windsor. Five worksites would be located in three main areas, shown in **Figure 4-11** to **Figure 4-15**. There would be one worksite at the Southern connection, three worksites at the north-western connection, including one at Gympie Road, and one worksite at the north-eastern connection respectively. These worksites would provide a base for adjacent surface works. All worksites would be fenced and appropriate security measures provided.

Tunnel portal worksites would be set up for the four tunnel portals, one at the Southern Connection, two at the north-western connection and one the north-eastern connection. These worksites would be provided with equipment to manage waste water from the tunnel, power supply and associated transformers, offices, workshop, labour facilities, first aid facilities, equipment storage, primary support materials storage including tunnel segments, air-conditioning for certain construction materials, material loading station, lining segment delivery, smoke duct segment delivery, water supply for machinery and temporary ventilation equipment.

4.3.3 Tunnel Portal Cover Sheds (TPCSs)

The driven tunnel portals would each be enclosed in a dust-sealed acoustically lined building structure over the portal to control dust and noise emission from the tunnelling operations.

At the southern connection the tunnel entrances would be covered with a shed (indicatively about 100m long, 60m wide and 15m tall), and all tunnelling operations would be contained within the acoustically lined shed. The loading of trucks with tunnel spoil would also be done within the shed or in a similarly acoustically designed structure. The ventilation fans for the tunnel during construction would be located inside the tunnel, and the ventilation from the tunnelling works would leave the shed, having passed through dust extraction equipment.



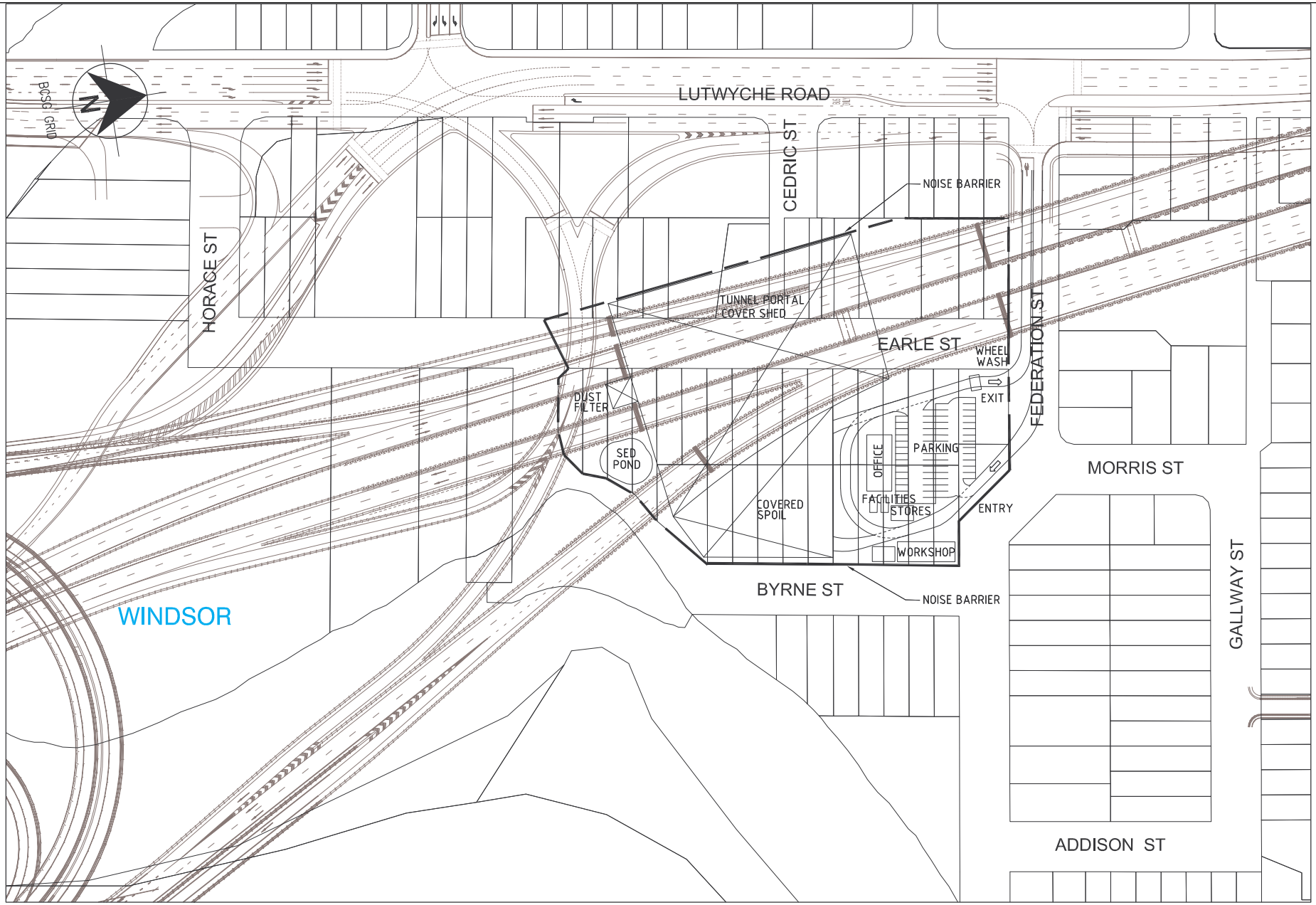
AIRPORT LINK - Figure 4-10

Program of Works

Airport Link

SKM Connell Wagner JOINT VENTURE

BRISBANE CITY



AIRPORT LINK - Figure 4-11

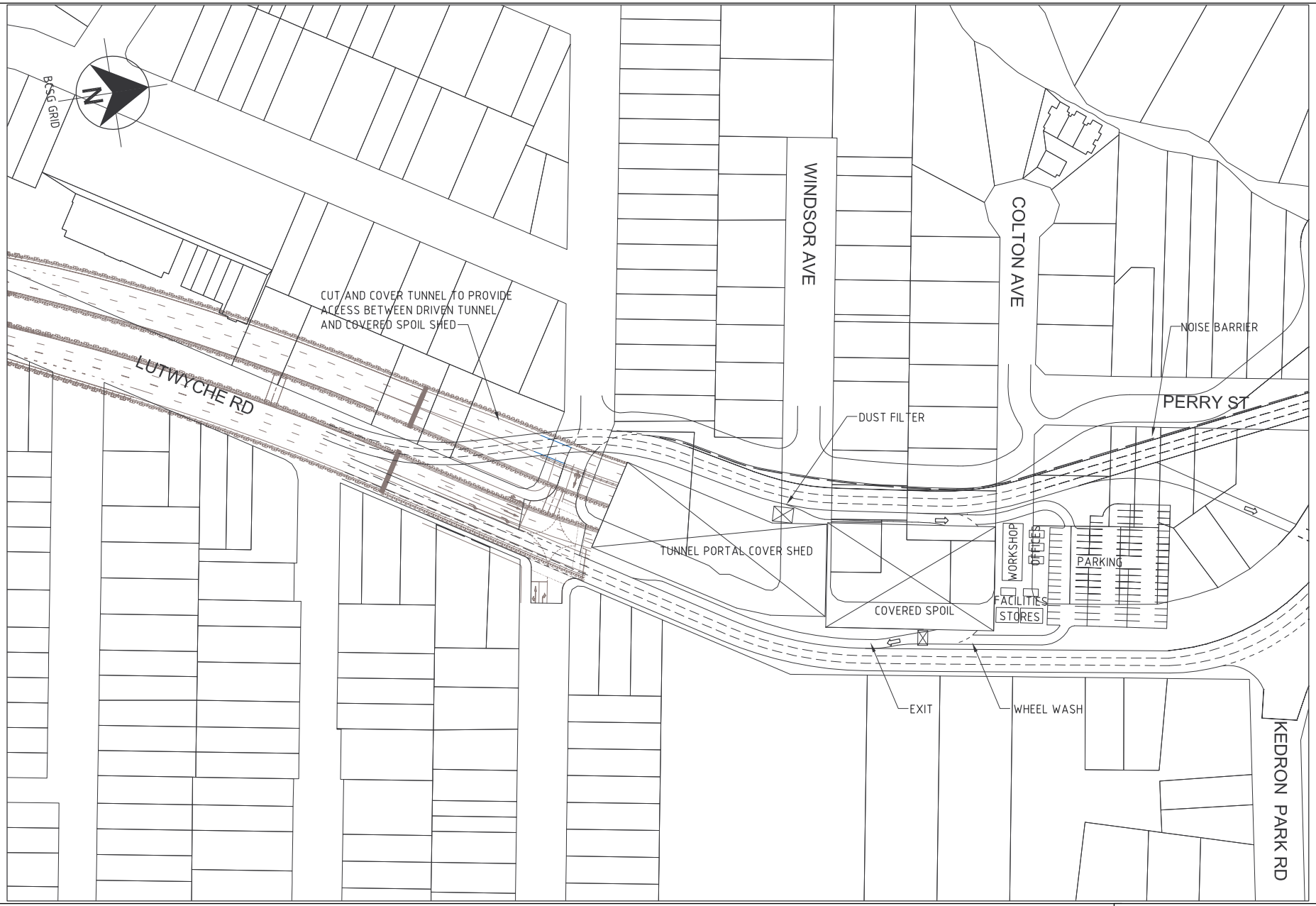
Southern Work Locations and Access Arrangement

Scale 1:1000

0 50 100m

Airport Link

SKM Connell Wagner JOINT VENTURE



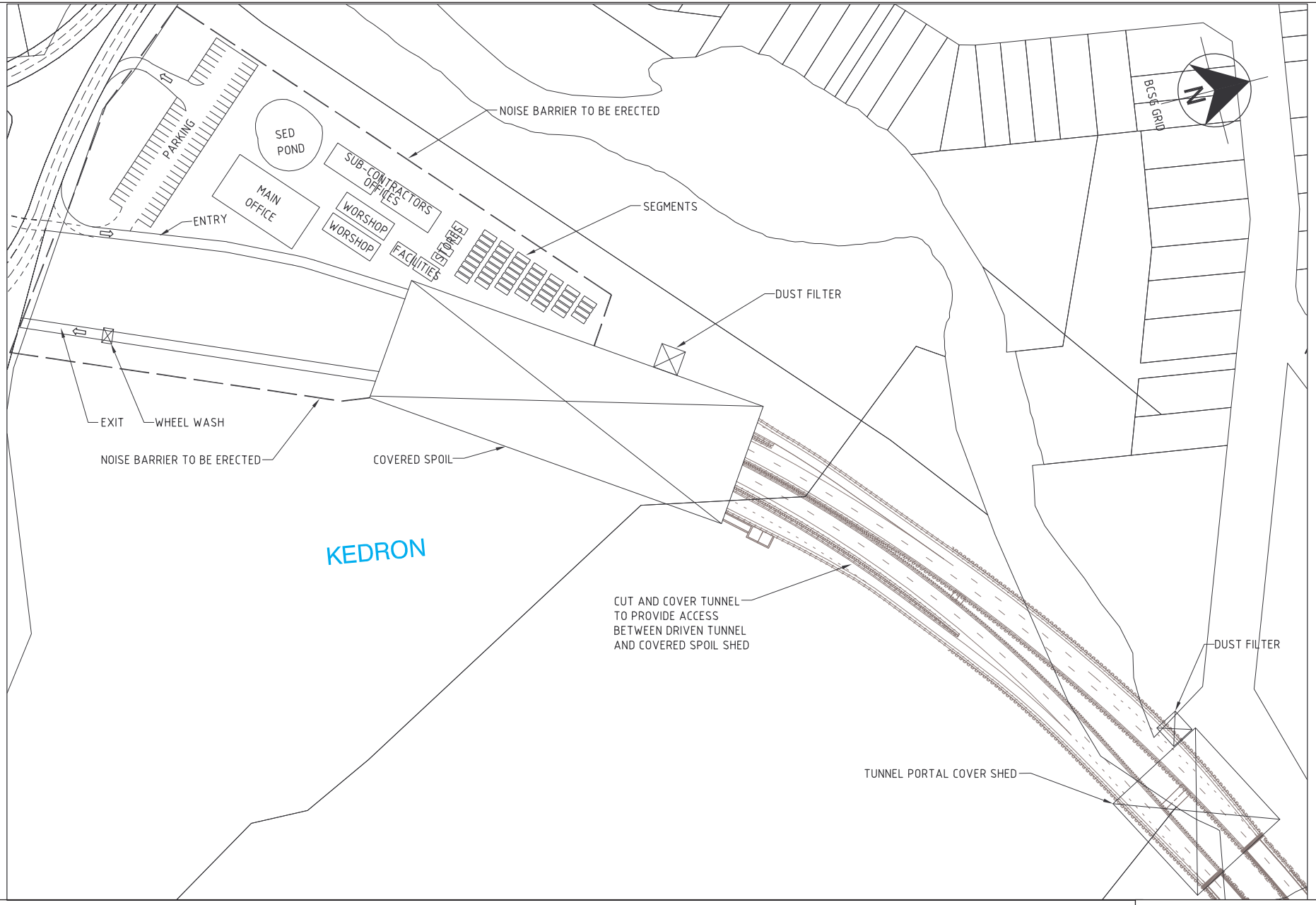
AIRPORT LINK - Figure 4-12

North Western Work Locations and Access Arrangement

Scale 1:1000 0 50 100m

Airport Link

SKM Connell Wagner JOINT VENTURE



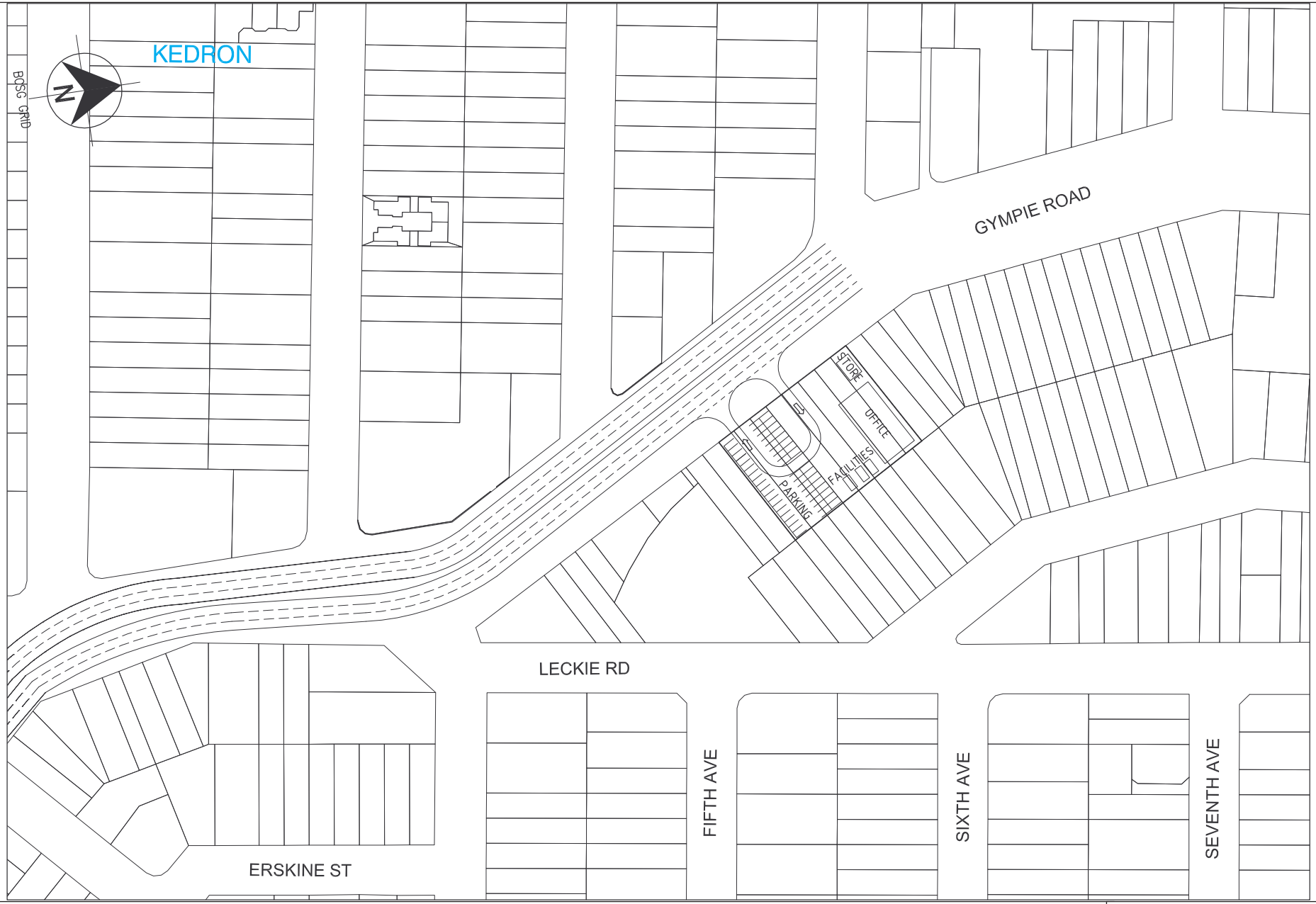
AIRPORT LINK - Figure 4-13

North Western Work Locations and Access Arrangement

Scale 1:1000 0 50 100m

Airport Link

SKM Connell Wagner JOINT VENTURE



AIRPORT LINK - Figure 4-14

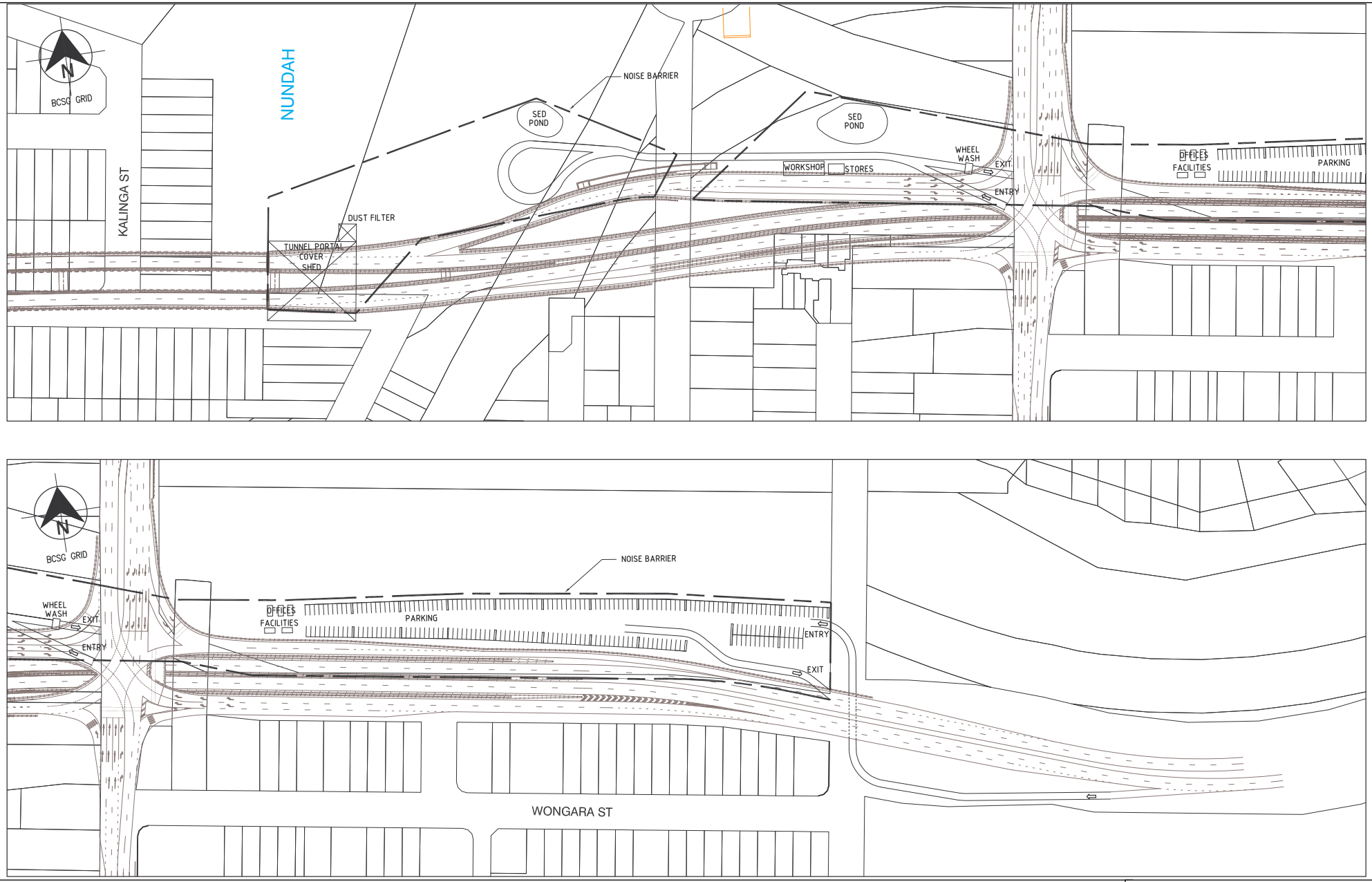
North Western Work Locations and Access Arrangement

Scale 1:1000

0 50 100m

Airport Link

SKM Connell Wagner JOINT VENTURE



AIRPORT LINK - Figure 4-15

North Eastern Work Locations and Access Arrangement

Scale 1:1000 0 50 100m

Airport Link

SKM Connell Wagner JOINT VENTURE

At the north-western connection there would be two TPCSs, and a spoil handling shed, as follows:

- Over the northern end of the north-south driven tunnel there would be a work-shed (indicatively 160m long, 30m wide and 15m high) between the northbound and southbound carriageways of Lutwyche Road between Norman and Colton Avenues. Tunnelling operations would be contained within this shed. The loading of trucks with tunnel spoil would be done within the covered spoil shed or some other acoustically lined structure. Ventilation fans for the tunnel during construction would be located inside the tunnel, and the ventilation from the tunnelling works would leave the shed having passed through dust extraction equipment;
- North of Kedron Park Road the worksite and program of works would be designed to minimise impacts on the Kedron State High School sports ovals. To that end, the cut and cover structure to accommodate the mainline carriageways beneath the sports ovals would be constructed so the ovals would be able to be restored in minimum time and preferably during a period of little or no formal use. This covered tunnel would then be used as access between the driven east-west tunnel and the covered spoil shed west of the high school;
- A work-shed (indicatively 50m long, 40m wide and 15m high) would be constructed over the launching chamber of the east-west driven tunnel near the western end of Brook Road. This shed would accommodate the TBM to drive the tunnel eastwards and then to receive the TBM when it returns from the north-eastern connection. It is likely that spoil excavated from the east-west driven tunnel would all come through this shed and the completed cut and cover tunnel west of it, then up constructed ramps west of the Kedron State High School ovals into the spoil handling shed. Ventilation fans for the tunnel during construction would be located inside the tunnel, and the ventilation from the tunnelling operations would leave the shed, having passed through dust extraction equipment; and
- The enclosed spoil shed on the main carriageway alignment at the eastern end of the Emergency Services site is likely to be about 170m long, 50m wide and 15m high. This TPCS would be used to handle spoil from the TBM, loading trucks, and also to transport construction materials and personnel into the east-west driven tunnel. Ventilation from the spoil shed would pass through dust extraction equipment before being vented.

Tunnel entrances at the north-eastern connection would be covered with a shed (indicatively about 50m long, 40m wide and 15m tall). This shed would receive the TBM driving east from Kedron, whereupon the machine would be turned around to drive the second tunnel back to Kedron. Spoil from the TBM would all be returned to the Kedron worksite for extraction. The ventilation fans for the tunnel during construction would be located inside the tunnel, and ventilation from the tunnelling works would leave the shed having passed through dust extraction equipment.

4.3.4 Demolition and Utility Modifications

Demolition works including removal of buildings, kerbs, roadways and fencing, would be undertaken as required. Where necessary, appropriate development approvals will need to be sought and obtained prior to the commencement of demolition works.

In all locations, especially where existing roads and footpaths are to be altered, there would be a significant number of utilities to be replaced, removed or relocated. In particular, there is a 200mm diameter high pressure gas main running along Campbell Street, a 1200mm diameter sewer main under the Emergency Services complex and the Kedron State High School sports fields and Optus underground network runs along the western side of the North Coast Railway and western side of the Schulz Canal bridge. These diversion works would take three to six months and in most cases would require traffic diversions.

In general, all utility diversion would commence as early as possible once the detailed design has reached a stage where the new route can be determined. Most diversions would be carried out with new trenches and access points located in footpaths, wherever possible. However, a number of utilities crossing Kedron Brook may need diversions during bridge construction and reinstatement.

4.3.5 Tunnel Construction

Tunnel construction would occur either as driven tunnel or as cut and cover tunnel. There are a number of methods for constructing driven tunnels, whereas cut and cover tunnel construction is more conventional. For the Airport Link Project, the mainline tunnels generally would be constructed as driven tunnels, with cut and cover techniques adopted for the sections where the tunnels are close to the surface, usually as they approach or leave the surface.

Mainline tunnel construction methods are defined by the cross-section requirements for predicted traffic flows and subterranean conditions that vary along the alignment. Options for tunnel construction methods were considered and a methodology identified, for the purpose of impact assessment in this EIS. The methodology adopted for this EIS is expected to allow construction impacts to be managed to meet both technical requirements and community expectations as reflected in the environmental objectives expressed in the draft outline environmental management plans provided in Chapter 19 of this EIS. However it is possible that the construction methods may change when the project is subject to detailed design and construction planning, supported by more detailed field survey data and investigations. It is also possible that a construction contractor might propose different construction methods for either technical or commercial reasons, or a combination of both technical and commercial reasons.

For the purpose of developing a Reference Project construction method and conducting this impact assessment, the project tunnels were separated geographically into:

- The driven tunnels aligned from north-south;
- The tunnels constructed for the north-western connection; and
- The driven tunnels aligned from east-west.

4.3.6 Construction of Tunnels Aligned from North to South

The tunnels aligned north-south would generally be constructed three lanes wide with sections near the driven portals at both the southern and north-western connections requiring four lanes. These tunnels would be constructed by roadheaders predominantly in competent rock of the Neranleigh Fernvale Formation or Brisbane Tuff. The driven portals at the north-western connection would be constructed through variable ground conditions. The tunnels would be designed as “drained”, due to the low risk of impacts associated with lowering the ground water levels through the north-south alignment. Drained tunnels would permit some inflow of groundwater, with such inflows to be collected and transferred by an internal drainage system to an approved point of discharge (refer to Chapter 7 – Hydrogeology and Groundwater Quality).

Due to the need for three lanes changing to four lanes near portals, the tunnel profile or cross-section would change to a wider cavern, with particular structural requirements for roof support. In such circumstances, the most likely construction method for the north-south tunnels would be the use of multiple roadheaders, operating from both the southern and north-western worksites. While the rock is not anticipated to be so hard as to warrant drill-and-blast excavation, some drill-and-blast construction works may be required for the mainline tunnel and/or cross passages due to strength of rock, access and construction staging requirements where environmental conditions permit.

With the operation of roadheaders from both ends, construction spoil would report to both the north-western and southern worksites. Construction spoil would be conveyed by a number of means to spoil handling and loading facilities at each worksite prior to removal and transportation to one of the identified spoil placement sites. The spoil storage, handling and loading facilities would be constructed and operated to achieve environmental objectives with regards noise and dustfall.

4.3.7 Construction of the North-western Connection Tunnels

Construction of the north-western connection tunnels would most likely be with cut and cover techniques due to the poor subterranean conditions, alluvium (sands and gravels) associated with Kedron Brook, and the complexity of the connections to the surface in this area. In this location, cut and cover construction is unlikely to warrant much drilling and blasting or even rock-hammer work, unless harder conditions are encountered. With cut and cover construction, it is expected that once a depth for excavator operation has been reached, a structural 'lid' would be placed over the excavation so that the remainder of construction works would be conducted below the newly installed surface. While this approach would permit surface impacts such as noise and dust to be managed, the extent of such work would need to be determined during detailed design and construction planning. In particular, the enclosure of the excavation with the lid structure may not be practical in all circumstances.

Between the north-south and east-west driven tunnels in the Kedron area, almost one kilometre of the mainline tunnel would be constructed with cut and cover techniques beneath the Lutwyche Road/Kedron Park Road intersection, and the green space adjacent to Kedron Brook. Traffic management and pedestrian connectivity and safety in these areas will need to be carefully managed and constantly monitored, having regard for the proximity of the high school and primary school, as well as community facilities and employment centres in the vicinity.

Spoil from the cut and cover construction would be removed to the north-western worksite, prior to its loading and transportation to one of the identified spoil placement sites.

4.3.8 Construction of the Tunnels Aligned from East to West

The east-west tunnels would be constructed for two traffic lanes tapering out where the driven tunnel connects with the cut and cover tunnel connections from Kedron. The east-west tunnels would be constructed predominantly within low strength rock of the Aspley and Tingalpa Formations and potentially through a small section of alluvium near the north-eastern connection at Sandgate Road. Most of the east-west tunnel alignment is overlain by saturated alluvium.

Due to the challenging ground conditions, these tunnels would need to be 'tanked' or lined immediately during excavation and would also need to be excavated in a way which could provide pressure against the cutting face to balance hydraulic pressure from groundwater to minimise dewatering impacts and help control ground water levels. For the purposes of this EIS, the most probable construction method would be an Earth Pressure Balance (EPB) machine which is a form of tunnel boring machine (TBM). An EPB machine would use a single pass concrete lining that provides immediate ground support and tanking of the tunnel. Because the rock is low strength, drill-and-blast construction methods are not anticipated.

For the Reference Project, this EIS has assumed that the TBM for each of the east-west tunnels would be launched from the north-western worksite at Kedron. If this approach was to be adopted by the contractor, there would need to be facilities at the eastern end for the recovery and removal of the TBM. The eastern worksite would need to be arranged and operated so that there is no requirement for local streets to transport either equipment or materials to or from the worksite.

With the use of TBMs in construction of the east-west tunnels, spoil from the work face would most likely be taken by conveyor underground back to the north-western worksite prior to its removal and transportation to the identified spoil placement sites. With the potential for TBMs to work 24 hours per day within the performance-based environmental requirements for surface impacts, there will be a need for spoil storage facilities either within the tunnels or within storage enclosures designed to achieve the environmental objectives for noise and dust nuisance.

4.3.9 Cross Passages

Cross passages would be constructed every 120m along the mainline tunnels for emergency egress, equipment and potentially sump storage requirements. Where cross passages are not possible between adjoining tunnels, longitudinal passages would be required. In the cut and cover tunnels at the north-eastern and north-western connections emergency egress would be via a sliding door between the two tunnels.

The cross passages would be approximately 5m by 5m in section, and a minimum of 10m door to door. Apart from the evacuation function, the cross passages would contain much of the mechanical and electrical equipment for the fire systems and lighting. In the cut and cover areas where a single sliding door arrangement is used, mechanical and electrical equipment would be located in dedicated equipment rooms adjacent to the tunnels.

Construction of cross passages, connections between the two mainline tunnels, would be undertaken with a mechanical excavator, and possibly with the aid of drilling and blasting in hard rock conditions. Construction spoil from the cross passages would be removed through the mainline tunnels or the cut and cover tunnels as required.

4.3.10 Cut and Cover Tunnels

Cut and cover tunnels that are required for transition to the surface would have a roof of constructed elements, as opposed to a natural rock arch. The roof would consist of prestressed concrete (PSC) deck units similar to the conventional bridges found in the region. Cut and cover tunnels at each portal would connect the driven tunnels to the surface or to surface ramps.

Cut and cover tunnel construction would mostly be located at the north-western connection, connecting the two driven tunnel components. Shorter sections of cut and cover tunnel for the surface ramps would be located at the north-eastern and southern connections.

The cut and cover tunnel under the North Coast Railway and Sandgate Road at the north-eastern connection and Lutwyche Road and Norman Avenue at the north-western connection would be constructed by installing the tunnel support and tunnel roof prior to excavation, thus minimising the disruption to the existing operation of these transport facilities. This work would involve some temporary closures of the North Coast Railway, Sandgate Road, Lutwyche Road, and Norman Avenue that would occur either at night and/or on weekends. Once the roof is in place and the existing surface, either road or rail, has been repaired or replaced, the works can continue underneath without disruption to the facilities above. Drainage and final concrete lining of the cut and cover tunnel in these sections would be applied during tunnel excavation.

The other cut and cover tunnels, if traffic diversions allow, could be constructed in open cut after the walls are installed. Temporary supports for the walls would be required as the excavation proceeds. For both methods the removal of material using an excavator would only be possible at the surface and drill and blast or mechanical splitting would be used. As excavation in the rock continued ground anchors and drains would be installed, prior to the concreting of the vertical walls.

For landscape rehabilitation needs, the structural deck units may be required to support a depth of cover soil and foundation material necessary for advanced plantings of selected tree species (eg *Aracuria* sp). In other situations, the structural deck units may need to support ventilation equipment or other equipment required for tunnel management and maintenance.

4.3.11 Surface Road Works

New surface roadworks would be required at each connection, with some at grade, and others on elevated structures, including bridges, retained soil structures and fill embankments. Any required fill would be obtained from the ongoing tunnel excavations, if suitable.

Conventional methods of road construction would be used for the new roads and for the modification to existing surface roads. This process would involve excavators, graders, compaction equipment and pavement placing equipment. Drainage, new utility ducting and kerbing would be installed and connected to existing systems during this stage. Following completion of the paving works the road furniture would be installed, consisting of safety barriers, noise barriers, line marking, lighting, signage and landscaping of surrounding areas.

4.3.12 New Surface Structures

There are several new structures that would be built above ground to complement the mainline tunnel assets including new bridges, embankments and ventilation stations. New elevated structures and embankments would be:

- Two new bridges would replace the existing Kedron Brook bridge to carry three lanes of outbound Lutwyche Road and five lanes of inbound Gympie Road;
- Two new elevated bridge structures would be constructed over Kedron Brook (between the old and new bridges described) to connect Gympie and Stafford Roads to the Airport Link tunnels.
- A retained soil structure embankment between the north bank of Kedron Brook and Lassetter Street would be built to carry the two elevated two-lane carriageways connecting to Airport Link;
- Two new elevated bridge structures over the northern intersection would carry the two two-lane carriageways to Gympie Road and Stafford Road;
- Elevated road structures at the north-eastern connection would provide access to Sandgate Road for traffic exiting Airport Link; and
- An elevated bridge for Sandgate Road traffic would be constructed to provide access to the East-West Arterial eastbound and extended from Sandgate Road to Melton Road/Widdop Street to provide additional lanes for the East-West Arterial.

4.3.13 Construction of Ventilation System

Three ventilation stations, ventilation outlets and associated buildings are to be constructed. The ventilation outlets would be erected using large, mobile cranes and would connect into the cut and cover, southbound tunnel. Space would be allowed in or adjacent to the ventilation station for possible installation of filtration equipment if a decision is made to provide filtration in the future.

4.3.14 Modification to Existing Structures

A number of existing structures would be modified as part of the project and include:

- Horace Street bridge over Enoggera Creek, which will be widened to accommodate three traffic lanes; and
- Sandgate Road Bridge over Schulz Canal, which would be widened to accommodate the left turn lane from Sandgate Road onto the East-West Arterial.

4.3.15 Airport Link Connection to NSBT Structures

The Airport Link Project would involve design and construction of a number of structures that interconnect directly with structures designed and constructed by the NSBT Project. They are:

- Widening of the NSBT to Lutwyche Road bridge, to accommodate the NSBT to Airport Link connection;
- Addition of a second tier above the ICB to Lutwyche Road bridge to carry the O'Connell Terrace and Campbell Street to Airport Link Tunnel ramps; and
- Widening of the Lutwyche Road to ICB bridge to provide for connections from Airport Link to ICB, O'Connell Terrace and Campbell Street.

4.3.16 Landscaping Works

Extensive landscaping works would be carried out at all of the connections and other key locations throughout the project, in accordance with landscape plans developed during detailed design. Concepts of these are described in Chapter 15. This work would be undertaken towards the end of the construction period and to suit appropriate planting seasons. Some landscape works may continue after the tunnel has opened, as the resultant reduction in traffic in this area would permit these works to be carried out with less disruption to traffic.

4.3.17 Rehabilitation of Construction Sites

The five construction worksites at the three connections would be rehabilitated following the completion of their use for construction works. Their future use would be determined at that time. Sedimentation and erosion control devices developed during construction, if no longer required would be decommissioned and surface contours and appropriate drainage lines reinstated. Sedimentation and erosion control devices may be retained in locations where surface drainage from the completed works would continue to risk on-going soil erosion. Such devices would be maintained and incorporated in any future use or development of the worksites.

The major worksite at the north-western connection in Kedron would be re-used to the extent possible by Department of Emergency Services (DES) or rehabilitated suitable for an appropriate purpose for the locality. The north-eastern worksite in Kalinga Park and adjacent to Kedron Brook and Schulz Canal would be landscaped and replanted. The worksite to be situated in the car park adjacent to Schulz Canal and the East-West Arterial would be rehabilitated as wetland for aesthetic and recreational purposes and for mitigation of local flooding.

4.3.18 Traffic and Access During Construction

Changes and potential disruptions to traffic and access arrangements during the construction phase are always of concern to residents, local businesses and community facilities. Also, the maintenance of efficient traffic flows along major arterial roads, such as Gympie Road, Lutwyche Road and Sandgate Road during construction is essential. At the same time, it is also important for construction traffic to have safe and efficient access to the construction worksites.

Access available during construction would include:

- The southern connection worksite access would be from Lutwyche Road onto Federation Street and into the worksite;
- The northern portal worksite of the north-south tunnels at the north-western connection would be accessible from additional lanes added to the inside lanes of Lutwyche Road. This access would first require the Norman Avenue intersection and the service road for Windsor and Colton Avenues and Perry Street to be constructed and the northbound Lutwyche Road to be sidetracked to the west;

- The western portal worksite of the east-west tunnel would require construction of access ramps from the Lutwyche Road/Kedron Park Road intersection. Access to site would then be provided from Lutwyche Road;
- The surface works site for the north-western connection would be accessible directly from Lutwyche Road;
- The north-eastern construction worksite is divided by Sandgate Road and would require two separate access routes. Access ramps to the west of Sandgate road would be constructed and access to the worksite from the East-West Arterial would be developed through phasing of the Sandgate Road/East-West Arterial intersection. Access would be provided to the eastern part of the site off the East-West Arterial's exit onto Widdop Road and the site would be accessible while vehicles exiting the eastern site would do so via a new access ramp that would connect directly to the East-West Arterial from within the site.

There would be traffic diversions at the major worksites for all three connections. At the southern connection these would include:

- The works on Campbell Street which would be staged to provide local access to properties in the area and the intersection works would then be staged to minimise impact;
- A diversion of traffic from the ICB to Lutwyche Road while the bridge above the proposed NSBT Changed Project connection is being constructed; and
- The realignment of traffic at the Lutwyche Road/Northey Street intersection during relocation of the intersection.

At the north-western connection the diversions would include:

- The realignment of Lutwyche Road to the west during the construction of the Norman Avenue/Lutwyche Road intersection. This would allow for local traffic to still gain access to Norman Avenue, although it would require some closures of Norman Street during construction;
- Construction of a service road from Norman Avenue to Perry Street that connects into Windsor Avenue and Colton Avenue. Once the service road is constructed access to these streets from Lutwyche Road can be severed;
- Diverting Lutwyche Road northbound to the west to allow for the tunnel construction site to be developed in the middle of Lutwyche Road;
- The realignment of Lutwyche Road traffic over the existing and new bridges at Kedron Brook to allow for the construction of the new structures; and
- The realignment of Gympie Road to allow for the road widening and construction of elevated structures.

At the north-eastern connection these would include:

- Realignment of East-West Arterial traffic onto the elevated structure constructed to the north to allow for construction of the transition structures that would be located in the middle of the East-West Arterial; and
- Realignment of the Sandgate Road intersection to allow for construction traffic to access the worksite from the East-West Arterial.

The potential impacts of construction worksites and activities on traffic flows could be severe without adequate management and pre-planning in advance of the commencement of construction activities. There are a number of sensitive community facilities and community movement lines near or immediately adjacent to the worksites

(e.g. Wooloowin State School, Kedron State High School, St Andrew's Anglican Church) with constrained access arrangements now.

Construction would need to proceed in accordance with a Construction Environmental Management Plan (EMP) and a Construction Traffic Management Plan (CTMP).

4.3.19 Management of Construction Spoil

About 1.6 million m^3 of bank material[1] (approximately 2.4 million m^3 loose) would be generated by the Airport Link Project, with the driven tunnel producing approximately 1 million m^3 of this bank material (1.5 million m^3 loose). The spoil generated at the three worksites would be:

- North-eastern worksite - approximately 185,000m^3 (approx 277,500m^3 loose);
- North-western worksite - approximately 975,000m^3 (approx 1,462,500m^3 loose); and
- Southern worksite - approximately 450,000m^3 (approx 675,000m^3 loose).

Two general areas have been considered for the placement of the excavated material, namely areas on or near the old Brisbane Airport (Viola Place recycling site, GUP on the Old Airport Site) and at the Port of Brisbane (Clunies Flat and Fisherman Islands). The spoil quantities that would be sent to these sites were estimated, for the purposes of assessment, as follows:

- Airport sites would take approximately 460,000m^3 bank material (approx. 690,000m^3 loose); and
- Fisherman Islands site would take approximately 1,140,000m^3 bank material (approx. 1,710,000m^3 loose).

The number of trucks required is shown in **Table 4-2**, and has been estimated from the spoil volumes estimated and the usage of trucks able to carry about 14 m^3 of bank material.

Table 4-2 Spoil Removal by Trucks (approximate numbers)

Worksite	Duration (months)	Truckloads (one way)	Average Daily Truckloads	Average Hourly Loaded Truck Movements
Southern connection	32	36,000	50	2
North-western Connection	30	81,000	115	5
North-eastern connection	16	14,000	40	2
Total		131,000		

An alternative placement site for some construction spoil is at Swanbank near Ipswich. It may be necessary to use this site if some of the construction spoil were to contain significant amounts of poor quality coal that made it unsuitable for placement at identified spoil sites.

In the event a TBM of the EPB type is used, the spoil generated would be a mixture of the excavated materials (i.e. natural soils and rock), conditioners, additives, and water. Because of the amount of water that would be in this spoil some different handling techniques would probably be required. The water can originate as groundwater or may have been artificially added to condition the spoil. The conditioners and additives used to control face stability, stickiness and handling would be biodegradable and non-toxic.

[1] Bank material is *in situ* material and does not include a 'bulking' factor for post-excavation calculations

Special care would be taken to suitably handle and dispose of the mixture of spoil, water, and other soil conditioners. This would include processing the spoil on site to dry and/or trucks equipped with watertight liners to prevent leakage to an off-site stockpiling site to dry the spoil, to acceptable water content levels, prior to placement. Bunding or other measures would be required to ensure water from the construction spoil did not enter the environment directly and without appropriate treatment to remove chemical or other additives used in the construction process. The dewatered spoil would be expected to contain residues from the additives and their use as an engineered fill would be subject to environmental constraints at the spoil placement site. Provisions would be made for the suitable handling, treating, and disposal of water generated from spoil processing activities.

Opportunities exist for reuse of spoil in the construction of embankments at the connections, particularly the north-western site where there are significant embankments planned. Also, suitable construction spoil could be used as invert fill in section of driven tunnel constructed with a tunnel boring machine.

The construction spoil would be transported to the spoil placement sites using trucks. The haul route from the north-western and southern worksites would follow Lutwyche Road onto Kingsford Smith Drive via Campbell Street or O'Connell Terrace, Montpellier Road and Breakfast Creek Road. The haul route from the north-eastern site would be along the East-West Arterial after first being conveyed under Sandgate Road from the construction face.

4.3.20 Demand on Resources

Energy

At the southern worksite, the estimated electrical demand would be approximately 3,500 kVA, allowing for construction with two roadheaders (one per tunnel) operating concurrently, for work area ventilation, for dewatering and surface office, workshop etc.

The north-western worksite is expected to represent the heaviest construction power requirements. The demand forecast for this site is based on two roadheaders (one per tunnel) driving the tunnel south towards the southern CWS plus a single tunnel boring machine driving the tunnel east towards Sandgate Road. It has been assumed that these operations could occur concurrently. Allowance has also been made for work area ventilation, dewatering and surface office, workshop etc. The estimated electrical demand for this combination of loads is approximately 11,300 kVA and would require specific power supply arrangements prior to commencement.

It is assumed no tunnelling equipment would be supplied from the north-eastern worksite. The load in this area would be limited to site office, workshop, crib room etc and is unlikely to exceed 100kVA. It is expected that this would be supplied from the existing Energex distribution in the area.

Water

The tunnelling methods used require the use of water for dust suppression and cooling of equipment. Water for construction purposes would be obtained from metered standpipes connected to the existing mains supply system. Total water usage for construction of the Airport Link Project is estimated to be of the order of 123,000,000 litres with 10,000,000 litres being used for the TBM driven tunnels, 90,000,000 litres for the roadheader driven tunnels and the remainder for the surface works, dust control, wheel washes etc. Ground water encountered during excavation will be collected in a sump and pumped to the surface to be treated before either recycling for use in construction (machinery operation, dust suppression, landscaping and rehabilitation) or disposal to the existing stormwater system. It would be possible also that water used in the construction works could be used, after treatment, for dust control and wheel washes.

This water, along with ground water inflows, would be pumped from the tunnel and treated. Where possible, water would be reused in the construction process and water conservation techniques would be used. These would include aerated taps, waste efficient appliances, trigger action hoses, low/dual flushing or composting toilets and prompt repair of leaking taps and pipes.

Materials

The materials used during the construction of the project would include precast concrete segments, concrete, reinforcing steel, shotcrete (sprayed concrete), rockbolts, rockbolt resin, waterproofing membrane, gaskets and asphalt. Other materials include ducting, pipework and cables for the mechanical and electrical systems. Indicative quantities of key construction materials are shown in **Table 4-3** below.

Table 4-3 Materials used for Site Construction

Material	Quantity
Concrete (in situ)	380,000 m^3
Concrete (precast)	238,000 tonnes
Reinforcement (steel)	80,000 tonnes
Bored Piling	190, 000 m^3
Controlled fill material	130,000 tonnes

Concrete for surface works will be sourced from local concrete batching plants. Recycled material will be used wherever possible and active procedures developed to minimise waste.

Workforce

Due to the specialist environment of the tunnel construction, the labour force would consist mainly of skilled technicians with a small portion of general skilled construction workers. The surface works associated with the connections for the tunnel will require general skilled construction workers. The possibility for job training and skills development would be investigated as a measure to increase the local component of the labour force for both tunnel construction and surface works.

At the commencement of the construction phase, the emphasis would be on the design and approval requirement, involving a significant team of designers and considerable co-ordination between the various disciplines.

Typical labour requirements for the construction phase of the Airport Link Project are likely to be:

- Tunnelling works – 200 full time equivalents;
- Surface works and bridges at the connections – 230 full time equivalents;
- Mechanical and electrical fit-out – 120 full time equivalents; and
- Project management staff, including site management, head office, etc – 65 full time equivalents.

Hours of work for the construction phase would be:

- Surface/above ground – 6.30am-6.30pm, Monday to Saturday with no work on Sundays or public holidays, although some out-of-hours work may be required on roads where high traffic volumes during the day preclude normal working hours;
- Tunnel works – 7 days per week, 24 hours per day, with all activities underground or within the acoustic sheds; and
- Spoil haulage – five and a half days per week, being 6.30am Monday to 6.30pm Saturday, with no haulage on Sundays or public holidays.

With regards to 24 hour spoil haulage, in practice this is likely to convert to 20 hours actual haulage, owing to shift changes and the need to avoid haulage in peak traffic periods, usually being 7.00am – 8.30am and 5.00pm – 6.30pm. Chapter 19 – Environmental Management Plans presents an outline of the requirements for 24 hour spoil haulage considered necessary to maintain reasonable living conditions for residents along nominated haulage routes and for businesses and sensitive community facilities (e.g. schools, child care, hospitals) to maintain reasonable patterns of business or activity. The Construction EMP will also need to address other potential impacts arising from 24 hour spoil haulage, such as traffic noise and vehicle fleet management.

The proposal to transport spoil on a 24 hour per day basis during the week is considered to be the 'least impact' approach having regard to the existing and likely future traffic conditions on the haul routes and the consequences of an alternative 'day time' haulage option. As noted in Chapter 3 – Project Development, spoil haulage by other means is considered to be neither feasible nor practical for the Airport Link Project. A Construction Traffic Management Plan would be required to address potential traffic implications for spoil haulage.

4.3.21 Commissioning of Works

The majority of commissioning would be associated with the mechanical and electrical systems in the tunnels. These systems would be tested locally during the installation period. Once all installation and testing is complete a period of system testing and system integration would be required.

A period of testing the operation of the tunnel and its associated road network would occur once the system integration is complete. This would involve traffic running on the new roadways and interacting with the tunnel control systems including the toll system.

4.4 Project Operations Mode

4.4.1 Facility Management

Tunnel Control Centre

In the operational phase, a number of services are required for the safe and effective operation of the tunnel. These services would be monitored and controlled from the Tunnel Control Centre, a dedicated building proposed to be located adjacent to the tunnel alignment in Windsor. The administrative functions associated with the Tunnel Control Centre could be located elsewhere, providing access arrangements and telecommunications and data transfer infrastructure can meet operational needs.

Within the Tunnel Control Centre building will be the support workshops, the incident control room, the traffic control room and office space for administration. All data collected by the in-tunnel monitoring systems would be processed and all the services controlled from this location. It is also from here the water tankers would

obtain water for the tunnel wash down operations and the pressure booster for use by the fire brigade would be installed.

A site in Kedron would provide parking, maintenance and marshalling areas for emergency vehicles. This site would need ready and direct access to the mainline tunnels in each direction, as well as access to the connection tunnels and ramps.

Fire protection, traffic management and control, communications and emergency procedures to provide for safety management will be provided and managed from the Tunnel Control Centre.

Traffic Management and Control System (TMCS)

A TMCS to control traffic movements in the tunnel and approaches would allow the operators to identify and respond to all reasonably foreseeable incidents to meet the requirements for public and staff safety. It would include:

- Surveillance of the tunnel, approaches and ancillary structures;
- Incident detection and alarm management;
- Interfacing with the BCC/DMR road management system; and
- Emergency operation of the TMCS by Tunnel Control Centre staff.

The traffic management system would also be linked to the tunnel ventilation system to assist with the management of in-tunnel air quality by controlling the inflow of traffic in circumstances of extreme traffic congestion or traffic incidents in the tunnel system. In such circumstances, the ventilation system would need to operate at an appropriate level to maintain in-tunnel air quality within the goals.

Electronic Tolling System

The proposed tolling system is electronic with transponder scanners mounted on overhead gantries at the entry portals, thereby eliminating the need for toll plazas and tollbooths for cash payment. The tolling system would be inter-operable with all Australian toll roads. Payment of the toll is likely to be by E-Toll where motor vehicles using the tunnel would need to be fitted with transponders. Transmitters and receivers on overhead gantries inside the tunnel would detect the transponders. Vehicles would be detected at high speed and at any lateral position across the carriageway. Classifiers on gantries would identify the size of vehicle and apply the appropriate toll amount. A process would be put in place to enable casual users of the tunnel to pay without the need for a transponder.

4.4.2 Tunnel Ventilation

A longitudinal ventilation system is proposed for the Airport Link tunnels. Each of the mainline tunnels will be equipped with its own ventilation system, which draws air in at each of the portals (entry and exit) to achieve acceptable in-tunnel air quality as well as to minimise the potential for vitiated air escaping from the exit portals.

The tunnel ventilation system performs two functions: the maintenance of an acceptable air quality in the tunnel under normal operation and the extraction of smoke in the event of a fire in the tunnel.

The air emissions generated by motor vehicles which are considered in ventilation design for tunnels are CO (carbon monoxide), particulates and various oxides of nitrogen, termed NO_x. The Permanent International Association of Road Congresses (PIARC) has recommended limits on the concentrations of these emissions within a tunnel. These limits have been adopted for the ventilation design of this tunnel, and are:

- A peak of 70 ppm (parts per million) of CO, with a peak of up to 90 ppm during extreme congestion;
- An average of 1 ppm of NO_2; and
- A visibility limit of $0.005m^{-1}$.

For design of the ventilation system, 'extreme congestion' would be achieved in the tunnels with heavy traffic travelling at or below 10kph, whereas 'congestion' in the tunnels would be achieved with heavy traffic travelling at or below 20kph.

In order to achieve air quality within the nominated limits, the air in the tunnels is diluted with large quantities of fresh air drawn from the surface through each of the tunnel portals using jet fans installed along the roof of each tunnel (refer to **Figure 4-16**). The mixed air is extracted at the ventilation station back from the exit portal and expelled to the atmosphere via the ventilation outlets. The ventilation stations would contain large axial fans which draw the air out of the tunnel and propel it upwards into the three ventilation outlets for dispersion into the atmosphere. No net discharge of air from the portals is being considered in the design of the ventilation system.

Predominant airflow in the tunnels would be in the same direction as the traffic flow until the areas near the exit portal. Here, the airflow would be reversed between the portal and the extraction point, to avoid the discharge of air at the portals.

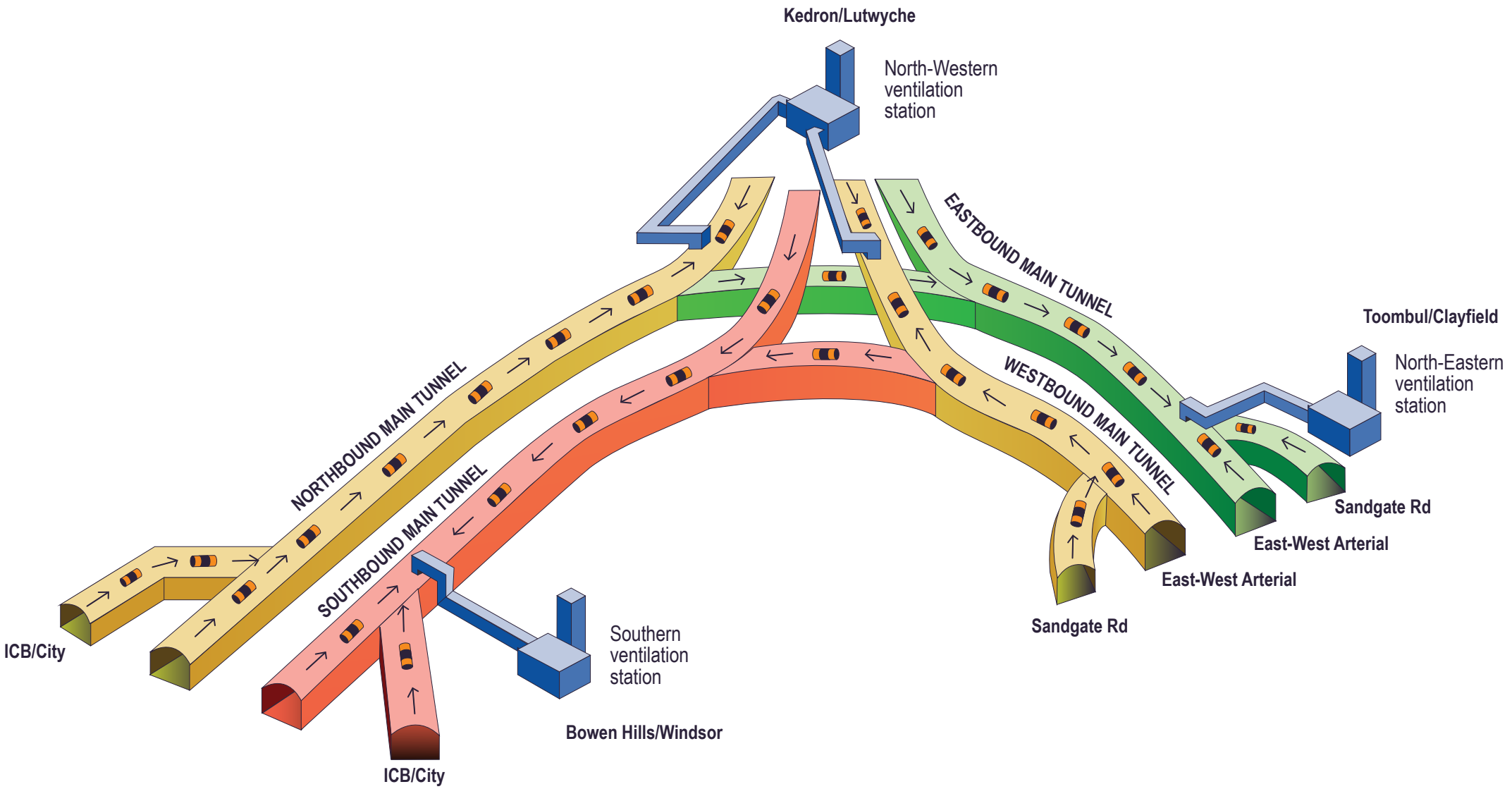
Visibility, air speed and gas monitors for CO and NO/NO_2 would be installed in each of the tunnels. Automated control systems respond to data collected by these air quality monitors, switching individual jet fans and axial fans on and off to regulate the overall airflow.

The exit velocities for air flow from each of the ventilation outlets will range from approximately 7m/sec to 20m/sec, or approximately 25kph to 70kph in response to traffic flows, in-tunnel air quality and weather conditions.

In the event of a fire in the tunnel, the extraction of air is automatically switched over to operate through the smoke duct, which is also housed in the roof of the tunnel. In the region of the fire, air valves on the underside of the smoke duct are opened to allow the smoke to be drawn in. Ventilation stations at each end of the affected tunnel are activated, drawing the smoke out both ends of the duct. Through the control of the jet fans in the roof space, the air speed in the tunnel would be adjusted to critical velocity. At this speed, the smoke plume upstream of the incident is held steady. Downstream of the incident, smoke would be mixed with the airflow, and that which is not extracted through the smoke duct would flow out of the portal.

The estimated energy usage for ventilation in the tunnel will be about 32 Gigawatt hours per year.

Provision will be made in the ventilation chambers or at the ventilation outlet site for each tunnel for filtration systems to be installed, should they prove to be effective and efficient in terms of energy consumption, and environmental benefits and impacts. A review of the technology and requirements for filtration is outlined in Chapter 9 – Air Quality and Greenhouse Gases.



LEGEND

Jet Fan

Air Flow

Ventilation Station
Location to be investigated

AIRPORT LINK - Figure 4-16

Ventilation System

Airport Link

SKM Connell Wagner JOINT VENTURE

BRISBANE CITY

4.4.3 Services

Electrical Supply

All electrical equipment, including substations, transformers and an Uninterruptible Power Supply (UPS) would be located so that removal and/or replacement could be achieved in a maximum tunnel shutdown period of 4 hours. Design of the electrical system ensures that equipment failure would not result in total loss of power to any section of the tunnel, nor any essential services equipment. The tunnel electrical systems would be fully automated and controlled through a Plant Monitoring and Control System (PMCS) to enable their normal operation without manual operation at the tunnel.

Six main connections would be made to the electricity supply grid, each from a different substation to provide two independent power supplies for each tunnel. Failure of any one connection would trigger its isolation and power supply from the remaining connection to all tunnel systems. A dedicated UPS, independent of the mains supply, would ensure operation of the tunnels' emergency services systems in any circumstance.

Twelve substations would be required along the length of the tunnels. Distribution from these substations would be fully interleaved, so that if one fails the adjoining substation would be able to supply both zones. Further duplication with backup units is designed into each substation.

In the event of a wider power systems failure, the whole tunnel would need to be closed down. The system would then initiate orderly cessation of all tunnel plant and services under the direction of tunnel operators using motorist advisory signs. Essential loads such as emergency lighting, signs, communications and central control would be maintained by the no-break UPS systems until the tunnel is cleared.

Lighting

Roadway lighting in the tunnel would be provided in zones. Lighting is brightest in the portal regions, with the intensity reducing progressively along the tunnel to a set minimum level. This gradation allows the driver's eyes to adjust to the dimmer environment. The intensity of the lighting in the portal region is set automatically, based on the ambient light conditions on the surface.

The base lighting would be fluorescent, with high-pressure sodium lamps in the portal areas. The lighting zones are interleaved, so that a failure in the distribution network would cause only a proportional loss of lighting in the affected zone.

Other lighting elements provided in the tunnel include:

- Directional signage to guide pedestrians towards the cross passages in the event of an incident; and
- Exit signage and emergency lighting in cross passages and egress tunnels.

4.5 Infrastructure Requirements

4.5.1 Utility Modifications

Relocation and disruption to utility services would occur at the all three connections. Construction of the tunnel proper would not impact on services due to the depth of the tunnels under the ground.

The following services are likely to be affected:

- Energex Electricity and Energex Gas;
- Origin Energy – Gas;

- Brisbane City Council Sewer and Water mains; and
- Telstra, Optus and other communication providers.

Service authorities may be interested in the incorporation of future services routes in conjunction with the Airport Link infrastructure. The provision for future services within the Airport Link Project would be considered in the preliminary design phase.

At the southern connection the following would need to be considered:

- A bank of 12 Telstra conduits along the eastern side of Lutwyche Road and west along the southern side of Newmarket Road would be above the driven tunnel but settlement impacts would need to be managed;
- A 600mm diameter sewer main across Lutwyche Road between Cedric and Horace Streets with an approximate invert level of -4.8m RL would be relocated as it would be affected by the cut and cover section of the mainline tunnel;
- High pressure gas lines in Campbell Street, O'Connell Terrace and Lutwyche Road would need to be realigned;
- An Optus underground network along Campbell Street and Lutwyche Road would need to be realigned; and
- An Energex substation, impacted upon by the Bowen Bridge Road on ramp to the ICB/Airport Link, would be relocated.

At the north-western connection major utility services requiring relocation or some form of treatment to avoid impacts are:

- A 450mm diameter sewer main crossing Gympie Road between Kedron Park Road and Kedron Brook and heading east under the Emergency Services Complex and Kedron State High School sports field with an approximate invert level of 4.3m RL;
- A 1200mm diameter sewer main crossing Gympie Road between Suez Street and Kedron Brook and heading east under Park Street with an approximate invert level of 3.6 to 4.0m RL;
- A 410mm diameter trunk water main along the north side of Stafford Road and west side of Gympie Road, crossing over to Leckie Road and Glen Kedron Lane;
- Major Telstra cables and optic fibre runs along the east side of Leckie Road and the east side of Gympie Road;
- A 33 kV underground cable from Leckie Road along the western side of Gympie Road and southern side of Kedron Park Road;
- The Energex sub-station on the south-western corner of the northern intersection;
- A high pressure gas line across the eastern side of Kedron Brook Bridge and Lutwyche Road;
- Optus aerial fibre along the southern side of Stafford Road, across Gympie Road and north along Gympie Road; and
- Optus underground network on both sides of the Kedron Brook Bridge and on both sides of Lutwyche Road.

At the north-eastern connection major utility services requiring relocation or some form of treatment to avoid impacts are:

- A 450mm diameter and a 675mm diameter sewer main across Kalinga Park and east beneath the North Coast railway with an approximate invert level of 0.2 to 0.5m RL;
- A 600mm diameter sewer main through Kalinga Park near the end of Stuckey Road and east beneath Sandgate Road and the East-West Arterial where it continues along the southern side of the East-West Arterial with an approximate invert level of 0.0m RL;
- A bank of 18 Telstra conduits and optic fibre across Kalinga Park and south along Elliott Street;
- A 33 kV underground cable along the western side of Widdop Street, Clayfield;
- A high-pressure gas main along Sandgate Road and under the North Coast railway;
- Optus underground network along the western side of the North Coast Railway and the western side of Schulz Canal bridge;
- Optus aerial coaxial cabling along the western side of Sandgate Road.

4.5.2 Energy

Augmentation of the energy supply network would be required for the construction and operation of the project. This is likely to include:

- A 33 kV transformer-ended feeder from Kedron 33/11kV substation to the north-western worksite to supply an on-site substation during construction and to become part of the permanent power supply for operation;
- A substation at the southern ventilation outlet area, either at the vent outlet location or in the work compound area, depending on the location of the ventilation equipment;
- An 11kV feeder from Energex 33/11kV substation established to provide construction supply to the Northern work site of the North South Bypass Tunnel or supply at 11kV from the Newstead 11kV substation; and
- A substation at the north-eastern ventilation outlet area, at the vent outlet location.

On completion of the works two 33 kV feeders at the north-western connection are to be supplied from different bulk supply systems. Each feeder would be capable of supplying 5 MW of power, to the ventilation station building as well as uninterrupted power to the tunnel should there be a feeder or substation outage.

4.5.3 Wastewater

As described above, large volumes of water are required for construction over the life of the construction program. Opportunities would be investigated to reuse water collected on the site or from tunnel inflow, especially for dust control, wheel-wash facilities and similar purposes.

Wastewater generated at the site compounds would include water from showers, toilets and kitchen facilities. It would either be discharged to the sewer via standard connections or collected in holding tanks and removed to a licensed waste disposal facility.

4.6 Permits, Licences and Approvals

The Coordinator-General of Queensland declared the project to be a significant project in October 2005 for which an environmental impact statement (EIS) is required, under the provisions of the *State Development and Public Works Organisation Act 1971*. Consequently, an EIS is required to be prepared and considered by the

Coordinator-General to ensure that the environmental values of the study corridor are recognised and any project-related impacts managed adequately. The project needs to be considered under both Commonwealth and State legislation to determine the approvals required.

Relevant Commonwealth legislation includes:

- The *Environment Protection & Biodiversity Conservation Act 1999*; and
- The *Native Title Act 1993*.

A referral was made to the Commonwealth Minister for the Environment and Heritage under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) to determine whether the project and its associated works are a 'controlled action' under the Act. The Delegate of the Commonwealth Minister for the Environment and Heritage determined on 19 January 2006 that the Project constitutes a controlled action pursuant to s75 of the *EPBC Act*.

The stated reasons for the "controlled action" primarily related to the proposed placement of spoil at a location within the Brisbane Airport Corporation area known as the Export Park West site. This site drains to the Kedron Brook Floodway and subsequently the Ramsar listed area of Moreton Bay (Moreton Bay site No 63) as a "wetland of international significance". The Commonwealth found that on the basis of the information presented that the proposed placement of spoil at this location may adversely affect the Ramsar listed wetland.

The Commonwealth decision was subsequently reconsidered following the withdrawal of proposed spoil placement at the Export Park West site. Based on this new information, a decision was made on 20 March 2006 by the Minister for the Environment and Heritage that the proposed action is not a controlled action and that assessment and approval of the proposal under the EPBC Act is not required. The Commonwealth Minister further noted that the 'Export Park West Site' on Commonwealth land at Brisbane Airport would not be used for placement of spoil from the project.

Relevant Queensland legislation includes:

- *Aboriginal Cultural Heritage Act 2003*;
- *Acquisition of Land Act 1967*;
- *Coastal Protection and Management Act 1995* (Coastal Protection Act);
- *Environmental Protection Act 1994*;
- *Fisheries Act 1994*;
- *Integrated Planning Act 1997*;
- *State Development and Public Works Organisation Act 1971* (State Development Act).

4.6.1 Approvals Pathway

The 'approvals pathway' for the Airport Link Project is a combination of the *State Development Act* and the *Integrated Planning Act*. The *State Development Act* sets out the process to be followed in respect of a significant project for which development approvals are required under the *Integrated Planning Act*. In particular, the Coordinator-General's report may:

- State conditions that must apply to a development approval under the *Integrated Planning Act*;
- Recommend requirements for inclusion in a designation under the *Integrated Planning Act*.

Further, a submission made in relation to this EIS is taken to be a submission for a later impact-assessable development application under the *Integrated Planning Act*.

The further approvals required upon completion and approval of the EIS are likely to include:

- Development approvals under City Plan (e.g. operational works for excavation or filling for spoil placement);
- Development approvals under Schedule 8 of the *Integrated Planning Act 1997* including for material change of use for environmentally relevant activities and contaminated land, operational work that is tidal work, development on a registered place under the *Queensland Heritage Act 1992*, and the removal of marine plants;
- Obtaining registration certificates for environmentally relevant activities if any are identified under the *Environmental Protection Act 1994*; and
- Obtaining other environmental permits or approvals relating to management of contaminated land and potential acid sulphate soils.

Community Infrastructure Designation

Where it is proposed to proceed with a designation of all or part of the Airport Link Project as community infrastructure under the *Integrated Planning Act*, any designation process will be informed by the preparation, consultation and assessment processes undertaken for this EIS. A designation can be for a volumetric parcel of land.

The designation could be undertaken either by a Minister of the Queensland Government or by the Brisbane City Council, following the processes established by the *Integrated Planning Act*. Development under a designation is exempt to the extent that approvals for assessable development involving material change of use and approvals for reconfiguration of a lot are not required under the planning scheme, City Plan 2000.

4.6.2 Development Approvals

Development approvals will be required for assessable development under City Plan 2000 and where identified in Schedule 8 of the *Integrated Planning Act 1997*.

City Plan makes exempt from assessment development involving the construction, maintenance or operation of roads and things associated with roads including:

- Activities undertaken for road construction;
- Traffic signs and controls;
- Depots;
- Road access works;
- Road construction site buildings;
- Ventilation facilities, including exhaust fans and outlets;
- Drainage works;
- Rest area facilities and landscaping;
- Parking areas;
- Public transport infrastructure;
- Control building; and
- Toll plazas.

Material Change of Use

The Airport Link Project is likely to require development approval for a material change of use for an environmentally relevant activity under the *Integrated Planning Act*.

Where the Airport Link Project involves development for a material change of use of premises for an environmentally relevant activity under the EP Act, that development is assessable development under the *Integrated Planning Act*.

The Airport Link Project works may include a number of environmentally relevant activities under the *Environmental Protection Act 1994*.

The likely range of environmentally relevant activities set out in **Table 4-4**.

Table 4-4 Environmentally Relevant Activities

No	ERA	Level
7	**Chemical storage** – including dangerous goods storage – in containers having a design storage volume greater than 10m^3 and less than 1000m^3	2

ERA 7 – Chemical & Dangerous Goods Storage

ERA 7 is the storage of more than 10 m^3 but less than 1,000 m^3 of chemicals or dangerous goods. If dangerous goods, including explosives, are stored on worksites in excess of these quantities, approval for a material change of use for an environmentally relevant activity is required. Considering the proximity to sensitive land uses to the southern and north-eastern worksites in particular, storage of explosives is not desirable.

Other Construction Activities

The conventional practice is for asphalt and concrete to be transported to the construction site rather than produced on-site. Should batching concrete or manufacture of asphalt be required at the worksite during construction, a development approval for a temporary or mobile environmentally relevant activity (ERA 59 for asphalt manufacturing or ERA 62 for concrete batching) is required for each activity.

Should excavation to place pylons in the bed of Enoggera Creek be necessary a development approval for a temporary, environmentally relevant activity (ERA 19a) would be required.

A development approval for material change of use on Strategic Port land is required where the development proposed (spoil placement) is inconsistent with the Land Use Plan for the Port. Whilst it is not expected that the spoil placement will be inconsistent with the Port Strategic Land Use Plan, the Fisherman Islands and Clunies Flat land is designated for port related activities under the Port Strategic Land Use Plan.

Building Works

The Airport Link project will require the construction of a number of buildings including:

- The erection of sheds over the worksites at each of the tunnel portals;
- Tunnel control building which includes operational and management functions;
- The ventilation stations and outlets adjacent to the each connection;
- Emergency services buildings to house vehicles and personnel attending to emergencies in the tunnel system; and
- General maintenance buildings.

Depending on the mode of project delivery, development approval requirements may be triggered under IPA. Where required, buildings will comply with the Building Code of Australia.

Operational Works

Applications for development approvals for operational works need approval prior to the commencement of any works where such development is assessable. These may include operational works for filling and excavation for spoil placement that materially affects premises or their use.[2] Development approval under City Plan for material change of use for filling and excavation for spoil placement will be required only if that is assessable under the City Plan designation for spoil placement locations, and not subject to a Community Infrastructure Designation.

Operational works includes 'tidal works' such as work in, on or above land under tidal water, or land that will or may be under tidal water because of development on or near the land.[3] The construction of a bridge, with supports in or on land under tidal water (i.e. Enoggera Creek and Kedron Brook/Schulz Canal) will constitute tidal works. The construction of road carriageways on the northern side of the East-West Arterial Road between Sandgate Road and Widdop Street would also constitute tidal works. Carrying out operational work that is tidal work is assessable development under the *Integrated Planning Act* (Sch 8, Part 1). A development application is required for tidal work that is prescribed tidal work, to be lodged with Brisbane City Council as the assessment manager.

Marine Plants

The Airport Link Project is likely to result in the removal or disturbance of marine plants in Enoggera Creek and Schulz Canal with the construction of additional works for the southern and north-eastern connections respectively. Any works which require the removal or disturbance of marine plants under section 51 of the *Fisheries Act* is assessable development under the *Integrated Planning Act 1997* and requires a development application to be made.

Cultural Heritage

Development carried out on a registered place under the *Queensland Heritage Act 1992* is assessable development under the *Integrated Planning Act 1997*. A development application, for code assessment, will be required and will be assessed by the Queensland Heritage Council. A cultural heritage management plan may be required to be approved prior to the construction of any works which adversely affect a place of cultural heritage significance included in the Queensland Heritage Register.

Reconfiguration of a Lot

Reconfiguration to create a lot for the tunnel is exempt development under the Integrated Planning Act where either the land is not under the Land Title Act or where acquired pursuant to the Acquisition of Land Act. .

4.6.3 Environmental Approvals

Contaminated Land

A strategic-level investigation of the study corridor has identified a number of sites which contain potentially contaminated soils as a consequence of previous activities (e.g. service stations, car repair stations) and which

[2] It is unlikely that an approval for clearing native vegetation under the *Vegetation Management Act* will be required.
[3] *Coastal Protection & Management Act 1995*, Schedule 2 and *Integrated Planning Act 1997* Schedule 8.

could be intercepted by construction of the Airport Link Project. A number of these sites are covered by site management plans prepared in accordance with the *Environmental Protection Act 1994*.

The construction of the Airport Link Project will need to comply with the conditions applying to the existing site management plans for each of the contaminated sites under which it passes.

A development approval for a material change of use for land on the Environmental Management Register or Contaminated Land Register is required under the *Integrated Planning Act*, where the land does not have an approved site management plan.

A disposal permit would be required under the *Environmental Protection Act* for removal of contaminated soil during construction for land on the Environmental Management Register or Contaminated Land Register.

Acid Sulphate Soils

There is some potential for construction works to intercept potential acid sulphate soils, particularly in areas below 5.0m AHD. In areas where the project requires excavations and there is an identified potential for interception of ASS, the Department of Natural Resources, Mines and Water would require the preparation of an environmental management plan. Construction work in these areas must be preceded by the approval of an acid sulphate soils management plan. The plan must be prepared in accordance with the QASSIT Guidelines and approved by the Department of Natural Resources, Mines and Water.

Cultural Heritage

Under the *Aboriginal Cultural Heritage Act 2003* a cultural heritage management plan is needed where an EIS is required. A cultural heritage survey is included in the EIS to identify the locality of places of cultural heritage significance.

Any works affecting a place of indigenous cultural heritage significance may require a permit to remove or relocate artefacts or other evidence of indigenous cultural heritage.

Works on a State Controlled Road

The approval of the Chief Executive Department of Main Roads is required under the *Transport Infrastructure Act 1994* if works are to be undertaken on a State Controlled Road or otherwise have a significant impact on a State Controlled Road.[4]

Works that Interfere with a Railway

The approval of Queensland Rail as the railway manager is required under the *Transport Infrastructure Act, 1994* if works are to be undertaken that will interfere with a railway.

Other Approvals

Prior to construction, other development approvals may be required with the coming into force of further amendments to the IP Act, as other State legislation is rolled into the IP Act.

[4] Amendments to the *Transport Planning and Coordination Act 1994* provide for codes under IDAS for works on a local government road that limit access or remove public passenger transport infrastructure. These provisions are not yet operative.

4.6.4 Local Laws

Local laws govern activities such as blasting, temporary road closures and local traffic management measures during construction. Approvals from the Brisbane City Council under relevant local laws or provisions of the *Local Government Act* will be required prior to the commencement of such activities. Permanent road closures will be required and applied for under the Land Act.