Technical Note

ARUP

To	Cross River Rail Delivery Authority	Date	14 November 2018
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Subject	Cross River Rail Request for Project Change 3 - Air quality impacts		

1 Introduction

The 2011 EIS for CRR contained a construction site to the east and west of Parkland Boulevard/Parkland Crescent, east of Hotel Jen (refer to Figure 1). The subsequently approved 2017 Request for Project Change (RfPC 1) realigned the station and CRR route, relocating and expanding the construction site to the north of Parkland Crescent and Hotel Jen (refer to Figure 2). RfPC 2 (June 2018) addressed the temporary solution for the relocation of the Roma Street Coach Terminal (refer to Figure 2).

The subject of RfPC 3 is to consider the demolition of the Brisbane Transit Centre (BTC) (East Tower) and Hotel Jen, with an overall impact area of approximately one-hectare (refer to Figure 3). This work required as part of RfPC 3 involves new property impacts and additional demolition works not previously assessed.

The demolition will occur over a 7-month period. Buildings within Lot 1 on SP207220 are proposed to be demolished sequentially with Hotel Jen and East Tower first, followed by the Podium and BTC (West Tower). The temporary utilisation of the adjacent open space park and Queensland Rail carpark is proposed for demolition access and worksite. The additional demolition work will occur prior to construction of the CRR Project, as part of the required early works. The construction of the temporary Roma Street Coach Terminal is unlikely to overlap with the demolition of Hotel Jen and the BTC (East Tower).

The purpose of this technical note is to analyse the air quality impacts that were assessed as part of the RfPC 1 (CRR 2017) project and determine the potential changes as a result of RfPC 3.

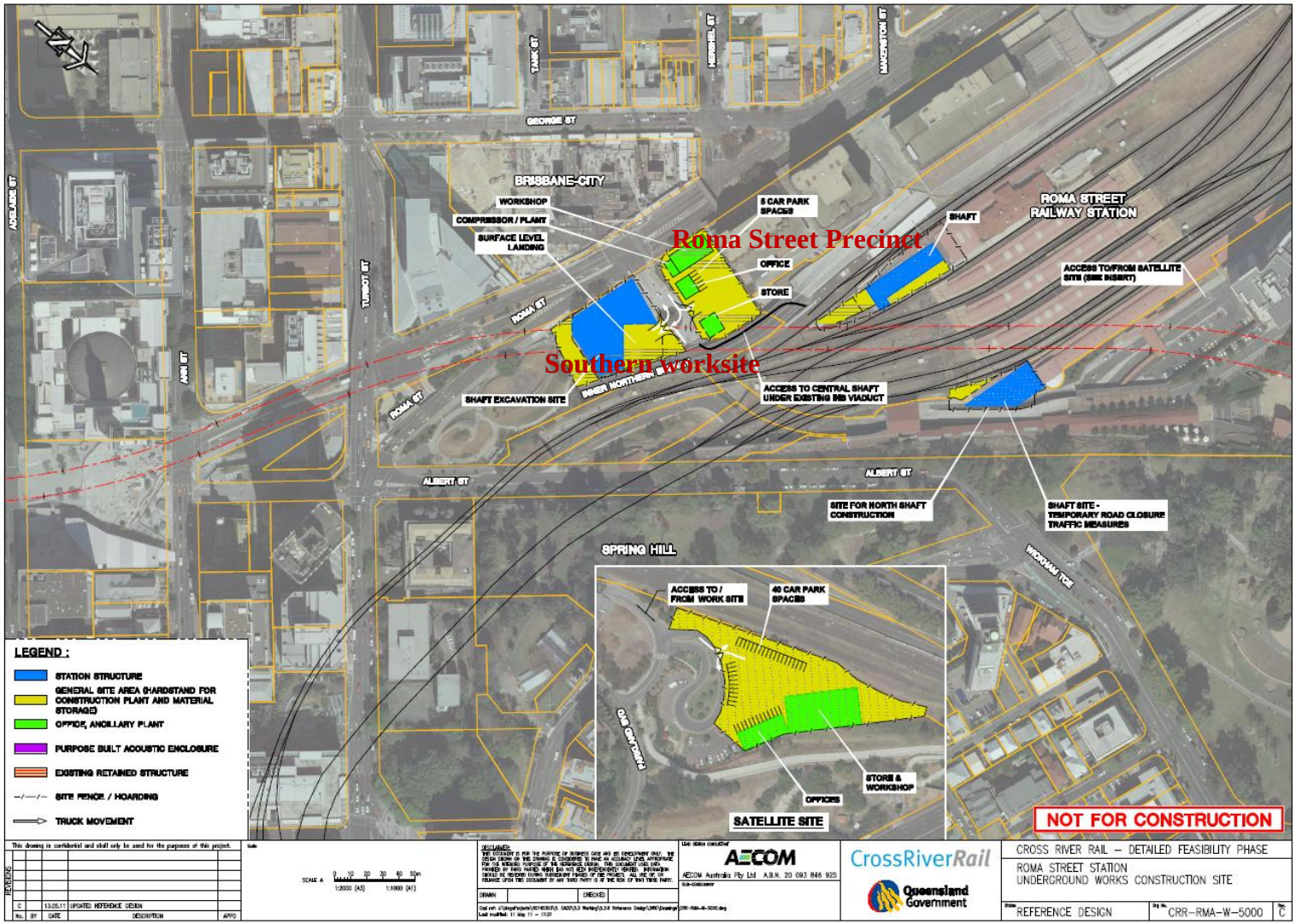

Figure 1: 2011 EIS construction site – Roma Street

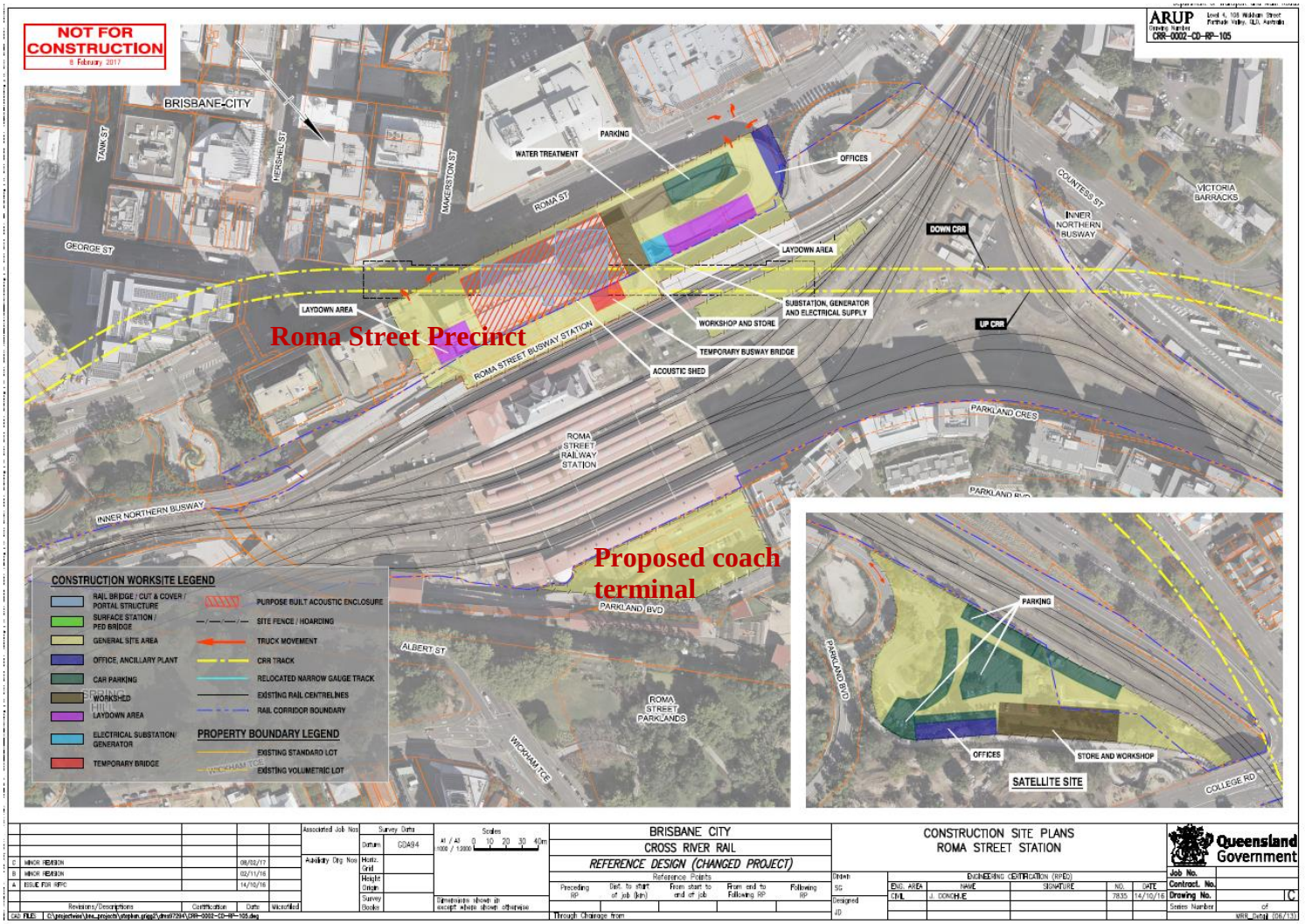

Figure 2: 2017 RfPC 1 construction site and RfPC 2 proposed coach terminal site

Figure 3: Proposed additional demolition area

2 CRR Project Approved Work and Impacts

2.1 Construction

Construction phase air quality impacts associated with dust generated at the Roma Street Precinct were not quantitatively assessed in the 2011 EIS as the works would occur primarily in the shaft or purpose-built shed. The 2011 EIS notes that dust would be minimised by the Contractor through dust management measures listed in section 15.4.5 of the 2011 EIS and included in the draft Outline Environmental Management Plan (OEMP).

In addition, air quality impacts associated with construction vehicles travelling to and from each site was not quantitatively assessed.

The transport assessment, Chapter 5 of the EIS, predicted that during peak construction, the Roma Street general site area would generate 10 heavy vehicles per hour or up to 130 vehicles per day (103 spoil and 27 deliveries). This results in 260 heavy vehicle movements per day (i.e. 130 movements to access the site and 130 movements to leave the site).

The assessment established that through the implementation of best practice management measures, including for construction traffic, there would be a low potential for adverse air quality impacts during construction. A recommendation for dust monitoring to be undertaken adjacent to an apartment complex in Roma Street parkland was also included.

RfPC 1 included some changes to the worksite at Roma Street Station, including the demolition of the west tower of the BTC and the Podium. These changes were not quantitatively assessed as the majority of works would continue to occur in the shaft or purpose-built acoustic shed and dust generated during demolition would be minimised by the Contractor through dust management measures listed in section 15.4.5 of the 2011 EIS and included in the draft OEMP. The draft OEMP would be updated and finalised as part of the approval process for the project however the draft OEMP includes a measure to:

"Ensure appropriate dust controls are used for demolition activities, including the use of water sprays and covering loads of material transported from the sites. Other measures may be initiated, particularly in respect of buildings containing hazardous or potentially hazardous materials."

This would apply to all demolition activities carried out under the project.

Construction vehicle movements for RfPC 1 were anticipated to reduce from those predicted in the 2011 EIS with 6 heavy vehicles per hour and up to 66 heavy vehicles (39 spoil and 27 deliveries) per day. This would result in 132 heavy vehicle movements per day accessing and exiting the site.

The assessment for RfPC 1 concluded that through the implementation of best practice management measures, including for construction traffic, a low potential for adverse air quality impacts during construction remains.

RfPC 2 identified that local air quality impacts associated with the construction of the proposed coach terminal on land north of Roma Street Station would be negligible. Minimal works are anticipated to construct the terminal such as general land clearing and erection of new structures such as a coach canopy and ticket kiosk. A maximum of three heavy vehicle movements per hour is

anticipated during the construction of the coach terminal. Dust management measures included in the draft OEMP would also be implemented during construction of the coach terminal.

2.2 Operation

The following key findings from the operational air quality assessment in the EIS were determined to be applicable across the alignment:

- Predicted changes to motor vehicle use and emissions from CRR are unlikely to affect regional air quality; and
- Predicted changes to train movements and emissions from CRR are unlikely to affect regional air quality.

Operational effects on local air quality at Roma Street Station and the surrounding area as a result of CRR were not assessed as part of the 2011 EIS or RfPC 1, as these were considered to be negligible.

RfPC 2 results in a redistribution of coach movements associated with the relocation of the proposed coach terminal from BTC to land north of Roma Street Station. It is anticipated that during operation of the proposed coach terminal, there would be around 75 coaches per day (i.e. 150 total coach movements – 75 coaches in and 75 coaches out), with a peak hour movement of approximately 13 coaches. This would result in a 4% increase in daily traffic flows on Parkland Boulevard and an 11% increase on Parkland Boulevard. Local air quality impacts would be localised to those routes which are not currently used by coaches to access the BTC. The addition and redistribution of coaches does not change the outcomes of RfPC 1 or the 2011 EIS and therefore local air quality impacts would be negligible.

RfPC 3 relates to demolition phase only therefore operational impacts have not been assessed.

3 Material Changes to Impacts

3.1 Assessment Methodology

A qualitative assessment approach has been completed to determine any potential material changes to the predicted air quality impacts detailed in the 2011 EIS and RfPC 1 and 2, from the increase of the impact area by one hectare and the additional demolition of two buildings (hereafter referred to as the 'site'). It is not considered that the additional demolition of buildings would warrant any detailed assessment such as dispersion modelling. The main dust-generating activities that would occur in this area as part of either RfPC1 or RfPC 3 would continue to be site excavation and spoil removal and transportation assessed as part of RfPC 1 which would primarily be enclosed in a purpose built shed. RfPC 3 works will occur prior to the commencement of other CRR works at Roma Street including those assessed as part of the RfPC 1.

Therefore, the methodology used is as follows:

- Determine the type and proximity of sensitive receptors from the site.
- Review and document the established background pollutant concentrations.
- Establish the predicted demolition traffic movements at the site.
- Provide commentary on the likelihood of localised air quality impacts and potential mitigation measures.

3.2 Results and Discussion

3.2.1 Site Location

The site is located in an urban area within the Brisbane Central Business District (CBD). To the west of the site is the BTC (West Tower) and the Podium. These buildings are earmarked for demolition as per RfPC 1. Demolition would occur sequentially moving from east to west therefore those building proposed to be demolished as part of RfPC 1 may remain operational during demolition at the site. Roma Street Station is located to the north of the site separated by the railway tracks.

There are sensitive community and open space receptors identified in Figure 15-3 of the 2011 EIS, these are located on the opposite side of Roma Street and to the east of the site respectively. The closest residential receptors to the site, is the Abbey Apartments approximately 60m to the west and the Meriton Apartments approximately 110m to the south. There is also a hotel and backpacker accommodation to the south of Roma Street.

Queen Elizabeth II Courts of Law (Supreme and District Courts) are located approximately 40 m across Roma Street and the magistrates court approximately 100m southeast.

Sensitive receptors are likely to include office workers in the area and transient receptors such as community members and train passengers entering/leaving the station complex. Residential receptors nearby may also be affected depending on wind direction.

3.2.2 Background Air Quality

Background air quality information shown in RfPC 1 and summarised in Table 1 was established based on data from four monitoring stations (Cannon Hill, Brisbane CBD, South Brisbane, Rocklea).

Table 1 also includes the air quality goals included in the CRR Project Imposed Conditions. While goals for $PM_{2.5}$ were not included in the original conditions, it was identified in RfPC 1 that National and State-wide air quality legislation has been updated in 2016 to include assessment criteria for $PM_{2.5.}$ This was therefore incorporated into the air quality assessment carried out for RfPC 1.

A review of data from the four monitoring stations used to determine the background concentrations in Table 1 for 2017 was carried out to ensure there had been no significant changes in existing air quality conditions since the assessment for RfPC 1 was undertaken. Monitored annual average PM_{10} and $PM_{2.5}$ concentrations for 2017 were found to be similar to those background concentrations in Table 1 and therefore these remain valid.

The data indicates that with the exception of annual $PM_{2.5}$, background concentrations are well below their respective air quality goals within the CRR Project Imposed Conditions.

Table 1: Background concentrations of air quality indicators against CRR Project goals

Air quality indicator	Averaging period	Units	Background concentration	Air quality goal	Criterion
TSP	Annual	$\mu g/m^3$	24	90	Human health
PM_{10}	24 hours	$\mu g/m^3$	17	50	
	Annual	$\mu g/m^3$	14.5	25	
$PM_{2.5}$	24 hours	$\mu g/m^3$	8.3	25	
	Annual	$\mu g/m^3$	6.5	8	
Dust deposition	30 days	$mg/m^2/day$	60	120	Nuisance
TSP	24 hours	$\mu g/m^3$	26	80	

3.2.3 Potential Demolition Impacts

Demolition at the site has the potential to result in dust generation as well as exhaust emissions from traffic travelling to and from the site. Impacts are likely to be similar to those identified in the 2011 EIS and RfPC 1 and 2 and could be effectively managed by the implementation of dust management measures.

The Project schedule shows that demolition at the site would not overlap with construction of the proposed coach terminal approved as part of RfPC 2. Construction impacts associated with the proposed coach terminal are minimal as limited demolition, earthworks or construction of structures is required. Therefore, there is unlikely to be any discernible cumulative impact to local air quality in the event that schedule changes created an overlap of these activities.

Demolition at the site would occur prior to demolition of the BTC (West Tower) and the Podium, therefore no cumulative impacts are anticipated in relation to these works. Dust management measures implemented under the draft OEMP would help minimise the generation and spread of dust to sensitive receptor locations.

With regard to demolition traffic, approximately two vehicles per hour (or four movements per hour) are anticipated. To allow for possible restrictions during peak periods and unforeseen delays in the program, a total of approximately four vehicles per hour (or eight movements per hour) is adopted as the worst case scenario. Either scenario is a small amount of additional traffic compared to existing traffic flows on Roma Street and is likely to be similar to the amount of traffic required for the demolition of adjacent buildings already considered as part of RfPC 1. Demolition traffic will use only designated routes in accordance with the Construction Environmental Management Plan and demolition waste haulage using heavy vehicles would be limited to current approved project hours, avoiding the need to haul waste during peak traffic hours. This means that demolition traffic would not contribute to congestion during peak hours and therefore does not increase local air quality impacts arising from congestion.

Demolition at the site would add an additional seven months to the program considered as part of the 2011 EIS and RfPC 1. This work would be carried out as early works, in advance of the works assessed as part of the previously approved EIS and RfPC, however impacts associated with dust generation are anticipated to be similar to the demolition of the BTC (West Tower) and the Podium which are approved under RfPC 1.

Dust management measures outlined in the draft OEMP would also be implemented during demolition at the site to manage dust generation and minimise dust spread during demolition. This includes dust monitoring at an apartment complex at Roma Street Parkland.

While the predominant wind direction in Brisbane is south-westerly and receptors downwind (i.e. north-east of the site) are likely to be most impacted during demolition, the nearest sensitive receptors are south-west and south-east of the site across Roma Street. Therefore, dust deposition monitoring is also to be implemented on the opposite side of Roma Street to the site near the Transcontinental Hotel, which would be representative of impacts at the Abbey apartments, other hotels and the Supreme Court.

Figure 4 shows the monitoring locations in Roma Street Parkland and proposed location south of Roma Street.

Figure 4 Air Quality Monitoring Locations

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Figure 4: Indicative Construction Monitoring Location at Roma Street Parkland.

3.2.4 Potential Operational Impacts

There are no operational impacts associated with the site as the current proposals only include demolishing the building to ground level with no future use currently identified. The project supports redevelopment of the Roma Street Precinct however any future development at the site would be assessed as part of a separate planning process. Where any redevelopment is likely to generate local air quality impacts, an air quality assessment would be carried out as part of a later planning application.

4 Recommendations and Conclusion

This technical note established that additional demolition of the BTC (East Tower) and Hotel Jen is not expected to result in any material change to the predicted air quality impacts presented in the 2011 EIS or RfPC 1 or 2, during the construction phase. Impacts are likely to be similar to the demolition of the BTC (West Tower) and the Podium, as assessed as part of the RfPC 1. This demolition would occur sequentially so there would not be any increased cumulative impacts however there would be an increase in duration of the impacts. While the additional demolition is unlikely to overlap with the construction of the proposed coach terminal (RfPC 2), in the event they did, no cumulative impacts are anticipated due to the distance and minimal works required for the terminal. Minimal demolition traffic movements are anticipated (approximately four vehicle movements per hour) and are likely to be similar to those assessed for the demolition of the BTC (West Tower) and the Podium.

With effective management measures outlined in the draft OEMP and the recommendation for additional dust deposition monitoring implemented, the CRR Project air quality goals would not be exceeded based on existing levels in the area and the likely scale of impact associated with the demolition.

Technical Note

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Prepared by	Click here to enter text.	Date	14 November 2018
Subject	Cross River Rail Request for Project Change 3 – Noise and Vibration Impacts		

1 Introduction

The 2011 EIS for CRR contained a construction site to the east and west of Parkland Boulevard/Parkland Crescent, east of Hotel Jen (refer to Figure 1). The subsequently approved 2017 Request for Project Change (RfPC1) realigned the station and CRR route, relocating and expanding the construction site to the north of Parkland Crescent and Hotel Jen (refer to Figure 2). RfPC2 (June 2018) addressed the temporary solution for the relocation of the Roma Street Coach Terminal (refer to Figure 2).

The subject of RfPC3 is to consider the demolition of the Brisbane Transit Centre (BTC) (East Tower) and Hotel Jen (refer to Figure 3). This work required as part of RfPC3 involves new property impacts and additional demolition works not previously assessed.

The demolition will occur over a 7-month period. Buildings within Lot 1 on SP207220 are proposed to be demolished sequentially with Hotel Jen and BTC (East Tower) first, followed by the Podium and BTC (West Tower). The temporary utilisation of the adjacent open space park and Queensland Rail carpark is proposed for demolition access and worksite. The additional demolition work will occur prior to construction of the CRR Project, as part of the required early works. The construction of the temporary Roma Street Coach Terminal is unlikely to overlap with the demolition of Hotel Jen and the BTC (East Tower).

The purpose of this technical note is to describe the potential noise and vibration impacts that were assessed as part of the RfPC1 and determine the potential changes as a result of RfPC3.

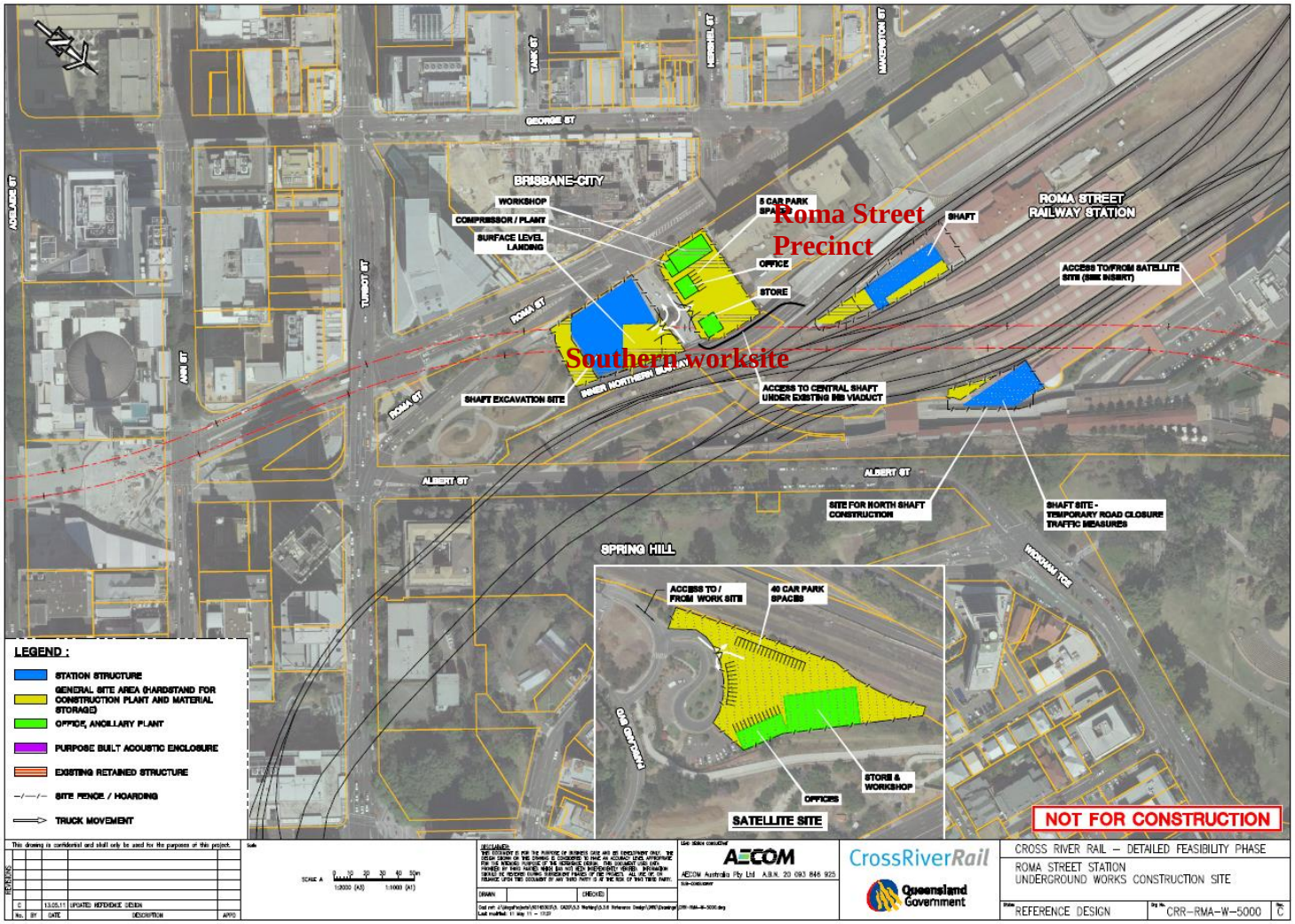

Figure 1: 2011 EIS construction site – Roma Street

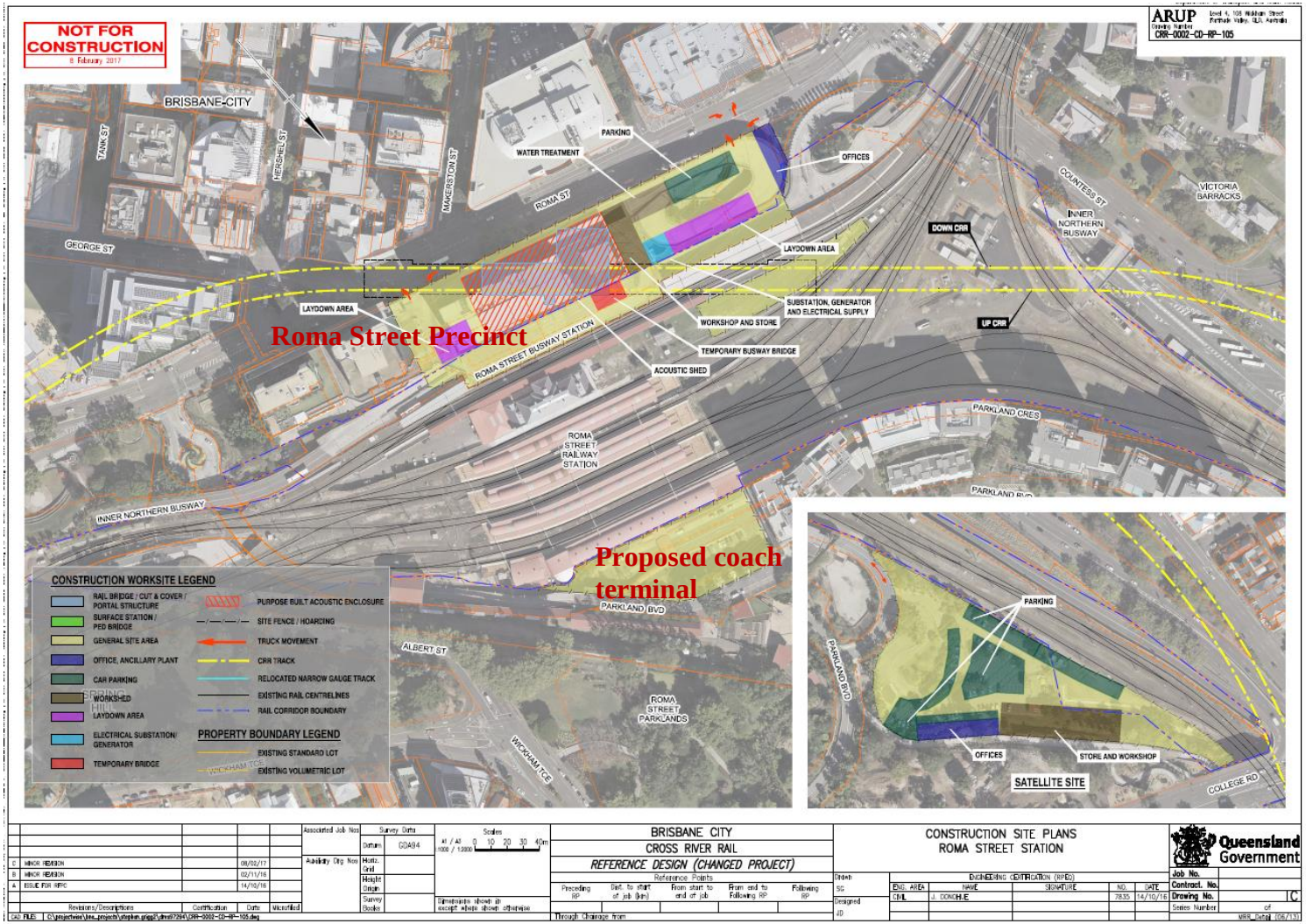

Figure 2: 2017 RfPC 1 construction site and RfPC 2 proposed coach terminal site

Figure 3: RfPC 3 proposed demolition works

2 CRR Project Approved Works and Impacts

2.1 Construction

2.1.1 Traffic Noise

Demolition of the BTC (West Tower) and the podium is expected to take 13 months. The frequency of truck movements is expected to not exceed that of the excavation stage. The peak hourly construction traffic during site establishment and demolition for both the EIS and the RfPC1 is presented in Table 1.

Table 1: Previously approved peak hourly construction traffic (one-way movements) for site establishment and demolition

Construction Worksite	**Peak Traffic Movements (Loads / Hour)**	
	2011 EIS	2017 RfPC 1
Roma Street	10	6

For both the EIS and RfPC1, peak daily spoil and delivery vehicle movements are compared in Table 2.

Table 2: Previously approved construction peak daily traffic (one way movements) for spoil and material haulage

Construction Worksite	**Peak Spoil Movements (Loads / Day)**		**Peak Delivery Movements (Loads / Day)**	
	2011 EIS	2017 RfPC 1	2011 EIS	2017 RfPC 1
Roma Street	103	39	27	27

Predicted change in traffic noise levels for construction traffic on haul routes was predicted in the EIS using the following parameters:

- L_{A10} (18hour) for between 6 am and 12 midnight; and
- L_{A10} (1hour) for the peak number of heavy vehicle movements during any hour between 12 midnight and 6 am.

The predicted change in traffic noise due to construction traffic in the EIS is presented in Table 3.

Table 3: Predicted change in road traffic noise attributable to construction traffic on haul routes

Worksite	**Road Segment**	**Change in Road Traffic Noise Level due to CRR**
Roma Street Station	Roma Street adjacent to existing station	L_{A10} (18hr) +0.3

For RfPC1, it was noted that the EIS traffic volumes were compliant with road traffic noise criteria, therefore the RfPC1 would also comply with the criteria given that construction traffic movement were no greater, and in many cases lower.

2.1.2 Construction Works

Construction activities identified in the 2011 EIS at the South Shaft Construction site adjacent to Hotel Jen are identified below:

Table 4: EIS approved construction activities at Roma Street South shaft site

Roma Street Station worksite - south shaft

	Element	Estimated durations (weeks)	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	Year 1
A	Site clearance and establishment	6																											
B	Establish piling rigs on site	4																											
C	Install piles	4																											
D	Construct acoustic shed	6																											
E	Excavate to formation level	10																											

Notes:
A: Dominant noise sources include excavators and cranes (mostly daytime construction works)
C: Dominant noise sources include piling rigs (mostly daytime construction works)
E: Dominant noise sources include jumbo drill rigs, excavators and front end loaders (potential for 24 hour per day construction with night time works carried out inside an acoustic enclosure at the south shaft)

The nearest identified noise sensitive receivers to the South Shaft site was the BTC and Holiday Inn (now Hotel Jen), referred to in the EIS as Receiver area H and I respectively.

Worst case construction noise levels were predicted in the EIS for three scenarios as follows:

- Scenario 1 – Site establishment including demolition
- Scenario 2 – Pilling of access shafts
- Scenario 3 – Shaft excavation

The predicted worst case construction noise levels to the residential receivers identified in the EIS were as presented in Table 5.

Table 5: EIS predicted worst case construction noise levels

Receiver Area	Scenario	Period	Noise Goal (dBA)[1]	Predicted Noise Level[2] (dBA)	Noise Goal Exceedance with level of Noise Mitigation (dBA)		
					3 m Hoarding	6 m Hoarding	Enclosure
H – Roma Street Station Commercial	1	Day	LA10,adj – 65	62 - 79	14	9	n/a
	2	Day	LA10,adj – 65	64 - 77	12	7	n/a
	3	Day	LA10,adj – 65	63 - 76	11	6	-
I – Holiday Inn Residential	1	Day	LA10,adj – 62	62 – 72	12	7	n/a
	2	Day	LA10,adj – 62	63 – 72	10	5	n/a
	3	Day	LA10,adj – 62	62 – 71	9	4	-
	1	Night	LAmax,adj – 57	67 – 77	20	15	n/a
	2	Night	LAmax,adj – 57	68 – 77	20	15	n/a
	3	Night	LAmax,adj – 57	67 – 76	19	14	7

Note 1 – LA10,adj and LAmax,adj (night-time) assessment parameters applicable for non-steady state and intermittent noise sources. LAeq,adj assessment parameter applicable to steady state or continuous (night-time) noise sources.

Note 2 – Predicted noise levels include 3 m acoustic hoarding between noise sources and receivers.

The EIS identified that the predicted construction noise levels indicate that with provision for 3 m hoarding around each site (where practicable), day-time construction noise levels would still be exceeded by up to 15 dB(A). However, it is likely that facade noise reductions for newer-build residential buildings located within the CBD are substantially higher than the 10 dB(A) assumed for this assessment.

Further, the EIS identified that in the case of CRR construction works required in the city precinct (i.e. Roma Street Station and Albert Street Station), it may prove onerous to apply absolute noise goals in acoustic environments characterised by relatively constant high ambient noise levels. For example, ambient night-time noise levels measured over a week at monitoring location 6 (i.e. Parkland Crescent) ranged between 75 to 80 dBL_{Amax} and 59 to 63 dBL_{Aeq}.

The RfPC1 assessment conducted worst case construction noise predictions from the Roma Street Station worksite based on the inclusion of a 3m site hoarding at worksites. Predicted receiver noise levels are shown in Table 6. Note that at the time of the initial 2011 EIS, the supreme and magistrates court were not built and therefore the 2011 EIS did not include noise predictions at these locations.

Table 6: Predicted worst case construction noise levels (unmitigated) from the Roma Street Station worksite for RFPC1

Receptor	Predicted external construction noise levels $LA_{10,adj,15min}$		
	Scenario 1	Scenario 2	Scenario 3
H - Magistrates Court	45 - 62	37 - 56	45 - 61
I - Supreme & District Courts	63 - 70	54 - 64	61 - 72
J - Roma Street Station Hotel (Hotel Jen)	52 - 58	48 - 51	52 - 56
K - Roma Street Station Commercial Building (including BTC East Tower).	59 - 85	56 - 74	58 - 82

Table 7: Construction airborne noise goals from RFPC1

Receiver location/type	Monday to Saturday 6:30 am to 6:30 pm		Monday to Saturday 6:30 pm to 6:30 am, Sundays and Public Holidays	
	Steady state (dBA $LA_{eq,adj,15min}$)[1]	Non-steady state (dBA $LA_{10,adj,15min}$)[1]	Continuous (dBA $LA_{eq,adj,15min}$)[1]	Intermittent (dBA LA_{max})[1]
H – Magistrates Court	57	67	-	-
I - Supreme & District Courts	57	67	-	-
J - Roma Street Station Hotel (Hotel Jen)	67	77	57	64
K - Roma Street Station Commercial Building	67	77	-	-

The RfPC1 assessment also included the following summary of the changed construction noise impacts between the 2011 EIS and the RfPC1 assessment (reproduced as Table 8 below):

Table 8 Summary of changed impacts between 2011 EIS and RfPC1 assessment

Construction worksite	**CRR 2011**	**RfPC1**	**Change in construction noise and / or vibration impacts (with mitigation) from RfPC1**
Roma Street Station (refer to Appendix E2 for detailed assessment results)	North of BTC, traversing below existing Roma Street Station.	Construction worksite now located on the site of the existing BTC (West Tower) and coach terminal.	For RfPC1, new properties predicted to be affected by exceedances of the daytime construction noise goals are: Roma Street (Abbey Apartments) residential receptors (up to 7 dBA); Queensland Police Headquarters and Watch House (up to 7 dBA). The night-time construction noise goals would also be exceeded at these receptor locations if works were undertaken during these times. Due to the location of the Roma Street Station worksite, the Roma Street Station Hotel (i.e. Hotel Jen) is now predicted to comply with the airborne noise criteria, which is a reduced impact from CRR 2011. Due to the removal of the CRR 2011 worksite adjacent to Parkland Boulevard, residential receptors in the Parkland Boulevard apartment building are now predicted to comply with the daytime airborne noise goals, which is a reduced impact from CRR 2011. Exceedance of the internal ground-borne noise goals is predicted for RfPC1 during station shaft/cavern excavation for: Roma Street Station building (up to 2 dBA);

Construction worksite	CRR 2011	RfPC1	Change in construction noise and / or vibration impacts (with mitigation) from RfPC1
			Roma Street commercial buildings (including BTC (East Tower)) (by 1 dBA); The Abbey Apartments on Roma Street (up to 10 dBA). Overall, the detailed assessment has identified an increase in ground-borne noise impacts compared with CRR 2011. The increase in predicted impacts is due to the new location of the station cavern and shaft.

3 Material Changes to Impacts

3.1 Assessment Methodology

For the purposes of identifying the risk of change from previously approved works adjacent to Roma Street Station, a comparison has been made between previously approved construction activities and those that are likely to occur under the proposal to demolish Hotel Jen and the BTC (East Tower) for RfPC3.

These comparisons also consider the relative distance of the proposed and previously approved activities as part of the identification of risk of change in noise impact.

Screening calculations of typical noise from demolition activities have been conducted to inform the expected noise and vibration impacts from the proposed change. As the closest receivers to the RfPC3 works are in close proximity and have line-of-sight to the worksite, spreadsheet-based calculations of noise propagation from source to receiver have been conducted, since screening or multiple reflections are not significant factors for the worst-affected receivers. Prior to demolition works, more-detailed predictions using a computer noise model should be conducted to predict the extent of impacts at more-distant receivers and to inform the production of a Construction Noise and Vibration Management Plan for the works.

3.2 Results and Discussion

At this early stage in the development of the design, the details of proposed demolition requirements have not been established. Therefore, for the purposes of the noise assessment, the key activities for the proposed demolition works have been modelled as follows:

- **Site establishment works** consisting of clearing of the site adjacent to Hotel Jen, earthworks, construction of a hard stand, fencing and hoarding. For noise and vibration emissions, this stage consists of two main activities: earthworks (involving use of excavators etc) and construction of the hardstand (involving concreting works).

- **Internal demolition works** (soft strip-out works within the buildings). This stage will be conducted within the retained façade of the buildings and is not considered to be significant for external noise or vibration impacts. No further assessment of this activity has been conducted.
- **Building demolition** works involving removal of the building structures. The proposed demolition methodology involves demolishing the buildings from the "inside out" – i.e. retaining the building façade as long as possible so that the façade can act as a noise barrier and shield surrounding receivers from some of the noise from demolition. However, the final stages of demolition would involve removal of the external building areas and therefore the worst case scenario for these works is for activities occurring with noise emission directly to atmosphere. Major noise and vibration sources during this stage include noise from breaking, cutting, sawing etc of the building structure and impact noise from debris falling from height.
- **Stockpile management** works involving collection of building debris and sorting into stockpiles via use of a tracked excavator or bobcat, loading material onto haul trucks and haul truck movements to remove the material from site.
- **Ground remediation** works involving levelling of the site and compaction of fill. Noise and vibration sources from this activity include mechanised equipment such as excavators etc, and compaction works which may result in high vibration levels depending on the adopted methodology (e.g. dynamic compaction or vibratory compaction).
- **Finishing works** involving construction of new drainage infrastructure. Noise and vibration sources from this activity will be similar to the site establishment works however the source location for these works may be closer to some receivers.

The demolition works will occur over a seven-month period commencing in Q3 2019 and being completed by Q1 2020.

The closest noise and vibration receivers to the proposed demolition works are (in increasing order of distance):

- Queen Elizabeth II Courts of Law (Supreme and District Courts), located approximately 40 m across Roma Street
- Abbey Apartments located approximately 60 m to the west
- Magistrates Court, located approximately 100 m to the south-east
- Meriton Apartments Herschel Street located approximately 110 m to the south
- Residential and healthcare buildings (including Brisbane Private hospital) located on Wickham Terrace approximately 200 m to the north-east.
- Pullman King George Square hotel located approximately 220 m to the south-east
- Parklands Apartments located approximately 225 m to the north-west

Compared to the demolition works approved as part of the EIS and RfPC1, the proposed demolition works of Hotel Jen and the BTC (East Tower) are closer to most sensitive receivers, with the exception of Abbey Apartments and Parklands Apartments. Noise and vibration impacts from demolition are therefore likely to be greater at the majority of receivers, but would be decreased compared to the EIS assessment for Abbey Apartments and for Parklands Apartments.

Noise generating activities will be undertaken during standard construction hours, being 6.30am to 6.30pm Monday to Saturday. No works will be undertaken during public holidays. Additional extended work hours may be required for activities which may potentially cause unnecessarily impacts to traffic or pedestrian movement. These works will be undertaken in such a way as to stay within the noise and dust Project goals established in the existing conditions.

3.2.1 Construction Noise

The project noise goals are given by Condition 11 of the Coordinator General's Report. Table 2 specifies internal construction noise goals during standard hours that are based on the background noise levels specified for various building usages in Australian Standard AS2107:2016 *Acoustics – Recommended design sound levels and reverberation times for building interiors*:

- The noise goal for continuous construction noise is a $L_{Aeq,adj,1hr}$ noise level equal to the maximum design sound level from AS2107.
- The noise goal for intermittent construction noise is a $L_{A10,adj,15min}$ noise level equal to the maximum design sound level from AS2107 plus 10 dB.

Internal noise levels have been predicted assuming a sealed façade with 6|12|6 double glazing (approximately R_w 33) for the Supreme Court and Magistrates Court, an operable façade with 6 mm glazing (approximately R_w 30) for all residential/hotel/hospital receivers, and a façade performance of 4 mm poorly-sealed glazing (approximately R_w 25) for places of worship. A room volume of 600 m³ and a mid-frequency reverberation time (RT) of 1.0 s was assumed for courtrooms, a room volume of 60 m³ and a RT of 0.5 s for residential or healthcare receivers (impacts on a bedroom or hospital private room), and a room volume of 3000 m³ and a RT of 2.5 s for places of worship.

Noise levels from the demolition works have been predicted for the following scenarios (Table 9). Source levels have been obtained from British Standard BS 5228.1 (2009) and Australian Standard AS2436 (2010) *Guide to noise and vibration control on construction, demolition and maintenance.*

Table 9 Noise prediction scenarios, RFPC3 demolition

Activity	**Construction Equipment/ Activities**	**Activity Adjusted Sound Power Level, L_{WA}**
Site Establishment – Earthworks	Excavators Haul/Dump Trucks Dozers	114 dB(A)
Site Establishment – Hardstand Construction	Concreting Mobile Crane Poker Vibrator	110 dB
Demolition of Hotel Jen and BTC (East Tower)	Breaking Concrete Cutting Steel Breaking Windows/Partitions Crushing Rubble Mobile Crane	121 dB
Stockpile Management	Excavator (Spreading Rubble) Loading Dump Truck Haul Truck Movements (On Site)	119 dB
Ground Remediation	Dozers Rollers Vibratory Compactor	111 dB
Finishing Works	Concreting Excavators Poker Vibrator	110 dB

Preliminary screening calculations indicate the following ranges of demolition noise levels at receivers (Table 10). The ranges are presented to account for variation in the noise source position across the site, and (for receivers located more than ~100 m from the works) the effect of meteorological effects such as wind which can affect long-distance sound propagation.

Activities that would exceed the noise goals (based on the highest predicted level) are highlighted in **orange**. Activities exceeding the noise goals by more than 20 dB are highlighted in **red**.

Table 10 Preliminary assessment of construction noise levels (Internal), proposed RfPC 3 demolition

Receiver	Noise Goal (Intermittent)	Site Establishment-Excavation	Site Establishment-Construction of Hardstand	Building Demolition	Stockpile Management	Ground Remediation	Finishing Works
Supreme Court	45 dB(A)	**49-56 dB(A)**	**45-52 dB(A)**	**46-60 dB(A)**	**43-57 dB(A)**	**35-50 dB(A)**	**41-55 dB(A)**
Magistrates Court	45 dB(A)	**38-46 dB(A)**	40-43 dB(A)	**38-50 dB(A)**	**36-46 dB(A)**	28-38 dB(A)	32-44 dB(A)
Abbey Apartments	50 dB(A)	40-47 dB(A)	36-43 dB(A)	**46-58 dB(A)**	**42-55 dB(A)**	35-48 dB(A)	41-49 dB(A)
Meriton Apartments	50 dB(A)	38-47 dB(A)	34-43 dB(A)	**43-53 dB(A)**	33-50 dB(A)	33-42 dB(A)	35-44 dB(A)
Pullman King George Square	50 dB(A)	32-42 dB(A)	28-38 dB(A)	32-46 dB(A)	31-45 dB(A)	23-37 dB(A)	26-40 dB(A)
Albert Street Uniting Church	50 dB(A)	32-44 dB(A)	29-39 dB(A)	33-48 dB(A)	31-46 dB(A)	24-38 dB(A)	26-40 dB(A)
Parklands Apartments	50 dB(A)	26-38 dB(A)	22-33 dB(A)	32-45 dB(A)	29-44 dB(A)	22-36 dB(A)	24-37 dB(A)
Brisbane Private Hospital	50 dB(A)	29-39 dB(A)	25-35 dB(A)	31-44 dB(A)	22-43 dB(A)	22-35 dB(A)	24-35 dB(A)
Wickham Terrace Residential	50 dB(A)	29-39 dB(A)	25-35 dB(A)	31-44 dB(A)	22-43 dB(A)	22-35 dB(A)	24-35 dB(A)
Liberal Catholic Church	50 dB(A)	30-41 dB(A)	27-37 dB(A)	31-46 dB(A)	30-44 dB(A)	24-37 dB(A)	25-37 dB(A)

The proposed RfPC3 demolition is likely to result in noise levels that exceed the CG requirements by up to 15 dB at the worst-affected receiver (Brisbane Supreme Court) and up to 8 dB at the worst-affected residential receiver (Abbey Apartments).

This means that all "practical and feasible" noise mitigation measures should be incorporated into the planning of the demolition activities. Exceedances of the CG noise goals are predicted to only occur for receivers in the vicinity of Roma Street / George Street – i.e. the Supreme Court, Magistrates Court and residential receivers such as Abbey Apartments and Meriton Apartments.

However, no location is predicted to experience noise levels more than 20 dB above the relevant noise goals, and therefore specific consultation with Directly Affected Persons is not required according to the CG Requirements.

3.2.2 Change in noise levels compared to RfPC1 approved works

It is also relevant to compare the increase in noise levels for RfPC3 compared to the approved demolition works under the EIS and RfPC1 (i.e. demolition of the BTC (West Tower) only). Due to the closer distance of the RfPC3 works to some receivers, noise levels (assuming the same activity sound power) would change as follows (compared to RfPC1 works):

- Supreme Court +9.5 dB
- Magistrates Court +4.7 dB
- Abbey Apartments -1.6 dB
- Meriton Apartments +1.6 dB
- Parklands Apartments -4.7 dB
- Pullman King George Square +3.3 dB
- Wickham Terrace receivers +2.2 dB

In general, the impacts from RfPC3 will be greater for nearby receivers due to the closer location of the demolition works. In particular, the impacts to the Supreme Court will increase significantly, which will likely require stakeholder consultation.

However, for some receivers (e.g. Abbey Apartments and Parklands Apartments) the RfPC3 works will be quieter than the approved RfPC1 works because the source location is further away.

An increase of noise level of less than 3 dB would typically be considered negligible. Increases of up to 5 dB would be considered a minor increase, with increases of up to 10 dB being considered a moderate increase. As such, the increase in noise levels from RfPC3 compared to the approved RfPC1 works would be best characterised as moderate for the worst-affected receiver, and at most minor for other receivers.

Mitigation measures for demolition noise will be limited in scope due to the elevated nature of the noise source and/or receiver for many scenarios. This will limit the effectiveness of the use of hoardings etc as noise barriers during demolition, although for entirely ground-based activities such as site clearing and finishing works temporary hoardings may be effective for some receivers.

Scheduling the demolition sequence to be "inside out" wherever possible to allow the building façade to provide partial screening of demolition activities would assist in reducing the duration of the worst-case impacts from demolition, although demolition of the external façade will necessarily involve works being conducted in the open.

Substitution of noisy demolition practices with quieter ones – e.g. using saw-cutting in place of breaking – may assist in reducing the noise impact from demolition. Avoiding the requirement to break glass in removal of the façade where possible will reduce noise levels, e.g. by removing glass as complete panes.

However, the effect of any proposed substitutions on the demolition program should also be assessed, as it may be preferable for surrounding receivers to accept a shorter demolition period using noisier methods than a more prolonged period using quieter methods, since impacts are likely to occur from any demolition activities regardless of method.

Materials handling will be an important part of managing noise impacts from demolition. Avoiding the need to drop materials from heights will reduce impact noise and vibration, e.g. by collecting materials in skips on each floor and then craning the skips down to ground when full. If unavoidable, the use of chutes (which could be treated with vibration-damping resilient materials to reduce secondary noise generation from materials sliding down the chute) would reduce the loudness of impact noise from materials being dropped. Bins and receptacles should be lined with resilient materials to reduce noise from materials being loaded.

3.2.3 Construction Traffic Noise

The proposed traffic movements from RfPC3 are approximately 2 vehicles per hour (possibly up to 4 as a worst case scenario) and are therefore less than the RfPC1 movements. The cumulative construction traffic movements from RfPC1 and RfPC3 (assuming that movements occur simultaneously) is still lower than the approved construction movements from the 2011 EIS.

As noted in the technical report for RfPC1, because the EIS traffic volumes complied with the noise criteria for construction traffic, the cumulative construction traffic from RfPC1 and RfPC3 would also comply with the noise criteria.

Hence, no traffic noise impacts are anticipated from RfPC3.

3.2.4 Construction Vibration

The project construction vibration goals are provided in Table 3 of the CG Change Report, and fall into three categories:

- Human comfort criteria based on the curves in Australian Standard AS2670.2 (1990) *Evaluation of human exposure to whole-body vibration. Part 2: Continuous and shock-induced vibration in buildings*.
- Building damage criteria based on British Standard BS 7385.2 (1993) *Evaluation and measurement of vibration in buildings. Part 2: Guide to damage levels from groundborne vibration*.
- Threshold values for consultation with Directly Affected Persons and provision of respite periods.

Courtrooms have been assessed as having the sensitivity of office buildings to vibration (a multiplier of 4 for daytime to the AS2670.2 base curves). Hospital buildings have been assessed as having residential sensitivity (a multiplier of 2 for daytime to the AS2670.2 base curves) however the propagation distance to the nearest healthcare building is such that vibration impacts would be negligible. Impacts would only be expected for the closest receivers on Roma Street / George Street.

Note that the criteria curves for both human comfort and building damage include different values at different frequencies. As a conservative approach, the lowest curve value at any frequency has been adopted as the target.

The applicable vibration goals (peak particle velocity) are as follows (most stringent value from curve):

- Human comfort
  - Residential 0.2 mm/s
  - Courtrooms 0.4 mm/s
- Threshold for consultation (all receivers) 10 mm/s
- Building damage
  - Heritage buildings 2 mm/s
  - Residential 15 mm/s
  - Courtrooms 50 mm/s

3.2.4.1 Prediction of Demolition Vibration

Screening calculations for items of construction plant have been conducted based on the information for demolition from Skipp and Buckley[1], Wiss[2] and Skipp[3]; information for general construction activity from Hiller and Crabb[4] and from Wiss[2]. Some prediction methods provide for a range of predicted levels in which case the upper bound vibration levels have been assumed at this stage – i.e. the assessment is deliberately conservative.

Propagation of vibration has been modelled using the Rahman-Orr equation[5] which accounts for both geometric spreading of vibration through the ground and also for internal losses within the propagation medium. In the absence of detailed geotechnical investigations values for soil of wave speed 1500 m/s and a material damping coefficient of 0.1 have been assumed for propagation.

Site establishment and finishing works are expected to be relatively low-vibration works, with major vibration sources being from earthworks (excavators) and from concreting works (vibration of concrete using poker vibrators or similar).

Demolition is expected to be one of the most significant sources of vibration, with major vibration producing activities including cutting, sawing or breaking activities as well as vibration from physical impacts on the ground from demolition debris.

Impacts from demolition debris are proportional to the potential energy of the debris (i.e. the mass of the object and the height from which it is dropped). This is difficult to predict in advance without a detailed demolition plan. Accordingly, for impact vibration, the maximum energy permissible without exceeding the vibration goals has been calculated, and planning of the demolition sequence should control the size/height of any dropping of debris so that vibration impacts do not occur.

Site remediation works have the potential to be high vibration works, depending on the adopted methodology for ground compaction.

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1 Skipp BO and Buckley JS (1977) *Ground vibration from impact* 9th International Conference on Soil Mechanics and Foundation Engineering, Tokyo Vol 2 pp397-400

2 Wiss JF (1981) *Construction vibrations: state of the art* ASCE Journal of the Geotechnical Engineering Division, Vol 107 No GT2, pp 167-181

3 Skipp BO (1984) *Dynamic ground movements – man made vibrations* Ground Movements and their Effects on Structures ed.s Attewell PB and Taylor RK pp381-434

4 Hiller DM and Crabb GI (2000) G*roundborne vibration from mechanised construction works*. Transport Research Laboratory Report 429.

5 Orr T L L and Rahman ME (undated) *Prediction of ground vibrations due to tunnelling*

Preliminary screening calculations indicate the following ranges of demolition vibration levels at receivers (Table 11). The ranges are presented to account for variation in the source position across the site.

Note that vibration from impacts of debris is assessed separately via calculation of the maximum impact energy at which the criteria are complied with.

Activities below the human threshold of perception of vibration (approx. 0.1 mm/s) are shown as "**<0.1 mm/s**". Activities that would exceed the human comfort goals (based on the highest predicted level) are highlighted in **orange**. Activities that would exceed the threshold values of 10 mm/s for community consultation CG requirements are highlighted in **purple**. Activities exceeding the building damage goals are highlighted in **red**.

Table 11 Preliminary assessment of vibration levels (mm/s PPV), RfPC3

Receiver	**Earthworks**		**Concreting**	**Demolition**			**Ground Remediation**
	Excavators	**Dozers**	**Poker Compactor**	**Metal Cutting**	**Mobile Crane**	**Concrete Breaker**	**Vibratory Compaction**
Supreme Court	<0.1-0.12 mm/s	<0.1-0.23 mm/s	**< 0.1 mm/s**	**< 0.1 mm/s**	<0.1-0.12 mm/s	<0.1-0.24 mm/s	**0.1-3.33 mm/s**
Magistrates Court	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**
Abbey Apartments	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	<0.1-0.19 mm/s
King George Chambers	**< 0.1 mm/s**	<0.1-0.16 mm/s	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	<0.1-0.16 mm/s	**<0.1-2.75 mm/s**
Roma Street Station Heritage Building	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	<0.1-1.90 mm/s*
Transcontinental Hotel	**< 0.1 mm/s**	<0.1-0.16 mm/s	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	<0.1-0.16 mm/s	**<0.1-2.75 mm/s**
McDonnell and East Co Building	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	<0.1-0.25 mm/s
Former Bank of Queensland	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**<0.1-1.1 mm/s**
Meriton Apartments	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**	**< 0.1 mm/s**

Receiver	Earthworks		Concreting	Demolition			Ground Remediation
	Excavators	Dozers	Poker Compactor	Metal Cutting	Mobile Crane	Concrete Breaker	Vibratory Compaction
Baby Clinic (Former)	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	<0.1-0.5 mm/s
Pullman King George Square	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s
Parklands Apartments	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s
Brisbane Private Hospital	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s	< 0.1 mm/s

*Note that Roma Street Station (Heritage Building) is not considered a vibration sensitive receiver for human comfort, only for building damage.

Maximum impact energy values for demolition works are as follows:

- Human comfort criteria 117.3 kJ (most sensitive receiver Supreme Court)
- Threshold of consultation 4.25 MJ
- Building damage 1.5 MJ (most sensitive receiver King George Chambers)

Activities that may potentially result in vibration impacts are therefore demolition (impact vibration) depending on the size and height from which debris is dropped, and ground remediation, depending on the adopted method of ground compaction.

Management of vibration impacts from demolition should be achieved by controlling the size of demolished sections of the façade such that material dropped from height does not exceed the potential energy (and hence impact energy) figures calculated above.

Ground remediation works requiring dynamic compaction or vibratory compaction could result in high ground vibration levels that may exceed human comfort criteria or building damage criteria.

Building damage impacts are predicted to be possible based on the maximum predicted values however it is important to note that the predicted maximum values are extremely conservative. The Transport Research Laboratory Report 429 (TRL 429), *Groundborne Vibration Caused by Mechanised Works prepared for Quality Services – Civil Engineering*, Highways Agency by Dr D M Hiller and GI Crabb and published in 2000 cites that there is a 5% chance of exceedance predicted for the largest vibratory compactor size for which the TRL429 prediction methodology is valid. Selection of a smaller vibratory compactor would therefore result in significantly lower vibration levels and therefore via a mitigation measure of appropriate equipment selection, building damage impacts should be able to be eliminated via design of the demolition sequence.

Should dynamic or vibratory compaction for ground remediation be required, a more-detailed vibration assessment should be conducted prior to works being carried out. The predicted vibration levels in this assessment are deliberately conservative, and therefore selection of smaller equipment may allow these activities to be conducted without causing impacts.

4 Recommendations and Conclusion

- The proposed demolition of the BTC (East Tower) and Hotel Jen has been reviewed for noise impacts and subject to assumptions about the scale and type of activities required is considered to result in a moderate increase compared to the noise levels previously approved under the EIS and RfPC1. Noise impacts to the Supreme Court and Magistrates Court are predicted for most activities, with impacts to surrounding residences also occurring for louder activities.
- The proposed traffic associated with the demolition works has also been compared against DTMR Road Traffic Noise criteria. Traffic volumes arising from the demolition activities would be compliant with noise limits.
- Vibration impacts from RFPC3 works would result in negligible vibration levels except for impact vibration from demolition and (depending on the adopted methodology) ground remediation. Control of the size of material dropped from heights and the selection of smaller equipment for ground remediation will be important to reduce vibration impacts.

Technical Note

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Project title	Cross River Rail Delivery Authority	Job number	246209
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Prepared by		Date	15 November 2018
Subject	Cross River Rail Request for Project Change 3 – Traffic Assessment Technical Note		

1 Introduction

The 2011 EIS for CRR contained a construction site to the east and west of Parkland Boulevard/Parkland Crescent, east of Hotel Jen (refer to Figure 1). The subsequently approved 2017 Request for Project Change (RfPC-1) realigned the station and CRR route, relocating and expanding the construction site to the north of Parkland Crescent and Hotel Jen (refer to Figure 2). RfPC-2 (June 2018) addressed the temporary solution for the relocation of the Roma Street Coach Terminal (refer to Figure 2).

The subject of RfPC-3 is to consider the demolition of the Brisbane Transit Centre (BTC) (East Tower) and Hotel Jen (refer to Figure 3). This work required as part of RfPC-3 involves new property impacts, and additional demolition works not previously assessed.

The demolition will occur over a 7-month period. Buildings within Lot 1 on SP207220 are proposed to be demolished sequentially with Hotel Jen and BTC (East Tower) first, followed by the Podium and BTC (West Tower). The temporary utilisation of the adjacent open space park is proposed for demolition access and worksite. The additional demolition work will occur before construction of the CRR Project, as part of the required early works. The construction of the temporary Roma Street Coach Terminal is unlikely to overlap with the demolition of Hotel Jen and the BTC (East Tower).

The purpose of this technical note is to review the EIS, the RFPC-1 and the RfPC-2 traffic-related approved works and impacts and compare these with the works and impacts associated with the RfPC-3 works. The key aspects addressed in the EIS traffic technical report included strategic transport impacts and benefits, local transport impacts during project operations, and construction transport impacts for the CRR project. This technical note pertains specifically to the traffic (including pedestrians, cyclists and bus) impacts to at Roma Street and the surrounds during the demolition works of the BTC (East Tower) and Hotel Jen.

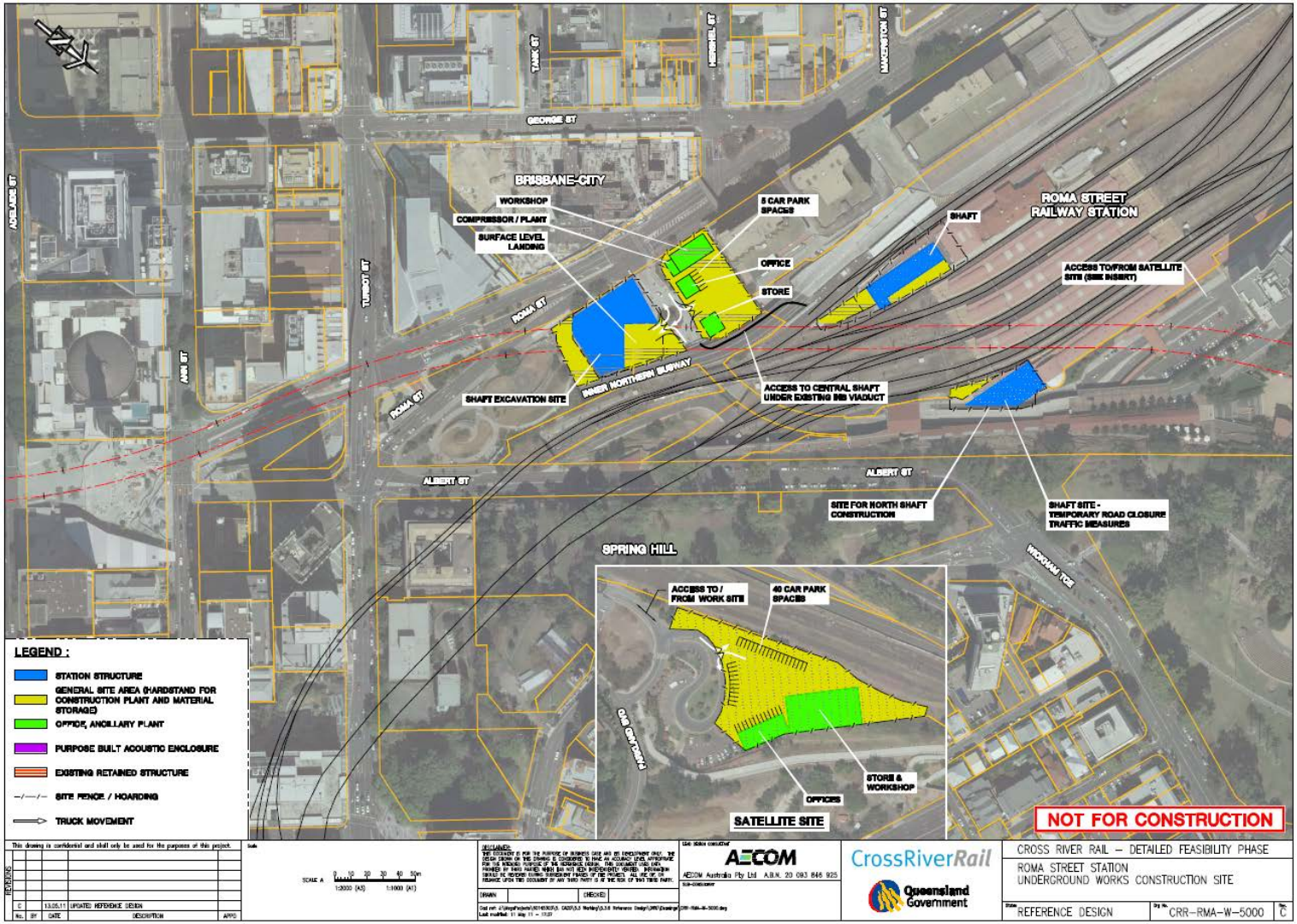


Figure 1: 2011 EIS construction site – Roma Street

Technical Note

246209 15 November 2018

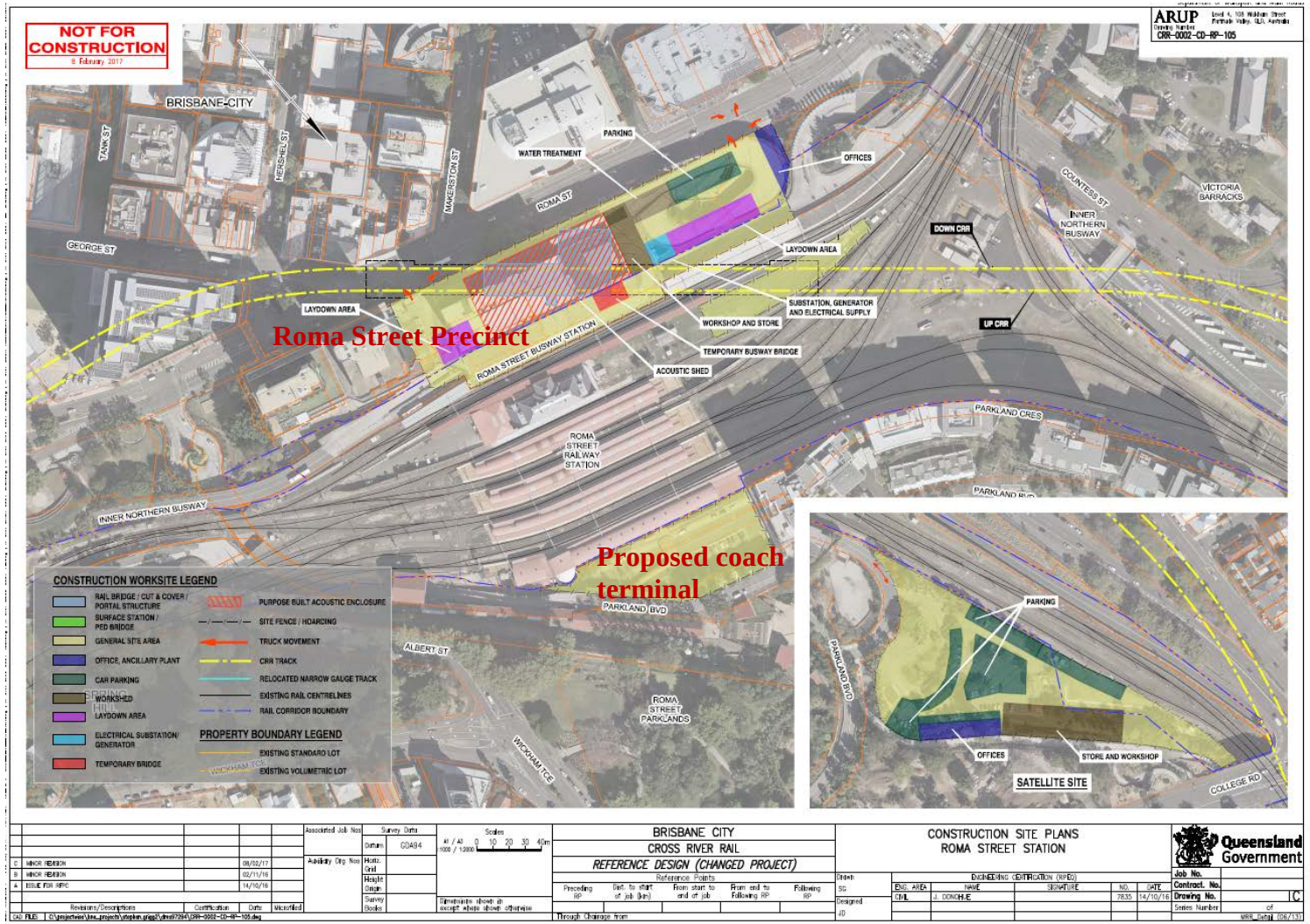


Figure 2: 2017 RfPC 1 construction site and RfPC 2 proposed coach terminal site

Figure 3: RfPC 3 proposed demolition works

2 CRR Project Approved Work and Impacts

The design progression of the sites relevant to this project is summarised in Table 1. The purpose of this technical note is to compare the impact of RfPC-3 against the previous reviews. Further detail regarding the changes included in each document are summarised further in the following pages.

Table 1: CRR Progression

Location	2011 EIS	2017 RfPC-1	2018 RfPC-2	2018 RfPC-3
Roma Street Station	Redeveloped but remains in the current location.	Relocates site approximately 150m to current BTC site.	As per 2017 RFPC-1	As per 2017 RFPC-1
Brisbane Transit Centre (including Coach Terminal)	No changes proposed.	Demolished as part of Roma Street relocation. Requires relocation of coach terminal (before demolition) and removal of ~600 car parking spaces.	As per 2017 RFPC-1	As per 2017 RFPC-1 but including demolition of the BTC (East Tower) and Hotel Jen and removal of ~190 car parking spaces.
Parkland Crescent Carpark Area	No changes proposed (however worksite proposed on the eastern end of the crescent).	Construction laydown area.	Proposed relocated coach terminal site.	As per 2018 RFPC-2
Parkland Boulevard	Permanent closure of roundabout immediately north of Roma Street. Alternative route via College Road / Gregory Terrace intersection.	No proposed changes to the roundabout or upper level.	No proposed changes to the roundabout. Upper level to be utilised for pick-up/drop-off (adjacent to escalators and café).	No road closure required.
Hotel Jen	No proposed changes.	No proposed changes.	No proposed changes.	Proposed demolition

2.2 2011 EIS

A summary of the identified impacts of the 2011 EIS is presented in Table 2.

Table 2 Construction impacts as per 2011 EIS

Mode	Construction impacts as per 2011 EIS
Vehicle Traffic	Closure of the roundabout on Parkland Boulevard (north of Roma Street) was identified as a permanent change but was brought forward to the construction stage. Closure of the westbound lane of Parkland Crescent, between Platform 10 and the Parkland Boulevard intersection. This is proposed to be managed by utilising the eastbound lane in a contraflow traffic arrangement, which would result in minor delays in accessing and egressing the station.
Car parking at Parkland Crescent	Car park to be retained.
Pick-up/drop-off at Parkland Crescent	Access to be retained.
Pedestrians	Worksite C would require the closure of the pedestrian footpath on the southern side of Parkland Crescent. A pedestrian detour would be required commencing at the Parkland Boulevard / Roma Street intersection and diverting pedestrians through Roma Street Station.
Cyclists	The worksite is not anticipated to impact cycle activity significantly, although cyclists will have to follow detours put in place for vehicles due to the closure of the westbound lane of Parkland Crescent.
Property Access	To be maintained. Possible minor diversions (and traffic control where required) in place at times.

2.3 2017 RfPC-1

A summary of the identified impacts of the 2017 RfPC-1 is presented in Table 3.

Table 3 Construction impacts as per 2017 RFPC-1

Mode	Construction impacts as per 2017 RFPC-1
Vehicle Traffic	As per 2011 EIS
Car parking at Parkland Crescent	Approval for the loss of the 32 car parks displaced by the worksite for the five-year construction period.
Pick-up/drop-off at Parkland Crescent	Not addressed. However, assume this would be impacted if the westbound lane of Parkland Crescent was required to be closed for construction.
Pedestrians	Potential for worksite to require the closure of the pedestrian footpath on the southern side of Parkland Crescent. If this is the case, it was proposed that a pedestrian detour would be provided.
Cyclists	The worksite is not anticipated to impact cycle activity, although cyclists will have to follow detours put in place for vehicles due to the closure of the westbound lane of Parkland Crescent.
Property Access	To be maintained. Possible minor diversions (and traffic control where required) in place at times.

2.4 2018 RfPC-2

A summary of the identified impacts of the 2018 RfPC-2 is presented in Table 4.

Table 4 Construction impacts as per 2018 RfPC-2

Mode	Construction impacts as per 2018 RfPC-2
Vehicle Traffic	No expected increase in general vehicle traffic volumes compared with existing. Access to Parkland Crescent is to be maintained at all times. Construction may require the occupation of some segments of the roadway adjacent to the site. Management of this closure may include implementing a contraflow traffic arrangement. Exact number of construction vehicles expected to be less than that from the 2017 RFPC-1
Car Parking at Parkland Crescent	All car parking removed to accommodate coach terminal. Relocation requirements not considered as part of this project.
Pick-up/drop-off at Parkland Crescent	Unconfirmed at this stage if existing facilities on Parkland Crescent will remain open during construction. If this is not the case, it is recommended that a pick-up/drop-off zone on Parkland Boulevard shall be provided before the commencement of construction on Parkland Crescent to maintain pick-up/drop off functionality of the area.
Pedestrians	Pedestrian access to be maintained at all times during construction. In some instances, this may involve detours and minor delays.
Cyclists	The worksite is not anticipated to impact cycle activity significantly, although cyclists will have to follow detours put in place for vehicles as a result of lane closures on Parkland Crescent. Impacts during construction expected to be similar to the schemes presented in the 2011 EIS and the 2017 RFPC.
Coaches	No impacts (existing coach terminal at BTC remains open during construction of new facilities).
Property Access	To be maintained. Possible minor diversions (and traffic control where required) in place at times.

3 Material changes to impacts

3.1 Site location

The changes to property impacts include:

- Increase of impact area to Lot 1 on SP207220 to include the entire lot and the demolition of Hotel Jen and the BTC (East Tower);
- Partial new impact area within Lot 60 on SP207215; and
- Lot 35 on SP207219 not previously impacted by the project.

Buildings within Lot 1 on SP207220 are proposed to be demolished sequentially with Hotel Jen and BTC (East Tower) first, followed by the Podium and BTC (West Tower). The property impact areas are shown in Figure 4.

Figure 4 Site location and property impact areas

3.2 Assessment methodology

The assessment undertaken to determine the traffic effects of demolition works includes:

- Review of traffic volumes added to Roma Street as a result of the heavy vehicles required movement in comparison with the baseline traffic flows;
- Swept path assessment of haulage trucks along Roma Street; and
- Review of potential changes to access for pedestrians and cyclists using Roma Street.

3.3 Traffic volume review

Demolition of the two buildings is expected to be completed within seven months. It is anticipated that approximately 90,000 tonnes of material will need to be removed from the site as per estimation of waste volume conducted by Arup (2018).

In areas of high pedestrian and cycle activity such as Roma Street, articulated or dog trailer vehicles could present a hazard to road users, due to the swept paths and vehicles tracking across kerbs at intersections, as well as road users failing to observe the trailer component of the vehicle when crossing the road. Therefore, it is suggested that the largest vehicle permitted would be the standard three axle semi-trailer which can carry up to 24 tonnes.

Based on approximate 31 working weeks within seven months, on a 12 hours / 6 days operation week as per approved working hours, it is anticipated that at least 500 tonnes of material can be removed from the site each day, which can be completed with approximately two vehicles per hour (or 4 movements per hour). To allow for possible restrictions during peak periods and unforeseen delays in the program, a total of approximately 4 vehicles per hour is adopted as the worst-case scenario.

It is noted that construction of the proposed coach terminal (refer to RfPC-2) estimated that a maximum of 3 construction vehicles are expected during peak hours. Although it is unlikely that construction vehicles of the two sites could overlap, in the event an overlap occurs, it is assumed that total vehicles will be below the estimated spoil haulage and delivery vehicles resulting from construction (at least ten heavy vehicles in peak hour)analysed in the worst-case scenario assessed in the 2011 EIS. Therefore, considering that this increase in volume would occur before the commencement of main CRR works, it is not expected to impact on the road network operation significantly.

3.4 Swept path analysis

The proposed routes identified in the 2011 EIS are assumed for this analysis, as per shown in Figure 5. It is noted that the truck routes shown represent one feasible way of routing trucks carrying spoil to and from the worksites. The contractor, in determining their Construction Traffic Management Plans, may propose other alternative routes. Heavy vehicle routes for the delivery of plant and materials are likely to have varied origins and destinations, and as such are expected to approach and depart the worksites using a variety of routes.

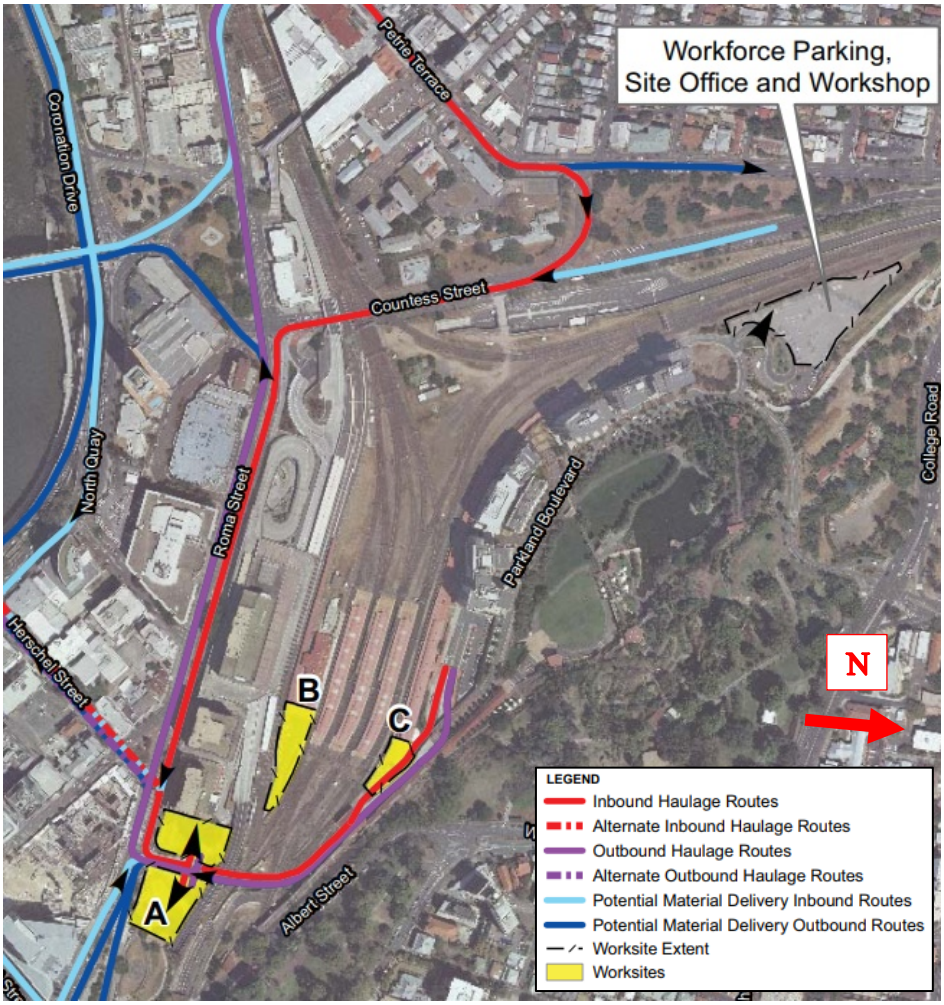


Figure 5 - Proposed haulage access routes as per 2011 EIS

Access to the worksite would be provided from Roma Street in two stages. Stage one would include the demolition of the BTC East Tower, during which vehicles would access from the northern leg of Roma Street (current access to the Hotel Jen) via Herschel Street and exit via Roma Street by using the adjacent open space park. Stage two would include the demolition of the Hotel Jen and would start once the BTC East Tower lot has been cleared, stage during which vehicles will access and exit via this lot. The proposed stages are shown in Figure 6.

Stage 1 – Demolition of BTC East Tower

Stage 2 - Demolition of Hotel Jen

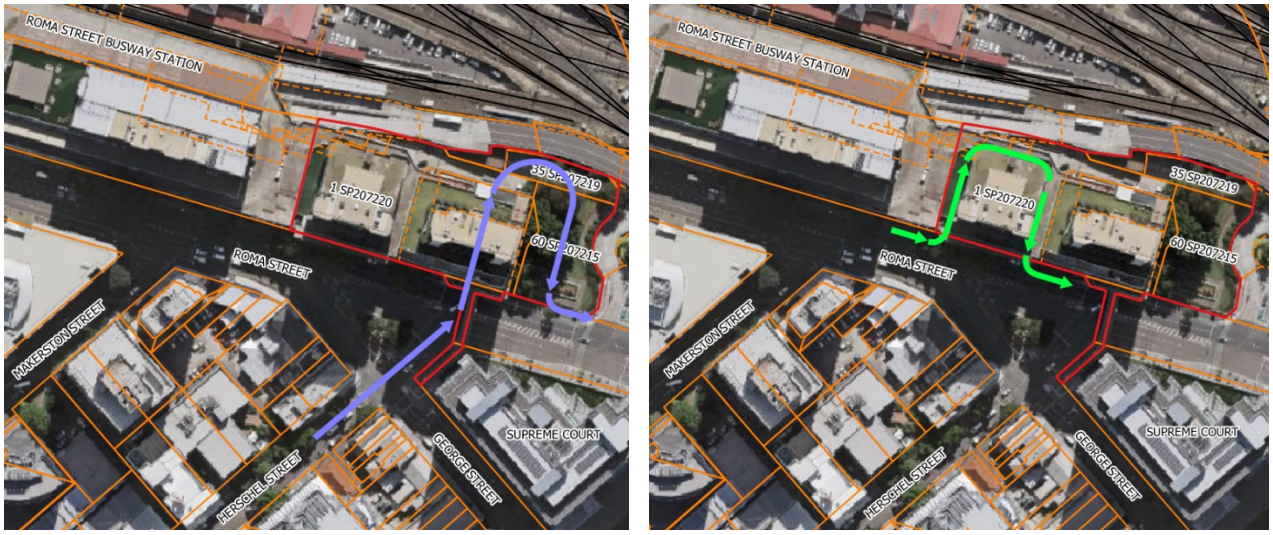


Figure 6 - Haulage access and exit points during demolition works

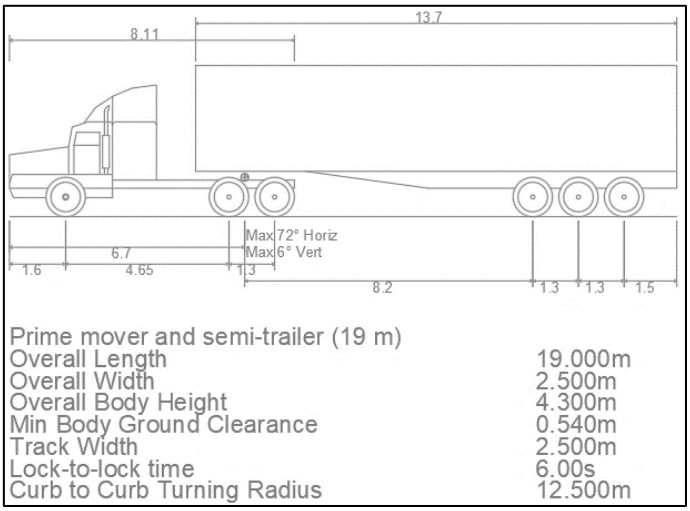


Figure 7 Common 3 axle semi-trailer profile

It is noted that the following analysis is based on aerial images given that a terrain survey was not available at the time of writing. Therefore, vehicle size and road dimensions utilised in this analysis are assumed to provide an approximate image of the scenario.

As shown in Figure 8, it is expected that a 19 meter 3 axle semitrailer would be able to enter and exit the site during stage one in a forward gear with 300mm clearance on either side of the vehicle. However, a semitrailer would not be able to maneuver in/out of the waiting bay should any other vehicle be located within its designated servicing area.

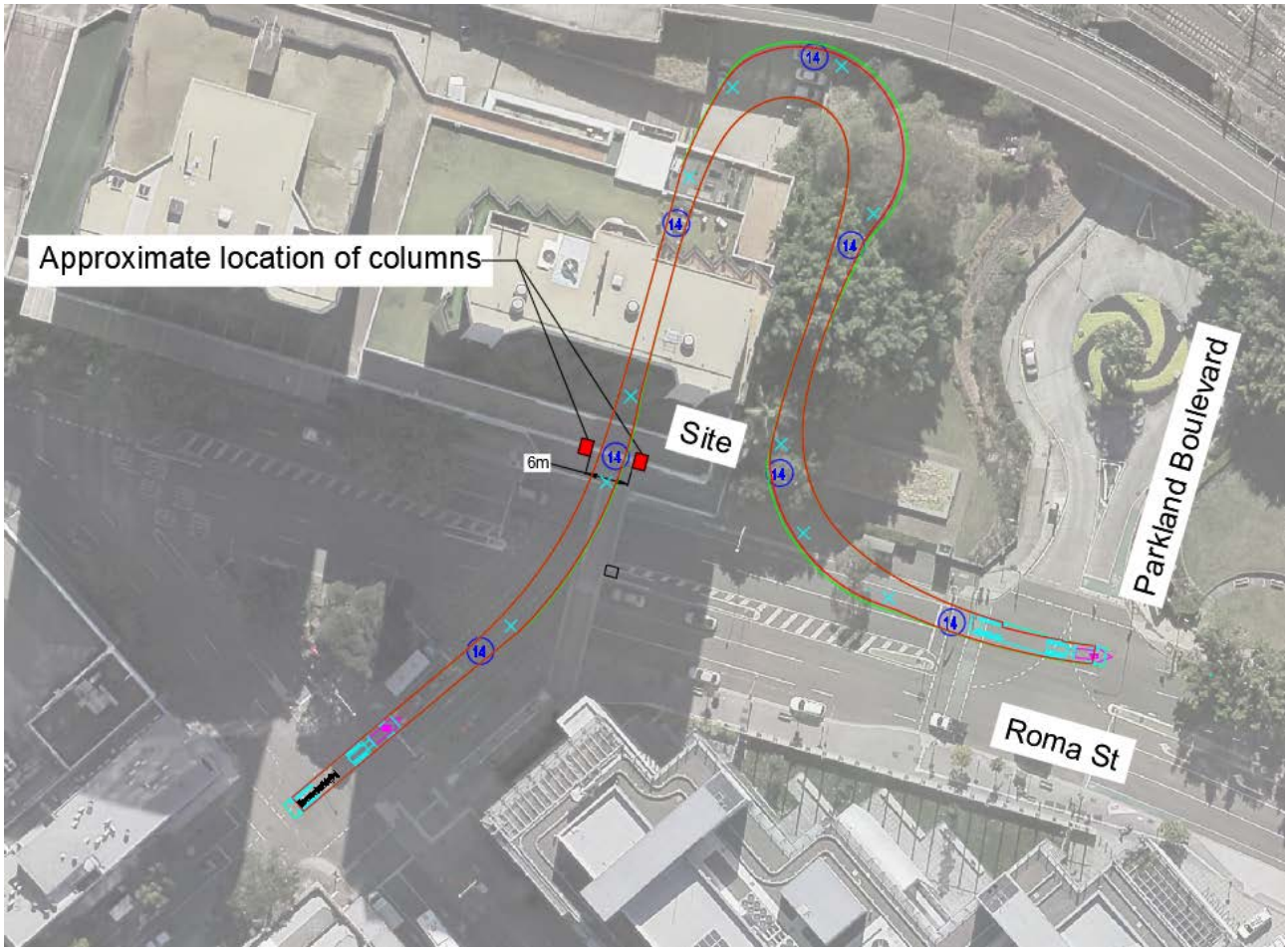


Figure 8 - Swept path analysis for Stage one – Forward in from Herschel Street

The swept path analysis also shows that accessing the site during stage two, eastbound from Roma Street, via a one-way in/one-way out setup adjacent to Roma Street is also possible by straddling the two lanes. Note that this operation is permitted under current Queensland road rules (Figure 9).

It is noted that height clearance through Hotel Jen is to be confirmed to ensure large heavy vehicles can access safely.

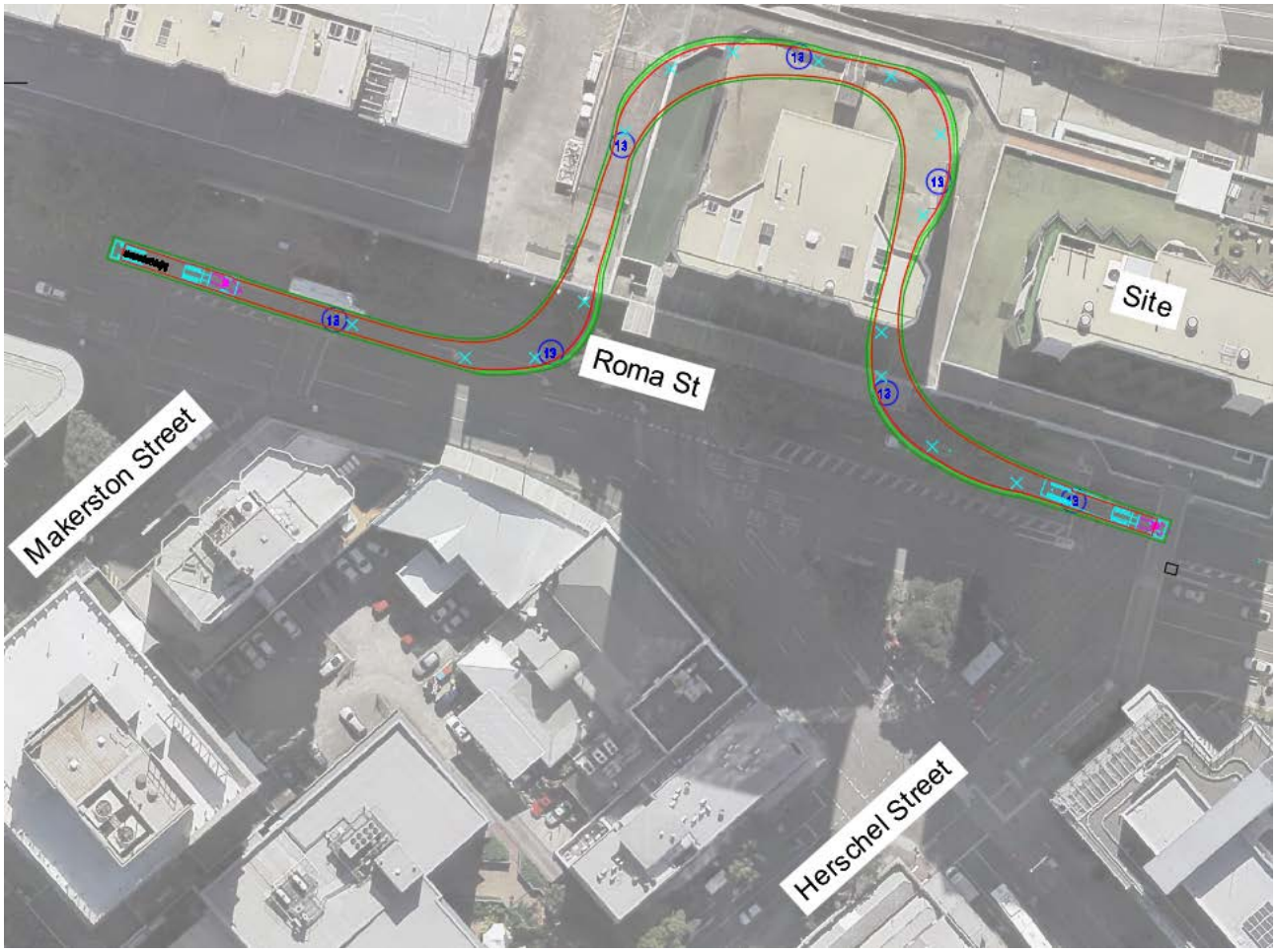


Figure 9 – Swept path analysis for Stage two – left in from Roma Street

Once the vehicle is loaded, exiting the site will also need to be controlled to mitigate the risk of an accident where Roma Street vehicular traffic could be involved.

Given that this analysis only provides a desktop review of the operation, it is recommended that the maneuver be confirmed with project stakeholders by completing a Road Safety audit to ensure that any impact on Roma Street is mitigated.

It is recommended to minimise heavy vehicle activity during peak times and assist the movement of heavy vehicles with traffic controllers to reduce disruption to the road network and ensure the safety of road users.

It is also noted that modifications to the grade of the adjacent open space park are required to ensure heavy vehicles can exit the site. The open park space is at a higher elevation from the road therefore some levelling will be required. Modifications to be confirmed in the construction phase once a survey of the site is completed.

3.5 Existing car parking spaces

Demolition of the BTC (East Tower) and Hotel Jen will include the loss of approximately 190 car parking spaces.

The existing BTC car park is principally used by tenants of the transit centre office buildings as well as some paid car parking for CBD commuters. With the demolition of the office buildings, there may be reduced car parking demand at Roma Street Station.

3.6 Pedestrian bridge

An existing pedestrian bridge at the Roma Street and Hershel Street intersection allows BTC customers to overpass Roma Street to and from the CBD. Due to the structural connection of the bridge to the Hotel Jen building, it is likely that the bridge will also be removed. Demolition works of the bridge will involve a temporary closure of Roma Street and the footpath along this section.

Therefore, a moderate impact to the road network is anticipated and is proposed to be controlled by completing the works during periods of lowest demand of traffic and pedestrians on the road network (i.e., Night hours). Mitigation plan to also include coordination with BCC and qualified traffic management controllers. Potential noise impacts from removal of the bridge will depend on the method of removal and may be minimal if the structure is removed by crane. The nearest noise sensitive receiver to the bridge is the supreme court, therefore removal outside of standard hours would likely mitigate impacts to this receiver. Noise during the demolition will be managed through the contractor's Noise and Vibration Management Plan.

3.7 Pedestrians

As per the 2011 EIS, it is anticipated that pedestrian and cyclist access to may be delayed or temporarily detoured during works. Modifications to normal operations caused by the work site will need to be included in the Traffic Management Plan expected to be completed for the works.

A significant number of pedestrians use the footpath on the northern side of Roma Street, adjacent to the site. It is projected that this footpath will remain open during demolition works, although the effective width of the footpath is likely to be reduced (i.e., by the installation of site fencing). Temporary disruptions to the flow of pedestrians will be coordinated by authorised traffic controllers if required, to ensure safety to users and demolition workers.

The existing bridge over the intersection of Roma Street and Herschel Street that caters for pedestrians in and out the BTC will most likely need to be removed due to its structural connection to the Hotel Jen building. Preliminary observations of the site suggest that a significant number of pedestrians frequent this bridge which provides a safe and effective linkage to and from the Brisbane CBD. The bridge location is shown in Figure 10.

In order to mitigate the impact of the loss of this pedestrian crossing, alternative crossing options will need to be provided. This will lead to a requirement for significant modifications to traffic signals at nearby intersections along Roma Street.

A SIDRA assessment of the Roma Street / Herschel Street intersection below the crossing has been undertaken based on a traffic count survey data collected on 15 March 2018 for AM and PM peak periods. In the analysis, it was assumed that to mitigate the impact of the closure of the subjective bridge, the Roma Street / Herschel Street intersection would be modified to provide signalised pedestrian crossing movements.

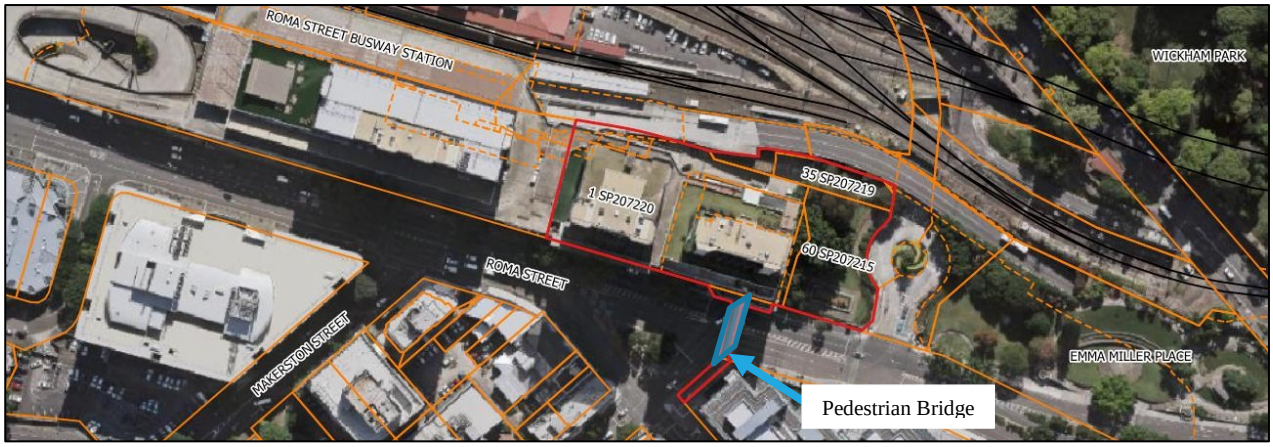


Figure 10 Pedestrian bridge location

3.7.1 SIDRA analysis

The intersection analysis was undertaken using the SIDRA Intersection 8.0 package. In order to quantify the intersection performance, the following performance measures have been reported:

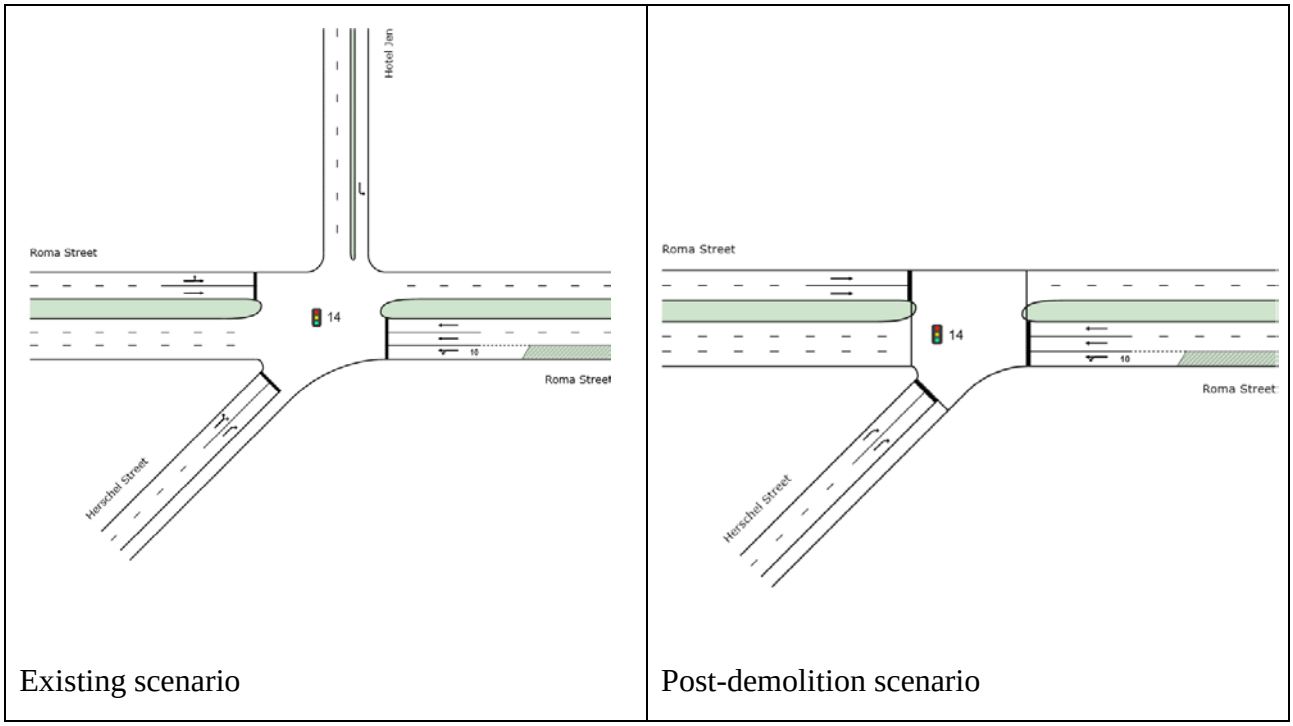
- Degree of Saturation (DOS) (%) –This is the ratio of demand flow to capacity. For a signalised intersection, the DOS should remain below 90%;
- Average Delay (sec) – The average delay per vehicle in seconds incurred by vehicles over the modelled time period;
- Level of Service (LOS) – An index of the operational performance of traffic on a given approach based on average delays; and
- 95th percentile Queue – A queue length measured in metres of which only 5% of queues are equal to or greater than.

3.7.2 Scenarios assessed

The Roma Street / Herschel Street intersection was assessed based on the following scenarios to effectively capture the anticipated impact from the demolition of the bridge:

- Base year 2018 – assess the intersection based on current (2018) traffic data for the AM and PM peak periods to demonstrate the current operational condition of the intersections.
- Post-demolition year 2019 – assess the intersection, assuming pedestrians will cross at the intersection at-grade. Due to the very high pedestrian demand demonstrated in the traffic count data, a scramble crossing arrangement has been assumed in the analysis to maximise the ability for pedestrians to cross. This scenario does not consider any growth in traffic as demolition is scheduled to start in early 2019. No additional impacts generated by other stages of the wider CRR project or other projects have been considered.

Layouts showing the two scenarios are presented in Figure 11 for reference.



Existing scenario

Post-demolition scenario

Figure 11 Scenarios layout

3.7.3 Assumptions and limitations

The following assumptions were incorporated into this analysis:

- Considering the CBD location of this intersection, an Area Type Factor of 0.9 has been incorporated into the SIDRA analysis to account for the effects of the operating environment;
- It is assumed at this stage that pedestrians will continue to travel to and from the BTC after demolition; and
- Thursday is assumed to be the peak day of the week based on previous surveys conducted in the CBD. Traffic data was collected on Thursday 15 March 2018.

3.7.4 Traffic volumes

Results of the survey used for the SIDRA analysis for light vehicles and heavy vehicles are provided in Figure 12 and Figure 13 respectively. The number of pedestrians currently using the bridge in peak hours is also shown on the right-hand side of the figures.

Technical Note

246209 15 November 2018

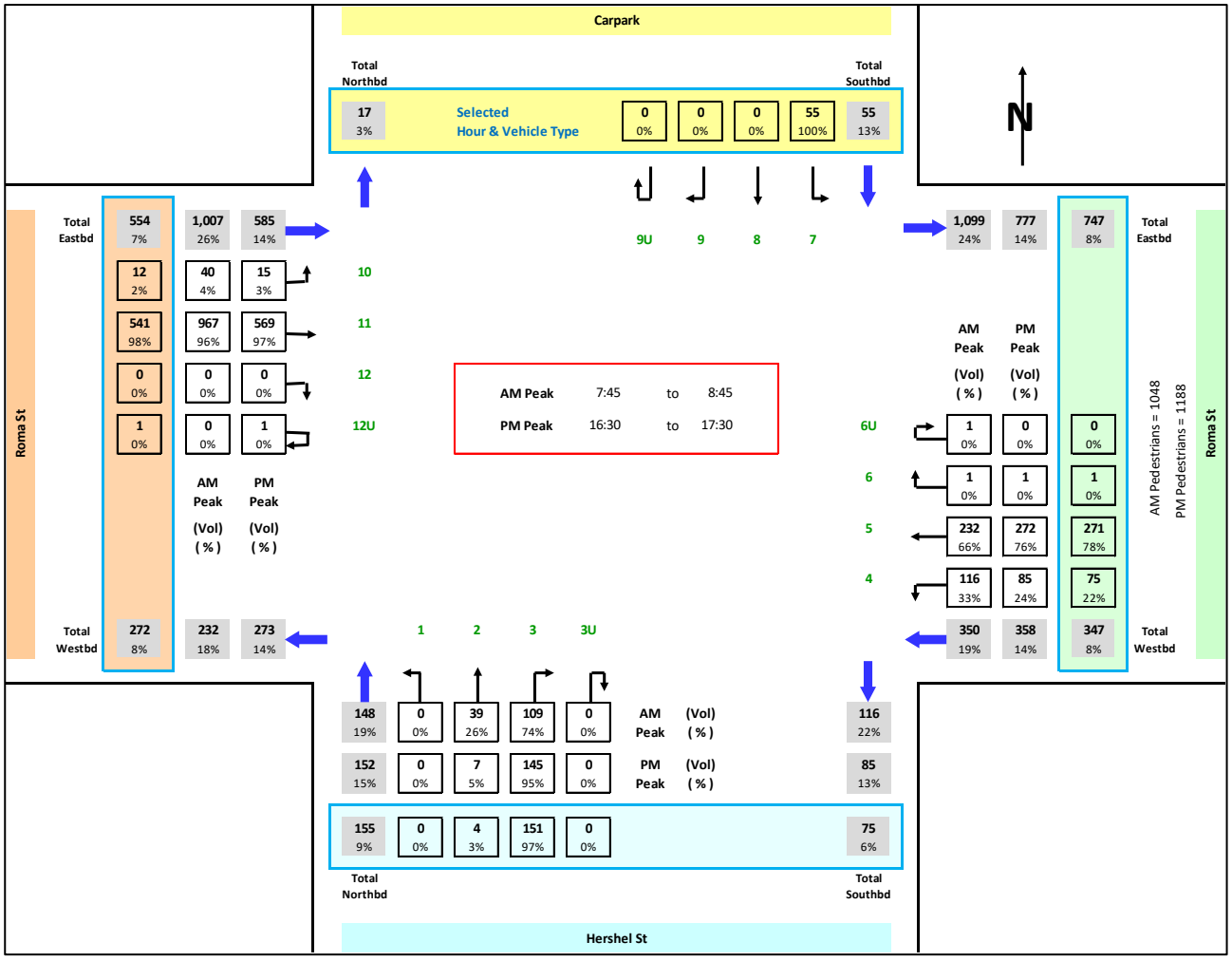


Figure 12 Traffic survey results - light vehicles

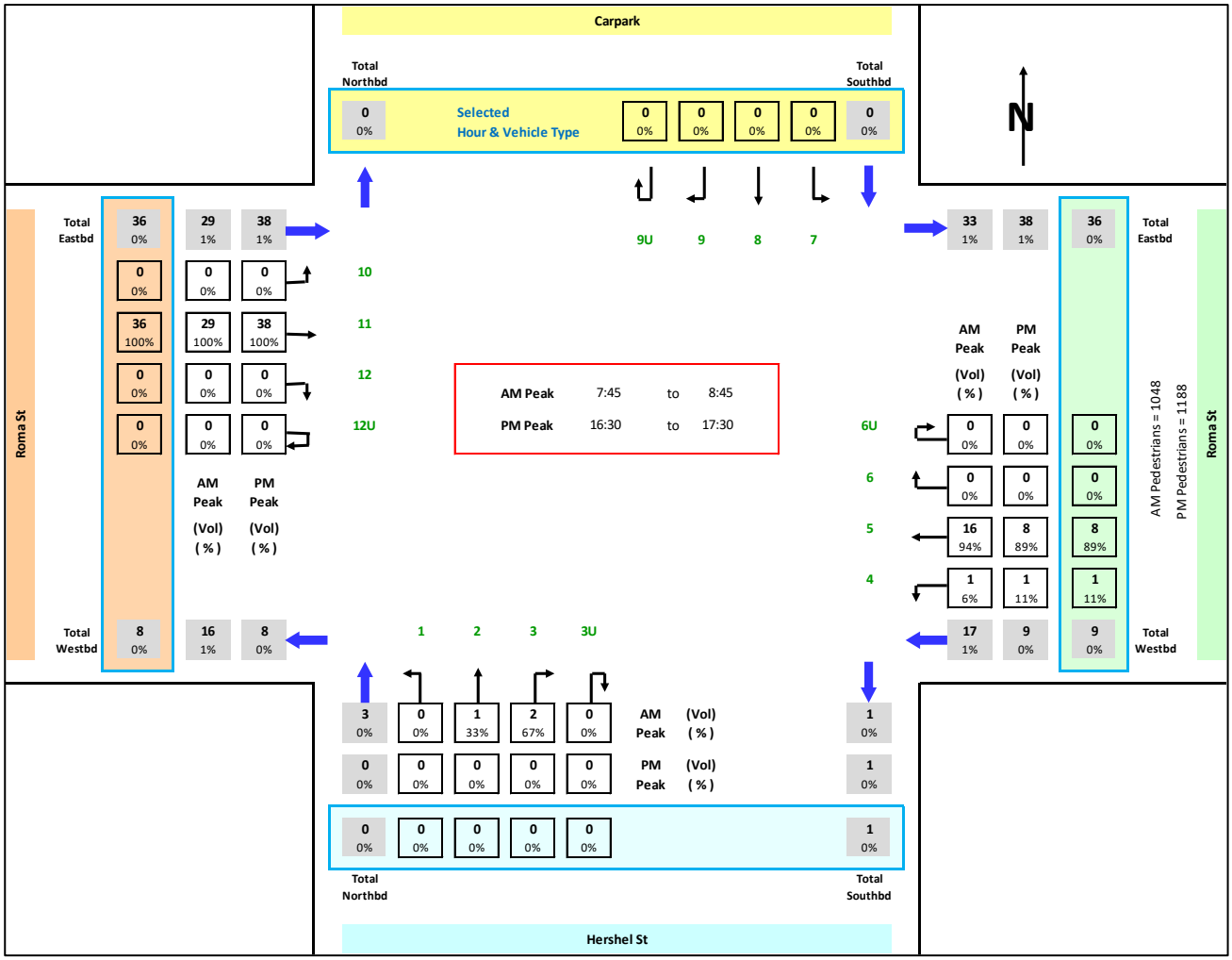


Figure 13 Traffic survey results - heavy vehicles

3.7.5 Phasing summary

The signal phase sequence proposed in the SIDRA model was extracted from a 2015 SATURN model provided by BCC (Refer for CRR-ARP-TN-RSP-TRA-002 for further information about the SATURN modelling). The proposed phasing sequence only adds one phase dedicated to pedestrian movement only.

In the current phasing sequence, the intersection operates in a three-phase configuration and does not include a pedestrian phase. This phasing sequence has been slightly amended and optimised in the future scenario assessment to accommodate the pedestrians and to maintain an acceptable level of service. As a very high number of pedestrians are expected to cross this intersection in the post-demolition scenario, the optimisation prioritises the pedestrian movements over vehicle performance. Figure 14 and Figure 15 shows the phasing sequence considered in existing and future year scenarios respectively.

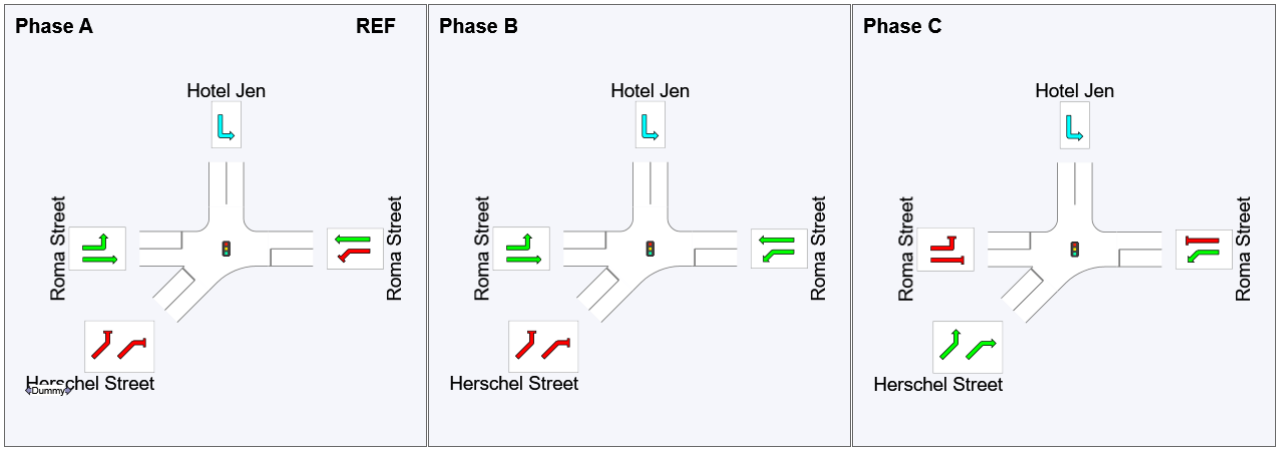


Figure 14 Output phase sequence for the existing scenario

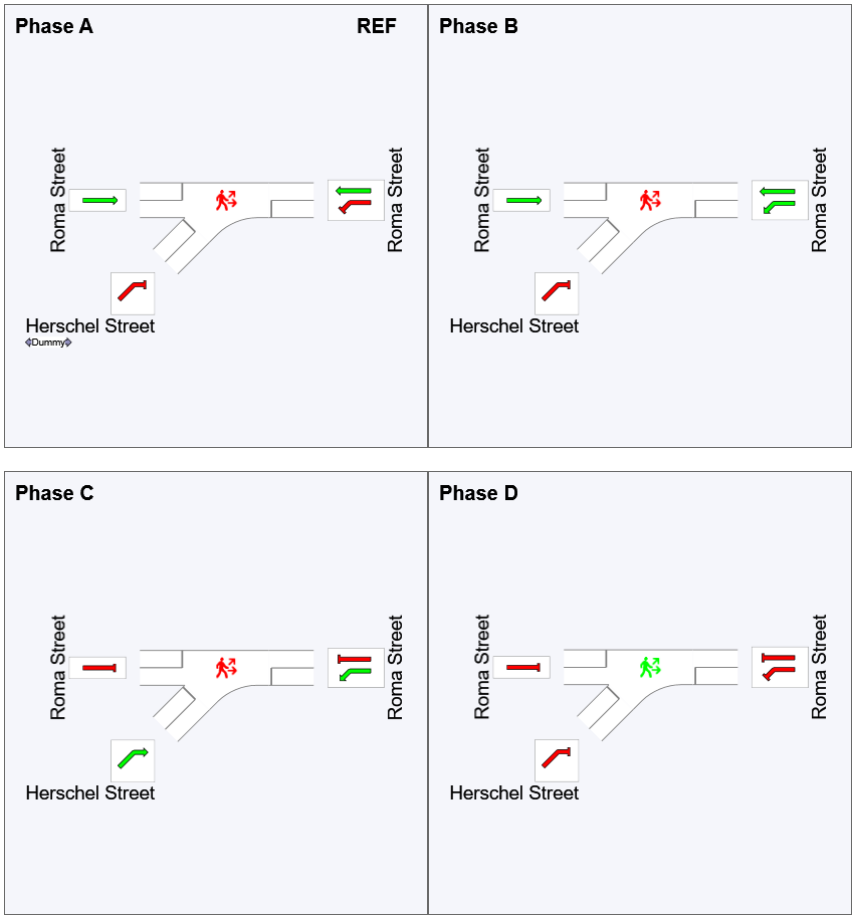


Figure 15 Output phase sequence for the post-demolition scenario

3.7.6 Analysis results – existing scenario

Results obtained from the analysis for the existing scenario are presented in Table 5.

Table 5 SIDRA analysis results for the existing scenario

Existing 2018		AM Peak					PM Peak				
Mov ID	OD Mov	Demand flows (veh/h)	DOS (v/c)	Average delay (Sec)	Level of service	% Back of queue (m)	Demand flows (veh/h)	DOS (v/c)	Average delay (Sec)	Level of service	% Back of queue (m)
East Roma Street											
4a	L1	123	11%	8	LOS A	12	80	12%	18	LOS B	13
5	T1	261	11%	6	LOS A	13	294	12%	6	LOS A	14
Approach		384	11%	6	LOS A	13	374	12%	8	LOS A	14
North Hotel Jen											
7	L2	25	2%	3	LOS A	0	58	4%	3	LOS A	0
Approach		25	2%	3	LOS A	0	58	4%	3	LOS A	0
West: Roma Street											
7	L2	42	45%	12	LOS B	69	13	27%	11	LOS B	35
8	T1	1048	45%	7	LOS A	69	609	27%	6	LOS A	35
Approach		1091	45%	7	LOS A	69	622	27%	6	LOS A	35
Southwest: Herschel Street											
10	L2	42	21%	27	LOS C	16	4	21%	27	LOS C	16
12	R2	117	21%	27	LOS C	16	159	21%	27	LOS C	16
Approach		159	21%	27	LOS C	16	163	21%	27	LOS C	16
All Vehicles		1659	45%	9	LOS A	69	1217	27%	9.5	LOS A	35

3.7.7 Analysis results – post-demolition scenario

Results obtained from the analysis for the existing scenario are presented in Table 6.

Table 6 SIDRA analysis results for the post-demolition scenario

Post-demolition		AM Peak					PM Peak				
Mov ID	OD Mov	Demand flows (veh/h)	DOS (v/c)	Average delay (Sec)	Level of service	% Back of queue (m)	Demand flows (veh/h)	DOS (v/c)	Average delay (Sec)	Level of service	% Back of queue (m)
East Roma Street											
4a	L1	123	22%	20	LOS B	3	91	29%	25	LOS C	23
5	T1	261	22%	18	LOS B	3	295	29%	22	LOS C	29
Approach		384	22%	19	LOS B	3	385	29%	23	LOS C	29
West: Roma Street											
11	T1	1048	83%	30	LOS C	19	639	63%	25	LOS C	73
Approach		1048	83%	30	LOS C	19	639	63%	25	LOS C	73
Southwest: Herschel Street											
12	R2	117	40%	38	LOS D	2	153	52%	38	LOS D	19
Approach		117	40%	38	LOS D	2	153	52%	38	LOS D	19
All Vehicles		1549	83%	28	LOS C	19	1177	63%	26	LOS C	73

Although results show that the intersection will still operate within the acceptable level of services for a CBD intersection, it is possible that some queue will impact on the Roma Street /Makerston Street pedestrian intersection. Due to limited data availability of the origins and destinations of the pedestrians currently using the bridge, this analysis only provides a conservative summary of the anticipated impacts based on current traffic demand volumes.

It is recommended that a more detailed assessment be undertaken in the proceeding stages of this study to effectively capture the wider road network impacts associated with the proposed bridge closure. This may include analysis of this intersection in conjunction with other nearby intersections to identify the effects of coordination.

3.8 CityCycle

It is anticipated that the CityCycle station in front of the BTC (East Tower) and Hotel Jen will need to be removed due to the reduction of the effective footpath width. A suitable area for relocation may be available nearby (i.e., eastern side of Parkland Boulevard). Relocation will have no significant impact on the road network.

3.9 Cyclists

Previous surveys organised by Arup (2018) showed that Roma Street currently caters for over 30 heavy vehicles in a single direction during peak times. As demonstrated before, additional volume generated by the site is estimated to be approximately two heavy vehicles. Generally, the limit for when impacts do not need to be considered is when the increase is under 5% (refer to TMR's Guide to Traffic Impact Assessment). In this case, the impacts are slightly above 5%. However, in vehicle terms, the level of exceedance is less than one vehicle in each direction. Therefore, provided that drivers and riders follow the road rules, it is assumed that the on-road cycleway will not be impacted significantly.

Parkland Boulevard is a primary cycle route under the BCC bicycle network overlay and is identified as a priority cycle route on the South East Queensland Principal Cycle Network Plan (SEQPCNP). Parkland Boulevard is expected to remain open to cyclists during the demolition. However, cyclists may have to follow detours or experience temporary delays due to the proposed Roma Street access. This to ensure the safety of riders during heavy vehicles movements in and out of the site. It is recommended that operation of the site access be controlled by a Traffic Management Plan.

3.10 Bus services

A bus stop shelter and seat currently located on the northern footpath of Roma Street, adjacent to the site (as per Figure 16) appears to be a decommissioned Translink bus stop. Available information from the Translink portal (at the time of writing) does not indicate that bus services require this bus stop for boarding or alighting purposes. However, bus operations on Roma Street are currently under review as part of the wider CRR project; modifications could include the activation of this stop.

A total of three Translink bus services (Routes No. 61, 350 and 352) travel eastbound on Roma Street daily through the intersection of Parkland Boulevard and Roma Street. However, no

significant disruptions or re-routing of these services are expected as a result of the demolition works.

Figure 16 - Decommissioned bus stop on Roma Street near Parkland Boulevard

No other Translink services on Roma Street were identified to be within the scope of the demolition works.

Bus network operation through the Inner Northern Busway will not be affected by the demolition works as the BTC (West Tower) will still be operational during works. Some minor disruptions to services are possible during demolition if required to ensure safety to users.

4 Results and discussion

The demolition impacts on the various modes of transport as a result of the proposed demolition works are shown in Table 7 with proposed mitigation measures.

Table 7 Demolition impacts as per proposed RfPC-3

Mode	Demolition impacts as per 2018 RfPC-3
Vehicle Traffic	No expected increase in general vehicle traffic volumes compared with existing. Access to Parkland Crescent is to be maintained at all times. Management of access and exit points to the site from Roma Street will include implementing Traffic Management Control. Number of construction vehicles expected to be less than that from the 2017 RFPC-1 and would occur before the commencement of main CRR works. It is not expected to impact on the road network operation significantly.
Car parking at Parkland Crescent	As per RfPC-1
Roma Busway	No significant impacts expected on the Translink network operations
Pedestrians	Potential for the worksite to require temporary delays to pedestrians on Roma Street. If this is the case, it is proposed that a mitigation plan be provided and controlled by a Traffic Management Plan. Potential significant impact on Roma Street vehicular traffic as a consequence of closing the pedestrian bridge that links the BTC (East tower) to Herschel Street
Cyclists	The worksite is not anticipated to impact cycle activity on Roma St, although cyclists may have to follow detours or experience temporary delays due to the proposed Roma Street access and exit points. This to ensure safety of riders during heavy vehicles movements in and out of the site. It is recommended that operation of the site access be controlled by a Traffic Management Plan.
Coaches	No impacts (existing coach terminal at BTC remains open during demolition works).
Property Access	To be maintained. Possible minor diversions (and traffic control where required) in place at times.

5 Conclusions and Recommendations

The following findings and recommendations are made as a result of this study:

- Additional traffic as a result of the demolition will not have a significant impact on the road network. However, due to spatial requirements/capacity impacts for turning movements – i.e. from the left/eastbound direction, it is recommended that consideration be given to these operations/movements only occurring outside of peak traffic periods.
- It is recommended that heavy vehicle traffic to and from the site be coordinated with the assistance of traffic management controllers;
- Public transport operations at the Inner Northern Busway, Roma Street Station and Roma Street bus stops are not expected to be significantly affected at this stage. However, modifications as part of the CRR project could include the activation of the decommissioned bus stop near the site.
- Closure of the pedestrian bridge that connects the BTC (East Tower) to Herschel Street could have an adverse impact on the road network. At this stage, is assumed that pedestrian traffic to and from the BTC (East Tower) will be re-accommodated on the Roma Street/Herschel Street intersection. Minor changes to the signal phases at this intersection could facilitate pedestrian crossing movements. However, further analysis is recommended to be undertaken to capture the wider impact generated as a result of changes of origin-destination patterns.
- A list of the identified impacts and mitigation for each aspect is included in Table 8.

Table 8 Summary of key traffic issues from RfPC-3

Aspect	Approved project	RfPC 3 Change in traffic impacts (with mitigation)
Traffic Generation	The transport of demolition waste is expected to have minimal impact on existing traffic as demolition truck activity is unlikely to coincide with the main construction activities. 27 trucks per day peak delivery and six trucks per hour peak total from Roma Street construction.	No expected significant increase in general vehicle traffic volumes compared with existing. Approximately two heavy vehicles per hour (at peak four per hour) for the demolition. It is recommended to operate outside peak times to reduce any impact on the network and increase safety to road users.
Bus Network	The inbound bus stop at Roma Street adjacent to the worksite will need to be relocated in coordination with TransLink during the demolition phase. This may include moving the bus stop further east along Roma Street in front of the BTC (East Tower) for buses continuing along Roma Street. Services travelling via Herschel Street may temporarily be unable to stop at Roma Street. Establishment of the construction worksite may also result in temporary disruption to the Inner Northern Busway adjacent to Roma Street Station.	This bus stop appears to be inactive. However, modification as part of the wider CRR project could activate the stop. No significant disruptions or re-routing of Roma Busway services expected as a result of the demolition works. Demolition works should not have adverse implications on any other bus stops or services on Roma street. Minor disruptions to the INB busway operation are expected to ensure safety of users. This is to be coordinated with Translink during demolition works.
CityCycle	The CityCycle station in front of the BTC (West Tower) will need to be relocated in coordination with BCC.	Suitable area for relocation may be available nearby (i.e., eastern side of Parkland Boulevard). Relocation will have no significant impact on the road network.
Worksite Access	During construction, there will be two access points to the work site off Roma Street, one at either end of the worksite.	Access to the worksite would be provided from Roma Street. Operation to be assisted by Traffic Management Controllers.

Aspect	Approved project	RfPC 3 Change in traffic impacts (with mitigation)
Pedestrian and Cycle Movement	Some delays to pedestrian and cycle movements will be caused by vehicles accessing the worksite along Roma Street.	Signals on Roma Street to be modified to relocate flow from the pedestrian bridge expected to be closed as a result of the demolition works. Modifications will be modelled and coordinated with BCC before demolition works commence. Cyclists and pedestrians will have to follow temporary roadwork instructions put in place for vehicles at the Roma Street accesses.

Technical Note

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Project title	Cross River Rail Delivery Authority	Job number	246209
cc	Click here to enter text (type a single space if not required).	File reference	Click here to enter text.
Prepared by	Click here to enter text. Click here to enter text (type a single space if not required).	Date	14 November 2018
Subject	Cross River Rail Request for Project Change 3 – Social Amenity, Landscape, Visual and Lighting Impacts		

1 Introduction

The 2011 Environmental Impact Statement (EIS) for Cross River Rail (CRR) contained a construction site to the north and south of Parkland Crescent, east of Hotel Jen (refer to Figure 1). The subsequently approved 2017 Request for Project Change (RfPC1) realigned the station and CRR route, relocating and expanding the construction site to the north of Parkland Crescent and Hotel Jen (refer to Figure 2). RfPC2 (June 2018) addressed the temporary solution for the relocation over the Roma Street Coach Terminal (refer to Figure 2).

The subject of RfPC3 is to consider the demolition of the Brisbane Transit Centre (BTC) (East Tower) and Hotel Jen, with an impact area of approximately one-hectare (refer to Figure 3). This work required as part of RfPC3 involves new property impacts and additional demolition works not previously assessed.

The demolition will occur over a 7-month period. Buildings within Lot 1 on SP207220 are proposed to be demolished sequentially with Hotel Jen and BTC (East Tower) first, followed by the Podium and BTC (West Tower). The additional demolition work will occur prior to construction of the CRR Project, as part of the required early works. The construction of the temporary Roma Street Coach Terminal is unlikely to overlap with the demolition of Hotel Jen and the BTC (East Tower).

The purpose of this technical note is to analyse the visual and social amenity, landscape and lighting impacts that were assessed as part of the RfPC1 and determine the potential changes as a result of RfPC3.

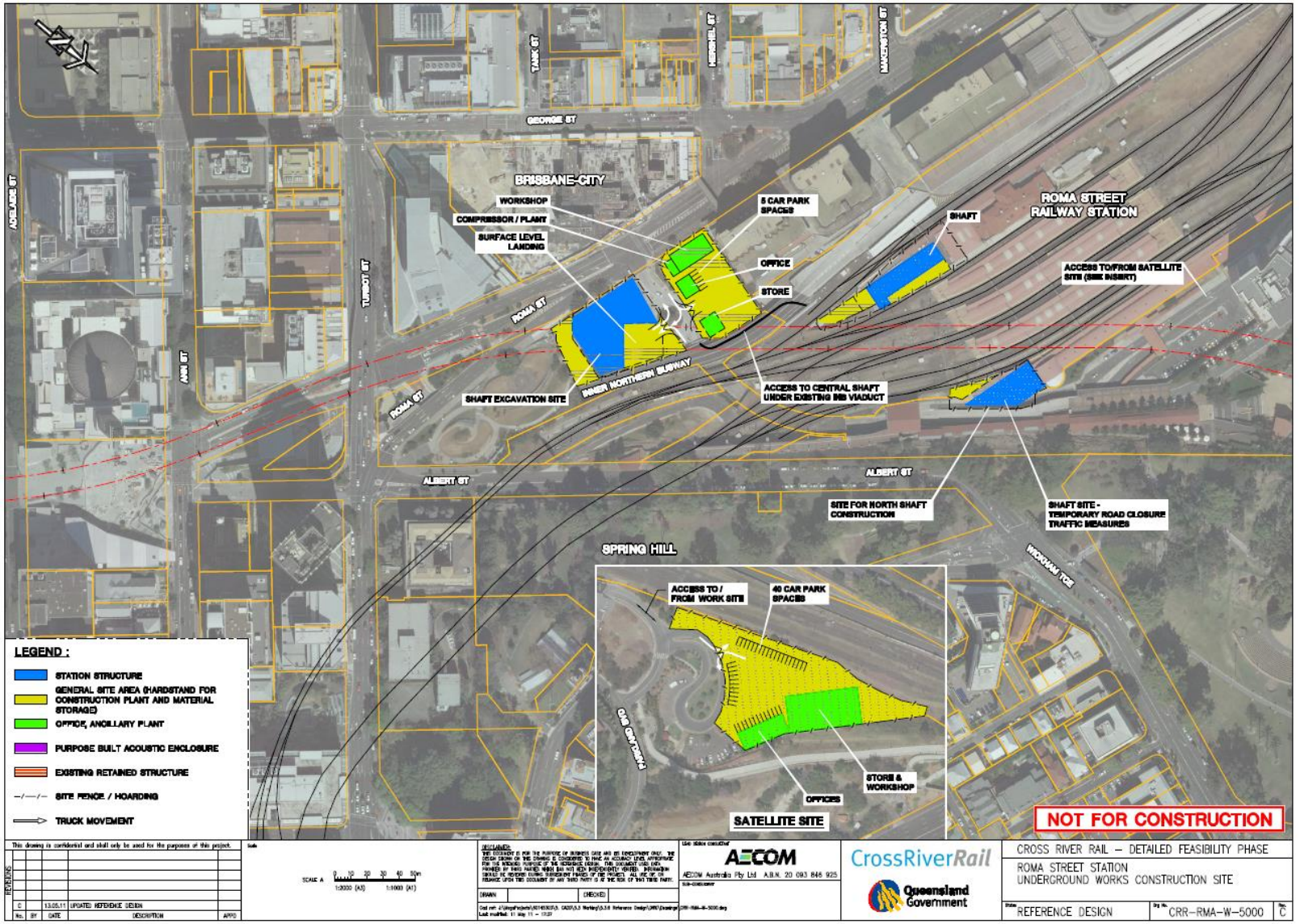


Figure 1: 2011 EIS construction site – Roma Street

Technical Note

246209 14 November 2018

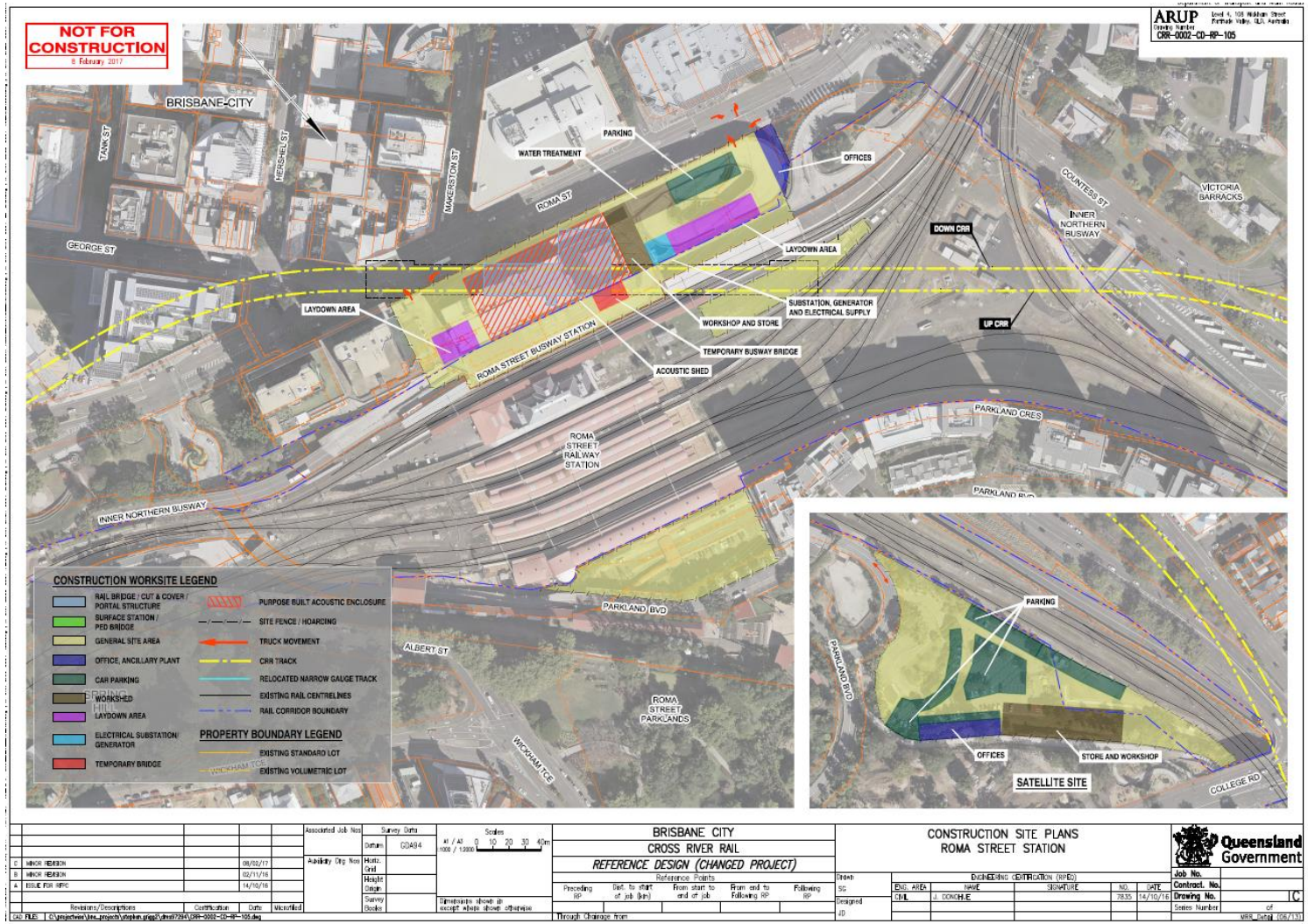


Figure 2: 2017 RfPC1 construction site and RfPC2 proposed coach terminal site

Figure 3 RfPC3 Proposed demolition works

2 RfPC3 Works

Key aspects of the demolition for RfPC3 that are relevant to the assessment of visual, social, landscape, and lighting impacts include:

- **Worksite establishment** to allow access for demolition, including, clearing, removal of infrastructure, earthworks, fencing and hoarding.
- **Building demolition** including demolition and crushing of materials, stockpiling of materials (and stockpile management by machinery), removal of demolished materials and debris from site by heavy vehicle haulage, backfilling the site consistent with surrounding ground.
- **Finishing works** including stormwater drainage and erosion and sediment controls.
- **Site fencing** including hoarding and branded signage on fence panels.
- **Site access** via Parkland Boulevard and heavy vehicle access throughout the demolition period.
- **Lighting** for site security during the demolition works will be installed within the worksite area.

3 Methodology

This landscape, social, visual and lighting assessment comprises of the following stages;

- **Current approved impacts (RfPC 1)** | A summary of the landscape, social amenity, visual and lighting impacts acknowledged as part of the approved CRR project.
- **Summary of material change** | An analysis of the potential landscape, social amenity, visual and lighting impacts that may arise as a result of RfPC3 demolition works.
- **Impact assessment |** A comparative analysis of the RfPC1 project and the RfPC3 demolition works project to identify any changes to the approved impacts.
- **Mitigation |** A comparative analysis of the RfPC1 project and the RfPC3 demolition works project to identify and potential additional mitigation measures that could be considered.

4 Current approved project impacts

4.1 Landscape

4.1.1 Construction

The RfPC1 project positioned Roma Street Station to the west of the CRR 2011 station. The RfPC1 Roma Street worksite was expanded and relocated in comparison to the 2011 worksite and included the demolition of the BTC (West Tower) and coach ramps.

The RfPC1 acknowledged that the demolition of the BTC (West Tower) and Coach ramp resulted in an increased extent of the construction site and resulted in an increase in the overall landscape construction impact in comparison to the 2011 project. However, the impact on Emma Miller Place was reduced with the extent of the construction compound limited to the west of the Roma Street Parkland entrance.

4.1.2 Operation

The RfPC1 identified that the project would result in a catalyst for change. Consistent with CRR 2011, the RfPC1 project was considered to result in a beneficial impact on the landscape.

4.2 Social Amenity

The 2011 EIS identified social infrastructure adjacent to the RfPC3 site, including Emma Miller place which is identified as 'recreation – parks/open space' and is acknowledged as providing a public meeting place. The EIS also identifies that parks and recreational areas provide a sense of place and local amenity. Roma Street Station, rail line and roads are recognised as providing important access and connectivity.

4.2.1 Construction

The 2011 EIS and RfPC1 identify that construction activities for the project may lead to changes in local amenity and liveability for communities near to construction works due to increased construction noise, changed access, traffic diversions and construction traffic issues including parking. This includes potential amenity impacts to residential apartments near Roma Street Station. Construction impacts are recognised as being temporary, which in the case of the whole project is 5.5 years.

4.2.2 Operation

RfPC1 identifies social amenity benefits compared to the 2011 EIS including reduced impact on Roma Street Parklands and Emma Miller Place, and reduced peak haulage movements compared to the forecast in the 2011 EIS. RfPC1 identifies potential impacts from the demolition and redevelopment of BTC (West Tower) including the change in land use and the possible redevelopment and renewal opportunities that may arise on the sites, subject to separate planning and approval processes.

4.3 Visual

A visual assessment was undertaken for the RfPC1 to compare the potential impacts in comparison to the CRR 2011 project. The assessment was undertaken with reference to the CRR 2011 representative viewpoints to be able to compare the findings. The representative viewpoint used for both were positioned on Makerston Street (refer to Figure 4).

4.3.1 Construction

The RfPC1 identified that the construction works at Roma Street would be highly visible from the adjacent buildings and the surrounding road network. The overall visual impacts were determined to increase in comparison to CRR 2011 due to the relocation of the station and extent of works. No visual impacts were anticipated at Emma Miller Place, which was required for construction activities in CRR 2011.

Overall, the RfPC1 construction impacts on the landscape at Roma Street were considered to be greater than CRR 2011.

4.3.2 Operation

The RfPC1 project was assessed to have a positive influence on the visual amenity of the area. The outcome was consistent with CRR 2011 but at a different location. Figure 4 provides a conceptual illustration of the potential visibility of the station from the representative viewpoint.

Figure 4 CRR 2016 illustration

4.4 Lighting

The CRR 2011 provided a description of the lighting sources anticipated during construction and operation. The RfPC1 construction and operational lighting impacts were anticipated to be consistent with CRR 2011, although at slightly different locations, reflecting the changes to the construction worksite locations and alignment.

4.4.1 Construction

Lighting was required at a number of locations as part of the RfPC1 project to assist and facilitate night time work activities and ensure the safety and security of personnel and property.

While most night time activities were identified to be undertaken underground or within the confines of the acoustic sheds, some works were identified as requiring external lighting. RfPC1 project identified that lighting generated at external locations within the construction worksites has the potential (*may*) be visible from nearby sensitive receptors. Although lighting would be focussed over the particular points of interest, some light trespass was determined as '*likely*.'

RfPC1 project identified that residential properties with limited visual barriers, such as high fences or vegetation, could be susceptible to light glare from passing construction vehicles.

4.4.2 Operation

Once operational, the RfPC1 project lighting requirements were assessed to be similar to the lighting requirements on Brisbane's existing rail network. Generally, light was considered to improve the amenity and safety and would be consistent within the urban environment.

Lighting along surface tracks were assessed to be minimal and in line with current QR lighting requirements. Due to the low lighting requirements, it was considered unlikely that the additional surface tracks provided (north of the Northern portal and south of the Southern portal) would generate light impacts on sensitive receptors. However, the increased frequency of trains operating on the network as a result of the project had the potential (*may*) increase the frequency of light impacts associated with train operations in some areas.

Consistent with CRR 2011, surface rail stations were lit as per the requirements of the *Disability Discrimination Act 1992* and QR standards. In coordination with other security measures, lighting was also used as a deterrent to crime. Some light trespass and glare had the potential (*may*) to be experienced at sensitive receptors located near stations.

5 Summary of material change

For the purposes of identifying changes from previously approved works, a comparison has been made between previously approved construction and operational activities and those that are likely to occur as a result of the proposed demolition works for RfPC3.

For the purposes of determining the potential impacts, the existing context and baseline information gathered to inform the RfPC1 project is considered to be consistent and applicable to the RfPC3 for Roma Street demolition works. Consistent with RfPC1 approach, the representative view from Makerston Street has been selected to comparatively document changes. Additional representative viewpoints have also been included to illustrate and capture the potential visual change that may arise.

5.1 Landscape

RfPC3 demolition works would result in an incremental expansion of the previously approved demolition works, removing the urban scale and form that exists to the north of Roma Street. The mature fig trees adjacent to BTC (East Tower) and Hotel Jen and the matures trees that bound the eastern side of Hotel Jen will be removed as part of RfPC3.

The additional demolition area would bring the works closer to Emma Miller Place, a park that is considered to include remnants of the original station garden of heritage value. The park area situated to the east of Hotel Jen is considered to be a historic section of the park, fragmented by the construction of Parkland Boulevard. This area is not designated as having heritage value, although the landscape amenity of the park area would be impacted as a result of the demolition works.

The expansion of the CRR Roma Street demolition area would result in an incremental increase in potential landscape impacts in comparison to the currently approved project.

5.2 Social Amenity

Potential impacts to social amenity arising from RfPC3 would be similar and incremental to the social amenity impacts from the approved RfPC1 works, which included demolition of the BTC (West Tower). Consideration of social amenity impacts includes changes to land use, traffic and access, potential noise and air quality impacts, public health, landscape and visual amenity.

Impacts arising from RfPC3 would include:

- Permanent removal of the commercial tenancies and hotel accommodation provided by the BTC (East Tower) and Hotel Jen respectively. Due to the location of the site in the inner city, there is a wide variety of other commercial tenancies and hotel accommodation in the immediate vicinity that are likely to be able to absorb this loss. Level 5 upwards of BTC (East Tower) is currently vacant, and other tenants are in various stages of relocation. Depending on the nature of any future development at the site, this may provide an opportunity for provision of commercial or hotel accommodation, subject to separate planning and approval processes.
- Temporary changes to access for traffic, cyclists and pedestrians during the demolition period to accommodate access by haulage vehicles during demolition. This would be managed through a traffic management plan. As per RfPC1, pedestrian and cycling access will be maintained along

the Roma Street frontage, however footpath narrowing may be required during RfPC3 for safety reasons.

- The works are not expected to significantly affect public transport operations in the vicinity of the site.
- Permanent loss of the pedestrian link over Roma Street, requiring pedestrian traffic to be accommodated on Roma Street. This would have potential impacts to pedestrian movements and the local road network due to required changes to signal phases to facilitate pedestrian crossing movements. This is a new impact to pedestrian connectivity compared to RfPC1.
- Encroachment of works into the park adjacent to Hotel Jen and closer to Emma Miller Place with potential reduction in social amenity that is provided by this public space. Other changes to landscape, visual amenity and lighting will also temporarily affect the social amenity of the area, as outlined in this technical note.
- Temporary air quality impacts during the demolition phase are expected to be similar in nature to the demolition of the BTC (West Tower) and the Podium, as assessed as part of the RfPC1. However, the duration of the impacts will increase for the additional demolition period. This demolition would occur sequentially so there would not be any increased cumulative impacts.
- An increase in the noise levels previously approved under the EIS and RfPC1, including at the Supreme Court and Magistrates Court and to surrounding residences for some demolition activities.
- Similar to the demolition of BTC (West Tower), there is a risk that hazardous materials such as asbestos will be encountered during demolition of East Tower and Hotel Jen Public with resulting health impacts if not properly managed. However, asbestos inspection reports have not detected asbestos in the buildings therefore the risk is low.

5.3 Visual

Six representative viewpoints have been identified to illustrate the potential visual change and impact that may arise as a result of the RfPC3 demolition works (refer to Figure 5). These representative viewpoints include:

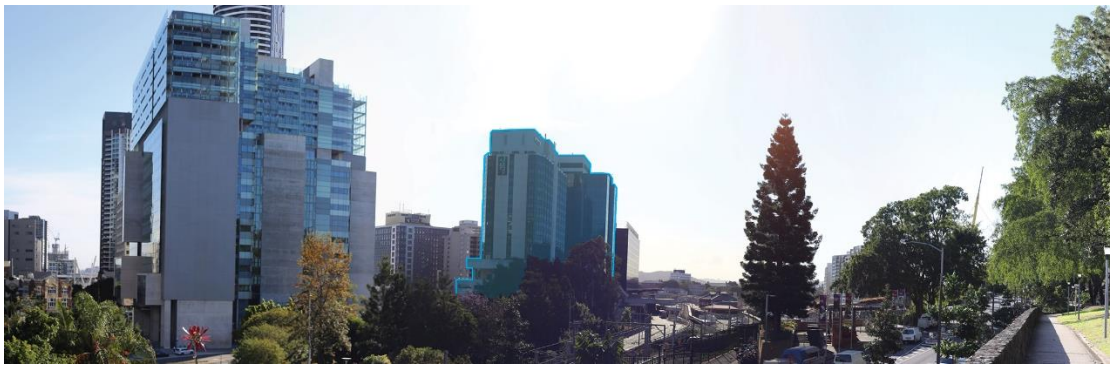
1. Roma Street Parkland - carriage shed
2. Roma Street Parkland – carriage deck
3. Wickham Park – Albert Street edge
4. Emma Miller Place
5. Makerston Street
6. Herschel Street

Figure 5: Viewpoint location plan

5.3.1 1. Roma Street Parkland – carriage shed

5.3.2 2. Roma Street Parkland – carriage deck

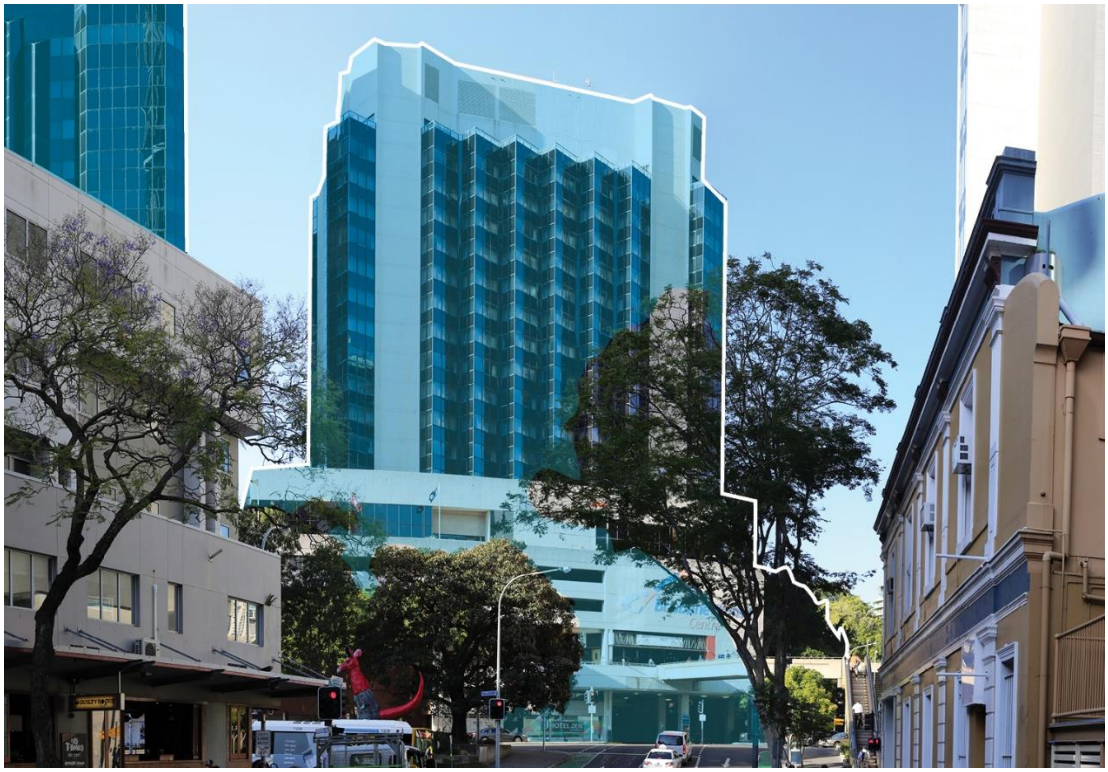
5.3.3 3. Wickham Park – Albert Street edge



5.3.4 4. Emma Miller Place

5.3.5 5. Makerston Street

5.3.6 6. Herschel Street



Viewpoint description	Changes to construction impacts (a comparison between RfPC1 and RfPC3)	Changes to operational impacts (a comparison between RfPC1 and RfPC3)
Viewpoint 1 and 2 | Roma Street Parkland Carriageway shed and carriageway deck		
View to the south from Roma Street Parkland carriage shed and carriageway deck. View above Roma Station towards the City skyline and built form.	The removal of BTC (West Tower) was assessed as part of the RfPC1. The removal of Hotel Jen and BTC (East Tower) will open up views towards Meriton Suites Hotel and adjacent smaller scale built form. Impacts are assessed to result in an incremental increase in adverse visual impacts during demolition, broadening the visibility of demolition works from the parkland edge, including views towards the gradual building demolition, construction machinery and stockpiled material.	On completion of the works, it is anticipated that the site boundary fencing with branded signage would remain in-situ. Consistent with the 2011 EIS and RfPC1 impact, it is assumed that the project is judged to have a positive influence on the visual amenity of the area, providing an opportunity to catalyse the redevelopment of the Roma Street Station precinct. At this stage, the proposed land-use within the area is unknown, and would be subject to separate planning and approval process.
Viewpoint 3 | Wickham Park – Albert Street edge		
View west along the Roma Street rail corridor with Hotel Jen and Brisbane Transit Tower (East Tower) bounding the rail corridor edge. Mature trees within Emma Miller Place are visible in the foreground of Hotel Jen with the Supreme Court of Queensland Library situated to the south of Roma Street.	The demolition of Hotel Jen and Brisbane Transit Tower (East Tower) will result in the further removal of built form to the north of Roma Street. In comparison to RfPC1, the impact is assessed to be incremental, reflecting the increase and expansion of visible works from this location, including the gradual building demolition, construction machinery and stockpiled material.	On completion of the demolition works, it is anticipated that views towards the site would be visible above the boundary fencing in areas, particularly the western extent. Views towards the eastern extent would be filtered by mature vegetation situated within Emma Miller Place. With the absence of built form, it is anticipated that views towards Mount Coot-ha would be achievable. Similar to viewpoint 1 and 2, visual impacts are assessed to be consistent with the 2011 EIS and RfPC1 impacts.
Viewpoint 4 | Emma Miller Place		
View from the eastern entrance to Emma Miller Place. View towards arched seating area and water fountain with Hotel Jen visible above park pergola.	View towards the demolition works would be more apparent in comparison to the RfPC1 project. Demolition works are anticipated to result in the localised removal of vegetation contained within the park to the south of Parkland Boulevard.	On completion of the RfPC3 demolition works, the change to the existing view would comprise the removal of Hotel Jen above the existing vegetation. Visual impacts from this location area assessed to be consistent with RfPC1 project.

	Impact on views from Emma Miller Place are assessed to be adverse and incremental in comparison to the CRR 2016 project.	
Viewpoint 5 | Makerston Street		
View north along Makerston Street towards Brisbane Transit Centre (west tower). View framed by development situated to the east and west of Makerston Street.	The RfPC1 project assessed the removal of the BTC (West Tower), a prominent building within this view. The RfPC3 would result in the remove of the BTC (East Tower). The eastern edge of this building is apparent in this view, although not a dominant feature. Impacts are assessed to be marginally incremental in comparison to the RfPC1 project.	On completion of the RfPC3 demolition works, views towards boundary fencing/hoarding are anticipated with the potential for views above the hoarding towards the busway, Roma Street station and rising topography associated with Wickham Park. Consistent with 2011 EIS and RfPC1 impact, it is assumed that the project is judged to have a positive influence on the visual amenity of the area, providing an opportunity to catalyse the redevelopment of the Roma Street Station precinct.
Viewpoint 6 | Herschel Street		
View north along Hershel Street towards Brisbane Transit Centre (east tower). View framed by development situated to the east and west of Herschel Street.	As part of the RfPC1 project, views towards the demolition and construction works would have been limited from this location. The removal of Hotel Jen and BTC (East Tower) would be prominent in this view. The temporary adverse impact is assessed to be heightened in comparison to the RfPC1 project.	On completion of the RfPC3 demolition works, views towards boundary fencing/hoarding are anticipated with the potential for views above the hoarding towards the busway, Roma Street station and rising topography associated with Wickham Park. Consistent with 2011 EIS and RfPC1 impact, it is assumed that the project is judged to have a positive influence on the visual amenity of the area, providing an opportunity to catalyse the redevelopment of the Roma Street Station precinct.

5.4 Lighting

5.4.1 Demolition

At this stage, the demolition phase lighting requirements for the RfPC3 demolition works are unknown, however it is assumed that, consistent with RfPC1, lighting will be required to assist and facilitate night time work activities and ensure the safety and security of personnel and property. Although lighting would be focussed over the particular point of interest, some light spill is anticipated with the potential to be visible from nearby sensitive receptors. Consistent with approved project, sensitive receptors with limited visual barriers, such as high fences or vegetation, could be susceptible to light glare from passing construction vehicles and demolition activity.

Overall, the distribution of light is assumed to be consistent with the approved project, although the expansion of the RfPC3 has the potential to increase the potential impacts.

5.4.2 Operation

Overall, the lighting requirements of the RfPC3 area are anticipated to be minimal, with a focus on ensuring the safety and security of the area. In comparison to the approved CRR project, lighting impacts arising from the RfPC3 are considered to be negligible.

6 Recommendations and Conclusions

This technical note has considered the landscape, social amenity, visual and lighting impacts from the demolition of BTC (East Tower) and Hotel Jen for RfPC3. RfPC3 will result in an incremental expansion of the previously approved CRR demolition works in the Roma Street precinct. The social amenity, visual, landscape and lighting impacts will be largely consistent with the previously approved project, but will occur during an additional 7 month period of early works. Additional impacts from the RfPC works will include an increase in noise levels at some sensitive receivers during the demolition period, the temporary removal of the park adjacent to Hotel Jen and the permanent removal of the pedestrian link over Roma Street with resulting impacts to pedestrian and vehicle traffic on Roma Street.

As for the previously approved project, RfPC3 may have a positive influence on the future visual amenity of the area, providing an opportunity to catalyse the redevelopment of the Roma Street Station precinct.

Recommendations to mitigate potential social amenity, visual, landscape or lighting impacts include:

- Hoarding during demolition to minimise the visual impacts during the works
- Traffic management plan for the demolition to manage temporary changes in access that may arise during demolition
- Further assessment of the traffic and pedestrian impacts arising from removal of the pedestrian link over Roma Street and options to mitigate this impact
- Use of all “practical and feasible” noise mitigation measures in the planning of the demolition activities, including scheduling the demolition sequence to be “inside out” wherever possible to allow the building façade to provide partial noise screening of demolition activities
- Engagement with stakeholders
- The proponent will liaise with Brisbane City Council to offset the loss of public open space/pocket parks in accordance with Element 6 Nature Conservation of the Draft Outline Environmental Management Plan (OEMP).