Business Case

RAYMONT ROAD / GRANGE ROAD INTERSECTION UPGRADE

CITY PROJECTS OFFICE

BRISBANE INFRASTRUCTURE

Document Change History

Document Control Sheet

Contact for enquiries and proposed changes. If you have any questions regarding this document or if you have a suggestion for improvements, please contact:

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Revision History

Revision	Author	Issue Purpose	Date
1	Fainks Rossouw, Paul Kane	Draft for review	23 February 2017
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Sponsor:

Name Alan Evans, Executive Manager, City Projects office

Signature A. Evans Date 17.5.17

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1 EXECUTIVE SUMMARY

1.1 BACKGROUND

Raymont Road and Grange Road in Grange are identified as suburban roads in the Brisbane City Plan[1] road hierarchy within the inner northern Brisbane road network as shown in Figure 1-1. Webster Road and Grange Road provide a significant north-south link to the Brisbane CBD via Days Road and Stafford Road. Similarly Raymont Road and Pickering Street provide a significant east-west link between Samford Road, South Pine Road and Grange Road.

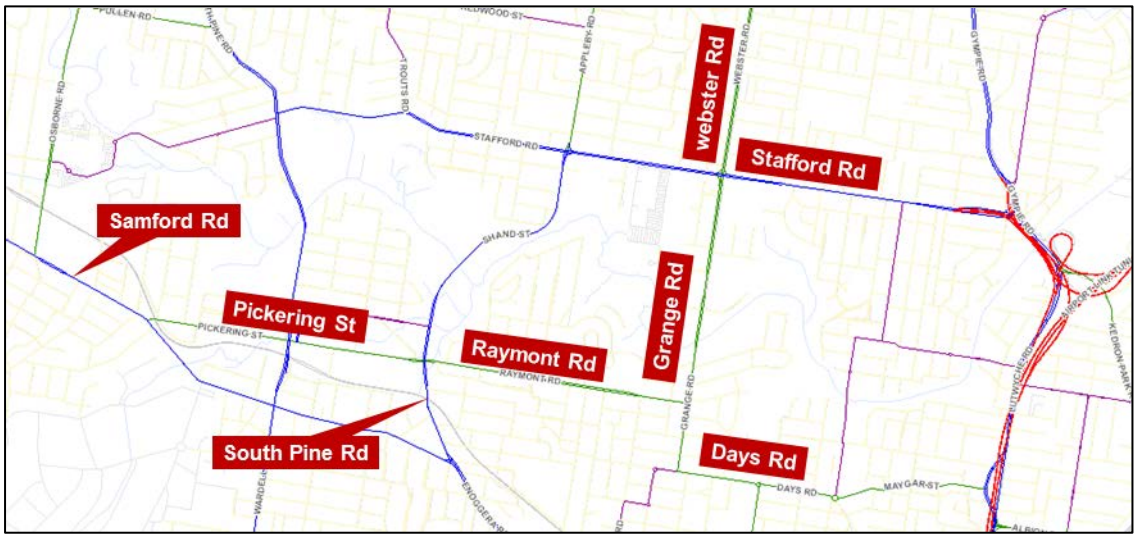

Figure 1-1: Project context

Brisbane City Council (Council) completed a Wilston-Grange Precinct Transport Study[2] in 2015, which identified a need to improve road safety at the Raymont Road / Grange Road intersection.

Existing traffic demands on Raymont Road exceed the intersection capacity during the morning peak period. Northbound afternoon peak period traffic demands on Grange Road are also approaching capacity.

The absence of right and left-turn lanes on Grange Road creates conflicts between turning and through traffic. The conflict risk for southbound Grange Road traffic is exacerbated by a filter[3] right-turn movement in the existing traffic signal phasing arrangement and poor visibility to judge gaps in northbound Grange Road traffic due to a crest south of the intersection.

The proposed Raymont Road / Grange Road intersection upgrade project provides turning lanes at the intersection to address the capacity and safety issues. Refer to Figure 1-2 for location details.

[1] (Brisbane City Council, 2014)
[2] (Brisbane City Council, 2015)
[3] Filtered turns - right turning traffic does not have its own signal phase and have to wait until there are gaps in the through traffic.

Figure 1-2: Location plan

1.2 PREVIOUS STUDIES

Council completed a Wilston-Grange Precinct Transport Study[4] in 2015, which included a strategic assessment of the Raymont Road / Grange Road intersection. The study identified a need to develop a corridor management strategy to improve road safety along Grange Road, including the creation of right-turn lanes where possible, as an immediate priority.

1.3 URGENCY

Failure to resolve the safety and capacity issues within the short term will:

- increase safety risks and traffic congestion at the Raymont Road / Grange Road intersection due to the absence of dedicated turning lanes on Grange Road
- increase incidence of through traffic using local streets to avoid traffic delays.

[4] (Brisbane City Council, 2015)

1.4 PROJECT OBJECTIVES

The Raymont Road / Grange Road intersection upgrade project objectives are to:

- improve safety
- reduce existing and predicted future congestion
- improve local access.

1.5 BENEFITS

Implementing the Raymont Road / Grange Road intersection upgrade project will:

- improve safety by providing turn lanes on Grange Road, and converting an existing filter right-turn movement to a fully controlled right-turn movement
- reduce travel times
- improve local access
- retain traffic on the major roads, thereby reducing routing of traffic through local roads

1.6 RECOMMENDATION

On the basis of a benefit-cost ratio of 4.1 for the project, it is recommended that the project should proceed with Option 2A as the preferred option.

Option 2A comprises provision of separate right and left-turn lanes on Grange Road at the Raymont Road / Grange Road intersection. Option 2A was developed to minimise the number of properties affected, by limiting road widening outside the current road reserve on the eastern side of Grange Road.

The estimated total project cost is $4.2 million.

2 DOCUMENT PURPOSE

The business case provides justification for the undertaking of the project, based on the costs (of development and implementation) against the planned benefits (improved safety, reduced congestion) to be gained, and offset by any associated risks.

It demonstrates the strategic value of the project through its alignment to corporate strategies, budget program objectives or Lord Mayoral directives. It provides an appraisal of the investment, based on a qualitative and quantitative assessment, that enables the project sponsor to determine whether the project will provide sufficient value for the investment and therefore is viable to proceed.

This project will follow PM^2: Council's Project Management Methodology defined in Figure 2-1.

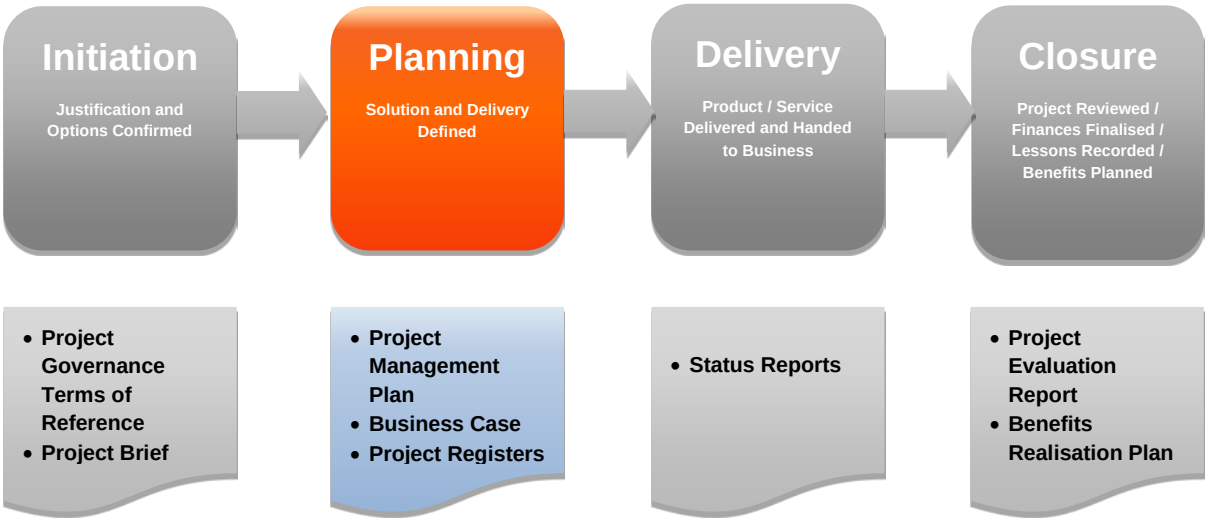

Figure 2-1: Council's project management methodology

3 BACKGROUND

3.1 BACKGROUND

3.1.1 Introduction

Raymont Road and Grange Road are identified as suburban roads in the Brisbane City Plan[5] road hierarchy with the inner northern Brisbane road network as shown in Figure 3-1.

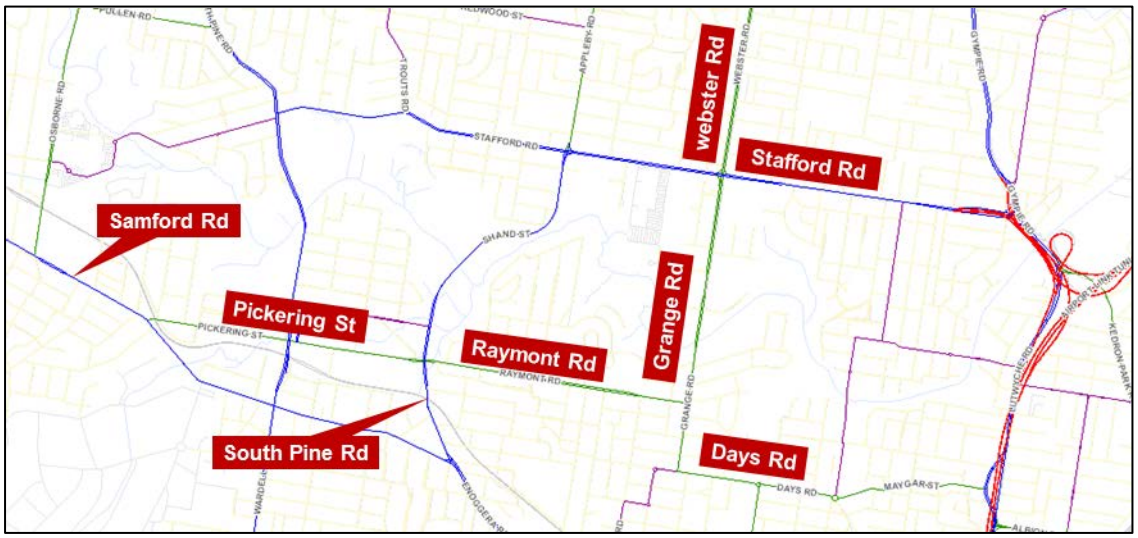

Figure 3-1: Project context

Webster Road and Grange Road provide a significant north-south link to the Brisbane CBD via Days Road and Stafford Road. They also provide one of the few crossing opportunities across Kedron Brook within the Wilston-Grange precinct as shown in Figure 3-2.

Similarly Raymont Road and Pickering Street provide a significant east-west link between Samford Road, South Pine Road and Grange Road.

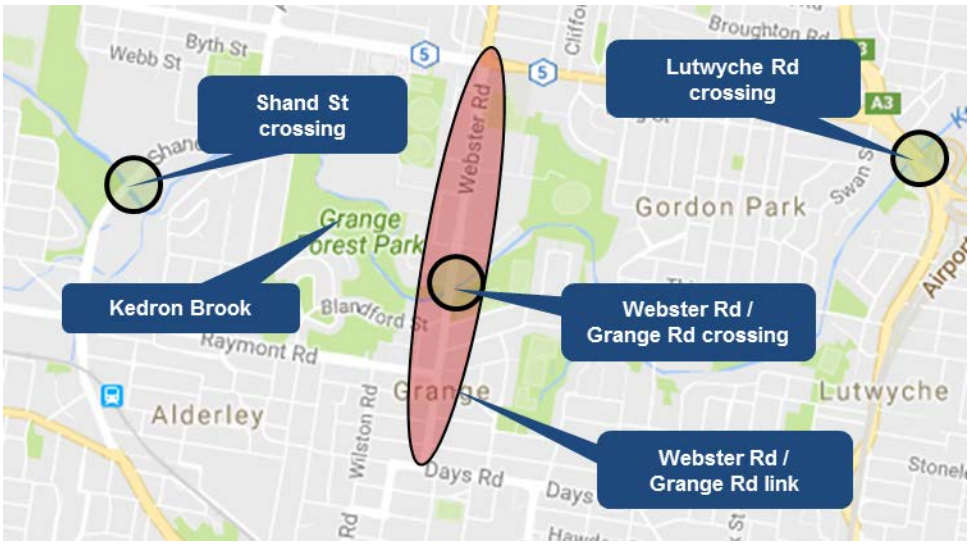

Figure 3-2: Kedron Brook crossing points

[5] (Brisbane City Council, 2014)

Brisbane City Council (Council) completed a Wilston-Grange Precinct Transport Study[6] in 2015, which included a strategic assessment of the Raymont Road / Grange Road intersection. It identified a need to develop a corridor management strategy to improve road safety along Grange Road, including the creation of right-turn lanes where possible, as an immediate priority.

This Business Case reports on the concept development and assessment undertaken for upgrading the Raymont Road / Grange Road intersection. Refer to Appendix A for the preferred option concept layout, Appendix B for the Traffic Assessment Technical Note[7], and Appendix C for the Wilston-Grange Precinct Intersections Concept Design Report[8].

3.1.2 Project location

Refer to Figure 3-3 for the project location.

Figure 3-3: Location plan

[6] (Brisbane City Council, 2015)
[7] (Brisbane City Council, 2017)
[8] (WorleyParsons, 2017)

3.2 CURRENT SITUATION

3.2.1 Physical Characteristics

Road network

The Raymont Road / Grange Road intersection is a signalised T-intersection. Grange Road is an undivided four-lane carriageway, with a shared through and right-turn lane on the southbound approach and a shared through and left-turn lane on the northbound approach. Raymont Road is an undivided two-lane carriageway, which has an eastbound approach comprising a shared left and right-turn lane and an additional right-turn lane.

Grange Road and Raymont Road both have posted speed limits of 60 km/h. The roads lie in a constrained inner suburban environment, with narrow carriageways and no medians or cycle lanes.

Other streets within the project area comprise Howard Street, Dennis Street and Chermside Street. These streets serve adjacent residential catchments.

Public transport

Grange Road is a significant public transport route, with bus routes 325, 335, 346 and 353 running along Grange Road and Webster Road. Route 379 runs along Raymont Road then along Grange Road north of Raymont Road.

Table 3-1 identifies bus stop locations within the project area.

Table 3-1: Bus stop locations

Road	Direction	Stop Reference	Routes	Location
Grange Road	Northbound	005098	325, 335, 346, 353, 379	North of Howard Street
	Southbound	010168	325, 335, 346, 353, 379	North of Howard Street
	Northbound	005097	346, 353, 379	North of Myrtle Street
	Southbound	005096	346, 353	North of Myrtle Street

Active transport facilities

Grange Road and Raymont Road are classified as secondary cycle routes.

There are existing footpaths on both sides of Raymont Road and Grange Road within the project area. The Raymont Road / Grange Road intersection has signalised crossings across Raymont Road and across the northern Grange Road approach. There are no formal cycling facilities within the project area.

Land use

The Raymont Road / Grange Road intersection is surrounded by residential land use. The houses adjacent to the intersection are in a character residential zone and have a traditional building character overlay. This designation places restrictions on demolition of buildings constructed in 1946 or earlier.

3.2.2 Traffic Characteristics

Existing traffic volumes

Traffic count surveys undertaken in 2016[9] identified approximately 2300 vehicles per hour on Grange Road south of the intersection during the morning peak period, with 1600 vehicles travelling southbound. During the afternoon peak period, there are approximately 2400 vehicles per hour on Grange Road south of the intersection, with approximately 1600 travelling northbound.

Raymont Road has hourly volumes of approximately 1000 vehicles during the morning and afternoon peak periods. Approximately 600 vehicles per hour are travelling eastbound during the morning peak period, which is reversed during with the afternoon peak period with approximately 700 vehicles per hour travelling westbound.

Existing traffic performance

In 2016 during the afternoon peak northbound traffic volumes on Grange Road are at intersection capacity with a calculated degree of saturation (DOS) of 0.90 and an estimated queue length of 220m[10]. Likewise the southbound morning peak is approaching capacity with a calculated DOS of 0.86 and an estimated queue length of 53m[11].

In 2016 traffic volumes on Raymont Road exceed the intersection capacity during the morning peak period with a DOS of 1.01 and a queue length of approximately 300m[12].

The degree of saturation, which is the ratio of the traffic volume and the capacity for an intersection movement, is typically used as a measure of intersection performance. For signalised intersections, a DOS of 1.0 indicates the movement traffic volume exceeds the available capacity[13].

Future traffic performance

Traffic volumes for 2031 have been forecast using the Brisbane Strategy Transport Model (BSTM) and Council's Wilston-Grange Model. The methodology for forecasting is defined in Chapters 9 to 13 of the Wilston Grange Precinct Transport Study Technical Report[14].

Forecast traffic performance in 2031 indicates traffic volumes on all approaches during the afternoon peak period exceed the intersection capacity, resulting in average delays of 4 to 6 minutes and a queue length of 1.8km for northbound Grange Road traffic. It should be noted that this is a theoretical length only as extensive local street shortcutting is likely to occur if queue lengths exceed 400m.

3.2.3 Safety Characteristics

There were five recorded crashes between 2010 and 2015 at the Raymont Road / Grange Road intersection on the database held by the Department of Transport and Main Roads

[9] Refer to Section 2.4.1 in the Traffic Assessment Technical Note.
[10] Refer to Table 5.3 in the Traffic Assessment Technical Note for further details.
[11] Refer to Table 5.3 in the Traffic Assessment Technical Note for further details.
[12] Refer to Table 5.3 in the Traffic Assessment Technical Note for further details.
[13] Refer to Section 5.1 and Table 5.2 in the Traffic Assessment Technical Note for further details.
[14] (Brisbane City Council, 2015)

Road Safety and Management Division, based on reports generated by the Queensland Police Service.

Four crashes involved southbound Grange Road vehicles: two were vehicles turning right into Raymont Road colliding with opposing vehicles resulting in hospitalisation; and two were rear-end collisions. The fifth crash involved a northbound kerbside lane motorcyclist falling off to avoid a collision.

These crashes are likely to reflect:

- shared movement lanes on Grange Road
- a filtered[15] right-turn phase for southbound Grange Road traffic with opposing northbound through traffic
- restricted sightlines along the Grange Road northbound approach, making it difficult for right-turning drivers to judge gaps in the northbound traffic.

3.3 PROJECT NEED

Existing traffic demands on Raymont Road exceed the intersection capacity during the morning peak period, and northbound afternoon peak period traffic demands on Grange Road are also approaching capacity.

The absence of right and left-turn lanes on Grange Road creates conflicts between turning and through traffic. The conflict risk for southbound Grange Road traffic is exacerbated by a filter right-turn movement in the existing traffic signal phasing arrangement and poor visibility to judge gaps in northbound Grange Road traffic due to a crest south of the intersection.

3.4 URGENCY

Failure to resolve the project need within the short term will:

- increase safety risks, with associated crashes, and traffic congestion at the Raymont Road / Grange Road intersection due to the absence of dedicated turning lanes on Grange Road
- increase incidence of through traffic using local streets to avoid traffic delays.

[15] Filtered turns enable southbound Grange Road vehicles to turn right into Raymont Road in the same signal phase as northbound through vehicles on Grange Road.

4 STRATEGIC ALIGNMENT

4.1 STRATEGIC OBJECTIVES

The Council's vision[16] states that in 2031 Brisbane will be an accessible city for everyone. Residents, workers, students, visitors and business people will be able to move easily throughout the city.

Road, public transport and active transport networks will provide safe, efficient, fast and reliable travel options throughout the city. These networks will help deliver economic benefits to Brisbane and support the City's growing community and changing economy.

The vision is consistent with the strategic objectives outlined in Council's Transport Plan for Brisbane 2008-2026[17]. The project aligns to the Transport Plan as detailed in Table 4-1.

Table 4-1: Alignment with Transport Plan for Brisbane objectives

Strategic Objective	Desired Outcome	Project Deliverables
1 Quality public transport	Public transport is the preferred mode of travel to the city's major centres. It provides a high level of access to all facilities and services in Brisbane, reducing the need to use a car.	Reduced delays and operational efficiency to bus services, particularly for the number of services operating along Grange Road.
2 Manage travel demand	A sustainable level of travel demand where the growth in traffic is less than the growth in population.	Reduced delays and improved operational efficiency to bus services, which will support more sustainable mode choices and changes in travel behaviour.
3 Coordinated transport and land use	Transport and land uses are managed to create a preferred urban form that increases accessibility and connectivity and supports sustainable travel behaviour.	Improved ability for Raymont Road and Grange Road to function as suburban roads, integrating their transport function with the residential nature of the surrounding land use.
4 Safe and efficient road network	People and goods can move safely on the road network by the most efficient modes and routes, and the impact of traffic on neighbourhoods and the environment is minimised.	Improved safety through providing turn lanes and controlled turn movements. Improved travel times.
5 Deliver goods on time to the right place	Freight moves efficiently and safely within Brisbane while the liveability of residential areas is protected.	Improved safety and travel times for local freight movements.
6 More clean and green transport	Clean and green personal transport is safe and attractive and provides a genuine alternative to driving.	Improved safety through removal of conflicting turn movements between cyclists and pedestrians, and general traffic.

[16] (Brisbane City Council, 2013)
[17] (Brisbane City Council, 2008)

4.2 STRATEGIC TRANSPORT PLANNING CONTEXT

4.2.1 Brisbane City Council

The Transport Plan for Brisbane 2008-2026 identifies Grange Road and Raymont Road as city distributors. City distributors provide connections between communities and major centres, and also connect major land uses to the regional network.

The Ashgrove–Grange Neighbourhood Plan within the Brisbane City Plan has an objective to reduce congestion to improve residential amenity. The plan does not refer to this project directly, however reduction in congestion will improve residential amenity which fits in with the objectives of the Neighbourhood Plan.

4.2.2 State Government

There is currently no Queensland Government regional transport plan for Brisbane or South East Queensland, since Connecting SEQ 2031 was withdrawn in 2012. The Department of Transport and Main Roads (TMR) is currently preparing a suite of regional transport plans across Queensland, but these are not expected to be completed before the end of 2017.

4.3 PROJECT OBJECTIVES

The Raymont Road / Grange Road intersection project objectives are to:

- improve safety
- reduce existing and predicted future congestion
- improve local access.

Considerations in developing a solution to achieve the objectives are:

- minimising land acquisition requirements
- minimising construction costs including the need for utility service relocations
- minimising impacts to residents and road users during construction.

4.4 RELATED PROJECTS

There are no known related projects.

5 BENEFITS AND OUTCOMES

5.1 PROJECT BENEFITS

Implementing the Raymont Road / Grange Road intersection preferred option will provide the following benefits:

- improve safety by providing turn lanes on Grange Road, and converting an existing filter right-turn movement to a fully controlled right-turn movement.
- reduce travel times
- improve local access.
- retain traffic on the major roads, thereby reducing routing of traffic through local roads

5.2 PROJECT IMPACTS

Implementing the Raymont Road / Grange Road intersection project preferred option will have the following impacts which will be managed during project delivery:

- Partial land acquisition of up to 11 residential properties, with eight on the eastern side of Grange Road south of Howard Street to provide for a new right-turn lane. The other three properties are on the western side of Grange Road south of Raymont Road are required for a new left-turn lane. The project scope has been refined to minimise impacts to deliver the scope.
- Disruption to public utility services.
- Typical construction impacts including traffic impacts, pedestrian impacts, and noise and dust disturbance.

5.3 SCOPE OF PROJECT

The preferred Option 2A provides separated right-turn and left-turn lanes on Grange Road at the Raymont Road / Grange Road intersection.

Key features of the project scope are:

- provision of a 75m long right-turn lane for southbound traffic on Grange Road to turn right into Raymont Road
- provision of a 40m long left-turn lane for northbound traffic on Grange Road to turn left into Raymont Road
- removal of filtered right-turns in the traffic signal phasing, and replacement with a controlled right-turn arrow phase
- retention of existing pedestrian crossing locations at the intersection

The intersection layout is based on Council's constrained corridor standard with minimum footpath widths and no centre medians except on the southern leg of Grange Road.

Refer to Figure 5-1 for the proposed upgrade details.

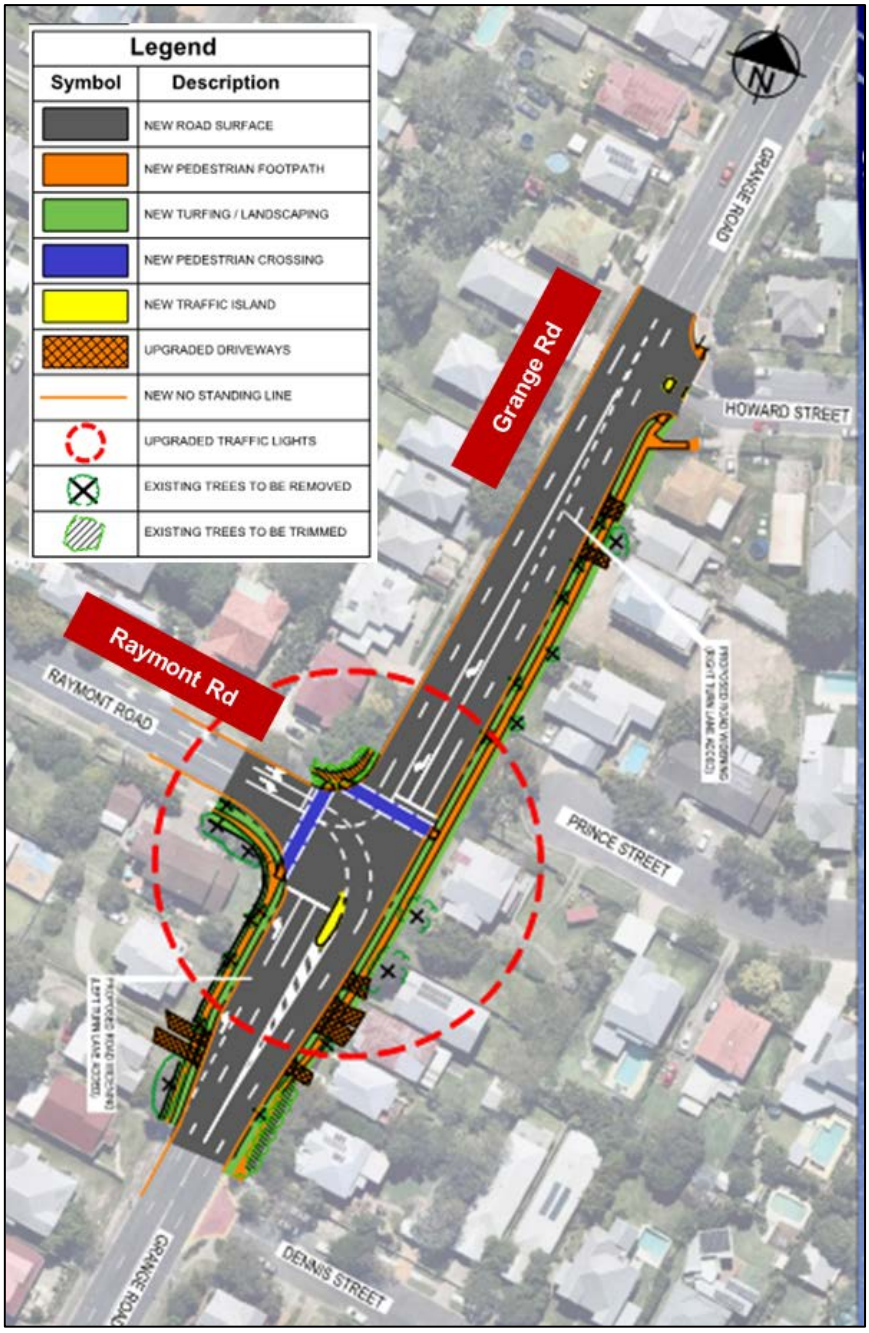

Figure 5-1: Project scope

5.4 OPTIONS CONSIDERED FOR UPGRADE

The 'do nothing' option was considered but discounted given the necessity for improvement as identified in the Wilston-Grange Precinct Transport Study.

Table 5-1 lists options for treatments at the Raymont Road / Grange Road intersection, identified in Section 6.1 of the Concept Design Report[18].

Table 5-1: Options

Option	Description
1	New right-turn lane on the Grange Road (north) approach only.
2	New right-turn lane on the Grange Road (north) approach and left-turn lane on the Grange Road (south) approach
3	New left-turn lane on the Grange Road (south) approach only.

The Concept Design Report identified Option 2 as the preferred option. Refer to the multi-criteria assessment in Section 5.5 to explain why Option 2 was selected.

The crest immediately south of the intersection fails to achieve sight distance criteria defined in the Austroads Guide to Road Design Part 4A[19], which has resulted in the installation of amber warning lights in advance of the intersection to alert drivers of this hazard. By locating the widening for the right-turn lane on the eastern side of Grange Road, Option 2 maintains a straight alignment for drivers travelling north through the intersection thus avoiding a horizontal alignment change immediately after a sub-standard crest.

The length of the proposed right-turn lane in the Option 2 initial concept design resulted in widening on eastern side of Grange Road extending north of the Grange Road / Howard Street intersection. To remove widening impacts on property north of Howard Street, Option 2A was developed as a modification of Option 2.

The preferred option, which is detailed in Section 5.3, is Option 2A.

5.5 MULTI CRITERIA ASSESSMENT

Option 2 in the Concept Design Report was selected as the preferred option as it provides the best overall traffic performance and highest level of safety.

Traffic analysis[20] demonstrates Option 2 has the lowest calculated delays in 2016, with average intersection delays of 20 seconds and 22 seconds during the morning and afternoon peak periods respectively. By 2031 the average forecast intersection delay remains at approximately 20 seconds during the morning peak period and increases to approximately 30 seconds during the afternoon peak period.

[18] Wilston – Grange Precinct – Intersection Concept Designs Report (WorleyParsons, 2017)
[19] (Austroads, 2010)
[20] Refer to Appendix 3 of the Concept Design Report in Appendix C.

A summary of the assessment against non-traffic attributes is listed in Table 5-2.

Table 5-2: Non-traffic option assessment[21]

Criteria	Option 1	Option 2	Option 3
Pedestrian facilities	No improvements to existing pedestrian facilities.		
Cycling facilities	No improvements to existing cycling facilities.		
Safety	Safety improved by providing a separated right-turn lane and right-turn signal phase for Grange Road southbound traffic.	Safety improved by providing: 1) a separated right-turn lane and right-turn signal phase for Grange Road southbound traffic. 2) a separated left-turn lane for Grange Road northbound traffic.	Some safety improvement by providing right-turn signal phase for Grange Road southbound traffic. However there will not be a separate right-turn lane.
Community impacts, including property impacts	8 residential properties with part resumptions.	11 residential properties with part resumptions.	3 residential properties with part resumptions.
Environmental	Low level impacts for all options		
Project costs	$2.8m	$3.9m	$1.3m
Utility services impacts	Electricity and telecommunications impacts	Electricity and telecommunications impacts	Low level
Constructability	All projects involve routine construction.		

A quantitative weighted multi-criteria assessment ranked Option 2 in preference to Option 1 and Option 3. Refer to Appendix C for details.

[21] Review and refinement of multi-criteria assessment, refer Wilston – Grange Precinct – Intersection Concept Designs Report (Worley Parsons, 2017)

6 COSTS

Table 6-1 is a cost summary for the project which is based on the estimate in the Concept Design Report[22].

Table 6-1: Cost summary

Summary information – project estimates			
Current funding		Current cost estimates	
Capital	$2,826,000	Capital	$2,826,000
Expense		Expense	
Ongoing costs (life of asset)		Ongoing costs (life of asset)	
Subtotal		***Subtotal***	
Revenue		Revenue	
Net total	$2,826,000	***Net total***	$2,826,000
Cost escalation and risk	$1,382,000	Cost escalation and risk	$1,382,000
TOTAL	$4,208,000	**TOTAL**	$4,208,000

Cash flow estimates			
Financial year	2016/17	2017/18	2018/19
Budget	$1,748,000	$1,534,000	$926,000
Current cost estimate	$1,748,000	$1,534,000	$926,000
Cumulative cost estimate	$1,748,000	$3,282,000	$4,208,000

Option 2A was developed to minimise the impact to properties on the eastern side of Grange Road.

[22] Refer to Section 7.4.7 of the Concept Design Report in Appendix C.

7 PROPOSED TIMING

The proposed timings for the project are detailed in Table 7-1. Timings for detailed design, land acquisition and construction are subject to funding approval.

The proposed timings are based on the current concept phase of the project. Procurement strategies and construction staging options will be investigated during the detailed design phase with the key objective of driving project efficiencies and value for money for Council.

Table 7-1: Proposed timings

Key activity / milestone	Start date	End date
Finalisation of concept design	April 2016	June 2016
Finalisation of business case	December 2016	May 2017
Stakeholder consultation	November 2016	May 2017
Detailed planning and design	November 2016	June 2017
Land acquisition	April 2017	March 2018
Road and civil construction	April 2018	Late 2018

8 RISKS

Key residual risks are documented in Table 8-1.

Table 8-1: Key residual risks

	Risk Severity	Risk Detail	Risk Owner
1	Minor	There are Telstra lines, mains gas, Energex lines and a water main located in the proposed widening.	Graham Nell
2	Minor	Design related risks include potentially unsuitable subgrade which will require additional test pits for pavement design. This may require an additional allowance for subgrade replacement.	Graham Nell
3	Minor	Construction impacts including traffic impacts, pedestrian impacts, and noise and dust disturbance.	Graham Nell

The project team will develop a risk management plan, including a risk register, with actions developed to target each of the risks identified above. The plan will be regularly updated to ensure that risks are managed appropriately and opportunities are developed to minimise the cost and impacts of the project.

9 INVESTMENT APPRAISAL

9.1 ROAD USER BENEFITS

Traffic assessment[23] shows introducing the project reduces the Raymont Road eastbound approach average morning peak period delay in 2016 from 100 seconds to 50 seconds, with a corresponding reduction in queue length from approximately 300m to 110m.

By 2031 average afternoon peak period delays are forecast to reduce from 300 seconds to 15 seconds for northbound Grange Road traffic and are forecast to reduce from 240 seconds to approximately 90 seconds for eastbound Raymont Road traffic.

The project is also forecast to improve safety at the intersection. Based on guidelines developed by Austroads[24], introducing a separate right-turn lane controlled by a right-turn signal has a crash reduction factor of 80% for right-turn vehicles colliding with opposing vehicles. Introducing separate left and right-turn lanes also has a combined crash reduction factor of 60% for rear-end collisions.

9.2 ECONOMIC ANALYSIS

The project has a benefit-cost ratio of 4.1, based on attributes shown in Table 9-1. The analysis is based on the preferred option.

Table 9-1: Economic analysis Net Present Value (NPV) summary

Parameter	NPV Value
Benefits	
• Crash savings	$1.8 million
• Operating savings	$15.5 million
• Total benefits	$17.3 million
Costs	$4.2 million

The economic analysis is based on a 15-year analysis period between 2016 and 2031, and a discount rate of 6%.

9.3 RECOMMENDATION

On the basis of a benefit-cost ratio of 4.1 for the project, it is recommended that the project should proceed with Option 2A as the preferred option.

Option 2A comprises provision of separate right and left-turn lanes on Grange Road at the Raymont Road / Grange Road intersection. Option 2A was developed to minimise the number of properties affected, by limiting road widening outside the current road reserve on the eastern side.

[23] Refer to Table 5.3 in the Traffic Assessment Report for further details.
[24] (Austroads, 2010)

10 REFERENCES

Austroads. (2010). Guide to Road Design Part 4A: Unsignalised and Signalised Intersections, Second Edition. Sydney: Austroads Ltd.

Brisbane City Council. (2013). *Brisbane Vision 2031.* Brisbane: Brisbane City Council.

Brisbane City Council. (2014). *Brisbane City Plan 2014 (ePlan).* Brisbane: Brisbane City Council.

Brisbane City Council. (2015). Wilston Grange Precinct Transport Study Technical Report, Issue 2, April 2015. Brisbane: Brisbane City Council.

Brisbane City Council. (2015). Wilston Grange Precinct Transport Study: Findings and Recommendations Study, Issue 2, April 2015. Brisbane: Brisbane City Council.

Brisbane City Council. (2017). Grange Road / Raymont Road Intersection, Intersection Upgrade Assessment Technical Note. Brisbane: Brisbane City Council.

Brisbane City Council. (2017). *PM2: Council's Project Management Methdology*. Retrieved from http://teams.bcc.qld.gov.au/sites/pmcoe/projectmanagement/Pages/default.aspx

WorleyParsons. (2017). Wilston-Grange Precinct - Intersection Concept Designs: Concept Design Report, Revision 2 issued on 14 February 2017. Brisbane: WorleyParsons.

11 APPENDIX A – PREFERRED OPTION CONCEPT LAYOUT

12 APPENDIX B – TRAFFIC REPORT

13 APPENDIX C – WILSTON-GRANGE PRECINCT INTERSECTIONS CONCEPT DESIGN REPORT