

Assessment of Contributions Plan No. 15 (2020) – Box Hill Precinct

The Hills Shire Council

Draft Report Local Government

September 2020

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Invitation for submissions

IPART invites written comment on this document and encourages all interested parties to provide submissions addressing the matters discussed.

Submissions are due by 29 September 2020

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Local Government Independent Pricing and Regulatory Tribunal PO Box K35 Haymarket Post Shop, Sydney NSW 1240

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1 Executive summary

The Hills Shire Council (the council) has revised its *Contributions Plan No. 15 – Box Hill Precinct* (CP15 (2020)) and submitted the draft to IPART for review. The council seeks to levy the full, uncapped contributions amount in CP15 (2020) from 1 January 2021.¹ To be able to do so, the plan must be assessed by IPART and the council must make any changes requested by the Minister for Planning and Public Spaces (the Minister) or his nominee.

This is the fourth time IPART has assessed CP15. Since the plan was first adopted in July 2014 we have completed reviews in December 2014, March 2016 and October 2018.

We found that the plan largely reflects the reasonable costs of local infrastructure required for the new development. However, we have also found that the council's approach to estimating the cost of some transport works, including roundabouts and signalised intersections, is not reasonable. We have made draft recommendations about the need (nexus) for some intersections and the amount of land the council has included in the plan for stormwater infrastructure. Our assessment also found that the council's approach to costing and apportioning the costs for the upgrade of Boundary Road is not reasonable.

Our draft recommendations would reduce the total cost of land, works and administration in CP15 (2020) from \$682.10 million to \$657.69 million. This equates to a decrease in total costs of 3.6% relative to the plan submitted to us. Our draft recommendations would also reduce the contribution rates in the plan. For a typical dwelling, our draft recommendations would reduce indicative contributions by \$4,345 (8.5%) to \$46,577 for the Killarney Chain of Ponds catchment and by \$3,803 (9.1%) to \$37,918 for the Second Ponds Creek catchment.

This Draft Report sets out our draft findings and recommendations to the Minister on the amendments required to ensure that the plan reflects the reasonable costs of providing the necessary local infrastructure to accommodate the development of the precinct.

¹ DPIE (letter from the Minister's Nominee), Letter to The Hills Shire Council, June 2020.



Have your say on Draft recommendations

We invite stakeholder comments on all our draft recommendations

We value the views of stakeholders and in particular ask for feedback to inform our assessment of the following topics:

Nexus for intersection changes proposed by the council

The council has provided traffic modelling to support changes to the treatment of intersections from the previous version of the plan. We found the council's approach is mostly reasonable, and invite stakeholder feedback on our findings and the council's modelling.

Half-width roads fronting non-developable land

The council has included all remaining half-width roads fronting non-developable land in the plan at a cost of over \$40 million, including land and works. The works costs are based on an IPART benchmark unit rate for local roads of \$1,982 per linear metre plus a 30% contingency allowance. We ask for stakeholder feedback on the council's approach and the unit rate the council has used to estimate the cost of half-width roads in the plan.

Apportionment of reasonable costs for the upgrade of Boundary Road

Boundary Road forms the boundary between The Hills LGA and Hawkesbury LGA. The section of Boundary Road between Menin Road and Windsor Road divides the Box Hill and Vineyard Stage 1 precincts. Our assessment found that the costs in the plan are too low and should be increased to reflect the IPART-assessed reasonable cost of the upgrade and revised traffic modelling which shows the demand arising from the Box Hill Precinct.

Inclusion of land that is not required for public infrastructure

The council has included an additional 17.2 hectares of land for stormwater in CP15 (2020) at a cost of \$5.13 million. The additional land is not required to deliver stormwater infrastructure. The council has included the additional land because of practical issues associated with land acquisition. We have found that nexus is not established for inclusion of the cost of this additional land for stormwater and ask for stakeholder feedback on:

- Whether any of the excess land that is not required for delivery of stormwater infrastructure has development potential and therefore should be removed from the plan
- Our draft recommendation to include any residual land as open space for the residents of Box Hill.

1.2 Our key findings

We have conducted this assessment in accordance with the guidance provided by the Department of Planning, Industry and Environment (DPIE) in its Practice Note.² We found that most aspects of the plan meet the assessment criteria in the Practice Note, with the exception of nexus, reasonable cost and apportionment for some transport infrastructure and nexus for some land for stormwater management.

Some signalised intersection and roundabout costs are based on unreasonable estimates

We found that the revised costing sources used by the council for most signalised intersections and two-lane roundabouts are not reasonable. For signalised intersections, we consider the costings used in the previous version of the plan are more reasonable. For roundabouts, we have recommended a more reasonable estimate based on the IPART-assessed reasonable cost of a comparable roundabout in North Kellyville. Our draft recommendations for intersections would reduce the cost of transport infrastructure in the plan by \$36.22 million.

More of the costs of upgrading Boundary Road should be apportioned to the plan

We found that the council's approach to costing the upgrade of Boundary Road to an urban standard collector road is not reasonable. We have recommended the council include additional costs, in recognition of is its shared role in planning and delivering the road. Our recommended approach to apportionment reflects advice from Transport for NSW (TfNSW) about the additional traffic volume expected to use the road from the Box Hill Precinct. Our draft recommendation would increase the cost of transport infrastructure in the plan by \$17.71 million.

The council should investigate opportunities to re-sell or re-purpose excess land

We found that the council has included additional stormwater land in the plan that is not required to deliver stormwater infrastructure. The council has included the additional land because of practical issues associated with land acquisition. We have found that nexus is not established for inclusion of additional stormwater land, but it may be if it can be used for open space; and that the council should:

- Identify land with development potential that can be resold, and remove the cost of this land from the plan
- Include any residual land as open space, to increase the provision of open space land for the residents of Box Hill.

Open space provision in the Box Hill Precinct should increase

We found that the overall provision of open space in the plan is low. The provision of 1.45 hectares of open space per 1,000 new residents is below the Growth Centres' benchmark of 2.83 hectares per 1,000 residents.

² See Department of Planning and Environment (DPE), Local Infrastructure Contributions Practice Note, January 2019 (Practice Note). We also assessed whether CP15 (2020) contains information required by the Environmental Planning and Assessment Regulation 2000.

The council has identified 44.27 hectares of water management land which may be suitable for recreation, but it has not included this land or its potential embellishment in the open space provision in CP15 (2020).³ If this was included as open space, it would increase the rate of provision to 2.49 hectares per 1,000 residents. We note there is also the potential for excess stormwater land to be included as open space.

1.3 Our draft recommendations

We have made 17 draft recommendations as a result of our assessment of CP15 (2020).

All our draft recommendations (and the page number on which they appear in the following chapters) for CP15 (2020) are listed below. All recommendations require action by the council.

Transport

1	Transfer verges adjoining roads and road bridges within open space to transport wo	rks.
	This would increase transport costs by \$1,549,248.	23

- Remove the cost of the signalised T-junction intersection at the corner of Terry Road and High Street [BHT18] because nexus is not established. This would reduce costs in the plan by \$5,300,000.
 23
- Increase the cost of the intersection at the corner of Prosper Street and Mount Carmel
 Drive [BHT17] by \$346,740 because nexus is established for a signalised intersection
 instead of a roundabout.
- 4 Reduce the cost of half-width roads by \$1,889,008 to reflect a lower contingency allowance of 20%.
- 5 Reduce the cost of the Northern Connection Road if it is partially funded through the NWGA SIC. 31
- Reduce the cost of two-lane roundabouts [BHR01, BHR02, BHR03, BHR08] by
 \$5,904,927, reflecting a more reasonable estimate of costs based on a comparable roundabout in North Kellyville.
 31
- Reduce the cost of signalised intersections [BHT10, BHT13, BHT14, BHT15, BHT20] by \$29,269,935, reflecting the previous estimated costs, which were based on AECOM's 2014 technical study.
 31
- Reduce the cost of the signalised intersection [BHT22] by \$1,043,040, reflecting an estimate based on the cost of installing signals only, plus a 20% contingency allowance.
 31
- 9 Apportion 67% of the costs of the Northern Connection Road to the plan, based on the most up-to-date population forecasts for Box Hill (CP15) and North Kellyville (CP13). 38

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³ CP15 (2020), p 24.

10	Revise the reasonable cost of upgrading Boundary Road to \$32,395,205 and include
	81.7% of this cost in the plan, reflecting the demand for the upgrade that is generated
	from the Box Hill Precinct. This would increase costs in CP15 (2020) by \$17,706,650.39

Stormwater management

11	Remove 4,034m ² of land for stormwater infrastructure from the plan, for which nexus not established. This would reduce the cost of stormwater land in the plan by \$664,398.	is 48
12	For a further 13,214m ² of stormwater land for which nexus is not established:	48
	 Remove the cost of any land with development potential from the plan 	48
	 Include any residual land as open space in the plan. 	48
Plan	administration	
13	Revise the cost of plan administration for CP15 (2020) to reflect 1.5% of the adjusted cost of works.	61
Cros	s category	
14	Recalculate all escalation factors using a compound annual average growth rate formula instead of a simple average formula.	65
15	Update the discount rate in the financial model to 3.2%, which is the latest available Local Government Discount Rate.	66
16	Comprehensively review the plan within the next five years to ensure assumptions about the scope, cost and apportionment of land and works reflect the progress of development in the precinct.	67
17	Update the plan to ensure that the maps showing locations of infrastructure are accurate and accessible.	67

The impact of our draft recommendations is presented in Table 1.1, Table 1.2 and Table 1.3. More detailed tables on the recommended changes are presented in each of the infrastructure category chapters, and summarised at Appendix A.

We note that draft recommendation 5 is not reflected in our assessed reasonable costs and there may be further adjustments to the cost of stormwater land, depending on the outcome of consultation.

The IPART-calculated contribution rates are indicative only and reflect our draft recommendations and the council's assumptions about the timing of revenues and costs in the plan. We have asked the council for additional information to clarify the revenue it has received to date from contributions in CP15 (2020), which may impact contribution rates.

	Cost in plan (\$Jun2019)	Draft IPART - recommended adjustment (\$)	Draft IPART - assessed reasonable cost (\$)
Transport			
Land	51,665,809	0	51,665,809
Works	180,953,757	-21,856,829	159,096,928
Stormwater			
Land	82,752,997	-664,398	82,088,599
Works	84,974,681	0	84,974,681
Open space			
Land	170,321,018	0	170,321,018
Works	105,865,380	-1,549,248	104,316,131
Community facilities			
Land	0	0	0
Plan administration	5,576,907	-351,091	5,225,816
Total	682,110,548	-24,421,566	657,688,981

Table 1.1 Summary of draft adjustments – CP15 (2020) (\$Jun2019)

Source: CP15 (2020) Works Schedule and IPART analysis.

Table 1.2Draft indicative contributions (Killarney Chain of Ponds) by dwelling type
(\$Jun2019)

	Occupancy rate per dwelling	Indicative contribution (\$)	Draft IPART- adjusted contribution (\$)	Difference (\$)	Difference (%)
Subdivision, dwelling house, dual occupancy	3.4	50,922	46,577	4,345	8.5
Integrated housing	2.7	40,438	36,987	3,451	8.5
Senior housing	1.5	22,466	20,549	1,917	8.5
Multi-unit housing rates:					
1 bedroom	1.7	25,461	23,288	2,173	8.5
2 bedroom	1.8	26,959	24,658	2,301	8.5
3 bedroom	2.5	37,443	34,248	3,195	8.5
4 bedroom	3.1	46,429	42,467	3,962	8.5

Source: CP15 (2020) p 6 and 19 and IPART analysis.

	Occupancy rate per dwelling	Indicative contribution (\$)	Draft IPART- adjusted contribution (\$)	Difference (\$)	Difference (%)
Subdivision, dwelling house, dual occupancy	3.4	41,721	37,918	3,803	9.1
Integrated housing	2.7	33,132	30,112	3,020	9.1
Senior housing	1.5	18,406	16,729	1,677	9.1
Multi-unit housing rates:					
1 bedroom	1.7	20,861	18,959	1,902	9.1
2 bedroom	1.8	22,088	20,074	2,014	9.1
3 bedroom	2.5	30,677	27,881	2,796	9.1
4 bedroom	3.1	38,040	34,573	3,467	9.1

Table 1.3Draft indicative contributions (Second Ponds Creek) by dwelling type
(\$Jun2019)

Source: CP15 (2020) p 6 and 19 and IPART analysis.

1.4 Structure of this Draft Report

The following chapters provide our analysis of CP15 (2020) against the criteria in the Practice Note, and explain the draft recommendations we have made for The Hills Shire Council to make adjustments to the plan.

- Chapter 2 outlines the context for our assessment of contributions plans
- Chapter 3 provides an overview of CP15 (2020)
- Chapter 4 presents our analysis of transport infrastructure
- Chapter 5 presents our analysis of stormwater infrastructure
- Chapter 6 presents our analysis of open space embellishment
- Chapter 7 presents our analysis of plan administration
- Chapter 8 presents our analysis of cross-category issues, ie, land costs, the council's financial model, timing of infrastructure delivery (Criterion 4), consultation (Criterion 6) and other matters (Criterion 7).

1.5 How you can have a say on this Draft Report

We are seeking written submissions on this Draft Report. Submissions should address the Practice Note criteria, set out in section 2.2.1 of this report, and IPART's assessment against the criteria. Submissions are due by **Tuesday**, **29 September 2020**. Late submissions may not be accepted. More information on how to make a submission can be found on page ii of this Draft Report. We will provide our Final Report to the Minister for Planning and Public Spaces in **November 2020**.

Figure 1.1 Our assessment timeline



Note: Our assessment was placed on hold between 3 June 2020 and 23 July 2020 while we waited for further information from the council to complete our assessment.

2 Context and approach for this assessment

We commenced our assessment of CP15 (2020) in March 2020. This is the fourth time we have assessed CP15. To provide context for our assessment, the sections below outline:

- Why the council submitted CP15 (2020) for assessment
- Our approach and consultation process for assessment
- What will happen next.

2.1 Why has the council submitted its plan to IPART?

IPART assesses contributions plans from councils that propose to levy contributions above \$30,000 per residential lot or dwelling in identified greenfield areas and \$20,000 per residential lot or dwelling in other areas.⁴

The council has submitted the draft plan for IPART's assessment because the contributions for some types of residential development exceed the \$30,000 per lot/dwelling review threshold, which applies under clause 6A(6) of the Ministerial Direction.⁵ In addition, the Minister requested the council revise the plan to reflect updated population figures for the Box Hill Precinct.⁶

The council has until 31 December 2020 to adopt a contributions plan that has been reviewed by IPART and reflects amendments requested by the Minister or Minister's Nominee.⁷

2.2 What approach did we use for this assessment?

In assessing CP15 (2020) we considered:

- The criteria set out in the Local Infrastructure Contributions Practice Note (Practice Note) issued by DPIE⁸
- Information and further advice from the council and DPIE on various aspects of the plan.

⁴ Minister for Planning, *Environmental Planning and Assessment (Local Infrastructure Contributions) Direction* 2012, 21 August 2012, as amended (Ministerial Direction).

⁵ Ministerial Direction, as amended by the *Environmental Planning and Assessment (Local Infrastructure Contributions) Further Amendment Direction 2018* (issued on 18 December 2018).

⁶ Minister for Planning, Letter to The Hills Shire Council, August 2019.

⁷ DPIE (letter from the Minister's Nominee), Letter to The Hills Shire Council, June 2020.

⁸ Department of Planning and Environment, *Practice Note - Local infrastructure Contributions*, January 2019. The January 2019 Practice Note replaces the January 2018 *Practice Note - Local infrastructure Contributions*. The 2019 revision clarifies the timing of when a council can adopt a contributions plan (particularly where the draft plan proposes a rate above the maximum cap amount in the Direction). The assessment criteria for our review remain the same.

2.2.1 We considered the assessment criteria in the Practice Note

IPART's assessment functions for local infrastructure contributions plans are based on terms of reference issued by the Premier under section 9 of the *Independent Pricing and Regulatory Tribunal Act* 1992 (see Appendix B).

As required by these terms of reference, we have assessed CP15 (2020) in accordance with the criteria set out in the Practice Note. The criteria require us to assess whether:

- 1. The public amenities and public services in the plan are on the essential works list.
- 2. There is a reasonable nexus between the proposed public amenities and public services in the plan and the development.⁹
- 3. The proposed development contribution is based on a reasonable estimate of the cost of the proposed public amenities and public services.
- 4. The proposed public amenities and public services can be provided within a reasonable timeframe.
- 5. The proposed development contributions are based on a reasonable apportionment of costs.
- 6. The council has conducted appropriate community liaison and publicity in preparing the contributions plan.
- 7. The plan complies with other matters we consider relevant.

We also assessed whether the plan contains the information required by Clause 27 of the *Environmental Planning and Assessment Regulation 2000*. A summary of our assessment of the CP15 (2020) against these requirements is provided at Appendix D.

2.2.2 We considered the Minister's advice on the recommendations from our 2016 and 2018 assessments of CP15

We previously assessed CP15 in 2014, 2016 and 2018, which enabled the council to apply for funding from the NSW Government to meet the gap between the contributions cap and the "IPART-assessed" reasonable cost of providing infrastructure in the plan. For the last review of CP15 in 2018, the Minister for Planning requested IPART focus its assessment on three nominated items, before the council could submit its application for Local Infrastructure Growth Scheme (LIGS) funding.

In response to our reviews of the plan in 2016 and 2018, the council was required to make 21 amendments to the plan. In assessing CP15 (2020), we have considered how the council has amended the plan to reflect the Minister's advice.

⁹ Nexus ensures that there is a connection between the land and facilities in a contributions plan and the demand for them arising from the new development.

Following our 2018 review, the Minister required the council to amend the plan in two stages:

- 1. **Stage 1** required the council to amend the plan to reflect 12 recommendations, before it was eligible to access LIGS funding. The council made the changes and adopted a version of the plan in November 2019.¹⁰
- 2. **Stage 2** required the council to reflect a higher estimated population for the precinct, make other minor changes and re-submit the plan to IPART for review.¹¹

The November 2019 version of the plan is currently in force 'CP15 (2019)'. The Minister's Nominee deemed CP15 (2019) to be an 'IPART reviewed contributions plan', enabling the council to levy contributions in accordance with that plan until 31 December 2020,¹² subject to clause 6E of the Ministerial Direction.¹³ The council will be able to levy contributions in accordance with CP15 (2020) once it satisfies all of the following:

- IPART has completed its review of CP15 (2020)
- The Minister (or Minister's Nominee¹⁴) has advised the council as to any amendments required to the plan
- The council approves the plan, having made the amendments in accordance with the advice of the Minister or Minister's Nominee.¹⁵

Having satisfied these requirements, CP15 (2020) will be an 'IPART reviewed contributions plan.'

2.2.3 We considered changes to the plan since our previous assessment

There have been changes to the plan since our previous assessment. These changes include a revised population projection for the Box Hill Precinct (with implications for the demand for and provision of infrastructure), new transport infrastructure items, revised scopes and costings of some infrastructure, and additional land in the plan. These changes are outlined further in Chapter 3 and in the relevant infrastructure chapters.

The Works Schedule for CP15 (2020) shows that the council has acquired over one third of the land in the plan, completed some stormwater and transport works, but delivered no open space embellishment.

Our assessment of CP15 (2020) has considered whether the council's actual and estimated costs are reasonable.

¹⁰ The Hills Shire Council, 26 November 2019, Ordinary Council Meeting Minutes, pp 8-9.

¹¹ Minister for Planning, letter to The Hills Shire Council, August 2019.

¹² Minister for Planning, letter to The Hills Shire Council, August 2019.

¹³ Ministerial Direction, 2012, as amended by the *Environmental Planning and Assessment (Local Infrastructure Contributions) Amendment Direction 2020* (issued on 18 June 2020). Subclause (4) provides that the council must not grant development consent relating to any land within The Hills local government area between 1 July 2020 and 31 December 2020 requiring the payment of a monetary contribution exceeding \$50,000 for each dwelling authorised by, or each residential lot authorised to be created by, the development consent. However, the council may impose a condition requiring the payment of a monetary contribution that exceeds \$50,000 per dwelling or per residential lot if the monetary contribution is paid after 1 July 2021 (subject to the provisions of the contributions plan and the other provisions of the amended Ministerial Direction that would, but for clause 6E, apply).

¹⁴ Ministerial Direction, 2012, as amended, cl 5(3)(c), *…the Minister (or a nominee of the Minister) has advised the relevant council as to any amendments required to the contributions plan.*'

¹⁵ Ministerial Direction, 2012, as amended, cl 5(3).

2.3 What happens next?

We are now seeking submissions on our draft findings and recommendations and invite comment from interested parties by 29 September 2020. You can find details of how to make a submission on page iii of this Draft Report.

A list of our draft recommendations is in section 1.3 of Chapter 1.

We will take stakeholder submissions into account in determining our recommendations in the Final Report. As required by our Terms of Reference, we will deliver our Final Report to the Minister and the council.

The Minister will then consider our assessment and, if appropriate, request the council to amend the contributions plan. Once the council has made any requested amendments, the plan becomes an 'IPART-reviewed plan' and the council may levy contributions in accordance with the adopted plan.

3 Overview of the plan

CP15 (2020) applies to development in the Box Hill Precinct, comprising the residential suburb of Box Hill and the Box Hill Industrial precinct, located approximately 40km north west of Sydney's CBD in the North West Growth Area (NWGA).

The precinct was rezoned for urban development in April 2013 and covers an area of 974 hectares, including approximately 724 hectares of land zoned for residential development and 133 hectares of industrial and commercial space.¹⁶

In 2017, DPIE released the *North West Priority Growth Area Land Use and Infrastructure Plan* (the LUIP), which included revised population estimates for the Box Hill Precinct.

3.1 Status of CP15 (2020)

The Hills Shire Council exhibited the revised CP15 (2020) between 17 December 2019 and 7 February 2020. The version of the plan that is currently in force was adopted in November 2019.

The revised plan, submitted to IPART in March 2020, is intended to address outstanding amendments relating to updated population projections for the Box Hill Precinct that the Minister requested in response to our 2018 review of the plan.

Since our 2018 review, the council has also made the following changes to the plan:

- Transport new items (land and works for half-width roads fronting non-developable land, bridge works, one intersection), changes to a number of intersections, revised costings and 3.1 hectares of additional transport land.
- Stormwater 1.7 hectares of additional land that has been included in the plan because of practical issues associated with land acquisition.
- **Open space** 0.2 hectares of additional land for an existing park.
- Administrative amendments and updated assumptions including updates to the Net Present Value (NPV) model used to calculate contributions and incorporation of actual expenditure and revenue up to 30 June 2019.

3.2 Land and development in the Box Hill Precinct

As shown in Figure 3.1, the Box Hill Precinct is located in the north-east of the NWGA. In relation to other precincts, Boundary Road creates the border of the precinct with the adjoining Vineyard precinct to the west and Windsor Road separates Box Hill from Riverstone and Riverstone East precincts to the south.

¹⁶ State Environmental Planning Policy (Sydney Region Growth Centres) Amendment (The Hills Growth Centres), gazetted April 2013; and DPE, Fact Sheet Box Hill and Box Hill Industrial, March 2013.



Figure 3.1 Map of the North West Growth Area

Source: DPIE website, https://www.planning.nsw.gov.au/-/media/Images/DPE/Maps/Plans-for-your-area/north-west-growth-area-map-2400x1696.gif?la=en

Figure 3.2 is the Box Hill Indicative Layout Plan (ILP), showing the broad level development outcomes for the Box Hill Precinct.



Figure 3.2 Box Hill Precinct Indicative Layout Plan

Source: DPIE, Box Hill Growth Centre Precincts, Development Control Plan, March 2018, p 45.

3.2.1 Changes to population projections

Since we reviewed CP15 (2018), the council has revised its estimate of the residential population to be accommodated in the Box Hill Precinct. The revised estimate reflects:

- Higher development yields arising from the NSW Government's Housing Diversity initiatives within the Growth Centre Precincts (in particular, application of minimum density targets without an associated maximum density limitation)
- Higher dwelling occupancy rates based on the 2016 Census.

The changes to population projections address two of the recommendations from our review of CP15 (2018). The Minister requested the council make these amendments to the plan.¹⁷

The expected net additional residential population in the plan's catchment area has increased by 11,796 people, from 30,687 in CP15 (2018)¹⁸ to 42,483 in CP15 (2020). When fully developed, the precinct is expected to provide 13,276 dwellings (an increase of 3,052 dwellings from CP15 (2018))¹⁹ and support around 17,700 jobs.²⁰

Table 3.1 sets out the average occupancy rates for the different types of residential development based on historical analysis of six similar development areas in The Hills Shire Council LGA as at the 2016 Census.²¹ The council uses these occupancy rates in CP15 (2020).

Dwelling type	Average occupancy rates
Dwelling Houses	3.4
Integrated Housing Development	2.7
Senior Housing	1.5
Multi-Unit Housing:	
1 Bedroom	1.7
2 Bedroom	1.8
3 Bedroom	2.5
4 Bedroom	3.1

Table 3.1 The Hills Shire Council – Average occupancy rates

Source: CP15 (2020), p 19.

Table 3.2 shows the land area, estimated floor space and resulting job forecast for development in the Box Hill Precinct.²²

¹⁷ Minister for Planning, Letter to The Hills Shire Council, August 2019.

¹⁸ CP15 (2018), p 20.

¹⁹ CP15 (2018), p 18.

²⁰ DPIE, North West Priority Growth Area, Land Use and Infrastructure Implementation Plan, 2017.

²¹ CP15 (2020), p 19.

²² CP15 (2020), p 21.

Land use	Development area (ha)	Jobs per hectare of development area	Total jobs
B7 Business Park	69.4	183	12,700
B6 Enterprise Corridor	26.9	128	3,447
IN2 Light Industrial	6.1	63	381
B2 Local Centre	13.0	97	1,261
Total	115.38		17,789

Table 3.2 Total estimated jobs in Box Hill Precinct

Source: CP15 (2020), p 21.

3.3 Cost of land and works in CP15 (2020)

The total cost of land, works and plan administration in CP15 (2020) is \$682.10 million (\$Jun2019). This comprises:

- \$304.74 million (44.7%) for the acquisition of land for local infrastructure
- \$371.79 million (54.5%) for local infrastructure works
- ▼ \$5.58 million (0.8%) for plan administration.

3.4 Contribution rates in CP15 (2020)

The council uses a NPV approach to calculate the contribution rates in CP15 (2020). It uses this approach to ensure that the value of contributions is not eroded over time and reflects the time value of money. For CP15 (2020) the council has two NPV models which calculate contribution rates for residential and non-residential development. The models reflect assumptions about the timing of revenues, ie, when development is expected to occur, and the timing of expenditure, ie, which it expects to deliver the infrastructure in the plan over the next 25 years (the life of the plan).

The model discounts revenues and costs, based on the council's assumptions, to arrive at a present value contribution rate. The council's approach to modelling contribution rates is discussed further in Chapter 8.

3.4.1 Contributions are levied on a per person or gross floor area basis

Contributions for transport, open space and plan administration costs are calculated on a per person basis for residential development, and on a per square metre of gross floor area (GFA) basis for non-residential development.

Contributions for stormwater infrastructure costs are calculated on a per person basis for residential development, and on a per square metre of GFA basis for non-residential development. In addition, the council calculates separate stormwater contribution rates for development in the Killarney Chain of Ponds (KCP) drainage catchment and the Second Ponds Creek (SPC) drainage catchment.

Table 3.4 shows the contribution rates by infrastructure category for residential and non-residential development.

Infrastructure category	Residential (per person)	Non-residential (per hectare)
Transport	4,187	862,600
Stormwater management (KCP)	3,745	276,800
Stormwater management (SPC)	1,040	73,800
Open space	6,937	0
Community facilities	0	0
Administration	108	10,600
Total (KCP)	14,977	1,150,000
Total (SPC)	12,271	947,000

 Table 3.4
 Contribution rates by infrastructure category (\$Jun2019)

Note: The plan includes separate contributions catchments for stormwater management costs. Development in the KCP catchment pays a contribution of \$14,977 per person, while development in the SPC catchment pays a contribution of \$12,271 per person.

School developments in Box Hill are only required to pay the per hectare contributions towards stormwater management land and works.

Source: CP15 (2020) pp 5 and 7.

3.4.2 Indicative residential contributions

Indicative residential contributions are derived by multiplying the per person rate by the expected number of occupants for each dwelling type. They range from \$20,861 for a 1-bedroom multi-unit dwelling in the Second Ponds Creek catchment to \$50,922 for a detached house in the Killarney Chain of Ponds catchment. Table 3.5 shows the indicative residential contribution rates in CP15 (2020).

Dwelling type	Occupants per dwelling	Indicative contribution (\$)	
		Killarney Chain of Ponds	Second Ponds Creek
Subdivision, dwelling house, dual occupancy	3.4	50,922	41,721
Integrated housing ^a	2.7	40,438	33,132
Senior housing and boarding house rooms	1.5	22,466	18,406
Multi-unit housing:			
1 bedroom	1.7	25,461	20,861
2 bedrooms	1.8	26,959	22,088
3 bedrooms	2.5	37,443	30,677
4 bedrooms	3.1	46,429	38,040

Table 3.5 Indicative residential contribution rates in CP15 (2020) (\$Jun2019)

a Small lot housing, The Hills Shire Council, LEP, cl 4.1B.

Source: CP15 (2020), pp 6 and 19.

3.4.3 Indicative non-residential contributions

Indicative non-residential contributions are derived from the per square metre rate of GFA. Contributions for schools are derived from the per square metre rate of GFA for stormwater management land and works only.²³ In the Killarney Chain of Ponds catchment, contributions are around \$1,150,000 per hectare for non-residential development and \$276,000 per hectare for schools. In the Second Ponds Creek catchment, the equivalent contributions are around \$947,000 and \$74,000 per hectare, respectively. Table 3.4 in section 3.4.1 above shows the indicative non-residential contribution rates in CP15 (2020).

²³ This approach is consistent with the Minister's advice to the council on 23 June 2017.

4 Transport

The total cost of transport land and works in CP15 (2020) is \$232.62 million (34.1% of total costs), comprising:

- ▼ \$51.67 million for land (17.0% of the total cost of land)
- ▼ \$180.95 million for works (48.7% of the total cost of works).

Our draft assessment of the transport land and works in CP15 (2020) is:

- Criterion 1: Essential works All transport land and works are consistent with the essential works list. Transport-related costs in open space, which we have recommended be moved to the transport category, are consistent with the essential works list.
- Criterion 2: Nexus There is nexus between most transport land and works in the plan and development in the Box Hill Precinct. The council's revised transport modelling supports changes for two intersections.
- Criterion 3: Reasonable cost The council's approach to estimating costs for different categories of transport works is reasonable, except:
 - The council should reduce the contingency allowance for half-width roads fronting non-developable land from 30% to 20%
 - The council should revise its estimated costs of some signalised intersections and two-lane roundabouts
 - The council should reduce the cost of the Northern Connection Road if it is funded through the North West Growth Area Special Infrastructure Contribution (NWGA SIC)
 - The cost of upgrading Boundary Road to an urban standard collector road is too low.
- Criterion 5: Apportionment The council's approach to apportioning costs is reasonable, except:
 - More costs for the upgrade of Boundary Road should be apportioned to CP15
 - The council should reflect the updated population estimates when apportioning costs for the Northern Connection Road.

Our draft assessment of land for transport against Criterion 3 (Reasonable cost) is in Chapter 8.

Based on our findings, we recommend adjustments to the plan we estimate would reduce the cost of transport land and works by \$21.86 million (9.4%). Our draft findings and recommendations are summarised in Table 4.1.

Criterion	Draft findings	Draft recommendations	Land	Works
Total costs in plan			51,665,809	180,953,757
Essential works	All land and works in the plan are consistent with the essential works list.			
	Some open space costs are better categorised as transport costs	Transfer the cost of verges and bridges from the open space category to transport works		1,549,248
Nexus	Nexus is established for all land and works in the plan, except:			
	The council's transport modelling supports changes to the treatment of intersections	 Remove the cost of upgrading BHT18 Increase the cost of delivering BHT17 		-4,953,260
Reasonable cost - Land	The cost of land for transport works is reasonable.			
Reasonable cost – Works	The cost of works is mostly reasonable, except:			
	The contingency allowance for half-width roads is too high	Reduce the contingency allowance from 30% to 20%		-1,889,008
	Part of the Northern Connection Road may be funded through the SIC	Reduce the cost of the road if funded through the SIC		Not costed
	Revised cost estimates for two-lane roundabouts are unreasonable	Revise costs based on the estimated cost of a similar roundabout in North Kellyville		-5,904,927
	Revised cost estimates for some signalised intersections are unreasonable	 Reduce the cost to reflect the AECOM 2014 technical study Reduce the cost of intersection BHT22 		-30,312,975
Apportionment	Approach is mostly reasonable			
	The Northern Connection Road should be apportioned based on revised population estimates	Increase the cost of the Northern Connection Road so that the plan includes 67% of the total cost, in line with its share of the total population of the Box Hill and North Kellyville Precincts		1,947,443
	More of the costs of upgrading Boundary Road should be apportioned to CP15 (2020)	Increase the cost of Boundary Road to reflect updated transport modelling from TfNSW		17,706,650
Total IPART-recom	mended cost adjustment		0	-21,856,829
Total IPART-asses	sed reasonable cost		51,665,809	159,096,928

 Table 4.1
 IPART-recommended adjustments for transport (\$Jun2019)

Source: CP15 (2020) Works schedule, IPART analysis.

4.1 Overview of transport works in CP15 (2020)

Prior to re-zoning, the transport network in Box Hill was designed to cater for rural traffic volumes only. Urbanisation of the area requires new and upgraded roads, new bridges, intersections, bus stops and cycleways.

Transport works account for around 48.7% of works costs in CP15 (2020). The cost of transport works is driven by the cost of intersections (\$63.0 million or 34.8% of total works costs) and bridges (\$38.41 million or 21.2% of total works costs). Table 4.2 shows the cost of transport land and works in the plan.

Since our last assessment of the plan in 2018, the council has made changes to the scope and cost of transport works. In particular, it has included an additional \$41.93 million to fund the upgrade of half-width roads fronting non-developable land.

Item	Cost of land	Cost of works	Total cost
New roads	10,270,365	29,632,127	39,902,492
Road upgrades	12,839,804	22,742,859	35,582,663
Road upgrades (half-width roads)	17,369,580	24,557,109	41,926,689
Bridges	5,792,187	38,411,785	44,203,972
Intersections	5,393,872	63,002,905	68,396,777
Bus stops	0	497,134	497,134
Cycleways	0	2,109,838	2,109,838
Total	51,665,809	180,953,757	232,619,565

Table 4.2 Transport land and works in CP15 (2020) (\$Jun2019)

Source: CP15 (2020) Works Schedule.

The plan does not provide a single, consolidated map showing the location of transport land and works in the plan. The locations of most transport land and works can be seen across multiple maps at pages 55-68 of CP15 (2020).

4.2 Criterion 1: Essential works

All land and works for transport in CP15 (2020) are consistent with the essential works list in the Practice Note.²⁴ The items of transport infrastructure in CP15 (2020) are set out in Table 4.3. There is a land component for most transport infrastructure items.

Table 4.3 Transport works items in CP15 (2020)

Items on the essential works list				
▼	New and upgraded roads	▼	Bus stops	
▼	Bridges	▼	Cycleways	
▼	Intersections			

Source: The Hills Shire Council, CP15 (2020), pp 37-39.

²⁴ Department of Planning and Environment, *Local Infrastructure Contributions Practice Note*, January 2019.

We also found that verges adjoining roads and bridges in the schedule of open space embellishment are more appropriately classified as transport infrastructure and their costs should be transferred to the transport category in the works schedule for CP15 (2020).

Draft recommendation

1 Transfer verges adjoining roads and road bridges within open space to transport works. This would increase transport costs by \$1,549,248.

4.3 Criterion 2: Nexus

In assessing whether there is nexus between the transport land and works and the development in the plan, we reviewed the findings in our previous assessments and consider they remain relevant. We have focused our assessment on changes to the plan since we last assessed it in 2016 and 2018.²⁵

Since we last assessed the plan, the council has changed the treatment of some intersections, included additional land for some roads and intersections and added all remaining, undelivered half-width roads fronting non-developable land.

We have found that:

- The council has changed the treatment of eight intersections and relies on its internal traffic modelling to establish nexus for the intersection changes. We consider the council's approach to the traffic modelling and changes to the treatment of intersections are mostly reasonable. However, the council's traffic modelling supports the following further changes to intersections:
 - BHT18: change from signalised intersection to give-way signed intersection
 - BHT17: change from a roundabout to a signalised intersection.
- Nexus is established for the signalised intersection of Terry Road and Old Pitt Town Road, although this is not supported by the technical studies.
- The council has included an additional 3.1 hectares of land for transport in CP15 (2020). The additional land is required to deliver transport infrastructure in the Box Hill Precinct. We have found that nexus is established for inclusion of this additional land to deliver transport infrastructure.
- The council has included \$41.93 million to deliver 9.5km of half-width roads fronting non-developable land. We have found that nexus is established for inclusions of these works.

Draft recommendations

2 Remove the cost of the signalised T-junction intersection at the corner of Terry Road and High Street [BHT18] because nexus is not established. This would reduce costs in the plan by \$5,300,000.

At the request of the Minister for Planning, our 2018 review of CP15 primarily focused on changes to the plan since out 2016 assessment. We consider the findings from both our 2016 and 2018 assessments remain relevant.

3 Increase the cost of the intersection at the corner of Prosper Street and Mount Carmel Drive [BHT17] by \$346,740 because nexus is established for a signalised intersection instead of a roundabout.

4.3.1 Nexus for most transport works is established through technical studies and consultant advice

The technical studies relied on by the council to establish nexus for most transport infrastructure are unchanged from CP15 (2020) (Table 4.4).

Author	Title	Date
GHD	Box Hill and Box Hill Industrial Precincts – Transport and Access Study	February 2011
GHD	Box Hill and Box Hill Industrial Precincts – Post Exhibition Traffic Study Review	April 2012
AECOM	Boundary Road Strategic Concept Design Study	February 2013
AECOM	Traffic Management & Open Space Strategic Design	January 2014
Calibre Consulting	SEPP Amendments to rezone land for the relocation of Mount Carmel Road, Box Hill	March 2014
Brown Consulting	Intersection Design and Traffic Assessment	March 2014

 Table 4.4
 Technical studies for transport works in CP15 (2020)

Source: CP15 (2020), p 26, IPART, Assessment of The Hills Shire Council's Section 94 Contributions Plan No 15, March 2016, p 31 and IPART, Assessment of revised Contributions Plan 15 for Box Hill, October 2018, p 36.

The proposed transport network in CP15 (2020) relies on strategic traffic modelling prepared by GHD in 2011 during precinct planning, which identified likely traffic volumes on the road network to inform the future road hierarchy in the Box Hill Precinct.²⁶

Since precinct planning, the council has made a number of changes to the initial scope and layout of transport infrastructure.

Our 2018 assessment considered changes to the transport network, in particular along Mount Carmel Road and Terry Road. Our 2018 assessment found:

- The additional technical studies commissioned by the council establish nexus for most items on Mount Carmel Road²⁷
- The changes to Mount Carmel Road were reflected in subsequent planning documents from DPIE.²⁸
- Changes to the scope of works along Terry Road were not supported by additional technical studies. However, we considered the council's explanations and intersection design maps provided to support the changes were sufficient to establish nexus for most items in the plan.

²⁶ GHD, Box Hill and Box Hill Industrial Precincts – Transport and Access Study, February 2011, p 87.

²⁷ Specifically the technical studies from Calibre Consulting and Brown Consulting listed in Table 4.4.

²⁸ DPE, Amendment to the Box Hill Precinct Plan (Mount Carmel Road), State Environmental Planning Policy (Sydney Region Growth Centres) 2006 – Finalisation Report, August 2016; DPE, Box Hill Growth Centre Precincts Development Control Plan, May 2017 (DCP).

Since our 2018 assessment, the council has amended the transport infrastructure in the plan to include:

- \$41.93 million for land and works to deliver 9.5km of half-width roads fronting nondevelopable land
- Four signalised intersections, one is a new item and three were previously identified as roundabouts; and two roundabouts which were previously identified as signalised intersections.
- 3.1 hectares of additional land to support the delivery of transport infrastructure we have previously assessed.

4.3.2 Nexus is established for intersection changes in CP15 (2020)

CP15 (2020) includes changes to intersections since we last reviewed the plan. These are outlined in Table 4.5.

ltem	CP15 (2018)	CP15 (2020)	Notes
BHT09	Signalised intersection	Roundabout	Change in scope and cost
BHT21	Signalised intersection	Roundabout	Change in scope and cost
BHT22	na	Signalised intersection	New item in the plan
BHR05	Roundabout	Signalised intersection	Change in scope and cost
BHR06	Roundabout	Signalised intersection	Change in scope and cost
BHR07	Roundabout	Signalised intersection	Change in scope and cost

 Table 4.5
 Changes to intersection treatments in CP15 (2020)

Source: CP15 (2018), Works Schedule.

The scope and treatment of intersections in the Box Hill Precinct was originally established by the 2011 GHD transport study. During our assessment, the council presented internal traffic modelling and analysis to support changes to the treatment of intersections. The analysis considers the Volume to Capacity (V/C ratio) of AM and PM peak flows on the precinct's traffic network, based on the revised population and dwelling forecasts to 2036. The council's full analysis is provided at Appendix E.

We consider the council's modelling establishes nexus for all changes in intersection treatments in CP15 (2020), except for BHT22 (as outlined below at section 4.3.4). The changes are needed to accommodate the higher demand on transport infrastructure resulting from the revised population in the Box Hill Precinct.

4.3.3 The council's updated traffic modelling affects nexus for other intersections in the plan

The council's traffic modelling also establishes nexus for a signalised intersection at Prosper Street and Mount Carmel Drive (BHT17). The intersection is identified in CP15 (2020) as a two-lane roundabout, but information from the council supports its upgrade to a signalised intersection.

However, the council's traffic modelling does not support the signalised intersection of Terry Road and High Street (BHT18). The intersection is identified in the technical studies as a signalised intersection, but the traffic modelling from the council suggests a T-junction intersection with giveway/yield signage on High Street will be sufficient. We have therefore found that nexus is not established for signalised intersection BHT18 and recommend the works costs are removed from the plan.

We note that there is also \$402,778 in the plan to acquire land to deliver the intersection. This land may not be required if the signalised intersection is not being delivered. We invite stakeholder feedback on this draft recommendation.

4.3.4 Nexus is established for the signalised intersection of Terry Road and Old Pitt Town Road (BHT22)

CP15 (2020) includes a new signalised intersection at the junction of Terry Road, Old Pitt Town Road and Fontana Drive. The council has not provided transport modelling or detailed information to support nexus for the additional signalised intersection. It explains that the plan has been updated to include only the signalised portion of the intersection. The other works, ie, site preparation, line-marking and road reserves, have already been delivered by a developer as a condition of development consent.

Based on the treatment of other intersections on Terry Road, the likely traffic volume on Terry Road and delivery of the road reserve to support a signalised intersection, we consider that nexus is established for the upgrade.

4.3.5 Nexus is established for additional land that is required for transport infrastructure

CP15 (2020) includes 3.1 hectares of additional land for transport works compared with CP15 (2018). Some of this additional land reflects changes requested by the Minister in response to our previous assessment of an intersection on Terry Road.²⁹ Other additions relate to intersections, bridges and road upgrade works and are outlined in Table 4.6.

Item	CP15 (2018)	CP15 (2020)	Difference
Signalised intersections	0.10	1.14	1.04
Roundabouts	0.00	0.37	0.37
Road upgrades	1.78	2.25	0.46
Bridges	0.00	1.18	1.18
Total	1.89	4.94	3.05

 Table 4.6
 Land added to the plan since our last assessment (hectares)

Source: The Hills Shire Council, Responses to Questions from IPART, 20 May 2020, CP15 (2018), Works Schedule.

The council explained that the need for additional land was identified following an update of designs and review of the likely land area required to deliver the works.

²⁹ IPART, Assessment of revised Contributions Plan 15 for Box Hill, October 2018, Recommendation 7.

We have reviewed the council's designs and consider the council's approach to revising the land areas is reasonable. The approach is consistent with our experience in other plans where councils have updated land areas for essential infrastructure following more detailed, site-specific designs and estimates.

4.3.6 Nexus is established for the inclusion of half-width roads

CP15 (2020) includes \$41.93 million for land and works to deliver 9.5km of half-width roads fronting non-developable land. The inclusion of these works represents a change in approach for the plan, with the council previously requiring developers to deliver the roads as a conditions of development consent. It is also the first time the council has taken an approach to include all half-width roads fronting non-developable land in a contributions plan. Figure 4.1 shows the location of half-width roads in the plan.



Figure 4.1 Half-width roads included in CP15 (2020)

Source: The Hills Shire Council, Response to questions from IPART, 20 May 2020.

The council has suggested that it may face difficulty requiring delivery of the roads, and their inclusion in the plan gives it a mechanism to 'require' the developers to fund or construct the roads.³⁰

The council also considers that the inclusion of land and works for half-width roads fronting non-developable land is consistent with IPART's technical advice.³¹

We provided advice to stakeholders in April 2019 about how we would assess nexus and apportionment of costs for roads in contributions plans. The relevant advice is outlined in Box 4.1.

³⁰ Meeting with The Hills Shire Council, 6 March 2020.

³¹ Meeting with The Hills Shire Council, 6 March 2020.

Box 4.1 Our method for assessing roads in contributions plans

Our method for assessing nexus for, and apportioning cost of, roads in contributions plans will involve consideration of the following principles:

- Councils should secure the delivery of local and collector roads through conditions of development consent, where possible.
- Where it is not possible or practical to secure the delivery of a local or collector road (or segment of road) through conditions of development consent, there may be a case for including the road in the plan. This may be the case when:
 - The road or half-road fronts public or non-developable land
 - The road services a critical role in the transport network or the road is required to lead or facilitate development
 - It is not practical for an individual developer to provide the road, and/or
 - There is fragmented ownership of adjoining land.
- When including a road in a plan, the council should provide an explanation and supporting information, preferably in explanatory notes as part of a contributions plan, to encourage stakeholder engagement when the draft plan is exhibited.
- When considering which road costs need to be included in a plan, councils should separately consider:
 - Land acquisition costs
 - Works costs
 - Design costs.
- A simple approach to the apportionment of transport costs across the plan area (on a per person basis for residential development) is preferred to a more complex – but more accurate – approach.

Source: IPART, Inclusion of roads in contributions plans Fact Sheet, April 2019, p.2.

For most contributions plans we have assessed, councils have required developers to deliver all local roads as conditions of development consent, rather than include the costs of these roads in contributions plans. However, some other plans we have recently assessed, such as Blacktown City Council's CP24 for the Schofields Precinct, included sections of collector and local roads fronting non-developable land that had not been identified as necessary by the technical studies. These roads were:

- Upgrades of existing roads fronting public or environmental land
- New roads with no potential for a developer to construct a section of the road as a condition of development consent.³²

For CP24 we found the council's approach was reasonable and nexus was established for the inclusion of the roads.

In practice, for CP15 (2020) we understand the council will continue to require developers to deliver the roads as a condition of development consent. It will then provide an offset against

³² IPART, Assessment of Contributions Plan No. 24 Schofields Precinct, August 2019, p 38.

the developer's contribution amount for the value of the road construction, as estimated in the plan.³³

We note the change in approach may slightly increase the costs of delivering these roads. This is because including the cost of these works in the plan increases plan administration costs.

Further, the council's approach effectively 'locks-in' the estimated cost of the infrastructure as the cost of the actual offset provided to developers. If the estimated costs in the plan are too high, then developers will deliver the roads for less than the contributions offset they receive. In this scenario, other developers who do not deliver the half-width roads end up paying a higher contribution rate, while developers that deliver the half-width roads pay a lower contribution rate.

We consider the council's approach is reasonable because it has provided a reasonable explanation for its change in approach and publicly consulted with stakeholders on the changes.

4.4 Criterion 3: Reasonable cost (works only)

The cost of transport works in CP15 (2020) is \$180.95 million (48.7% of the total cost of works). This is \$82.24 million (83.3%) higher than the cost of works in CP15 (2018), as shown in Table 4.7.

The higher costs primarily reflect the changed treatment of some intersections, the inclusion of half-width roads fronting non-developable land, and additional bridge works.³⁴

The council has 'locked-in' approximately 20% of the costs of transport infrastructure in the plan through the Hills of Carmel Voluntary Planning Agreement (VPA) and by delivering a small portion of works. The VPA includes works relating to Mount Carmel Road, including a bridge and intersections. The agreed value of the items in the VPA are the base costs in the plan indexed to the expected date of construction, with no further allowances applied.

The cost estimates for the remaining transport works in the plan are based on cost estimates we previously considered in our 2016 and 2018 assessments and new estimates for some works including intersections and half-width roads. The council has indexed outstanding estimated costs for transport works to the revised base period of the plan (June 2019), using the ABS 3101 Road and bridge construction index for NSW.

³³ Meeting with The Hills Shire Council, 6 March 2020.

³⁴ The change in the cost of bridge works is being driven by the increase to the cost of the Northern Connection Road. The council includes all of the cost of the road and bridge as a bridge cost in the plan.

	CP15 (2018)	CP15 (2020)	Difference	% change
New roads	30,400,685	29,632,127	-768,558	-2.5%
Road upgrades	22,553,059	22,742,859	189,800	0.8%
Half-width roads	0	24,557,109	24,557,109	100%
Bridges	25,259,310	38,411,785	13,152,475	52.1%
Intersections	17,925,471	63,002,905	45,077,433	251.5%
Bus stops	497,134	497,134	0	0%
Cycleways	2,082,838	2,109,838	27,000	0%
Total	98,718,498	180,953,757	82,235,259	83.3%

Table 4.7 Cost of works in CP15 (2018) and CP15 (2020) (\$Jun2019)

Note: CP15 (2018) costs have been indexed to the base period of CP15 (2020).

Source: CP15 (2020) Works Schedule and CP15 (2017) Works Schedule.

We found that:

- The use of actual costs for completed transport works, and costs agreed through the Hills of Carmel VPA, is reasonable.
- The council's approach to estimating costs for most transport works is largely unchanged from our previous assessment, and our previous findings remain relevant.
- The council's base cost estimate for half-width roads fronting non-developable land is reasonable, but the contingency allowance is too high.
- The council's revised cost estimate for the Northern Connection Road is reasonable, but the council should remove any costs if they are funded through the NWGA SIC.
- The council's revised cost estimate for two-lane roundabouts is not reasonable.
- The council's revised cost estimate for signalised intersections is not reasonable.
- The cost of upgrading Boundary Road is too low.

Draft recommendations

- 4 Reduce the cost of half-width roads by \$1,889,008 to reflect a lower contingency allowance of 20%.
- 5 Reduce the cost of the Northern Connection Road if it is partially funded through the NWGA SIC.
- 6 Reduce the cost of two-lane roundabouts [BHR01, BHR02, BHR03, BHR08] by \$5,904,927, reflecting a more reasonable estimate of costs based on a comparable roundabout in North Kellyville.
- 7 Reduce the cost of signalised intersections [BHT10, BHT13, BHT14, BHT15, BHT20] by \$29,269,935, reflecting the previous estimated costs, which were based on AECOM's 2014 technical study.
- 8 Reduce the cost of the signalised intersection [BHT22] by \$1,043,040, reflecting an estimate based on the cost of installing signals only, plus a 20% contingency allowance.
4.4.1 The base cost of half-width roads fronting non-developable land is reasonable, but the contingency allowance is too high

CP15 (2020) includes \$24.56 million in works costs to deliver 9.5km of half-width roads fronting non-developable land. The council has used the IPART Benchmark cost for new local roads of \$3,964 per linear metre (\$Jun2019), divided by two to calculate the base cost of the half-width roads and then added a 30% contingency allowance.

We found that:

- The council's base estimate for the half-width roads is reasonable, but high compared with estimates for half-width roads in other plans we have recently assessed.
- The 30% contingency allowance applied by the council is higher than we have seen in other plans we have recently assessed.

Based on our comparison with other plans and the nature of the works, ie local roads being delivered as part of subdivision and precinct delivery, we recommend the council reduce the contingency allowance from 30% to 20% for these works.

We invite stakeholder comments on the estimated cost of half-width roads in the plan. We are aware that some developers have already delivered local roads in the precinct. These developers may have better, site-specific costs that could inform the contributions plan.

4.4.2 The revised cost of the Northern Connection Road is reasonable

CP15 (2020) includes \$15.79 million in works costs for the Northern Connection Road, which is a new road and bridge that will link Box Hill and North Kellyville.

In our review of CP13 (2018), we found the council's proposed cost estimate for the Northern Connection Road, including a bridge over Caddies Creek, was reasonable. This cost estimate was based on a detailed site-specific estimate by its cost consultant, Opus.

The costs of the Northern Connection Road have increased since our 2018 assessment of CP15. The council's cost estimates include a new additional road segment (\$6.75 million) and revised cost estimate for the bridge, based on consultant advice.

We also note that \$5.0 million is earmarked to partially fund the upgrade of the Northern Connection Road in the draft NWGA SIC, published in September 2018.³⁵ If the Northern Connection Road infrastructure in CP15 (2020) [BRNKB01 and BRNKB01A] are funded through the NWGA SIC, the cost in the plan should be reduced by the extent of any funding provided.

4.4.3 The council's revised cost estimate for signalised intersections is not reasonable

CP15 (2020) includes \$49.09 million in works costs to deliver 14 signalised intersections. The cost estimates are based on three sources:

³⁵ Information from The Hills Shire Council, 24 December 2019.

- Costs based on the 2014 AECOM study:
 - Signalised intersections (4): site specific 'high-level' estimates based on the 2014 AECOM study which we previously assessed as reasonable in our 2016 assessment, indexed to the base period of the plan.³⁶
- Costs based on a two-lane, four-way intersection in North Kellyville at Barry Road and Withers Road. This estimate includes allowances for design (6%), project management (5.5%) and contingency (17%). Notably, the estimate also includes an adjustment to relocate public utilities, which accounts for approximately 24% of the cost estimate.
 - Four-way signalised intersections (7)³⁷: an estimated cost of \$5.3 million per intersection
 - T-junction signalised intersections (2): an estimated cost of \$3.0 million per intersection, which is based on the same estimate as the four-way intersection, but has been adjusted down by the council to arrive at an approximation for a T-junction signalised intersection.
- Costs for the intersection of Old Pitt Town Road, Terry Road and Fontana Drive:
 - The council has applied a rate of \$1.5 million, and has not explained the source of the estimate. The works schedule indicates this is for the 'signals only' and does not include other works associated with delivering the intersection.

We have found that:

- The cost estimates for four signalised intersections based on the 2014 AECOM study are reasonable.
- The cost estimates for all other signalised intersections are not reasonable.

Table 4.8 compares the cost of signalised intersections in CP15 (2020) with the costs in CP15 (2018), which were based on the 2014 AECOM study.

³⁶ The individual cost estimates are: \$442,125 for BHT06, \$1,771,448 for BHT11, \$1,497,330 for BHT12, \$777,035 for BHT19.

³⁷ Including: BHT14, BHT15, BHT18, BHT20, BHR05, BHR06, BHR07.

Item	CP15 (2018)	CP15 (2020)	Difference
Signalised intersections identified	in CP15 (2018)		
BHT06	442,125	442,125	0
BHT10	1,005,834	3,000,000	1,994,166
BHT11	1,771,448	1,771,448	0
BHT12	1,497,330	1,497,330	0
BHT13	826,774	3,000,000	2,173,226
BHT14	1,351,429	5,300,000	3,948,571
BHT15	1,988,089	5,300,000	3,311,911
BHT18	1,183,421	5,300,000	4,116,579
BHT19	777,035	777,035	0
BHT20	877,618	5,300,000	4,422,382
Sub-total	11,721,102	31,687,937	19,966,835
New signalised intersections			
BHR05	na	5,300,000	5,300,000
BHR06	na	5,300,000	5,300,000
BHR07	na	5,300,000	5,300,000
BHT22	na	1,500,000	1,500,000
Total	11,721,102	49,087,937	37,366,835

 Table 4.8
 Comparison of signalised intersection costs in CP15 (2020) (\$Jun2019)

Source: CP15 (2018), Works Schedule.

Signalised intersection costs based on the North Kellyville intersection are not reasonable

To support the costs of four-way signalised intersections, the council provided information about the intersection on which these costs are based, at Barry Road and Withers Road in North Kellyville, including:

- The detailed design prepared by Diversi Consulting in August 2019
- An accompanying cost estimate by quantity surveyors Mitchell Brandtman, prepared in October 2019.

The Diversi Consulting designs cover works that extend beyond the signalised intersection and include re-alignment and widening the future sub-arterial, Withers Road, and future collector road, Barry Road in North Kellyville (Figure 4.2).



Figure 4.2 Site area for the Withers Road/Barry Road & Hezlett Road and Barry Road bypass roads

Source: Diversi Consulting, Withers Road and Barry Road Intersection: Civil Engineering Works Drawings, August 2019, Mitchell Brandtman, Kellyville Intersections Withers Road and Barry Road & Hezlett Road and Barry Road Bypass, 15 October 2019.

The cost estimate from Mitchell Brandtman reflects the total cost of works extending beyond the signalised intersection as provided in the Diversi Consulting designs. Further, the cost estimate includes \$1,540,609 for *public utilities adjustments* and \$773,864 for *traffic management and temporary works*.

We consider that the scope of works included in the cost estimate is unlikely to be reflective of the cost of upgrading intersections in the less-developed Box Hill Precinct. For example, the North Kellyville intersection adjoins an existing shopping centre and includes overhead powerlines and new adjoining developments.

We have found that it is not reasonable for the council to use the North Kellyville intersection cost to estimate the cost of signalised intersections in CP15 (2020). The North Kellyville intersection is a major two-lane, four-way signalised intersection and the cost estimate includes works beyond the intersection upgrade. The council has applied the estimate to most remaining signalised intersections in CP15 (2020), regardless of whether they are of a similar design. For example, the council applies the \$5.3 million cost estimate to BHT18 and BHT20,

which are intersections of single-lane collector or local roads. It is also unreasonable to use the North Kellyville intersection to estimate the cost of T-junction intersections in CP15 (2020).

We recommend the council re-apply the cost estimates from the 2014 AECOM report, indexed to the base period of the plan, or propose a more reasonable estimate of the cost of upgrading intersections in the Box Hill Precinct.

For intersections BHR05, BHR06, BHR07, which are not costed in the 2014 AECOM report, the council should apply the estimate used for BHT13 in the 2014 AECOM report of \$826,774. This cost estimate is the most consistent with the description of works for the intersections that have changed from roundabouts in CP15 (2018).

The council's estimated cost for the Old Pitt Town Road / Terry Road / Fontana Drive signalised intersection [BHT22] is not reasonable.

The council costs the upgrade of the signalised intersection at Old Pitt Town Road, Terry Road and Fontana Drive intersection at \$1,500,000 for the 'signals only.' The council does not provide any further information on the source of this cost information.

It appears that the developer has delivered the intersection as a condition of development consent, with the council agreeing to fund the additional signals to be installed at the site at a later date.

In the absence of a more detailed, site specific estimate, we have applied the cost of the traffic signals only from the council's recent estimate for the signalised upgrade to Samantha Riley Drive and Hezlett Road from CP13 (2018).

The revised cost estimate is \$456,960 and includes a 20% contingency allowance. Using the revised cost estimate reduces the cost of the signalised intersection by \$1,043,040.

4.4.4 The council's cost estimates for two-lane roundabouts are too high

CP15 (2020) includes \$13.91 million in works costs to deliver nine roundabouts. The cost estimates per roundabout vary and include:

Single-lane roundabouts (5):

- \$464,564 per roundabout for BHT07 and BHT08, which is from the Hills of Carmel VPA, indexed to the base period of the plan
- \$480,034 per roundabout for BHT09 and BHT17, which is from the Hills of Carmel VPA, indexed to the base period of the plan
- \$468,910 for BHT21, which is based on the IPART-benchmark rate, plus a 30% contingency allowance, indexed to the base period of the plan.
- Two-lane roundabouts (4) [BHR01, BHR02, BHR03, BHR08] an estimated cost of \$2,889,215 per roundabout, which is based on a two-lane roundabout at Withers Road and Russell Reserve Access Road in North Kellyville. The estimate includes allowances for design (2.5%), project management (2.5%) and contingencies (33%).

We consider the council's estimated costs for single-lane roundabouts, based on costs in the Hills of Carmel VPA or the IPART-benchmark are reasonable. These are similar to the costs

we have seen in other recently-assessed plans and they are unchanged from our previous assessment.

We asked the council for additional information to support its cost estimate for two-lane roundabouts. In response, the council provided costings for the proposed two-lane roundabout at the intersection on Withers Road and Russell Reserve Access Road in North Kellyville. The council also advised:

The dual lane roundabout will be very similar to the proposed roundabout at the intersection of Withers Road and the Russell Reserve access, which also accommodates the designated access for the new Hillsbus Depot site. The roundabout has been designed and estimated to accommodate the turning paths for the largest type buses available to Hillsbus.

The cost estimate provided by the council is significantly higher than the reasonable cost of other two-lane roundabouts we have recently assessed in other plans, and higher than the estimates provided by AECOM in 2014. For our assessment of CP13 (2018) we engaged Axess Advisory (Axess) to estimate the cost of three two-lane roundabout on sub-arterial roads in North Kellyville (Table 4.9).

Table 4.9	Axess costed two-lane roundabouts in CP13 (\$Jun2019)
	•	• • •

Roundabout location	Cost estimate
Samantha Riley Drive and Foxall Road	974,471
Hezlett Road and Gum Nut Close	864,480
Hezlett Road and Curtis Road	1,123,116

Source: Axess Advisory, Independent Cost Review of three, two-lane roundabouts – North Kellyville Precinct Contribution Plan 13, April 2019

We consider the Axess estimate for the two-lane roundabout on Samantha Riley Drive is a better estimate of the cost of similar works in CP15 (2020). As the Axess estimates apply to standard two-lane roundabouts they will also accommodate the turning circles of large buses. We therefore recommend a cost estimate of \$974,471 for each two-lane roundabout, which is similar to the cost we have seen in other recently assessed plans.

4.4.5 The council's cost estimate for upgrading Boundary Road is too low

CP15 (2020) includes \$8,757,039 in works costs for upgrades along Boundary Road, including:

- \$1,185,648 for road resurfacing
- \$7,571,391 for the full cost of upgrading the bridge over the Killarney Chain of Ponds.

The plan also identifies two signalised intersection. Our analysis of these intersections is addressed separately in section 4.4.3.

In our recent assessment of Hawkesbury City Council's draft Vineyard Contributions Plan (Vineyard CP), we assessed Boundary Road in detail and made recommendations about the cost of the road.

A draft recommendation in the Vineyard assessment found that the council's cost estimate for upgrading the road to a sub-arterial standard was unreasonable. In response to our Draft

Report, the council engaged quantity surveyors Mitchell Brandtman to re-cost the road as a collector road.

The IPART-assessed reasonable cost of Boundary Road in the draft Vineyard CP was \$32,395,205 (\$Jun2019).

This cost, which was based primarily on Mitchell Brandtman's cost estimate, comprises three components:

- Upgrade of the road segment to a collector-road standard
- Replacement of the existing bridge across the Killarney Chain of Ponds
- Upgrade of the signalised intersection of Windsor and Boundary Roads.³⁸

The revised cost estimate supplied by Hawkesbury City Council also included a proportion of the costs of the two intersections and the road resurfacing costs from CP15 (2020).

The IPART-assessed reasonable cost for Boundary Road is the best available estimate of the cost of upgrading the road to an urban collector standard. We consider the cost of the Boundary Road upgrade in CP15 (2020) is too low and that it is reasonable for the council to include additional costs for the upgrade.

Our proposed recommendation combines our findings on the reasonable cost of upgrading Boundary Road and the apportionment of this cost between CP15 (2020) and the draft Vineyard CP. Our assessment of apportionment is in section 4.5.

4.5 Criterion 5: Apportionment

In assessing the apportionment of transport costs in CP15 (2020), we have taken into account demand for infrastructure arising from:

- Existing and new development
- Different types of development (i.e. residential vs non-residential)
- Development within and outside the precinct.

As outlined below, we found the council's approach to apportionment, which is unchanged since our last assessment, is mostly reasonable except that it should update the population estimates when apportioning costs of the Northern Connection Road; and apportion more of the costs of upgrading Boundary Road.

Draft recommendations

9 Apportion 67% of the costs of the Northern Connection Road to the plan, based on the most up-to-date population forecasts for Box Hill (CP15) and North Kellyville (CP13).

³⁸ We made adjustments to the Mitchell Brandtman cost estimate including around assumptions about the quantity of excavated materials to be removed from the site, reduced allowances for design costs and reduced contingency allowances.

10 Revise the reasonable cost of upgrading Boundary Road to \$32,395,205 and include 81.7% of this cost in the plan, reflecting the demand for the upgrade that is generated from the Box Hill Precinct. This would increase costs in CP15 (2020) by \$17,706,650.

4.5.1 The council's approach to apportionment of transport costs is mostly reasonable

For most transport items in the plan, the council apportions costs between residential and non-residential development based on traffic modelling. The outcome is that around 60% of transport costs are apportioned to residential development, with the remaining 40% apportioned to non-residential development.

Transport costs are then apportioned within residential development on a per person basis and within non-residential development on a GFA basis.

The cost of some transport items in CP15 (2020) also involves the apportionment of costs to development outside Box Hill:

- The cost of the Northern Connection Road (which includes a bridge) between Edwards Road and Stringer Road is apportioned between CP15 and CP13 based on the anticipated populations in both plans.
- The cost of the upgrade of Annangrove Road to a sub-arterial road is apportioned equally between CP15 and CP11 (*Contributions Plan 11: Annangrove Road Light Industrial*).
- The cost of the upgrade of Boundary Road between Menin Road and Windsor Road is apportioned between CP15 and Hawkesbury City Council's Vineyard CP. The costs in the Vineyard CP are based on transport modelling (which is likely to be out of date), while the costs in CP15 (2020) reflect the costs of some items only and represent a partial funding of the upgrade of Boundary Road.

We consider the following findings of our previous assessments are still relevant:

- Apportionment of transport costs within the plan to residential and non-residential development based on traffic modelling for most items is reasonable. We note that the transport modelling was conducted by GHD as part of its precinct planning in conjunction with DPIE and was based on the planning assumptions known at that time.
- The equal apportionment of costs for Annangrove Road between CP15 and CP11 is reasonable. Our previous assessment found this approach reflected the fact that the nonresidential areas of both precincts will use the road as it directly bisects the Box Hill Precinct and the Annangrove Road Light Industrial Area. We also found that the relative amount of floor space for employment purposes was split fairly evenly between both precincts.

We consider the council's approach to apportioning costs for the Northern Connection Road is reasonable in principle, but it should update the calculation based on the latest available population estimates of each development area. This is consistent with our recommendation in CP13 (2018).

We have found that it is reasonable for the council to apportion more of the costs of upgrading Boundary Road to CP15 (2020), based on modelling of traffic volumes undertaken by TfNSW.

4.5.2 Costs for the Northern Connection Road should be apportioned based on the latest population figures

In CP15 (2020), the council apportions costs for the Northern Connection Road based on the population forecasts in the adopted version of CP15 (2018) and the North Kellyville Precinct (CP13 (2018)). This apportions approximately 60% of the costs to CP15 (2020).

In our Final Report for CP13 (2018), we make a recommendation for the council to update its apportionment calculation based on the latest available population estimate for Box Hill. We propose to make the same recommendation for CP15 (2020).

Based on the most up-to-date population estimates for Box Hill and North Kellyville, approximately 67% of costs of the Northern Connection Road should be apportioned to CP15 (2020).

This would increase costs in CP15 (2020) by \$1.95 million.

4.5.3 More of the cost of upgrading Boundary Road should be included in CP15

The costs for Boundary Road in CP15 (2020) include costs for the bridge over the Killarney Chain of Ponds and costs from The Hills of Carmel VPA, including for road resurfacing and two intersections. These costs are apportioned 100% to the plan. In past assessments we considered this approach was reasonable.

For our assessment of the draft Vineyard CP, we assessed nexus, the cost and apportionment of Boundary Road in more detail. We found that Hawkesbury City Council's approach to apportionment was based on advice from transport consultants, Arup.

In 2015, Arup advised DPE that it expected future traffic demand on Boundary Road would come from:

- ▼ Box Hill 48%
- Vineyard Stage 1 Precinct 43%
- Other areas 9%

DPIE provided this advice to both councils.³⁹ The traffic modelling undertaken by Arup to inform this advice was based on now-outdated planning assumptions and a different road network hierarchy. Notably, the differences are:

- The road network hierarchy has changed. Traffic flows within the area are likely to change as vehicles use Menin Road to access Windsor Road and use Bandon Road instead of Boundary Road.
- The density of development in Box Hill has surpassed the expected dwelling yields which informed the original transport modelling. However, the expected density of development in the Vineyard Stage 1 Precinct has not changed because development will be governed by density controls.

³⁹ Email from Arup to DPE – Vineyard Precinct – Boundary Road Traffic Volumes, 30 June 2015.

These changes mean that the apportionment of costs in the draft Vineyard CP is based on traffic modelling which is inaccurate because the underlying assumptions have significantly changed. For CP15 (2020), the costs in the plan are not consistent with the approach in the draft Vineyard CP and do not account for all of the costs of upgrading the road.

In our assessment of the Vineyard CP we found Hawkesbury City Council's approach to the apportionment of costs was reasonable, but noted concerns with the funding arrangements between the two plans. We made a recommendation to DPIE to assist in resolving the issues for Boundary Road:

The Department of Planning, Industry and Environment co-ordinate the planning and delivery of Boundary Road by establishing a working group that includes Hawkesbury City Council, The Hills Shire Council and RMS. The working group could consider matters such as:

- Design requirements, standard and costs
- Apportionment of costs (including any State Government funding)
- Who will lead delivery and the timeframe for delivery.

We met with DPIE and TfNSW to resolve cost and apportionment issues with Boundary Road

We met with DPIE and TfNSW to clarify the role of Boundary Road in the traffic network hierarchy and discuss an approach to the apportionment of costs between the two plans.

We asked TfNSW to investigate the traffic volumes on Boundary Road between Windsor Road and Old Pitt Town Road using its Strategic Traffic Forecasting Model to inform our apportionment calculations.

TfNSW's model calculates the traffic volumes using variables for the Vineyard Stage 1 and Box Hill Precincts. It considers both the AM and PM peak 2-hour periods, and produces the following results:

- ▼ 59% of the trips are from/to Box Hill Precinct, 12% of the trips are from/to Vineyard Precinct (AM Peak 2-hour period)
- ▼ 58% of the trips are from/to Box Hill Precinct, 13% of the trips are from/to Vineyard Precinct (PM Peak 2-hour period)

The model identifies trip volumes coming from other sources outside the two precincts. This result is expected from traffic modelling that considers regional traffic flows.

It is reasonable to apportion 100% of Boundary Road costs between the Vineyard CP and CP15 $\,$

We consider it is reasonable for developers in the Box Hill Precinct and the Vineyard Stage-1 Precinct to pay, in aggregate, 100% of the costs for the upgrade of Boundary Road between Menin Road and Windsor Road. This approach is consistent with the approach used in other plans we have assessed, where major 'council owned' roads bordering precincts are entirely funded within the plan. The marginal demand for the road upgrade is being driven by the new development and therefore nexus is established to include all of the works in contributions plans. For example, we have found that the following council approaches to apportioning the cost of roads that border two or more precincts within The Hills Shire LGA are reasonable:

- Apportioning the costs of upgrading Samantha Riley Drive equally between CP13 and CP08.
- Apportioning the costs of upgrading the Northern Connection Road based on the expected populations in CP15 and CP13.

Apportionment of costs for Boundary Road between CP15 and the draft Vineyard CP should be updated to better reflect the demand for upgrading the road

Table 4.10 details different approaches that have and could be taken to apportion the costs of upgrading Boundary Road between CP15 (2020) and the Vineyard CP.

Unfunded Approach **Draft Vineyard CP** CP15 (2020) Current approach 8,757,039 9,708,228 13,929,938 Arup traffic modelling (2014) 13,929,938 15,549,698 2,915,568 Population 0 4,854,873 27,540,332 50/50 split 0 16,197,603 16,197,603 TfNSW traffic modelling (2020) 4,211,377 18,789,219 9,394,609 TfNSW traffic modelling (2020) (Ratio) 5,931,516 26,463,689 0 [IPART-preferred approach]

 Table 4.10 Apportionment approaches for Boundary Road (\$Jun2020)

Note: Population, CP15 (2020), 42,483 persons and Draft Vineyard CP, 7,489 persons.

Sources: CP15 (2020), p. 4. Draft Vineyard CP, p. 19; Email from ARUP to DPE – Vineyard Precinct – Boundary Road Traffic Volumes; Email from TfNSW – Boundary Road-Box Hill, 2 June 2010; Email from TfNSW – Modelling of traffic flow – Boundary Road, 10 July 2020.

Our preferred approach to apportioning 100% of the costs of upgrading Boundary Road between the two plans is to use a ratio of trips generated between the Vineyard Stage 1 and Box Hill Precincts. We consider this approach best represents the demand that is generated for the upgrade of Boundary Road from each precinct.

Under this approach, 81.7% of the costs of upgrading Boundary Road would be apportioned to CP15 (2020). This would increase the costs of the road in the plan by \$17,706,650.

We are interested in stakeholder feedback on this proposed change to the apportionment of costs of upgrading Boundary Road between CP15 (2020) and the Vineyard CP.

5 Stormwater

The total cost of stormwater land and works in CP15 (2020) is \$167.73 million (24.6% of total costs), comprising:

- \$82.75 million for land (27.2% of the total cost of land)
- ▼ \$84.97 million for works (22.9% of the total cost of works).

Our draft assessment of the stormwater land and works in CP15 (2020) is:

- Criterion 1: Essential works The land and works are consistent with the essential works list.
- Criterion 2: Nexus There is nexus between the stormwater land and works in the plan and development in the Box Hill Precinct, except for additional land that is not required to deliver stormwater infrastructure.
- Criterion 3: Reasonable cost Actual and estimated stormwater management works costs are reasonable.
- Criterion 5: Apportionment The council's approach of apportioning stormwater management costs between the Killarney Chain of Ponds and Second Ponds Creek catchments and then residential and non-residential development is reasonable.

Our draft assessment of land for stormwater against Criterion 3 (Reasonable cost) is in Chapter 8.

Based on our findings, we recommend adjustments to the plan we estimate would reduce the cost of stormwater land and works by \$0.66 million (0.4%). Our draft findings and recommendations are summarised in Table 5.1.

Criterion	Draft findings	Draft recommendations	Land	Works
Total costs in plan			82,752,997	84,974,681
Essential works	All land and works in the plan are consistent with the essential works list.			
Nexus	Nexus is established for all land and works in the plan except:			
	Additional land that is not required for the delivery of stormwater infrastructure	Remove 4,034m ² of additional land that is not required for stormwater infrastructure	-664,398	
		 For 13,214m² of additional land for which nexus is not established: Remove the cost of any land with development potential from the plan Include any residual land as open space in the plan. 	Not costed	
Reasonable cost – Land	The cost of land is reasonable			
Reasonable cost – Works	The cost of works is reasonable			
Apportionment	Approach is reasonable			
Total IPART-recomm	nended cost adjustment		-664,398	0
Total IPART-assesse	ed reasonable cost		82,088,599	84,974,681

 Table 5.1
 IPART-recommended adjustments for stormwater (\$Jun2019)

Source: CP15 (2020) Works schedule, IPART analysis.

5.1 Overview of stormwater works in CP15 (2020)

The major stormwater catchment in the Box Hill Precinct is the Killarney Chain of Ponds (KCP), covering approximately 635.35 hectares. The precinct also includes the smaller Second Ponds Creek (SPC) catchment, covering approximately 55.45 hectares (Figure 5.1).



Figure 5.1 Location of stormwater catchments in CP15 (2020)

Source: CP15 (2020) p 53.

The urbanisation of the Box Hill Precinct will require significant investment in a new, comprehensive water cycle management scheme to cater for the increase in impervious surfaces which affect the hydrological cycle.⁴⁰

The stormwater works items and costs in the plan are unchanged since we last assessed them in 2016, except for the indexation of costs to the revised base period of the plan (June 2019). The scope of works are also unchanged from when the council first adopted the plan in 2014.

Table 5.2 shows the cost of stormwater land and works in the plan, and Figure 5.2 shows the location of stormwater works in the precinct.

		-	
Item	Cost of land	Cost of works	Total cost
Killarney-Chain of-Ponds (KCP)			
9 combined basin and raingarden facilities	80,412,530	64,024,679	144,437,209
6 single raingarden facilities	640,735	6,018,407	6,659,143
7 culvert crossings	0	13,696,556	13,696,556
3 gross pollutant traps	0	196,500	196,500
Subtotal (KCP)	81,053,266	83,936,143	164,989,408
Second Ponds Creek (SPC)			
3 single raingarden facilities	1,699,731	1,038,539	2,738,270
Subtotal (SPC)	1,699,731	1,038,539	2,738,270
Total	82,752,997	84,974,681	167,727,678

 Table 5.2
 Stormwater land and works in CP15 (2020) (\$Jun2019)

Note: No land is required for the culvert crossings and gross pollutant traps

Source: CP15 (2020) Works Schedule.

⁴⁰ CP15 (2020), p 31.



Figure 5.2 Location of stormwater management infrastructure in CP15 (2020)

Source: The Hills Shire Council, Presentation to IPART, 8 September 2014.

5.2 Criterion 1: Essential works

All land and works for stormwater in CP15 (2020) are consistent with the essential works list in the Practice Note.⁴¹ The works items are set out in Table 5.3.

⁴¹ Department of Planning and Environment, *Local Infrastructure Contributions Practice Note*, January 2019.

Table 5.3	Stormwater works items in CP15 (2020)
-----------	---------------------------------------

lte	ms on the essential works list		
▼	Combined basin and raingarden facilities	▼	Single raingarden facilities
▼	Culvert crossings	▼	Gross pollutant traps

Source: CP15 (2020), p 37.

5.3 Criterion 2: Nexus

The council has included an additional 17,248m² of land for stormwater in CP15 (2020) at a cost of \$5.13 million. The additional land is not required to deliver stormwater infrastructure in the Box Hill Precinct; the council has included the additional land because of practical issues associated with land acquisition. We have found that nexus is not established for inclusion of this additional land to deliver stormwater infrastructure.

There are no changes to the scope of stormwater works items in CP15 (2020) from the previous versions of the plan we assessed in 2016 and 2018. We consider that the higher projected population in Box Hill is unlikely to require additional stormwater infrastructure, as the additional population largely reflects increased density and there is no significant change in impervious area. We consider the findings of our previous assessments are still relevant and that nexus is established for the stormwater management works in the plan.

Draft recommendations

- 11 Remove 4,034m² of land for stormwater infrastructure from the plan, for which nexus is not established. This would reduce the cost of stormwater land in the plan by \$664,398.
- 12 For a further 13,214m² of stormwater land for which nexus is not established:
 - Remove the cost of any land with development potential from the plan
 - Include any residual land as open space in the plan.

5.3.1 Nexus is not established for additional land that is not required for stormwater infrastructure

The council identified an additional 17,248m² of land it needs to acquire because of practical issues associated with land acquisition. This land is included in CP15 (2020) as land for stormwater infrastructure.

The council advised that, for the five lots of land involved, it needs to acquire the whole lots, not just the areas that are required for stormwater infrastructure in the plan. The areas, costs and locations of the relevant lots of land are provided at Appendix F.

We acknowledge the practical challenges councils face in acquiring land for public infrastructure and that there will be occasions where whole lot acquisition is required to facilitate the timely provision of infrastructure to support development.

However, these practical challenges do not generally establish nexus for additional land in a contributions plan, particularly where this additional land represents a significant area and

cost in the plan. Where a council needs to acquire land in excess of the requirements to deliver public infrastructure, it should:

- Re-sell any land that has development potential
- Incorporate any residual land for use by the residents of a precinct, wherever it is practical to do so.

We recognise that a council's ability to incorporate residual land for use by residents will depend on a range of factors, including the area of land available and its location. For example, small areas of residual land that a council acquires to facilitate the delivery of transport infrastructure may not have any other practical use for residents. It would be reasonable to include excess land in a contributions plan in these limited circumstances.

For the additional stormwater land in CP15 (2020), the council has advised that, with the progress of negotiations with one landholder, it no longer needs to acquire 4,034m² of the additional 17,248m².⁴² The cost of this 4,034m², being \$664,398, should therefore be removed from the plan. For the remaining 13,214m², the council should:

- Identify land with development potential that can be resold, and remove the cost of this land from the plan
- Include any residual land as open space, to increase the provision of open space land for the residents of Box Hill.

We consider that it may be reasonable for the council to include residual land without development potential in the plan as open space, given the overall provision of open space in CP15 (2020) is low (see section 6.3.1). To retain the land in the plan, the council would need to demonstrate that this land is suitable as dual-purpose stormwater and open space land. It may also need to include additional embellishment costs in the plan to enable use of this land as open space.

The council has advised that it is not clear if there would be a market for any of the remaining 13,214m² of land or if it would have any value to an adjoining developer. The council notes that it would seek to sell the land if possible, but if it is unable to do so the land would remain in council ownership.⁴³ We therefore seek stakeholder feedback on our draft recommendation, including:

- Whether any of the excess land that is not required for delivery of stormwater infrastructure has development potential and therefore should be removed from the plan (see Appendix F)
- Our draft recommendation to include any residual land as open space for the residents of Box Hill.

⁴² This relates to acquisition of land at 39-41 Boundary Road, Box Hill: Information from The Hills Shire Council, 20 May 2020.

⁴³ Information from The Hills Shire Council, 22 July 2020.

5.3.2 Nexus for stormwater works is established through technical studies and consultant advice

The technical studies relied upon by the council to establish nexus for stormwater infrastructure, listed in Table 5.4, are unchanged from those used in our 2016 assessment. In addition to these studies, nexus for three culvert crossings was established in 2014 based on advice from AECOM.⁴⁴

Author	Title	Date
J. Wyndham Prince	Box Hill/Box Hill Industrial Precinct Water Cycle Management Strategy Report	February 2011
J. Wyndham Prince	Box Hill/Box Hill Industrial Precinct Water Cycle Management Post Exhibition Strategy Report	June 2012
J. Wyndham Prince	Box Hill/Box Hill Industrial Precinct Water Cycle Management Post Re-exhibition Strategy Report	November 2012

Table 5.4	Technical studies for stormwater works in (CP15 (2020)
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Note: The technical studies were commissioned by DPIE.

5.4 Criterion 3: Reasonable cost (works only)

The stormwater works items and costs in the plan are unchanged since we last assessed them in 2016, except for indexation of costs to the revised base period of the plan.

Since our last assessment, three stormwater management items, representing 15% of stormwater works costs, were included in the Hills of Carmel VPA, executed on 19 June 2018. The agreement was further amended on 13 December 2018 to reflect changes to the area of land. This has not resulted in any changes to the cost of works in the plan.

We found that:

- The council's approach to estimating costs for different categories of stormwater works is unchanged from our previous assessment, therefore our previous finding that this approach is reasonable is still relevant.
- The use of actual costs for completed stormwater works is reasonable. These actual costs are for works delivered as part of the VPA, including a detention basin (component of BH03B), a single raingarden (RGBH10) and culvert crossing (CR-D). The actual costs also include some basin and drainage structure works delivered by the council.

⁴⁴ The Hills Shire Council, Response on queries to Box Hill CP15, 15 October 2014.

5.5 Criterion 5: Apportionment

The council's approach is unchanged since our previous assessment. We consider the findings of our 2016 assessment are still relevant and the council's approach to apportionment is reasonable.

CP15 (2020) apportions stormwater management costs between the KCP and SPC catchments based on the location of the works. Within each catchment, costs are apportioned between residential and non-residential development on a per hectare of Net Developable Area (NDA) basis. They are then apportioned amongst residential development on a per-person basis, and non-residential development on a GFA basis.

6 Open space

The total cost of open space land and embellishment in CP15 (2020) is \$276.19 million (40.5% of total costs), comprising:

- \$170.32 million for land (55.9% of the total cost of land)
- ▼ \$105.87 million for open space embellishment (28.1% of the total cost of works).

Our draft assessment of the open space land and embellishment in CP15 (2020) is:

- Criterion 1: Essential works The land and embellishment for open space are consistent with the essential works list. We have made a draft recommendation to move transportrelated work costs to the transport infrastructure category (see Draft recommendation 1 in Chapter 4 - Transport).
- Criterion 2: Nexus Nexus is established for the total area of land for open space and its embellishment. However, we note that the overall provision of open space is low.
- **Criterion 3: Reasonable cost –** The open space embellishment costs are reasonable.
- Criterion 5: Apportionment The council's approach to apportioning open space costs to residential development on a per person basis is reasonable.

Our draft assessment of the reasonable cost of land for open space against **Criterion 3** (**Reasonable cost**) is in Chapter 8.

Based on our findings, we recommend \$1.55 million (1.5%) of open space embellishment costs be classified as transport works. This adjustment would not change the total cost in the plan, as costs would just be transferred from open space to transport. Our draft findings and recommendations are summarised in Table 6.1.

Criterion	Draft findings	Draft recommendation	Land	Works
Total costs in pl	an		170,321,018	105,865,380
Essential works	All land and works in the plan are consistent with the essential works list, however:			
	Road verges and bridges are transport costs	Transfer costs of road verges and bridges to the transport category		-1,549,248
Nexus	Nexus is established for all land and works in the plan			
Reasonable cost - Land	The cost of land is reasonable			
Reasonable cost - Works	The cost of embellishment is reasonable			
Apportionment	Approach is reasonable			
Total IPART-rec	ommended cost adjustment			-1,549,248
Total IPART-ass	essed reasonable cost			104,316,131

Table 6.1IPART-recommended adjustments for plan administration in CP15 (2020)
(\$Jun2019)

Source: CP15 (2020) Works schedule, IPART analysis.

6.1 Overview of open space in CP15 (2020)

CP15 (2020) includes 61.60 hectares⁴⁵ of open space, comprising 11 local parks, five sporting facilities and one district sporting facility.⁴⁶ These parks and sporting facilities will serve the revised total projected population of 42,483 people resulting from the development in the Box Hill Precinct.

In addition to the land in the plan, the precinct includes 0.66 hectares of open space in Turnbull Reserve, which serves 934 existing residents. This results in a total of 62.26 hectares of open space in the precinct.

Table 6.2 shows the cost of open space in the plan, and Figure 6.1 shows the location of open space in CP15 (2020).

⁴⁵ The plan states that CP15 (2020) includes 62.6 hectares of open space, however, the council has confirmed this should be amended to 61.6 hectares. Information from The Hills Shire Council, 16 March 2020.

⁴⁶ The plan includes land for 10 local parks and embellishment for 11 local parks (the additional park is an existing park in the precinct – Turnbull Reserve). The council has identified that it will be embellishing these parks at a varying levels (we note that local, urban and suburban parks are included under the category of local parks in the council's Recreation Strategy) and that it plans to embellish one of the parks (LP08) to a district park level. Information from The Hills Shire Council, 16 April 2020.

Table 6.2	Open space c	osts in CP15	(2020)	(\$Jun2019)	
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Item	Cost of land	Cost of embellishment	Total cost
Local parks			
11 local parks ^a	45,086,190	8,673,816	53,760,006
Sporting facilities			
One district facility including six playing fields, 10 multi-purpose courts and a playground	49,243,623	26,611,113	75,854,736
Five sporting facilities including 13 playing fields, 12 multi-purpose courts and playgrounds	75,991,205	70,580,451	146,571,655
Total	170,321,018	105,865,380	276,186,397

a The land cost includes the cost of 10 new local parks and embellishment cost includes the cost of 11 parks including the existing Turnbull Reserve.

Source: The Hills Shire Council, Works Schedule, February 2020.

Figure 6.1 Location of open space land and works in CP15 (2020)



Source: Box Hill Growth Centre Precincts Development Control Plan March 2018, p 91.

6.2 Criterion 1: Essential works

We found that the land and embellishment in CP15 (2020) are consistent with the essential works list in the Practice Note.⁴⁷ Consistent with our approach in previous assessments, we find that road verges and bridges should be characterised as transport works and transferred to the transport infrastructure category (see Draft Recommendation 1 in Chapter 4 - Transport). The embellishment items in CP15 (2020) are set out in Table 6.3.

Table 6.3 Open space embellishment items in CP15 (2020)

Items consistent with the essential works list

Local parks (11 parks, a total of 12.43 hectares)

Nine parks will include: Pathways, playground, fencing, shelter and seating, bins, drinking water, water connections, signage, landscaping and tree planting for all local parks. For selected parks, shade structure, public amenities, dog off-leash areas, outdoor fitness equipment, BBQ, park lighting depending on the local park classification.^a

One park will include: All of the above embellishments plus on-site car parking, dog off-leash area, public amenities, outdoor fitness equipment, BBQ facilities and park lighting.

Sporting facility (BHPF01, 5.16 hectares)

Grassed athletics track, football pitch bounded by athletics track, jump, throw and vault facilities, multipurpose field, amenities building, car park, local playground, sports ground floodlighting, park furniture, BBQ, 2.5m wide cycleway, site establishment works, planting and turfing.

Sporting facility (BHPF02, 5.57 hectares)

Australian Rules football field, multi-purpose field, local playground, park furniture, BBQ, car park, amenities building, local playground, sports ground floodlighting, 2.5m wide cycleway, 1.5m wide pedestrian path, site establishment works, planting and turfing.

Sporting facility (BHPF03, 10.37 hectares)

Two soccer fields, two cricket fields, 12 tennis courts, local playground, park furniture, BBQ, car park, amenities building, 2.5m wide cycleway, 1.5m wide pedestrian path, site establishment works, planting and turfing.

Sporting facility (BHPF04, 5.37 hectares)

One rugby field, one cricket field, local playground, park furniture, BBQ, car park, amenities building, sports field lighting 2.5m wide cycleway, 1.5m wide pedestrian path, site establishment works, planting and turfing.

Sporting facility (BHPF06, 7.88 hectares)

One soccer field, one cricket field, local playground, park furniture, BBQ, car park, amenities building, sports field lighting 2.5m wide cycleway, 1.5 m wide pedestrian path, site establishment works, planting and turfing.

District sporting facility (BHPF05, 15.45 hectares)

Two baseball fields, two soccer fields, two cricket fields, netball multi-purpose court, district playground, park furniture, BBQ, car park, amenities building, 2.5m wide cycleway, 1.5m wide pedestrian path, boardwalk and bridge over riparian corridor, kick-about passive open space.

a The council's 2019 Recreation Strategy specifies a hierarchy of local parks – basic park, local park, local suburban and local urban. The hectares are for 10 local parks (the other park is an existing park, and the land for this park is not included in the plan).

Source: AECOM study, Information from The Hills Shire Council, 16 April 2020 and The Hills Shire Council Recreation Strategy, October 2019.

⁴⁷ Department of Planning and Environment, *Local Infrastructure Contributions Practice Note*, December 2019.

6.3 Criterion 2: Nexus

Based on information from the council and our analysis, we consider nexus is established for open space land and embellishment in the plan. However, we note that the overall provision of open space is low.

We found that:

- The council has added 0.16 hectares of open space to the plan, increasing the land area for an existing local park (LP08). The land area for this park increased when the precinct was rezoned in August 2016.⁴⁸
- The provision of 1.45 hectares of open space per 1,000 new residents is below the Growth Centres' benchmark of 2.83 hectares per 1,000 residents. However, the council considers the overall provision of land for recreation is appropriate.⁴⁹
- The council has identified 44.27 hectares of water management land which may be suitable for recreation but it has not included this land or its potential embellishment in the open space provision in CP15 (2020).⁵⁰ If this was included as open space, it would increase the rate of provision to 2.49 hectares per 1,000 residents.

6.3.1 Nexus is established for open space land but the overall rate of provision is low

The plan includes 61.60 hectares of open space land, comprising 11.77 hectares of land for local/district open space and 49.82 hectares for sporting facilities.

Our previous assessments of CP15 have made varying recommendations on the provision of land in the plan, with changes reflecting updated population estimates and the availability of land which could potentially be used for open space. Our previous assessments and recommendations are summarised in Box 6.1.

⁴⁸ The 'Box Hill Employment Land' rezoning, which came into force on 22 August 2016, increased the area of land zoned RE1 in this park from 32,935 square metres to 34,500 square metres. The revised land area in CP15 (2020) seeks to amend the incorrect area included in the current version of the plan. Information from The Hills Shire Council, 22 July 2020.

⁴⁹ CP15 (2020), p 24.

⁵⁰ CP15 (2020), p 24.

Box 6.1 Changes in open space land in CP15

Our 2014 assessment found that nexus was established between open space land in CP15 and the expected development in the Box Hill Precinct. We found the open space provision of 59.60 hectares in CP15 was low, but that the open space met the requirements identified in the technical studies. We recommended that the open space land for Turnbull Reserve should be excluded from the plan as it served existing residents. We noted that there were likely to be other opportunities for passive open space in the precinct in the future, particularly on drainage land.

Our 2016 assessment found that the 62.60 hectares of open space land in the plan was excessive, when taking into account 44.27 hectares of available stormwater land considered suitable as passive open space. We recommended the removal of 23.28 hectares of open space in the plan and the associated embellishment costs. The Minister did not accept this recommendation.

Our 2018 assessment considered that an expected increase in population may justify the inclusion of all land zoned for open space. We recommended the council confirm whether the quantity of open space land and associated embellishment in the plan meets the needs of the projected population.

Source: IPART's assessment of CP15 Box Hill Precinct, December 2014, Assessment of CP15 Box Hill Precinct, March 2016 and Assessment of CP15 Box Hill Precinct, October 2018.

The council has made small increases to open space provision in the plan over time, but these increases are marginal relative to the increase in the projected population of the precinct. The projected additional population in the current plan is 42,483 people compared with an anticipated additional population of 30,687 people in CP15 (2018).⁵¹ For the increased population, the overall rate of open space provision is 1.45 hectares per 1,000 people.⁵² This provision is low compared with the Growth Centres' benchmark rate of 2.83 hectares per 1,000 people, however, the council considers the level of provision is appropriate.⁵³

The plan identifies water management land that could be suitable for passive recreation. This land is not included in the plan as open space but the council notes that if it were included, open space provision would increase to 2.49 hectares per 1,000 new residents.

CP15 (2020) includes additional stormwater land that is not required to deliver stormwater management infrastructure. As discussed in Chapter 5, while the council has explained the need to acquire the land for practical reasons, nexus is not established for its inclusion in the plan. Ideally, the council should resell any additional land that has development potential. For any residual land, the council should investigate options for it being used as open space. If the land is suitable for open space, the plan should be updated to include the land and the reasonable embellishment costs required to bring it up to an appropriate standard for use.

We also note that the council intends to build a community centre within Bligh Reserve (District Sporting Facility 5).⁵⁴ This could reduce the total area of open space in the plan, as

⁵¹ The population in CP15 (2018) was unchanged from 2016.

⁵² This estimate relates to the land and population in CP15 (2020) only (ie, it does not include the existing population in the Box Hill Precinct, or the existing provision of land in Turnbull Reserve). The total value for the precinct, including the existing population (934 people) and land (0.66 hectares), results in provision of 1.43 hectares per 1,000 people.

⁵³ CP15 (2020), p 24.

⁵⁴ Council business papers, Ordinary meeting, 28 April 2020. The council removed the cost of the indoor recreation facility (community facility) from the plan based on our 2016 recommendation. It now intends to fund the cost of the facility outside CP15 (2020), through the sale of council owned land.

the land on which the community facility is to be constructed should be re-classified as community facilities land in the plan. As the council does not yet own all land for Bligh Reserve, there are no fixed timeframes for the completion of master planning work. If the planning for this community centre proceeds and its location in Bligh Park is confirmed, the council should update the plan and provision of open space accordingly.⁵⁵

6.3.2 Nexus for open space embellishment is established through technical studies and the council's recreation strategy

The council relies on the technical studies listed in Table 6.4 and its October 2019 Recreation Strategy to establish nexus for the embellishment of local parks and sporting facilities.⁵⁶ Based on embellishments we have considered reasonable in similar facilities and plans, we consider nexus is established for the embellishments in the plan.

Author	Title	Date
Urbis	Demographics and Social Infrastructure Assessment: Box Hill and Box Hill Industrial Precincts	Feb 2011
AECOM	Traffic Management and Open Space Strategic Design and Cost Estimates	Jan 2014

Table 6.4 Technical studies establishing nexus for open space in CP15 (2020)

Note: The Urbis Study was commissioned by the then Department of Planning and Environment to inform the open space needs of the Box Hill Precinct during the precinct planning process.

We note that the plan includes embellishment costs for Turnbull Reserve, which is an existing local park in the precinct that serves the needs of existing residents.⁵⁷ The land for Turnbull Reserve is not included in the plan.

The council notes that the embellishment costs in CP15 (2020) for Turnbull Reserve will provide for additional recreational demand resulting from the adjoining high density development.⁵⁸ Noting the relatively low provision of open space in the precinct, and that we find the costs of local parks are reasonable on a per square metre basis (see section 6.4), we consider that nexus is established for including these additional embellishment costs in the plan.

⁵⁵ The council business papers note that Precinct and Contributions Planning for Box Hill Precinct had anticipated that a community facility would be located at the future Bligh Reserve and, as such, the dimensions and area of this future reserve are sufficient to accommodate this, while still meeting its requirements for open space in Box Hill.

⁵⁶ Recreation Strategy, The Hills Shire Council, October 2019.

⁵⁷ IPART, Assessment of CP15 Box Hill Precinct, December 2014.

⁵⁸ Information from The Hills Shire Council, 20 May 2020.

6.4 Criterion 3: Reasonable cost (embellishment only)

To date, the council's actual costs for open space embellishment reflect 0.5% of the total cost of open space embellishment in the plan. As such, the costs in the plan are based on estimated rather than actual costs. We found:

- The council's approaches to estimating embellishment costs (council estimates from delivering similar parks, and AECOM cost estimates based on detailed strategic designs)⁵⁹ are unchanged from our previous assessment. We consider our previous finding that these approaches are reasonable is still relevant.
- The per square metre embellishment cost estimates for local parks are reasonable, based on comparison with costs in similar plans we have assessed as reasonable.
- The per square metre embellishment cost estimates for sporting facilities (excluding embellishments we have classified as transport works)⁶⁰ are reasonable, based on comparison with costs for similar facilities we have assessed as reasonable. The council has adjusted the costs of the sporting facilities in response to our previous assessments of the plan, removing the indoor recreation facility from the district sporting facility and the 'sundry unmeasured items' from all facilities. The council has also removed the cost of water quality drainage basins, which are funded through stormwater management works in the contributions plan.

6.5 Criterion 5: Apportionment

CP15 (2020) apportions all open space land and embellishment costs to the net additional residential population of the Box Hill Precinct on a per person basis. The council assumes that the need for open space is generated only by the residential development in the precinct. We consider this approach is reasonable.

⁵⁹ AECOM, Traffic Management and Open Space Strategic Design and Cost Estimates, Jan 2014.

⁶⁰ The per square metre embellishment costs used for this analysis exclude the cost of road verges, bridges and cycleways. We have made a recommendation to transfer the cost of road verges and bridges to open space (see Draft recommendation 1 in the transport chapter), but have not made a recommendation to transfer the cost of cycleways. This is consistent with our approach to classifying cycleway costs in other contributions plans from The Hills Shire Council. However, we have excluded the cost of cycleways from this calculation, consistent with our approach in other open space assessments.

7 Plan administration

CP15 (2020) includes \$5.58 million for plan preparation and administration.

Our draft assessment of the plan administration costs in CP15 (2020) is:

- Criterion 1: Essential works Plan administration costs are consistent with the essential works list.
- Criterion 2: Nexus There is nexus between plan administration costs and development in the Box Hill Precinct.
- Criterion 3: Reasonable cost It is reasonable to estimate plan administration costs using 1.5% of the total cost of works over the lifecycle of the plan. This estimate should be updated to reflect the revised cost of works based on IPART's recommendations on CP15 (2020).
- Criterion 5: Apportionment The apportionment of plan administration costs between residential and non-residential development is reasonable.

Based on our draft findings and recommendations to adjust the total costs of works in CP15 (2020), we estimate the cost of plan administration would decrease by \$351,091 (6.3%).

Our draft findings and recommendation for plan administration costs in CP15 (2020) is summarised in Table 7.1.

Criterion	Draft findings	Draft recommendation	Works
Total costs in plan			5,576,907
Essential works	Plan administration is on the essential works list		
Nexus	Nexus is established		
Reasonable cost	Calculating costs using IPART's benchmark of 1.5% of works costs is reasonable	Reduce administration costs to be 1.5% of the revised cost of works	-351,091
Apportionment	Approach is reasonable		
Total IPART-recommend	ded cost adjustment		-351,091
Total IPART-assessed r	easonable cost		5,225,816

Table 7.1IPART-recommended adjustments for plan administration in CP15 (2020)
(\$Jun2019)

Source: The Hills Shire Council, Works Schedule, February 2020 and IPART calculations.

7.1 Criterion 1: Essential works

Plan preparation and administration costs are consistent with the essential works list.

7.2 Criterion 2: Nexus

We consider there is nexus between plan preparation and administration activities and the expected development in the Box Hill Precinct.

7.3 Criterion 3: Reasonable cost

CP15 (2020) includes a cost of \$5.58 million for plan administration, which is 1.5% of the total cost of works in the plan. The use of 1.5% of the total cost of works is consistent with IPART's *Local Infrastructure Benchmark Cost Report* (April 2014), and we consider this is reasonable.

Given our other recommendations to change the costs of works in CP15 (2020), the council should update its plan administration costs to equate to 1.5% of the revised cost of works.

Draft recommendation

13 Revise the cost of plan administration for CP15 (2020) to reflect 1.5% of the adjusted cost of works.

7.4 Criterion 5: Apportionment

In CP15 (2020), the council first apportions plan administration costs between residential and non-residential development. This occurs on an NDA basis for plan administration costs, which follows the same method as stormwater management costs, but is different from the apportionment methodology for transport costs (based on the traffic management study for transport and then an NDA basis).

Costs are then apportioned amongst:

- Residential development on a per-person basis
- Non-residential development on a per square metre of GFA basis.

We consider this approach is reasonable.

8 Cross category considerations

This chapter presents our assessment of criteria which apply across multiple infrastructure categories:

- Criterion 3: Reasonable cost (in relation to the cost of land and the council's financial model)
- Criterion 4: Timing of infrastructure delivery
- Criterion 6: Consultation
- Criterion 7: Other matters.

Our draft assessment is that:

- **Criterion 3: Reasonable cost (land)** The cost of land is reasonable.
- Criterion 3: Reasonable cost (financial model) The council's approach to using escalation factors is reasonable for administration costs, but unreasonable for land and works costs. The escalation factors for land and works are calculated using a simple linear average of four quarters of annual change in each respective index, and we consider that the council should instead use a geometric average, which will better account for compound annual average growth. We are also asking the council to update the model with additional information on the revenue it has received to date.
- Criterion 4: Timing of infrastructure delivery The council's approach to forecasting the timing of infrastructure delivery appears reasonable.
- **Criterion 6: Consultation –** The council's consultation on the draft plan was reasonable.
- Criterion 7: Other matters The council should review the plan within five years and consider options to better map and show the location of infrastructure in the plan.

8.1 Criterion 3: Reasonable cost – land

CP15 (2020) includes \$304.74 million for land acquisition, as shown in Table 8.1. This represents 44.7% of the total costs in the plan. The council has acquired around 31.6% of the land area in the plan. We found the cost of land in CP15 (2020) is reasonable.

Category	Total area (ha)	Total cost	Area acquired (ha)	Area yet to be acquired (ha)
Transport	20.9	51,665,809	4.4	16.5
Stormwater	46.0	82,752,997	10.5	35.5
Open space	61.6	170,321,018	25.6	36.0
Community services	-	-	-	-
Total	128.5	304,739,824	40.6	88.0

Table 8.1	Land areas and costs in CP15	(2020)	(\$Jun2019)
		()	(*******

Source: CP15 Works Schedule and IPART analysis.

8.1.1 The council's approaches to costing land are reasonable

The council uses different approaches to costing land, depending on whether it has already acquired the land or whether it is yet to acquire the land:

- Land already acquired in the plan The cost of the land already acquired in CP15 (2020) is the actual cost of each acquisition, that is, the sum of the nominal (non-indexed) costs. The council does not index the actual cost of land to the base year of the plan because the council uses a nominal cash flow model (net present value approach) to calculate contributions. We consider this is reasonable.⁶¹
- **Land yet to be acquired in the plan** The council estimates the cost by:
 - Applying the average market values (dollars per square metre) for different categories of unconstrained land, as advised by its qualified valuer in 2017, based on its assumptions about the underlying zonings of the land
 - Applying the average value for flood constrained land as required by the Minister⁶²
 - Adding an allowance of 1.5% to cover the amount that the council may have to pay in association with land acquisition costs, such as: legal and conveyancing fees; survey fees; and/or compensation payments to land-owners for compulsory acquisition of their land.

We found that the council's application of the average market values advised by its valuer mostly reflects the underlying zonings and constraints applying to land in the plan.

For two parcels of stormwater land that the council is yet to acquire (at 4 Nelson Road and 805 Windsor Road, Box Hill), it has incorrectly applied the value for R3 – Medium Density Residential, when the land has an underlying zoning of R2 – Low Density Residential. In section 5.3 we outlined that nexus is not established for the inclusion of this land for the delivery of stormwater infrastructure; it is included in draft recommendation 12 and details of the land are further outlined at Appendix F. If the land remains in the plan, its value should be adjusted to reflect the average per square metre value advised by the council's valuer for R2 land, consistent with its underlying zoning.

The allowance applied to land costs in CP15 (2020) is the same as other plans we have assessed recently from The Hills Shire Council.⁶³ We consider this allowance is reasonable.

Overall we consider that the estimated cost of land that the council is yet to acquire is reasonable, noting that some adjustment may be required through our final recommendations if land that is excess to the requirements for stormwater infrastructure remains in the plan.

⁶¹ It may be reasonable for the council to index the cost of land already acquired by CPI to the base period of the model. This approach may be consistent with the EP&A regulation, but in practice is likely to only slightly change the contribution rate.

⁶² Minister for Planning, Letter to The Hills Shire Council, August 2019.

⁶³ Including for CP12 – Balmoral Road, CP13 – North Kellyville and CP17 – Castle Hill North.

8.2 Criteria 3 and 4: Reasonable cost and timing - the council's financial model

The council uses a NPV approach to calculate the contribution rates in CP15 (2020). The council submitted two models which separately calculate developer contributions for residential and non-residential development.

The base period of the plan and model is June 2019. In updating the base year of the plan, the council has amended the starting point of the model but assumed that development will continue to occur over the same 25 year period.

We examined the council's approach and the assumptions it has made in the models and assessed its approach to modelling contribution rates against:

- Criterion 3 (Reasonable costs)
- Criterion 4 (Timeframe).⁶⁴

8.2.1 The amount of revenue reflected in the model may be too low

The council's NPV model is updated when a plan is reviewed to reflect the latest available information about the costs of infrastructure and the revenue received from developers. The revenue applied in the council's NPV model appears low, relative to the amount of development that has occurred in CP15 (2020) to date. We have asked the council to update the information, if applicable, and will make a recommendation in our Final Report if required.

8.2.2 Timing of expenditure is based on the council's expected staging of infrastructure

The council's NPV model includes assumptions about the timing of expenditure, which are based on its forecasts of when infrastructure and associated land acquisitions are required in order to facilitate development of the precinct.

The council assumes development will occur over 25 years and reflects this assumption in the model. Its assumptions around the delivery of infrastructure for incomplete works are largely unchanged since our 2016 assessment of the plan. The council has updated its delivery timetable for works that have been delivered and made minor amendments to when it expects to deliver the remaining works.

The council's approach to forecasting the timing of infrastructure delivery appears reasonable. We asked the council if it would like to revise its infrastructure delivery timetable and modelling assumptions if there was concern they may change due to the impact of the Covid-19 pandemic. The council has not changed its infrastructure delivery timetable or modelling assumptions for CP15 (2020).

⁶⁴ We assessed this criterion in relation to the council's assumptions about the timing of development and timeframe for delivery of infrastructure in its NPV model.

8.2.3 Timing of revenue is determined by the council's assumed development path

The council's assumed timing for receipt of contributions revenue is based on its expected profile of development over the duration of the plan. We refer to this as the 'development path.'

The council's assumed development path for the Box Hill Precincts is similar to the assumed development path we have seen in other contributions plans, in particular the council's Contributions Plan No. 17 – Castle Hill North, where the council also assumed a 'double-peak' in development applications in the Box Hill Precinct. We consider this approach is reasonable.

8.2.4 The council escalates the costs of land and works from June 2019 onwards

The council derives escalation factors from all land and works costs by calculating average annual growth over a 15-year period (June 2004 to June 2019) of several representative ABS indices. For administration costs, the council assumes an escalation factor of 2.5%, which represents the midpoint of the Reserve Bank of Australia's inflation target of 2-3%.

We consider the council's approach is reasonable for administration costs, but unreasonable for land and works costs. The escalation factors for land and works are calculated using a simple linear average of four quarters of annual change in each respective index. The annual change figures are then summed and averaged to calculate the council's escalation factors. This method does not properly account for the effects of compounding on the time series.

The council should instead use a geometric average, which will better account for compound annual average growth. This draft recommendation is consistent with recommendations in our recent assessment of the council's CP12, CP13 and CP17. Table 8.2 compares the council's approach with our recommended approach.

Type of infrastructure	Index used	15-year simple-average to June 2019ª	15-year compound (geometric)- average to June 2019
Land costs	ABS Established House Price Index – Sydney	4.55%	4.22%
Open space works	ABS PPI for non-residential building construction – New South Wales	2.85%	2.74%
Stormwater and transport works	ABS PPI for road and bridge construction – New South Wales	3.25%	3.15%

Table 8.2	Cost escalation factors for land and works

a These are the escalation factors used in the NPV models for CP15 (2020). They are based on the simple average method. **Note:** PPI = producer price index.

Source: ABS index values for the relevant indices and IPART calculations.

Draft recommendation

14 Recalculate all escalation factors using a compound annual average growth rate formula instead of a simple average formula.

8.2.5 The council's revenue escalation factor of 2.5% is reasonable

The council uses a rate of 2.5% to escalate future revenues, which represents the midpoint of the Reserve Bank of Australia's inflation target of 2-3%. The future value of revenues are then discounted to present values using the discount rate in the model.

We consider the council's method of escalating revenues and the use of a 2.5% factor is reasonable, and is consistent with guidance in our 2018 Technical Paper.⁶⁵

8.2.6 The council should update its discount rate to 3.2%

The council uses IPART's local government discount rate of 3.7% (published in August 2019) to discount all the escalated cash flows to their present values at the base period. This was consistent with the recommendation in our Technical Paper to use the IPART calculated discount rate, at the time the council exhibited the plan.⁶⁶

However, we recommend the council should update the model to use the latest available discount rate of 3.2%, which was published in August 2020. The next update to the Local Government Cost Index will occur in February 2021.

Draft recommendation

15 Update the discount rate in the financial model to 3.2%, which is the latest available Local Government Discount Rate.

8.3 Criterion 4: Timing of infrastructure delivery

In CP15 (2020) development is assumed to occur over 25 years. The council's assumptions around the delivery of infrastructure for incomplete works are largely unchanged since our 2016 assessment. The council has updated its delivery timetable for works that have been delivered and made minor amendments to when it expects to deliver the remaining works.

We consider our previous assessment remains relevant and the council's timing of infrastructure delivery is reasonable.

8.4 Criterion 6: Consultation

We consider the council's process for CP15 (2020) satisfies the consultation criterion.

The council publicly exhibited the draft plan from 17 December 2019 to 7 February 2020, and received one submission from Calibre Consulting on behalf of Mogul Stud Pty, Jundu Pty Ltd and DH Box Hill Pty Ltd, who collectively own around half the developable residential land in the precinct.

The council appears to have considered the submission in detail and amended the plan in response to the submission. For example, the submission noted the double counting of half-

⁶⁵ IPART, Modelling for local infrastructure contributions in a present value framework, August 2018, p 11.

⁶⁶ IPART, *Modelling for local infrastructure contributions in a present value framework*, August 2018, p 5.

width roads fronting non-developable land which had already been delivered in the precinct. The council removed the double-counted roads from the plan before submitting it to us for assessment; which reduced costs in the plan compared with the plan that was exhibited.

8.5 Criterion 7: Other matters

Our assessment of the CP15 (2020) has identified two other relevant matters:

- The frequency of plan review
- The adequacy of maps within the contributions plan that show the location of proposed infrastructure.

We found that, given the stage of development in the Box Hill Precincts, the council should comprehensively review the plan within the next five years. We also found that the council should update the plan to ensure that the maps showing locations of infrastructure are accurate and accessible.

Draft recommendations

- 16 Comprehensively review the plan within the next five years to ensure assumptions about the scope, cost and apportionment of land and works reflect the progress of development in the precinct.
- 17 Update the plan to ensure that the maps showing locations of infrastructure are accurate and accessible.

8.5.1 The council should review CP15 within the next five years

This is our fourth review of CP15 since 2014. We consider regular review of the plan is important to ensure planning assumptions and expectations are updated and reflected in the plan. As development progresses in the Box Hill Precincts, the council should continue to monitor the need for the plan to be reviewed. We consider a review cycle of three years is reasonable for early stage plans, and every five years for plans where development has progressed and the planning assumptions are more certain.

We recommend the council review CP15 within five years.

8.5.2 The council should update CP15 to include accurate and accessible infrastructure maps

The *Environmental Planning and Assessment Regulation 2000* provides that contributions plans must include a map or maps that show the specific public amenities and services proposed to be provided by the council.⁶⁷ CP15 (2020) includes 14 maps that show the locations of most, but not all, of the infrastructure in the plan.⁶⁸ For example, the maps do not show the location of proposed half-width roads adjoining non-developable land.

⁶⁷ Environmental Planning and Assessment Regulation 2000, clause 27(1)(h).

⁶⁸ CP15 (2020), pp 55-68.
We have also found that the presentation of these maps makes it difficult to identify the location of infrastructure in the plan. We recommend the council review and update the maps in CP15 (2020) to ensure that all infrastructure is included and that the maps are accessible for stakeholders. One possible improvement may be to include separate maps of the Box Hill Precincts for each infrastructure category with, for example, all infrastructure works in each category shown on a single map.

A Summary of draft recommendations

Table A.1Summary of draft recommendations – CP15 (2020) works and plan
administration (\$Jun2019)

	Cost in plan	IPART- recommended adjustment	IPART- assessed reasonable cost
Transport works	180,953,757		
Transfer some open space costs to transport		1,549,248	
Remove the cost of upgrading intersection BHT18		-5,300,000	
Increase the cost of intersection BHT17		346,740	
Reduce contingency allowance for half-width roads		-1,889,008	
Reduce the cost of the Northern Connection Road if funded through the SIC		Not costed	
Revise cost estimates for two-lane roundabouts		-5,904,927	
Revise cost estimates for signalised intersections		-29,269,935	
Reduce the cost of intersection BHT22		-1,043,040	
Apportion 67% of the Northern Connection Road cost to CP15		1,947,443	
Apportion 81.7% of the cost of upgrading Boundary Road to the plan		17,706,650	
			159,096,928
Stormwater management works	84,974,681		
No adjustments			
			84,974,681
Open space embellishment	105,865,380		
Transfer some open space costs to transport		-1,549,248	
			104,316,132
Plan administration	5,576,907		
Reduce administration costs to be 1.5% of the revised cost of works		-351,091	
			5,225,816
Total works	371,793,817	-23,406,077	348,387,740
Total works and administration	377,370,724	-23,757,168	353,613,556

Source: CP15 (2020) Works Schedule and IPART analysis.

Table A.2 Summary of draft recommendations – CP15 (2020) land costs (\$Jun2019)

Cost in plan	IPART- recommended adjustment	IPART- assessed reasonable cost
51,665,809		
		51,665,809
82,752,997		
	-664,398	
		-82,088,599
170,321,018		
		170,321,018
304,739,824	-664,398	304,075,425
	Cost in plan 51,665,809 82,752,997 82,752,997 170,321,018 304,739,824	Cost in plan IPART-recommended adjustment 51,665,809 - 82,752,997 - 82,752,997 - 170,321,018 - 304,739,824 -664,398

Source: CP15 (2020) Works Schedule and IPART analysis.

B Terms of reference

INDEPENDENT PRICING AND REGULATORY TRIBUNAL ACT 1992 TERMS OF REFERENCE

Reviewable Contributions Plans - Environmental Planning and Assessment Act 1979

I, GLADYS BEREJIKLIAN MP, Premier, under section 9 of the *Independent Pricing and Regulatory Tribunal Act 1992* approve provision, by the Independent Pricing and Regulatory Tribunal (**IPART**), of services to the Minister for Planning with respect to reviewing Reviewable Contributions Plans, in accordance with the following terms of reference.

Premier

1+/11/15

Dated:

Background

The Environmental Planning and Assessment (Local Infrastructure Contributions) Direction 2012 contemplates that a Council may submit a Contributions Plan to IPART for review, where the Plan would (but for the Direction) authorise a contribution under section 7.11 of the EP&A Act that exceeds the maximum amount that the Direction allows to be imposed as a contribution in relation to residential development.

The Minister for Planning may also refer any contributions plan to IPART for review where the Minister considers there is merit in having an independent assessment.

Services

On and from the date that these terms of reference are issued to IPART, IPART is to review each Reviewable Contributions Plan submitted to it and provide the Minister for Planning and the relevant Council with a report on its review. In providing the services, IPART must:

- (a) review the relevant Reviewable Contributions Plan in accordance with the assessment criteria set out in the Practice Note, including whether the public amenities and services to which the Contributions Plan relates are on the essential works list (if any) set out in the Practice Note;
- (b) consider, in its review of the Reviewable Contributions Plan, whether the estimate of the costs of providing those public amenities and services, as set out in the Plan, are reasonable;
- (c) publish a report of its review on its website; and
- (d) provide a copy of the report to the Minister for Planning and the relevant Council.

Consultation

In conducting a review under these terms of reference, IPART must:

- (a) consult with the Department of Planning and Environment (NSW);
- (b) consult with the relevant Council and any other person IPART considers appropriate; and
- (c) consider any criteria set out in the Practice Note (in addition to any other matters IPART considers relevant).

Definitions

Contributions Plan means a contributions plan or draft contributions plan prepared by the relevant Council for the purposes of imposing conditions under section 7.11 of the EP&A Act.

Council has the same meaning as it has in the *Local Government Act 1993*.

EP&A Act means the Environmental Planning and Assessment Act 1979.

Practice Note means the "Revised Local Development Contributions Practice Note: For the assessment of Local Contributions Plans by IPART" issued by the Department of Planning and Environment and dated January 2018, as amended or replaced from time to time.

Reviewable Contributions Plan means a Contributions Plan submitted to IPART as contemplated by the *Environmental Planning and Assessment (Local Infrastructure Contributions) Direction 2012* or referred to it by the Minister for Planning.

C Overview of contributions plans and their assessment

C.1 What are contributions plans?

In NSW, local councils are primarily responsible for providing local or community infrastructure required to meet the additional demand for services and facilities generated by new development in their local government area. Councils can levy developers for local infrastructure contributions to fund the costs of providing this infrastructure.

However, to do so, a council must prepare a contributions plan which sets out:

- The local infrastructure required to meet the demand associated with development in a specific area
- The estimated cost of the land, works and administration required to provide this infrastructure
- The contribution rates for different types of development which the council proposes to levy on developers.⁶⁹

C.2 What is IPART's role?

IPART's assessment functions for local infrastructure contributions plans are based on terms of reference issued by the Premier under section 9 of the *Independent Pricing and Regulatory Tribunal Act* 1992 (see Appendix B).

We assess contributions plans from councils that propose to levy contributions above \$30,000 per residential lot or dwelling in identified greenfield areas and \$20,000 per residential lot or dwelling in other areas. From 1 July 2020, and IPART-reviewed contributions plan entitles the council to levy the full contribution amount in accordance with the adopted plan.

In undertaking our assessment, we publish a Draft Report including our draft recommendations on the land, works and administration in the plan, and invite submissions from stakeholders. We consider all submissions in the preparation of our Final Report.

When we have completed our assessment of the contributions plan, our Final Report is submitted to the Minister for Planning and Public Spaces (the Minister). If appropriate, the Minister (or his Nominee) will request the council to amend its contributions plan by actioning some or all of the recommendations in the Final Report. Once the council has made the requested amendments, the plan becomes an IPART-reviewed plan and the council may levy contributions in accordance with the adopted plan.

⁶⁹ A consent authority may impose a condition under section 7.11 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) only if it is in accordance with a contributions plan. The *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) makes provision for or with respect to the preparation and approval of contributions plans, including the format, structure and subject-matter of plans.

C.3 How do we assess contributions plans?

As required by the terms of reference, we assess contributions plans in accordance with the criteria set out in the *Local Infrastructure Contributions Practice Note* (Practice Note) issued by DPIE.⁷⁰ The criteria require us to assess whether:

- 1. The public amenities and public services in the plan are on the essential works list.
- 2. There is reasonable nexus between the proposed public amenities and public services in the plan and the development.⁷¹
- 3. The proposed development contribution is based on a reasonable estimate of the cost of the proposed public amenities and public services.
- 4. The proposed public amenities and public services can be provided within a reasonable timeframe.
- 5. The proposed development contribution is based on a reasonable apportionment of costs.
- 6. The council has conducted appropriate community liaison and publicity in preparing the contributions plan.
- 7. The plan complies with other matters we consider relevant.

We also assess whether the plan contains the information required by Clause 27 of the *Environmental Planning and Assessment Regulation 2000*. A summary of our assessment of CP15 (2020) against these requirements is provided at Appendix D.

C.4 What is the aim of our assessment?

Broadly, our assessments are intended to bring greater transparency and accountability to setting local development contributions. More specifically, in conducting the assessment and making our recommendations, we aim to ensure the plan reflects the reasonable costs of providing necessary local infrastructure to support the new development.

If costs in the plan are too high (ie, higher than the reasonable costs of infrastructure with a nexus to the development), developers will pay too much for local infrastructure. Development could be unduly impeded if the costs in the plan are too high and not aligned with the benefits provided by essential local infrastructure. On the other hand, if costs in the plan are too low (ie, lower than the reasonable costs of infrastructure with a nexus to the development), then the new development would effectively be subsidised by the council's ratepayers or necessary infrastructure may not be able to be provided.

Contributions that reflect the reasonable costs of local infrastructure provision are important for reasons of both efficiency and equity. They are necessary to:

⁷⁰ Department of Planning and Environment, Practice Note – Local Infrastructure Contributions, January 2019. The January 2019 Practice Note replaces the January 2018 Practice Note – Local Infrastructure Contributions. The 2019 revision clarifies the timing of when a council can adopt a contributions plan (particularly where the draft plan proposes a rate above the maximum cap amount in the Direction). The assessment criteria for our review remain the same.

⁷¹ Nexus ensures that there is a connection between the land and facilities in a contributions plan and the demand for them arising from the new development.

- Signal the costs of developing different areas which, in turn, can assist in ensuring that development occurs where it should (ie, where the benefits of the development are greater than its costs)
- Ensure that there are sufficient funds available to deliver the infrastructure necessary for the new development area
- Ensure that developers do not pay too much for infrastructure or that, on the other hand, other parties (such as a council's ratepayers) do not have to fund any shortfall between the actual costs of providing local infrastructure and the revenue received from development consents.

In the context of CP15 (2020), our assessment recognises that the release area is around seven years into its 25 year development period, with most development yet to occur.⁷²

⁷² At the time of application, the council advised that 16.0% of residential development and 10.2% of non-residential development had been approved and/or constructed: The Hills Shire Council, Application for assessment of a local infrastructure contributions plan, p.4.

D Assessment against information requirements in the EP&A Regulation

Clause 27 of the Environmental Planning and Assessment Regulation 2000 requires certain information to be included in a contributions plan. As part of our assessment we have checked that CP15 (2020) contains the information required by this clause of the Regulation. A summary of this analysis is provided in the table below.

Subclause		Location in CP
1(a)	Purpose of the plan.	Section 2.4
1(b)	Land to which the plan applies.	Section 2.3
1(c)	The relationship between the expected types of development in the area to which the plan applies and the demand for additional public amenities and services to meed that development.	Sections 3.1, 3.2, 3.3, 3.4, 3.5 & 3.6.
1(d)	The formulas to be used for determining the section 7.11 contributions required for different categories of public amenities and services.	Section 2.20
1(e)	The section 7.11 contribution rates for different types of development, as specified in a schedule in the plan.	Section 1, Table 10 & Table 11
1(g)	The council's policy concerning the timing of the payment of monetary section 7.11 contributions section, section 7.12 levies and the imposition of section 7.11 conditions or section 7.12 conditions that allow deferred or periodic payment.	Section 2.11 & 2.12
1(h)	A map showing the specific public amenities and services proposed to be provided by the council, supported by a works schedule that contains an estimate of their cost and staging (whether by reference to dates or thresholds).	Section 4, Part D, Figure 6 (Sheets 1-14) & Section 3.8 (works schedule), Table 8 & Table 9
1(i)	If the plan authorises monetary section 7.11 contributions or section 7.12 levies paid for different purposes to be pooled and applied progressively for those purposes, the priorities for the expenditure of the contributions or levies, particularised by reference to the works schedule.	Section 2.18
1A	Despite subclause (1)(g), a contributions plan made after the commencement of this subclause that makes provision for the imposition of conditions under section 7.11 contributions and section 7.12 levies in accordance with those conditions is to be made before the commencement of any building work or subdivision work authorised by the certificate.	Section 2.14
2	In determining the section 7.11 contribution rates or section 7.12 levy percentages for different types of development, the council must take into consideration the conditions that may be imposed under section 4.17(6)(b) of the Act or section 97(1)(b) of the <i>Local Government Act 1993</i> .	Section 2.5

Table D.1 Assessment against information requirements in the EP&A Regulation

3	A contributions plan must not contain a provision that authorises monetary section 7.11 contributions or section 7.12 levies paid for different purposes to be pooled and applied progressively for those purposes unless the council is satisfied that the pooling and progressive application of the money paid will not unreasonably prejudice the carrying into effect, within a reasonable time, of the purposes for which the money was originally paid.	Section 2.18

E Traffic modelling provided by the council to support changes to intersections



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INFORMATION FOR ASSESSMENT OF CP15 (2020)

IPART requested THSC to provide additional information on the previous responses on CP15. The questions and THSC responses are mentioned below:

Question 5: Please provide information (i.e. technical study, traffic modelling, etc.) to support the change of BHT09 from a signalised intersection to a roundabout.

In continuation to Question 5, the following four intersections were also part of the similar discussion and require response from the council.

- BHT07 Gardiner Drive / Mt Carmel Drive;
- BHT08 Brahman Street / Mt Carmel Drive; and
- BHT09 George Street / Mt Carmel Drive

Response: For BHT07, BHT08 and BHT09 the roundabouts would be sufficient than the traffic signals as originally anticipated during the precinct planning. The summary of the intersection modelling analysis for all three intersections for year 2036 is shown below and the supporting documents are presented in Appendix 1. All the intersections as a roundabout are performing well at a level of service A for the year 2036 AM and PM Peak.

Intersection Modelling Summary (Year 2036)				
Intersections	Type of Intersection analysed	Level Of Service AM Peak	Level Of Service PM Peak	
BHT07 – Gardiner Drive / Mt Carmel Drive	Roundabout	A	А	
BHT08 – Brahman Street / Mt Carmel Drive	Roundabout	А	А	
BHT09 – George Street / Mt Carmel Drive	Roundabout	А	А	

Roundabout to Signal

• BHT17– Prosper Street / Mt Carmel Drive

BHT17 performed well within desired level of service as a roundabout for year 2036 for AM peak; however, it is failing in PM peak and therefore it should be established as a signalized intersection.

Intersection Modelling Summary (Year 2036)			
Intersections	Type of Intersection	Level Of Service AM Peak	Level Of Service PM Peak
BHT17– Prosper Street / Mt Carmel Drive	Signals ¹	D	D

¹ - New Intersection control proposed.



Question 6-13: intersection treatment at the following locations with the evidence to support the explanations.

- BHT20: Signals at Grandhill Parkway /The Water Lane; near the SW corner of Park6 (BHPF06)
- BHT21: Roundabout at Grandhill Parkway /Box Road;
- BHR05: Signals at Mt Carmel Drive/Old Pitt Town Road/Valetta Drive;
- BHR06: Signals at Boundary Road/George Street;
- BHR07: Signals at Boundary Road/Brahman Road; and
- BHR08: Roundabout at The Water Lane/Outback Street

Response: For BHT20, BHT21, BHR05, BHR06, BHR07 and BHR08 intersection modelling summary for year 2036 is presented below and the relevant supporting documents are presented in **Appendix 2**.

The traffic modelling shows that these intersections will operate at desired LOS for both peak period in Year 2036.

Intersection Modelling Summary (Year 2036)				
Intersections	Type of	Level Of Service AM	Level Of Service	
	analysed	reak	FINIFEAK	
BHT20: Grandhill Parkway /The Water Lane	Signals	D	D	
BHT21: Grandhill Parkway/Box Road	Roundabout	A	А	
BHR05: Mt Carmel Drive/Old Pitt Town Road/Valetta Drive	Signals	В	В	
BHR06: Boundary Road/George Street	Signals	В	В	
BHR07: Boundary Road/ Brahman Road	Signals	В	В	
BHR08: The Water Lane/Outback Street	Roundabout	A	A	

In relation to Question 17: IPART requires the supporting studies/ justification for the intersection designs mentioned in Table 2 of the information request document. These intersections are listed below:

•	BHT10 –Terry Road/Hynds Road	CALIBRE
•	BHT11 –Terry Road/Mason Road	ACE/CALIBRE
•	BHT12 –Terry Road/George Street	CALIBRE
•	BHT13 –Mason Road/The Water Lane	MWH
•	BHT14 –Hynds Road/The Water Lane	JEM
•	BHT15 - Nelson Road/The Water Lane	JEM



•	BHT18 –Terry Road and High Street	ACE/CALIBRE
•	BHT20 - Grandhill Parkway/The Water Lane	JEM
•	BHR02 –Mason Road/Old Pitt Town Road	CADDMANN
•	BHR06 – Boundary Road/George Street	OPUS
•	BHR07 – Boundary Road/Brahman Road	OPUS
•	BHR08 –The Water Lane/Outback Street	CADMANN
•	BHRU02B – Road upgrade of Terry Road	CALIBRE
	(Town Centre to Mason Road Bypass)	
•	BHRU08A – Road upgrade of The Water Lane	JEM
	(Nelson Rd to Annangrove Rd)	
•	BHRU08B - Road upgrade of The Water Lane	JEM
	(Mason Road to Hynds Road)	
•	ARU1 – Upgrade of Annangrove Road	JEM
•	NKB01A – Edwards Road Bridge	OPUS

Response: For all the above intersection, the intersection modelling summary for year 2036 is presented below and the relevant supporting documents are presented in **Appendix 3**.

Intersection Modelling Summary (Year 2036)			
Intersections	Type of Intersection analysed	Level Of Service AM Peak	Level Of Service PM Peak
BHT10 – Terry Road/ Hynds Road	Signals	В	С
BHT11 – Terry Road/Mason Road	Signals	E	F
BHT12 – Terry Road/George Street	Signals	В	D
BHT13 – Mason Road/The Water Lane	Signals	В	D
BHT14 – Hynds Road/The Water Lane	Signals	В	В
BHT15 - Nelson Road/The Water Lane	Signals	D	E
BHT18 – Terry Road and High Street	Priority Control (Left In Left Out) ¹	A	A
BHT20 - Grandhill Parkway/The Water Lane	Signals	D	D
BHR02 – Mason Road/Old Pitt Town Road	Roundabout	A	А
BHR06 – Boundary Road/George Street	Signals	В	В
BHR07 –Boundary Road/Brahman Road	Signal	В	В
BHR08 – The Water Lane/Outback Street	Roundabout	А	А



BHT07 – Gardiner Drive / Mt Carmel Drive	Roundabout	А	А
BHRU02B – Road upgrade of Terry Road and Mason Road Bypass	Road Upgrade	Link V/C Ratio ²	Link V/C Ratio ²
1BHRU08A – Road upgrade of The Water Lane (Nelson Rd to Annangrove Rd)	Road Upgrade	Link V/C Ratio ²	Link V/C Ratio ²
BHRU08A_1 The Water Lane/Terrain Street	Priority Control (Left In Left Out)	А	А
BHRU08A_2 The Water Lane/Mirage Street	Priority Control (Left In Left Out)	A	А
BHRU08A_3 The Water Lane/Scenary Street	(Left In Left Out)	A	А
BHRU08B - Road upgrade of The Water Lane (Mason Road to Hynds Road)	Road Upgrade	Link V/C Ratio ²	Link V/C Ratio ²
ARU1 – Upgrade of Annangrove Road	Road Upgrade	Link V/C Ratio ²	Link V/C Ratio ²
Annangrove/Water Lane/Withers Road	Signal	С	В
NKB01A – Edwards Road Bridge	-	-	-

¹ - New Intersection control proposed.

²- Link V/C ratio presented in Appendix3



Appendix 1

Evidence and supporting documents for Question 5

Response for Intersections: BHT07, BHT08, BHT09 and BHT17



BHT07 – Gardiner Drive / Mt Carmel Drive





Intersection BHT07 -

Site: BHT07 [AM_Mount Carmel Drive_Gardiner Drive]

New Site Site Category: (None) Roundabout

Move	Movement Performance - Vehicles Mov Turn Demand Flows Deg Average Level of 95% Back of Queue Prop Effective Aver No Average														
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h			
South:	Mount C	Carmel Driv	е												
2	T1	148	0.0	0.194	4.4	LOS A	1.4	9.9	0.45	0.53	0.45	55.5			
3	R2	95	0.0	0.194	10.1	LOS A	1.4	9.9	0.45	0.53	0.45	56.6			
Appro	ach	243	0.0	0.194	6.6	LOS A	1.4	9.9	0.45	0.53	0.45	56.0			
East: 0	Gardiner	Drive													
4	L2	581	0.0	0.730	10.1	LOS A	10.3	72.1	0.93	0.99	1.23	45.7			
6	R2	166	0.0	0.730	15.3	LOS B	10.3	72.1	0.93	0.99	1.23	44.0			
Appro	ach	747	0.0	0.730	11.2	LOS A	10.3	72.1	0.93	0.99	1.23	45.5			
North:	Mount C	Carmel Drive	Э												
7	L2	61	0.0	0.350	4.0	LOS A	2.8	19.4	0.35	0.40	0.35	53.1			
8	T1	445	0.0	0.350	4.1	LOS A	2.8	19.4	0.35	0.40	0.35	57.1			
Approa	ach	506	0.0	0.350	4.1	LOS A	2.8	19.4	0.35	0.40	0.35	56.8			
All Vel	nicles	1497	0.0	0.730	8.1	LOS A	10.3	72.1	0.66	0.71	0.81	50.2			

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Carmel_Gardiner Dr.sip8

Site: BHT07 [PM_Mount Carmel Drive_Gardiner Drive]

New Site Site Category: (None) Roundabout

Move	Novement Performance - Vehicles Movement Demand Flows Deg Average Level of 95% Back of Queue Prop Effective Aver No Average													
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h		
South:	Mount C	Carmel Driv	е											
2	T1	518	0.0	0.600	4.3	LOS A	6.7	46.8	0.45	0.50	0.45	55.4		
3	R2	388	0.0	0.600	9.9	LOS A	6.7	46.8	0.45	0.50	0.45	56.5		
Approa	ach	906	0.0	0.600	6.7	LOS A	6.7	46.8	0.45	0.50	0.45	55.9		
East: 0	Gardiner	Drive												
4	L2	219	0.0	0.233	3.1	LOS A	1.7	11.7	0.43	0.48	0.43	47.9		
6	R2	83	0.0	0.233	8.3	LOS A	1.7	11.7	0.43	0.48	0.43	48.7		
Approa	ach	302	0.0	0.233	4.6	LOS A	1.7	11.7	0.43	0.48	0.43	48.1		
North:	Mount C	armel Drive	Э											
7	L2	201	0.0	0.341	5.9	LOS A	2.5	17.4	0.67	0.63	0.67	51.6		
8	T1	157	0.0	0.341	6.1	LOS A	2.5	17.4	0.67	0.63	0.67	56.1		
Approa	ach	358	0.0	0.341	6.0	LOS A	2.5	17.4	0.67	0.63	0.67	54.1		
All Veh	nicles	1566	0.0	0.600	6.1	LOS A	6.7	46.8	0.49	0.53	0.49	53.9		

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHT08 – Brahman Street / Mt Carmel Drive



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Site: BHT08 [AM_Mount Carmel Drive_Brahman Road]

New Site Site Category: (None) Roundabout

Move	Movement Performance - Vehicles Mov Turn Demand Flows Deg. Average Level of 95% Back of Queue Prop. <u>Effective Aver. No. Average</u>														
Mov	Turn	Demand I	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Aver. No.	Average			
ID		Total	HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Cycles	Speed			
South	: Mount	Carmel Driv	e	v/C	360		Ven					KI11/11			
1	L2	186	0.0	0.218	4.1	LOS A	1.5	10.8	0.22	0.51	0.22	54.2			
1a	L1	5	0.0	0.218	4.0	LOS A	1.5	10.8	0.22	0.51	0.22	49.0			
3a	R1	123	0.0	0.218	8.0	LOS A	1.5	10.8	0.22	0.51	0.22	52.6			
Appro	ach	315	0.0	0.218	5.6	LOS A	1.5	10.8	0.22	0.51	0.22	53.6			
North	East: Mo	ount Carmel	Drive												
24a	L1	261	0.0	0.280	5.5	LOS A	1.9	13.2	0.53	0.58	0.53	52.1			
26a	R1	38	0.0	0.280	9.4	LOS A	1.9	13.2	0.53	0.58	0.53	55.5			
26	R2	5	0.0	0.280	10.5	LOS A	1.9	13.2	0.53	0.58	0.53	52.7			
Approach		304	0.0	0.280	6.0	LOS A	1.9	13.2	0.53	0.58	0.53	52.8			
North	West: Ha	ackney Ave													
27	L2	16	0.0	0.033	6.0	LOS A	0.2	1.3	0.54	0.61	0.54	49.9			
29a	R1	11	0.0	0.033	9.8	LOS A	0.2	1.3	0.54	0.61	0.54	46.1			
29b	R3	5	0.0	0.033	11.9	LOS A	0.2	1.3	0.54	0.61	0.54	54.4			
Appro	ach	32	0.0	0.033	8.3	LOS A	0.2	1.3	0.54	0.61	0.54	50.1			
West:	Brahma	in Road													
10b	L3	5	0.0	0.218	3.9	LOS A	1.4	9.8	0.37	0.58	0.37	45.2			
10a	L1	33	0.0	0.218	3.3	LOS A	1.4	9.8	0.37	0.58	0.37	46.8			
12	R2	235	0.0	0.218	8.1	LOS A	1.4	9.8	0.37	0.58	0.37	46.5			
Appro	ach	273	0.0	0.218	7.5	LOS A	1.4	9.8	0.37	0.58	0.37	46.5			
All Ve	hicles	923	0.0	0.280	6.4	LOS A	1.9	13.2	0.38	0.56	0.38	50.5			

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: BHT08 [PM_Mount Carmel Drive_Brahman Road]

New Site Site Category: (None) Roundabout

Movement Performance - Vehicles Mov Turn Demand Flows Deg. Average Level of 95% Back of Queue Prop. <u>Effective Aver. No. Average</u>														
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h		
South	: Mount	Carmel Driv	е											
1	L2	263	0.0	0.385	4.0	LOS A	3.3	23.2	0.20	0.52	0.20	53.9		
1a	L1	16	0.0	0.385	3.9	LOS A	3.3	23.2	0.20	0.52	0.20	48.5		
3a	R1	322	0.0	0.385	7.9	LOS A	3.3	23.2	0.20	0.52	0.20	52.2		
Appro	ach	601	0.0	0.385	6.1	LOS A	3.3	23.2	0.20	0.52	0.20	53.0		
North	East: Mo	ount Carmel	Drive											
24a	L1	231	0.0	0.242	5.5	LOS A	1.6	11.5	0.55	0.58	0.55	52.1		
26a	R1	19	0.0	0.242	9.4	LOS A	1.6	11.5	0.55	0.58	0.55	55.5		
26	R2	5	0.0	0.242	10.5	LOS A	1.6	11.5	0.55	0.58	0.55	52.8		
Approach		255	0.0	0.242	5.9	LOS A	1.6	11.5	0.55	0.58	0.55	52.6		
North\	Nest: H	ackney Ave												
27	L2	1	0.0	0.014	7.2	LOS A	0.1	0.6	0.65	0.64	0.65	47.2		
29a	R1	5	0.0	0.014	11.1	LOS A	0.1	0.6	0.65	0.64	0.65	42.5		
29b	R3	5	0.0	0.014	13.2	LOS A	0.1	0.6	0.65	0.64	0.65	52.1		
Appro	ach	12	0.0	0.014	11.7	LOS A	0.1	0.6	0.65	0.64	0.65	48.7		
West:	Brahma	an Road												
10b	L3	21	0.0	0.282	5.5	LOS A	1.8	12.8	0.59	0.69	0.59	44.6		
10a	L1	11	0.0	0.282	4.9	LOS A	1.8	12.8	0.59	0.69	0.59	46.3		
12	R2	253	0.0	0.282	9.7	LOS A	1.8	12.8	0.59	0.69	0.59	45.9		
Appro	ach	284	0.0	0.282	9.2	LOS A	1.8	12.8	0.59	0.69	0.59	45.8		
All Vel	hicles	1152	0.0	0.385	6.9	LOS A	3.3	23.2	0.38	0.58	0.38	50.5		

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHT09 – George Street / Mt Carmel Drive



Site: BHT09 [AM_Mount Carmel Drive_George St]

New Site Site Category: (None) Roundabout

Movement Performance - Vehicles Mov Turn Demand Flows Deg. Average Level of 95% Back of Queue Prop. <u>Effective Aver. No. Average</u>													
Mov ID	Turn	Demand F Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h	
South	: Mount	Carmel Drive	е										
1	L2	28	0.0	0.133	4.4	LOS A	0.8	5.5	0.31	0.52	0.31	54.7	
2	T1	76	0.0	0.133	4.8	LOS A	0.8	5.5	0.31	0.52	0.31	55.9	
3	R2	67	0.0	0.133	9.4	LOS A	0.8	5.5	0.31	0.52	0.31	54.4	
Appro	bach	172	0.0	0.133	6.5	LOS A	0.8	5.5	0.31	0.52	0.31	55.2	
East:	George	Street											
4	L2	75	0.0	0.124	3.2	LOS A	0.7	5.2	0.25	0.40	0.25	47.2	
5	T1	75	0.0	0.124	3.2	LOS A	0.7	5.2	0.25	0.40	0.25	48.8	
6	R2	19	0.0	0.124	7.7	LOS A	0.7	5.2	0.25	0.40	0.25	49.0	
Approach		168	0.0	0.124	3.7	LOS A	0.7	5.2	0.25	0.40	0.25	48.2	
North	: Mount (Carmel Drive	e										
7	L2	13	0.0	0.063	4.3	LOS A	0.4	2.5	0.27	0.47	0.27	55.5	
8	T1	54	0.0	0.063	4.7	LOS A	0.4	2.5	0.27	0.47	0.27	56.5	
9	R2	15	0.0	0.063	9.3	LOS A	0.4	2.5	0.27	0.47	0.27	57.1	
Appro	ach	81	0.0	0.063	5.5	LOS A	0.4	2.5	0.27	0.47	0.27	56.5	
West:	George	Street											
10	L2	25	0.0	0.043	3.6	LOS A	0.2	1.7	0.36	0.44	0.36	48.1	
11	T1	19	0.0	0.043	3.6	LOS A	0.2	1.7	0.36	0.44	0.36	48.5	
12	R2	8	0.0	0.043	8.2	LOS A	0.2	1.7	0.36	0.44	0.36	48.6	
Appro	bach	53	0.0	0.043	4.3	LOS A	0.2	1.7	0.36	0.44	0.36	48.3	
All Ve	hicles	474	0.0	0.133	5.1	LOS A	0.8	5.5	0.29	0.46	0.29	52.0	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: BHT09 [PM_Mount Carmel Drive_George St]

New Site Site Category: (None) Roundabout

Move	Movement Performance - Vehicles Mov Turn Demand Flows Deg. Average Level of 95% Back of Queue Prop. <u>Effective Aver. No. Average</u>														
Mov ID	Turn	Demand I Total veh/h	lows= HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h			
South	: Mount	Carmel Driv	е												
1	L2	24	0.0	0.240	4.3	LOS A	1.6	11.5	0.29	0.43	0.29	55.5			
2	T1	299	0.0	0.240	4.6	LOS A	1.6	11.5	0.29	0.43	0.29	56.7			
3	R2	11	0.0	0.240	9.3	LOS A	1.6	11.5	0.29	0.43	0.29	55.5			
Appro	ach	334	0.0	0.240	4.8	LOS A	1.6	11.5	0.29	0.43	0.29	56.6			
East:	George	Street													
4	L2	44	0.0	0.094	4.0	LOS A	0.6	3.9	0.44	0.53	0.44	46.1			
5	T1	21	0.0	0.094	4.1	LOS A	0.6	3.9	0.44	0.53	0.44	47.9			
6	R2	42	0.0	0.094	8.6	LOS A	0.6	3.9	0.44	0.53	0.44	48.1			
Approach		107	0.0	0.094	5.8	LOS A	0.6	3.9	0.44	0.53	0.44	47.4			
North:	Mount (Carmel Drive	Э												
7	L2	57	0.0	0.195	4.6	LOS A	1.3	9.2	0.38	0.48	0.38	55.4			
8	T1	174	0.0	0.195	5.0	LOS A	1.3	9.2	0.38	0.48	0.38	56.4			
9	R2	17	0.0	0.195	9.6	LOS A	1.3	9.2	0.38	0.48	0.38	57.1			
Appro	ach	247	0.0	0.195	5.2	LOS A	1.3	9.2	0.38	0.48	0.38	56.2			
West:	George	Street													
10	L2	16	0.0	0.133	4.8	LOS A	0.8	5.6	0.54	0.58	0.54	47.5			
11	T1	84	0.0	0.133	4.9	LOS A	0.8	5.6	0.54	0.58	0.54	47.7			
12	R2	37	0.0	0.133	9.4	LOS A	0.8	5.6	0.54	0.58	0.54	47.8			
Appro	ach	137	0.0	0.133	6.1	LOS A	0.8	5.6	0.54	0.58	0.54	47.7			
All Ve	hicles	825	0.0	0.240	5.3	LOS A	1.6	11.5	0.38	0.48	0.38	53.6			

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHT17- Prosper Street / Mt Carmel Drive



Site: BHT17 [AM_Mt Carmel Drive_Prosper Street]

New Site

Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay) Variable Sequence Analysis applied. The results are given for the selected output sequence.

Move	lovement Performance - Vehicles lov Turn Demand Flows Deg. Average Level of 95% Back of Queue Prop. Effective Aver. No. Average													
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h		
South	: Mount	Carmel Driv	е											
1	L2	804	0.0	0.546	6.9	LOS A	9.2	64.5	0.27	0.64	0.27	46.4		
2	T1	233	0.0	0.228	43.8	LOS D	6.3	44.3	0.83	0.67	0.83	30.2		
3	R2	805	0.0	0.843	65.0	LOS E	28.2	197.4	1.00	0.92	1.12	18.5		
Appro	ach	1842	0.0	0.843	37.0	LOS C	28.2	197.4	0.66	0.77	0.71	26.6		
East:	Prosper	Street												
4	L2	82	0.0	0.068	11.6	LOS A	1.6	11.2	0.35	0.63	0.35	42.3		
5	T1	26	0.0	0.109	55.5	LOS D	1.9	13.1	0.90	0.67	0.90	20.2		
6	R2	5	0.0	0.109	61.1	LOS E	1.9	13.1	0.90	0.67	0.90	26.8		
Approach		114	0.0	0.109	24.0	LOS B	1.9	13.1	0.50	0.65	0.50	33.1		
North:	Mount (Carmel Drive	e											
7	L2	99	0.0	0.858	64.5	LOS E	33.1	232.0	1.00	0.99	1.33	25.6		
8	T1	840	0.0	0.858	57.8	LOS E	33.1	232.0	0.99	0.97	1.21	26.0		
9	R2	87	0.0	0.165	45.5	LOS D	4.4	31.0	0.79	0.75	0.79	28.7		
Appro	ach	1026	0.0	0.858	57.4	LOS E	33.1	232.0	0.98	0.96	1.19	26.1		
West:	Urban w	/ay												
10	L2	5	0.0	0.206	63.1	LOS E	3.3	22.9	0.93	0.72	0.93	23.0		
11	T1	26	0.0	0.206	58.5	LOS E	3.3	22.9	0.93	0.72	0.93	18.0		
12	R2	74	0.0	0.206	63.0	LOS E	3.3	22.9	0.93	0.74	0.93	17.2		
Appro	ach	105	0.0	0.206	61.9	LOS E	3.3	22.9	0.93	0.73	0.93	17.8		
All Vel	hicles	3087	0.0	0.858	44.1	LOS D	33.1	232.0	0.77	0.83	0.87	26.2		

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Move	Movement Performance - Pedestrians													
Mov ID	Description	Demand Flow	Average Delay	Level of Service	Average Bacl Pedestrian	k of Queue Distance	Prop. Queued	Effective Stop Rate						
		ped/h	sec		ped	m								
P1	South Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96						
P2	East Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96						
P3	North Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96						
P4	West Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96						
All Pe	destrians	211	64.3	LOS F			0.96	0.96						

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Site: BHT17 [PM_Mt Carmel Drive_Prosper Street]

New Site

Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 130 seconds (Site Optimum Cycle Time - Minimum Delay) Variable Sequence Analysis applied. The results are given for the selected output sequence.

Move	lovement Performance - Vehicles lov Turn Demand Flows Deg. Average Level of 95% Back of Queue Prop. Effective Aver. No. Average													
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h		
South	: Mount	Carmel Driv	e											
1	L2	16	0.0	0.010	6.2	LOS A	0.1	0.6	0.14	0.57	0.14	47.4		
2	T1	726	0.0	0.849	40.7	LOS C	19.2	134.6	1.00	0.94	1.16	31.3		
3	R2	43	0.0	0.054	33.2	LOS C	0.8	5.7	0.82	0.69	0.82	27.6		
Appro	ach	785	0.0	0.849	39.6	LOS C	19.2	134.6	0.97	0.92	1.12	31.3		
East:	Prosper	Street												
4	L2	815	0.0	0.758	24.0	LOS B	30.9	216.1	0.81	0.89	0.92	32.8		
5	T1	11	0.0	0.328	52.6	LOS D	5.6	39.4	0.93	0.77	0.93	19.7		
6	R2	88	0.0	0.328	58.2	LOS E	5.6	39.4	0.93	0.77	0.93	26.4		
Approach		914	0.0	0.758	27.7	LOS B	30.9	216.1	0.82	0.88	0.92	31.5		
North:	Mount	Carmel Drive	е											
7	L2	68	0.0	0.742	66.2	LOS E	8.9	62.4	1.00	0.93	1.48	24.9		
8	T1	239	0.0	0.742	63.5	LOS E	9.8	68.6	1.00	0.89	1.25	24.5		
9	R2	68	0.0	0.368	66.3	LOS E	4.2	29.3	0.98	0.76	0.98	23.3		
Appro	ach	376	0.0	0.742	64.5	LOS E	9.8	68.6	1.00	0.87	1.24	24.4		
West:	Urban v	way												
10	L2	92	0.0	0.844	57.3	LOS E	29.7	207.8	1.00	0.94	1.11	23.7		
11	T1	11	0.0	0.844	52.7	LOS D	29.7	207.8	1.00	0.94	1.11	18.7		
12	R2	815	0.0	0.844	57.2	LOS E	29.7	207.8	1.00	0.94	1.11	18.2		
Appro	ach	917	0.0	0.844	57.1	LOS E	29.7	207.8	1.00	0.94	1.11	18.9		
All Ve	hicles	2992	0.0	0.849	44.5	LOS D	30.9	216.1	0.94	0.91	1.07	25.9		

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Move	Movement Performance - Pedestrians													
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of . Service	Average Bacl Pedestrian ped	< of Queue Distance m	Prop. Queued	Effective Stop Rate						
P1	South Full Crossing	53	59.3	LOS E	0.2	0.2	0.96	0.96						
P2	East Full Crossing	53	59.3	LOS E	0.2	0.2	0.96	0.96						
P3	North Full Crossing	53	59.3	LOS E	0.2	0.2	0.96	0.96						
P4	West Full Crossing	53	35.2	LOS D	0.1	0.1	0.91	0.91						
All Pe	destrians	211	53.3	LOS E			0.94	0.94						

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.



Appendix 2

Evidence and supporting documents for Questions 6-13

Intersections

BHT20, BHT21, BHR05, BHR06, BHR07 and BHR08



BHT20: Grandhill Parkway /The Water Lane



Site: BHT20 [AM_Water Lane_Grandhill Parkway]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Move	lovement Performance - Vehicles lov Turn Demand Flows Deg. Average Level of 95% Back of Queue Prop. Effective Aver. No. Average													
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h		
South	: Grand	hill Parkway												
1	L2	126	2.0	0.567	52.2	LOS D	8.6	61.2	0.98	0.80	0.98	15.3		
2	T1	42	2.0	0.567	47.6	LOS D	8.6	61.2	0.98	0.80	0.98	18.5		
3	R2	181	2.0	0.617	52.6	LOS D	9.3	66.4	0.99	0.81	0.99	20.8		
Appro	ach	349	2.0	0.617	51.8	LOS D	9.3	66.4	0.98	0.81	0.98	18.8		
East:	The Wa	ter Lane												
4	L2	72	2.0	0.694	40.7	LOS C	20.1	143.0	0.94	0.82	0.94	24.9		
5	T1	765	2.0	0.694	35.9	LOS C	20.1	143.0	0.94	0.81	0.94	22.7		
6	R2	36	2.0	0.115	47.2	LOS D	1.7	11.8	0.89	0.72	0.89	21.9		
Appro	ach	873	2.0	0.694	36.7	LOS C	20.1	143.0	0.93	0.81	0.93	22.8		
North	: Water	Lane Reserv	e											
7	L2	25	2.0	0.379	50.5	LOS D	5.6	39.8	0.94	0.76	0.94	21.7		
8	T1	55	2.0	0.379	45.9	LOS D	5.6	39.8	0.94	0.76	0.94	19.3		
9	R2	34	2.0	0.379	50.5	LOS D	5.6	39.8	0.94	0.76	0.94	16.1		
Appro	ach	114	2.0	0.379	48.3	LOS D	5.6	39.8	0.94	0.76	0.94	19.0		
West:	The Wa	ater Lane												
10	L2	34	2.0	0.909	58.2	LOS E	35.0	249.1	1.00	1.08	1.25	14.7		
11	T1	964	2.0	0.909	53.7	LOS D	35.0	249.1	0.98	1.07	1.25	17.9		
12	R2	278	0.0	0.882	64.1	LOS E	16.9	118.2	1.00	0.99	1.31	13.1		
Appro	ach	1276	1.6	0.909	56.1	LOS D	35.0	249.1	0.98	1.06	1.27	16.8		
All Ve	hicles	2612	1.8	0.909	48.7	LOS D	35.0	249.1	0.96	0.93	1.10	18.9		

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians													
Mov		Demand	Average	Level of .	Average Bacł	k of Queue	Prop.	Effective					
ID	Description	Flow	Delay	Service	Pedestrian	Distance	Queued	Stop Rate					
		ped/h	sec		ped	m							
P1	South Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95					
P2	East Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95					
P3	North Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95					
P4	West Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95					
All Pe	destrians	211	49.3	LOS E			0.95	0.95					

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay) Pedestrian movement LOS values are based on average delay per pedestrian movement. Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Site: BHT20 [PM_Water Lane_Grandhill Parkway]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Grandhill		nill Parkway										
1	L2	221	2.0	0.879	67.9	LOS E	17.8	127.0	1.00	0.99	1.28	12.6
2	T1	53	2.0	0.879	63.3	LOS E	17.8	127.0	1.00	0.99	1.28	15.5
3	R2	126	2.0	0.399	53.4	LOS D	6.7	47.8	0.94	0.78	0.94	20.6
Appro	ach	400	2.0	0.879	62.7	LOS E	17.8	127.0	0.98	0.93	1.17	15.5
East:	The Wa	ter Lane										
4	L2	215	2.0	0.884	49.0	LOS D	43.5	309.4	1.00	0.99	1.13	22.2
5	T1	1179	2.0	0.884	44.1	LOS D	43.5	309.4	0.98	0.99	1.11	20.1
6	R2	49	2.0	0.348	64.0	LOS E	2.9	20.5	0.99	0.74	0.99	18.3
Approach		1443	2.0	0.884	45.5	LOS D	43.5	309.4	0.99	0.98	1.11	20.4
North:	: Water I	_ane Reserv	/e									
7	L2	47	2.0	0.486	56.0	LOS D	7.7	55.0	0.96	0.79	0.96	20.3
8	T1	55	2.0	0.486	51.4	LOS D	7.7	55.0	0.96	0.79	0.96	17.9
9	R2	39	2.0	0.486	55.9	LOS D	7.7	55.0	0.96	0.79	0.96	14.9
Appro	ach	141	2.0	0.486	54.2	LOS D	7.7	55.0	0.96	0.79	0.96	18.0
West:	The Wa	iter Lane										
10	L2	47	2.0	0.340	29.9	LOS C	10.9	77.4	0.72	0.65	0.72	22.9
11	T1	506	2.0	0.340	25.6	LOS B	11.0	78.4	0.73	0.63	0.73	26.8
12	R2	126	0.0	0.875	74.3	LOS F	8.3	58.3	1.00	0.99	1.40	11.8
Appro	ach	680	1.6	0.875	35.0	LOS C	11.0	78.4	0.78	0.70	0.85	22.3
All Ve	hicles	2664	1.9	0.884	45.9	LOS D	43.5	309.4	0.93	0.89	1.05	19.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians											
Mov		Demand	Average	Level of .	Average Bacl	k of Queue	Prop.	Effective			
ID	Description	Flow	Delay	Service	Pedestrian	Distance	Queued	Stop Rate			
		ped/h	sec		ped	m					
P1	South Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95			
P2	East Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95			
P3	North Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95			
P4	West Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95			
All Pe	destrians	211	54.3	LOS E			0.95	0.95			

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay) Pedestrian movement LOS values are based on average delay per pedestrian movement. Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.



BHT21: Grandhill Parkway/Box Road



Site: BHT21 [AM_Grandhill Parkway_Box Hill Road]

New Site Site Category: (None) Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand F Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Grandhill Parkway												
1	L2	116	2.0	0.262	7.2	LOS A	1.6	11.6	0.67	0.75	0.67	49.8
2	T1	21	2.0	0.262	7.4	LOS A	1.6	11.6	0.67	0.75	0.67	51.3
3	R2	95	2.0	0.262	12.0	LOS A	1.6	11.6	0.67	0.75	0.67	51.2
Appro	ach	232	2.0	0.262	9.2	LOS A	1.6	11.6	0.67	0.75	0.67	50.5
East:	Box Hill F	Road										
4	L2	25	2.0	0.348	5.1	LOS A	2.4	17.4	0.50	0.59	0.50	50.9
5	T1	246	2.0	0.348	5.4	LOS A	2.4	17.4	0.50	0.59	0.50	53.7
6	R2	135	2.0	0.348	10.0	LOS A	2.4	17.4	0.50	0.59	0.50	53.6
Approach		406	2.0	0.348	6.9	LOS A	2.4	17.4	0.50	0.59	0.50	53.5
North:	Grandhi	ll Parkway										
7	L2	218	2.0	0.441	7.2	LOS A	3.1	22.4	0.74	0.79	0.74	51.5
8	T1	26	2.0	0.441	7.5	LOS A	3.1	22.4	0.74	0.79	0.74	51.3
9	R2	158	2.0	0.441	12.1	LOS A	3.1	22.4	0.74	0.79	0.74	52.7
Appro	ach	402	2.0	0.441	9.2	LOS A	3.1	22.4	0.74	0.79	0.74	52.0
West:	Box Hill	Road										
10	L2	194	2.0	0.502	5.7	LOS A	3.8	27.2	0.59	0.61	0.59	52.9
11	T1	364	2.0	0.502	5.9	LOS A	3.8	27.2	0.59	0.61	0.59	54.2
12	R2	22	2.0	0.502	10.6	LOS A	3.8	27.2	0.59	0.61	0.59	52.7
Appro	ach	580	2.0	0.502	6.0	LOS A	3.8	27.2	0.59	0.61	0.59	53.7
All Ve	hicles	1620	2.0	0.502	7.5	LOS A	3.8	27.2	0.62	0.67	0.62	52.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: BHT21 [PM_Grandhill Parkway_Box Hill Road]

New Site Site Category: (None) Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand F Total veh/h	Flows HV %	Deg. Satn v/ <u>c</u>	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance <u>m</u>	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/ <u>h</u>
South: Grandhill Parkw		ill Parkway										
1	L2	67	2.0	0.356	9.4	LOS A	2.6	18.3	0.87	0.89	0.87	48.0
2	T1	62	2.0	0.356	9.7	LOS A	2.6	18.3	0.87	0.89	0.87	49.3
3	R2	102	2.0	0.356	14.3	LOS A	2.6	18.3	0.87	0.89	0.87	49.2
Appro	ach	232	2.0	0.356	11.6	LOS A	2.6	18.3	0.87	0.89	0.87	48.9
East:	Box Hill F	Road										
4	L2	121	2.0	0.686	8.0	LOS A	8.0	56.7	0.82	0.79	0.92	49.5
5	T1	440	2.0	0.686	8.2	LOS A	8.0	56.7	0.82	0.79	0.92	52.4
6	R2	177	2.0	0.686	12.8	LOS A	8.0	56.7	0.82	0.79	0.92	52.3
Approach		738	2.0	0.686	9.3	LOS A	8.0	56.7	0.82	0.79	0.92	52.0
North:	Grandhi	ll Parkway										
7	L2	223	2.0	0.582	11.0	LOS A	5.6	40.1	0.91	0.99	1.11	49.1
8	T1	64	2.0	0.582	11.2	LOS A	5.6	40.1	0.91	0.99	1.11	48.4
9	R2	154	2.0	0.582	15.9	LOS B	5.6	40.1	0.91	0.99	1.11	50.2
Appro	ach	441	2.0	0.582	12.7	LOS A	5.6	40.1	0.91	0.99	1.11	49.4
West: Box Hill Road												
10	L2	202	2.0	0.690	8.6	LOS A	7.9	56.6	0.81	0.82	0.95	51.4
11	T1	438	2.0	0.690	8.9	LOS A	7.9	56.6	0.81	0.82	0.95	52.6
12	R2	89	2.0	0.690	13.5	LOS A	7.9	56.6	0.81	0.82	0.95	50.8
Appro	ach	729	2.0	0.690	9.4	LOS A	7.9	56.6	0.81	0.82	0.95	52.1
All Ve	hicles	2140	2.0	0.690	10.3	LOS A	8.0	56.7	0.84	0.85	0.96	51.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHR05: Mt Carmel Drive/Old Pitt Town Road/Valetta Drive



Site: BHR05 [AM_Mount Carmel Drive_Old Pitt Town Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	Novement Performance - Vehicles											
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Mount	Carmel Driv	е									
1	L2	25	2.0	0.360	43.5	LOS D	5.2	36.8	0.91	0.75	0.91	39.4
2	T1	65	2.0	0.360	38.0	LOS C	5.2	36.8	0.91	0.75	0.91	40.6
3	R2	29	2.0	0.360	43.4	LOS D	5.2	36.8	0.91	0.75	0.91	35.1
Appro	ach	120	2.0	0.360	40.5	LOS C	5.2	36.8	0.91	0.75	0.91	39.2
East:	Old Pitt	Town Road										
4	L2	15	2.0	0.411	13.9	LOS A	10.8	76.7	0.53	0.50	0.53	43.6
5	T1	409	2.0	0.411	9.3	LOS A	10.8	76.7	0.53	0.50	0.53	45.4
6	R2	34	2.0	0.411	13.9	LOS A	10.8	76.7	0.53	0.50	0.53	45.0
Appro	ach	458	2.0	0.411	9.8	LOS A	10.8	76.7	0.53	0.50	0.53	45.3
North:	Mount	Carmel Drive	Э									
7	L2	29	2.0	0.505	46.7	LOS D	6.4	45.7	0.95	0.79	0.95	38.6
8	T1	40	2.0	0.505	41.2	LOS C	6.4	45.7	0.95	0.79	0.95	39.2
9	R2	72	2.0	0.505	46.6	LOS D	6.4	45.7	0.95	0.79	0.95	41.3
Appro	ach	141	2.0	0.505	45.1	LOS D	6.4	45.7	0.95	0.79	0.95	40.2
West:	Old Pitt	Town Road										
10	L2	39	2.0	0.507	13.3	LOS A	15.0	107.0	0.54	0.52	0.54	46.3
11	T1	560	2.0	0.507	8.8	LOS A	15.0	107.0	0.54	0.52	0.54	45.7
12	R2	26	2.0	0.507	13.3	LOS A	15.0	107.0	0.54	0.52	0.54	45.0
Appro	ach	625	2.0	0.507	9.2	LOS A	15.0	107.0	0.54	0.52	0.54	45.7
All Ve	hicles	1344	2.0	0.507	16.0	LOS B	15.0	107.0	0.61	0.56	0.61	44.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Move	Movement Performance - Pedestrians												
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of . Service	Average Back Pedestrian ped	of Queue Distance m	Prop. Queued	Effective Stop Rate					
P11	South Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P12	South Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P21	East Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P22	East Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P31	North Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P32	North Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P41	West Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P42	West Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94					
All Pe	destrians	421	44.3	LOS E			0.94	0.94					

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Site: BHR05 [PM_Mount Carmel Drive_Old Pitt Town Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	Movement Performance - Vehicles Move Turn Demand Flows Deg Average Level of 95% Back of Queue Prop Effective Aver No Average											
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Mount	Carmel Driv	е									
1	L2	18	2.0	0.323	50.8	LOS D	2.9	21.0	0.96	0.75	0.96	37.0
2	T1	23	2.0	0.323	45.3	LOS D	2.9	21.0	0.96	0.75	0.96	38.1
3	R2	22	2.0	0.323	50.7	LOS D	2.9	21.0	0.96	0.75	0.96	32.5
Appro	ach	63	2.0	0.323	48.8	LOS D	2.9	21.0	0.96	0.75	0.96	36.0
East:	Old Pitt	Town Road										
4	L2	100	2.0	0.744	18.3	LOS B	27.4	194.8	0.76	0.72	0.76	41.2
5	T1	637	2.0	0.744	13.8	LOS A	27.4	194.8	0.76	0.72	0.76	43.4
6	R2	75	2.0	0.744	18.3	LOS B	27.4	194.8	0.76	0.72	0.76	43.1
Appro	ach	812	2.0	0.744	14.7	LOS B	27.4	194.8	0.76	0.72	0.76	43.2
North:	Mount	Carmel Drive	Э									
7	L2	15	2.0	0.742	53.3	LOS D	9.5	67.6	1.00	0.89	1.13	37.3
8	T1	116	2.0	0.742	47.7	LOS D	9.5	67.6	1.00	0.89	1.13	37.8
9	R2	58	2.0	0.742	53.2	LOS D	9.5	67.6	1.00	0.89	1.13	40.0
Appro	ach	188	2.0	0.742	49.9	LOS D	9.5	67.6	1.00	0.89	1.13	38.5
West:	Old Pitt	Town Road										
10	L2	87	2.0	0.692	17.5	LOS B	24.5	174.4	0.71	0.68	0.71	44.8
11	T1	628	2.0	0.692	12.9	LOS A	24.5	174.4	0.71	0.68	0.71	43.8
12	R2	57	2.0	0.692	17.5	LOS B	24.5	174.4	0.71	0.68	0.71	43.2
Appro	ach	773	2.0	0.692	13.8	LOS A	24.5	174.4	0.71	0.68	0.71	43.9
All Ve	hicles	1836	2.0	0.744	19.1	LOS B	27.4	194.8	0.77	0.72	0.78	42.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Move	Novement Performance - Pedestrians												
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Bacl Pedestrian ped	of Queue Distance m	Prop. Queued	Effective Stop Rate					
P11	South Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P12	South Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P21	East Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P22	East Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P31	North Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P32	North Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P41	West Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P42	West Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94					
All Pe	destrians	421	44.3	LOS E			0.94	0.94					

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)



BHR06: Boundary Road/George Street



Site: BHR06 [AM_Boundary Road_George Street_1]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	Movement Performance - Vehicles Move Turn Demand Flows Deg Average Level of 95% Back of Oueue Pron Effective Aver No Average											
Mov ID	Turn	Demand l Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Bounda	ary Road										
1	L2	41	2.0	0.230	21.7	LOS B	6.2	43.8	0.62	0.57	0.62	45.8
2	T1	398	2.0	0.230	16.1	LOS B	6.2	44.2	0.62	0.54	0.62	47.2
3	R2	21	2.0	0.049	24.2	LOS B	0.6	4.3	0.62	0.67	0.62	42.5
Appro	ach	460	2.0	0.230	17.0	LOS B	6.2	44.2	0.62	0.55	0.62	46.8
East:	George	Street										
4	L2	67	2.0	0.089	24.4	LOS B	2.0	14.4	0.65	0.69	0.65	37.2
5	T1	40	2.0	0.050	19.4	LOS B	1.2	8.4	0.64	0.48	0.64	39.6
6	R2	11	2.0	0.019	24.5	LOS B	0.3	2.2	0.64	0.64	0.64	37.4
Appro	ach	118	2.0	0.089	22.7	LOS B	2.0	14.4	0.65	0.62	0.65	38.0
North:	Bounda	ary Road										
7	L2	16	2.0	0.220	21.6	LOS B	5.9	41.8	0.62	0.54	0.62	46.2
8	T1	404	2.0	0.220	16.1	LOS B	5.9	41.9	0.62	0.53	0.62	47.4
9	R2	58	2.0	0.139	25.0	LOS B	1.8	12.5	0.65	0.72	0.65	41.7
Appro	ach	478	2.0	0.220	17.3	LOS B	5.9	41.9	0.62	0.55	0.62	46.6
West:	Menin F	Road										
10	L2	32	2.0	0.233	26.7	LOS B	4.4	31.2	0.71	0.72	0.71	36.6
11	T1	16	2.0	0.233	22.1	LOS B	4.4	31.2	0.71	0.72	0.71	36.9
12	R2	86	2.0	0.233	26.6	LOS B	4.4	31.2	0.71	0.72	0.71	36.8
Appro	ach	134	2.0	0.233	26.1	LOS B	4.4	31.2	0.71	0.72	0.71	36.8
All Ve	hicles	1189	2.0	0.233	18.7	LOS B	6.2	44.2	0.63	0.58	0.63	44.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: BHR06 [PM_Boundary Road_George Street_1]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	Novement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h	
South	: Bound	ary Road											
1	L2	126	2.0	0.324	19.7	LOS B	9.2	65.4	0.61	0.61	0.61	46.3	
2	T1	553	2.0	0.324	14.2	LOS A	9.4	66.7	0.61	0.56	0.61	48.2	
3	R2	75	2.0	0.143	20.7	LOS B	2.0	14.3	0.58	0.70	0.58	44.3	
Appro	ach	754	2.0	0.324	15.7	LOS B	9.4	66.7	0.60	0.58	0.60	47.5	
East:	George	Street											
4	L2	11	2.0	0.016	27.0	LOS B	0.3	2.3	0.68	0.64	0.68	36.2	
5	T1	36	2.0	0.051	22.8	LOS B	1.1	8.1	0.69	0.52	0.69	38.2	
6	R2	16	2.0	0.038	30.5	LOS C	0.5	3.8	0.72	0.66	0.72	35.3	
Appro	ach	62	2.0	0.051	25.5	LOS B	1.1	8.1	0.70	0.58	0.70	37.1	
North:	Bounda	ary Road											
7	L2	11	2.0	0.162	18.3	LOS B	4.2	29.9	0.54	0.47	0.54	48.2	
8	T1	331	2.0	0.162	12.8	LOS A	4.2	30.0	0.54	0.46	0.54	49.5	
9	R2	42	2.0	0.123	23.8	LOS B	1.2	8.8	0.62	0.71	0.62	42.3	
Appro	ach	383	2.0	0.162	14.1	LOS A	4.2	30.0	0.55	0.49	0.55	48.6	
West:	Menin I	Road											
10	L2	66	2.0	0.328	30.4	LOS C	6.8	48.5	0.78	0.73	0.78	35.5	
11	T1	52	2.0	0.328	25.8	LOS B	6.8	48.5	0.78	0.73	0.78	35.8	
12	R2	72	2.0	0.328	30.3	LOS C	6.8	48.5	0.78	0.73	0.78	35.7	
Appro	ach	189	2.0	0.328	29.1	LOS C	6.8	48.5	0.78	0.73	0.78	35.7	
All Ve	hicles	1388	2.0	0.328	17.6	LOS B	9.4	66.7	0.62	0.58	0.62	45.1	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHR07: Boundary Road/ Brahman Road



Site: BHR07 [AM_Boundary Road_Brahman Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	Average I even of the second sec											
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Bound	ary Road										
1	L2	51	2.0	0.315	20.8	LOS B	8.9	63.6	0.62	0.57	0.62	46.3
2	T1	382	2.0	0.315	17.1	LOS B	8.9	63.6	0.65	0.60	0.65	46.1
3	R2	68	2.0	0.315	27.2	LOS B	6.1	43.3	0.72	0.67	0.72	42.3
Appro	ach	501	2.0	0.315	18.9	LOS B	8.9	63.6	0.66	0.61	0.66	45.5
East:	Brahma	n Road										
4	L2	23	2.0	0.363	29.3	LOS C	8.1	57.9	0.77	0.70	0.77	36.5
5	T1	145	2.0	0.363	24.7	LOS B	8.1	57.9	0.77	0.70	0.77	36.8
6	R2	60	2.0	0.363	29.3	LOS C	8.1	57.9	0.77	0.70	0.77	36.5
Appro	ach	228	2.0	0.363	26.4	LOS B	8.1	57.9	0.77	0.70	0.77	36.7
North:	Bounda	ary Road										
7	L2	124	2.0	0.369	21.3	LOS B	10.7	76.4	0.65	0.63	0.65	45.5
8	T1	328	2.0	0.369	17.4	LOS B	10.7	76.4	0.67	0.65	0.67	45.4
9	R2	103	2.0	0.369	27.9	LOS B	6.4	45.7	0.74	0.71	0.74	41.5
Appro	ach	556	2.0	0.369	20.2	LOS B	10.7	76.4	0.68	0.66	0.68	44.6
West:	Brahma	an Road										
10	L2	18	2.0	0.176	28.0	LOS B	3.8	26.9	0.72	0.63	0.72	37.1
11	T1	80	2.0	0.176	23.4	LOS B	3.8	26.9	0.72	0.63	0.72	37.4
12	R2	16	2.0	0.176	28.0	LOS B	3.8	26.9	0.72	0.63	0.72	37.1
Appro	ach	114	2.0	0.176	24.8	LOS B	3.8	26.9	0.72	0.63	0.72	37.3
All Ve	hicles	1399	2.0	0.369	21.1	LOS B	10.7	76.4	0.69	0.64	0.69	42.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: BHR07 [PM_Boundary Road_Brahman Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	Movement Performance - Vehicles Movement Demand Flows Deg Average Level of 95% Back of Queue Prop Effective Aver No Average											
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Bound	lary Road										
1	L2	112	2.0	0.500	22.7	LOS B	16.0	113.7	0.71	0.66	0.71	45.0
2	T1	615	2.0	0.500	18.6	LOS B	16.0	113.7	0.73	0.68	0.73	45.1
3	R2	109	2.0	0.500	26.6	LOS B	11.6	82.4	0.76	0.71	0.76	42.7
Appro	ach	836	2.0	0.500	20.2	LOS B	16.0	113.7	0.73	0.68	0.73	44.8
East:	Brahma	in Road										
4	L2	68	2.0	0.501	32.4	LOS C	11.1	79.3	0.84	0.77	0.84	35.0
5	T1	116	2.0	0.501	27.8	LOS B	11.1	79.3	0.84	0.77	0.84	35.3
6	R2	103	2.0	0.501	32.4	LOS C	11.1	79.3	0.84	0.77	0.84	35.1
Appro	ach	287	2.0	0.501	30.5	LOS C	11.1	79.3	0.84	0.77	0.84	35.1
North:	Bound	ary Road										
7	L2	65	2.0	0.236	20.0	LOS B	6.3	45.1	0.59	0.57	0.59	46.4
8	T1	333	2.0	0.236	16.2	LOS B	6.3	45.1	0.62	0.57	0.62	46.7
9	R2	19	2.0	0.236	23.7	LOS B	5.4	38.3	0.65	0.57	0.65	44.9
Appro	ach	417	2.0	0.236	17.2	LOS B	6.3	45.1	0.62	0.57	0.62	46.6
West:	Brahma	an Road										
10	L2	36	2.0	0.468	33.4	LOS C	9.5	67.9	0.84	0.76	0.84	34.8
11	T1	109	2.0	0.468	28.9	LOS C	9.5	67.9	0.84	0.76	0.84	35.0
12	R2	99	2.0	0.468	33.4	LOS C	9.5	67.9	0.84	0.76	0.84	34.8
Appro	ach	244	2.0	0.468	31.4	LOS C	9.5	67.9	0.84	0.76	0.84	34.9
All Ve	hicles	1784	2.0	0.501	22.7	LOS B	16.0	113.7	0.74	0.68	0.74	41.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHR08: The Water Lane/Outback Street



Site: BHR08 [AM_Water Lane_Outback Street]

New Site Site Category: (None) Roundabout

Move	Movement Performance - Vehicles													
Mov ID	Turn	Demand l Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h		
South	: Outbac	k Street												
1	L2	57	2.0	0.219	5.3	LOS A	1.0	6.9	0.64	0.69	0.64	43.5		
2	T1	80	2.0	0.219	5.0	LOS A	1.0	6.9	0.64	0.69	0.64	45.1		
3	R2	25	2.0	0.219	10.5	LOS A	1.0	6.9	0.64	0.69	0.64	46.4		
Appro	ach	162	2.0	0.219	6.0	LOS A	1.0	6.9	0.64	0.69	0.64	44.6		
East:	The Wat	er Lane												
4	L2	141	2.0	0.430	3.7	LOS A	2.7	19.0	0.48	0.41	0.48	44.0		
5	T1	792	2.0	0.430	3.3	LOS A	2.7	19.0	0.49	0.44	0.49	47.1		
6	R2	118	2.0	0.430	8.9	LOS A	2.6	18.6	0.50	0.48	0.50	46.8		
Appro	ach	1051	2.0	0.430	4.0	LOS A	2.7	19.0	0.49	0.44	0.49	46.7		
North:	Outbacl	k Street												
7	L2	22	2.0	0.162	5.4	LOS A	0.7	5.0	0.64	0.73	0.64	41.4		
8	T1	53	2.0	0.162	5.1	LOS A	0.7	5.0	0.64	0.73	0.64	43.9		
9	R2	43	2.0	0.162	10.5	LOS A	0.7	5.0	0.64	0.73	0.64	45.9		
Appro	ach	118	2.0	0.162	7.1	LOS A	0.7	5.0	0.64	0.73	0.64	44.2		
West:	The Wat	ter Lane												
10	L2	189	2.0	0.460	3.5	LOS A	3.0	21.1	0.45	0.40	0.45	45.1		
11	T1	807	2.0	0.460	3.1	LOS A	3.0	21.1	0.46	0.43	0.46	47.1		
12	R2	174	2.0	0.460	8.7	LOS A	2.9	20.7	0.47	0.48	0.47	47.2		
Appro	ach	1171	2.0	0.460	4.0	LOS A	3.0	21.1	0.46	0.43	0.46	46.8		
All Ve	hicles	2501	2.0	0.460	4.3	LOS A	3.0	21.1	0.49	0.47	0.49	46.5		

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: BHR08 [PM_Water Lane_Outback Street]

New Site Site Category: (None) Roundabout

Movement Performance - Vehicles													
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h	
South	: Outbac	k Street											
1	L2	126	2.0	0.439	8.0	LOS A	2.4	17.1	0.81	0.94	0.94	41.0	
2	T1	47	2.0	0.439	7.7	LOS A	2.4	17.1	0.81	0.94	0.94	41.8	
3	R2	68	2.0	0.439	13.1	LOS A	2.4	17.1	0.81	0.94	0.94	43.0	
Appro	ach	242	2.0	0.439	9.4	LOS A	2.4	17.1	0.81	0.94	0.94	41.6	
East:	The Wate	er Lane											
4	L2	63	2.0	0.596	5.2	LOS A	5.1	36.2	0.69	0.58	0.74	42.4	
5	T1	1180	2.0	0.596	4.9	LOS A	5.1	36.2	0.70	0.62	0.76	45.8	
6	R2	72	2.0	0.596	10.7	LOS A	5.0	35.7	0.70	0.67	0.78	45.5	
Appro	ach	1315	2.0	0.596	5.3	LOS A	5.1	36.2	0.70	0.62	0.76	45.6	
North:	Outback	< Street											
7	L2	100	2.0	0.451	5.4	LOS A	2.4	17.4	0.64	0.76	0.70	41.5	
8	T1	158	2.0	0.451	5.2	LOS A	2.4	17.4	0.64	0.76	0.70	44.0	
9	R2	137	2.0	0.451	10.6	LOS A	2.4	17.4	0.64	0.76	0.70	46.0	
Appro	ach	395	2.0	0.451	7.1	LOS A	2.4	17.4	0.64	0.76	0.70	44.1	
West:	The Wat	ter Lane											
10	L2	102	2.0	0.266	3.2	LOS A	1.5	10.5	0.36	0.35	0.36	45.7	
11	T1	489	2.0	0.266	2.8	LOS A	1.5	10.5	0.37	0.38	0.37	47.8	
12	R2	88	2.0	0.266	8.3	LOS A	1.4	10.3	0.37	0.42	0.37	47.9	
Appro	ach	680	2.0	0.266	3.5	LOS A	1.5	10.5	0.37	0.38	0.37	47.5	
All Ve	hicles	2632	2.0	0.596	5.5	LOS A	5.1	36.2	0.61	0.61	0.67	45.5	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Appendix 3

Evidence and supporting documents for Question 17

Intersections

BHT10, BHT11, BHT12, BHT13, BHT14, BHT15, BHT18, BHT20, BHR07, BHR08, BHT07, BHR02, BHR06, BHR07, BHR08, BHT07, BHRU02B, BHRU08A, BHRU08B and ARU1



BHT10 - Terry Road/ Hynds Road

SITE LAYOUT

Site: BHT10 [AM_Terry Road_Hynds Road]

New Site Site Category: (None) Signals - Fixed Time Isolated





Intersection BHT10 -

Site: BHT10 [AM_Terry Road_Hynds Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	ovement Performance - Vehicles												
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h	
South:	Terry R	oad											
2	T1	675	2.0	0.262	7.0	LOS A	6.5	46.0	0.43	0.37	0.43	53.8	
3	R2	62	2.0	0.339	52.8	LOS D	3.0	21.0	0.97	0.75	0.97	31.6	
Approa	ach	737	2.0	0.339	10.8	LOS A	6.5	46.0	0.47	0.41	0.47	50.8	
East: H	Hynds R	oad											
4	L2	541	2.0	0.848	42.2	LOS C	26.8	191.1	0.96	0.94	1.11	31.5	
6	R2	63	2.0	0.164	39.7	LOS C	2.5	18.1	0.86	0.74	0.86	32.2	
Approa	ach	604	2.0	0.848	41.9	LOS C	26.8	191.1	0.95	0.92	1.08	31.6	
North:	Terry Ro	bad											
7	L2	63	0.0	0.855	33.3	LOS C	39.6	277.4	0.94	0.92	1.02	40.3	
8	T1	1637	0.0	0.855	28.0	LOS B	39.8	278.4	0.94	0.92	1.02	41.0	
Approa	ach	1700	0.0	0.855	28.2	LOS B	39.8	278.4	0.94	0.92	1.02	41.0	
All Veh	nicles	3041	0.9	0.855	26.7	LOS B	39.8	278.4	0.83	0.80	0.90	40.5	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians													
Mov	Description	Demand	Average	Level of	Average Back	c of Queue	Prop.	Effective					
ID	Description	Flow	Delay	Service	Pedestrian	Queued	Stop Rate						
		ped/h	sec		ped	m							
P1	South Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94					
P2	East Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94					
All Pe	destrians	105	44.3	LOS E			0.94	0.94					

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay) Pedestrian movement LOS values are based on average delay per pedestrian movement. Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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Site: BHT10 [PM_Terry Road_Hynds Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	ovement Performance - Vehicles													
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h		
South:	Terry Ro	bad												
2	T1	1847	2.0	0.765	7.8	LOS A	31.6	224.8	0.59	0.55	0.59	53.2		
3	R2	462	2.0	0.929	56.8	LOS E	25.5	181.8	0.80	0.99	1.22	30.6		
Approa	ach	2309	2.0	0.929	17.6	LOS B	31.6	224.8	0.63	0.64	0.72	46.3		
East: Hynds R		bad												
4	L2	75	2.0	0.063	11.3	LOS A	1.3	9.2	0.38	0.63	0.38	42.9		
6	R2	73	2.0	0.264	46.1	LOS D	3.2	22.9	0.92	0.75	0.92	30.5		
Approa	ach	147	2.0	0.264	28.5	LOS B	3.2	22.9	0.65	0.69	0.65	35.7		
North:	Terry Ro	bad												
7	L2	62	2.0	0.925	64.4	LOS E	25.0	178.1	1.00	1.13	1.40	29.9		
8	T1	760	2.0	0.925	58.9	LOS E	25.0	178.1	1.00	1.13	1.40	30.4		
Approa	ach	822	2.0	0.925	59.3	LOS E	25.0	178.1	1.00	1.13	1.40	30.4		
All Veh	nicles	3279	2.0	0.929	28.5	LOS C	31.6	224.8	0.73	0.76	0.89	40.5		

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Move	Movement Performance - Pedestrians													
Mov	Description	Demand	Average	Level of	Average Back	c of Queue	Prop.	Effective						
ID	Description	Flow	Delay	Service	Pedestrian	Distance	Queued	Stop Rate						
		ped/h	sec		ped	m								
P1	South Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94						
P2	East Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94						
All Pe	destrians	105	44.3	LOS E			0.94	0.94						

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay) Pedestrian movement LOS values are based on average delay per pedestrian movement. Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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BHT11 – Terry Road/Mason Road



Site: BHT11 [AM_Terry Road_Mason Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 75 seconds (Site User-Given Cycle Time)

Move	Average Level of 95% Back of Oueue Prop Effective Aver No Average											
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Terry	Road										
1	L2	37	2.0	0.240	14.5	LOS B	4.7	33.7	0.54	0.50	0.54	50.5
2	T1	478	2.0	0.240	9.0	LOS A	4.8	34.0	0.54	0.48	0.54	52.1
3	R2	98	2.0	0.947	55.8	LOS D	4.3	30.7	1.00	1.01	1.88	31.0
Appro	ach	613	2.0	0.947	16.8	LOS B	4.8	34.0	0.61	0.56	0.75	46.9
East:	Mason	Road										
4	L2	112	2.0	0.530	30.7	LOS C	8.8	63.0	0.90	0.78	0.90	40.6
5	T1	454	2.0	0.530	25.1	LOS B	9.0	64.2	0.90	0.76	0.90	42.1
6	R2	238	2.0	1.187	221.5	LOS F	26.5	188.5	1.00	1.87	3.44	12.6
Appro	ach	803	2.0	1.187	84.0	LOS F	26.5	188.5	0.93	1.09	1.65	24.9
North:	: Terry F	Road										
7	L2	223	2.0	0.982	63.1	LOS E	62.9	448.1	1.00	1.34	1.58	30.1
8	T1	1485	2.0	0.982	59.2	LOS E	62.9	448.1	0.88	1.26	1.52	30.3
9	R2	492	2.0	1.111	165.1	LOS F	49.2	350.3	1.00	1.63	2.78	15.9
Appro	ach	2200	2.0	1.111	83.2	LOS F	62.9	448.1	0.92	1.35	1.81	25.2
West:	Settler	nent Drive										
10	L2	49	2.0	0.584	31.1	LOS C	10.1	71.6	0.91	0.78	0.91	41.0
11	T1	295	2.0	0.584	26.4	LOS B	10.1	71.6	0.92	0.79	0.92	41.3
12	R2	94	2.0	0.584	38.7	LOS C	4.6	32.4	0.97	0.81	1.01	36.7
Appro	ach	438	2.0	0.584	29.6	LOS C	10.1	71.6	0.93	0.79	0.94	40.2
All Ve	hicles	4054	2.0	1.187	67.5	LOS E	62.9	448.1	0.87	1.12	1.52	28.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: BHT11 [PM_Terry Road_Mason Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Practical Cycle Time)

Move	Novement Performance - Vehicles											
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Terry	Road										
1	L2	117	2.0	1.397	408.8	LOS F	167.3	1191.0	1.00	1.94	2.85	7.2
2	T1	1488	2.0	1.397	412.7	LOS F	167.3	1191.0	1.00	2.14	2.86	7.3
3	R2	196	2.0	0.560	34.3	LOS C	8.1	57.9	0.91	0.81	0.91	37.8
Appro	ach	1801	2.0	1.397	371.3	LOS F	167.3	1191.0	0.99	1.99	2.65	8.0
East:	Mason	Road										
4	L2	154	2.0	0.921	83.3	LOS F	32.4	230.8	1.00	1.07	1.47	25.7
5	T1	515	2.0	0.921	78.7	LOS F	32.4	230.8	0.98	1.06	1.39	26.0
6	R2	473	2.0	1.424	453.5	LOS F	97.0	690.7	1.00	1.72	2.97	6.9
Appro	ach	1141	2.0	1.424	234.6	LOS F	97.0	690.7	0.99	1.33	2.05	12.0
North:	Terry I	Road										
7	L2	117	2.0	0.664	49.2	LOS D	27.1	193.0	0.91	0.81	0.91	33.9
8	T1	611	2.0	0.664	41.9	LOS C	27.1	193.0	0.87	0.76	0.87	35.3
9	R2	408	2.0	1.540	532.8	LOS F	79.9	569.2	1.00	1.69	3.27	5.7
Appro	ach	1136	2.0	1.540	219.2	LOS F	79.9	569.2	0.92	1.10	1.73	12.3
West:	Settler	nent Drive										
10	L2	159	2.0	1.382	416.9	LOS F	82.2	585.5	1.00	2.08	2.86	7.4
11	T1	585	2.0	1.382	411.2	LOS F	82.2	585.5	1.00	2.09	2.86	7.4
12	R2	80	2.0	1.382	416.7	LOS F	78.8	561.2	1.00	2.09	2.86	7.4
Appro	ach	824	2.0	1.382	412.9	LOS F	82.2	585.5	1.00	2.09	2.86	7.4
All Ve	hicles	4902	2.0	1.540	311.2	LOS F	167.3	1191.0	0.98	1.65	2.33	9.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHT12 – Terry Road/George Street



Site: BHT12 [AM_Terry Road_George Street]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles												
Mov ID	Turn	Demand l Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Terry F	Road										
1	L2	137	2.0	0.812	32.9	LOS C	18.7	132.9	0.97	0.96	1.13	39.9
2	T1	439	2.0	0.812	28.5	LOS B	18.7	132.9	0.98	0.97	1.16	40.1
3	R2	106	2.0	0.812	43.4	LOS D	6.2	44.2	1.00	1.01	1.43	35.0
Appro	ach	682	2.0	0.812	31.7	LOS C	18.7	132.9	0.98	0.97	1.20	39.2
East:	George	Street										
4	L2	116	2.0	0.201	20.8	LOS B	3.2	22.8	0.72	0.71	0.72	38.9
5	T1	21	2.0	0.201	16.2	LOS B	3.2	22.8	0.72	0.71	0.72	39.2
6	R2	21	2.0	0.061	27.8	LOS B	0.6	4.1	0.81	0.69	0.81	35.9
Appro	ach	158	2.0	0.201	21.1	LOS B	3.2	22.8	0.73	0.71	0.73	38.5
North:	Terry F	load										
7	L2	21	2.0	0.660	15.6	LOS B	17.2	122.7	0.71	0.65	0.71	50.2
8	T1	1349	2.0	0.660	9.9	LOS A	17.2	122.7	0.75	0.67	0.75	51.5
9	R2	26	2.0	0.660	15.3	LOS B	13.3	94.8	0.79	0.68	0.79	50.2
Appro	ach	1397	2.0	0.660	10.0	LOS A	17.2	122.7	0.75	0.67	0.75	51.4
West:	George	Street										
10	L2	9	2.0	0.070	27.7	LOS B	0.8	5.9	0.81	0.63	0.81	37.2
11	T1	21	2.0	0.070	23.1	LOS B	0.8	5.9	0.81	0.63	0.81	37.5
12	R2	269	2.0	0.803	38.3	LOS C	10.1	72.0	1.00	0.97	1.26	32.6
Appro	ach	300	2.0	0.803	36.9	LOS C	10.1	72.0	0.98	0.93	1.21	33.0
All Ve	hicles	2537	2.0	0.812	19.7	LOS B	18.7	132.9	0.84	0.78	0.92	43.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: BHT12 [PM_Terry Road_George Street]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Mov	ement l	Performanc	ce - Vel	hicles								
Mov ID	Turn	Demand I Total	Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back Vehicles	of Queue Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
South	n: Terry F	Road	70	V/C	Sec	_	ven	111	_	_	_	K111/11
1	12	221	2.0	0.931	42.9	LOSID	72.0	512.4	0.97	1.02	1.12	36.1
2	 T1	1406	2.0	0.931	42.0		72.0	512.4	0.98	1.05	1.21	35.1
3	R2	257	2.0	0.001	56.0		48.6	345.9	1 00	1.00	1 37	31.8
Appr	h	188/	2.0	0.001	44.0		72.0	512 /	0.00	1.10	1.07	34.7
Аррі	Jach	1004	2.0	0.951	44.0	L03 D	72.0	512.4	0.99	1.05	1.22	54.7
East:	George	Street										
4	L2	189	2.0	0.278	25.6	LOS B	7.4	53.0	0.70	0.73	0.70	36.9
5	T1	21	2.0	0.278	21.0	LOS B	7.4	53.0	0.70	0.73	0.70	37.2
6	R2	21	2.0	0.057	40.6	LOS C	0.9	6.6	0.78	0.69	0.78	31.9
Appro	bach	232	2.0	0.278	26.5	LOS B	7.4	53.0	0.71	0.72	0.71	36.4
North	: Terry F	Road										
7	L2	13	2.0	0.799	56.9	LOS E	20.3	144.7	1.00	0.93	1.10	32.0
8	T1	566	2.0	0.799	53.5	LOS D	20.3	144.7	1.00	0.93	1.12	31.9
9	R2	15	2.0	0.799	62.3	LOS E	15.1	107.3	1.00	0.93	1.15	30.5
Appro	bach	594	2.0	0.799	53.8	LOS D	20.3	144.7	1.00	0.93	1.12	31.8
West	: George	e Street										
10	L2	14	2.0	0.069	39.6	LOS C	1.5	10.7	0.78	0.63	0.78	33.0
11	T1	21	2.0	0.069	35.0	LOS C	1.5	10.7	0.78	0.63	0.78	33.3
12	R2	234	2.0	0.906	74.8	LOS F	16.6	118.1	1.00	1.04	1.41	24.6
Appro	bach	268	2.0	0.906	69.9	LOS E	16.6	118.1	0.97	0.99	1.32	25.4
All Ve	hicles	2978	2.0	0.931	47.0	LOS D	72.0	512.4	0.97	1.00	1.17	33.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHT13 – Mason Road/The Water Lane



Site: BHT13 [AM_Mason Road_Water Lane]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	Movement Performance - Vehicles											
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: The W	ater Lane										
1	L2	89	2.0	0.449	44.1	LOS D	7.4	52.4	0.93	0.78	0.93	35.1
2	T1	126	2.0	0.449	40.1	LOS C	7.4	52.4	0.94	0.78	0.94	35.2
3	R2	59	2.0	0.449	48.1	LOS D	4.9	34.8	0.95	0.77	0.95	33.7
Appro	ach	275	2.0	0.449	43.1	LOS D	7.4	52.4	0.94	0.78	0.94	34.8
East:	Mason F	Road										
4	L2	79	2.0	0.534	14.1	LOS A	16.8	119.4	0.54	0.53	0.54	50.9
5	T1	616	2.0	0.534	8.5	LOS A	16.8	119.4	0.54	0.53	0.54	52.2
6	R2	189	2.0	0.548	24.7	LOS B	6.6	46.9	0.74	0.79	0.74	41.8
Appro	ach	884	2.0	0.548	12.5	LOS A	16.8	119.4	0.58	0.58	0.58	49.4
North:	: Galileo	Street										
7	L2	82	2.0	0.402	43.7	LOS D	6.5	46.3	0.92	0.77	0.92	35.2
8	T1	68	2.0	0.402	38.2	LOS C	6.5	46.3	0.92	0.77	0.92	35.8
9	R2	95	2.0	0.527	51.8	LOS D	4.6	32.5	0.98	0.79	0.98	31.9
Appro	ach	245	2.0	0.527	45.3	LOS D	6.5	46.3	0.94	0.78	0.94	34.0
West:	Mason	Road										
10	L2	147	2.0	0.534	14.1	LOS A	16.7	119.0	0.54	0.55	0.54	50.5
11	T1	568	2.0	0.534	8.9	LOS A	16.7	119.0	0.55	0.56	0.55	51.3
12	R2	177	2.0	0.534	23.9	LOS B	6.8	48.4	0.72	0.77	0.72	42.5
Appro	ach	893	2.0	0.534	12.7	LOS A	16.7	119.0	0.58	0.60	0.58	49.2
All Ve	hicles	2297	2.0	0.548	19.8	LOS B	16.8	119.4	0.66	0.63	0.66	44.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Move	Movement Performance - Pedestrians													
Mov		Demand	Average	Level of .	Average Back	of Queue	Prop.	Effective						
ID	Description	Flow	Delay	Service	Pedestrian	Distance	Queued	Stop Rate						
		ped/h	sec		ped	m								
P1	South Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94						
P2	East Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94						
P3	North Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94						
P4	West Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94						
All Pe	destrians	211	44.3	LOS E			0.94	0.94						

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay) Pedestrian movement LOS values are based on average delay per pedestrian movement. Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Site: BHT13 [PM_Mason Road_Water Lane]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	Movement Performance - Vehicles Mov Turn Demand Flows Deg. Average Level of 95% Back of Queue Prop. Effective Aver. No. Average												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h	
South	: The W	ater Lane											
1	L2	241	2.0	0.827	44.7	LOS D	24.7	175.5	0.99	0.95	1.11	35.0	
2	T1	256	2.0	0.827	39.1	LOS C	24.7	175.5	0.99	0.95	1.11	35.6	
3	R2	366	2.0	1.102	166.0	LOS F	38.3	273.0	1.00	1.41	2.34	15.7	
Appro	ach	863	2.0	1.102	94.5	LOS F	38.3	273.0	0.99	1.15	1.63	23.1	
East:	Mason I	Road											
4	L2	173	2.0	0.674	22.1	LOS B	24.5	174.5	0.76	0.73	0.76	45.3	
5	T1	651	2.0	0.674	19.9	LOS B	24.5	174.5	0.79	0.75	0.80	44.4	
6	R2	91	2.0	0.674	42.5	LOS D	9.1	64.5	0.94	0.85	1.00	35.7	
Appro	ach	914	2.0	0.674	22.6	LOS B	24.5	174.5	0.80	0.75	0.81	43.5	
North:	Galileo	Street											
7	L2	92	2.0	0.293	33.1	LOS C	6.4	45.9	0.79	0.72	0.79	39.3	
8	T1	84	2.0	0.293	27.5	LOS B	6.4	45.9	0.79	0.72	0.79	40.0	
9	R2	79	2.0	0.692	59.3	LOS E	4.2	29.6	1.00	0.84	1.18	30.0	
Appro	ach	255	2.0	0.692	39.3	LOS C	6.4	45.9	0.86	0.76	0.91	36.0	
West:	Mason	Road											
10	L2	177	2.0	0.743	23.3	LOS B	28.9	205.4	0.82	0.77	0.82	44.8	
11	T1	615	2.0	0.743	17.7	LOS B	28.9	205.4	0.82	0.77	0.82	45.8	
12	R2	195	2.0	1.089	165.4	LOS F	20.5	146.0	1.00	1.44	2.43	15.8	
Appro	ach	986	2.0	1.089	47.9	LOS D	28.9	205.4	0.85	0.90	1.13	33.2	
All Vel	hicles	3018	2.0	1.102	52.8	LOS D	38.3	273.0	0.88	0.91	1.16	31.7	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Move	Movement Performance - Pedestrians													
Mov		Demand	Average	Level of .	Average Back	c of Queue	Prop.	Effective						
ID	Description	Flow	Delay	Service	Pedestrian	Distance	Queued	Stop Rate						
		ped/h	sec		ped	m								
P1	South Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94						
P2	East Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94						
P3	North Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94						
P4	West Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94						
All Pe	destrians	211	44.3	LOS E			0.94	0.94						

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay) Pedestrian movement LOS values are based on average delay per pedestrian movement. Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.



BHT14 – Hynds Road/The Water Lane



Site: BHT14 [AM_The Water Lane_Hynds Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	ment F	Performanc	ce - Vel	nicles								
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: The W	ater Lane										
1	L2	158	2.0	0.269	32.8	LOS C	5.7	40.9	0.79	0.77	0.79	38.3
2	T1	161	2.0	0.261	27.1	LOS B	5.8	41.5	0.78	0.64	0.78	41.6
3	R2	21	2.0	0.062	34.3	LOS C	0.8	5.4	0.76	0.70	0.76	37.9
Appro	ach	340	2.0	0.269	30.2	LOS C	5.8	41.5	0.78	0.71	0.78	39.7
East:	Hynds F	load										
4	L2	189	2.0	0.264	17.6	LOS B	6.8	48.7	0.55	0.65	0.55	46.5
5	T1	371	2.0	0.264	12.1	LOS A	7.1	50.3	0.55	0.52	0.55	49.5
6	R2	84	2.0	0.112	16.6	LOS B	1.9	13.6	0.50	0.69	0.50	46.3
Appro	ach	644	2.0	0.264	14.3	LOS A	7.1	50.3	0.54	0.58	0.54	48.2
North:	The Wa	ater Lane										
7	L2	25	2.0	0.205	32.1	LOS C	4.4	31.6	0.77	0.65	0.77	40.5
8	T1	226	2.0	0.205	26.6	LOS B	4.5	31.9	0.77	0.63	0.77	41.6
9	R2	58	2.0	0.190	37.3	LOS C	2.3	16.0	0.82	0.74	0.82	36.7
Appro	ach	309	2.0	0.205	29.0	LOS C	4.5	31.9	0.78	0.65	0.78	40.5
West:	Hynds I	Road										
10	L2	26	2.0	0.032	15.9	LOS B	0.7	5.1	0.47	0.60	0.47	47.2
11	T1	42	2.0	0.032	10.3	LOS A	0.7	5.3	0.47	0.40	0.47	50.8
12	R2	79	2.0	0.186	21.2	LOS B	2.2	15.6	0.59	0.72	0.59	43.7
Appro	ach	147	2.0	0.186	17.2	LOS B	2.2	15.6	0.53	0.60	0.53	46.2
All Ve	hicles	1441	2.0	0.269	21.5	LOS B	7.1	50.3	0.65	0.63	0.65	44.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: BHT14 [PM_The Water Lane_Hynds Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	Movement Performance - Vehicles											
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: The W	ater Lane										
1	L2	47	2.0	0.468	30.0	LOS C	12.7	90.2	0.80	0.70	0.80	41.6
2	T1	653	2.0	0.468	24.4	LOS B	12.8	90.8	0.80	0.70	0.80	42.7
3	R2	89	2.0	0.257	32.6	LOS C	3.3	23.3	0.77	0.76	0.77	38.5
Appro	ach	789	2.0	0.468	25.7	LOS B	12.8	90.8	0.79	0.70	0.79	42.1
East:	Hynds F	Road										
4	L2	26	2.0	0.076	19.8	LOS B	1.8	12.7	0.56	0.54	0.56	46.3
5	T1	116	2.0	0.076	14.3	LOS A	1.8	13.0	0.56	0.48	0.56	48.1
6	R2	232	2.0	0.477	27.3	LOS B	8.1	57.9	0.76	0.79	0.76	40.8
Appro	ach	374	2.0	0.477	22.7	LOS B	8.1	57.9	0.68	0.68	0.68	43.2
North:	The Wa	ater Lane										
7	L2	32	2.0	0.260	27.7	LOS B	6.4	45.5	0.72	0.63	0.72	42.7
8	T1	358	2.0	0.260	22.2	LOS B	6.4	45.8	0.72	0.61	0.72	43.8
9	R2	63	2.0	0.285	38.8	LOS C	2.6	18.3	0.84	0.76	0.84	36.1
Appro	ach	453	2.0	0.285	24.9	LOS B	6.4	45.8	0.74	0.63	0.74	42.5
West:	Hynds I	Road										
10	L2	189	2.0	0.211	21.0	LOS B	5.2	37.0	0.60	0.73	0.60	43.7
11	T1	116	2.0	0.123	14.7	LOS B	3.0	21.5	0.57	0.46	0.57	48.4
12	R2	221	2.0	0.364	23.3	LOS B	6.8	48.6	0.67	0.76	0.67	42.7
Appro	ach	526	2.0	0.364	20.6	LOS B	6.8	48.6	0.63	0.69	0.63	44.2
All Ve	hicles	2142	2.0	0.477	23.7	LOS B	12.8	90.8	0.72	0.68	0.72	42.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHT15 - Nelson Road/The Water Lane



Site: BHT15 [AM_Nelson Road_The Water Lane]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 77 seconds (Site Optimum Cycle Time - Minimum Delay)

Move	ement l	Performanc	ce - Vel	hicles								
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Nelsor	n Road										
1	L2	11	2.0	0.123	24.4	LOS B	1.0	6.9	0.85	0.66	0.92	39.8
2	T1	83	2.0	0.123	24.0	LOS B	1.5	10.4	0.85	0.65	0.89	42.9
3	R2	342	2.0	0.959	64.9	LOS E	18.3	130.0	1.00	1.15	1.71	23.7
Appro	bach	436	2.0	0.959	56.1	LOS D	18.3	130.0	0.97	1.05	1.54	26.9
East:	The Wa	ter Lane										
4	L2	352	2.0	0.809	38.3	LOS C	16.2	115.6	0.99	0.94	1.16	31.4
5	T1	303	2.0	0.809	38.1	LOS C	16.2	115.6	1.00	0.95	1.24	23.7
6	R2	237	2.0	0.830	46.3	LOS D	9.9	70.7	1.00	0.96	1.31	28.5
Appro	bach	892	2.0	0.830	40.4	LOS C	16.2	115.6	1.00	0.95	1.23	28.4
North	: Nelsor	n Road										
7	L2	395	2.0	0.928	42.8	LOS D	17.1	121.8	1.00	1.10	1.55	29.8
8	T1	399	2.0	0.928	48.2	LOS D	17.1	121.8	1.00	1.14	1.57	33.3
9	R2	26	2.0	0.079	34.3	LOS C	0.8	6.0	0.86	0.70	0.86	32.9
Appro	bach	820	2.0	0.928	45.2	LOS D	17.1	121.8	1.00	1.11	1.53	31.8
West	The Wa	ater Lane										
10	L2	42	2.0	0.055	19.9	LOS B	0.9	6.7	0.62	0.69	0.62	39.8
11	T1	476	2.0	0.793	38.6	LOS C	9.6	68.5	1.00	0.94	1.23	23.8
12	R2	32	2.0	0.111	36.5	LOS C	1.0	7.5	0.89	0.71	0.89	31.9
Appro	bach	549	2.0	0.793	37.1	LOS C	9.6	68.5	0.96	0.91	1.16	25.6
All Ve	hicles	2697	2.0	0.959	43.7	LOS D	18.3	130.0	0.99	1.01	1.36	28.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Move	Movement Performance - Pedestrians													
Mov		Demand	Average	Level of .	Average Bacł	of Queue	Prop.	Effective						
ID	Description	Flow	Delay	Service	Pedestrian	Distance	Queued	Stop Rate						
		ped/h	sec		ped	m								
P1	South Full Crossing	53	32.8	LOS D	0.1	0.1	0.92	0.92						
P2	East Full Crossing	53	32.8	LOS D	0.1	0.1	0.92	0.92						
P3	North Full Crossing	53	32.8	LOS D	0.1	0.1	0.92	0.92						
P4	West Full Crossing	53	32.8	LOS D	0.1	0.1	0.92	0.92						
All Pe	destrians	211	32.8	LOS D			0.92	0.92						

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay) Pedestrian movement LOS values are based on average delay per pedestrian movement. Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Site: BHT15 [PM_Nelson Road_The Water Lane]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)

Move	ement l	Performanc	ce - Vel	hicles								
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Nelsor	n Road										
1	L2	21	2.0	0.237	52.5	LOS D	4.0	28.8	0.91	0.73	0.99	27.7
2	T1	126	2.0	0.237	54.2	LOS D	4.7	33.4	0.91	0.72	0.95	31.7
3	R2	269	2.0	0.978	110.2	LOS F	25.5	181.2	1.00	1.06	1.50	16.8
Appro	ach	417	2.0	0.978	90.3	LOS F	25.5	181.2	0.97	0.94	1.31	20.9
East:	The Wa	ter Lane										
4	L2	297	2.0	0.736	41.2	LOS C	36.9	262.9	0.89	0.83	0.89	31.2
5	T1	727	2.0	0.736	33.3	LOS C	36.9	262.9	0.82	0.74	0.82	25.5
6	R2	547	2.0	0.973	86.8	LOS F	47.0	334.3	0.86	1.01	1.23	19.8
Appro	ach	1572	2.0	0.973	53.4	LOS D	47.0	334.3	0.84	0.85	0.97	23.6
North	Nelson	Road										
7	L2	128	2.0	0.380	40.1	LOS C	7.0	50.0	0.90	0.78	0.90	30.7
8	T1	106	2.0	0.380	61.1	LOS E	7.0	50.0	0.95	0.76	0.95	29.9
9	R2	42	2.0	0.192	70.5	LOS E	2.8	20.0	0.94	0.74	0.94	22.6
Appro	ach	277	2.0	0.380	52.8	LOS D	7.0	50.0	0.93	0.76	0.93	28.9
West:	The Wa	ater Lane										
10	L2	68	2.0	0.133	48.5	LOS D	3.7	26.3	0.78	0.74	0.78	27.6
11	T1	421	2.0	0.920	87.4	LOS F	17.8	126.8	1.00	1.04	1.36	13.5
12	R2	38	2.0	0.172	70.2	LOS E	2.5	18.0	0.93	0.73	0.93	22.5
Appro	ach	527	2.0	0.920	81.1	LOS F	17.8	126.8	0.97	0.98	1.26	15.8
All Ve	hicles	2793	2.0	0.978	64.1	LOS E	47.0	334.3	0.89	0.88	1.07	22.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Move	Movement Performance - Pedestrians													
Mov		Demand	Average	Level of .	Average Bacł	k of Queue	Prop.	Effective						
ID	Description	Flow	Delay	Service	Pedestrian	Distance	Queued	Stop Rate						
		ped/h	sec		ped	m								
P1	South Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96						
P2	East Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96						
P3	North Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96						
P4	West Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96						
All Pe	destrians	211	69.3	LOS F			0.96	0.96						

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay) Pedestrian movement LOS values are based on average delay per pedestrian movement. Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.



BHT18 – Terry Road and High Street









▽ Site: BHT18 [AM_Terry Road_High Street]

New Site Site Category: (None) Giveway / Yield (Two-Way)

Move	ment Pe	erformanc	e - Vel	nicles								
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South:	Terry Ro	bad										
2	T1	613	2.0	0.159	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approa	ach	613	2.0	0.159	0.0	NA	0.0	0.0	0.00	0.00	0.00	60.0
East: High Street												
4	L2	144	2.0	0.109	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.5
Approa	ach	144	2.0	0.109	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.5
North:	Terry Ro	ad										
7	L2	1564	2.0	0.854	6.0	LOS A	0.0	0.0	0.00	0.57	0.00	52.9
8	T1	126	2.0	0.066	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approa	ach	1691	2.0	0.854	5.5	NA	0.0	0.0	0.00	0.53	0.00	53.4
All Veh	nicles	2447	2.0	0.854	4.2	NA	0.0	0.0	0.00	0.40	0.00	54.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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V Site: BHT18 [PM_Terry Road_High Street]

New Site Site Category: (None) Giveway / Yield (Two-Way)

Move	Movement Performance - Vehicles														
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h			
South:	Terry R	oad													
2	T1	1801	2.0	0.468	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9			
Appro	ach	1801	2.0	0.468	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9			
East: High Street															
4	L2	205	2.0	0.155	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.5			
Appro	ach	205	2.0	0.155	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.5			
North:	Terry Ro	bad													
7	L2	660	2.0	0.360	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.5			
8	T1	184	2.0	0.096	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0			
Approa	ach	844	2.0	0.360	4.4	NA	0.0	0.0	0.00	0.45	0.00	54.8			
All Vel	nicles	2851	2.0	0.468	1.7	NA	0.0	0.0	0.00	0.17	0.00	57.8			

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHT20 - Grandhill Parkway/The Water Lane



Site: BHT20 [AM_Water Lane_Grandhill Parkway]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Move	ement l	Performanc	ce - Vel	hicles								
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Grand	hill Parkway										
1	L2	126	2.0	0.567	52.2	LOS D	8.6	61.2	0.98	0.80	0.98	15.3
2	T1	42	2.0	0.567	47.6	LOS D	8.6	61.2	0.98	0.80	0.98	18.5
3	R2	181	2.0	0.617	52.6	LOS D	9.3	66.4	0.99	0.81	0.99	20.8
Appro	ach	349	2.0	0.617	51.8	LOS D	9.3	66.4	0.98	0.81	0.98	18.8
East:	The Wa	ter Lane										
4	L2	72	2.0	0.694	40.7	LOS C	20.1	143.0	0.94	0.82	0.94	24.9
5	T1	765	2.0	0.694	35.9	LOS C	20.1	143.0	0.94	0.81	0.94	22.7
6	R2	36	2.0	0.115	47.2	LOS D	1.7	11.8	0.89	0.72	0.89	21.9
Appro	ach	873	2.0	0.694	36.7	LOS C	20.1	143.0	0.93	0.81	0.93	22.8
North	: Water	Lane Reserv	e									
7	L2	25	2.0	0.379	50.5	LOS D	5.6	39.8	0.94	0.76	0.94	21.7
8	T1	55	2.0	0.379	45.9	LOS D	5.6	39.8	0.94	0.76	0.94	19.3
9	R2	34	2.0	0.379	50.5	LOS D	5.6	39.8	0.94	0.76	0.94	16.1
Appro	ach	114	2.0	0.379	48.3	LOS D	5.6	39.8	0.94	0.76	0.94	19.0
West:	The Wa	ater Lane										
10	L2	34	2.0	0.909	58.2	LOS E	35.0	249.1	1.00	1.08	1.25	14.7
11	T1	964	2.0	0.909	53.7	LOS D	35.0	249.1	0.98	1.07	1.25	17.9
12	R2	278	0.0	0.882	64.1	LOS E	16.9	118.2	1.00	0.99	1.31	13.1
Appro	ach	1276	1.6	0.909	56.1	LOS D	35.0	249.1	0.98	1.06	1.27	16.8
All Ve	hicles	2612	1.8	0.909	48.7	LOS D	35.0	249.1	0.96	0.93	1.10	18.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Move	Movement Performance - Pedestrians													
Mov		Demand	Average	Level of .	Average Bacł	k of Queue	Prop.	Effective						
ID	Description	Flow	Delay	Service	Pedestrian	Distance	Queued	Stop Rate						
		ped/h	sec		ped	m								
P1	South Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95						
P2	East Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95						
P3	North Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95						
P4	West Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95						
All Pe	destrians	211	49.3	LOS E			0.95	0.95						

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay) Pedestrian movement LOS values are based on average delay per pedestrian movement. Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
Site: BHT20 [PM_Water Lane_Grandhill Parkway]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)

Move	ement F	Performanc	ce - Vel	hicles								
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Grand	nill Parkway										
1	L2	221	2.0	0.879	67.9	LOS E	17.8	127.0	1.00	0.99	1.28	12.6
2	T1	53	2.0	0.879	63.3	LOS E	17.8	127.0	1.00	0.99	1.28	15.5
3	R2	126	2.0	0.399	53.4	LOS D	6.7	47.8	0.94	0.78	0.94	20.6
Appro	ach	400	2.0	0.879	62.7	LOS E	17.8	127.0	0.98	0.93	1.17	15.5
East:	The Wa	ter Lane										
4	L2	215	2.0	0.884	49.0	LOS D	43.5	309.4	1.00	0.99	1.13	22.2
5	T1	1179	2.0	0.884	44.1	LOS D	43.5	309.4	0.98	0.99	1.11	20.1
6	R2	49	2.0	0.348	64.0	LOS E	2.9	20.5	0.99	0.74	0.99	18.3
Approach		1443	2.0	0.884	45.5	LOS D	43.5	309.4	0.99	0.98	1.11	20.4
North:	: Water I	_ane Reserv	/e									
7	L2	47	2.0	0.486	56.0	LOS D	7.7	55.0	0.96	0.79	0.96	20.3
8	T1	55	2.0	0.486	51.4	LOS D	7.7	55.0	0.96	0.79	0.96	17.9
9	R2	39	2.0	0.486	55.9	LOS D	7.7	55.0	0.96	0.79	0.96	14.9
Appro	ach	141	2.0	0.486	54.2	LOS D	7.7	55.0	0.96	0.79	0.96	18.0
West:	The Wa	iter Lane										
10	L2	47	2.0	0.340	29.9	LOS C	10.9	77.4	0.72	0.65	0.72	22.9
11	T1	506	2.0	0.340	25.6	LOS B	11.0	78.4	0.73	0.63	0.73	26.8
12	R2	126	0.0	0.875	74.3	LOS F	8.3	58.3	1.00	0.99	1.40	11.8
Appro	ach	680	1.6	0.875	35.0	LOS C	11.0	78.4	0.78	0.70	0.85	22.3
All Ve	hicles	2664	1.9	0.884	45.9	LOS D	43.5	309.4	0.93	0.89	1.05	19.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Move	Movement Performance - Pedestrians														
Mov		Demand	Average	Level of .	Average Bacl	< of Queue	Prop.	Effective							
ID	Description	Flow	Delay	Service	Pedestrian	Distance	Queued	Stop Rate							
		ped/h	sec		ped	m									
P1	South Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95							
P2	East Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95							
P3	North Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95							
P4	West Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95							
All Pe	destrians	211	54.3	LOS E			0.95	0.95							

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay) Pedestrian movement LOS values are based on average delay per pedestrian movement. Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.



BHR02 – Mason Road/Old Pitt Town Road



Site: BHR02 [AM_Mason Road_Old Pitt Town Road]

New Site Site Category: (None) Roundabout

Move	ement P	erformanc	e - Vel	hicles								
Mov ID	Turn	Demand F Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Old Pitt	Town Road										
1	L2	116	2.0	0.284	6.1	LOS A	1.5	10.4	0.67	0.66	0.67	53.4
2	T1	265	2.0	0.284	6.3	LOS A	1.5	10.4	0.67	0.71	0.67	54.3
3	R2	95	2.0	0.284	12.4	LOS A	1.4	9.8	0.68	0.77	0.68	53.6
Appro	ach	476	2.0	0.284	7.5	LOS A	1.5	10.4	0.67	0.71	0.67	53.9
East:	Mason R	oad										
4	L2	124	2.0	0.426	6.1	LOS A	2.4	17.2	0.67	0.64	0.70	53.3
5	T1	427	2.0	0.426	6.2	LOS A	2.4	17.2	0.67	0.70	0.71	54.3
6	R2	237	2.0	0.426	12.4	LOS A	2.3	16.7	0.68	0.84	0.73	52.9
Approach		788	2.0	0.426	8.0	LOS A	2.4	17.2	0.67	0.73	0.72	53.7
North	: Old Pitt	Town Road										
7	L2	124	2.0	0.376	5.6	LOS A	2.0	14.4	0.61	0.58	0.61	53.6
8	T1	384	2.0	0.376	5.6	LOS A	2.0	14.4	0.61	0.63	0.61	54.7
9	R2	239	2.0	0.376	11.6	LOS A	1.9	13.9	0.62	0.76	0.62	53.3
Appro	ach	747	2.0	0.376	7.5	LOS A	2.0	14.4	0.61	0.66	0.61	54.0
West:	Mason F	Road										
10	L2	213	2.0	0.357	5.6	LOS A	1.9	13.5	0.60	0.61	0.60	53.8
11	T1	388	2.0	0.357	5.7	LOS A	1.9	13.5	0.60	0.65	0.60	54.7
12	R2	114	2.0	0.357	11.6	LOS A	1.8	12.9	0.61	0.68	0.61	54.4
Appro	ach	715	2.0	0.357	6.6	LOS A	1.9	13.5	0.60	0.64	0.60	54.4
All Ve	hicles	2726	2.0	0.426	7.4	LOS A	2.4	17.2	0.64	0.69	0.65	54.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: BHR02 [PM_Mason Road_Old Pitt Town Road]

New Site Site Category: (None) Roundabout

Move	ment P	erformanc	e - Vel	hicles								
Mov ID	Turn	Demand F Total veh/h	Flows HV %	Deg. Satn v/ <u>c</u>	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance <u>m</u>	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/ <u>h</u>
South	: Old Pitt	Town Road										
1	L2	156	2.0	0.437	6.5	LOS A	2.6	18.6	0.72	0.71	0.77	53.1
2	T1	513	2.0	0.437	6.8	LOS A	2.6	18.6	0.72	0.75	0.79	54.3
3	R2	80	2.0	0.437	12.9	LOS A	2.5	17.7	0.72	0.79	0.80	54.0
Appro	ach	748	2.0	0.437	7.4	LOS A	2.6	18.6	0.72	0.75	0.79	54.0
East:	Mason R	load										
4	L2	84	2.0	0.448	7.3	LOS A	2.8	19.9	0.76	0.77	0.85	52.8
5	T1	358	2.0	0.448	7.3	LOS A	2.8	19.9	0.76	0.79	0.85	54.0
6	R2	264	2.0	0.448	13.9	LOS A	2.6	18.6	0.76	0.94	0.87	51.5
Approach		706	2.0	0.448	9.7	LOS A	2.8	19.9	0.76	0.85	0.86	52.9
North:	Old Pitt	Town Road										
7	L2	116	2.0	0.471	6.7	LOS A	3.0	21.3	0.75	0.72	0.82	52.9
8	T1	451	2.0	0.471	6.8	LOS A	3.0	21.3	0.75	0.77	0.83	53.9
9	R2	221	2.0	0.471	13.1	LOS A	2.8	20.1	0.75	0.89	0.85	52.6
Appro	ach	787	2.0	0.471	8.6	LOS A	3.0	21.3	0.75	0.80	0.84	53.4
West:	Mason F	Road										
10	L2	227	2.0	0.580	8.0	LOS A	4.3	30.7	0.79	0.88	0.96	52.7
11	T1	446	2.0	0.580	8.2	LOS A	4.3	30.7	0.79	0.91	0.97	53.4
12	R2	314	2.0	0.580	14.6	LOS B	4.0	28.8	0.79	0.99	0.99	51.5
Appro	ach	987	2.0	0.580	10.2	LOS A	4.3	30.7	0.79	0.93	0.98	52.6
All Ve	hicles	3229	2.0	0.580	9.0	LOS A	4.3	30.7	0.76	0.84	0.87	53.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHR06 – Boundary Road/George Street



Site: BHR06 [AM_Boundary Road_George Street_1]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	ement P	erformanc	ce - Vel	nicles								
Mov ID	Turn	Demand l Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Bounda	ary Road										
1	L2	41	2.0	0.230	21.7	LOS B	6.2	43.8	0.62	0.57	0.62	45.8
2	T1	398	2.0	0.230	16.1	LOS B	6.2	44.2	0.62	0.54	0.62	47.2
3	R2	21	2.0	0.049	24.2	LOS B	0.6	4.3	0.62	0.67	0.62	42.5
Appro	ach	460	2.0	0.230	17.0	LOS B	6.2	44.2	0.62	0.55	0.62	46.8
East:	George	Street										
4	L2	67	2.0	0.089	24.4	LOS B	2.0	14.4	0.65	0.69	0.65	37.2
5	T1	40	2.0	0.050	19.4	LOS B	1.2	8.4	0.64	0.48	0.64	39.6
6	R2	11	2.0	0.019	24.5	LOS B	0.3	2.2	0.64	0.64	0.64	37.4
Appro	ach	118	2.0	0.089	22.7	LOS B	2.0	14.4	0.65	0.62	0.65	38.0
North:	Bounda	ary Road										
7	L2	16	2.0	0.220	21.6	LOS B	5.9	41.8	0.62	0.54	0.62	46.2
8	T1	404	2.0	0.220	16.1	LOS B	5.9	41.9	0.62	0.53	0.62	47.4
9	R2	58	2.0	0.139	25.0	LOS B	1.8	12.5	0.65	0.72	0.65	41.7
Appro	ach	478	2.0	0.220	17.3	LOS B	5.9	41.9	0.62	0.55	0.62	46.6
West:	Menin F	Road										
10	L2	32	2.0	0.233	26.7	LOS B	4.4	31.2	0.71	0.72	0.71	36.6
11	T1	16	2.0	0.233	22.1	LOS B	4.4	31.2	0.71	0.72	0.71	36.9
12	R2	86	2.0	0.233	26.6	LOS B	4.4	31.2	0.71	0.72	0.71	36.8
Appro	ach	134	2.0	0.233	26.1	LOS B	4.4	31.2	0.71	0.72	0.71	36.8
All Ve	hicles	1189	2.0	0.233	18.7	LOS B	6.2	44.2	0.63	0.58	0.63	44.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: BHR06 [PM_Boundary Road_George Street_1]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	ement F	Performanc	ce - Vel	hicles								
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Bound	ary Road										
1	L2	126	2.0	0.324	19.7	LOS B	9.2	65.4	0.61	0.61	0.61	46.3
2	T1	553	2.0	0.324	14.2	LOS A	9.4	66.7	0.61	0.56	0.61	48.2
3	R2	75	2.0	0.143	20.7	LOS B	2.0	14.3	0.58	0.70	0.58	44.3
Appro	ach	754	2.0	0.324	15.7	LOS B	9.4	66.7	0.60	0.58	0.60	47.5
East:	George	Street										
4	L2	11	2.0	0.016	27.0	LOS B	0.3	2.3	0.68	0.64	0.68	36.2
5	T1	36	2.0	0.051	22.8	LOS B	1.1	8.1	0.69	0.52	0.69	38.2
6	R2	16	2.0	0.038	30.5	LOS C	0.5	3.8	0.72	0.66	0.72	35.3
Appro	ach	62	2.0	0.051	25.5	LOS B	1.1	8.1	0.70	0.58	0.70	37.1
North:	Bounda	ary Road										
7	L2	11	2.0	0.162	18.3	LOS B	4.2	29.9	0.54	0.47	0.54	48.2
8	T1	331	2.0	0.162	12.8	LOS A	4.2	30.0	0.54	0.46	0.54	49.5
9	R2	42	2.0	0.123	23.8	LOS B	1.2	8.8	0.62	0.71	0.62	42.3
Appro	ach	383	2.0	0.162	14.1	LOS A	4.2	30.0	0.55	0.49	0.55	48.6
West:	Menin I	Road										
10	L2	66	2.0	0.328	30.4	LOS C	6.8	48.5	0.78	0.73	0.78	35.5
11	T1	52	2.0	0.328	25.8	LOS B	6.8	48.5	0.78	0.73	0.78	35.8
12	R2	72	2.0	0.328	30.3	LOS C	6.8	48.5	0.78	0.73	0.78	35.7
Appro	ach	189	2.0	0.328	29.1	LOS C	6.8	48.5	0.78	0.73	0.78	35.7
All Ve	hicles	1388	2.0	0.328	17.6	LOS B	9.4	66.7	0.62	0.58	0.62	45.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHR07 – Boundary Road/Brahman Road



Site: BHR07 [AM_Boundary Road_Brahman Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	ement F	Performan	ce - Vel	nicles								
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Bound	ary Road										
1	L2	51	2.0	0.315	20.8	LOS B	8.9	63.6	0.62	0.57	0.62	46.3
2	T1	382	2.0	0.315	17.1	LOS B	8.9	63.6	0.65	0.60	0.65	46.1
3	R2	68	2.0	0.315	27.2	LOS B	6.1	43.3	0.72	0.67	0.72	42.3
Appro	ach	501	2.0	0.315	18.9	LOS B	8.9	63.6	0.66	0.61	0.66	45.5
East:	Brahma	n Road										
4	L2	23	2.0	0.363	29.3	LOS C	8.1	57.9	0.77	0.70	0.77	36.5
5	T1	145	2.0	0.363	24.7	LOS B	8.1	57.9	0.77	0.70	0.77	36.8
6	R2	60	2.0	0.363	29.3	LOS C	8.1	57.9	0.77	0.70	0.77	36.5
Appro	ach	228	2.0	0.363	26.4	LOS B	8.1	57.9	0.77	0.70	0.77	36.7
North:	Bounda	ary Road										
7	L2	124	2.0	0.369	21.3	LOS B	10.7	76.4	0.65	0.63	0.65	45.5
8	T1	328	2.0	0.369	17.4	LOS B	10.7	76.4	0.67	0.65	0.67	45.4
9	R2	103	2.0	0.369	27.9	LOS B	6.4	45.7	0.74	0.71	0.74	41.5
Appro	ach	556	2.0	0.369	20.2	LOS B	10.7	76.4	0.68	0.66	0.68	44.6
West:	Brahma	an Road										
10	L2	18	2.0	0.176	28.0	LOS B	3.8	26.9	0.72	0.63	0.72	37.1
11	T1	80	2.0	0.176	23.4	LOS B	3.8	26.9	0.72	0.63	0.72	37.4
12	R2	16	2.0	0.176	28.0	LOS B	3.8	26.9	0.72	0.63	0.72	37.1
Appro	ach	114	2.0	0.176	24.8	LOS B	3.8	26.9	0.72	0.63	0.72	37.3
All Ve	hicles	1399	2.0	0.369	21.1	LOS B	10.7	76.4	0.69	0.64	0.69	42.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: BHR07 [PM_Boundary Road_Brahman Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Move	ement l	Performan	ce - Vel	hicles								
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Bound	lary Road										
1	L2	112	2.0	0.500	22.7	LOS B	16.0	113.7	0.71	0.66	0.71	45.0
2	T1	615	2.0	0.500	18.6	LOS B	16.0	113.7	0.73	0.68	0.73	45.1
3	R2	109	2.0	0.500	26.6	LOS B	11.6	82.4	0.76	0.71	0.76	42.7
Appro	ach	836	2.0	0.500	20.2	LOS B	16.0	113.7	0.73	0.68	0.73	44.8
East:	Brahma	in Road										
4	L2	68	2.0	0.501	32.4	LOS C	11.1	79.3	0.84	0.77	0.84	35.0
5	T1	116	2.0	0.501	27.8	LOS B	11.1	79.3	0.84	0.77	0.84	35.3
6	R2	103	2.0	0.501	32.4	LOS C	11.1	79.3	0.84	0.77	0.84	35.1
Appro	ach	287	2.0	0.501	30.5	LOS C	11.1	79.3	0.84	0.77	0.84	35.1
North:	Bound	ary Road										
7	L2	65	2.0	0.236	20.0	LOS B	6.3	45.1	0.59	0.57	0.59	46.4
8	T1	333	2.0	0.236	16.2	LOS B	6.3	45.1	0.62	0.57	0.62	46.7
9	R2	19	2.0	0.236	23.7	LOS B	5.4	38.3	0.65	0.57	0.65	44.9
Appro	ach	417	2.0	0.236	17.2	LOS B	6.3	45.1	0.62	0.57	0.62	46.6
West:	Brahma	an Road										
10	L2	36	2.0	0.468	33.4	LOS C	9.5	67.9	0.84	0.76	0.84	34.8
11	T1	109	2.0	0.468	28.9	LOS C	9.5	67.9	0.84	0.76	0.84	35.0
12	R2	99	2.0	0.468	33.4	LOS C	9.5	67.9	0.84	0.76	0.84	34.8
Appro	ach	244	2.0	0.468	31.4	LOS C	9.5	67.9	0.84	0.76	0.84	34.9
All Ve	hicles	1784	2.0	0.501	22.7	LOS B	16.0	113.7	0.74	0.68	0.74	41.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHR08 – The Water Lane/Outback Street



Site: BHR08 [AM_Water Lane_Outback Street]

New Site Site Category: (None) Roundabout

Move	ement P	erformanc	e - Vel	hicles								
Mov ID	Turn	Demand l Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Outbac	k Street										
1	L2	57	2.0	0.219	5.3	LOS A	1.0	6.9	0.64	0.69	0.64	43.5
2	T1	80	2.0	0.219	5.0	LOS A	1.0	6.9	0.64	0.69	0.64	45.1
3	R2	25	2.0	0.219	10.5	LOS A	1.0	6.9	0.64	0.69	0.64	46.4
Appro	ach	162	2.0	0.219	6.0	LOS A	1.0	6.9	0.64	0.69	0.64	44.6
East:	The Wat	er Lane										
4	L2	141	2.0	0.430	3.7	LOS A	2.7	19.0	0.48	0.41	0.48	44.0
5	T1	792	2.0	0.430	3.3	LOS A	2.7	19.0	0.49	0.44	0.49	47.1
6	R2	118	2.0	0.430	8.9	LOS A	2.6	18.6	0.50	0.48	0.50	46.8
Approach		1051	2.0	0.430	4.0	LOS A	2.7	19.0	0.49	0.44	0.49	46.7
North:	Outbacl	k Street										
7	L2	22	2.0	0.162	5.4	LOS A	0.7	5.0	0.64	0.73	0.64	41.4
8	T1	53	2.0	0.162	5.1	LOS A	0.7	5.0	0.64	0.73	0.64	43.9
9	R2	43	2.0	0.162	10.5	LOS A	0.7	5.0	0.64	0.73	0.64	45.9
Appro	ach	118	2.0	0.162	7.1	LOS A	0.7	5.0	0.64	0.73	0.64	44.2
West:	The Wat	ter Lane										
10	L2	189	2.0	0.460	3.5	LOS A	3.0	21.1	0.45	0.40	0.45	45.1
11	T1	807	2.0	0.460	3.1	LOS A	3.0	21.1	0.46	0.43	0.46	47.1
12	R2	174	2.0	0.460	8.7	LOS A	2.9	20.7	0.47	0.48	0.47	47.2
Appro	ach	1171	2.0	0.460	4.0	LOS A	3.0	21.1	0.46	0.43	0.46	46.8
All Ve	hicles	2501	2.0	0.460	4.3	LOS A	3.0	21.1	0.49	0.47	0.49	46.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: BHR08 [PM_Water Lane_Outback Street]

New Site Site Category: (None) Roundabout

Move	ment P	erformanc	ce - Vel	hicles								
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Outbac	k Street										
1	L2	126	2.0	0.439	8.0	LOS A	2.4	17.1	0.81	0.94	0.94	41.0
2	T1	47	2.0	0.439	7.7	LOS A	2.4	17.1	0.81	0.94	0.94	41.8
3	R2	68	2.0	0.439	13.1	LOS A	2.4	17.1	0.81	0.94	0.94	43.0
Appro	ach	242	2.0	0.439	9.4	LOS A	2.4	17.1	0.81	0.94	0.94	41.6
East:	The Wate	er Lane										
4	L2	63	2.0	0.596	5.2	LOS A	5.1	36.2	0.69	0.58	0.74	42.4
5	T1	1180	2.0	0.596	4.9	LOS A	5.1	36.2	0.70	0.62	0.76	45.8
6	R2	72	2.0	0.596	10.7	LOS A	5.0	35.7	0.70	0.67	0.78	45.5
Approach		1315	2.0	0.596	5.3	LOS A	5.1	36.2	0.70	0.62	0.76	45.6
North:	Outback	< Street										
7	L2	100	2.0	0.451	5.4	LOS A	2.4	17.4	0.64	0.76	0.70	41.5
8	T1	158	2.0	0.451	5.2	LOS A	2.4	17.4	0.64	0.76	0.70	44.0
9	R2	137	2.0	0.451	10.6	LOS A	2.4	17.4	0.64	0.76	0.70	46.0
Appro	ach	395	2.0	0.451	7.1	LOS A	2.4	17.4	0.64	0.76	0.70	44.1
West:	The Wat	ter Lane										
10	L2	102	2.0	0.266	3.2	LOS A	1.5	10.5	0.36	0.35	0.36	45.7
11	T1	489	2.0	0.266	2.8	LOS A	1.5	10.5	0.37	0.38	0.37	47.8
12	R2	88	2.0	0.266	8.3	LOS A	1.4	10.3	0.37	0.42	0.37	47.9
Appro	ach	680	2.0	0.266	3.5	LOS A	1.5	10.5	0.37	0.38	0.37	47.5
All Ve	hicles	2632	2.0	0.596	5.5	LOS A	5.1	36.2	0.61	0.61	0.67	45.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHT07 – Gardiner Drive / Mt Carmel Drive





Intersection BHT07 -

Site: BHT07 [AM_Mount Carmel Drive_Gardiner Drive]

New Site Site Category: (None) Roundabout

Move	ment P	erformanc	e - Vel	nicles								
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South:	Mount C	Carmel Driv	е									
2	T1	148	0.0	0.194	4.4	LOS A	1.4	9.9	0.45	0.53	0.45	55.5
3	R2	95	0.0	0.194	10.1	LOS A	1.4	9.9	0.45	0.53	0.45	56.6
Appro	ach	243	0.0	0.194	6.6	LOS A	1.4	9.9	0.45	0.53	0.45	56.0
East: 0	Gardiner	Drive										
4	L2	581	0.0	0.730	10.1	LOS A	10.3	72.1	0.93	0.99	1.23	45.7
6	R2	166	0.0	0.730	15.3	LOS B	10.3	72.1	0.93	0.99	1.23	44.0
Appro	ach	747	0.0	0.730	11.2	LOS A	10.3	72.1	0.93	0.99	1.23	45.5
North:	Mount C	Carmel Drive	Э									
7	L2	61	0.0	0.350	4.0	LOS A	2.8	19.4	0.35	0.40	0.35	53.1
8	T1	445	0.0	0.350	4.1	LOS A	2.8	19.4	0.35	0.40	0.35	57.1
Approa	ach	506	0.0	0.350	4.1	LOS A	2.8	19.4	0.35	0.40	0.35	56.8
All Vel	nicles	1497	0.0	0.730	8.1	LOS A	10.3	72.1	0.66	0.71	0.81	50.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Carmel_Gardiner Dr.sip8

Site: BHT07 [PM_Mount Carmel Drive_Gardiner Drive]

New Site Site Category: (None) Roundabout

Move	ment Pe	erformanc	e - Ver	nicles								
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South:	Mount C	Carmel Driv	е									
2	T1	518	0.0	0.600	4.3	LOS A	6.7	46.8	0.45	0.50	0.45	55.4
3	R2	388	0.0	0.600	9.9	LOS A	6.7	46.8	0.45	0.50	0.45	56.5
Approa	ach	906	0.0	0.600	6.7	LOS A	6.7	46.8	0.45	0.50	0.45	55.9
East: 0	Gardiner	Drive										
4	L2	219	0.0	0.233	3.1	LOS A	1.7	11.7	0.43	0.48	0.43	47.9
6	R2	83	0.0	0.233	8.3	LOS A	1.7	11.7	0.43	0.48	0.43	48.7
Approa	ach	302	0.0	0.233	4.6	LOS A	1.7	11.7	0.43	0.48	0.43	48.1
North:	Mount C	armel Drive	Э									
7	L2	201	0.0	0.341	5.9	LOS A	2.5	17.4	0.67	0.63	0.67	51.6
8	T1	157	0.0	0.341	6.1	LOS A	2.5	17.4	0.67	0.63	0.67	56.1
Approa	ach	358	0.0	0.341	6.0	LOS A	2.5	17.4	0.67	0.63	0.67	54.1
All Veh	nicles	1566	0.0	0.600	6.1	LOS A	6.7	46.8	0.49	0.53	0.49	53.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHRU02B – Road upgrade of Terry Road and Mason Bypass





BHRU08A – Road upgrade of The Water Lane (Nelson Rd to Annangrove Rd)

Intersections already discussed earlier in The Water Lane (Nelson to Annangrove Road) are:

- BHT15 Nelson Road/The Water Lane
- BHT20 Grandhill Parkway/The Water Lane
- BHR08 The Water Lane/Outback Street

The other intersection upgrades within this segment are shown below:

BHRU08A_1 The Water Lane/Terrain Street



▽ Site: BHRU08A [AM_Water Lane_Terrain Street]

New Site Site Category: (None) Giveway / Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h	
South: Terrain Street													
1	L2	65	2.0	0.073	7.4	LOS A	0.3	1.9	0.42	0.66	0.42	43.8	
Appro	ach	65	2.0	0.073	7.4	LOS A	0.3	1.9	0.42	0.66	0.42	43.8	
East:	East: The Water Lane												
4	L2	65	2.0	0.232	4.4	LOS A	0.0	0.0	0.00	0.09	0.00	51.8	
5	T1	826	2.0	0.232	0.0	LOS A	0.0	0.0	0.00	0.04	0.00	58.9	
Appro	ach	892	2.0	0.232	0.3	NA	0.0	0.0	0.00	0.04	0.00	58.3	
North:	GreyBox	k Street											
7	L2	68	2.0	0.099	8.9	LOS A	0.3	2.4	0.52	0.76	0.52	35.6	
Appro	ach	68	2.0	0.099	8.9	LOS A	0.3	2.4	0.52	0.76	0.52	35.6	
West:	The Wat	er Lane											
10	L2	37	2.0	0.315	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	54.9	
11	T1	1176	2.0	0.315	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.3	
Appro	ach	1213	2.0	0.315	0.2	NA	0.0	0.0	0.00	0.02	0.00	59.1	
All Vel	nicles	2238	2.0	0.315	0.7	NA	0.3	2.4	0.03	0.07	0.03	56.8	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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▽ Site: BHRU08A [PM_Water Lane_Terrain Street]

New Site Site Category: (None) Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South:	Terrain	Street										
1	L2	108	2.0	0.196	10.8	LOS A	0.7	4.9	0.63	0.84	0.63	39.9
Appro	ach	108	2.0	0.196	10.8	LOS A	0.7	4.9	0.63	0.84	0.63	39.9
East:	The Wate	er Lane										
4	L2	34	2.0	0.389	4.4	LOS A	0.0	0.0	0.00	0.03	0.00	53.0
5	T1	1463	2.0	0.389	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	59.5
Appro	ach	1497	2.0	0.389	0.1	NA	0.0	0.0	0.00	0.01	0.00	59.4
North:	GreyBo	x Street										
7	L2	22	2.0	0.023	7.0	LOS A	0.1	0.6	0.38	0.60	0.38	38.0
Appro	ach	22	2.0	0.023	7.0	LOS A	0.1	0.6	0.38	0.60	0.38	38.0
West:	The Wat	er Lane										
10	L2	79	2.0	0.214	5.6	LOS A	0.0	0.0	0.00	0.12	0.00	53.5
11	T1	740	2.0	0.214	0.0	LOS A	0.0	0.0	0.00	0.05	0.00	58.3
Appro	ach	819	2.0	0.214	0.5	NA	0.0	0.0	0.00	0.06	0.00	57.6
All Vel	nicles	2446	2.0	0.389	0.8	NA	0.7	4.9	0.03	0.07	0.03	56.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHRU08A_2 The Water Lane/Mirage Street



V Site: BHRU08A_2 [AM_Water Lane_Mirage Street]

New Site Site Category: (None) Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand F Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South:	Mirage S	Street										
1	L2	53	2.0	0.060	7.5	LOS A	0.2	1.5	0.43	0.66	0.43	43.7
Approa	ach	53	2.0	0.060	7.5	LOS A	0.2	1.5	0.43	0.66	0.43	43.7
East: 1	The Wate	r Lane										
4	L2	47	2.0	0.231	4.4	LOS A	0.0	0.0	0.00	0.06	0.00	52.3
5	T1	839	2.0	0.231	0.0	LOS A	0.0	0.0	0.00	0.03	0.00	59.2
Approa	ach	886	2.0	0.231	0.2	NA	0.0	0.0	0.00	0.03	0.00	58.8
North:	Green Ri	dge Street	t									
7	L2	68	2.0	0.101	9.0	LOS A	0.4	2.5	0.53	0.77	0.53	35.4
Approa	ach	68	2.0	0.101	9.0	LOS A	0.4	2.5	0.53	0.77	0.53	35.4
West:	The Wate	er Lane										
10	L2	37	2.0	0.324	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	54.9
11	T1	1207	2.0	0.324	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.4
Approa	ach	1244	2.0	0.324	0.2	NA	0.0	0.0	0.00	0.02	0.00	59.1
All Veh	nicles	2252	2.0	0.324	0.6	NA	0.4	2.5	0.03	0.06	0.03	57.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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V Site: BHRU08A_2 [PM_Water Lane_Mirage Street]

New Site Site Category: (None) Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South:	Mirage	Street										
1	L2	116	2.0	0.189	10.0	LOS A	0.7	4.8	0.59	0.82	0.59	40.8
Approa	ach	116	2.0	0.189	10.0	LOS A	0.7	4.8	0.59	0.82	0.59	40.8
East:	The Wat	er Lane										
4	L2	78	2.0	0.380	4.4	LOS A	0.0	0.0	0.00	0.06	0.00	52.2
5	T1	1381	2.0	0.380	0.0	LOS A	0.0	0.0	0.00	0.03	0.00	59.1
Approa	ach	1459	2.0	0.380	0.2	NA	0.0	0.0	0.00	0.03	0.00	58.7
North:	Green I	Ridge Street	t									
7	L2	11	2.0	0.011	6.7	LOS A	0.0	0.3	0.35	0.57	0.35	38.2
Appro	ach	11	2.0	0.011	6.7	LOS A	0.0	0.3	0.35	0.57	0.35	38.2
West:	The Wa	ter Lane										
10	L2	93	2.0	0.199	5.6	LOS A	0.0	0.0	0.00	0.15	0.00	53.0
11	T1	669	2.0	0.199	0.0	LOS A	0.0	0.0	0.00	0.06	0.00	57.9
Approa	ach	762	2.0	0.199	0.7	NA	0.0	0.0	0.00	0.07	0.00	57.0
All Vel	nicles	2347	2.0	0.380	0.9	NA	0.7	4.8	0.03	0.09	0.03	56.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHRU08A_3 The Water Lane/Scenary Street



SITE LAYOUT

Intersection BHRU08A_3 -



✓ Site: BHRU08A_3 [AM_Water Lane_Scenary Street]

New Site Site Category: (None) Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov	Turn	Demand I	Flows	Deg. Sata	Average	Level of	95% Back	of Queue	Prop.	Effective Stop Pate	Aver. No.	Average
		veh/h	%	v/c	Sec	Service	venicies veh	m	Queueu		Cycles	km/h
South: Scenary Street												
1	L2	52	2.0	0.059	7.4	LOS A	0.2	1.5	0.42	0.65	0.42	43.8
Approa	ach	52	2.0	0.059	7.4	LOS A	0.2	1.5	0.42	0.65	0.42	43.8
East: 1	The Wate	r Lane										
4	L2	57	2.0	0.232	4.4	LOS A	0.0	0.0	0.00	0.07	0.00	52.0
5	T1	835	2.0	0.232	0.0	LOS A	0.0	0.0	0.00	0.03	0.00	59.0
Approa	ach	892	2.0	0.232	0.3	NA	0.0	0.0	0.00	0.04	0.00	58.5
West:	The Wate	er Lane										
11	T1	1276	2.0	0.331	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approa	ach	1276	2.0	0.331	0.0	NA	0.0	0.0	0.00	0.00	0.00	59.9
All Veł	nicles	2219	2.0	0.331	0.3	NA	0.2	1.5	0.01	0.03	0.01	58.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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V Site: BHRU08A_3 [PM_Water Lane_Scenary Street]

New Site Site Category: (None) Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov	Turn	Demand I	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective Stop Pate	Aver. No.	Average
		veh/h	пv %	v/c	Sec	Service	venicies veh	m	Queueu		Cycles	speed km/h
South: Scenary Street												
1	L2	116	2.0	0.187	9.9	LOS A	0.7	4.7	0.58	0.82	0.58	40.9
Approa	ach	116	2.0	0.187	9.9	LOS A	0.7	4.7	0.58	0.82	0.58	40.9
East: 1	The Wate	er Lane										
4	L2	57	2.0	0.364	4.4	LOS A	0.0	0.0	0.00	0.05	0.00	52.6
5	T1	1343	2.0	0.364	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.3
Approa	ach	1400	2.0	0.364	0.2	NA	0.0	0.0	0.00	0.02	0.00	59.0
West:	The Wat	ter Lane										
11	T1	680	2.0	0.177	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approa	ach	680	2.0	0.177	0.0	NA	0.0	0.0	0.00	0.00	0.00	60.0
All Veh	nicles	2196	2.0	0.364	0.6	NA	0.7	4.7	0.03	0.06	0.03	57.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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BHRU08B - Road upgrade of The Water Lane (Mason Road to Hynds Road)





ARU1 – Upgrade of Annangrove Road



Site: ARU1 [AM_Water Lane_Annangrove Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles												
Mov ID	Turn	Demand I Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Annan	grove Road										
1	L2	340	2.0	0.389	24.5	LOS B	10.8	77.1	0.70	0.78	0.70	44.1
2	T1	717	2.0	0.391	19.0	LOS B	11.4	81.2	0.70	0.61	0.70	51.9
3	R2	241	2.0	1.025	123.2	LOS F	22.1	157.4	1.00	1.38	2.05	29.6
Appro	ach	1298	2.0	1.025	39.8	LOS C	22.1	157.4	0.76	0.80	0.95	43.7
East:	Withers	Road										
4	L2	280	2.0	0.351	26.7	LOS B	9.2	65.8	0.72	0.78	0.72	48.6
5	T1	603	2.0	0.360	21.2	LOS B	10.0	71.1	0.73	0.62	0.73	46.7
6	R2	84	2.0	0.299	34.1	LOS C	3.2	22.7	0.79	0.76	0.79	46.7
Appro	ach	967	2.0	0.360	23.9	LOS B	10.0	71.1	0.73	0.68	0.73	47.4
North:	Annan	grove Road										
7	L2	29	2.0	0.034	21.2	LOS B	0.8	5.5	0.57	0.67	0.57	50.4
8	T1	816	2.0	0.444	19.6	LOS B	13.4	95.4	0.73	0.63	0.73	51.7
9	R2	107	2.0	0.507	34.9	LOS C	4.4	31.2	0.84	0.79	0.84	40.5
Appro	ach	953	2.0	0.507	21.3	LOS B	13.4	95.4	0.73	0.65	0.73	50.6
West:	The Wa	ater Lane										
10	L2	300	2.0	0.376	26.0	LOS B	10.0	71.4	0.73	0.77	0.73	38.4
11	T1	316	2.0	0.188	19.4	LOS B	4.8	34.2	0.67	0.55	0.67	41.0
12	R2	239	2.0	1.026	122.1	LOS F	21.8	155.4	1.00	1.45	2.05	21.0
Appro	ach	855	2.0	1.026	50.4	LOS D	21.8	155.4	0.78	0.88	1.08	31.8
All Ve	hicles	4073	2.0	1.026	33.9	LOS C	22.1	157.4	0.75	0.75	0.88	43.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Project: \\ROAMING\Redirected\gsingh\Documents\THSC\PROJECTS\MOUNT CARMEL STUDY\ANALYSIS\NOT REQUIRED\06_Water lane_Anangrove Road.sip8

Site: ARU1 [PM_Water Lane_Annangrove Road]

New Site Site Category: (None)

Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles												
Mov ID	Turn	Demand I Total veh/h	lows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Annar	igrove Road										
1	L2	331	2.0	0.471	31.4	LOS C	12.3	87.6	0.81	0.81	0.81	41.3
2	T1	707	2.0	0.479	25.9	LOS B	13.2	93.9	0.82	0.70	0.82	49.5
3	R2	193	2.0	0.883	64.4	LOS E	11.8	83.9	1.00	1.08	1.47	39.1
Appro	ach	1231	2.0	0.883	33.4	LOS C	13.2	93.9	0.84	0.79	0.92	45.7
East:	Withers	Road										
4	L2	207	2.0	0.214	19.9	LOS B	5.5	39.1	0.58	0.73	0.58	50.9
5	T1	858	2.0	0.422	16.3	LOS B	12.9	92.0	0.67	0.59	0.67	49.2
6	R2	60	2.0	0.137	22.6	LOS B	1.7	12.1	0.61	0.70	0.61	50.4
Appro	ach	1125	2.0	0.422	17.3	LOS B	12.9	92.0	0.65	0.62	0.65	49.7
North:	Annan	grove Road										
7	L2	62	2.0	0.088	27.4	LOS B	2.0	13.9	0.68	0.71	0.68	48.3
8	T1	651	2.0	0.441	25.5	LOS B	11.9	84.8	0.80	0.69	0.80	49.6
9	R2	126	2.0	0.747	51.5	LOS D	6.6	47.2	0.98	0.93	1.21	35.2
Appro	ach	839	2.0	0.747	29.5	LOS C	11.9	84.8	0.82	0.73	0.85	47.6
West:	The Wa	ater Lane										
10	L2	62	2.0	0.064	17.7	LOS B	1.5	10.7	0.53	0.66	0.53	41.4
11	T1	416	2.0	0.204	14.2	LOS A	5.5	38.9	0.58	0.49	0.58	43.1
12	R2	202	2.0	0.918	72.9	LOS F	14.2	101.3	1.00	1.21	1.61	27.6
Appro	ach	680	2.0	0.918	32.0	LOS C	14.2	101.3	0.70	0.72	0.88	36.8
All Ve	hicles	3875	2.0	0.918	27.6	LOS B	14.2	101.3	0.76	0.71	0.82	45.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Annangrove Link V/C ratio



F Additional land for stormwater – seeking stakeholder comment

In section 5.3 we outline our finding that nexus is not established for the inclusion of an additional 17,248m² of land for stormwater in CP15 (2020). The council has indicated that 4,034m² of this land can be removed from the plan. This appendix provides details from the plan of the location, areas of land, underlying zonings and constraints of the four lots of land that comprise the remaining 13,214m² of additional land.

Table F.1 provides a summary relating to the four lots.

Address	Item # in CP15	Underlying	Constraint	$\Delta rea (m^2)$
Address	(2020)	zoning	Constraint	Area (iii)
4 Nelson Rd, Box Hill	KC01002	R3 a	Flood prone	215
			None	2,865
805 Windsor Rd, Box Hill	KC01008	R3 a	Flood prone	970
			None	1,376
30 Hynds Rd, Box Hill	KC02005	R3	Flood prone	2,388
33 Terry Rd, Box Hill	BH02A1009	R3	None	5,400
Totals				13,214

Table F.1 Additional land for stormwater in CP15 (2020)

a The council uses an underlying zoning of R3 for estimating the cost of this land. We note that the land actually has an underlying zoning of R2. This only impacts the value of unconstrained land. We propose to recommend an adjustment to the cost of this land if it remains in the plan.

Source: CP15 (2020) Works Schedule and IPART analysis.

F.1 Whole lot acquisition of 4 Nelson Road, Box Hill

Figure F.1 shows the location and underlying zonings applying to 4 Nelson Road, Box Hill. The underlying zonings for this lot are:

- SP2 Special Purpose Infrastructure this land is marked in yellow on the map; the council will acquire this land to deliver stormwater infrastructure
- RE1 Public Recreation this land is marked in green on the map; the council will acquire this land to deliver open space
- R2 Low Density Residential this land is marked in pink on the map; this is additional land that is not needed for public infrastructure in the plan.

We would like stakeholder feedback on whether the R2 land at 4 Nelson Road, Box Hill has development potential and can be resold. We note that the R2 land at this lot adjoins the R2 land at 805 Windsor Road, Box Hill (see section F.2) and 2 Nelson Road, Box Hill.



Figure F.1 4 Nelson Rd, Box Hill – location of lot and underlying zonings

Note: The R2 land at 4 Nelson Rd, Box Hill, adjoins the R2 land at 805 Windsor Rd and 2 Nelson Rd, Box Hill. **Source:** Information from The Hills Shire Council, 22 May 2020.

F.2 Whole lot acquisition of 805 Windsor Rd, Box Hill

Figure F.2 shows the location and underlying zonings applying to 805 Windsor Road, Box Hill. The underlying zonings for this lot are:

- SP2 Special Purpose Infrastructure this land is marked in yellow on the map; the council will acquire this land to deliver stormwater infrastructure
- R2 Low Density Residential this land is marked in pink on the map; this is additional land that is not needed for public infrastructure in the plan.

We would like stakeholder feedback on whether the R2 land at 805 Windsor Road, Box Hill has development potential and can be resold. We note that the R2 land at this lot adjoins the R2 land at 4 Nelson Road, Box Hill (see section F.1) and 807 Windsor Road, Box Hill.



Figure F.2 805 Windsor Rd, Box Hill – location of lot and underlying zonings

Note: The R2 land at 805 Windsor Rd, Box Hill, adjoins the R2 land at 4 Nelson Rd and 807 Windsor Rd, Box Hill. **Source:** Information from The Hills Shire Council, 22 May 2020.

F.3 Whole lot acquisition of 30 Hynds Rd, Box Hill

Figure F.3 shows the location and underlying zonings applying to 30 Hynds Road, Box Hill. The underlying zonings for this lot are:

- SP2 Special Purpose Infrastructure this land is marked in yellow on the map; the council will acquire this land to deliver stormwater infrastructure
- R3 Medium Density Residential this land is marked in dark pink on the map; this is additional land that is not needed for public infrastructure in the plan.

We would like stakeholder feedback on whether the R3 land at 30 Hynds Road, Box Hill has development potential and can be resold. We note that the R3 land at this lot adjoins R3 land at 12 Alan Street, 793 Windsor Road and 32-24 Hynds Road, Box Hill (see Figure F.4).



Figure F.3 30 Hynds Rd, Box Hill - location of lot and underlying zonings

Note: The R3 land at 30 Hynds Rd, Box Hill, adjoins R3 land at 12 Alan St, 793 Windsor Rd and 32-34 Hynds Rd, Box Hill (see Figure F.4).

Source: Information from The Hills Shire Council, 22 May 2020.



Figure F.4 R3 lots adjoining 30 Hynds Rd, Box Hill

Note: The R3 land at 30 Hynds Rd, Box Hill, adjoins R3 land at 12 Alan St, 793 Windsor Rd and 32-34 Hynds Rd, Box Hill **Source:** IPART analysis.

F.4 Whole lot acquisition of 33 Terry Rd, Box Hill

Figure F.5 shows the location and underlying zonings applying to 33 Terry Road, Box Hill. The underlying zonings for this lot are:

- SP2 Special Purpose Infrastructure this land is marked in yellow on the map; the council will acquire this land to deliver stormwater infrastructure
- R3 Medium Density Residential this land is marked in dark pink on the map; this is additional land that is not needed for public infrastructure in the plan.

We would like stakeholder feedback on whether the R3 land at 33 Terry Road, Box Hill has development potential and can be resold. We note that the R3 land at this lot adjoins R3 land at 35 Terry Road, Box Hill (see Figure F.5).


Figure F.5 33 Terry Rd, Box Hill – location of lot and underlying zonings

Note: The R3 land at 33 Terry Rd, Box Hill, adjoins R3 land at 35 Terry Rd, Box Hill. **Source:** Information from The Hills Shire Council, 22 May 2020.