Economic Development Queensland

Ripley Valley
Priority Development Area
Infrastructure Plan Background Report

Effective July 2022

Queensland Government

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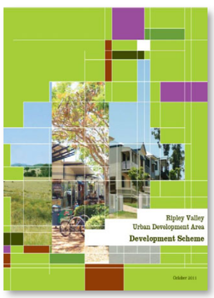
1 Background

1.1 Ripley Valley Priority Development Area

The Ripley Valley Priority Development Area (PDA) was declared on 8 October 2010 under the *Urban Land Development Act 2007* (since repealed and replaced with the *Economic Development Act 2012*). Covering 4,680 hectares, the Ripley Valley PDA is located within the Ipswich City Council area, approximately five kilometres south east of the Ipswich Central Business District (CBD).

1.2 Key infrastructure planning regulations and documents

The following summarises key infrastructure planning documents specific to the Ripley Valley PDA. Further information on these documents can be found at www.dsdmip.qld.gov.au.



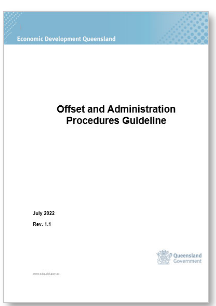
Development Scheme

The Ripley Valley PDA Development Scheme (the Development Scheme) commenced on 8 October 2011 and provides the regulatory framework for planning, implementing, coordinating and controlling land development within the PDA.

The Development Scheme provides the vision, land use plan, infrastructure plan and implementation strategy for the Ripley Valley PDA.

Development Charges and Offset Plan

A Development Charges and Offset Plan (DCOP) identifies the infrastructure contributions, how these charges are calculated, levied, and administered, and the trunk infrastructure required to service the PDA.



Offset and Administration Procedures

The Offsets and Administrations Procedures Guideline facilitates and assists applicants in preparing and obtaining infrastructure offsets, including provisional and final offsets for trunk infrastructure, implementation works, and value uplift works (affordable housing and Ecological Sustainable Development).

1.3 Purpose of Infrastructure Planning Background Report

The purpose of the Infrastructure Planning Background Report (IPBR) is to provide background information that has informed inputs and assumptions into the Ripley Valley Development Charges and Offsets Plan (DCOP). The report will assist users of the infrastructure plan within the DCOP to understand how infrastructure planning has been undertaken and how development charges were determined. The IPBR includes further detail on:

- Growth projections
- Infrastructure demand projections
- Desired standards of service
- Infrastructure planning
- Infrastructure costs
- Financial inputs and charge calculation

2 Growth projections

2.1 Introduction

Growth projections for the years 2016 – 2066 have been prepared by SGS Economics & Planning for the PDA and include analysis of the future residential growth, summarised below. Full analysis on growth projections is provided in Appendix E.

2.2 Growth projection years

The Ripley Valley PDA growth projection years are:

- 2020 – the base year
- 2026 – projection year
- 2031 – projection year
- 2041 – projection year
- 2066 – ultimate development.

2.3 Potential development capacity

The ultimate potential development capacity for the Ripley Valley PDA is based on an ultimate persons per household rate of 2.7 in 2066. The persons per household rate is forecast to decline from higher rates in 2016, as this is a common trend experienced in similar greenfield development areas, due to more apartments being built and changing age profiles. The Ripley Valley household size is still expected to remain slightly above the State average of 2.6 persons per household. Further information on the approach to determining the persons per household rate is provided in Appendix E.

2.4 Development constraints

Development constraints across the Ripley Valley PDA were considered in the Development Scheme taking into consideration known development constraints and current approvals which may limit the potential yield of land. Consideration was given to strategic plans to identify possible development constraints.

2.5 Growth rates

The rate and location of growth for residential development was determined based on recent dwelling approvals, developer feedback data (where provided), assumptions on the timing of development and further refined in the *Demographic Analysis for Three Priority Development Areas* by SGS Economics and Planning, February 2020.

2.6 Growth projections summary

The Ripley Valley PDA is forecast to experience notable growth in population, employment and residential dwellings from the base year (2020) to the ultimate development year (2066). Tables 2.6.1 and 2.6.2 identify the source information, and revised projections of population, employment, and dwellings for the area which have informed the DCOP planning assumptions.

Table 2.6.1 Growth projections for the Ripley Valley PDA – Identified within SGS Demographic Analysis Report

	2020 DCOP Base Date	2026 Projection year	2031 Projection year	2041 Projection year	2066 Ultimate development
Population	10,930	33,522	56,740	94,493	135,001
Employment (jobs)	1,824	4,083	6,405	10,180	14,231
Average household (occupancy rate)	3.00	3.00	3.00	2.90	2.70
Residential dwellings	3,643	11,174	18,913	32,584	50,000

Following preparation of the SGS Demographic Analysis, planning processes identified that an additional 4 primary school sites, 2 secondary school sites, 2 ambulance sites, 1 health centre precinct and 1 urban and fire rescue site were necessary, requiring additional land. To appropriately reflect the ultimate capacity of the PDA, the following adjustments were made to the growth projections:

- Non-residential yield – *No change*. Additional sites assumed to be required in residential areas
- Residential yield – *Reduction* to ultimate residential dwelling yield of 1,250 dwellings to accommodate the additional state community facility sites
- This capacity reduction is not anticipated to impact the growth rate identified in the Demographic Analysis, and on this basis has been applied only to the 2066 ultimate development

Table 2.6.2 Growth projections for the Ripley Valley PDA – Adopted for DCOP

	2020 DCOP Base Date	2026 Projection year	2031 Projection year	2041 Projection year	2066 Ultimate development
Population	10,930	33,522	56,740	94,493	131,626
Employment (jobs)	1,824	4,083	6,405	10,180	14,231
Average household (occupancy rate)	3.00	3.00	3.00	2.90	2.70
Residential dwellings	3,643	11,174	18,913	32,584	48,750

3 Demand projections

Demand projections have been informed by the Demographic Analysis for Three Priority Development Areas Report (SGS Demographic Study), with consideration given to the charge distribution in the current EDQ Infrastructure Funding Framework (IFF) between residential and non-residential uses.

3.1 Cost Apportionment Unit

To retain consistency in infrastructure charges applied under former charging frameworks, the DCOP has established a Cost Apportionment Unit (CAU) as a basis for the equitable distribution of infrastructure cost across the varying residential and non-residential use types. A CAU represents the level of demand placed on the network by a single detached dwelling (using charge rates as the common measure) and has been determined on the following basis.

3.1.1 CAU Inputs

The CAU calculation utilises the following inputs:

- Dwelling projections prepared within the SGS Demographic Study
- Realistic gross floor area (GFA) targets for non-residential development categories as prescribed within the Development Scheme
- Development Charges applicable under the IFF
- EDQ reporting of charges collected to date and unused offsets currently held by developers

3.1.2 CAU Methodology

The timing of non-residential GFA growth has been proportionally assigned, consistent with the rate of residential growth within the SGS Demographic study.

Table 3.1.2.1 Non-residential GFA projections

Non-residential use	2020 DCOP Base Date	2026 Projection year	2031 Projection year	2041 Projection year	2066 Ultimate development
Retail	20,969	64,311	108,855	181,285	259,000
Commercial	3,076	9,436	15,971	26,598	38,000
Community[1]	5,117	15,693	26,562	44,236	63,200
Industry	2,024	6,208	10,507	17,499	25,000

The following proportional dwelling mix is applied to all dwelling growth.

Table 3.1.2.2 Residential dwelling mix

Residential dwelling type	Proportion
Small Dwelling	5%
Medium Dwelling	8%
Large Dwelling / Lot	87%

[1] No CAUs for community uses have been calculated, as these uses are typically associated with public schools or other community-based services which do not normally attract an infrastructure charge.

The most recent IFF charges are applied to all projected residential and non-residential development, to establish an estimated future revenue for each time period and at ultimate development. This assessment is separately calculated for residential and non-residential revenue for:

- Catalyst charge
- Public Transport charge
- Balance municipal charge (by individual network)
- State charge
- Sub-regional charge
- Implementation charge

For the parks and community facilities (local and state) networks, the ***residential*** revenue for each year is divided by the charge rate for a single detached dwelling to determine CAU's for that year.

For all other networks and charge components, the ***total*** revenue for each year is divided by the charge rate for a single detached dwelling to determine the CAU's for that year.

A summary of the demand in CAU's for each network and charge component are identified in Table 3.1.2.3 below.

Table 3.1.2.3 Infrastructure Demands (CAU)

Charge Category	Network	2021	2026	2031	2036	2041	2066 Ultimate Development
Municipal Charge	Catalyst Charge	4,121	10,783	18,603	26,090	32,416	48,750
	PT Charge						
	Water Supply	4,290	11,260	19,441	27,231	33,786	50,502
	Sewerage	4,290	11,260	19,441	27,231	33,786	50,502
	Transport	4,290	11,260	19,441	27,231	33,786	50,502
	Public Parks	4,068	10,388	17,807	24,910	30,911	46,407
	Local Community Facilities	4,068	10,388	17,807	24,910	30,911	46,407
State Charge	State Community Facilities	4,086	10,519	18,071	25,302	31,410	47,185
Subregional Charge	Water Supply	4,195	10,951	18,880	26,451	32,834	49,213
	Sewerage	4,195	10,951	18,880	26,451	32,834	49,213
	Transport	4,195	10,951	18,880	26,451	32,834	49,213
Implementation Charge		4,068	10,388	17,807	24,910	30,911	46,407

4 Desired standard of service (DSS)

The DSS adopted for each infrastructure network appear below. The DSS referenced outline the standards to which infrastructure should be planned, designed and delivered within the Ripley Valley PDA.

4.1 Water Supply

The SEQ Water Supply and Sewerage Code, Urban Utilities' standard of service, as well as the Water Supply Code of Australia (WSA 03-2011) are the basis of hydraulic modelling and network planning.

The DSS are the same as used for the Urban Utilities Water Reticulation Master Plan for Ipswich – April 2017. The unit demand and peaking factors are summarised in Table 1.1.1 and network design parameters in Table 4.1.2 as may be amended from time to time.

Table 1.1.1 Ripley Valley PDA adopted unit demand and peaking factors

Year	AD (L/EP/day)		MDMM/AD Factor		PD/AD Factor		PH/PD Factor		PD (L/EP/day)		MDMM (L/EP/day)	
	Res[2]	Non-Res[3]	Res	Non-Res	Res	Non-Res	Res	Non-Res	Res	Non-Res	Res	Non-Res
2021	193	230	1.2	1.1	1.6	1.1	1.9	1.5	309	253	232	253
2026	210	230	1.2	1.1	1.6	1.1	1.9	1.5	336	253	252	253
2031	228	230	1.2	1.1	1.6	1.1	1.9	1.5	365	253	274	253
2041	230	230	1.2	1.1	1.6	1.1	1.9	1.5	368	253	276	253
2066	230	230	1.2	1.1	1.6	1.1	1.9	1.5	368	253	276	253

Table 4.1.2 Ripley Valley PDA water network planning parameters

Water Network Desired Standards of Service	
Parameter	**Criteria**
Reservoir storage assessment	PD demand
Reservoir storage size	3 x (PD – MDMM) + greater of 4 hrs MDMM and Firefighting Storage, subject to a minimum reservoir size of 150 kL
Reservoir minimum operating storage	Four hours consecutive demand
Pump supplying a ground level reservoir	MDMM over 20 hrs
Minimum service pressure at PH	On demand areas • 22 m at the property boundary based on reservoir at minimum operating level (MOL). MOL defined as 15% of storage height or top of emergency storage • 37m at model demand point based on 22m at property boundary plus 10m elevation difference allowance and 5m reticulation loss
Maximum service pressure	80 m
Trunk main capacity	MDMM in 20 hrs
Trunk main peak velocity	Design velocity 0.8 m/s to 1.4 m/s with a max of 2.5 m/s. (Up to 4 m/s in special cases)
Trunk main maximum headloss PH	5 m/km for DN<=150, 3 m/km for DN>=200

2 'Res' refers to residential.
3 'Non-Res' refers to non-residential.

More information is provided in Appendix D of this report.

4.2 Sewerage

The DSS for the sewer network is detailed in Table 4.2.1, as may be amended from time to time.

Table 4.2.1 Ripley Valley PDA sewer network planning criteria

Sewerage Network Planning Criteria	
Parameter	**Criteria**
Average Dry Weather Flow (ADWF)	Existing sewer 210 L/EP/day NuSewer 180 L/EP/day
Peak Wet Weather Flow (PWWF)	Existing 5 x ADWF NuSewer 3.64 x ADWF
Maximum depth of flow	70% for planned pipes 100% for existing pipes

4.3 Stormwater

Stormwater Quality and Quantity does not qualify as offsetable works under the DCOP. Such works are required to be conditioned upon future development and should be consistent with the desired standards of service and overall strategy provided in Appendix D.

4.4 Transport

The DSS provided in the Ipswich City Council's LGIP Support Document Transport (Roads) was adopted for the transport network (see Table), while acknowledging the ultimate development horizons for this report and the Support Document differ by 25 years. The Ripley Valley PDA Strategic Transport Model Update and Mesoscopic Model Development Report and PDA Guideline No.6 are also referenced as part of the Appendix D (see **Error! Reference source not found.**).

Table 4.4.1 Council's DSS for trunk roads

PDA Guideline no. 06			**Council LGIP Extrinsic Material**		
PDA street network	Number of lanes (both directions)	Daily traffic volume, vpd	Link function	Number of lanes (single direction)	Daily capacity threshold, vpd
Motorway / Highway	2 lanes	NA	Motorway / Highway	1 lane	14,000 - 15,600
	4 lanes	NA		2 lanes	30,300 - 33,700
Urban Arterial	2 lanes	NA	Arterial	1 lane	9,000 - 10,800
	4 lanes	NA		2 lanes	19,800 - 23,400
Trunk Connector	2 lanes	7,500 - 18,000	Sub-Arterial	1 lane	8,100 - 9,000
	4 lanes	18,001 - 30,000		2 lanes	17,100 - 19,800

To facilitate the delivery of a resilient transport network, trunk roads within the PDA will have the DSS standards applied as presented in Table 4.4.2:

Table 4.4.2 Ripley Valley PDA DSS Road Requirements

PDA Guideline no. 06		
PDA street network	**Number of Lanes (both directions)**	**Daily Traffic Volume, vpd**
Urban Arterial	2 lanes	7,500 – 23,500*
	4 lanes	23,500 – 40,000*
Trunk Connector	2 lanes	7,500 - 18,000
	4 lanes	18,001 - 30,000

*In the absence of EDQ Policy standard industry practice has been applied, these values are estimates of the range for maximum vpd

DSS requirements for trunk intersections as detailed in the Ipswich City Council LGIP extrinsic material have a maximum Degree of Saturation threshold of:

- 0.90 for traffic signals
- 0.85 for roundabout
- 0.80 for priority control.

4.5 Active transport

For active transport, the DSS adopts the Level of Traffic Stress (LTS) methodology.

The LTS methodology was developed by TMR and is a method for understanding the level of stress experienced by cyclists in different on-road and off-road environments. If the goal is for a transport network to facilitate and encourage cyclist trips for a high mode share, the transport infrastructure should not force cyclists into high stress environments. As such, LTS 1 or 2 is the desired standard of service for active transport infrastructure within trunk road corridors and for off-road pathways. Each type and its characteristics are outlined in Table 4.5.1.

Table 4.5.1 Level of Traffic Stress categories

LTS	Viability of cycling as a realistic mode choice	Proportion of people willing to cycle
LTS 1	Minimal traffic stress and requires less attention, making this suitable for all bicycle riders. This includes children trained to safely cross the road unsupervised (typically a 10-year-old), or younger children under supervision of parents.	63% to 75%
LTS 2	A little traffic stress that requires more attention than young children can handle. It is suitable for most teen and adult bicycle riders with adequate bicycle handling skill.	
LTS 3	Moderate traffic stress that would require higher levels of cycling skill and confidence to interact with traffic using cycle lanes on roads with lower traffic speeds or volumes	12% to 28%
LTS 4	High level of traffic stress only suitable for very skilled bicycle riders with confidence to interact with traffic on busy roads with minimal or no on-road cycle facilities	5% to 7%

4.6 Parks and open space

The DSS adopted for parks and open space is generally aligned to the DSS specified in EDQ's Park Planning and Design PDA Guideline No. 12 (Guideline 12). However, the DSS was slightly adjusted to incorporate feedback received from stakeholders. It was also adjusted based on consideration of the quantity of parks and the area that would be required for the projected population in the Ripley Valley PDA.

The DSS adopted for rates of provision, minimum area, and accessibility is detailed in Table 4.6.1.

DSS relating to all other aspects of planning and design remain consistent with Guideline 12. This includes:

- Shape, frontage and location
- Active recreation spaces
- Slopes, batters and retaining walls
- Flood and stormwater management
- Lakes and other permanent water bodies
- Managing access
- Shade cover
- Embellishments
- Engineering design and construction.

Table 4.6.1 Rates of provision, minimum area and accessibility requirements

Park Type	Rates of Provision		Minimum Area	Accessibility Requirements
	Land (ha/1,000 pop'n)	No. of parks per pop'n		
Local recreation park	0.0 – 0.2	NA	0.05 ha	NA
Neighbourhood recreation park (1)	0.5 – 1.1	1/1,000-1,500	0.5 ha	90% of dwellings within 400m of a neighbourhood recreation park or other park providing equivalent informal recreation opportunities
Local linear park (2), (3)	0.0 – 0.8	NA	NA	NA
District recreation park (4)	0.5 – 1.0	1/10,000-15,000	5 ha	90% of dwellings within 1km, must comply with location criteria in Guideline 12
Regional recreation park (5)	0.5 – 1.0	1/20,000+	10 ha	90% of dwellings within 2km, must comply with location criteria in Guideline 12
Major linear park (3)	0.0 – 0.5	NA	NA	NA
District sports park	0.75 – 1.2	1/10,000-20,000	7.5 ha	90% of dwellings within 1km, must comply with location criteria in Guideline 12
Regional sports park	0.5 – 1.0	1/25,000+	15 ha	90% of dwellings within 2km, must comply with location criteria in Guideline 12
Community land (6)	0.2	NA	NA	NA

<u>Notes:</u>

(1) Includes allowance for civic parks in neighbourhood centres.

(2) A local linear park is within or adjoining a predominantly residential neighbourhood.

(3) The actual rate of provision for linear parks may exceed the indicated maximum rate, particularly in areas with extensive waterway or other environmental corridors. The allocation in the table sets the parameters for

determining the contribution of linear parks to offsetable park area.

(4) This is the base requirement of parks for neighbourhood or local area planning purposes (e.g., context plans) for areas that do not include a designated higher order recreation or sports park. Local parks must be provided within or adjacent to the neighbourhoods they serve and cannot be offset by contributions elsewhere within the PDA.

(5) Includes allowance for civic parks in district centres.

(6) Refer to PDA Guideline 11: Community Facilities for more information

More information on the DSS criteria can be found in Appendix D.

4.7 Community facilities

The DSS for community facilities adopted was a combination of the DSS specified in EDQ's Community Facilities PDA Guideline No. 11 and Ipswich City Council's DSS within the LGIP.

Community facilities are split between facilities provided from the State facilities and provided from the local government. The DSS adopted for both State provided facilities and local government facilities are detailed in Table and

Table .

Table 4.7.1 DSS for State facilities

Facilities	Hierarchy of Provision	No. of Facilities (pop. Triggers)	Indicative site/ facility area
Ambulance	District – depends on a range of factors including current and projected population, planned future development, hazard and risk assessment, road network, incident profile for area.	1:25,000 Consider response time profile, case load per day, proximity to existing ambulance stations and health services.	Local site: 3,000 m^2 District site: 10,000m^2
Fire & Rescue	Depends on response time and incident history, proximity to existing facilities and population forecasts.	Over 25,000 people	Site: 3,000-4,000 m2 (auxiliary station) 3,000-6,000 m2 (permanent station) 10,000-20,000 sqm (permanent with specialist facilities)
Health Care Centre	Community Health Centre	1:20,000 – 30,000	GFA: 2,000 – 4,000 m^2 Site: up to 1.6 ha
	Community Care Hub	1:30,000 – 100,000	GFA: 4,000 – 8,000 m^2 Site: 1.6 – 3.2 ha
	Community Care Precinct	1:100,000 – 300,000	GFA: 8,000 – 10,000 m^2 Site: 3.2 – 4.0 ha (including parking)
Hospital – Public	Based on local planning and need analysis	Likely to serve a catchment of over 100,000 people	10-15 ha depending on level of service
Police	Main road location preferred by ingress and egress must offer left and right turns Security important Best location in town centre/shopping centre	1:20,000 – 30,000	Police Station Site: 4,000-5,000 m^2 GFA varies according to local needs – shopfronts, rented space, stations

Primary School - State		1:3,000 dwellings	6.5 -7.0 ha for 700-900 P-7 students[4]
Secondary School - State		1:8,000 dwellings	12 ha for 1,500-1,800 students[4]

Table 4.7.2 DSS for local government facilities

Scale	Facility	Land Area
City Wide Facilities (1:130,000 – 150,000)	Central Library	6,900 m^2
	Cultural/Performing Arts Centre	8,200 m^2
	Art Galley	2,000 m^2
	Multi-Purpose Meeting Space	2,500 m^2
	Outdoor Space	400 m^2
	Total (integrated facility)	2 ha
District Facilities (1:30,000 – 50,000)	Branch Library	2,100 m^2
	Performance/Theatre Space (Auditorium) and General Display Area	9,550 m^2
	Multi-Purpose Meeting Space	2,250 m^2
	Outdoor Space	100 m^2
	Total (Integrated Facility)	1.4 ha
Local Facilities (1:10,000 – 15,000)	Multi-Purpose Meeting Space	1,950 m^2
	Outdoor Space	50 m^2
	Total (Integrated Facility)	0.2 ha

More information on the DSS criteria can be found in **Error! Reference source not found.**.

4 As per the Department of Education New School Site Selection Guideline or as otherwise specified in the latest version of this guideline

5 Infrastructure planning

5.1 Planning horizon

The infrastructure plans for the Ripley Valley PDA have been prepared to reflect the ultimate development outcome (nominally 2066). This is based on the ultimate dwelling yield, informed by the total number of potential dwellings in the PDA at full build out.

5.2 Water Supply

The SEQ Water Supply and Sewerage Code, Urban Utilities' standard of service, as well as the Water Supply Code of Australia (WSA 03-2011) are the basis of hydraulic modelling and network planning outlined in this report and were followed throughout the design process.

The network DSS were used for assessing existing network deficiencies and for sizing new infrastructure.

Land acquisition requirements have been identified on the following basis:

- 500m² land requirements per pump station site
- 5,000m² land requirement per reservoir site

The timing of infrastructure is based on the growth of the population in the Ripley Valley PDA. Population projections have been broken down into 122 transport zones[5]. When the population in these zones reach 50 EP, servicing infrastructure is required which determines the timing.

The proposed trunk water supply infrastructure plan (ultimate) is provided in the DCOP mapping. Further information regarding infrastructure staging and non-trunk network outcomes are contained in Appendix D.

5.3 Sewerage

The SEQ Water Supply and Sewerage Code (SEQ WS&S D&C Code), Urban Utilities' standard of service and the Sewer Supply Code of Australia (WSA 03-2011) formed the basis of the hydraulic modelling and network planning and were followed throughout the design process.

The Urban Utilities DSS were used for assessing existing network deficiencies and for sizing new infrastructure. The Ripley Valley PDA is being developed as a NuSewer area with fully welded pipes which reduces the infiltration and inflow potential and consequential reduction in peak wet weather flows.

The timing of infrastructure is based on the growth of the population in the Ripley Valley PDA. When the population in the transport zones reach 50 EP, servicing infrastructure is required which determines the timing.

The proposed trunk sewerage supply infrastructure plan (ultimate) is provided in the DCOP mapping. Further information regarding infrastructure staging and non-trunk network outcomes are contained in Appendix D.

5.4 Transport

The timing of municipal infrastructure is based on the growth of the population in the Ripley Valley PDA. Population projections have been broken down into 122 transport zones. When the population in these zones reaches 50, servicing infrastructure is required, determining the timing of the infrastructure. The proposed trunk transport infrastructure plan (ultimate) is provided in the DCOP mapping. Further information regarding infrastructure staging and non-trunk network outcomes are contained in Appendix D.

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[5] The SGS Demographic projections (provided in Appendix E) break down the population and employment projections for the Ripley Valley PDA into 122 travel zones.

Sub-regional infrastructure outcomes have been identified to align with the City of Ipswich iGO Transport Plan (June 2016).

5.4.1 Cross-sections

When considering the mid-block cross section requirements of the PDA, alignment with Guideline No. 6 Movement Network was maintained where possible.

However, to minimise corridor impacts on adjacent land parcels and to provide efficient staging of roads that ultimately go to four lanes, a variation was made. This adjustment was made to the requirements of the four-lane trunk connector and urban arterial. Specifically, to accommodate a two-way 3m separated cycle track on one side in the interim, the clearance abutting the kerb used for tree planting and stormwater pits, was reduced from 2m to 1.5m. This allowed the ultimate corridor width to remain the same, even with the addition of 1m to one of the one-way cycle tracks. The proposed typical cross sections are shown in below figures. A detailed schedule of cross-sections, including non-standard cross sections, is provided in Appendix B.

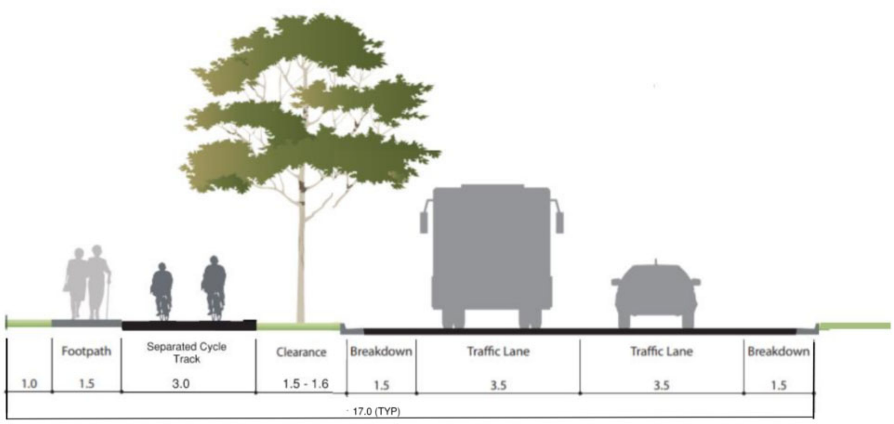


Figure 5-1 Interim four-lane urban arterial (two-lane no parking)

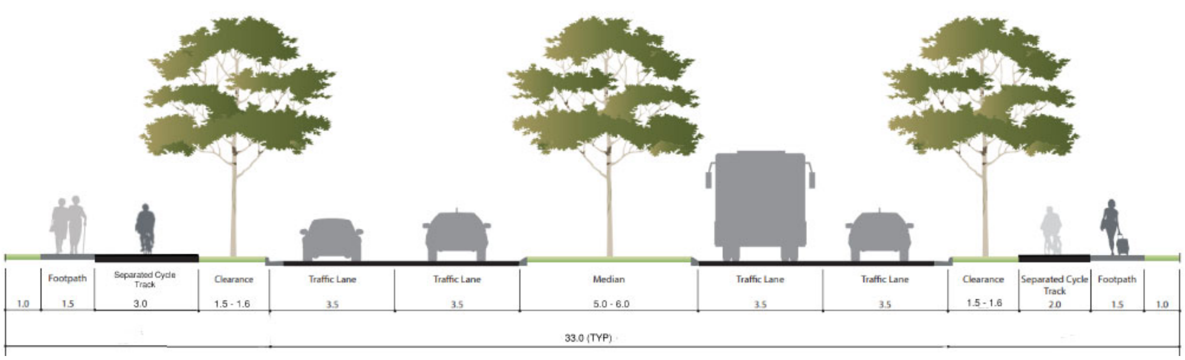


Figure 5-2 Ultimate four-lane urban arterial (no parking)

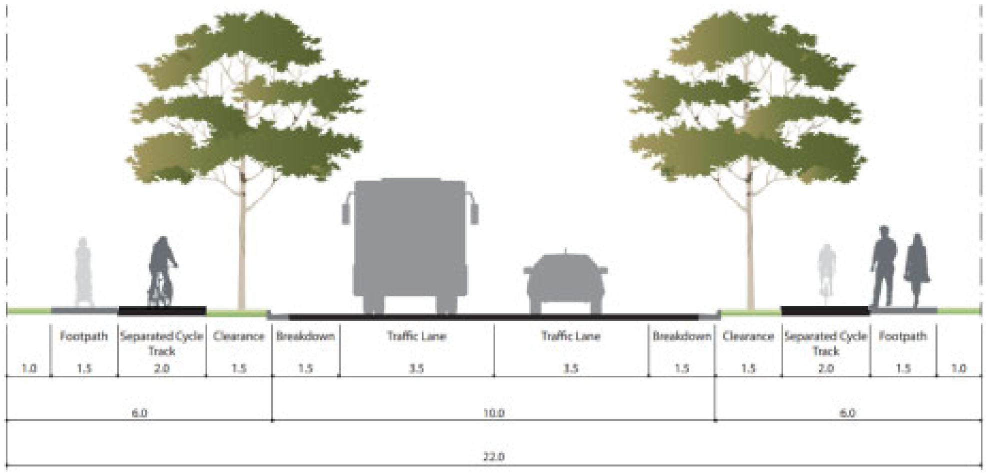


Figure 5-3 Ultimate two-lane trunk connector (no parking)

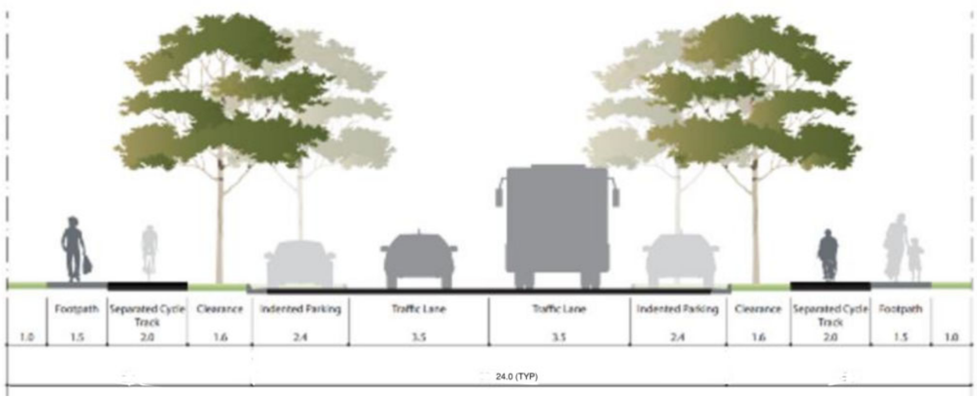


Figure 5-4 Ultimate two-lane trunk connector (with parking)

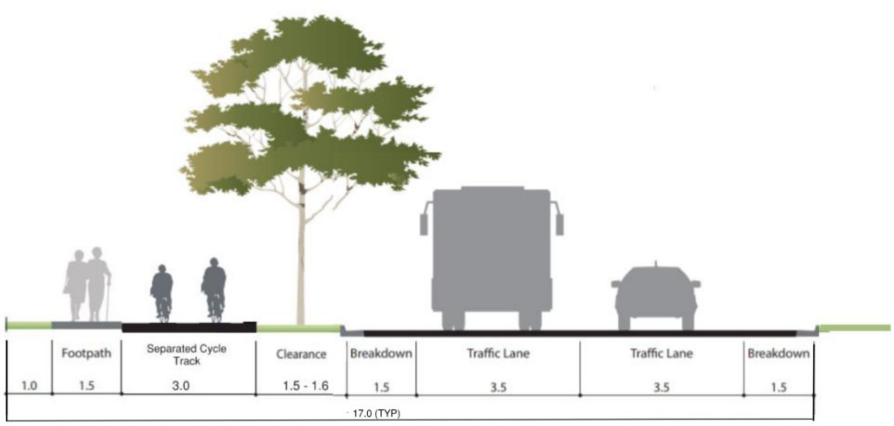


Figure 5-5 Interim four-lane trunk connector (two-lane no parking)

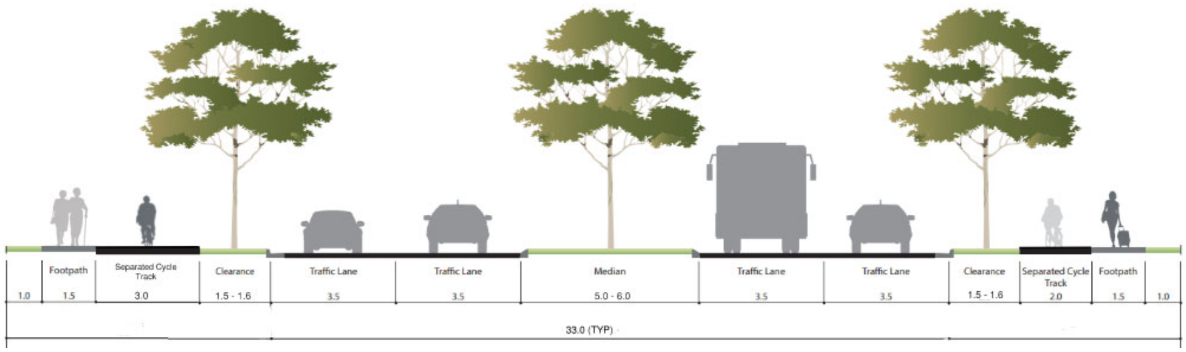


Figure 5-6 Ultimate four-lane trunk connector (no parking)

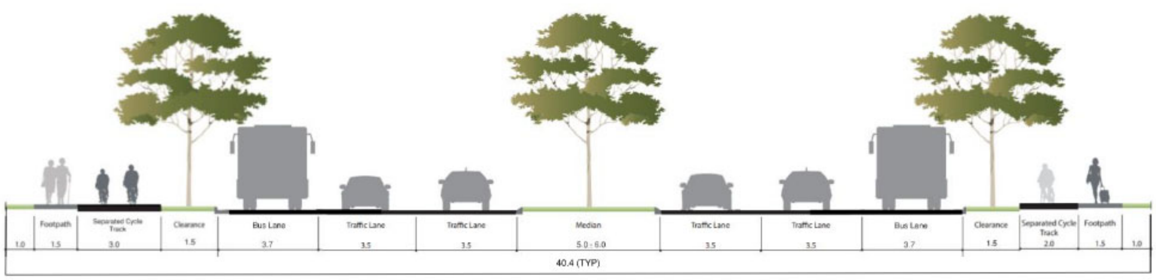


Figure 5-7: Ultimate four-lane trunk connector (with bus lanes)

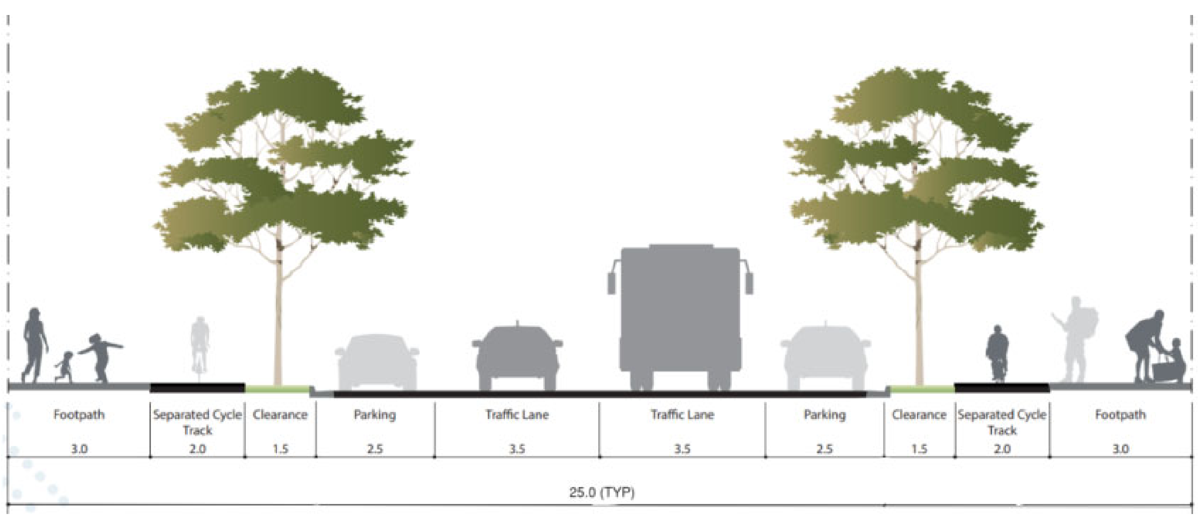


Figure 5-8 Ultimate two-lane centre connector (with parking)

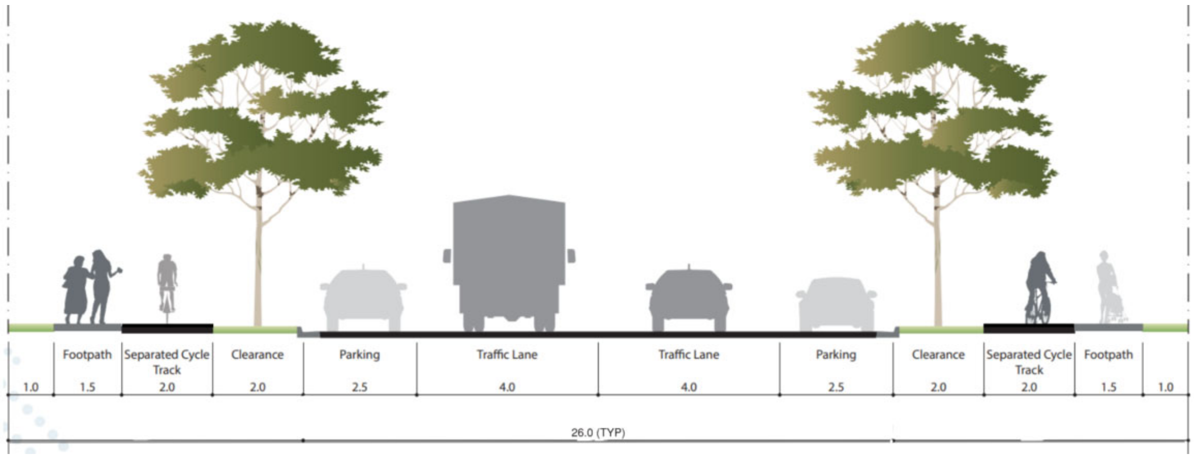


Figure 5-9 Ultimate two-lane industrial connector (with parking)

Figure 5-10 Ultimate Two-Lane Trunk Connector (with on-road cycling)

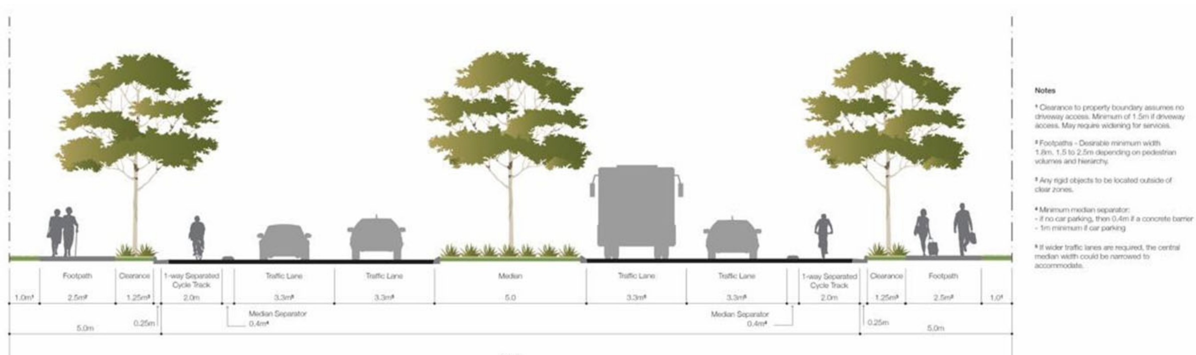


Figure 5-11 Ultimate Four-Lane Trunk Connector (with on-road cycling)

5.4.2 Intersections

A summary of the different staging for the intersections is provided in Table . To minimise the cost of upgrades a maximum of three intersection upgrades has been allowed for at each intersection.

Table 2 Trunk intersection requirements and staging

Asset ID	Design cohort	Control	Intersection legs	Major flow through lanes	Bus provisions
RI001	2026 - 2031	Signalised	4	2	No
	2031 - 2041	Signalised	4	2	No
RI003	2026 - 2031	Signalised	4	4+2 T2	Yes
	2031 - 2041	Signalised	4	4+2 T2	Yes
RI004	2021 - 2026	Signalised	4	2	No
	2031 - 2041	Signalised	4	2	No
RI007	2021 - 2026	Signalised	4	4	No
	2026 - 2031	Signalised	4	4	No
	2031 - 2041	Signalised	4	4	No
RI010	2021 - 2026	Signalised	4	4+2 T2	Yes
	2026 - 2031	Signalised	4	4+2 T2	Yes
RI011	2021 - 2026	Priority	4	2	No
	2026 - 2031	Signalised	4	2	No
	2031 - 2041	Signalised	4	4	No
	2041 - 2066	Signalised	4	4	No
RI012	2021 - 2026	Signalised	4	4	No
	2026 - 2031	Signalised	4	4+2 T2	Yes
	2041 - 2066	Signalised	4	4+2 T2	Yes
RI015	2021 - 2026	Priority	4	2	No
	2026 - 2031	Signalised	4	4	No
	2031 - 2041	Signalised	4	4	No
RI016	2021 - 2026	Signalised	4	2	No
RI017	2026 - 2031	Signalised	3	2	No
	2031 - 2041	Signalised	3	2	No
RI018	2021 - 2026	Priority	3	2	No
	2026 - 2031	Signalised	3	2	No
	2031 - 2041	Signalised	3	4	No
RI019	2021 - 2026	Signalised	4	2	No
	2026 - 2031	Signalised	4	2	No
	2031 - 2041	Signalised	4	2	No
RI023	2021 - 2026	Priority	3	2	No
	2026 - 2031	Signalised	3	2	No
	2031 - 2041	Signalised	3	4	No
RI024	2021 - 2026	Priority	4	2	No
	2026 - 2031	Signalised	4	2	No
	2031 - 2041	Signalised	4	2	No
RI025	2021 - 2026	Priority	4	2	No
	2031 - 2041	Signalised	4	4	No
RI026	2021 - 2026	Signalised	4	2	No
	2031 - 2041	Signalised	4	2	No
RI027	2021 - 2026	Priority	4	2	No
	2031 - 2041	Signalised	4	2	No
RI028	2026 - 2031	Priority	3	2	No
	2041 - 2066	Signalised	3	2	No

RI029	2021 - 2026	Signalised	4	2	No
RI029	2026 - 2031	Signalised	4	2	No
RI029	2031 - 2041	Signalised	4	2	No
RI030	2021 - 2026	Priority	4	2	No
RI030	2031 - 2041	Signalised	4	4	No
RI031	2021 - 2026	Priority	4	2	No
RI031	2031 - 2041	Signalised	4	2+2 T2	Yes
RI031	2041 - 2066	Signalised	4	4+2 T2	Yes
RI032	2021 - 2026	Signalised	3	2	No
RI032	2031 - 2041	Signalised	3	4	No
RI033	2021 - 2026	Priority	4	2	No
RI033	2026 - 2031	Signalised	4	2+2 T2	Yes
RI033	2031 - 2041	Signalised	4	4+2 T2	Yes
RI034	2026 - 2031	Signalised	4	2+2 T2	Yes
RI034	2031 - 2041	Signalised	4	4+2 T2	Yes
RI035	2021 - 2026	Signalised	4	2	No
RI035	2031 - 2041	Signalised	4	4+2 T2	Yes
RI036	2026 - 2031	Priority	3	2	No
RI037	2021 - 2026	Priority	3	2	No
RI037	2031 - 2041	Signalised	3	2	No
RI038	2021 - 2026	Signalised	4	2	No
RI038	2026 - 2031	Signalised	4	2+2 T2	Yes
RI038	2031 - 2041	Signalised	4	4+2 T2	Yes
RI039	2021 - 2026	Priority	4	2	No
RI039	2026 - 2031	Signalised	4	2	No
RI039	2031 - 2041	Signalised	4	4	No
RI040	2021 - 2026	Signalised	4	2	No
RI040	2026 - 2031	Signalised	4	2+2 T2	Yes
RI040	2031 - 2041	Signalised	4	4+2 T2	Yes
RI041	2021 - 2026	Priority	3	2	No
RI041	2031 - 2041	Signalised	3	4	No
RI042	2021 - 2026	Priority	3	2	No
RI042	2026 - 2031	Signalised	3	2+2 T2	Yes
RI043	2026 - 2031	Signalised	3	2	No
RI043	2031 - 2041	Signalised	3	4	No
RI044	2021 - 2026	Signalised		2	No
RI044	2026 - 2031	Signalised	4	2+2 T2	Yes
RI044	2031 - 2041	Signalised	4	4+2 T2	Yes
RI044	2041 - 2066	Signalised	4	4+2 T2	Yes
RI045	2021 - 2026	Roundabout	4	2	No
RI046	2021 - 2026	Roundabout	3	2	No
RI046	2031 - 2041	Roundabout	4	2	No
RI047	2021 - 2026	Roundabout	4	2	No
RI048	2021	Signalised	2	2	No
RI049	2021 - 2026	Signalised	3	2	No
RI050	2031 - 2041	Priority	4	2	No
RI050	2041 - 2066	Signalised	4	4	No
RI051	2026 - 2031	Priority	4	2	No
RI051	2031 - 2041	Signalised	4	4	No
RI052	2031 - 2041	Priority	4	2	No
RI052	2041 - 2066	Signalised	4	4	No

RI053	2031 - 2041	Priority	3	2	No
	2041 - 2066	Signalised	3	4	No
RI054	2031 - 2041	Signalised	3	4	No
RI055	2026 - 2031	Priority	4	2	No
	2031 - 2041	Signalised	4	4	No
RI056	2026 - 2031	Priority	4	2	No
	2031 - 2041	Signalised	4	4	No
RI057	2026 - 2031	Priority	4	2	No
	2031 - 2041	Signalised	4	4	No
RI058	2026 - 2031	Signalised	2	2	No
	2031 - 2041	Signalised	2	4	No

Should development occur out of sequence from what has been modelled (using the latest demographics), this may result in a change in intersection treatment and upgrade horizon.

The proposed trunk transport infrastructure plans (ultimate) are provided in the DCOP mapping. Further information regarding infrastructure staging and non-trunk network outcomes are contained in Appendix D.

5.4.3 Land acquisition

The land acquisition requirements for trunk road infrastructure are derived from the intersection of the natural surface with the embankment slopes in the carriageway, less any existing road corridor areas.

5.5 Active transport

The timing of the active transport network is underpinned by the growth of population, which in turn drives the timing of transport infrastructure.

With the majority of the trunk road network proposed to have cycle tracks on both sides of the road, the following methodology has been applied for when there will be an interim stage before the ultimate road is constructed (typical scenario is a two-lane road that is upgraded to four-lane road). Indicative cross-sections of the staged infrastructure delivery have been provided in Section 5.6.1 below.

The staging of the active transport infrastructure is largely to correspond with the road network. The active transport network planning was undertaken to identify where future infrastructure should go as part of the expansion of the area (i.e., new developments and road upgrades), and did not assess potential deficiencies throughout existing development.

5.5.1 Staged cycle infrastructure cross-sections

Interim Cycle Infrastructure

Road side 1	Road side 2
• 1.5m footpath (minimum) • 3m two-way cycle track on single side of road • 1.5m vegetation clearance	• No infrastructure

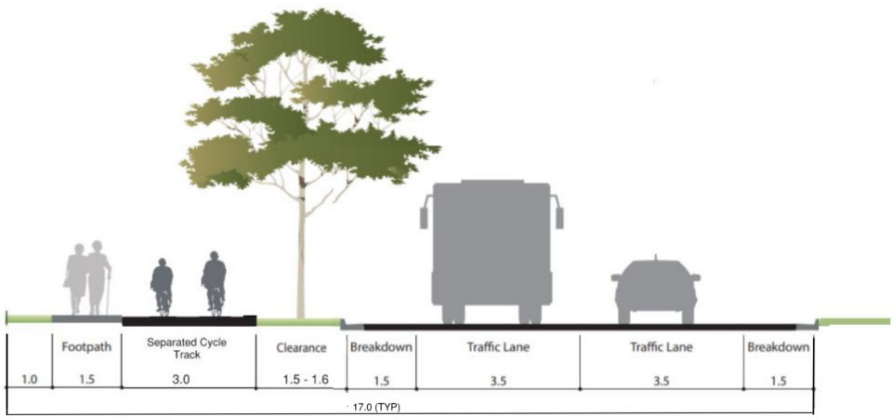


Figure 5-12 Interim staging of active transport infrastructure

Ultimate Cycle Infrastructure

Road side 1	Road side 2
• Interim infrastructure remains • Convert 3m two-way cycle track to 3m one-way cycle track. If a level edge between the footpath and cycle track is used (see Edge Treatment Method below), there may be opportunity to redistribute some of the space for pedestrians, if the pedestrian volumes are substantial (i.e., 2m one-way cycle track and 2.5m footpath).	• 1.5m footpath (minimum) • 2m one-way cycle track • 1.5m vegetation clearance

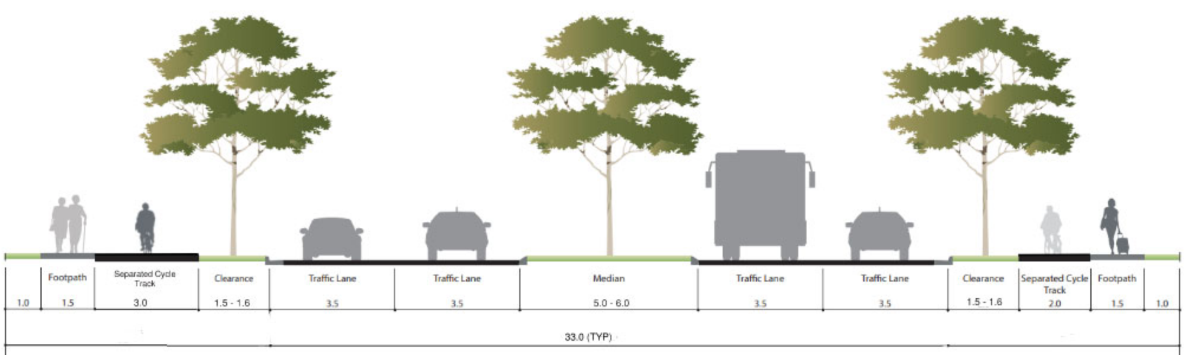


Figure 5-1 Ultimate staging of active transport infrastructure

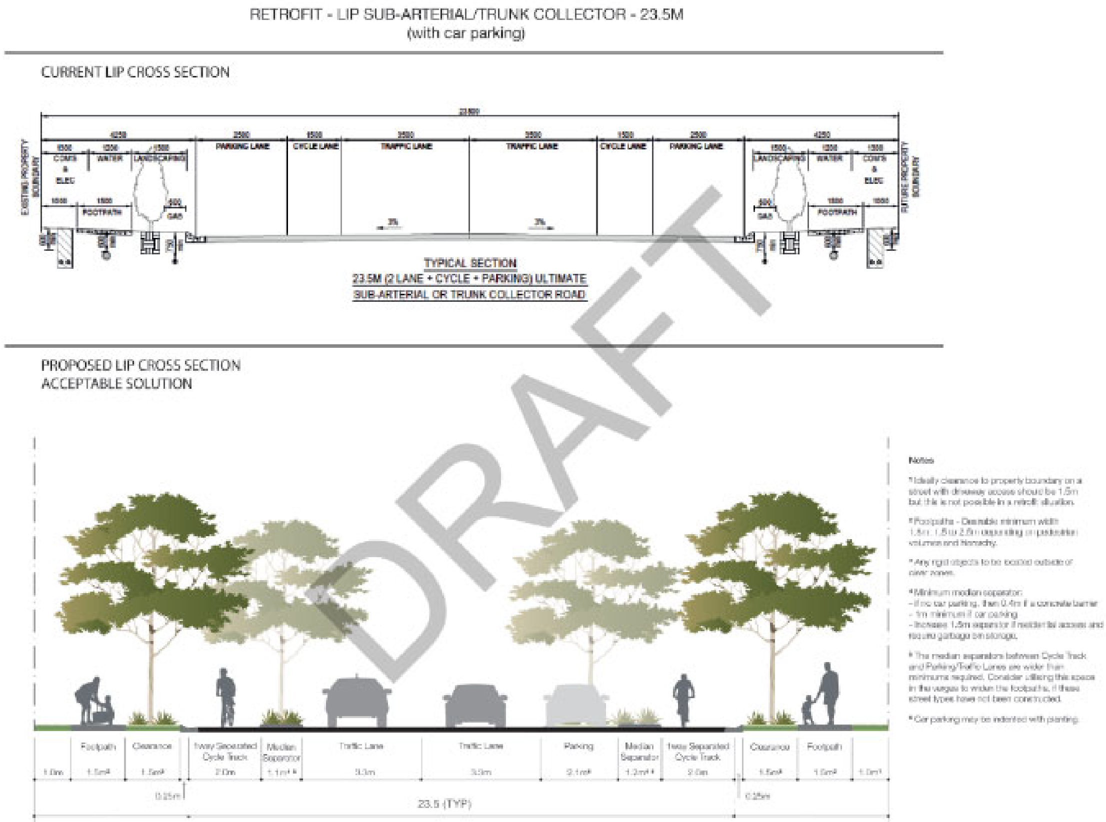


Figure 5-14 Retrofit cycle track with trunk connector

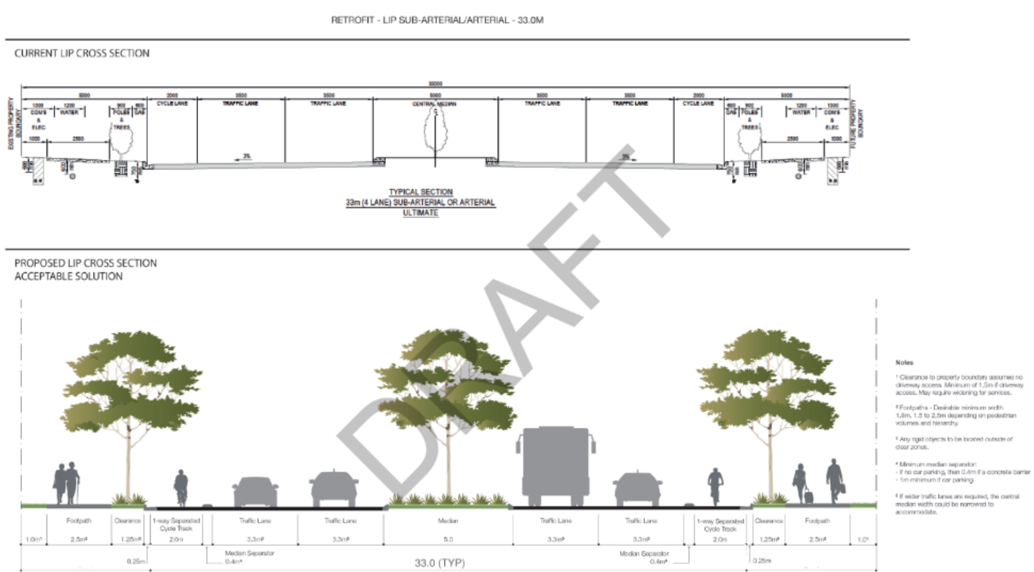


Figure 5-15 Retrofit cycle track with arterial

For shared paths, it is recommended that the interim cycle infrastructure (i.e., road side 1) is built on the side of the road that will form part of the ultimate road cross-section.

While the guideline does indicate a 2m minimum clearance to traffic lanes for higher order roads, a 1.5m clearance was adopted for the above scenarios where cycle tracks are staged. To support this, reference has been made to the Selection and Design of Cycle Tracks Guideline (TMR, October 2019) and the clearance requirements from static objects.

5.6 Parks and open space

The parks and open space infrastructure requirements have been determined based on the projected population growth, with reference to the DCOP DSS. Indicative sequencing of open space has been determined having regard to:

- Population projections and the timing of when population benchmarks are likely to be reached
- A balanced delivery of park typologies and uses in line with the DSS
    - This ratio of delivery is often organically achieved and controlled through the context planning approval process and the construction delivery phasing determined through conditional development approvals
- The projected areas of population density and establishing what catchments within the open space network will be most utilised.
- The surrounding road network, acknowledging that access to the site will need to be provided before parks can be operational. Additionally, areas with topography restrictions and access constraints may trigger earlier, indirect park location sequencing.

Key Corridor Parks have been identified located along both Bundamba and Deebing Creeks and other smaller tributaries and connecting corridors within the PDA. These are inclusive of:

- Riparian areas requiring rehabilitation and revegetation
    - Minor (local) corridors up to 30m (15m each side of waterway/corridor)
    - Major corridors up to 100m (50m each side of waterway/corridor)
- Linear Park areas
    - Minor (local) corridors up to 20m (10m each side of waterway/corridor)
    - Major corridors up to 30m (15m each side of waterway/corridor)

Figure 5-16 shows an environmental corridor cross-section.

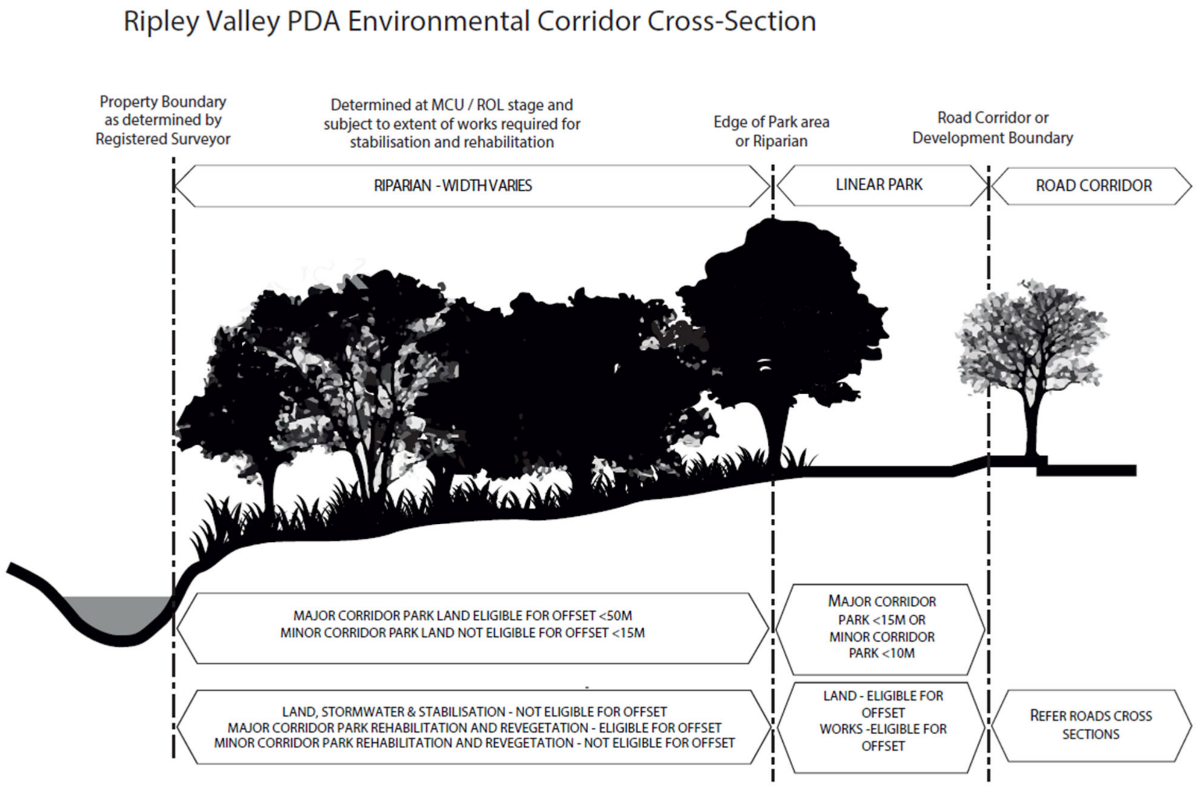


Figure 5-16 Environmental corridor cross section

5.7 Community facilities

The community facilities infrastructure requirements have been determined based on the projected population growth, with reference to the DCOP DSS. Indicative sequencing of community facilities has been determined having regard to:

- Population projections and the timing of when population benchmarks are likely to be reached
- Input from relevant state agencies
- The projected areas of population density and establishing what catchments within the community facilities network will be most utilised.
- The surrounding road network, acknowledging that access to the site will need to be provided before the community facility can be operational. Additionally, areas with topography restrictions and access constraints may trigger earlier, indirect community facility location sequencing.

5.8 Innovation

Innovation analysis was also undertaken as part of the strategic trunk infrastructure review of the existing Infrastructure Charging Offset Plan for the Ripley Valley PDA. Provided in Appendix D is infrastructure innovations that can be applied and aspired to over the developable life of the PDA.

6 Infrastructure valuation methodology

As the Ripley Valley DCOP is a live document currently under implementation, it is necessary to account for existing, partially complete and future DCOP Items. These different cost methodologies are schematically depicted in Figure 1, with detailed descriptions for each approach outlined in the next sections.

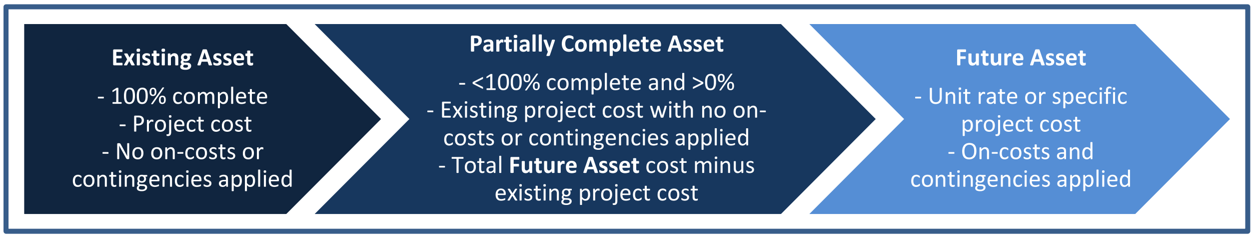


Figure 6-1. Method to determine asset costs

6.1 Existing Assets

Offsets that have been approved by EDQ were identified for any DCOP items that have been provided across the DCOP networks. For DCOP items completed in their entirety, the offset value has been assigned as a "project cost" against that asset, with no on-costs or contingencies applied as the approved offset amount is considered to be inclusive of such costs.

6.2 Future Assets

For DCOP items only partially completed, an approved offset value for the works completed has been identified, and this value has been:

- Included as an existing infrastructure cost; and
- Subtracted from the total establishment cost of the future asset (calculated based on construction of the complete asset).

As with the existing assets above, no on-costs or contingencies are applied to the "project cost" for completed works, however they are applied to the future establishment costs for the asset (refer to Figure 1).

$$\begin{aligned} &Remaining\ Future\ Asset\ Establishment\ Cost \\ &\quad = Total\ Future\ Establishment\ Cost - Value\ of\ offsets\ provided\ to\ date \end{aligned}$$

Future asset costs are calculated using either unit rates or specifically identified project costs and are subject to on-costs and contingencies.

All partially completed and future DCOP assets and their costs have been identified for each infrastructure network within the cost schedules for the presented in Section 4.1 of the DCOP.

As the charging framework and infrastructure policy has changed over time (from LIP to ICOP to DCOP), it is recognised that EDQ has committed to provide offsets for the provision of several infrastructure items that no longer meet the DCOP definition of trunk infrastructure. These items have been included as 'Prior Committed Offsets' and are included as a future expense to the DCOP within the DCOP cost schedules.

All costs included within the DCOP are presented as an Establishment Cost, which is reflective of the costs associated with building the asset for the 'first time', with consideration for any factors affecting construction costs such as terrain or ground conditions or construction method. Figure 2 below outlines the typical cost build-up approach which are presented within the Cost Schedules. Further detail regarding each of the relevant inputs, as well as any cost apportionment and financial considerations have been provided in the following sections of this extrinsic material report.

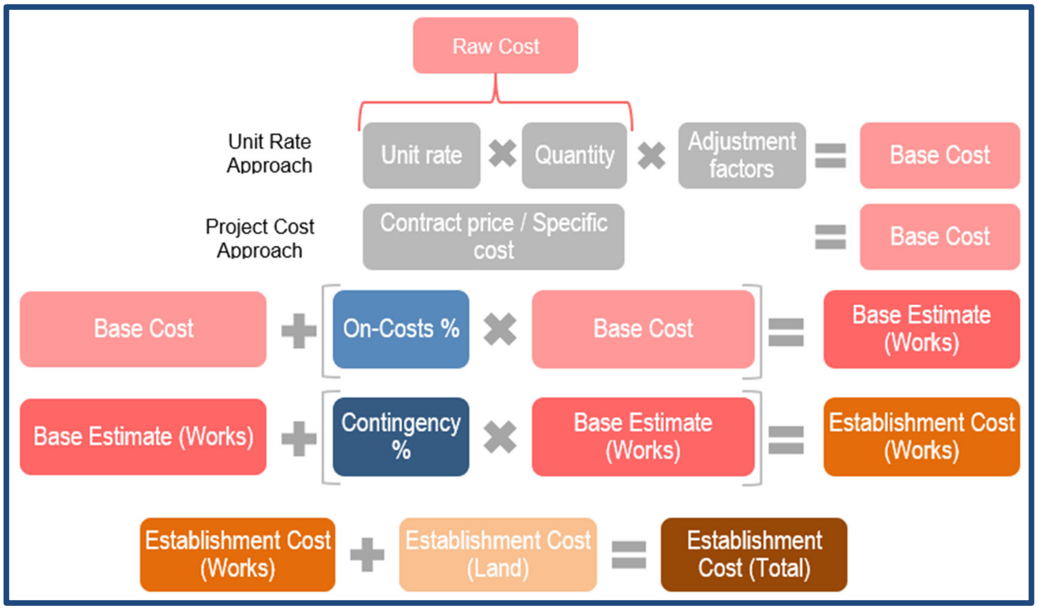


Figure 6-2. Establishment cost build-up

6.3 Determination of Establishment Costs (Works)

6.3.1 Base Costs

As depicted within Figure 2 above, the base costs for DCOP assets have been determined using either unit rates or specific project costs, having consideration for any adjustment factors necessary to reflect the construction method, location or site conditions.

Any works or land not specifically identified within the base cost inclusions outlined for each infrastructure network below are not considered offsetable, unless otherwise determined at the discretion of the MEDQ.

6.3.2 Unit Rate Benchmarking

As part of the DCOP preparation, a unit rate benchmarking assessment was undertaken, based on feedback provided by developers and engineers currently operating within the Ripley Valley PDA. This assessment included review and rationalisation of the responses provided, into a consistent format that could inform unit rates that are more reflective of the current construction costs within the local industry. Specifically, this included:

- For the water supply and sewer networks, identification of main construction cost, typical fittings, manholes, bridging structures and the cost impacts of factors such as rocky soil, trench depth, micro-tunnelling and traffic management
- For the transport network, identification of component costs, allowing specific costs to be estimated for each relevant cross-section type (including non-standard cross sections), in addition to typical costs associated with preliminaries, and the cost impacts of factors such as service relocations and traffic management
- For open space and community facilities networks, identification of embellishment and site preparation component costs, allowing specific costs to be estimated for each relevant park hierarchy, and site preparation costs to be estimated for different community facility types
- For all networks, identification of typical professional fees/on-costs associated with construction

The feedback from the developer group was utilised in addition to previous ICOP unit rates and cost reporting prepared by RLB, to determine median infrastructure construction costs for the DCOP unit rates. Network specific costs and inclusions are outlined in more detail below.

6.3.3 Water Supply and Sewerage

Base costs for all municipal water supply mains, sewer mains, and sewer manholes included within the DCOP have been based on unit rates, selected as the ***median*** rate from the following sources:

- ICOP unit rates, indexed to July 2021 using the ABS PPI (RBC) index
- Developer unit rates, provided as part of the unit rate benchmarking assessment
- RLB unit rates, as identified within Opinion of Cost assessment and detailed cost breakdowns

These rates are outlined in Tables 6.3.3.1, 6.3.3.2 and 6.3.3.3 below and presented in July 2022 dollars. All SRIP infrastructure has used a 'project cost', which is inclusive of all on-costs, contingencies and adjustment factors.

Table 6.3.3.1 Water Supply Main Unit Rates

Water Supply	
Diameter	**Rate $/m**
225	$370.16
250	$395.87
300	$448.48
315	$448.48
375	$730.04
450	$1,001.96
525	$1,094.57
600	$1,133.86
675	$1,314.17

Notes:
- *All costs are presented in July 2022 dollars*
- *Pipe diameters identify the minimum internal diameter*
- *Includes allowance for valves/fittings*

Table 6.3.3.2 Sewerage Main Unit Rates

Sewerage		
Diameter	**Asset Type**	**Rate $/m**
250	Gravity Main	$567.21
300	Gravity Main	$567.21
315	Gravity Main	$567.21
355	Gravity Main	$595.38
375	Gravity Main	$595.38
400	Gravity Main	$634.44
450	Gravity Main	$800.78
500	Gravity Main	$786.92
525	Gravity Main	$917.18
560	Gravity Main	$1,020.59
600	Gravity Main	$1,052.39
675	Gravity Main	$1,508.28
700	Gravity Main	$1,555.20

Note:
- *All costs are presented in July 2022 dollars*
- *Pipe diameters identify the minimum internal diameter*
- *Assumes average depth of 1.5m to 3.0m*

Table 6.3.3.3 Sewerage Manhole Allowance

Sewerage			Note
Diameter	Asset Type	Rate $/m	
1050	Sewer Manhole	$156.93	Applied to GM up to and including 600mm dia
1200	Sewer Manhole	$275.91	Applied to GM over 600mm dia

Notes:
• *All costs are presented in July 2022 dollars*
• *Assumes 1 manhole every 75m*

Project Costs have been based on the opinion of cost reporting prepared by RLB. These have been applied to the following asset types:

- Pressure reduction valves
- Water pump stations; and
- Water reservoirs

Adjustment factors are applied to assets where additional costs are anticipated due to known site characteristics, soil/terrain types or construction method factors. For example, a 1.4 terrain factor has been applied to sewer gravity mains for possible trenching in rock or unsuitable material. The applicable adjustment factors employed within the cost build-up for the Water Supply and Sewerage network are presented in Table 6.3.3.4.

Table 6.3.3.4 Water Supply and Sewerage Adjustment Factors

Network	Asset Type	Application / Reason	Adjustment Factor
Water Supply	Water Main	PDA-wide – Rocky Soil	1.25
Water Supply	Water Main	Ripley Road – Traffic management	1.225
Water Supply	Water Main	PDA-wide – Micro-Tunnelling	5.00
Sewerage	Gravity Main	PDA-wide – Soil/Terrain	1.40
Sewerage	Gravity Main	Ripley Road – Traffic management	1.225
Sewerage	Gravity Main	PDA-wide – Micro-Tunnelling	5.00
Sewerage	Rising Main	PDA-wide – Soil/Terrain	1.25

A number of sewer bridges have been identified to traverse larger watercourses throughout the Ripley Valley. A Nominal value of $100,000 (in July 2022 dollars) has been identified as an extra cost in addition to the determined sewer main values. This is to account for the bridging abutments and an additional allowance for geotechnical costs over and above the typical on-cost allowance.

Sub-regional Infrastructure Costs have been determined by EDQ Engineers in consultation with Queensland Urban Utilities. These costs and network outcomes are subject to further refinement as the Water and Sewerage Strategy for the wider region is progressed.

6.3.4 Transport and Pathways

Base costs for transport infrastructure have been determined using unit rates and specific project costs.

Unit rates for roads have been created using a nominal Bill of Quantity assessment for each cross-section type. Where alternative (non-standard) cross sections are known to be required, these have been identified so that an adjusted unit rate value could be determined.

The cost of each cross-section component is based on the median of the following:

- ICOP background reporting (Cost Build Ups, Variations and Infrastructure Planning Assumptions – Ripley Valley PDA LIP & SRIP – Final draft, 14 May 2018, Cardno), indexed to July 2021 using the ABS PPI (RBC) index

- Developer unit rates, provided as part of a unit rate benchmarking assessment
- RLB unit rates, as identified within background data to the Opinion of Cost assessment

The road unit rates are inclusive of the following:

- Typical cross-sections as identified within Section 5.5.1 and Appendix B
- Non-standard cross-sections area identified within Appendix B
- 2m cut/fill balance across the corridor cross section for each road type
- Allowance for Bus stop bays (excluding Translink shelter infrastructure)

Off-road Pathway unit rates are based on those provided within the RLB Opinion of Cost assessment, which closely algin to the developer unit rate feedback for the road construction costs. These are based on the delivery of the pathway construction only, as it is assumed to be located within an existing road reserve or linear park. Allowances for minor earthworks, drainage, pathway furniture and surface marking are included within the linear park valuation (see Appendix C).

Pathway bridges have been specifically identified where crossing major waterways.

Intersection costs are provided as specific costs for each DCOP item, as identified within the RLB Opinion of Cost assessment. Where intersections have been identified in addition to those in the RLB Opinion of Costs assessment, EDQ have applied costs based on similar intersection arrangements assessed by RLB.

Table 6.3.4.1 Road Unit Rates

Roads			
Code	**Cross-section Type**	**Description**	**Rate $/m**
2Li	Standard	Interim 2 lane + cycle	$3,899.73
2Li (upg)	Non-Standard 1	Interim 2 lane + cycle (upgrade existing)	$2,678.93
2Li (upg)	Non-Standard 2	Interim 2 lane + cycle (upgrade existing)	$2,678.93
2Li (upg)	Non-Standard 3	Interim 2 lane + cycle (upgrade existing)	$2,678.93
2Lu	Standard	Ultimate 2 lane with parking + cycle	$4,882.81
2Lu	Non-Standard 1	Ultimate 2 lane with parking + cycle	$4,176.32
2Lu	Non-Standard 2	Ultimate 2 lane with parking + cycle	$4,176.81
2Lu	Non-Standard 3	Ultimate 2 lane with parking + cycle	$3,947.71
2Lu	Non-Standard 4	Ultimate 2 lane with parking + cycle	$4,023.91
2Lu (upg)	Non-Standard 1	Ultimate 2 lane with parking + cycle (upgrade existing)	$3,155.21
2LBi	Standard	Interim 2 lane + bus (or parking/cycle)	$5,000.19
2LBi (upg)	Non-Standard 1	Interim 2 lane + bus (or parking/cycle) (upgrade existing)	$3,979.08
2LBi (upg)	Non-Standard 2	Interim 2 lane + bus (or parking/cycle) (upgrade existing)	$3,979.08
2LBi (upg)	Non-Standard 3	Interim 2 lane + bus (or parking/cycle) (upgrade existing)	$3,979.08
2LBi (upg)	Non-Standard 4	Interim 2 lane + bus (or parking/cycle) (upgrade existing)	$3,979.08
2LO	Standard	2 lane + cycle	$4,067.07
4Lu	Standard	Ultimate 4 lane + cycle with median	$7,169.86
4LBu	Standard	Ultimate 4 lane + bus + cycle with median	$8,795.21
4LBu	Non-Standard 1	Ultimate 4 lane + bus + cycle with median	$7,982.53
4LBu	Non-Standard 2	Ultimate 4 lane + bus + cycle with median	$8,554.94
4LBu	Non-Standard 3	Ultimate 4 lane + bus + cycle with median	$8,947.62
4LBu	Non-Standard 4	Ultimate 4 lane + bus + cycle with median	$8,795.21
6Lu	Standard	Ultimate 6 lane + cycle with median	$8,554.94
CW	Standard	Cycleway upgrade	$1,808.32

Notes:
• *All costs are presented in July 2022 dollars*

• *Unit rates for ‘upgrades’ identify the ultimate cross-section cost (i.e., inclusive of the cost of any interim works).*
• *Includes 2m cut/fill balance across road corridor*
• *Includes allowance for bus stop infrastructure*
• *Excludes temporary/sacrificial works for interim infrastructure*
• *All cross-section details are summarised in Appendix B*

Table 6.3.4.2 Intersection Project Costs

Intersections		
DCOP ID	Intersection Type	Base Cost
RI001A	Signalised	$783,921
RI001B	Signalised	$133,310
RI003A	Signalised	$879,958
RI003B	Signalised	$90,690
RI004A	Signalised	$1,109,047
RI004B	Signalised	$216,236
RI007A	Signalised	$1,139,277
RI007B	Signalised	$115,779
RI007C	Signalised	$629,790
RI010A	Signalised	$595,139
RI010B	Signalised	$937,127
RI011A	Priority Controlled	$77,117
RI011B	Signalised	$787,315
RI011C	Signalised	$1,451,036
RI011D	Signalised	$57,067
RI012A	Signalised	$1,340,810
RI012B	Signalised	$300,346
RI012C	Signalised	$15,423
RI015A	Priority Controlled	$624,752
RI015B	Signalised	$878,416
RI015C	Signalised	$392,989
RI016A	Signalised	$937,744
RI017A	Signalised	$532,005
RI017B	Signalised	$272,069
RI018A	Priority Controlled	$90,690
RI018B	Signalised	$491,699
RI018C	Signalised	$272,069
RI019A	Signalised	$90,690
RI019B	Signalised	$1,064,628
RI019C	Signalised	$1,029,977
RI023A	Priority Controlled	$60,460
RI023B	Signalised	$431,239

Intersections		
DCOP ID	Intersection Type	Base Cost
RI032B	Signalised	$30,230
RI033A	Priority Controlled	$120,920
RI033B	Signalised	$716,058
RI033C	Signalised	$43,391
RI034A	Signalised	$758,627
RI034B	Signalised	$80,613
RI035A	Signalised	$595,139
RI035B	Signalised	$141,073
RI036A	Priority Controlled	$122,154
RI037A	Priority Controlled	$60,460
RI037B	Signalised	$431,239
RI038A	Signalised	$746,288
RI038B	Signalised	$362,759
RI038C	Signalised	$503,832
RI039A	Priority Controlled	$60,460
RI039B	Signalised	$723,770
RI039C	Signalised	$9,254
RI040A	Signalised	$655,599
RI040B	Signalised	$60,460
RI040C	Signalised	$151,150
RI041A	Priority Controlled	$60,460
RI041B	Signalised	$503,729
RI042A	Priority Controlled	$60,460
RI042B	Signalised	$401,009
RI043A	Signalised	$431,239
RI043B	Signalised	$107,347
RI044A	Signalised	$716,058
RI044B	Signalised	$140,250
RI044C	Signalised	$80,613
RI044D	Signalised	$92,952
RI045A	Roundabout	$298,186
RI046A	Roundabout	$992,241

RI023C	Signalised	$186,007
RI024A	Priority Controlled	$120,920
RI024B	Signalised	$665,675
RI024C	Signalised	$70,536
RI025A	Priority Controlled	$120,920
RI025B	Signalised	$856,309
RI026A	Signalised	$581,463
RI026B	Signalised	$130,996
RI027A	Priority Controlled	$60,460
RI027B	Signalised	$595,139
RI028A	Priority Controlled	$98,093
RI028B	Signalised	$401,009
RI029A	Priority Controlled	$60,460
RI029B	Signalised	$645,522
RI029C	Signalised	$20,873
RI030A	Priority Controlled	$120,920
RI030B	Signalised	$595,139
RI031A	Priority Controlled	$151,150
RI031B	Signalised	$619,096
RI031C	Signalised	$33,315
RI032A	Signalised	$461,469

RI046B	Roundabout	$462,703
RI047A	Roundabout	$298,186
RI048	Signalised	$260,268
RI049	Signalised	$461,469
RI050A	Priority Controlled	$120,920
RI050B	Signalised	$595,139
RI051A	Priority Controlled	$120,920
RI051B	Signalised	$595,139
RI052A	Priority Controlled	$120,920
RI052B	Signalised	$595,139
RI053A	Priority Controlled	$120,920
RI053B	Signalised	$595,139
RI054	Signalised	$595,139
RI055A	Priority Controlled	$120,920
RI055B	Signalised	$595,139
RI056A	Priority Controlled	$120,920
RI056B	Signalised	$595,139
RI057A	Priority Controlled	$120,920
RI057B	Signalised	$595,139
RI058A	Signalised - Pedestrian Crossing	$200,230
RI058B	Signalised - Pedestrian Crossing	$200,230

Notes:
• All costs are presented in July 2022 dollars
• Base costs identified prior to the application of on-costs and contingencies

Table 6.3.4.3 Pathway Unit Rates

Pathways		
Description	**Typical Width**	**Rate $/m²**
Shared Path	2.5m – 4.0m	$92.54
Separate Cycle Path and Footpath	5.0m	$92.54
On-Road Cycle Lanes / Shared Path	4.0m	$128.53
Shared Path Bridge	6.0m	$856.86

Notes:
• All costs are presented in July 2022 dollars
• Base costs identified prior to the application of on-costs and contingencies

Unit rates for bridges is based on the median of the following:

- ICOP background reporting (Cost Build Ups, Variations and Infrastructure Planning Assumptions – Ripley Valley PDA LIP & SRIP – Final draft, 14 May 2018, Cardno)
- Developer unit rates, provided as part of a unit rate benchmarking assessment
- RLB unit rates, as identified within background data to the Opinion of Cost assessment

Table 6.3.4.4 Bridges and Culvert Unit Rates

Road Bridges and Culverts		
Asset Type	**Rate**	**Unit of Measure**
Bridge	$4,524.21	Per m² of Deck Area
Culvert	$2,459.56	Per m² of Deck Area

Notes:
• *All costs are presented in July 2022 dollars*
• *Base costs identified prior to the application of on-costs and contingencies*

Adjustment factors are applied to assets where additional costs are anticipated due to known site characteristics, soil/terrain types or construction method factors. For example, a 1.1 factor for more substantial traffic management requirements (e.g., side tracks) has been applied to roadworks along Ripley Road. The applicable adjustment factors employed within the cost build-up for the transport network are presented in Table 6.3.4.5.

Table 6.3.4.5 Transport Network Adjustment Factors

Network	Asset Type	Application / Reason	Adjustment Factor
Transport	Roads	Ripley Rd (north of Centenary Hwy) / Service Relocation Allowance	1.2
	Intersections	Swanbank Road Intersection / Service Relocation Allowance	1.2
Transport	Roads	Ripley Rd / Additional Traffic Management Allowance	1.1
	Intersections	Swanbank Road Intersection / Additional Traffic Management Allowance	1.1

6.3.5 Parks and Open Space and Local Community Facilities

Base costs for the embellishment of land for parks and community facilities have been created on a first principles basis, incorporating the required level of embellishment for a standard size park identified within EDQ Guideline 12, and the median of:

- Developer unit rates for embellishment items and park works, provided as part of a unit rate benchmarking assessment
- Indicative embellishment item costs identified within the RLB Opinion of Cost assessment (where available); and
- Where no other sources were available, nominal amounts as agreed by EDQ

Base Costs associated with local and major linear parks have been determined from this same benchmarking exercise, with the proposed works and embellishments based on the cross-section provided in Figure 5-16.

Base Costs associated environmental areas allow for basic revegetation and rehabilitation of the riparian area. All other works associated with the provision of the greenspace network are not included within the DCOP, such as:

- Stormwater management
- Bank stabilisation; or
- Any earthworks requirements.

For local community facilities, the included scope of works in the base costs includes:

- Clearing and grubbing
- Bulk earthworks (one metre cut to fill allowance) and grassing suitable for the site purposes

- Service connections including potable water, sewerage, telephony, broadband, stormwater, and electricity
- Service connection to non-potable water, if adjacent to a supply system
- Half construction of a Neighbourhood Access Road cross section, along a single frontage, including a 2.5m wide pathway. The maximum frontage length allowed for in the cost build up are as follows:
  - Community facility (local) – 125m per hectare of land provided
  - Community facility (district) – 83m per hectare of land provided
  - Community facility (citywide) – 67m per hectare of land provided

A combined 12-month maintenance and establishment period is included for all parks and open space.

A summary schedule of inclusions for parks and community facilities has been provided in Appendix C.

All costs for parks and community facilities have been converted to a 'per m²' rate for inclusion in the DCOP, identified in Table 6.3.5.1.

Table 6.3.5.1 Parks and Local Community Facility Embellishment Unit Rates

Parks and Community Facilities Embellishments		
Asset Type	**Size Range**	**Rate $/m²**
Neighbourhood Recreation Park	≥ 0.5 ha	$119.93
Neighbourhood Recreation Park	≥ 1ha	$73.22
District Recreation Park	All sizes	$42.78
Major Recreation Park	All sizes	$39.45
Regional Recreation Park	All sizes	$48.39
City Park / Town Square	All sizes	$119.95
District Sports Ground	All sizes	$87.03
Regional Sports Ground	All sizes	$82.70
Local Linear Park*	Max 20m wide	$29.63
Major Linear Park*	Max 30m wide	$23.56
Linear Park – Rehabilitation*	Max 50m wide	$5.14
Local Community Facility - Local	All sizes	$52.99
Local Community Facility - District	All sizes	$35.42
Local Community Facility - Citywide	All sizes	$30.23

Note: All costs are presented in July 2022 dollars
** Local Linear Park embellishments limited to a maximum width of 20m (valued on the provision of a pathway on each side of the corridor/waterway).*
** Major Linear Park embellishments limited to a maximum width of 30m (valued on the provision of a pathway on each side of the corridor/waterway).*
** Except where specifically identified, Environmental Areas associated with Major Linear Parks limited to a maximum width of 100m (up to 50m each side of the corridor/waterway).*

6.3.6 State Government Facilities and Other Provisions

Base costs for the preparation of land for state community facilities have been created on a first principles basis, based on the required works for the standard land area identified within background planning, assuming a regular shaped block, and the median of:

- Developer unit rates for all site preparation works, provided as part of a unit rate benchmarking assessment
- Indicative site preparation works costs identified within the RLB Opinion of Cost assessment (where available)

This cost has been converted to a 'per hectare' rate for inclusion in the DCOP.

The included scope of works in the base costs includes:

- Clearing and grubbing
- Bulk earthworks (one metre cut to fill allowance) and grassing suitable for the site purposes
- Service connections including potable water, sewerage, telephony, broadband, stormwater, and electricity
- Service connection to non-potable water, if adjacent to a supply system
- Half construction of a Neighbourhood Access Road cross section, along a single frontage, including a 2.5m wide pathway. The maximum frontage length allowed for in the cost build up are as follows:
    - Community facility (state) – 100m per hectare of land provided
    - Community facility (primary school) – 300m per school site
    - Community facility (secondary school) – 300m per school site

Additionally, the scope of works for school sites also includes:

- Provision of up to 2 bus bays
- Safety fencing in the road reserve, if required up to a length of 300m

A detailed schedule of inclusions has been provided in Appendix C.

Table 6.3.6.1 State Government Facilities Site Works Unit Rates

State Government Facility Embellishment Cost	
Asset Type	**Rate $/m²**
Ambulance Station	$40.62
Fire & Rescue Station	$40.62
Police Station	$40.62
Health Care Centre	$40.62
Health Precinct	$40.62
State Primary School	$27.69
State Secondary School	$22.00

Note: All costs are presented in July 2022 dollars

Table 6.3.6.2 Other Provisions Costs

The public transport operations allowance is a cost that has been identified to enable initial public transport services, until such time as fees from increased patronage become sufficient to continue operating.

Description	Cost
Public Transport Operations Allowance	$7,081,410

Note: All costs are presented in July 2022 dollars

6.4 Determination of Establishment Costs (Land)

6.4.1 Allowances for Land Valuation Costs

Base costs for land have been determined using the land costs defined in the *Taylor Byrne Land Value Estimates – Greenfield Sites (2011)* for various flood immunity levels (i.e., land locations).

The land categorisation for each DCOP item is to be applied as follows:

- Based on the pre-development flood immunity for any land dedication for DCOP Infrastructure
- For parks and open space, including linear parks, the maximum rate to be applied is typically the *'Greater than Q20 & less than Q100'* pre-development flood immunity
    - In specific instances, where identified in the DCOP schedule of works and at the sole discretion of MEDQ, the 'greater than Q100 (at current market rate)' value may be applied. This has been applied in locations where land was not previously identified (new network planning requirements)
- For State community facilities
    - The DCOP schedule of works identifies the maximum rate to be applied and funded through the DCOP is the 'Greater than Q100' pre-development flood immunity
- For State community facilities identified as 'additional' within the DCOP mapping and Schedule of Works (i.e., those facilities in excess of the facilities identified in the Ripley Valley Infrastructure Charging Offset Plan, June 2020, or where relocated to a different landholding)
    - The relevant State agency may enter a commercial agreement with the land-owner to acquire the 'additional' land (including relocated sites as identified above)
    - Where the agreement results in a land value exceeding the DCOP value, the relevant State agency is responsible for funding through normal budgetary processes, providing any difference in value to the land-owner through the agreement.

Table 6.4.1.1 Land valuation allowances

Land Location	Rate $/m²	Rate $/ha
Less than Q20	$2.43	$24,317
Greater than Q20 & less than Q100	$4.26	$42,556
Greater than Q100	$30.40	$303,966
Greater than Q100 (at current market rate)	$100.00	$1,000,000

Note: All costs are presented in July 2022 dollars

6.5 On-Costs

On-costs are applied to the base costs for infrastructure in order to properly account for the project owner's costs such as project management, contract supervision, survey and design fees. The on-costs are applied as a percentage against the works base costs determined for each DCOP item and have been identified by EDQ on the basis of previous infrastructure delivery costs within the PDA. On-costs are not applied to the following:

- Existing DCOP asset costs (i.e., previously committed/provided offsets)
- DCOP items included under the category 'Other Provisions'; or
- Land costs

Table 6.5.1 Application of on-costs across all DCOP networks

On-cost percentages applied				
Water Supply and Sewerage	**Transport and Paths**	**Parks and Community Facilities**	**State Government Facilities**	**Other Provisions**
15%	15%	15%	15%	n/a

6.6 Contingencies

To account for any potential cost increases to DCOP infrastructure resulting from future unknowns, such as asset location / extent, design, construction method, etc, the DCOP has applied contingencies to all future assets. The procedure used for calculating the contingency amount is on a percentage basis, applied against the base estimate (works) (refer to figure 6-2 in section 6.2 above).

Table 6.6.1 presents the contingency percentages that have been applied to infrastructure in the current DCOP. Contingencies do not apply to the following:

- Existing DCOP asset costs, including partial infrastructure items (i.e., previously committed/provided offsets)
- DCOP items included under the category 'Other Provisions'; or
- Land costs

Table 6.6.1 Application of Contingencies – All DCOP networks

Contingency percentage used				
Water Supply and Sewerage	**Roads and Intersections**	**Other Transport and Paths**	**State Government Facilities**	**Parks and Community Facilities**
20%	15%	20%	10%	10%

7 DCOP Infrastructure

Table 7.1 identifies the criteria that was used in identifying DCOP infrastructure. This table should be read in conjunction with the remainder of the IPBR document to determine:

- Scope of planned infrastructure (i.e., Infrastructure Planning, IPBR section 5)
- Scope of inclusions in infrastructure delivery cost (i.e., Infrastructure Valuation methodologies, IPBR section 6); and
- Trunk infrastructure items (i.e., DCOP Infrastructure, Table 8.1)

DCOP infrastructure is identified at the discretion of MEDQ, and in addition to the criteria below, consideration may also be given to the overall network function to deliver a coherent, contiguous network. This may include alternative and innovative infrastructure solutions that provide an equivalent level of service at a lower cost to the community (e.g., efficient staging of works, or alternative design/alignment).

Table 7.1 DCOP Infrastructure Criteria

Network	Asset Type	Infrastructure Criteria
Water Supply	Water Main	• Mains with 225mm internal diameter and greater • Mains with an internal diameter less than 225mm, where providing a critical link/loop function to ensure the function and continuity of the wider DCOP network and depicted in the DCOP mapping.
	Pump Station	• All pump stations identified in the DCOP mapping
	Reservoirs	• All reservoirs identified in the DCOP mapping
Sewerage	Gravity main	• Gravity mains with 300mm internal diameter and greater • Mains with an internal diameter less than 300mm, where providing a critical link/loop function to ensure the function and continuity of the wider DCOP network and depicted in the DCOP mapping.
	Rising main	• All rising mains associated with DCOP pump stations
	Pump station	• All pump stations identified in the DCOP mapping
Transport	Roads	• Arterial and connector roads with cross-sections consistent with those in section 5.4.1 of this document where also identified within the transport model as carrying greater than 7,500 vehicle trips per day

	Intersection	• Signalised intersections (at ultimate) where two or more DCOP roads intersect
		• Roundabout intersections (at ultimate) where two or more DCOP roads intersect
		• Signalised intersections (at ultimate) where a DCOP road intersects with a non-DCOP road (as qualified above), and where the following applies:
		  ○ Signalised intersections exceeding a Degree of Saturation (DOS) of 0.9 in the ultimate; and
		  ○ Provides for a rationalised access (e.g., service road) to the trunk road network; and
		  ○ Does not provide direct access from a development premises or private property (i.e., front gate works).

Network	Asset Type	Infrastructure Criteria
	Bridge	• Bridges located on DCOP roads (as qualified above)
	Culverts	• Culverts located on DCOP roads (as qualified above)
	Off-road pathway	• Pathways, between 2.5-5.0m wide, and Shared Path Bridges servicing the PDA, where depicted in the DCOP mapping
Parks	Recreation Park	• Neighbourhood recreation parks • District recreation parks • Major recreation parks
	Sports Park	• District sports parks • Major sports parks
	Linear Park	• Linear parks lo depicted in the DCOP mapping (note: this excludes biodiversity and revegetation areas)
	Special Function Parks	• Regional Park and Garden • Town Centre Plaza
Community Facilities	Land and basic site works for Local community facilities	• Sites identified in the DCOP mapping for: ○ Local ○ District ○ Citywide
	Land and basic site works for State community facility	• Sites identified in the DCOP mapping for: ○ Ambulance facilities ○ Fire & rescue facilities ○ Police facilities ○ Health facilities ○ Primary schools ○ Secondary schools ○ Rail corridors
Implementation	Implementation Works	• Implementation works

8 Financial modelling inputs and assumptions

8.1 Indexation and Escalation of Costs

There are a number of price adjustments applied within the cost modelling to ensure the costs presented in the cost schedules are reflective of values. As several costs have been sourced from data prepared prior to July 2020, these have been indexed to bring into alignment with the base year (i.e., July 2020). Table 8.1.1 identifies the price adjustments applied to the various cost elements in the modelling and the basis for their calculation. Increases in all costs, unit rates, and charges between the modelled base year and the current financial year for presentation within the DCOP and IPBR have been made in accordance with the DCOP indexation methodology.

Table 8.1.1 Cost Alignment Assumptions – Existing Values

Application	Basis for calculation
Alignment of Land and Works Costs	PPI Index (RBC, Queensland) smoothed based on the 3-yearly moving average quarterly percentage change between financial quarters. Indexed from the date of valuation to the July 2020 quarter.

As part of the discounted cashflow methodology for the charge calculation, it is necessary to identify the following financial assumptions:

- Future escalation of land and works
- Future inflation of levied charge rates
- Weighted Average Cost of Capital (WACC)

These assumptions have been identified in Table 8.1.2

Table 8.1.2 Financial Input Assumptions – Future Expenditures and Revenues

Application	Rate per annum	Basis for calculation
Escalation of Works Costs	1.74%	10-year average of PPI (RBC, Queensland), as at July 2020
Escalation of Land Costs	1.74%	10-year average of PPI (RBC, Queensland), as at July 2020
Inflation of Levied Charge	1.74%	10-year average of PPI (RBC, Queensland), as at July 2020
Weighted Average Cost of Capital (Nominal)	3.31%	A risk free rate of 1.81%, based on the QTC 10-year 20-day Average Bond Rate (as at 30 June 2020), plus a risk margin of 1.5%
Weighted Average Cost of Capital (Real)	1.54%	Based on the Nominal WACC rate, adjusted for inflation using the Fisher Equation

8.2 Delivery Timing for Financial Model

The modelled timing of infrastructure was adjusted for financial modelling purposes based on a consistent methodology to appropriately reflect a more likely and realistic expenditure profile. Key issues that have made this approach necessary are:

- Engineering assessment of timing identifies a trigger point, while the delivery of relevant infrastructure may occur over a longer period of years
- The engineering assessment of timing is considered optimistic, and in some cases inefficient from a

delivery perspective. This would require a substantial increase in development activity from what has been observed at the time of DCOP preparation on several development fronts, and results in a forward-focussed delivery profile, which is not currently reflected in the projected demands.

- Under the discounted cashflow and user pays methodology (discussed in section 8.3) modelling a realistic expenditure profile is necessary to ensure the resultant charge rate is appropriate. Delivery profiles which assume a higher rate of expenditure in the forward years results in higher charge rates under this approach due to the increased funding risks.

The adjustments to infrastructure timing for financial modelling are identified in Table 8.2.1 below.

Table 8.2.1 Timing for Financial Modelling

Delivery Cohort	Adjustment Applied	Notes
2021-2026 *Under construction*	No change	Assets known to be under construction. No change required.
2021-2026 *All others*	Expenditure assumed over approximately twice the identified timeframe	Identified expenditure, annualised, was approximately double that currently being delivered. It is not considered likely that all of the identified infrastructure could be delivered within the 5-year timeframe.
2027-2031	Expenditure distributed equally over the 2027 – 2066 timeframe	Identified expenditure was heavily weighted over the first 20 years, with minimal expenditure in the last 20. It is expected that expenditures are more likely to show alignment to the modelled demands, and therefore will be more evenly distributed across this period.
2032-2041		
2042-2066		
2021-2066		

8.3 Charge Method Approach

The current modelling approach employs a discounted cashflow and the user pays method for calculation of the charge for DCOP Infrastructure items. This approach ensures that all infrastructure investment is recovered across all users, regardless of where within development horizon they arrive. This approach is represented in the following formula.

$$User\ Pays = \frac{Existing\ Infrastructure\ Cost\ +\ NPV\ (Nominal)\ of\ Future\ Infrastructure\ Cost}{Existing\ Infrastructure\ Demand\ +\ NPV\ (Real)\ of\ Future\ Infrastructure\ Demand}$$

Table 7.2.1 Charge Method

DCOP Network	Cost apportionment basis
Water and Sewer	User pays
Transport and Paths	User pays
Stormwater	User pays
Parks and community facilities	User pays
State Government Facilities and Other Provisions	User pays

8.3.1 Municipal charge - catalyst component

To facilitate development within the PDA, EDQ has brought forward the funding for key items of infrastructure through a loan facility, which must be repaid over a shorter horizon than the projected ultimate DCOP development (i.e., before all of the revenues have been received). To facilitate the repayment of this loan, a catalyst charge has been separated from the remainder of the municipal charges. The catalyst charge is based on the necessary repayments to the loan facility, and is comprised of the following:

- A ‘bring forward’ premium, being the additional cost associated with the delivery mechanism (loan facility) as opposed to a business-as-usual approach (through development conditions, charges, and offsets over the life of the plan); plus
- A quarantined portion of the total calculated balance municipal charge, to make up the required loan repayment amount.

Once the catalyst loan facility has been repaid in full, the quarantined component of the charge will return to the balance municipal charge, and the premium associated with bringing the infrastructure forward will no longer apply. In practical terms, this means that:

- The catalyst charge will no longer apply
- The balance municipal charge will increase by the amount that is currently quarantined for the purposes of the catalyst charge

The quarantined value currently comprises approximately 96% of the catalyst charge, however this amount may vary over time depending on the rate of development, as this will have a direct impact on the rate at which the loan facility is able to be repaid.

9 Infrastructure cost summaries

Summaries of infrastructure costs for each network servicing the Ripley Valley PDA are detailed below in Tables 19 and 20. Detailed schedules of DCOP infrastructure are provided within the DCOP document and mapping (section/s)

Table 19 Municipal Infrastructure Schedule of Works costs

Infrastructure	Existing ($)	2026 ($)	2031 ($)	2041 ($)	2066 ($)	Total ($)
Water supply	$4,281,851	$25,194,158	$28,713,901	$19,103,470	$13,331,342	$90,624,721
Sewerage	$9,022,037	$27,960,608	$22,905,758	$10,176,961	$1,775,651	$71,841,014
Transport	$40,260,461	$105,444,675	$121,082,841	$133,511,986	$148,887,987	$549,187,951
Parks and open space	$13,750,652	$9,518,248	$66,125,079	$117,020,962	$158,499,128	$364,914,069
Local Community facilities	$0	$324,793	$1,733,668	$2,947,667	$3,944,849	$8,950,977
State community facilities	$9,387,391	$7,530,581	$26,829,858	$41,610,787	$54,037,976	$139,396,593
Total	**$76,702,391**	**$175,973,064**	**$267,391,106**	**$324,371,832**	**$380,476,932**	**$1,224,915,325**

Notes: all values presented in July 2022 dollars as incremental costs per reporting period, inclusive of Catalyst Infrastructure values

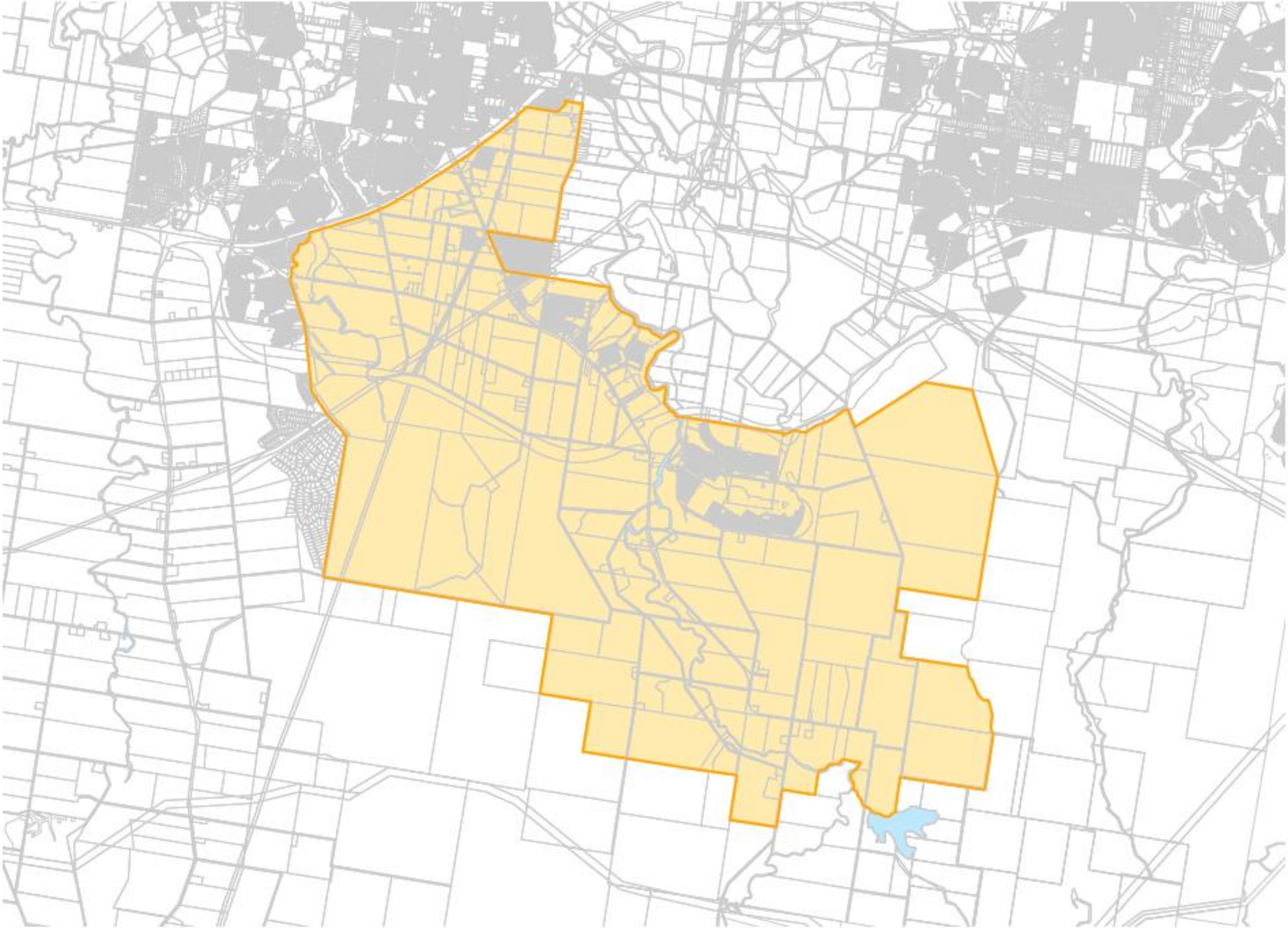
Table 20 Sub-Regional Infrastructure Schedule of Works costs

Infrastructure	Total ($)	Proportion of Total (%)
Water supply	$67,204,527	18.80%
Sewerage	$215,366,149	60.25%
Transport	$74,905,468	20.95%
Total	**$357,476,145**	**100%**

Notes: all values presented in July 2022 dollars

Appendix A PDA Boundary

Ripley Valley DCOP
PDA Boundary



Legend
- Development Area (PDA) Boundary
- Property Boundary
- Easements
- Waterways

N

0 250 500 1,000 1,500 2,000

Metres

Map created at: A3

Projection: GDA 1994 MGA Zone 56

Map produced by the Department of State Development, Infrastructure, Local Government and Planning Spatial Services Unit, 4/02/2022

Department of State Development, Infrastructure, Local Government and Planning

Queensland Government

Path: S:\Projects\EDO\Ripley Valley\20211203_Draft_DCOP\EDO_RV_DCOP2.aprx

Appendix B Road cross sections

Ripley Valley

Code	Cross-section	Clearance	Footpath	Cycle Path	Clearance	Breakdown	Bus Lane	Travel Lane	Median	Travel Lane	Bus Lane	Breakdown	Clearance	Cycle Path	Footpath	Clearance	Total Corridor Width	Total Pavement Width	Carriageways
2Li	Standard	0	0	0	0	1.5	0	3.5	0	3.5	0	1.5	1.5	3	1.5	1	17	10	1
2Li (upg)	Non-Standard 1	0	0	0	0	1.5	0	0	0	0	0	1.5	1.5	3	1.5	1	10	3	1
2Li (upg)	Non-Standard 2	0	0	0	0	1.5	0	0	0	0	0	1.5	1.5	3	1.5	1	10	3	1
2Li (upg)	Non-Standard 3	0	0	0	0	1.5	0	0	0	0	0	1.5	1.5	3	1.5	1	10	3	1
2Lu	Standard	1	1.5	2	1.6	2.4	0	3.5	0	3.5	0	2.4	1.6	2	1.5	1	24	11.8	1
2Lu	Non-Standard 1	1	0	3	1.5	2	0	3.5	0	3.5	0	2	1.5	0	1.5	1	20.5	11	1
2Lu	Non-Standard 2	1	1.5	0	0	2.4	0	3.5	0	3.5	0	2.4	2	3	0	1	20.3	11.8	1
2Lu	Non-Standard 3	1	1.5	0	0	2	0	3.5	0	3.5	0	2	1.5	3	0	1	19	11	1
2Lu	Non-Standard 4	1	1.5	0	0	2	0	3.5	0	3.5	0	2	2	3	0	1	19.5	11	1
2Lu (upg)	Non-Standard 1	1	0	3	1.5	2	0	0	0	0	0	2	1.5	0	1.5	1	13.5	4	1
2LBi	Standard	0	0	0	0	1.5	3.7	3.5	0	3.5	3.7	1.5	1.5	3	1.5	1	24.4	17.4	1
2LBi (upg)	Non-Standard 1	0	0	0	0	1.5	3.7	0	0	0	3.7	1.5	1.5	3	1.5	1	17.4	10.4	1
2LBi (upg)	Non-Standard 2	0	0	0	0	1.5	3.7	0	0	0	3.7	1.5	1.5	3	1.5	1	17.4	10.4	1
2LBi (upg)	Non-Standard 3	0	0	0	0	1.5	3.7	0	0	0	3.7	1.5	1.5	3	1.5	1	17.4	10.4	1
2LBi (upg)	Non-Standard 4	0	0	0	0	1.5	3.7	0	0	0	3.7	1.5	1.5	3	1.5	1	17.4	10.4	1
2LO	Standard	1	1.5	0	0	1.5	0	3.5	0	3.5	0	1.5	1.5	3	1.5	1	19.5	10	1
4Lu	Standard	1	1.5	2	1.5	0	0	7	6	7	0	0	1.5	3	1.5	1	33	14	2
4LBu	Standard	1	1.5	2	1.5	0	3.7	7	6	7	3.7	0	1.5	3	1.5	1	40.4	21.4	2
4LBu	Non-Standard 1	1	1.5	2	1.5	0	3.7	7	6	7	0	0	1.5	3	1.5	1	36.7	17.7	2
4LBu	Non-Standard 2	1	1.5	2	1.5	0	0	10.5	6	10.5	0	0	1.5	3	1.5	0	39	21	2
4LBu	Non-Standard 3	1	1.5	2	2	0	3.7	7	6	7	3.7	0	2	3	1.5	1	41.4	21.4	2
4LBu	Non-Standard 4	1	1.5	2	1.5	0	3.7	7	6	7	3.7	0	1.5	3	1.5	1	40.4	21.4	2
CW	Standard	5	0	0	0	0	0	0	0	0	0	1.5	8	3	1.5	3	22	1.5	1

	Standard Cross-section
	Varied from standard cross-section

Appendix C Open space and community facilities embellishments

Facility Type / Hierarchy	Typical Size (m²)	Earth works		Amenities													Sports Facilities					Landscaping				Infrastructure												
		Minor earthworks/ levelling	*Bulk earthworks*	*BBQ (Electric)*	*Play Equipment*	*Shade Structure*	*Shelter*	*Rotunda*	*Rubbish Bin*	*Table and Bench set*	*Bench Seating*	*Toilets*	*Water Bubbler*	*Signage Set - Small*	*Signage Set - Large*	*Fitness Node*	*Playing Field Surface Turf*	*Tennis, Netball, Basketball Courts*	*Basketball Half-court*	*Grandstand*	*Spectator Mound*	*Mulching & Planting*	*Shade Trees*	*Turf - Seeding*	*Turf*	*Irrigation*	*Lighting*	*Fencing*	*Bollards*	*Post and rail*	*Service Connections (incl. WiFi)*	*Pathways (concrete)*	*Paved plaza area*	*Internal Access Road*	*Bicycle parking facilities*	*Bitumen (Carpark)*	*Verve works - Half Road*	*Bus Indent Bay*
Neighbourhood Recreation	5,000 -10,000		x		x	x	x		x	x			x	x					x			x	x	x			x	x	x	x	x	x			x			
District Recreation	50,000		x	x	x	x	x	x	x	x		x	x		x	x			x			x	x	x			x	x	x	x	x	x		x	x	x		
Major Recreation	100,000		x	x	x	x	x	x	x	x		x	x		x	x			x			x	x	x			x	x	x	x	x	x		x	x	x		
Regional Park and Garden	100,000		x	x	x	x	x	x	x	x		x	x		x				x			x	x		x	x	x	x	x	x	x	x		x	x	x		
Town Centre Plaza	5,000		x				x	x		x				x													x					x	x		x			
District Sport	75,000		x		x	x	x		x	x	x	x	x		x		x	x		x	x		x		x	x	x	x	x	x	x	x		x	x	x		
Regional Sport	150,000		x		x	x	x		x	x		x	x		x		x	x		x			x		x	x	x	x	x	x	x	x		x	x	x		
Local Linear	10,000	x									x													x								x						
Major Linear	10,000	x								x	x		x											x								x						
State Community Facility	10,000		x																												x						x	
Local Community Facility - Local	4,000		x																												x						x	
Local Community Facility - District	15,000		x																												x						x	
Local Community Facility - Citywide	30,000		x																												x						x	
Primary Education Facility	70,000		x																									x			x						x	x
Secondary Education Facility	120,000		x																									x			x						x	x

Appendix D Technical report

Economic Development Queensland

Ripley Valley Priority Development Area

Appendix D: Technical Report

July 2022

Queensland Government

The Department of State Development, Infrastructure, Local Government and Planning improves productivity and quality of life in Queensland by leading economic strategy, industry development, infrastructure and planning, for the benefit of all.

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1 Introduction

The analysis contained in this Technical Report (the Report) is to inform the Development Charges and Offset Plan (DCOP) that supports growth within the Priority Development Area (PDA).

The objective of this Report is to detail infrastructure opportunities and constraints based on current and projected future infrastructure demands within the Ripley Valley PDA. The scope of this analysis was including but not limited to:

- A review of all existing Infrastructure Charging Offset Plan (ICOP) and Infrastructure Management Plans (IMP's),
- Engage with Key Stakeholders to receive, analyse and include changes to their respective Desired Standards of Service (DSS),
- Review and critic new policy implications,
- Migrate, analysis and modelling of all offsetable trunk infrastructure with emphasis on innovative thought and application,
- Estimate the staging and sequencing of the collective offsetable trunk infrastructure, and
- Calculate the cost of the above offsetable trunk infrastructure.

When undertaking the above, significant effort was invested to identify innovative opportunities that can be applied or aspired to over the developable life of the PDA. For the purposes of this Report, innovation practises are categorised by the following two terms:

Innovation by design: approaches using proven, currently available technologies and/or construction methods to achieve innovative outcomes (e.g. provision for charging stations of electric cars, like the Tesla models, incorporated into street, carparking and building infrastructure).

Innovation by aspiration: approaches using conceptual or cutting-edge technologies and/or construction methods to achieve innovative outcomes (e.g. preparing for autonomous vehicles by installing conduit or similar in road infrastructure).

Innovation by design has been expanded upon within each of the relevant chapters. Aspirational innovation has been expanded upon within Chapter 11.

Limitations

While the analysis is based on best available data, where limitations have occurred, these are detailed in the relevant chapter and should be noted.

2 Demographic Analysis

2.1 Introduction

The Ripley Valley Priority Development Area (PDA) lies within the Ipswich City Council Region and is a key greenfield development within Southeast Queensland. Ipswich City Council (LCC) is working with Economic Development Queensland (EDQ) to plan, design and deliver all Municipal and Sub-Regional infrastructure that will service the PDA into the future.

In 2019, EDQ commissioned SGS Urban to revisit the demographic projections for the Ripley-Valley PDA. The land projections were produced using a method that combines a ‘top down’ approach with a ‘bottom up’ approach to produce a robust set of projections.

2.2 Methodology Overview

The key ‘top down’ data input is the Southeast Queensland (SEQ) population projections produced by SGS. These account for the total demand for future housing and where that housing is likely to take place. These are informed by State Government and Australian Bureau of Statistics (ABS) population projections and relevant data on the economic performance of SEQ.

The ‘bottom up’ input data includes Census data, building approvals data, information from developers in the PDAs, Council population projections and transport model land use data. Each of these datasets has its own strengths and weaknesses, which have been assessed.

These various data sources are brought together to create a coherent view of the growth in dwellings, population and employment over the next 50 years.

Some of the key aspects and assumptions of our ‘top down’ approach with a ‘bottom up’ methodology is summarised below.

2.2.1 Dwellings

The ultimate dwelling yield has been estimated as the total number of potential dwellings at full build out. The ultimate dwelling yield is based around the expected dwelling densities and the amount of net developable land. Full build out is assumed to be 2066 for Ripley Valley PDA.

Forecast dwelling timing between 2019 and 2031 has been informed by the feedback provided by developers. In Ripley Valley SGS has used recent dwelling approvals, developer feedback data (where available) and assumptions on the timing of development to estimate total dwellings in this PDA.

2.2.2 Population

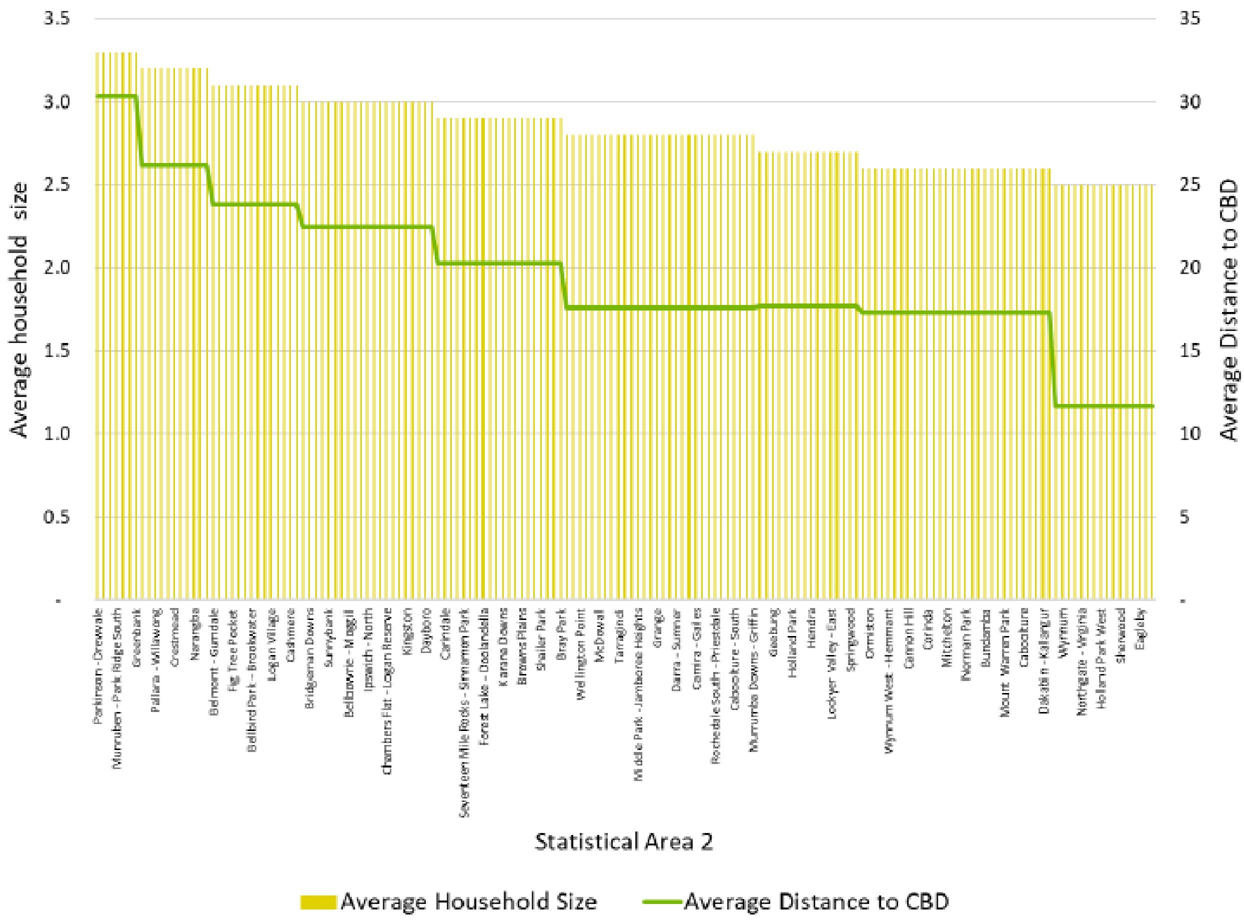
The population projection is based on applying an average person per household to the dwelling projections. This has been informed by the dwelling mix based on Council forecasts of attached and detached dwellings, and the average household size expected in a greenfield area adjusted to account for variations in dwelling mix (e.g. detached houses or medium density).

Figure 2-1 below presents the average distance to Brisbane CBD and average household size grouping. The purpose of this figure is to illustrate that, in general, as distance to the CBD increases, the average household size increases1. Locations like Springfield, Coomera and North Lakes all have average household sizes between 3.0-3.2 persons per household.

For Ripley Valley an average household size of around 3.0 could be expected. This will vary within the PDAs as popular product mix change over time.

This analysis is supported by the average household size used by Jacobs Engineering and Ipswich City Council. In the long term, the average person per household does decline as the first generation of children born in the PDA, move out of home and their parents remain. Although even in the later years of the analysis the PDA average person per households is still above State average of 2.6.

The age profile is derived from the population projection. After a review by SGS, the QGSO projections for share of population in each age group was used to create the age breakdowns.



Source: SGS Economic and Planning from ABS Census data 2016

Figure 2-1 Average Household Size by the Average Distance to the Brisbane CBD (SA2)

Note: This figure compares the average household size of the SA2 with the average distance of the SA2 from the CBD, not the actual distance. For example, the average household size of Dakabin-Kallangur SA2 is 2.6 persons per households. Typically, areas with an average household size of 2.6 persons are located 17km from the CBD, which is closer than the actual distance of the SA2 to the CBD. This illustrates that Dakabin-Kallangur SA2 has a lower household size than other SA2s of a similar distance from the CBD.

2.2.3 Employment

The bulk of the employment which will be located in the Ripley Valley PDA will be population serving. To produce a projection of future employment, a set of job to population ratios have been utilised and applied to the projected population.

Table 2-1 below presents the assumed employment growth for population serving based on the historical averages for greenfield areas. Using these numbers, the rate of employment growth is between 0.3 jobs per new household in Ripley Valley.

Table 2-1 Population Serving Employment Assumptions (Ripley Valley)

Industry	Jobs per 1,000 new Residents
Construction	22
Retail Trade	20
Accommodation and Food Services	9
Financial and Insurance Services	1
Rental, Hiring and Real Estate Services	4
Professional, Scientific and Technical Services	26
Administrative and Support Services	9
Public Administrative and Safety	12
Education and Training	22
Health Care and Social Assistance	34
Arts and Recreation Services	1
Other Services	5
Total Population Servicing Employment	**165**

Source: SGS Economics and Planning based on ABS Census (1996 – 2016)

2.3 Comparison of Forecasts

2.3.1 Dwellings

Table 2-2 below highlights the variation in dwelling forecasts for the City of Ipswich between the State Government ShapingSEQ and the Queensland Government Statistician's Office's (QGSO) 2018 projections. Whilst 2016 estimates are in line, the growth forecast for the LGA varies dramatically between the two sources in 2041. The QGSO projections are based on more recently released ABS Census data and suggest a greater level of growth forecast.

Table 2-2 Ipswich City Council Dwelling Forecasts

Projection Source	2016	2041	Growth 2016 – 2061
ShapingSEQ	72,092	183,792	111,700
QGSO 2018 Projections	72,090	218,102	146,012

Source: ShapingSEQ, Ipswich City Council, QGSO Forecasts 2018

Feedback was received from a number of developers in Ripley Valley on their realistic and aspirational dwelling yields per year to 2031. The realistic dwelling yield figures provided by developers have been revised in consultation with EDQ and are as summarised in Table 2-3 below. Annual dwelling yield is expected to be between 25 and 259 dwellings per year across the developer areas. This information has been used to inform SGS' dwelling forecasts, specifically the timing and location of dwelling growth to 2031.

Aspirational dwelling figures information was provided by developers in Ripley Valley to provide alternative dwelling forecasts for the developer areas. In an effort to provide a conservative estimate, these figures have not been used to inform SGS' dwelling forecasts.

Table 2-3 Ripley Valley Developer Expected Dwellings in 2031

Developer Area	Realistic 2031 Dwellings	Realistic Dwellings per year	Aspirational 2031 Dwellings	Aspirational Dwellings per year
Intrapac	1,034	94	1,352	123
Okeland Communities	4,419	259	4,495	295
Satterley Property Group	740	56	804	63
South Ripley Developments	262	25	642	58
Stockland's	1,270	127	1,420	129
Total	**7,725**	**561**	**8,713**	**668**

Source: SGS and Ripley Valley Developers 2019

Recent data shows that between 600 to 700 dwellings have been approved per year.

Table 2-4 shows the dwelling forecasts for the Ripley Valley PDA prepared by SGS, compared to those prepared by ICC and Jacobs. SGS forecasts total dwellings in Ripley Valley PDA to reach 50,000 dwellings at ultimate development in 2051. This is broadly in line with ICC and Jacobs forecasts of ultimate development, however SGS expects this ultimate dwelling estimate to be reached later than 2046.

SGS forecasts in 2046 are lower than Jacobs and ICC forecasts due to the different datasets and assumptions used by SGS. As shown in Figure 2-4, SGS forecasts are below the Jacobs and ICC forecasts up to 2046, due to the use of recent dwelling approvals, new lot approvals and developer feedback data.

These forecasts assume that major infrastructure would have been provided and a number of sub-precincts would have been planned and activated by 2066.

Table 2-4 Ripley Valley PDA Dwelling Forecasts

Projection Source	2016	2046	2066	Growth 2016 – 2066
SGS	1,444	37,971	50,000	48,556
Ipswich City Council	1,555	49,453	49,453	47,898
Jacobs Engineering	NA	50,004	NA	NA

Source: SGS Economics and Planning 2019, Ipswich City Council, Jacobs Transport Modelling

Table 2-5 below presents SGS' forecasts of dwellings by developer area within the Ripley Valley PDA. Areas with the largest forecast dwellings include Okeland Communities, Sekisui, Intrapac, South Ripley Developments, McHale and Stockland's. These forecasts have been informed by the developer feedback provided by a number of developers on their realistic and aspirational dwelling yields to 2031, as well as information provided by EDQ on approved lots.

Table 2-5 Ripley Valley PDA Dwelling Forecasts by Developer

Developer Area	2016	2041	2066	Growth 2016 – 2061
Intrapac	-	2,289	2,289	2,289
AB Ripley	1	190	190	189
Okeland Communities (East)	1	1,586	1,761	1,760
Okeland Communities (SUCE)	624	2,720	2,720	2,096
Okeland Communities (West)	-	1,585	1,760	1,760
AV Jennings - Cadence	-	303	303	303
AV Jennings – Grampian	1	178	178	177
Avon Capital	1	369	369	368
Pock Properties	1	137	137	136
Constant 13	-	86	86	86
Defence Housing Authority	1	370	370	369
Frasers	1	970	970	969
Goldfields Group	1	1,125	1,125	1,124
Villaworld / Avid	-	600	600	600
JHC Holding	3	316	316	313
Orchard Property Group - Kelly	1	63	63	62
McHale - Monterea	-	543	543	543
McHale - South	1	63	63	62
Other	55	7,442	13,860	13,805
Orchard Property Group – Daleys	-	426	426	426
Podium	1	450	450	449
Ripley Land Holdings	1	437	437	436
Ripley Unit Trust	1	294	294	293
Rosengreen	1	102	102	101
Satterley Property Group Pty Ltd	1	1,050	1,050	1,049
Sekisui	724	8,158	12,012	11,277
South Ripley Development’s No. 1	12	2,362	2,812	2,800
Stockland’s	1	2,020	2,100	2,099
Total Ripley Valley PDA	**1,444**	**37,971**	**50,000**	**48,556**

Source: SGS Economics and Planning 2019,

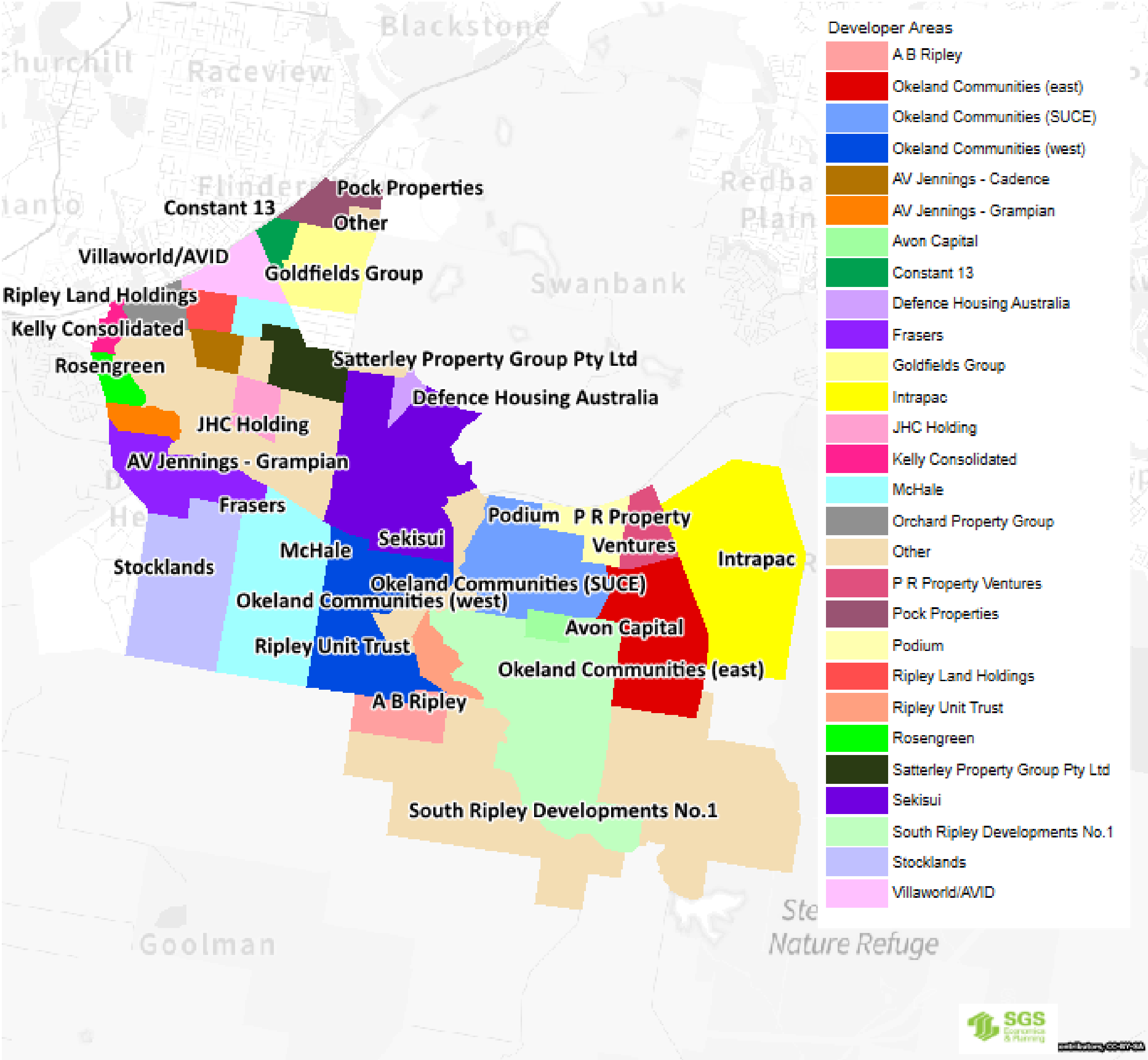


Figure 2-2 Ripley Valley PDA Developer Areas

Source: EDQ

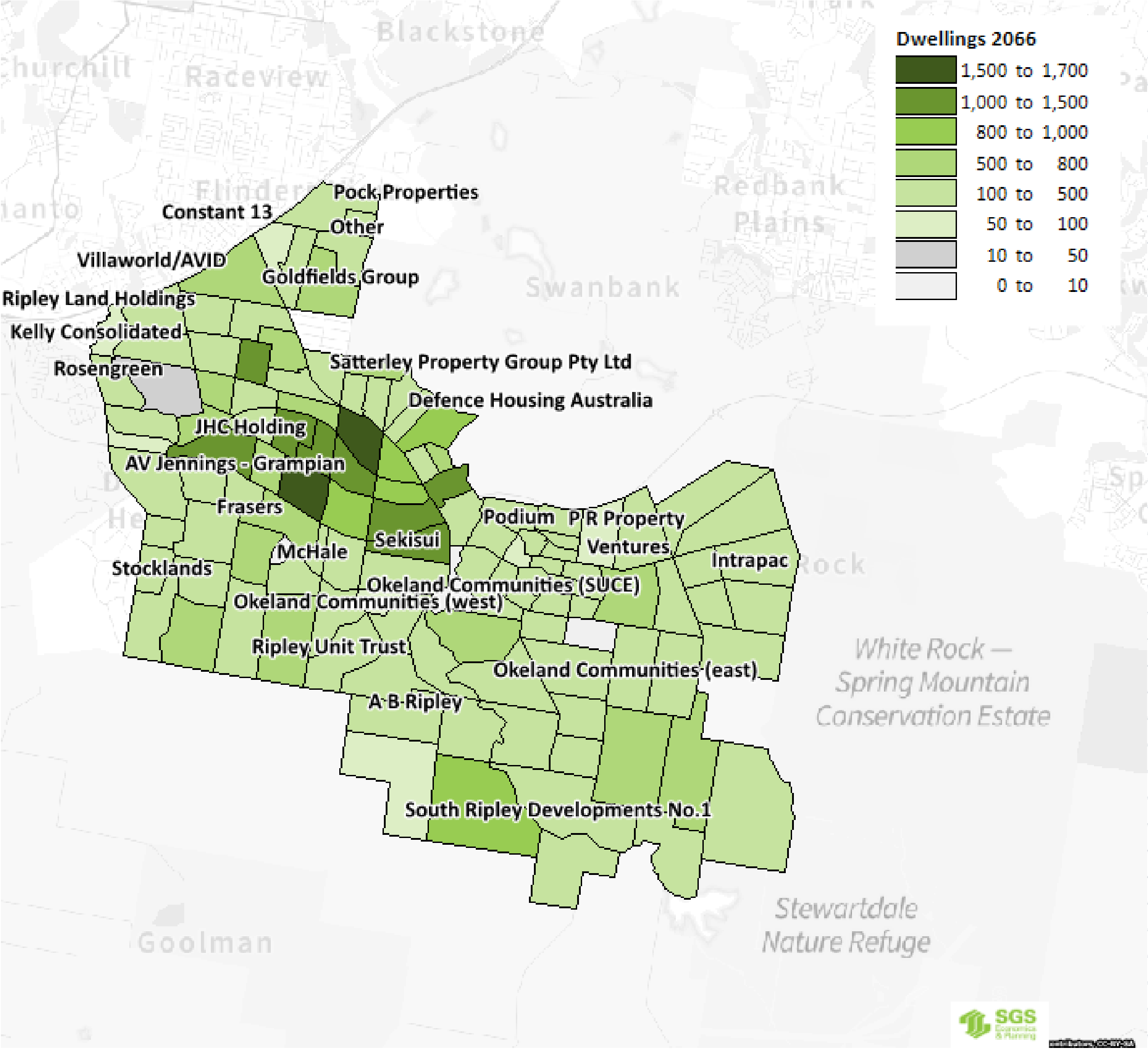


Figure 2-3 Ripley Valley PDA Dwelling Forecast for 2066

Source: SGS Economics and Planning 2019, VLC Transport Modelling

2.3.2 Population

Table 2-6 below highlights the variation in population forecasts for the City of Ipswich between the State Government ShapingSEQ and Queensland Government Statistician's Office 2018 projections. While values are similar in 2016, there is considerable variation in forecasts for 2041. QGSO are projecting more people in the Ipswich LGA by 2041 (i.e. a faster rate of population growth).

Table 2-6 Ipswich Local Government Area Population Forecast

Projection Source	2016	2041	Growth 2016 – 2061	Average household size 2016	Average household size 2061
Shaping SEQ	200,100	520,000	319,900	2.8	2.8
QGSO 2018 Projections	200,123	557,649	357,526	2.8	2.6

Source: ShapingSEQ, Ipswich City Council, Jacobs Transport Modelling, QGSO Forecasts 2018

As shown in Table 2-7 below, an estimated 135,000 residents are forecast for the PDA in 2066, based on an average household size of 2.7 persons per household. This is slightly higher than ICC and Jacobs forecasts of population as a result of the higher average household size that has been used.

Table 2-7 Ripley Valley PDA Population Forecasts

Projection Source	2016	2046	2066	Growth 2016 – 2066
SGS	4,188	110,116	135,001	130,813
Avg household size	2.9	2.9	2.7	
Ipswich City Council	2,857	102,546	102,546	99,689
Avg household size	1.8	2.1	2.1	
VLC	NA	120,002	NA	NA
Avg household size	NA	2.4	NA	NA

Source: SGS Economics and Planning 2019, Ipswich City Council, VLC Transport Modelling,

As shown in Figure 2-4 below, SGS forecasts of population are below the Jacobs and ICC forecasts up to 2046, in line with our dwelling forecast. Beyond 2046 SGS forecasts are higher than Jacobs and ICC as a result of the higher average household size. The ICC population forecast appears to be based on historical average household size for the PDA area, which reflects a rural residential population (with less people per household) rather than a greenfield development area.

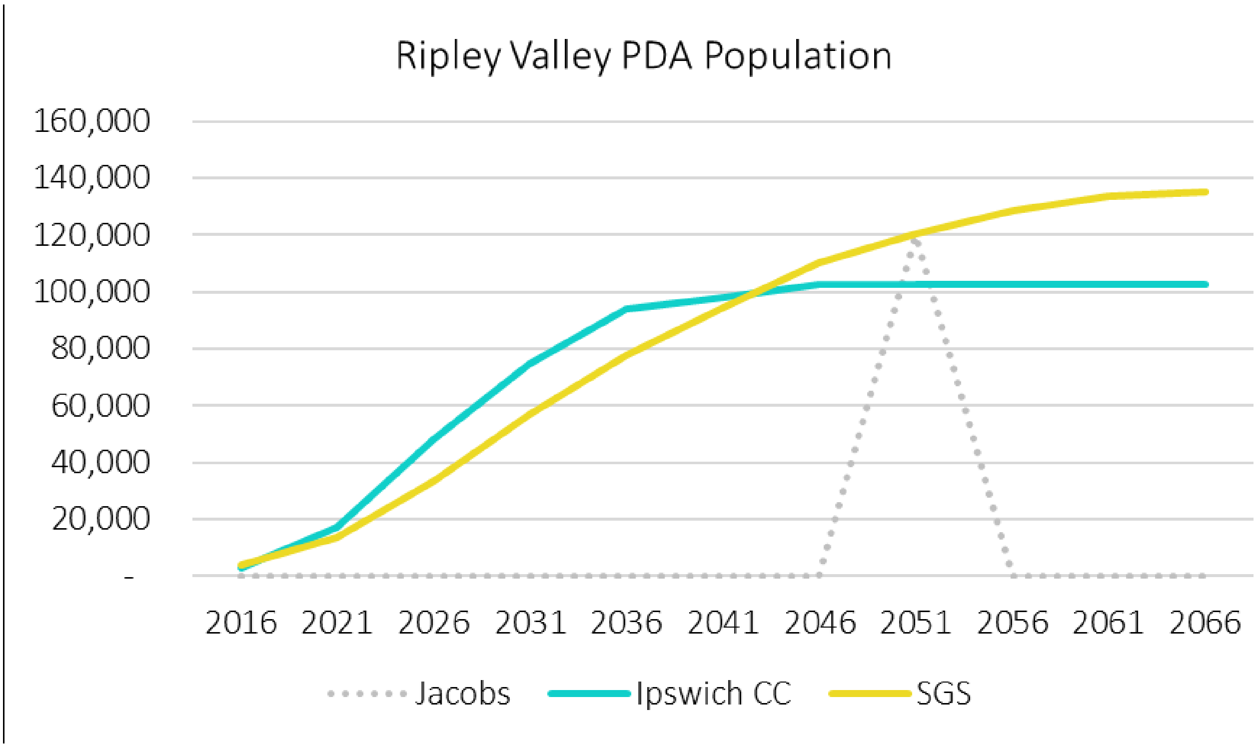


Figure 2-4 Ripley Valley PDA Population Forecasts

Source: SGS Economics and Planning 2019, Ipswich City Council, Jacobs Transport Modelling,

SGS forecasts a decline in average household size, from a high of 2.9 in 2016, to 2.7 by 2066. This trend is seen in older growth areas that have already developed. Average household size tends to be higher in the early development stages as families with children move in to detached dwellings. This is expected to decline in the longer term due to more apartments being built and changing age profiles, with more older people less school aged people.

Ripley Valley household size is still expected to remain slightly above the QLD average household size of 2.6 persons per household.

Population forecasts by age group have been prepared for Ripley Valley using the QGSO population by age forecasts for the SA2 in which it is located (Ripley SA2). It has been assumed that as the PDA develops there will be a changing age profile of residents. The proportion of older age people (50 to 64 and 65+) is forecast to increase in 2036 and 2066 (see Figure 2-5). This is in line with state-wide trends of an ageing population.

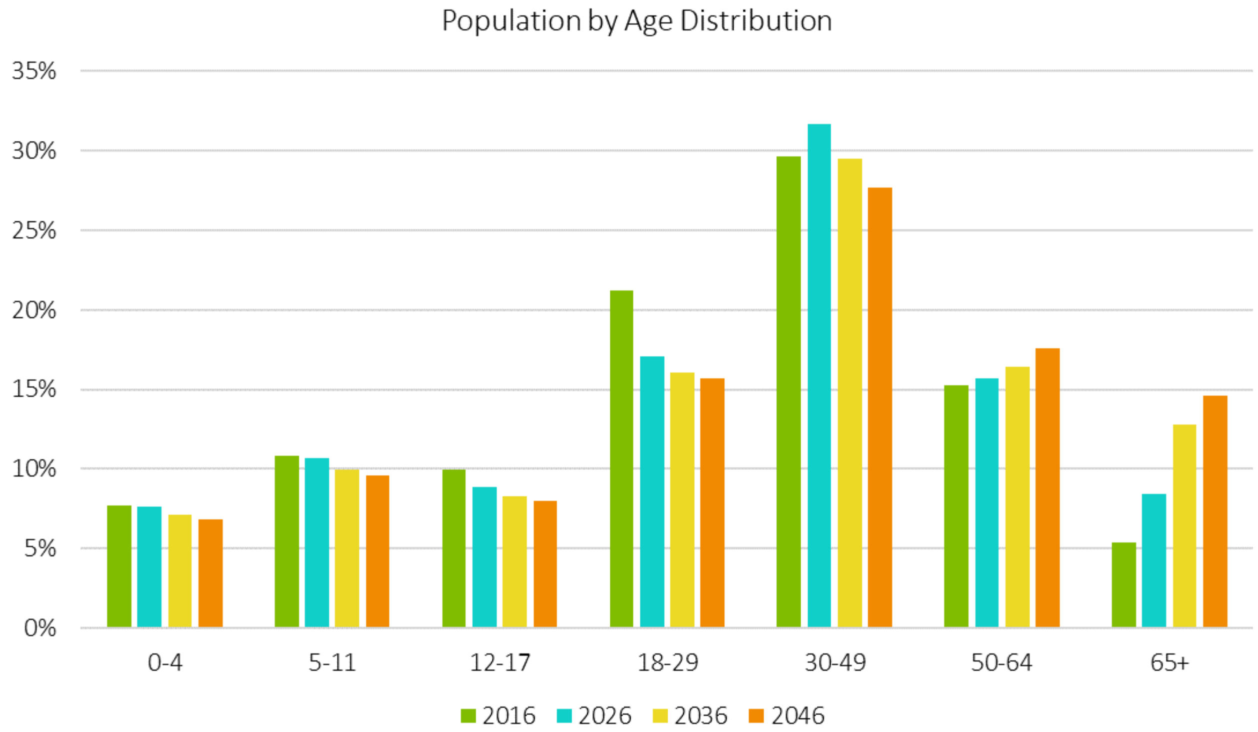


Figure 2-5 Ripley Valley PDA Population by Age – Share of Age Group

Source: SGS Economics and Planning 2019

As shown in Figure 2-6 below, the number of primary school aged children (5-11 years) living in Ripley Valley is forecast to increase by 12,400 people to 2066. The number of secondary school aged children (12-17 years) is forecast to increase by 10,400 people to 2066. The largest amount of population growth is forecast for the 30-49 and 50-64 age group.

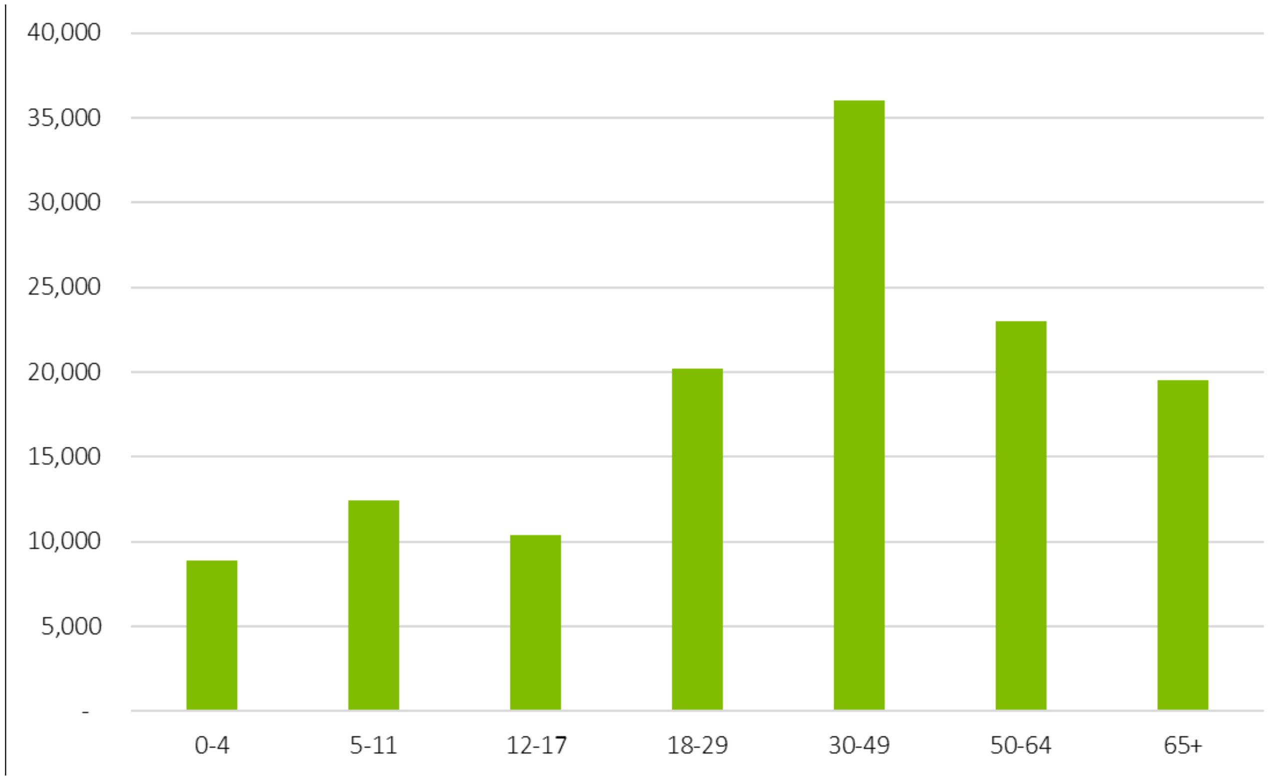


Figure 2-6 Ripley Valley PDA Population – Forecast Growth by Age Group

Source: SGS Economics and Planning 2019

There is of course a high degree of uncertainty regarding the future age breakdown of the PDA. This is particularly the case for school aged children. The size of this age group clearly has implications for future school provision. Looking at the existing shares of school aged children for SA2 across Greater Brisbane provides an indication of a possible future range for the PDA (using 2016 ABS Census data).

For children aged 5-11 years, the percentage can be as high as 13 per cent (for example the North Lakes - Mango Hill SA2 is 13.1 per cent). Other SA2 with a similar percentage of children aged 5-11 include the Redbank Plains SA2 (13.5 per cent), Narangba SA2 (13.2%) and Goodna (12.7%). On average, 9.3 per cent of the population across Greater Brisbane were aged 5 to 11 years (in 2016).

Applying this 13 per cent to the PDA projections provides an indication of a future with a very high percentage of primary school aged children. Table 2-8 compares the baseline forecast of primary school aged children in Ripley Valley PDA (aged 5 to 11 years), with a high scenario forecast.

Table 2-8 Primary School Aged Children – High Scenario

Population aged 5-11 years	2016	2026	2036	2046	2056	2066	Growth 2016-66
Baseline Forecast	453	3,587	7,703	10,536	12,311	12,917	12,464
Share of the total population	11%	11%	10%	10%	10%	10%	
High scenario	453	4,023	10,095	13,214	15,440	16,200	15,747
Share of total population	11%	12%	13%	12%	12%	12%	

Source: SGS Economics and Planning based on ABS Census data 2016

For secondary school children, the current (2016) percentage of the population aged 12-17 years can be as high as 10 per cent (for example the Marsden and Crestmead SA2 are 10.1 per cent). Other SA2 with a similar percentage of children aged 12-17 years include the North Lakes – Mango Hill SA (9.3 per cent), Goodna SA2 (9.2%) and Wakerley (9.2%). On average, 7.6 per cent of the population across Greater Brisbane were aged 12 to 17 years (in 2016).

Applying this 10 per cent to the PDA projections in 2036 provides an indication of a future with a very high percentage of secondary school aged children. Table 2-9 compares the baseline forecast of secondary school aged children in Ripley Valley PDA (aged 12 to 17 years), with a high scenario forecast.

Table 2-9 Secondary School Aged Children – High Scenario

Population aged 12-17 years	2016	2026	2036	2046	2056	2066	Growth 2016-66
Baseline Forecast	416	2,966	6,414	8,837	10,325	10,834	10,418
Share of total population	10%	9%	8%	8%	8%		
High scenario	416	3,352	7,765	9,910	11,580	12,150	11,734
Share of total population	10%	10%	10%	9%	9%	9%	

Source: SGS Economics and Planning based on ABS Census data 2016

2.3.3 Employment

SGS forecasts total employment in Ripley Valley PDA to reach 11,700 jobs by 2046, and 14,200 jobs by 2066 (ultimate development). This represents 0.3 additional jobs per additional household in Ripley Valley.

The majority of these jobs are expected to be population serving industries including retail, accommodation and food services, health, education and construction.

SGS forecasts are slightly higher than Jacobs and ICC forecasts due to the different method used by SGS. SGS employment forecasts are linked to the population growth, which is also higher than Jacobs and Ipswich,

Table 2-10 Ripley Valley PDA Employment Forecasts

Projection Source	2016	2041	2066	Growth 2016 – 2061
SGS	1,150	11,743	14,231	13,081
Ipswich City Council	218	12,541	NA	12,323
Jacobs Engineering	NA	12,534	NA	NA

Source: SGS Economics and Planning 2019, Ipswich City Council, Jacobs Transport Modelling,

Table 2-11 below presents SGS' forecasts of total employment by developer area within the Ripley Valley PDA. Areas with the largest forecast number of jobs include Sekisui and Okeland Communities (SUCE).

Table 2-11 Ripley Valley PDA Employment Forecasts by Developer

Developer Area	2016	2041	2066	Growth 2016 – 2061
Intrapac	18	188	228	210
AB Ripley	-	-	-	-
Okeland Communities (East)	30	307	372	341
Okeland Communities (SUCE)	109	1,115	1,351	1,242
Okeland Communities (West)	37	381	462	425
AV Jennings - Cadence	4	45	55	51
AV Jennings – Grampian	4	46	55	51
Avon Capital	3	34	41	38
Pock Properties	5	50	60	56
Constant 13	0	0	0	0
Defence Housing Authority	1	14	17	16
Frasers	18	186	226	208
Goldfields Group	23	237	287	264
Villaworld / Avid	4	37	45	41
JHC Holding	7	67	81	74
Orchard Property Group - Kelly	5	50	60	56
McHale - Monterea	12	122	148	136
McHale - South	12	122	148	136
Other	119	1,217	1,475	1,356
Orchard Property Group – Daleys	28	290	351	323
Podium	4	45	55	50

Developer Area	2016	2041	2066	Growth 2016 – 2061
Ripley Land Holdings	0	0	0	0
Ripley Unit Trust	-	-	-	-
Rosengreen	-	-	-	-
Satterley Property Group Pty Ltd	21	216	262	241
Sekisui	577	5,888	7,136	6,559
South Ripley Development's No. 1	69	708	857	788
Stockland's	37	377	457	420
Total Ripley Valley PDA	**1,150**	**11,743**	**14,231**	**13,081**

Source: SGS Economics and Planning 2019

2.4 Implications on Water and Sewer Modelling

The population for the Urban Utilities Sub-Regional strategies is based on the 2015 population projection that was used in the Water Master Plan for Ipswich Trunk Network 2015 and the Bundamba Sewerage Network Master Plan Addendum September 2017. It is noted that Urban Utilities' projections differ significantly between water and sewer, with sewer growth projections 30% higher than water by 2041.

The latest SGS projections developed for EDQ for the Ripley Valley PDA are higher in total projected growth and rate of growth than those adopted by Urban Utilities for their water and wastewater planning.

The basis for allocation of non-residential development projections adopted by Urban Utilities was 27% of residential equivalent persons (EP), which is high for the Ripley Valley PDA which is to be predominately residential development. SGS provides projections for non-residential demand in terms of jobs. An assumption of 1 EP per job was used to generate the total EP load for the purposes of this study. The revised PDA population projections differ substantially and would require additional infrastructure for both water and sewerage systems.

Updated population and employment growth projections from SGS for the Ripley Valley PDA for each of the planning horizons are presented in Table 2-12 and Figure 2-7 below. A comparison of these projections with those adopted by Urban Utilities for water and sewerage planning is also provided.

Table 2-12 Ripley Valley PDA population and employment projections

Projections	2021	2026	2031	2041	2066	Growth 2021-66
Population	13,745	33,521	56,745	94,491	135,004	121,259
Dwellings	4,580	11,179	18,916	32,588	49,999	45,419
Employment	2,104	4,082	6,403	10,179	14,232	12,128
Total PDA EP	15,849	37,603	63,148	104,670	149,236	133,387
Urban Utilities Water [1]	5,866	15,025	23,150	46,274	-	40,408

Projections	2021	2026	2031	2041	2066	Growth 2021-66
Urban Utilities Sewer [2]	5,614	12,792	29,420	60,130	85,601	80,000

Source: Water Reticulation Master Plan for Ipswich, April 2017
Source: Bundamba Sewerage Network Master Plan Addendum, September 2017

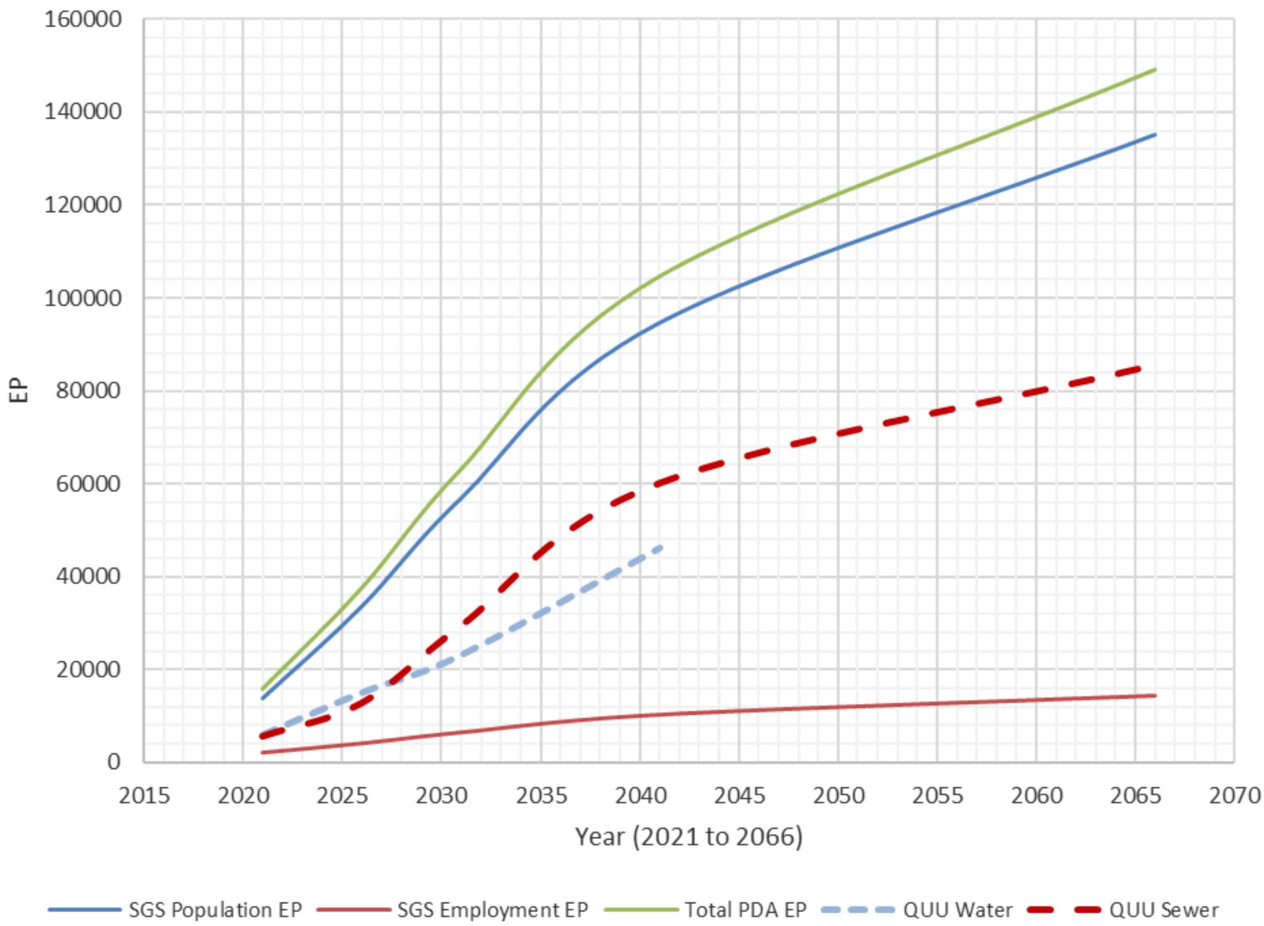


Figure 2-7 Ripley Valley PDA Population and Employment Projections

The SGS demographic projections break down the population and employment projections for the Ripley Valley PDA into 122 travel zones. This analysis assumed that when the zone population reached 50 EP, servicing infrastructure was required. This then determines the timing of servicing infrastructure. The SGS growth projection indicates that almost all the zones will commence development before 2026 and will require infrastructure servicing. Figure 2-8 shows the resultant timing of development across the Ripley Valley PDA.

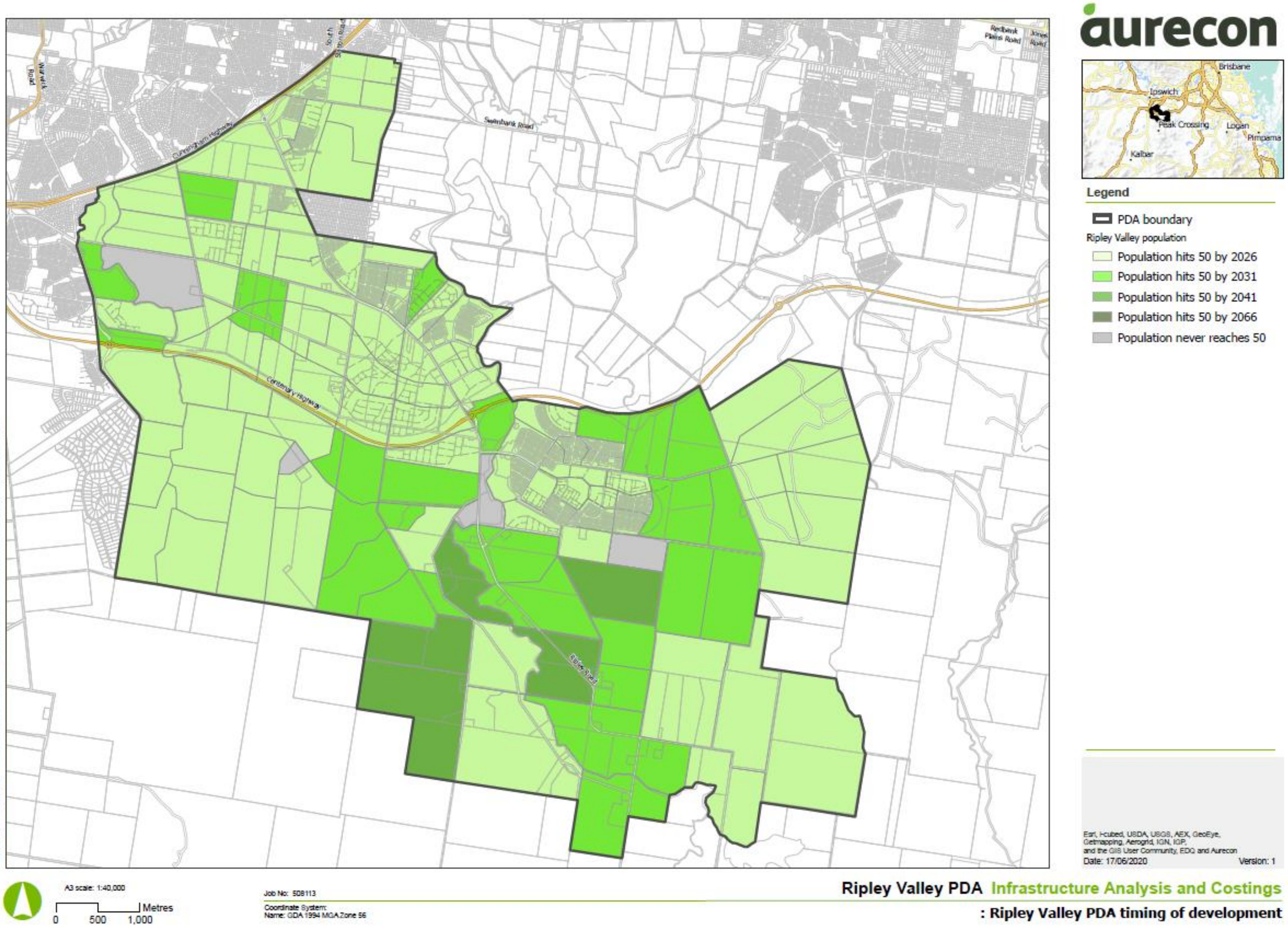


Figure 2-8 Ripley Valley PDA Timing of Development

3 Water Supply

The Ipswich water network is supplied by Seqwater from the Mt Crosby Water Treatment Plant via gravity supply from the Cameron's Hill Storage Tanks. Bulk water is delivered via four trunk mains and the Southern Regional Water Pipeline (SRWP) connections to the trunk system. Water can be transferred northwards from Seqwater's southern treatment plants via the SRWP when required, however the normal operation is from Mt Crosby southwards.

3.1 Bulk Transmission and Storage Reservoirs

For clarity the Ipswich network is subdivided geographically into four areas based on the various trunk main supplies as follows:

- Western System supplied by the 375mm diameter Kholo main
- Central Kholo System supplied by the 450mm and 600mm diameter Kholo mains
- Eastern System supplied by the 1050mm diameter trunk main
- Central/Southern Trunk System supplied by the SRWP and pumped supplies from the central and eastern areas including Ripley Valley via the South Station Road and Griffiths WPS.

3.2 Central/Southern System

The Central/Southern System was historically serviced by a 500 mm diameter trunk main from Cameron's Hill Reservoirs. The southern section is active and connected to the Bundamba SRWP connection which supplies the Jones Street Reservoir. The existing Blackstone SRWP connection will supply the Jones Street Reservoir and the Bundamba offtake will only be used as a backup supply. This trunk main supplies six water supply zones (WSZs) as follows:

- Blackstone which is operated as two pressures zones. The Blackstone LLZ is supplied via Jones Street Reservoir and Blackstone HLZ is supplied via the Jones Street WBS
- Ripley LLZ is partially supplied via the South Station Road WPS which in turn supplies Ebenezer, Peak Crossing, Harrisville and Warrill View WSZs.

The layout and extent of the Ipswich Trunk Network are shown in Figure 3-1 below. A detailed water supply system network schematic is shown in Figure 3-2 with the approximate location of the Ripley Valley PDA outlined in red.

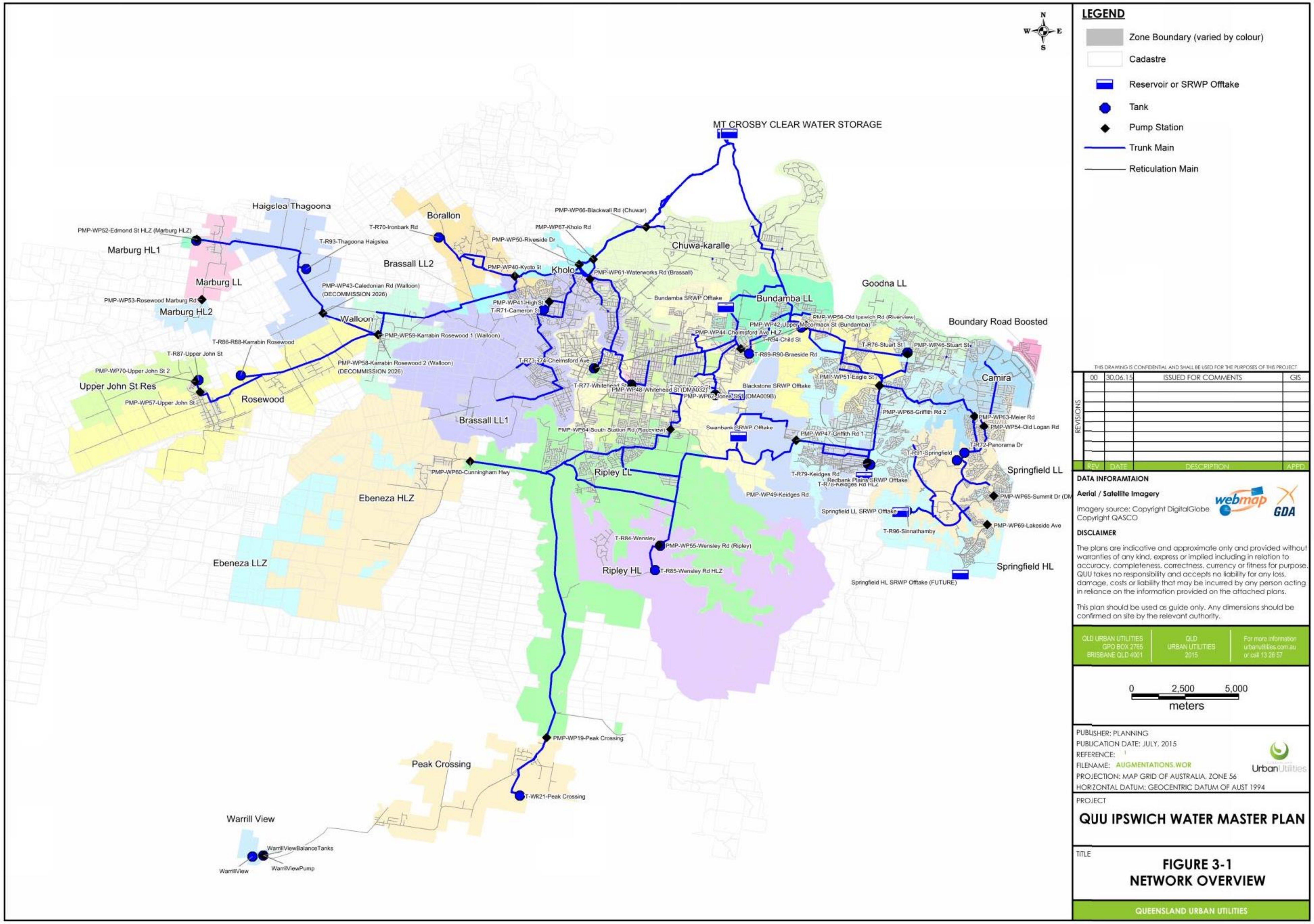


Figure 3-1 Ipswich Water Network Overview

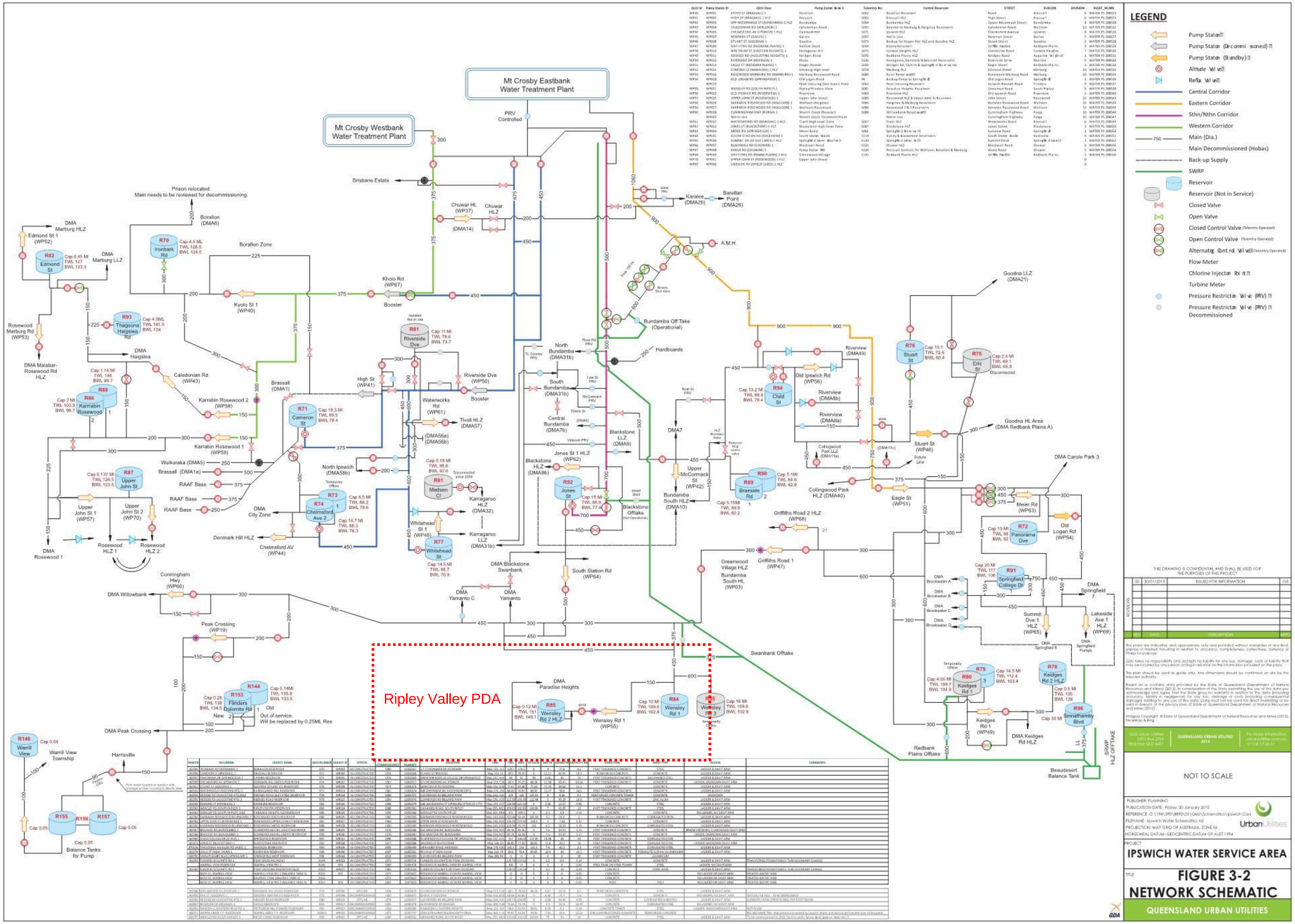


Figure 3-2 Ipswich Water Supply System Network Schematic

3.3 Reference Standards

The following standards were referenced for the purposes of planning the Municipal water supply infrastructure in the Ripley Valley PDA:

- Water Supply Code of Australia Version 3.1, April 2011, last updated August 2018 (WSA 03-2011)
- Southeast Queensland Water Supply and Sewerage Design and Construction Code, July 2013 (SEQ Code)
- Urban Utilities Desired Standards of Service (DSS) as defined in the Urban Utilities Water Netserv Plan Version 1, March 2020.

3.4 Past Reports and Development IMPs

The following reports were referenced in this analysis:

- Water Trunk Master Plan for Ipswich, Urban Utilities, July 2015
- Infrastructure Charging Offset Plan - Ripley Valley Priority Development Area, Economic Development Queensland, August 2019
- Ripley Valley LIP – Local Infrastructure Plan Version 20, prepared for EDQ by Cardno, July 2016.
- Ripley Valley PDA – Sub-Regional Water Infrastructure Planning, 2020

The following infrastructure master plans (IMPs) have been referenced in the analysis:

- Constant 13 4/2011/ILUP IMP
- Monterea Land Holdings Pty Ltd 29/2013/PDA IMP
- Goldfields 2018 IMP
- Satterleys 2013 IMP
- Sekisui House 2013 IMP
- Amex Providence 7566/2017/MAPDA IMP
- RP Property Ventures 6226/2018/PDACA IMP
- Intrapac 2020 IMP
- Amex East 2013 IMP
- South Ripley Developments 9521/2018/PDA IMP
- Amex West 3/2012/ILUP IMP
- McHale South 26/2013/PDA IMP
- Stockland 2018 IMP
- HB Doncaster 2020 IMP

3.5 Desired Standards of Service

The SEQ Code, Urban Utilities' DSS, as well as the Water Supply Code of Australia (WSA 03-2011), formed the basis of hydraulic modelling and network planning outlined in this report.

The DSS were adopted and documented in the Water Reticulation Master Plan for Ipswich – April 2017. Therefore, the assumptions in this master plan were used for assessing existing network performances and for sizing new infrastructure. Based on these assumptions, the network demand is summarised in Table 3-1 and network design parameters in Table 3-2.

A review of these demands was carried out. The adopted unit EP demand was 193L/EP/day bouncing back to 230 L/EP/day, plus a leakage allowance 30 L/EP/day (13%). The average residential consumption for Southeast Queensland was 169 L/EP/day (1 July 2015) with the majority being internal demand and the median state-wide leakage of 5.1%. In conclusion, the adopted demand assumptions were assessed as conservative and an opportunity for future review.

Table 3-1 Ripley Valley PDA Unit Demand and Peaking Factors Adopted for Water Network Modelling

Year	AD1 (L/EP/day)		MDMM/AD2 Factor		PD/AD3 Factor		PH/PD4 Factor		PD5 (L/EP/day)		MDMM6 (L/EP/day)	
	Res	Non-Res	Res	Non-Res	Res	Non-Res	Res	Non-Res	Res	Non-Res	Res	Non-Res
2021	193	230	1.2	1.1	1.6	1.1	1.9	1.5	309	253	232	253
2026	210	230	1.2	1.1	1.6	1.1	1.9	1.5	336	253	252	253
2031	228	230	1.2	1.1	1.6	1.1	1.9	1.5	365	253	274	253
2041	230	230	1.2	1.1	1.6	1.1	1.9	1.5	368	253	276	253
2066	230	230	1.2	1.1	1.6	1.1	1.9	1.5	368	253	276	253

Notes:
Average day (AD) demand in litres per equivalent population (EP) per day
Mean day max month (MDMM) to average day (AD) factor used to scale up estimated average day demand to the mean day max month demand
Peak day (PD) to average day (AD) factor used to scale up average day demand to peak day demand
Peak hour (PH) to peak day (PD) factor used to scale up peak day demand to peak hour demand
Peak day (PD) demand used for sizing of reservoirs
Mean day max month (MDMM) used for sizing trunk water infrastructure

Table 3-2 Ripley Valley PDA Water Network Planning Parameters

Water Network Desired Standards of Service (DSS)	
Parameter	**Criteria**
Reservoir storage assessment	Peak day (PD) demand.
Reservoir storage size	3 x (PD – MDMM) + greater of 4 hrs MDMM and Firefighting Storage, subject to a minimum reservoir size of 150 kL.
Reservoir minimum operating storage	Four hours consecutive demand.
Pump supplying a ground level reservoir	MDMM over 20 hrs.
Minimum service pressure at PH	On demand areas 22 m at the property boundary based on reservoir at minimum operating level (MOL). MOL defined as 15% of storage height or top of emergency storage.

Water Network Desired Standards of Service (DSS)	
	37m at model demand point based on 22m at property boundary plus 10m elevation difference allowance and 5m reticulation loss
Maximum service pressure	80 m.
Trunk main capacity	MDMM in 20 hrs.
Trunk main peak velocity	Design velocity 0.8 m/s to 1.4 m/s with a max of 2.5 m/s. (Up to 4 m/s in special cases)
Trunk main maximum head loss PH	5 m/km for DN<=150, 3 m/km for DN>=200

The following additional assumptions were adopted during the water network planning process:

- Elevation heights were obtained from the digital elevation model (DEM) and are Australian Height Datum – provided by Ipswich City Council
- Water supply pressure at the study boundary limits (refer to Figure 3-2):
    - Available head of 117 m at Swanbank SRWP offtake
    - Available head of 150 m upstream of East Reservoir
- Only the distribution infrastructure to the supply points of the travel zones has been assessed which may be lower than the highest point in the area. An allowance of 10m for elevation difference and 5m for friction loss, thus a total of 15m, was added to the distribution offtake when assessing the minimum pressure
- Minimum pipe pressure rating of PN 16 for all pipework
- Adopted pipe materials:
    - MSCL for pipelines above DN750
    - MSCL for pipelines with pressures above 1600 kPa
    - GRP for pipelines between DN375 and DN750 and pressures below 1600 kPa.
    - PVC for pipelines below DN375 and pressures below 1600 kPa

3.6 Stakeholder Engagement

The water servicing strategy presented in this report was developed in consultation with EDQ and Urban Utilities, both of which provided a significant amount of information and data to reference in this study.

Two stakeholder engagement workshops were held with EDQ and Urban Utilities:

- Workshop 1 – Wednesday 29th January 2020 – Aurecon reported back to EDQ and Urban Utilities on progress in obtaining and collating all the relevant water planning information and data and discuss any gaps
- Workshop 2 – Monday 24th February 2020 – present progress on water network planning, discuss outstanding gaps and issues and present draft innovation opportunities.

In addition to these structured workshops, regular communication and collaboration occurred with EDQ and Urban Utilities to confirm approaches and assumptions and to resolve issues as planning progressed.

Urban Utilities were also given the opportunity to review the water network modelling and provide feedback on the water supply plan. The water network modelling for the Ripley Valley PDA was then updated to incorporate this feedback and address any issues identified by the Urban Utilities water planner.

3.7 Innovation by Design

Given the majority of innovation by design options available to water supply, sewerage and stormwater are collectively known as Integrated Water Management, these have been consolidated and expanded upon within Chapter 6.

3.8 Sub-Regional Water Supply Strategy

Urban Utilities completed their Water Trunk Master Plan for Ipswich in 2015, which included planning of Municipal water supply infrastructure within the PDA to service growth up to 2046, including the Ripley Valley PDA. This strategy was then updated again in 2017. The Urban Utilities' water supply strategy was adopted as the basis for this study. Urban Utilities' previously proposed water infrastructure servicing plan is presented in Figure 3-3 below.

Urban Utilities' water supply strategy proposes supply to the PDA from the following water sources:

- Water for the PDA will be supplied by Seqwater from the Mt Crosby Water Treatment Plant via the SRWP
- The strategy to supply the Ripley area is from the Future Swanbank SRWP connection rather than the QUU proposed School Road SRWP connection.
- Dedicated supply to the Wensley Road Reservoirs from the Swanbank SRWP offtake via a dedicated trunk water main and a water pump station located at the SRWP offtake. The Swanbank SRWP connection is considerably more secure, robust and efficient than the previously proposed School Road SRWP connection, allowing gravity supply for most of the time to the PDA. It also allows significant capital deferment by using the existing spare network capacity to supply the Ripley low level zone (LLZ).
- Supply to a small area in the southeast of the PDA from the Redbank Plains SRWP offtake via a proposed water supply reservoir in Redbank Plains SWRP offtake.

While Urban Utilities' previous water supply strategy was used as a basis for this study, it required modification and augmentation of proposed infrastructure to accommodate significantly higher growth projections rate than had been adopted by Urban Utilities.

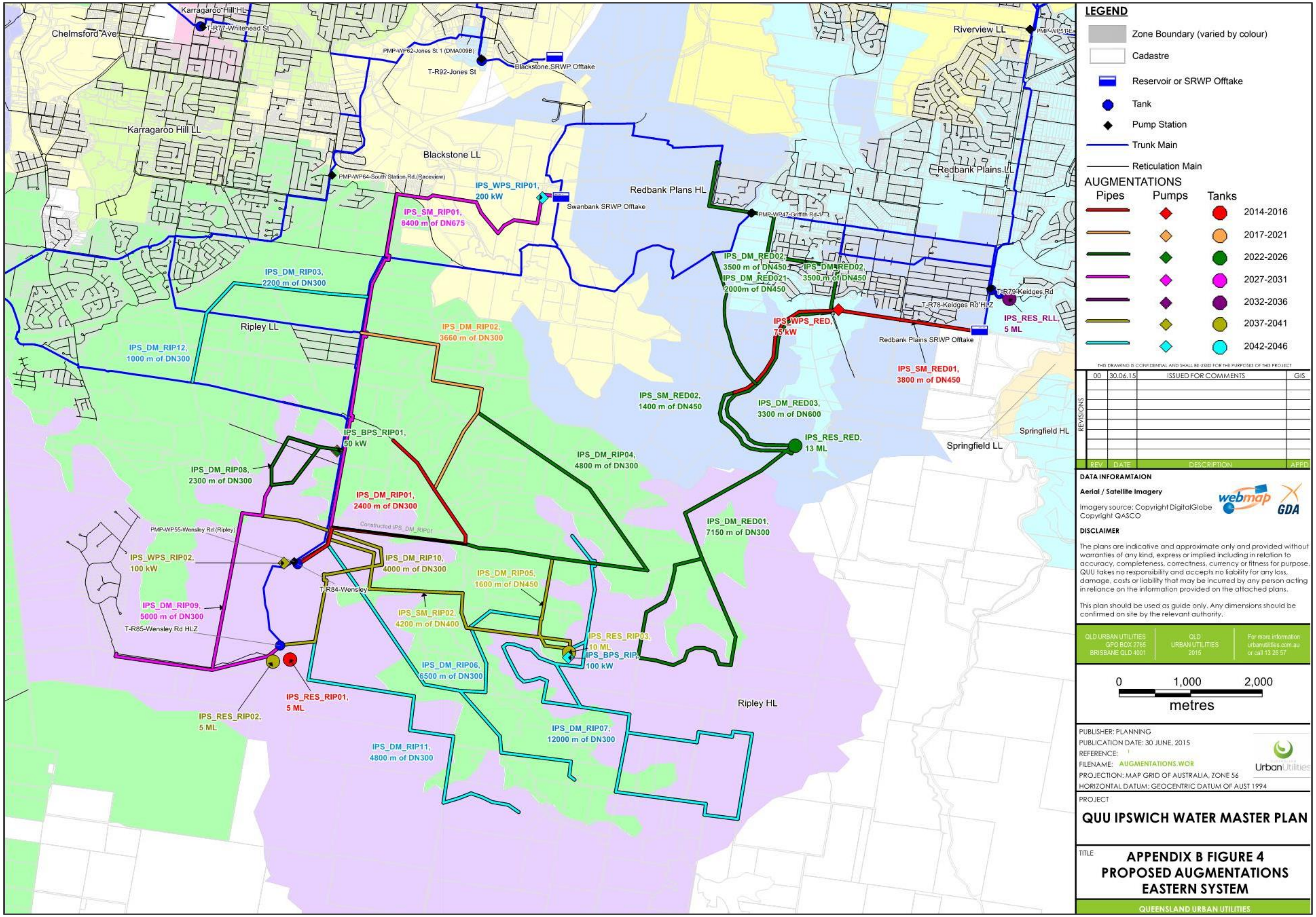


Figure 3-3 Urban Utilities Previous Water Supply Strategy Adopted as the Basis for Updating Municipal Water Infrastructure within the Ripley Valley PDA

3.9 Demand Projections

The updated SGS growth projections presented in Chapter 1 were converted into demand projections to enable infrastructure planning to be updated. The unit demands and peaking factors presented in Table 3-3 were used in this conversion. The resulting population and demand data are summarised for each planning horizon in Table 3-3. Figure 3-4 illustrates the projected demand growth for the Ripley Valley PDA from 2021 to 2066.

Table 3-3 Ripley Valley PDA Population, Employment and Water Demand Projections

Description	2021	2026	2031	2041	2066
Population (EP)	13,745	33,521	56,745	94,491	135,004
Employment (EP)	2,104	4,082	6,403	10,179	14,232
Total PDA (EP)	15,849	37,603	63,148	104,670	149,236
Water demand AD (ML/d)	3.14	7.98	14.41	24.07	34.32
Water demand PD (ML/d)	4.78	12.30	22.33	37.35	53.28

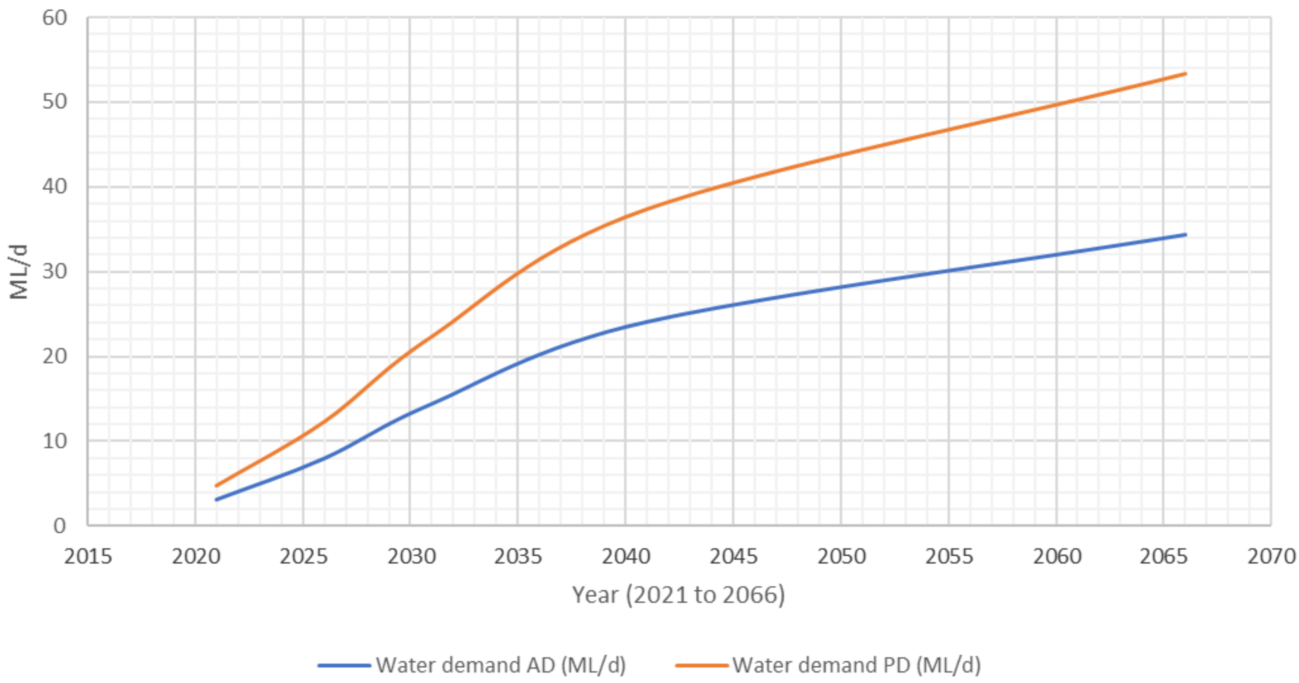


Figure 3-4 Ripley Valley PDA Demand Forecast

In addition to the above there are three areas that are outside the Ripley Valley PDA that need to be serviced by the trunk infrastructure within the PDA, as shown in Table 3-4**Error! Reference source not found.** below. Demand projections for these areas were obtained from Urban Utilities' existing hydraulic model. This model only forecasts projections up to 2041 which has been assumed to be full development for 2066. These demand projections are summarised in Table 3-4.

Table 3-4 Demand projections for areas adjacent to the Ripley Valley PDA up to 2041

Adjacent Area	2026	2031	2041
Area A	3,471	5,495	10,645
Area B	1,438	2,282	4,448
Area C	834	846	865
Total	**5,743**	**8,623**	**15,958**

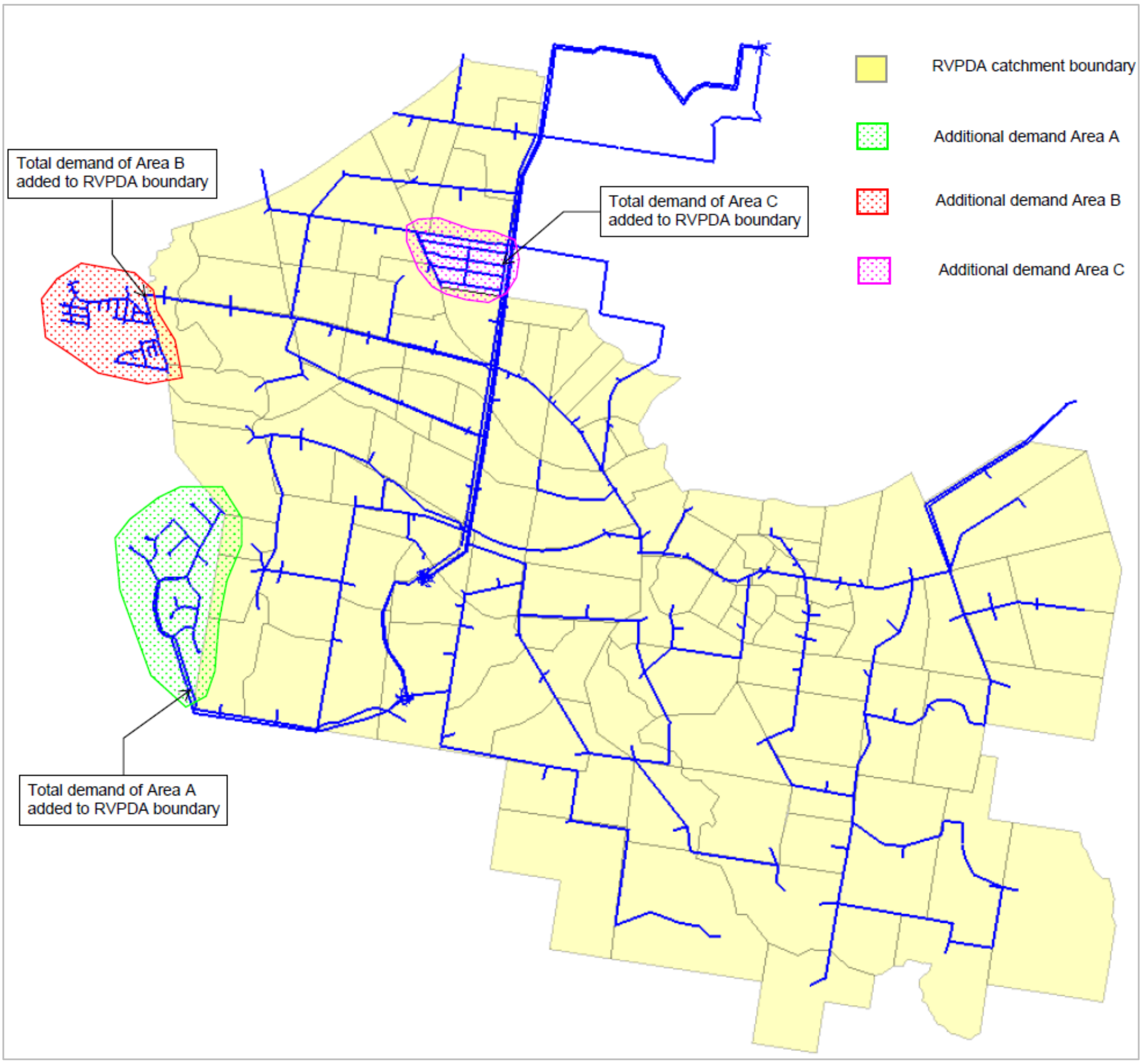


Figure 3-5 Additional Demand Areas Serviced by Infrastructure within the Ripley Valley PDA

3.10 Growth Distribution and Network Layout

The SGS demographic projections broke down the population and employment projections for Ripley Valley into 122 travel zones. The water network planning analysis assumed that when the zone population reached 50, servicing infrastructure is required which then determined the timing of the infrastructure.

The proposed water network is based on the baseline water network provided by Urban Utilities in their trunk water network model, as described in Section 3.8. This water network model was then updated to reflect the estimated demand from Section 3.9, based on the latest SGS population projections. The process and outcomes from updating the water network model are described in the following sections.

3.11 Catchment Analysis (Characteristics and Constraints)

The topography of the Ripley Valley PDA is shown in Figure 3-6. Several high lying areas fall within the PDA that are suitable for placing reservoirs to service the network. The static pressure (no flow) contours/profile with the reservoirs placed at the high points is shown in Figure 3-7.

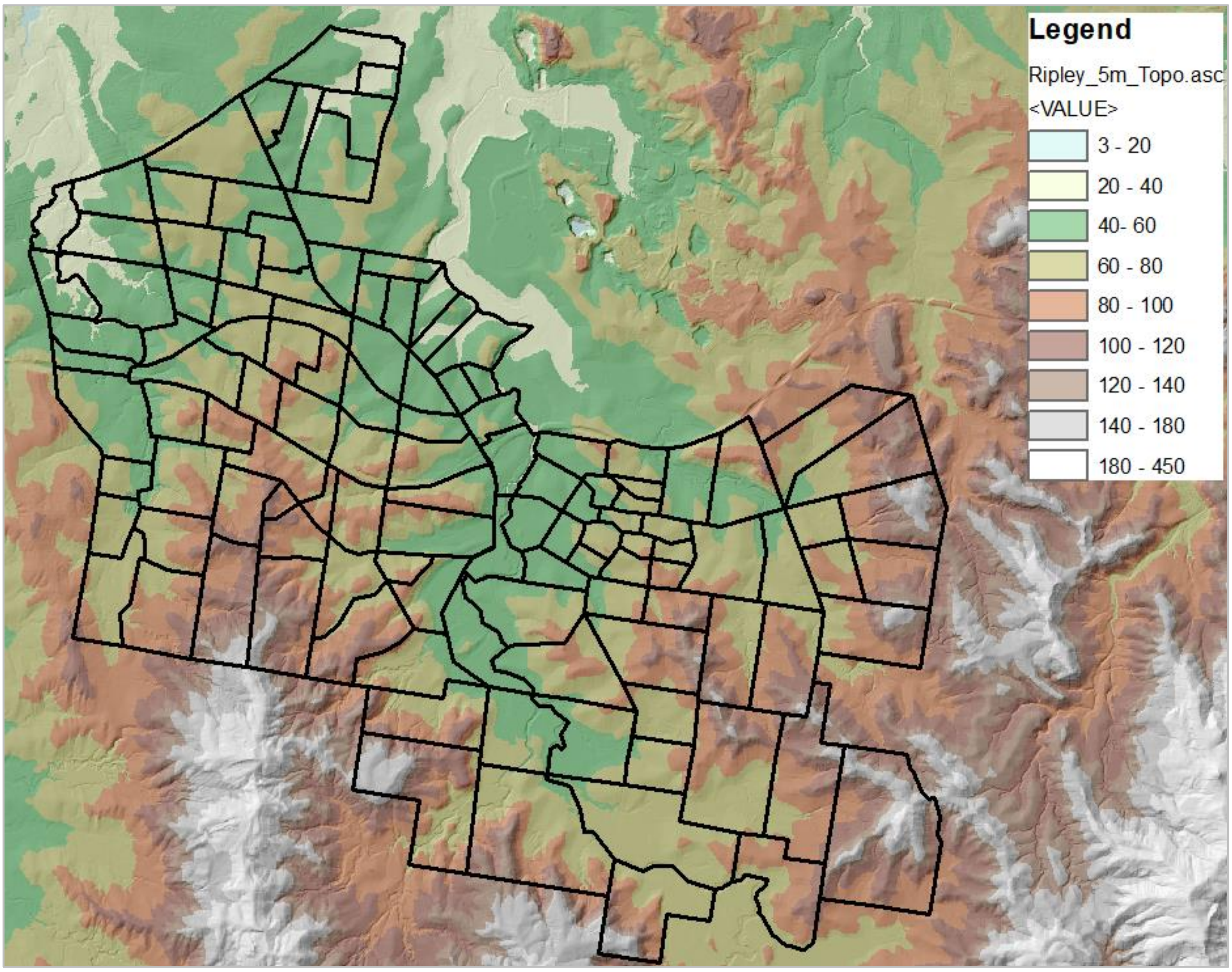


Figure 3-6 Ripley Valley PDA Topography

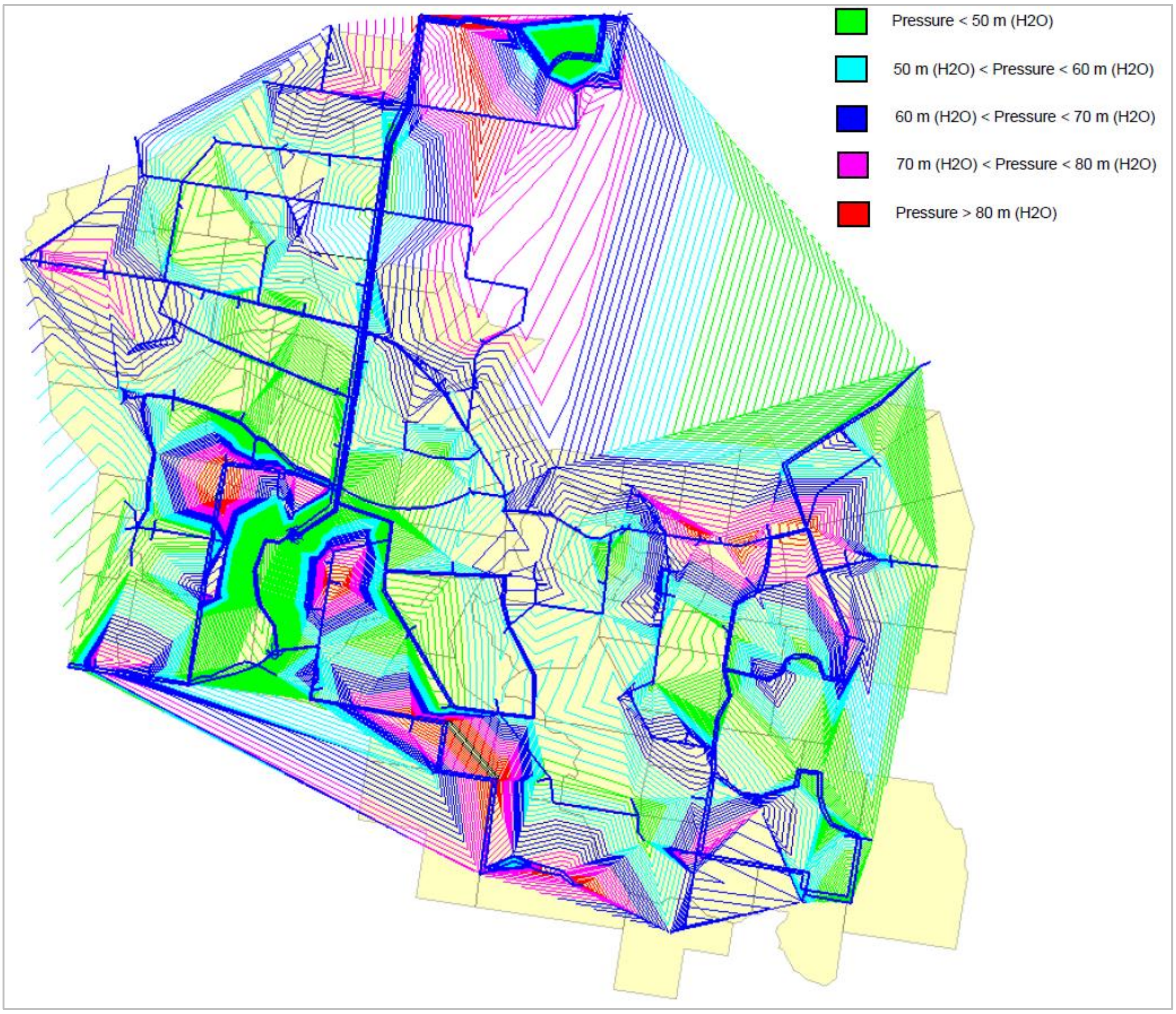


Figure 3-7 Ripley Valley PDA Network Static Pressure

Three pressure zones have been proposed for the Ripley Valley PDA. These are:

- Northern pressure zone - HGL 117 m
- South Western pressure zone - HGL 155 m
- Eastern pressure zone - HGL 142 m.

Figure 3-8 shows these three pressure zones and their relationship to the proposed water network. The network was assessed against the proposed growth profile for the Ripley Valley PDA. The assessment ensured that sufficient capacity is available during peak demand events.

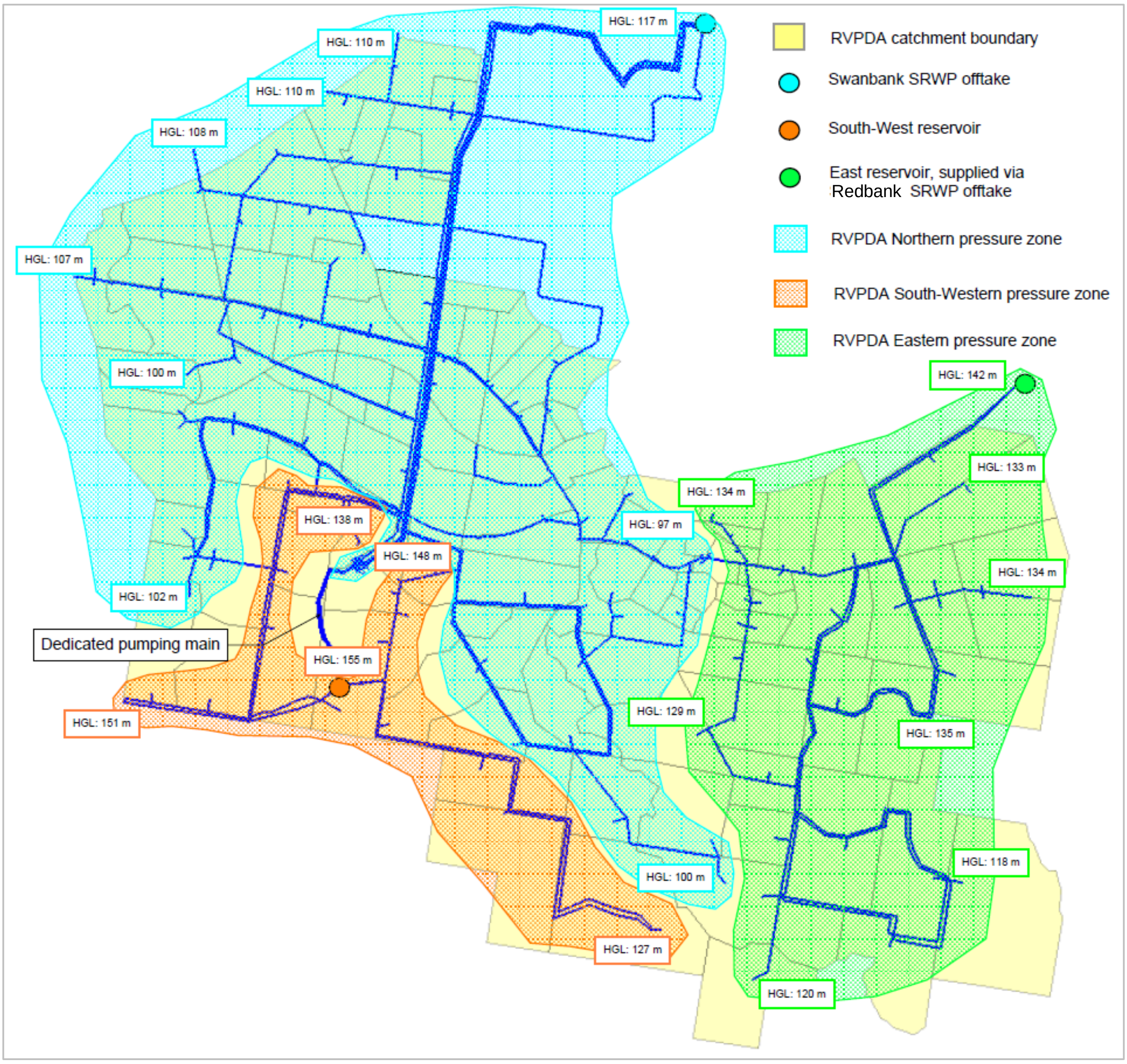


Figure 3-8 Ripley Valley PDA Proposed Water Supply Pressure Zones

3.12 Extent of Hydraulic Modelling

The objective of the hydraulic model was to size the proposed trunk Municipal infrastructure components within the Ripley Valley PDA. Secondary reticulation networks of specific zones were not analysed for the purposes of this design and a head difference of 15m (10m elevation difference & 5m head loss) was assumed from the model point to the property boundary for modelling purposes. A minimum of 37m of pressure head (22 m required at property boundary plus 15m head loss) is thus required at the model points.

The boundaries of the hydraulic model were the following supply points:

- Swanbank SRWP offtake, head of 117m was assumed at this point for modelling purposes
- East Reservoir - no infrastructure upstream of this reservoir was modelled but is assumed to be supplied from the new Redbank offtake from the SRWP to the East of the Ripley Valley PDA. An available head of 142m was assumed upstream of this reservoir for modelling purposes.

- The following scenarios were analysed to check for minimum and maximum service pressures:
- Peak hour during the 2026, 2031, 2041 and 2066 ultimate scenarios for minimum pressures
- Static scenario (all demands closed) for maximum pressures.

The modelling was undertaken based on the parameters outlined above, including to assess staging opportunities and optimise sizing at the 2026, 2031, 2041 and 2066 ultimate horizons. Existing and proposed (relevant IMP's) reticulation pipes were considered where they provided notable hydraulic connectivity to optimise the Municipal network.

It is important to note that the hydraulic modelling was focused on the Municipal infrastructure requirements to service future growth and demand under normal mode of operation. In this context, there are several considerations that require further investigation during detailed planning and design, as follows:

- Fire-fighting requirements and the potential influence of fire flows on the proposed Municipal infrastructure sizing and staging
- Security of supply in the event of asset failure and O&M requirements i.e. consideration of risk implications at the Municipal level
- Preferred operational configuration of the Municipal water network based on QUU's requirements i.e. the potential for sub-zones, district metered areas, pressure managed areas etc.

3.13 **Servicing Strategy**

Supply to the Ripley Valley PDA is assumed to be from the SRWP at the Swanbank offtake and a second proposed Redbank offtake from the SRWP to service the South Eastern section of the PDA, both feeding into balancing reservoirs to service the area.

The SRWP offtakes, pump stations, supply mains and main storage reservoir to the Ripley LLZ zone are Sub-Regional infrastructure for which costs are apportioned on the basis of marginal cost to service the PDA. The downstream infrastructure, including pumps and high-level zone reservoirs and distribution pipelines in the PDA, are identified as Municipal infrastructure servicing the PDA.

Supply zones were determined by analysis of the Ripley Valley topography and the resultant static pressure from the SWRP offtake (117mHGL). Where minimum static pressures in accordance with the Desired Service Standards (DSS) were not able to be achieved, additional higher-level zones were created to achieve the requirement. Zone boundaries also avoided any low-lying areas which would exceed the DSS maximum pressure requirements. The system was then analysed under peak hour demand to determine infrastructure sizes to deliver at least DSS minimum supply pressure at the points of supply in the model.

The approach to infrastructure staging involved overlaying the ultimate water network on the timing of development across the Ripley Valley PDA based on the population projections. The population and employment projection for Ripley Valley is distributed into 122 travel zones. The water network planning analysis assumed that when the zone population reached 50 EP, servicing infrastructure is required. This assumption then determined the timing of the infrastructure. As most zones commence development before 2026, most infrastructure was identified as required in the 2026 planning horizon. Where there were efficiency benefits, Municipal distribution infrastructure was staged to meet demand growth but is generally required by 2041.

Overlaying the development projections for the Ripley Valley PDA on the infrastructure plan and considering the potential for staging of infrastructure, Table 3-5 and Table 3-6 summarise the Municipal water infrastructure required at each planning horizon. It is noted that the DCOP does not include the following:

- Existing infrastructure that has been implemented through to 2020
- Reticulation pipes which are less than 225 mm nominal diameter water main sizes.
- Sub-Regional assets that provide a broader strategic servicing function within and/or beyond the extent of the PDA

The proposed water supply network is shown within Figure 3-9 below.

Table 3-5 Ripley Valley PDA – Municipal Water Infrastructure Requirements and Timing

Nominal diameter	Quantity (m)				
	2026	**2031**	**2041**	**Ultimate**	**Total**
225	16,898	5,929	-	-	22,827
250	10,770	1,258	-	-	12,028
300	19,233	2,244	2,206	-	23,683
375	5,124	3,927	2,827	-	11,878
450	1,169	-	-	-	1,169
525	2,044	936	435	-	3,415
600	587	-	3,424	-	4,011
675	-	312	46	-	358
Totals	**55,825**	**14,606**	**8,938**	**0**	**79,369**

Table 3-6 Ripley Valley PDA – Municipal Water Reservoirs and Pumps Timing

Item	2026	2031	2041	Ultimate
Pressure Reduction Valves	1 x DN300	-	-	-
Water Pump Stations1	1 x 150kW	-	1 x 75kW	-
Water Reservoirs2	1 x 8ML	-	1 x 2ML	-

Notes:

1. The water pump station represents the South Western Supply Pump which is proposed to boost supply from the South Western LL to HL Reservoir. The pump station represents an ultimate capacity of 225 kW (staged in 2026 and 2041).
2. The water reservoir represents the South Western HL Reservoir staged in 2026 and 2041.

3.14 **Adopted Water Network**

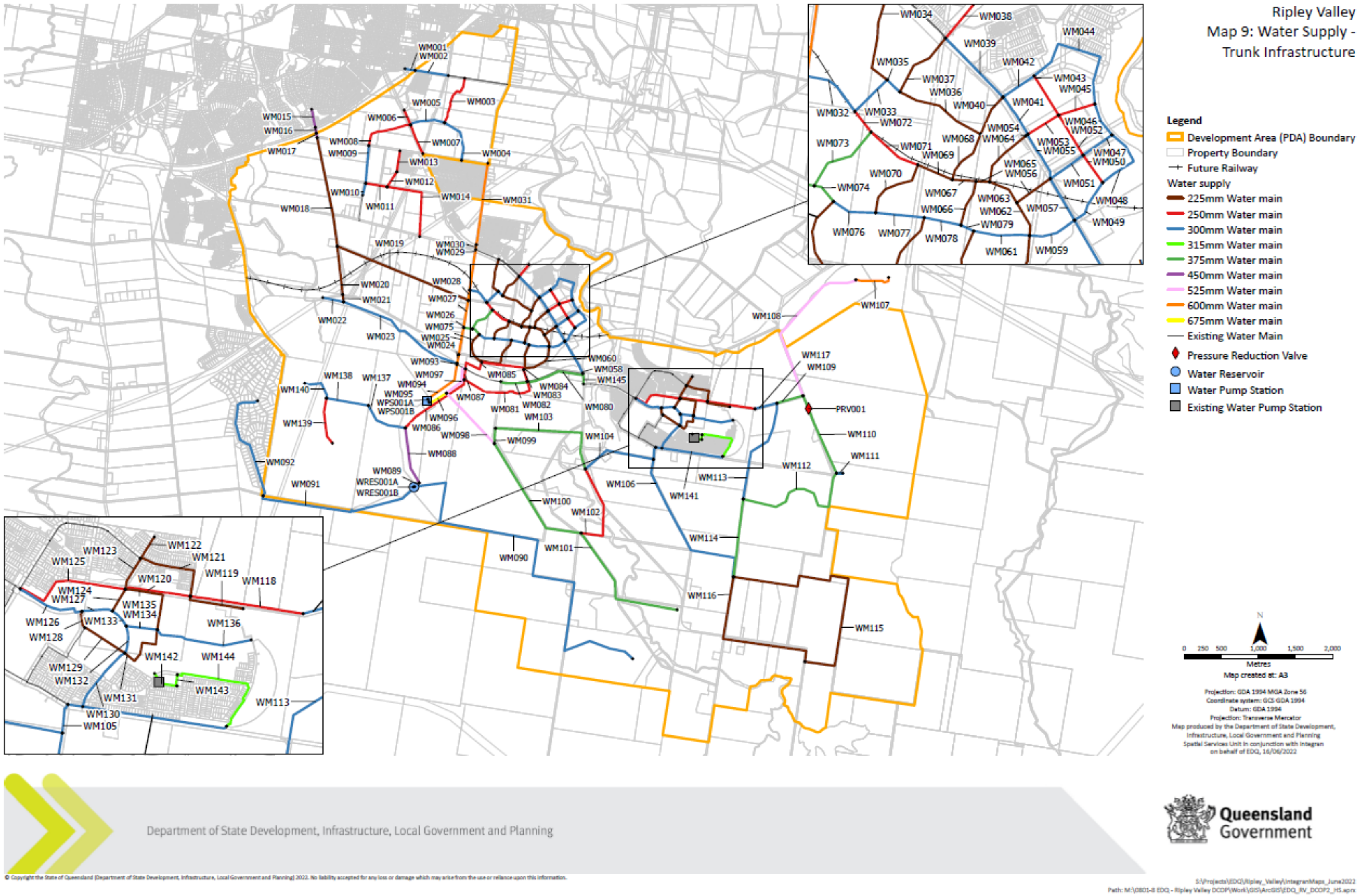


Figure 3-9 Ripley Valley PDA Water Network

3.15 **Opinion of Cost**

Rider Levett Bucknall (RLB) were engaged to develop an opinion of the cost of water infrastructure to service the Ripley Valley PDA. The quantities of water infrastructure were derived from the updated network plan developed as part of this study. Municipal costs for Ripley Valley PDA were then extracted from the RLB estimates and inserted into the Financial Offset Model per planning horizon, the summaries of which can be found within the Schedule of Works containing within the body of this Infrastructure Planning Background Report (IPBR).

3.16 **Cost Apportionment**

There are a number of Municipal water assets subject to cost apportioning as they are proposed to service both PDA and non-PDA development in regard to the Deebing Heights area (beyond the extent of the PDA boundary). This includes the following Municipal assets:

- South Western HL Reservoir (10 ML)
- DN300 water main (3,875m) – South Western HL Reservoir to Deebing Heights

The cost apportioning for these Municipal assets is estimated to be approximately 66% (PDA) and 33% (non-PDA) however the apportioning is not incorporated into the opinion of cost as it remains subject to negotiation between EDQ and QUU, which is beyond the scope of this report. For the purposes of the DCOP the entire cost of these assets (100%) is included in the opinion of cost.

It is noted that there is also Sub-Regional water infrastructure located within the boundary of the PDA, which also services areas outside of the PDA. For this Sub-Regional infrastructure, EDQ will need to agree an apportionment of costs to the PDA with QUU.

4 Sewerage

Ripley Valley PDA lies within the Bundamba trunk sewerage catchment and sewerage services are provided by Urban Utilities. Sewage generated in this catchment is conveyed to Bundamba Sewage Treatment Plant (STP) for treatment and discharge to the Bremer River.

The existing sewerage catchment extent is shown in Figure 4-1 along with the Ripley Valley and Deebing Creek catchments within the Ripley Valley PDA. The current sewerage catchment covers an area of approximately 9,100 hectares and the PDA will increase the serviced catchment by a further 4680 hectares when fully serviced.

The Ripley Valley PDA is separated into two natural catchment, Deebing Creek catchment in the north western corner of the PDA and Bundamba Creek catchment, covering the remainder of the PDA. Deebing Creek catchment drains by gravity to Briggs Road pumping station SP381 via the Deebing Creek trunk sewer. It is then pumped to Bundamba STP via two major sewage pumping stations, Lobley Street SP331 and Hanlon Street SP322.

The remainder of the Ripley Valley PDA drains via gravity to the temporary Nevis Street pumping station SP384. From there sewage is pumped to Bundamba STP via the Hanlon Street SP322 and the Bundamba Trunk Sewer.

The existing Bundamba sewerage network is shown in Figure 4-1 and a schematic diagram of the sewerage network is presented in Figure 4-3.

As part of the Ripley Valley PDA DCOP review, a hydraulic model of the potential sewer network required to service the Bundamba Creek and Deebing Creek areas within the PDA was developed. The sewer network was used to estimate the infrastructure requirements to service projected growth in the catchments up to and including the year 2066.

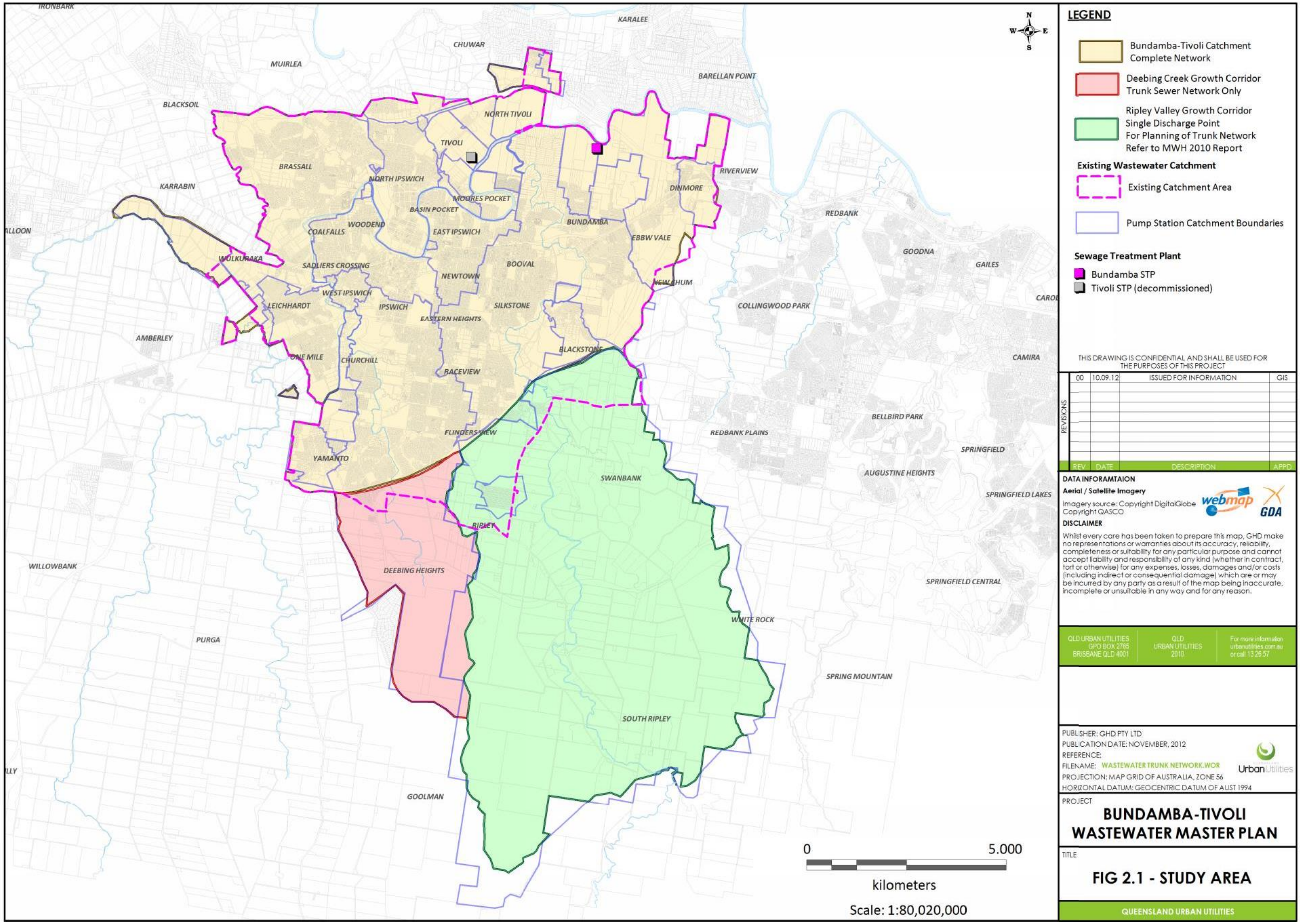


Figure 4-1 Bundamba Sewerage Network Catchment Including the Ripley Valley PDA

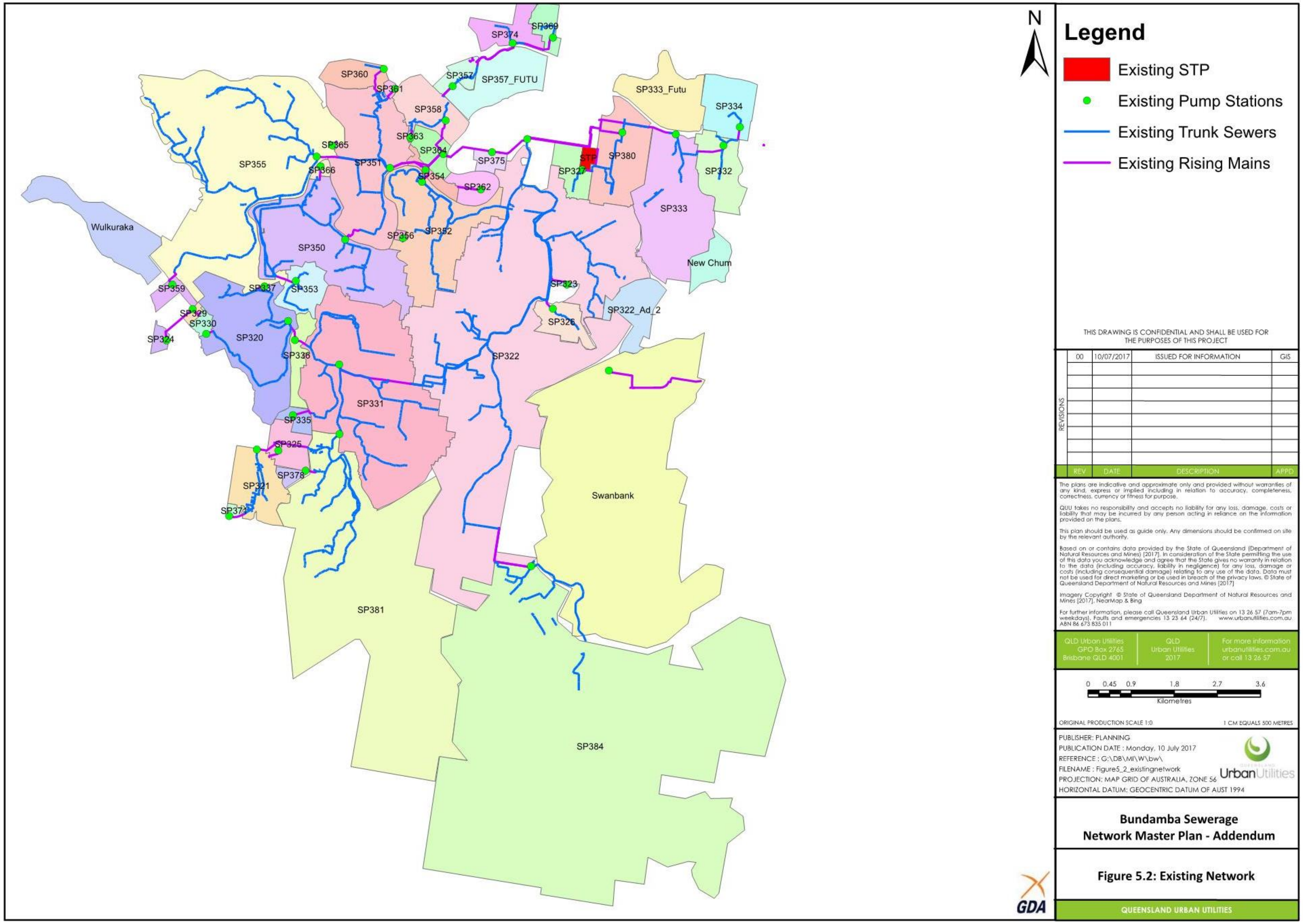


Figure 4-2 Existing Bundamba Sewerage Network

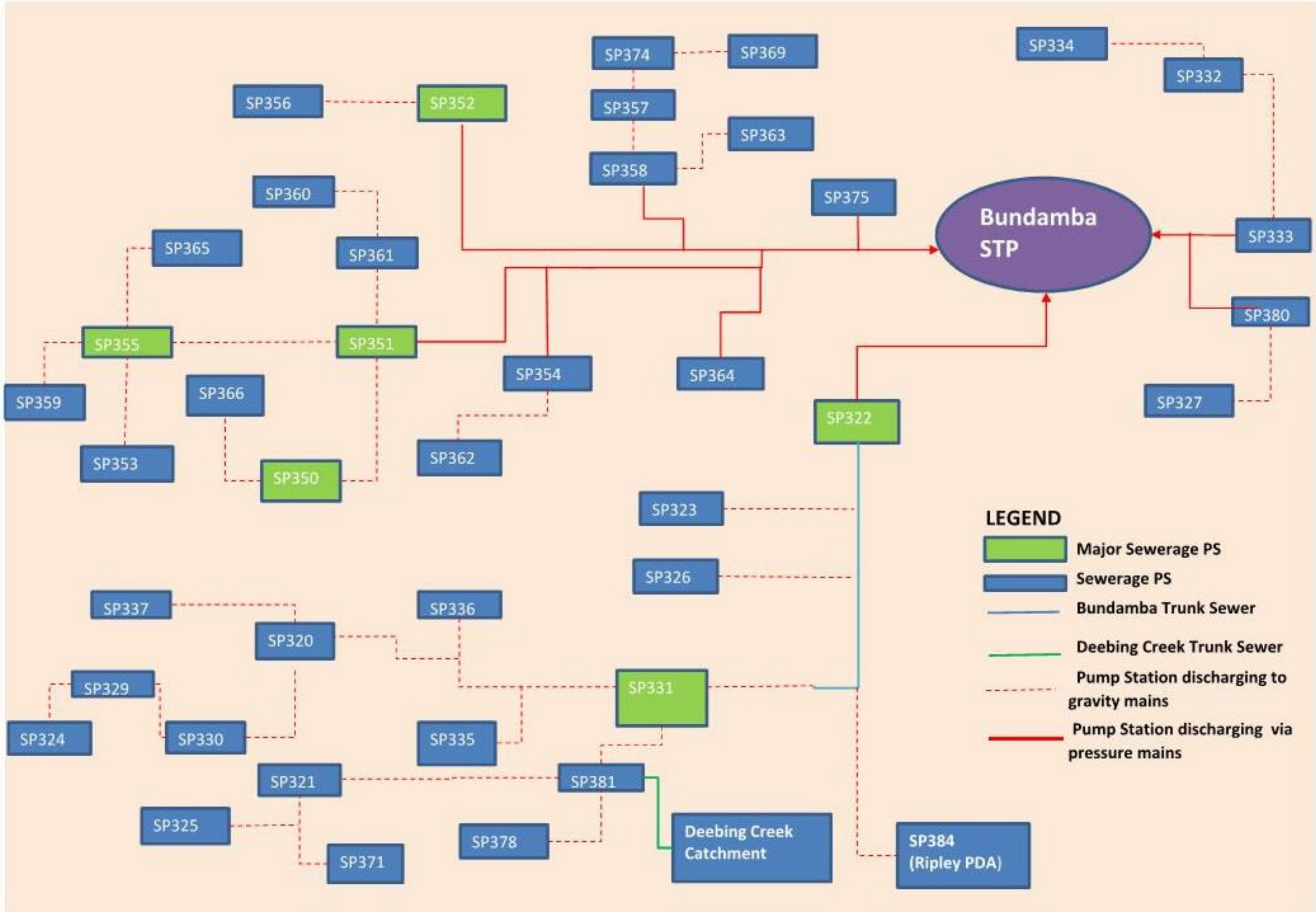


Figure 4-3 Existing Bundamba sewerage network schematic diagram

4.1 Reference Standards

The following standards were referenced for the purposes of planning the Municipal sewerage infrastructure in the Ripley Valley PDA:

- Gravity Sewer Supply Code of Australia Version 3.1, July 2014 (WSA 02-2014)
- Southeast Queensland Water Supply and Sewerage Design and Construction Code, July 2013 (SEQ Code)
- Urban Utilities Desired Standards of Service (DSS) as defined in the Urban Utilities Water Netserv Plan Version 1, March 2020.

4.2 Past Reports and Development IMPs

The following reports were referenced in this analysis:

- Bundamba and Tivoli Sewerage Master Plan 2007
- Wastewater Master Plan for Bundamba-Tivoli 2013
- Ripley Valley PDA Sewerage Servicing Planning Study – Options Assessment 2017
- Bundamba Sewerage Master Plan – Addendum 2017
- Bundamba STP Mainstream Upgrade Feasibility Study 2018
- Preliminary Assessments of the Revised Ripley Valley Servicing Strategy 2018
- Bundamba STP Master Plan 2019
- Ripley/Bundamba Integrated Servicing Plan 2019

The following infrastructure master plans (IMPs) have been referenced in the analysis:

- Constant 13 4/2011/ILUP IMP
- Monterea Land Holdings Pty Ltd 29/2013/PDA IMP
- Goldfields 2018 IMP
- Satterleys 2013 IMP
- Sekisui House 2013 IMP
- Amex Providence 7566/2017/MAPDA IMP
- RP Property Ventures 6226/2018/PDACA IMP
- Intrapac 2020 IMP
- Amex East 2013 IMP
- South Ripley Developments 9521/2018/PDA IMP
- Amex West 3/2012/ILUP IMP
- McHale South 26/2013/PDA IMP
- Stockland 2018 IMP
- HB Doncaster 2020 IMP

4.3 Desired Standards of Service

The SEQ Code, Urban Utilities' DSS and the Sewer Supply Code of Australia (WSA 03-2011) formed the basis of the hydraulic modelling and network planning and were outlined in this report.

The DSS were adopted for assessing existing network performances and for sizing new infrastructure. The DSS are the same as used for the Wastewater Master Plan for Bundamba-Tivoli (February 2013). The Ripley Valley PDA is being developed as a NuSewer area with fully welded pipes, which reduces the infiltration and inflow potential and consequential reduction in peak wet weather flows.

The key criteria for the sewerage network planning are detailed in the Table 4-1. Maximum flow depth was the primary performance criterion used for pipe sizing.

Table 4-1 Ripley Valley PDA Sewer Network Planning Criteria

Sewerage Desired Standards of Service (DSS)	
Parameter	**Criteria**
Average Dry Weather Flow (ADWF)	Existing sewer 210 L/EP/day NuSewer 180 L/EP/day
Non-residential demand	1 job = 1 EP
Peak Wet Weather Flow (PWWF)	Existing 5 x ADWF NUSewer 3.64 x ADWF
Maximum depth of flow (at PWWF)	70% for planned pipes 100% for existing pipes
Gravity sewer requirements (conventional) Roughness equation Pipe friction coefficient	Manning's equation All smart sewers (NuSewer and RIGS) – n = 0.128

4.4 Stakeholder Engagement

The wastewater servicing strategy presented in this report was developed in consultation with EDQ and Urban Utilities, both of which provided a significant amount of information and data to reference in this study.

Two stakeholder engagement workshops were held with EDQ and Urban Utilities:

- Workshop 1 – Wednesday, 29 January 2020 – Aurecon reported back to EDQ and Urban Utilities on progress in obtaining and collating all the relevant wastewater planning information and data and discuss any gaps
- Workshop 2 – Monday, 24 February 2020 – present progress on wastewater network planning, discuss outstanding gaps and issues and present draft innovation opportunities.

In addition to these structured workshops, regular communication and collaboration occurred with EDQ and Urban Utilities to confirm approaches and assumptions and to resolve issues as planning progressed.

Urban Utilities were also given the opportunity to review the wastewater network modelling and provide feedback on the wastewater servicing plan. The wastewater network modelling for the Ripley Valley PDA was then updated to incorporate this feedback and address any issues identified by the Urban Utilities sewer planner.

4.5 Innovation by Design

Given the majority of innovation by design options available to water supply, sewerage and stormwater are collectively known as Integrated Water Management, these have been consolidated and expanded upon within Chapter 6.

4.6 Sub-Regional Servicing Strategy

The Sub-Regional servicing strategy for the Ripley Valley PDA has undergone several changes since the Sewerage Master Plan was first developed to incorporate growth within Ripley Valley PDA in 2007.

The key strategies developed over the last 13 years are:

- Bundamba and Tivoli Sewerage Master Plan 2007 - Ipswich Water developed a servicing strategy to convey both Ripley Valley and Deebing Creek catchment flows to Bundamba STP via gravity.
- Wastewater Master Plan for Bundamba-Tivoli 2013 - Urban Utilities updated the strategy to incorporate revised population projections and development information. The revised strategy focused on options to upgrade the Bundamba Trunk Sewer (BTS) which conveys flows from Ripley Valley PDA to Bundamba STP. The preferred option involved a combined pressure/gravity sewer, operating as a gravity sewer in dry weather and a pressure sewer in peak flow conditions.
- Ripley Valley PDA Sewerage Servicing Planning Study – Options Assessment 2017 – Urban Utilities explored alternative options to service the Ripley Valley PDA. The preferred option involved discharging to Bundamba STP until 2026 and then diverting sewer flows from Ripley Valley and Deebing Creek catchments to a new Ripley Valley STP. This was a significant change in strategy and was primarily driven by capacity future constraints at Bundamba STP.
- Bundamba Sewerage Master Plan – Addendum 2017 – Urban Utilities updated their sewerage master plan to capture the revised infrastructure requirements under the revised strategy involving a new Ripley Valley STP. Minor augmentations to the BTS were identified but major augmentation of the BTS was deferred until beyond 2046.
- Bundamba STP Mainstream Upgrade Feasibility Study 2018 – The introduction of Urban Utilities' Bubble Licence for managing nutrient discharges to waterway, along with reductions in trade loads at Bundamba STP, presented an opportunity to reconsider the proposed Ripley Valley STP. This capacity review suggested that, even with the required trunk sewer upgrades, centralising sewage treatment at Bundamba STP will provide $137 million cost savings over the life of the scheme.
- Preliminary Assessments of the Revised Ripley Valley Servicing Strategy 2018 – In light of the change in strategy, Urban Utilities recommended the adoption of the combined pressure/gravity sewer upgrade option for the BTS from the Wastewater Master Plan for

Bundamba-Tivoli 2013 as the business-as-usual trunk sewer augmentation to support growth in the Ripley Valley PDA. A layout plan of the proposed BTS augmentation is presented in Figure 4-4.

- Bundamba STP Master Plan 2019 – Based on the outcomes of the Bundamba STP Mainstream Upgrade Feasibility Study, Urban Utilities updated their Bundamba STP Master Plan and capital investment program to reflect the change back to a centralised strategy where flows from Ripley Valley PDA would be conveyed to Bundamba STP for treatment.
- Ripley/Bundamba Integrated Servicing Plan 2019 - Urban Utilities has also been exploring effects-based planning options to manage wet weather flows closer to the source and provide better environmental outcomes at lower cost to the community. They have identified a potential site near the Nevis Street Pumping Station in the Ripley Valley PDA as a potential site for an effects-based water weather management solution.

The current Sub-Regional sewerage servicing strategy for the Bundamba catchment provides for a population increase from 92,000 EP (based on sewerage characterization) to 257,000 EP.

The recommended strategy in the Bundamba STP Master Plan (July 2019) is to centralise treatment at the Bundamba STP with a major bioreactor upgrade (additional bioreactor) and outfall upgrade in 2032/2033 (estimated to cost $36.5 million). In addition, the following items are proposed for delivery prior to the major upgrade:

- Minor upgrade projects are required to realise the full capacity of the existing STP at an estimated cost of $7.4 million
- Renewals and safety improvements (estimated to cost $19.1 million)
- A new effluent disinfection process using ultra-violet light to replace the existing chlorine-based disinfection because of chlorine toxicity concerns for the Bremer River. The cost for this project is estimated at $3 million. Further investigation of actual chlorine toxicity was recommended to confirm the requirement for this upgrade.

To cater for the growth of the catchment, including Ripley Valley PDA, the receiving Bundamba Trunk Sewer will also need to be upgraded, as shown in Figure 4-4.

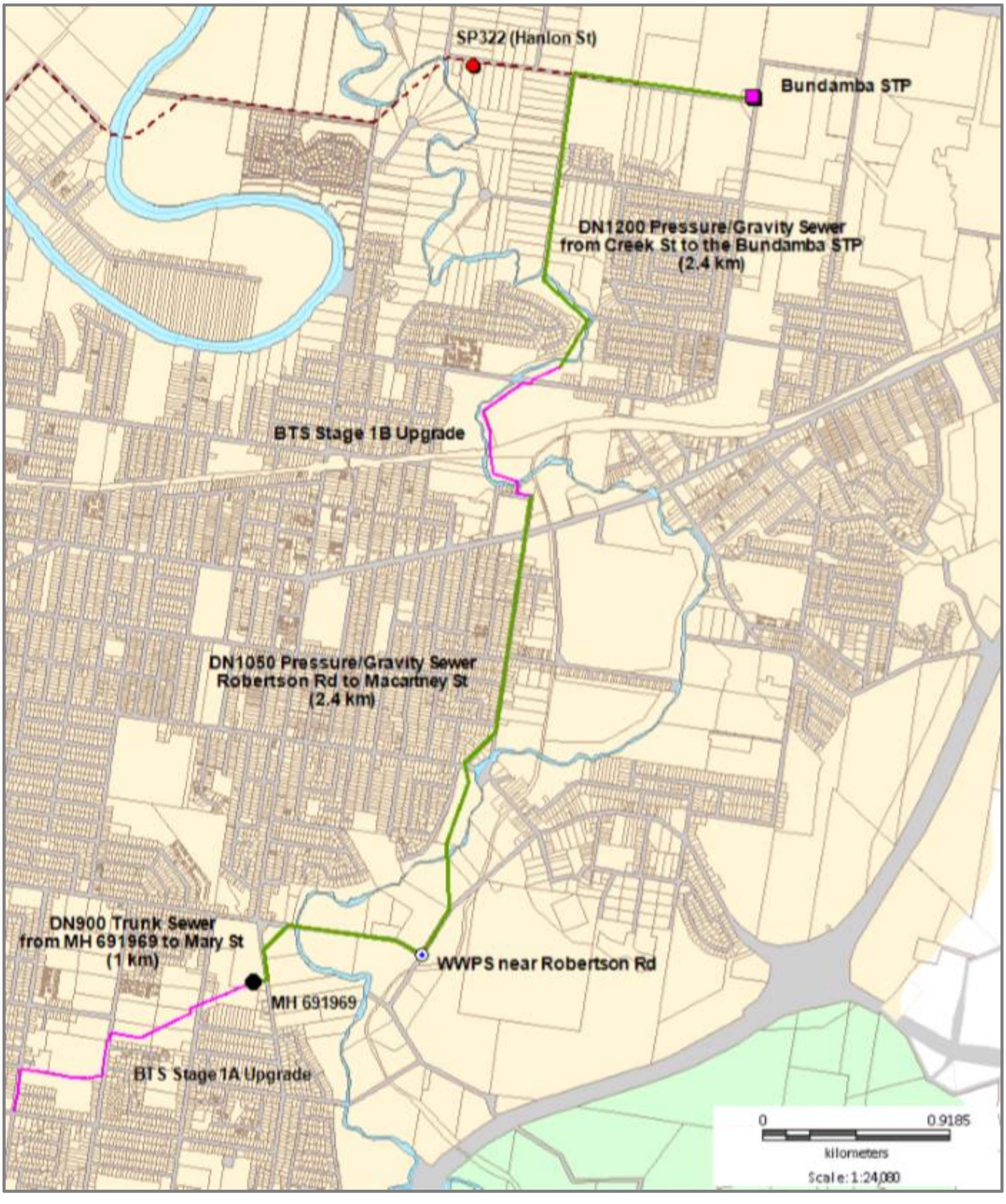


Figure 4-4 Layout plan of the proposed BTS augmentation from Wastewater Master Plan for Bundamba-Tivoli 2013

4.7 Population Projections and Hydraulic Loading

The updated SGS growth projections presented in Section 2.4 were converted into wastewater flow projections to enable infrastructure planning to be updated. Table 4-2 shows the population data adopted in the wastewater modelling.

Four growth horizons have been considered for the development of the sewerage network - 2026, 2031, 2041, and 2066 (ultimate). Employment has been accounted for by adopting a conservative approach of assuming 1 employed person is equivalent to 1 resident person in each zone.

Table 4-2 Ripley Valley PDA Population and Employment Projections

Description	2021	2026	2031	2041	2066
Population (EP)	13,745	33,521	56,745	94,491	135,004
Employment (EP)	2,104	4,082	6,403	10,179	14,232
Total PDA (EP)	**15,849**	**37,603**	**63,148**	**10,4670**	**149,236**

The SGS demographic projections broke down the population and employment projections for Ripley Valley PDA into 122 travel zones. The analysis assumed when the zone population reached 50 EP, servicing infrastructure was required, which then determines the timing of servicing infrastructure.

The proposed sewer network is based on the baseline sewer network provided by Urban Utilities in their trunk sewer network model. This sewer network model was then updated to reflect the updated SGS population projections and the developments IMPs. The process and outcomes from updating the sewer network model are described in the following sections.

The model network was sized to convey the Peak Wet Weather Flow (PWWF) from the projected growth areas. PWWF was calculated using the sewerage network criteria above. Flows are modelled based on EP, whereby 1 EP directly corresponds to population in the model. For example, a sub-catchment with a population of 300 has an EP of 300.

To generate PWWF profiles, the modelled network has been divided into existing sewers and NuSewer. Existing pipes along the Bundamba – Tivoli wastewater network model alignments are considered existing sewer. The remainder of the network is considered NuSewer.

The following assumptions were made to determine the future flows:

- Average Dry Weather Flow (ADWF) of 210 L/EP/day was adopted for existing pipes
- An ADWF of 180 L/EP/day was adopted for NuSewer pipes
- Peak Wet Weather Flow (PWWF) for existing pipes is 5 times the ADWF which equates to 1050 L/EP/day
- Peak Wet Weather Flow (PWWF) for new pipes has been assumed as NuSewer is 3.64 times the ADWF which equates to 655 L/EP/day.

All sub-catchments within the Ripley PDA were assumed to be NuSewer connecting to NuSewer and therefore a PWWF of 655 L/EP/day was applied.

An example of the flow profile applied in the network model to generate PWWF is shown in Figure 4-5. The profile shows the multiplication factor applied to the ADWF across a day to generate the PWWF. This profile was adopted from the Bundamba – Tivoli WW network model.

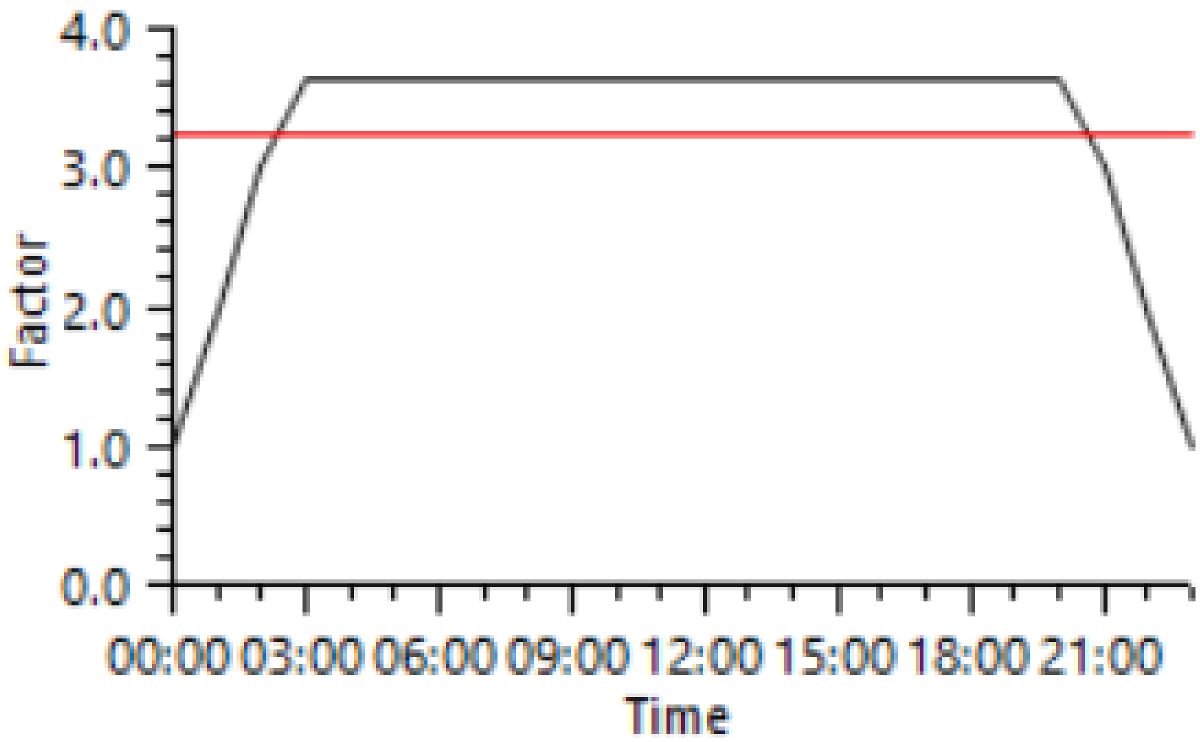


Figure 4-5 NuSewer PWWF Profile - the profile shows the multiplication factor applied to the ADWF across a day to generate the PWWF

4.8 Catchment Analysis (Characteristics and Constraints)

The Ripley Valley and Deebing Creek catchments are presented in **Error! Reference source not found.** above.

The Ripley Valley PDA, as the name suggests, is predominately within the Bundamba Creek valley which drains from the south to north, and the servicing sewers follow the drainage lines of the valley. The western edge of the Ripley Valley PDA also covers the adjacent Deebing Creek valley that also drains from south to north into a separate part of the receiving Bundamba sewerage system. Being natural upper catchment valleys with ample gradient and not crossing ridge lines, the area can be primarily served by gravity sewers.

4.9 Extent of Hydraulic Modelling

The modelled sewerage network has been developed from a mixture of data sources, listed in Table 4-3 below. These sources include GIS data and previous models developed for the area and the wider Bundamba – Tivoli region.

A small portion of the Ripley Valley PDA has been developed to date and is serviced by a limited amount of existing network. This network drains to the Nevis Street Pump Station, from which it is conveyed via a rising main to a sub-main network along Monterea Road. The existing network is shown in Figure 4-6.

This network is currently in place in the PDA, so it has been adopted as the basis for the modelling. That is, within the extent of the existing network, the model network corresponds with existing sewers.

The Nevis Street Pump Station is currently in place to service the sewer network developed for the current population of Ripley Valley south and west of Nevis Street. Data provided by Urban Utilities indicates the pump is automatically activated by water levels at the station and can pump at a maximum rate of 25 l/s.

Table 4-3 Ripley Valley PDA Sewer Network Data Sources

Item	Format	Source	Comment
Bundamba – Tivoli WW network model	ICM model network	Urban Utilities	This dataset provides a small portion of network for the current modelling to connect into.
Sewer Gravity Main 2	Esri shapefile	EDQ	This dataset provides the alignment and sizes of a limited number of trunk main pipes in the Ripley Valley PDA.
Existing PDA Sewers	Esri shapefile	Urban Utilities	This dataset provides the limited existing network in the PDA.
2009 Opus Sewerage Strategy	ICM model network	Urban Utilities	This dataset provides the alignment, sizes, and initial levels of the trunk main and sub-main pipes in the Ripley Valley PDA.

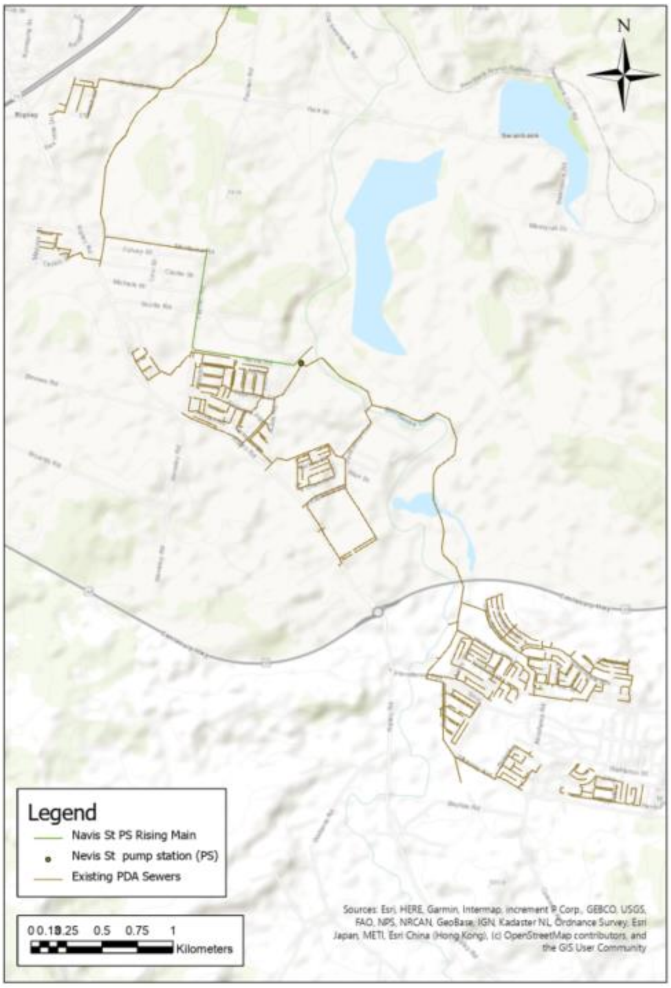


Figure 4-6 Existing Sewers in Ripley Valley PDA, Including the Nevis St Pump Station and Rising Main

The preliminary sewerage network model was developed in Innovyze ICM (Version 9.5). The network layout and pipe sizing were developed using a combination of data sources and assigning priority levels to the data from the various sources. The order of priority adopted, from highest to lowest, was:

1. Existing PDA_Sewers (blue pipes)
2. Sewer Gravity Main 2 GIS layer (red pipes)
3. Bundamba – Tivoli WW network model (orange pipes)
4. 2009 Opus Sewerage Strategy (black pipes).

The resulting network layout, and respective data sources, is shown in Figure 4-7.

Pipe invert levels were initially set using levels in the existing PDA Sewers, Bundamba – Tivoli WW network model, and the 2009 Opus Sewerage Strategy. However, pipe levels adopted from the 2009 Opus Sewerage Strategy have been adjusted in places to ensure adequate cover depths.

Network sections generated from the Sewer Gravity Main 2 GIS layer did not have any level data associated with them, so pipe inverts have been inferred to ensure network connectivity and grade continuity where possible. Data flags were used to record the source of level data and pipe diameters.

Ground levels for nodes were inferred from a combined 1 m grid ground model generated from 1 m DEMs for the Bundamba Creek and Deebing Creek catchments available from the Ipswich City Council website.

Sub-catchments for the network have been generated from the SGS GIS layer of travel zones. Each sub-catchment contains a population attribute corresponding to the projected population at each growth horizon. Employment has also been accounted for in the sub-catchment population attributes. In areas of the network outside of the Ripley Valley PDA, sub-catchments in the 2009 Opus Sewerage Strategy model network have been retained and applied.

Further information regarding the hydraulic modelling can be reference in the supplementary technical memo “Ripley Valley PDA – Water & Sewer Network Modelling (Phase 2)”. The modelling was undertaken based on the parameters outlined above, including to assess staging opportunities and optimise sizing at the 2026, 2031, 2041 and 2066 ultimate horizons

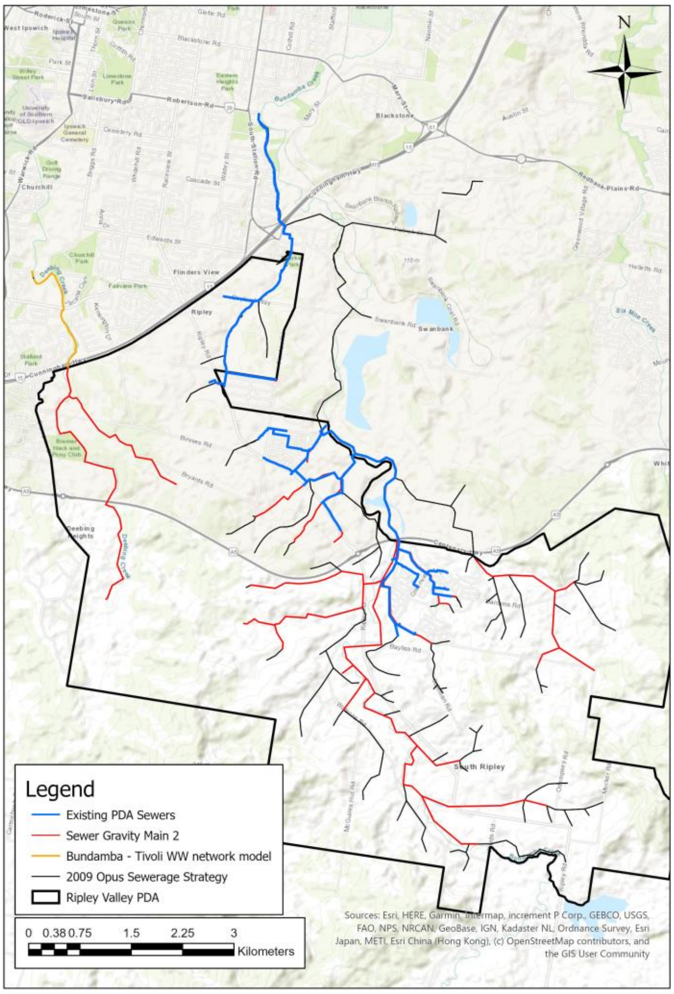


Figure 4-7 Ripley Valley PDA and Deebing Creek Preliminary Sewer Network Extent and Data Sources

4.10 Servicing Strategy

The Ripley Valley PDA is predominately within the Bundamba Creek valley which drains from the south to north, and the servicing sewers follow the drainage lines of the valley. The western edge of the Ripley Valley PDA also covers the adjacent Deebing Creek valley that also drains from south to north into a separate part of the receiving Bundamba sewerage system. Being natural upper catchment valleys with ample gradient and not crossing ridge lines, the area can be served by gravity sewers.

The layout for the preliminary sewer network for the Ripley Valley PDA has been primarily defined by the topography of the PDA. The areas that gravitate into the network and their ultimate population has determined the sewage flows and the grade of the land have then determined the pipe sizes and invert levels to accommodate the PWWF for the ultimate growth horizon (2066).

The approach to staging of infrastructure across the four planning horizons involved overlaying the ultimate sewer network on the timing of development across the Ripley Valley PDA based on the population projections. The population and employment projections for Ripley Valley is distributed into 122 travel zones. The sewer network planning analysis assumed that when the zone population reached 50, servicing infrastructure is required. This assumption then determined the timing of the infrastructure and because most zones commence development before 2026, most of the required infrastructure was allocated to the 2026 planning horizon. Because of the typical depth of sewers and the requirements of grades, duplication of sewers has only been considered where the existing sewer reaches capacity.

The Ripley Valley PDA currently discharges to the existing trunk sewer network at two locations:

- The Deebing Creek catchment drains to SP 381 via the Deebing Creek gravity sewer
- The remainder of the Ripley Valley PDA primarily drains to the Nevis Street pump station which lifts flows into the Bundamba system and on to SP322 and the Bundamba Trunk Sewer.

The Deebing Creek gravity sewer was adopted as the long-term solution to receive flows from the Deebing Creek catchment.

Nevis Street pump station was designed as an interim solution, with a capacity of 25 L/s. It will become significantly undersized by the nearest growth horizon 2026, at which time expected flow at this location is approximately 220 l/s. Therefore, a new gravity sewer was adopted as the long-term solution to received flows from the Ripley Valley catchment. Further detailed planning and options assessment is recommended to explore alternative sewerage servicing options for this area.

Overlaying the development projections for the Ripley Valley PDA to the infrastructure plan and considering the potential for staging of infrastructure, Table 4-4 summarise the Municipal sewer infrastructure required at each planning horizon. The DCOP does not include the following:

- Existing infrastructure that has been implemented through to 2020.
- Reticulation infrastructure including sewer pipes which are less than 300mm nominal diameter (unless they are proposed to perform a Municipal function for trunk connectivity and capacity purposes).
- Sub-Regional assets that provide a broader strategic servicing function within and/or beyond the extent of the PDA.

The proposed sewer network and future infrastructure requirements is shown within .

Table 4-4 Ripley Valley PDA - Municipal Sewerage Infrastructure Requirements and Timing

Nominal diameter (mm)	Quantity (m)				
	2026	**2031**	**2041**	**2066**	**Totals**
300	10,532	363	-	-	10,895
375	4,332	-	69	-	4,401
400	2,898	-	317	-	3,215
450	4,222	-	-	-	4,222
500	1,621	931	-	-	2,552
525	936	128	101	-	1,165
560	468	-	-	-	468
600	4,014	281	193	-	4,488
675	40	-	-	-	40
Totals	**29,063**	**1,703**	**680**	**0**	**31,446**

4.11 Adopted Sewerage Network

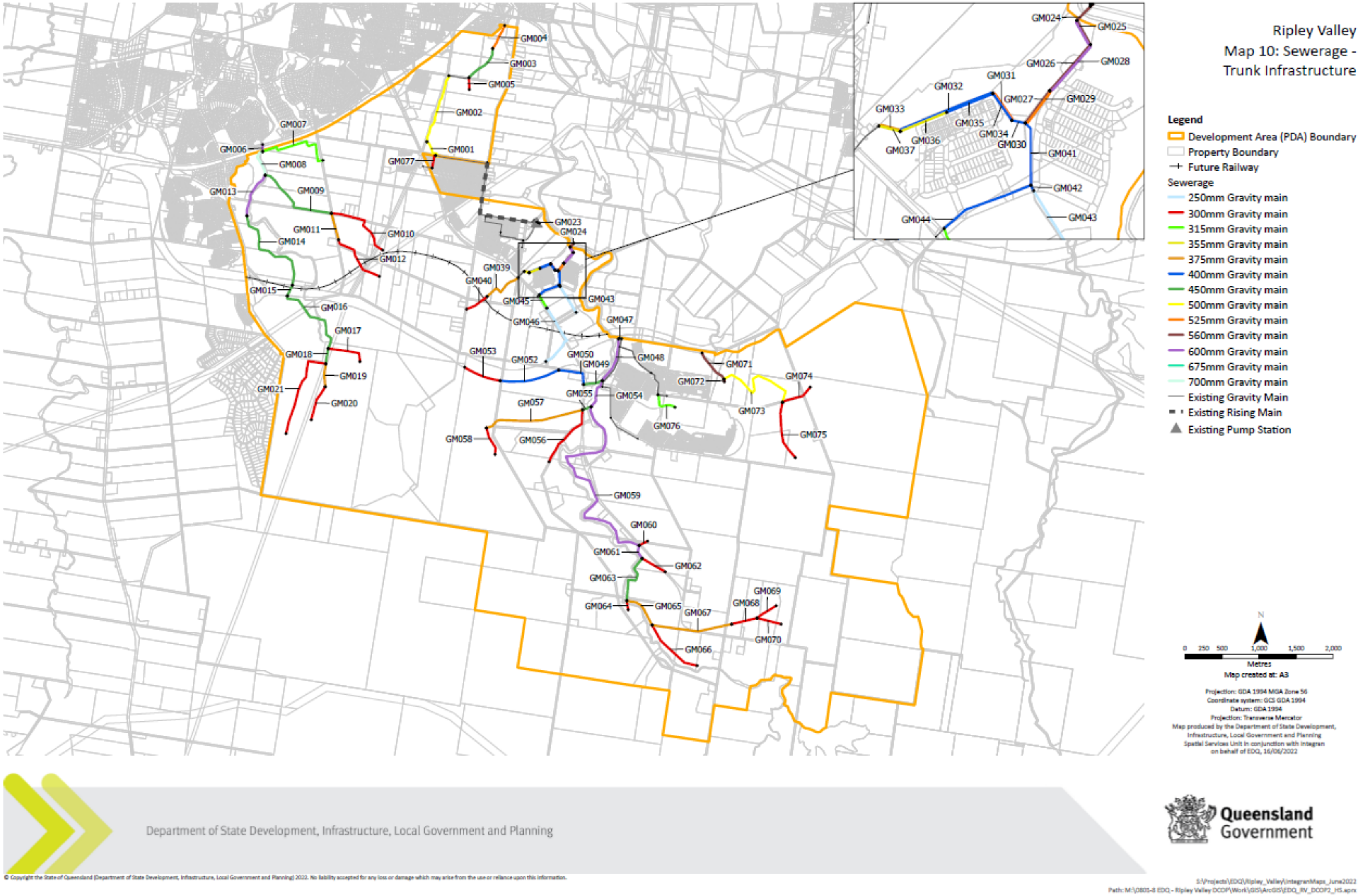


Figure 4-8 Ripley Valley PDA Sewer Network

4.12 **Opinion of Cost**

Rider Levett Bucknall (RLB) were engaged to develop an opinion of the cost of sewerage infrastructure to service the Ripley Valley PDA. The quantities of sewerage infrastructure were derived from the updated network plan developed as part of this study. Municipal costs for Ripley Valley PDA were then extracted from the RLB estimates and inserted into the Financial Offset Model per planning horizon, the summaries of which can be found within the Schedule of Works containing within the body of this Infrastructure Planning Background Report (IPBR).

4.13 **Cost Apportionment**

There is no cost apportionment related to municipal sewer infrastructure within the PDA.

5 Stormwater

5.1 Reference Standards

For Ripley Valley Priority Development Area (PDA), Economic Development Queensland (EDQ) has developed a guideline with engineering standards for the design and construction for service infrastructure including stormwater infrastructure, PDA Guideline no.13, May 2015. The document lists legislative and reference standards in relation to quantity and quality management, as follows:

- Quantity:
    - The Queensland Urban Drainage Manual (QUDM)
    - Australian Rainfall and Runoff Guideline (ARR).
- Quality:
    - Queensland Environmental Protection (Water) Policy 2009
    - Queensland State Planning Policy 2013 – water quality
    - Water by Design: Concept Guidelines for WSUD 2009
    - Water by Design: WSUD technical guidelines in SEQ 2006
    - Water by Design: Bioretention Technical Guidelines 2011
    - Water by Design: Framework for the Integration of Flooding and Stormwater Management.

The guideline states that this is a starting point for the development scheme and the development applications may specify a different standard where innovative solutions can be proposed in consultation with the Minister for Economic Development Queensland (MEDQ).

The Ripley Valley PDA sits within the Ipswich City Council (ICC) local government area (LGA) and EDQ has delegated the approvals process to ICC. Changes to these standards based on incorporation of innovative total water cycle management (TWCM) principles should be considered as these solutions evolve. Details of potential TWCM solutions are outlined in Chapter 6.

The Ipswich City Council Planning Scheme – Implementation Guideline No 24, Stormwater Management is the primary reference document for compliance from a stormwater perspective. This document refers to the Environmental Protection (Water) Policy, 2009 and the State Planning Policy (SPP), July 2014 and refers to several sub-sections of the Planning Scheme and best practice and industry standard guidelines, including:

- Quantity
    - Institute of Public Works Engineering Australasia (2017), Queensland Urban Drainage Manual, Fourth Edition (QUDM)
    - Ipswich City Council (2013), Ipswich Planning Scheme, Part 11 – Overlays, Section 11.4.7 – Flooding and Urban Catchment Flow Paths.
- Quality
    - Queensland Department of Environment and resource Management (2010), Urban Stormwater Quality Planning Guideline (Chapter 2)

- Healthy Waterways (2006), Water Sensitive Urban Design – Technical Design Guidelines for Southeast Queensland
- Water by Design (2014), Bioretention Technical Design Guidelines.

It is noted that the State Planning Policy now July 2017 update which refers to State interest policies and assessment benchmarks.

Secondary documents and data sources referenced include:

- Quality
  - Water by Design (2010), Deemed to Comply Solutions - Stormwater Quality Management (Southeast Queensland)
  - Water by Design (2010), Deemed to Comply Worked Solutions and Examples, Stormwater Quality Management (Southeast Queensland)
  - Ipswich City Council (2010), Waterway and Channel Rehabilitation Guidelines – Final V3
  - Ipswich City Council (2015), Ipswich Integrated Water Strategy 2015 – A Total Water Cycle Framework for Ipswich
  - Healthy Waterways (2006), Water Sensitive Urban Design- Technical Guidelines for Southeast Queensland.
- Quantity
  - Ipswich City Council Planning Scheme – Sub-Regional Detention Basin locations map (2013)
  - Ipswich City Council – 1% AEP flooding extent GIS layer.

Additional data sources

- Google Maps aerial imagery
- Topographic LIDAR data sourced from the Australian Government, Department of Industry, Science, Energy and Resources and ANZLIC Foundation Spatial Data Framework (FSDF).

5.2 Previous Reports and Developer IMP's

Several existing strategic/master planning documents and Infrastructure Master Plans (IMPs) apply across the PDA. This includes:

- Economic Development Queensland, Infrastructure Charges Offset Plan Maps 2019
- Ripley Valley reconfiguring a lot applications map June 2019
- Ripley Valley Local Infrastructure Plan - V20 - 2016
- Bundamba Creek Corridor Plan 2015
- CRC for Water Sensitive Cities, Ideas for Ripley Valley 2015
- Ripley Valley Urban Development Area, Development Scheme, 2011

- ICC Waterway Health Strategy 2009.

Within the Ripley Valley PDA there are several existing Developer Infrastructure Master Plans (IMPs) that include proposed local stormwater management infrastructure. The IMPs have been submitted for consideration from a stormwater compliance perspective and would form part of the PDA. The infrastructure proposed in these IMPs will be paid for, designed and constructed by the developer and is local infrastructure.

The PDA area currently includes areas of completed development, areas with development plans (IMPs) in place and undeveloped areas where specific plans are yet to be submitted. While the developer IMPs are in various stages of the approval process and are not yet binding on EDQ, they have been referred to as indicative of the extents of development in the PDA for the staging and catchment analysis. The IMPs have also been used to understand current planning for local stormwater management within planned developments and to identify opportunities for Sub-Regional stormwater management, integration with other services and/or potential sites to incorporate innovative solutions.

The available context plans and IMPs for Ripley Valley PDA are presented below. The available IMPs have been prepared by various consultants and have varied levels of detail relating to proposed stormwater quantity and quality management infrastructure. Table 5-1 summarises the IMP reports made available and the layout plans from each IMP used to support catchment analysis.

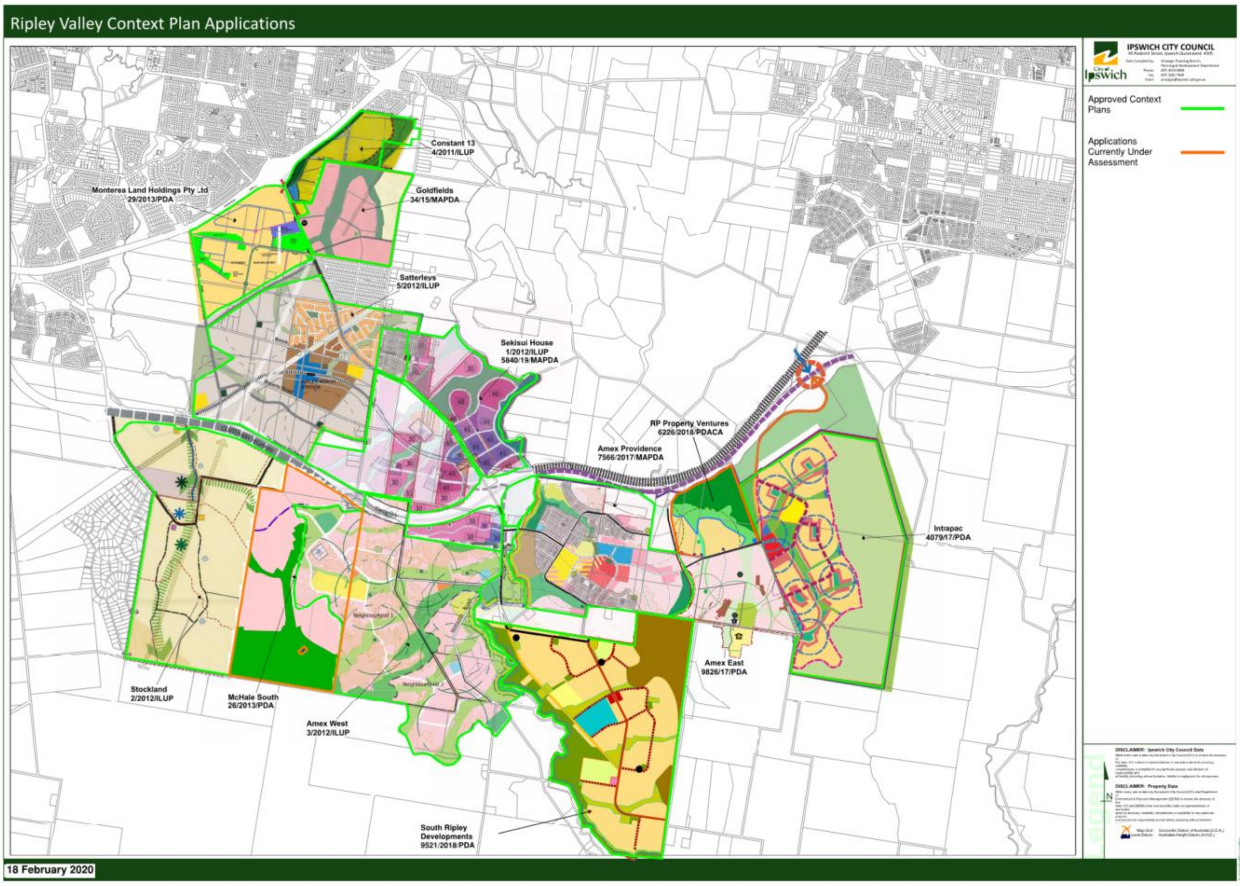


Figure 5-1 Locations of Context Plans in the Ripley Valley PDA

Table 5-1 Ripley Valley PDA – Developer Areas, IMPs and Context Plans

Developer Name	Location Reference	IMP Document	Status
Amex Providence	7566/2017/MAPDA 40/2015/PDA 6658/2017 (Providence North) 2/2010/ILUP 5715/2015/PDA	4_2012_ILUP Stormwater Infrastructure Master Plan - Endorsed.PDF	Approved
Amex West	3/2012/ILUP	3_12ILUP Decision Notice and Plans.PDF	Approved
AV Jennings	7787/2008/MAMC/A 2834/2019/PDA	Not Available	Approved
Avon Capital	7251/2018/PDA	N/A	Pending
Constant 13	3131/15/PDA	4130_16_MA_A PDA Amendment Application Approval Plans alias.pdf	Approved
Daleys Road	5/2011/ILUP	N/A	Approved
Frasers	6241/2017/PDA	N/A	Approved
Goldfields	8736/2017/RAL & 34/15/MAPDA	34_2015_MAPDA_B Approved Plans.pdf 1141_18_PDACA Endorsed Water, Sewer, Stormwater and Earthworks IMP and TWCM OSS#2.pdf	Approved
Intrapac	4678/2019/PDA 4079/17/PDA	4079_2017_PDA Approval Plans alias.pdf	Pending
Kelly’s	4616/2017/PDA	N/A	Approved
Lin Hai Development	7193/2017/PDA	N/A	Pending
McHale North	7949/2015/PDA 25/2013/PDA	N/A	Approved
McHale South	26/2013/PDA	DA Plan Lodged - Concept Plan.pdf	Pending

Developer Name	Location Reference	IMP Document	Status
Monterea Land Holdings Pty Ltd	29/2013/PDA	29_13 DA Plans Approved#2.PDF	Approved
RP Property Ventures	6226/2018/PDACA	6226_18_PDA - Response to Information Request - App A - Proposal Plans.pdf	Pending
Rosengreen	5707/2009/CA	N/A	Approved
Satterleys	3253/2017/PDA	N/A	Approved
Satterleys	7565/2017/PDA	N/A	Approved
Satterleys	5/2012/ILUP	DEV2012_293 ApprovedPlans.pdf 5_2012_ILUP Stormwater Infrastructure Master Plan - (Part A, B&C) Endorsed.PDF	Pending
Sekisui	4781/2015/PDA	N/A	Approved
Sekisui	7947/2015/PDA	N/A	Approved
Sekisui	9140/2016/MA/B	N/A	Approved
Sekisui	1/2010/ILUP	1_2012_ILUP Stormwater Infrastructure Master Plan - Endorsed.PDF	Approved
Stockland	10/2012/ILUP 3/2010/ILUP	N/A	Approved

5.3 Desired Standards of Service

The desired standard of service for stormwater management for the Ripley Valley PDA is listed within EDQ's PDA guideline no.13, May 2015, as well as those required by ICC. ICC requires stormwater quality and quantity standards to be maintained from pre to post development conditions at each time horizon. This is in accordance with guidelines and standards and the targets set out in the ICC's planning scheme policy.

The ICC guidelines and compliance standards are considered a suitable benchmark for the PDAs as they represent standards that are adopted throughout Southeast Queensland and beyond. They require a high level of performance from any stormwater management measures proposed. This includes:

- Achieving a no worsening standard for stormwater quantity compared to the pre-development baseline.
- Meeting pollution reduction targets for post development stormwater runoff.

This PDA represents an opportunity to 'raise the bar' with regards to setting standards for managing stormwater. Observing the principles of integrated stormwater and total water cycle management while meeting stormwater quantity and quality requirements represents an opportunity to manage stormwater in an innovative way and provide additional benefits to the community, such as public amenity, ecological benefits, improved aesthetics in urban design and/or integration with water and wastewater infrastructure. Details of innovative approaches that could deliver these additional benefits to the future communities of Ripley Valley are outlined in Chapters 6 and 10.13.

Realising these additional benefits is likely to require careful consideration of the trade-offs with additional costs of development. The ICC guidelines are based on the Queensland Urban Drainage Manual (QUDM). QUDM was developed to strike a balance between stormwater management outcomes and cost to serve. The targets in QUDM represent the point where additional investment would lead to diminishing returns in terms of performance. Therefore, the ICC guidelines and compliance standards have been adopted for the purposes of this DCOP and the economic viability of innovations to deliver increased service outcomes should be assessed further in feasibility studies as part of the next stage of planning.

Consistent with the standards set out in QUDM, the following desired standards of service are detailed in the Ipswich City Planning Scheme:

- Quantity

  A ‘no-worsening’ (zero net balance) outcome with respect to stormwater management with regards to:

  - Flood levels
  - Flood volumes and storage
  - Velocities
  - Timing
  - Flow characteristics
  - Inundation duration, and
  - Cumulative flooding impact.

- Quality

  For construction phase of development water quality values are to be maintained in accordance with standards set out in Tables 2.1 and 2.2 of Urban Stormwater Quality Planning Guideline, 2010 (from the Department of Environment and Resource Management and as referenced in the ICC Planning Scheme), for the following indicators:

  - Coarse, fine sediment
  - Turbidity
  - Nutrients (N & P)
  - pH
  - Litter
  - Hydrocarbons
  - Cations/anions.

  For the operational phase (post construction) of development the mean annual loads from unmitigated development are to be reduced by the following percentages for key pollutants:

- Total Suspended Solids (TSS) – 80%
- Total Phosphorous (TP) – 60%
- Total Nitrogen (TN) – 45%
- Gross pollutants >5mm – 90%.

The applicability of these water quality standards will depend upon the existing water quality and the potential to introduce measures that would make a material change. This would need to be assessed during detailed planning and feasibility assessment of individual stormwater management solutions.

5.4 Stakeholder Engagement

For the preparation of this chapter stakeholder consultation was carried out with EDQ for collation of IMP reports and collection of available master planning and development information.

Feedback from EDQ was also received regarding the required formatting of mapping and GIS outputs from the analysis completed for this report, for example locations of possible Sub-Regional stormwater infrastructure with proposed time horizon and other attribute data attached.

The concept for the proposed methodology for identifying Sub-Regional infrastructure locations and developing an opinion of costs for the updated DCOP was presented to EDQ and officers from the ICC for feedback on 10 February 2020. Council feedback was taken into consideration in the preparation of this report, particularly around identifying the potential physical constraints that will form part of the feasibility assessment proposed for Phase 2 works. These included identification of any ecologically sensitive areas and issues related to erosive soils.

5.5 Innovation by Design

Given the majority of innovation by design options available to water supply, sewerage and stormwater are collectively known as Integrated Water Management, these have been consolidated and expanded upon within Chapter 6.

5.6 Stormwater Infrastructure Classification

Consideration of potential infrastructure for stormwater management has been split into local measures and Sub-Regional measures. The terms Sub-Regional and trunk infrastructure are interchangeable terms for the purpose of this report. It has been assumed that local infrastructure would be paid for, designed and constructed by the developers with the rollout of each individual development within the PDA area. Regional infrastructure opportunities are those that could be used as an alternative to local solutions where they may be more cost effective or deliver better outcomes than several local solutions.

Sections 5.6.1 and 5.6.2 give an overview of typical stormwater management infrastructure that is considered as either local or Sub-Regional/trunk infrastructure.

5.6.1 Local Infrastructure

Local stormwater infrastructure is that infrastructure that would be designed by the developer were proposing the development of an area within the PDA. Examples of this infrastructure exists within Infrastructure Master Plans (IMPs) that have been submitted to ICC for development assessment and approval. The existing IMPs are varied and contain some examples of local stormwater management infrastructure though not necessarily an exhaustive list of examples of potential measures.

Typical local stormwater management features include:

- Longitudinal drainage infrastructure along roads, e.g. pits, pipes and culverts
- Local detention basins
- Stormwater harvesting infrastructure.
- Localised Water Sensitive Urban Design (WSUD) infrastructure, such as;
    - Bioretention basins
    - Rainwater tanks
    - Street side swales
    - Street tree pits and infiltration basins
    - Infiltration swales and terraces
    - Green roofs and permeable pavements.

Longitudinal drainage is the drainage infrastructure that runs adjacent to the roads within the PDA area. Cross drainage locations are locations where bridges or large culverts are positioned on waterways and drains under arterial and/or local roads.

The remaining listed typical local infrastructure including stormwater harvesting infrastructure and WSUD measures are further discussed in Chapter 6.

5.6.2 Sub-Regional Infrastructure

For the purpose of managing stormwater quality and quantity, the following Sub-Regional infrastructure is considered appropriate:

Constructed wetland treatment systems

- Stormwater detention basins
- Large scale stormwater treatment swales
- Waterway rehabilitation works
- Combinations of these elements.

Regional infrastructure opportunities could be funded by developer contributions in lieu of implementing local scale infrastructure.

5.7 Catchment Analysis

The catchment analysis consisted of a desktop assessment of available information and has focused on identifying potential locations for Sub-Regional stormwater management infrastructure.

The purpose of this infrastructure is either for stormwater quality treatment via bioretention or wetland treatment, and/or stormwater quantity control through detention.

There are two stages of planning required for the identification of appropriate Sub-Regional infrastructure sites and solutions. This assessment focuses on the first stage whereby a list of potential sites has been identified for consideration.

5.7.1 Background Information

The available IMP documents, in combination with available spatial data, were used as the primarily sources of information. The IMPs contain many proposed sites for stormwater management at a local scale, which have also been considered in the analysis to determine if they could be considered for augmentation as a Sub-Regional stormwater management facility. They also contain information relating to potential locations of parks and sporting facilities which could be integrated with Sub-Regional stormwater infrastructure management solutions.

The following information was incorporated into Stage 1 planning:

- IMP development areas as indicated in the IMP reports listed above.
- Proposed local stormwater management infrastructure as indicated in the IMP reports listed above.
- Details of proposed parks and open spaces as indicated in the IMP reports listed in above.
- 5m topographic LIDAR layer sourced from the Australian Government, Department of industry, Science, Energy and Resources and ANZLIC FSDF
- Ipswich City Council, 100-year ARI flood extents
- Google Maps aerial imagery
- Ipswich City Council Planning Scheme – Sub-Regional Detention Basin locations map (2013).

5.7.2 Phase 1 – Identification of Potential Sub-Regional Infrastructure

Potential locations for Sub-Regional stormwater management infrastructure were identified by overlaying various layers of existing information. With the overlay of information, some assumptions have then been made regarding the likely staging of the construction of Sub-Regional infrastructure based on the SGS growth projections discussed in Chapter 2. An analysis of the stormwater catchments contributing to each location was used for approximate sizing of infrastructure.

The consolidation of data in the GIS includes:

- Proposed 'local' stormwater management infrastructure from IMP reports as listed in above,
- ICC proposed potential Sub-Regional detention basin locations from Ipswich City Council Planning Scheme – Sub-Regional Detention Basin locations map (2013),
- PDA boundaries as indicated in the IMP reports in above,
- Publicly available topographic information as per the FSDF for determination of stormwater sub-catchment boundaries, and
- Google Maps aerial imagery.

Locating feasible areas for Sub-Regional stormwater infrastructure, based on the following criteria:

- Locations near waterways that drain a significant catchment area,
- Locations that are nearby significant existing or proposed development ,
- Locations that overlap with proposed parks and open spaces as indicated in the IMP reports as listed in above,

- Opportunity to integrate with potential effects-based management of sewer wet weather flows and/or wastewater treatment effluent nutrient offset locations proposed by Urban Utilities or Ipswich City Council,
- Infrastructure locations identified in the Ipswich City Council Planning Scheme for Sub-Regional Detention Locations (2013),
- Consideration of potential additional development areas in the PDA, for example with no existing IMP or proposed development plans), and
- Is there space for the Sub-Regional system and is the terrain conducive, for example is there enough flat area where capture of significant oncoming flow can be captured and treated?

Once a list of locations was identified, analysis to determine the most suitable type of Sub-Regional stormwater infrastructure was undertaken. For example, it considered a detention basin for quantity management, a Sub-Regional swale or waterway rehabilitation opportunity for quality management, or a wetland for both water quantity and quality management.

Potential locations were mapped in GIS and a preliminary footprint size for each element was determined.

5.7.3 Phase 2 – Preliminary Sizing of Potential Sub-Regional Infrastructure

For the purpose of estimating costs for the DCOP, preliminary sizing of Sub-Regional stormwater infrastructure was undertaken. Noting that any potential Sub-Regional locations could be a water quantity (detention) and/or water quality (biofiltration or wetland) structure, an assumption was made to adopt a uniform approach to sizing.

Two methods of preliminary sizing of Sub-Regional stormwater infrastructure were considered and are listed below.

Method 1 – Sizing Sub-Regional infrastructure for water quality compliance

Method 1 for sizing is based on water quality compliance. This is where a rule of thumb regarding the sizing for the active surface area of bioretention basin to reach the target pollutant reduction targets. Filtration areas are typically set between 1.5% and 2.0% of the contributing catchment area. This is based on studies completed to monitor bioretention system performance (swales and basins) across Southeast Queensland. A summary of the findings of these studies is presented in the healthy Waterways Water Sensitive Urban Design Guidelines (2006).

The guideline states that for typical bioretention configurations, and to reach the recommended pollutant removal targets e.g. 80% TSS, 60% TP and 45%TN, filtration areas of at least 1.5% of the contributing catchment area were required. It is also noted that for filtration areas of greater than 2.0% of the contributing catchment size, the rate of additional pollutant reduction reduces dramatically, representing a point of diminishing returns.

The application of this method would therefore consider the location of the Sub-Regional infrastructure and nominate a required footprint to be at least 1.5% of the contributing catchment size.

Method 2 – Sizing Sub-Regional infrastructure for water quantity compliance

Method 2 is based on water quantity compliance. This is where detention of the increase in runoff volume from the contributing catchment as a result of development is to be captured and slowly released. To determine the increase in peak runoff the rational method is used with some assumptions around pre and post development conditions. These flows are then taken and applied to a high-level basin sizing method, as proposed in QUDM 2006, to account for capturing the additional runoff volume created

The application of this method requires assumptions to be made regarding contributing catchment conditions in the pre and post development condition, regarding extent of development

It is noted that with both proposed options there are limitations to their reliability for use in the absence of rigorous design procedure, with feasibility assessment and stormwater modelling to verify performance. The method of applying the 1.5% rule for water quality is typically used for sizing of bioretention systems for smaller urbanised catchments. Similarly, the reliability of the rational method is noted to reduce for larger and rural catchment applications. These methods have been considered suitable in this instance as a preliminary guide to sizing.

Comparison of the estimated size from each method at one of the proposed Sub-Regional infrastructure locations found that Method 2 estimated a larger required footprint area. Method 2 was therefore adopted, on the assumption that a system of a size sufficient to satisfy the water quantity standard would also be able to satisfy the water quality requirement.

Note that this approach is preliminary only and is not considered to be a substitute for more appropriate sizing based on detailed stormwater modelling, which is recommend being undertaken in the next stage of planning.

For the application of the Method 2 preliminary basin sizing the following assumptions were made:

- A maximum basin depth of 1m was adopted for operational safety reasons
- No embankment width or batters were considered for footprint sizing
- All catchments contributing to the Sub-Regional infrastructure location have been assumed to be greenfield (0% impervious) for the existing scenario and completely developed (75% impervious) for the fully developed scenario.
- Regional catchment sizes have been estimated using 5m resolution publicly available topography DTM information.

Table 5-2 indicates an initial estimated footprint size for each of the potential Sub-Regional infrastructure locations. This is a conservative starting point for sizing, to establish a high-level estimate of potential construction cost across the PDA.

Figure 5-2 presents the proposed Sub-Regional stormwater management infrastructure locations as well as the proposed local treatment/detention basin locations from available IMPs and context plans.

Table 5-2 Ripley Valley PDA Potential Sub-Regional Stormwater Management Infrastructure

ID	Source	Location and opportunities for integrated water management	Proposed management approach	Estimated Footprint (Hectares)
R01	IMP proposed	Daleys Road Development – Stormwater harvesting opportunity	Detention and Bioretention	0.56
R02	ICC Planning Scheme	Within Pock Properties development area. Located within parkland and open space.	Detention and Bioretention	6.81
R03	New Location	Confluence of Deebing Creek tributaries. Located within planned parkland/nature reserve.	Detention and Bioretention	6.82
R04	New Location	Downstream of Satterleys development area. Located within planned parkland.	Detention and Bioretention	0.78
R05	IMP Proposed & ICC Planning Scheme	Within Sekisui development area. Located within planned parkland. A landscaped wetland or detention system could be designed to provide community amenity and aesthetics.	Wetland, Bioretention and Detention	3.74
R06	IMP Proposed	JCH Holdings Development. Located within planned parkland.	Detention and Bioretention	6.98
R07	New Locations	Low lying area adjacent centre intersection of Ripley Road and Centenary Highway. Highly	Wetland and Bioretention	5.78

ID	Source	Location and opportunities for integrated water management	Proposed management approach	Estimated Footprint (Hectares)
		visible with opportunity for community park and aesthetics and amenity benefits.		
R08	IMP proposed and ICC Planning Scheme	Primary detention area proposed with the Amex development area. Existing construction sedimentation pond. Opportunity for retrofit to wetland.	Wetland and Detention	1.42
R09	IMP Proposed	Detention area proposed with the Amex development area. Existing construction sedimentation pond. Opportunity for retrofit to bioretention.	Bioretention	8.03
R10	New Location	Bottom of the main tributary to Bundamba Creek within the PDA area. opportunity for additional open space and aesthetics benefits	Wetland and Detention	2.07
R11	ICC Planning Scheme	Eastern tributary to Bundamba Creek. Located within planned parkland	Detention and Bioretention	13.05
R12	New Location	Low lying area adjacent Bundamba Creek. Located within planned parkland	Wetland and Detention	11.91
R13	New Location	Low lying area adjacent Bundamba Creek. Located within planned parkland	Wetland and Detention	11.91

ID	Source	Location and opportunities for integrated water management	Proposed management approach	Estimated Footprint (Hectares)
R14	ICC Planning Scheme	Upper tributary to Bundamba Creek. Opportunity to extend parkland and open space to include a detention system	Detention and Bioretention	2.09

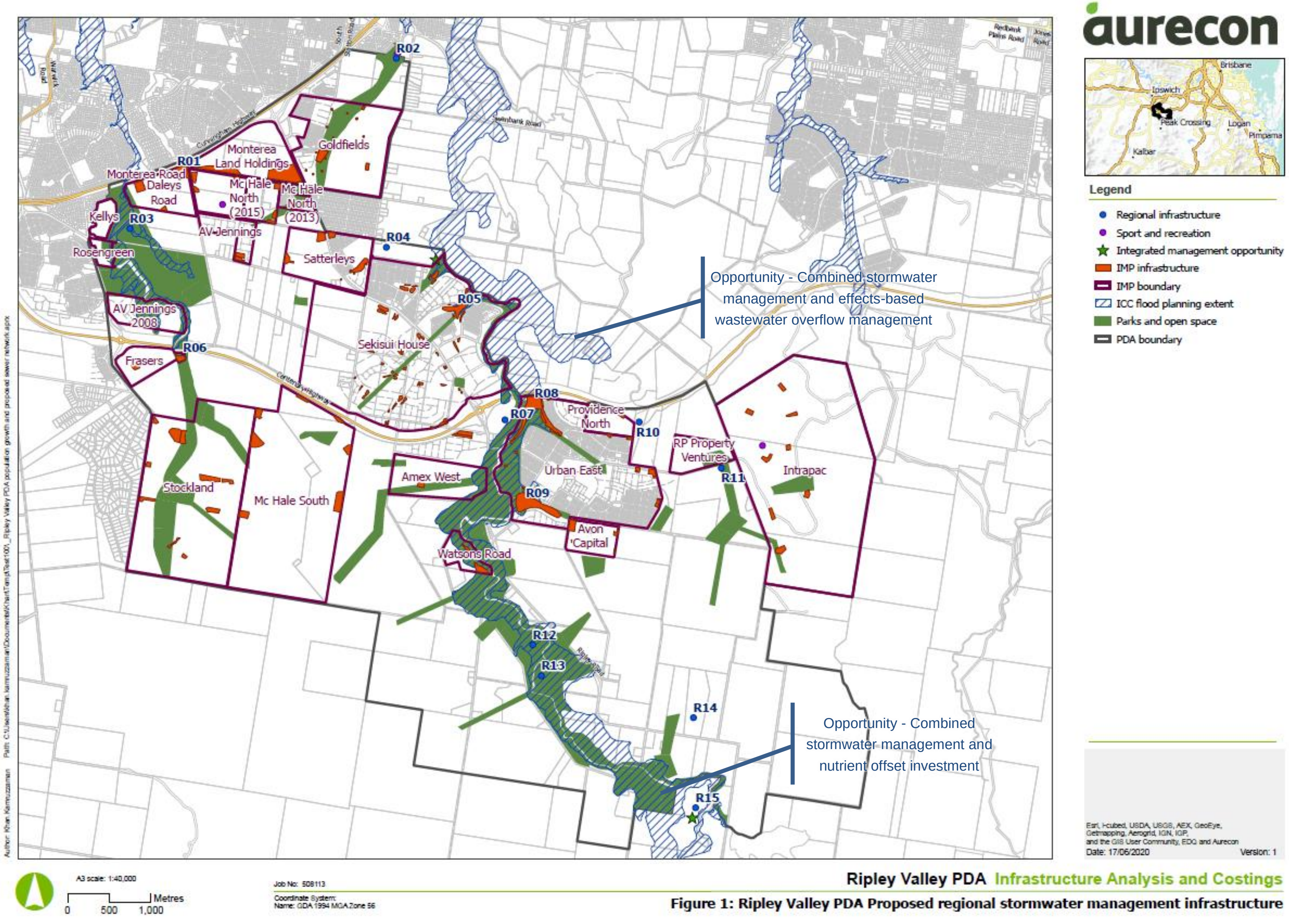


Figure 5-2 Ripley Valley PDA Potential Sub-Regional Stormwater Management Infrastructure Locations

5.7.4 Phase 3 – Feasibility Assessment

The identification and sizing of potential Sub-Regional stormwater management infrastructure in Phases 1 and 2 was based on a high-level desktop assessment. Potential locations were identified but no detailed modelling or design work was undertaken. Further feasibility assessment of the identified sites be undertaken before they are progressed as viable options. It is anticipated that the number of locations identified in Phase 1 will be reduced and refined through detailed feasibility assessment in Phase 3.

Consultation with Ipswich City Council representatives identified several potential physical considerations within the Ripley Valley PDA area, including presence of dispersive/erodible soils, and ecologically sensitive locations that would need to be considered as part of the feasibility assessment. This is not an exhaustive list of constraints and the functionality of each proposed location would be to subject to further analysis in the context of the broader PDA area and balancing local and Sub-Regional infrastructure measures.

The proposed Sub-Regional infrastructure locations identified in this study were developed on the basis of the current IMP development areas. It is acknowledged that developer proposed IMP layouts may change over time. In the next stage of planning, collaboration with EDQ, developers and Council in regard to stormwater management and compliance requirements for the broader PDA will provide opportunities for efficiency in infrastructure delivery and may improve the cost effectiveness of stormwater management within the PDA.

It is suggested that the Phase 3 feasibility assessment includes the following:

- Consideration of the proposed location in terms of:
  - physical constraints, for example is there existing buried infrastructure, contaminated land, dispersive soils or areas of ecological significance?
  - Is the site reasonable from a topographic point of view, for example is there enough free low-lying space and can it be positioned to capture and discharge catchment runoff in a suitable manner?
- Detailed modelling to assess how the potential locations function in terms of hydraulic performance of the watercourses they discharge into?
  - Will the implementation of Sub-Regional detention features have a negative impact on flood risk from the point of view of timing of flood peaks in the Bundamba Creek and/or Deebing Creek and their tributaries?
  - Modelling will enable refinement of the area required for each location and consideration of the integration of the proposed works with the surrounding environment.
- Consideration of the ongoing maintenance and failure risks associated with Sub-Regional options.
- Comparison of how the Sub-Regional options perform in comparison to local stormwater management opportunities:
  - Does a Sub-Regional opportunity use land that could otherwise be developable?
  - Would a local approach mean that stormwater management infrastructure is better positioned to take advantage of innovation opportunities such as locating stormwater basins near or within proposed parks, sports fields and community open spaces?

- Does the Sub-Regional option provide an opportunity for developments to tailor their layouts to take advantage of a Sub-Regional stormwater management location?

There are multiple innovative stormwater management options presented in Chapter 6, covering innovation. These opportunities should be considered in the Phase 3 Feasibility Assessment to address integrated and total water cycle management principles.

Whilst there are a number of IMPs approved, if the DA has not been lodged or approved, then the developer should instigate discussion with EDQ and their delegate. The outcomes of the Phase 3 analysis will form the basis to review and agree stormwater management solutions including those that should be adopted on a Sub-Regional catchment basis.

5.8 Planning Horizons

Demographics analysis has been carried out by EDQ to estimate the likely population densities and land uses through time as the PDA area develops. Development at various planning horizons has been assessed including 2026, 2031, 2041 and 2066. These years have been considered in terms of three development categories for Sub-Regional stormwater management infrastructure, the near term (2026), interim horizons (2031 & 2041) and the ultimate development (2066).

It has been assumed that development could proceed in any order, with regards to the rollout of the existing approved developer IMPs and associated Development Approvals (DAs). Infrastructure locations that are nearby (downstream) of existing development have been prioritized for construction timing and have been flagged for the nearest time horizon, 2026. This is to prioritize treatment where impacts to Sub-Regional stormwater quantity and quality may already be occurring.

Stormwater management infrastructure locations nearby approved IMPs containing detailed layout plans, that are yet to be constructed, have been flagged with the intermediate time horizons, considered to represent 2031 or 2041. An indication of the planning horizon has been given for the intermediate time periods based on the demographic analysis, but this is indicative only.

Locations that have been identified to be consistent with sites identified in master planning documents only (without detailed development layouts) have been flagged for ultimate development, the 2066 planning horizon.

Comments have been added on rationale for locating assets and planning horizons in Table 5-3.

Staging of Sub-Regional stormwater management infrastructure in relation to these planning horizons is acknowledged to be very difficult. Interaction between developers will be required to identify interim solutions in relation to the timing of Sub-Regional infrastructure will be required. Potential options include the use of land within developments in the short term as a stormwater treatment location, and release of these sites for rehabilitation and development once the Sub-Regional stormwater infrastructure solution is delivered. This would defer the need for a Sub-Regional solution to be constructed until development had progressed to a point where it is financially viable, while freeing up this land for development at a later date. It may also reduce the number of local stormwater basins required within the development, creating more developable land.

Table 5-3 Estimated time horizons for rollout of Sub-Regional stormwater infrastructure

ID	Comment	Estimated time horizon for construction
R01	Downstream of approved IMPs	2031
R02	Downstream of approved IMPs	2031
R03	No detailed IMP information yet	2066
R04	Downstream of approved IMPs	2031
R05	Downstream of existing development	2026
R06	Downstream of approved IMPs	2031
R07	Downstream of approved IMPs	2031
R08	Downstream of existing development	2026
R09	Downstream of existing development	2026
R10	Downstream of approved IMPs	2041
R11	No detailed IMP information yet	2066
R12	No detailed IMP information yet	2066
R13	No detailed IMP information yet	2066
R14	No detailed IMP information yet	2066

5.9 Opinion of Cost

The proposed locations for Sub-Regional stormwater management infrastructure have been provided for estimating the cost of construction. The limitations of the preliminary analysis conducted in this stage of planning should be noted along with the detailed feasibility assessment recommended for the next stage of planning.

Rider Levett Bucknall (RLB) were engaged to develop an opinion of the cost of stormwater infrastructure to service the Ripley Valley PDA. The quantities of stormwater infrastructure were derived from the updated network plan developed as part of this study. Municipal costs for Ripley Valley PDA were then extracted from the RLB estimates and inserted into the Financial Offset Model per planning horizon, the summaries of which can be found within the Schedule of Works containing within the body of this Infrastructure Planning Background Report (IPBR).

6 Integrated Water Management

In South-East Queensland alone, the population is projected to grow from 3.5M to 5.3M by 2042. To accommodate this growth will require 800,000 new homes and 950,000 new jobs (ShapingSEQ 2017).

At the same time as this population and development growth is occurring, there is significant change anticipated across a range of factors, including climate, technology, demographics, community expectations and the world of work. Climate change predictions for South-East Queensland by 2030 indicate a 0.6-1.3 oC, increasing to as much as 1.3-3.3oC by 2070. South-East Queensland is likely to experience more days exceeding 35oC annually and more frequent and extreme heatwave events (State of Queensland 2019).

Future challenges like urban heat have been discussed frequently over the last decade. However, these temperature changes became very real in 2020, with heat waves and bushfires occurring across the country. Where temperatures were measured in Sydney, urban ambient air temperatures reached up to 50 degrees, with radiant heat from bitumen nearly up to 80oC. Media headlines started describing areas of Sydney that would be ‘unliveable’ within decades, covering the health impacts associated with high temperatures (https://www.abc.net.au/news/science/2021-01-24/heatwaves-sydney-uninhabitable-climate-change-urban-planning/12993580).

With the challenges faced in the last year, Australian awareness of climate, heat waves, floods, droughts and bushfires is at an all-time high. This awareness, coupled with the significantly different ways that we have been living our lives during Covid, is leading to some fundamental shifts in the concept of homes, how homes are constructed and how people view their neighbourhoods and cities.

Globally, the latest health research is also showing the importance of considering cooling strategies and green spaces with respect to physical and mental health of the community. In an Epidemiology study looking at health data from 1988 to 2009 in Brisbane, Tong et al. (2014) found that there was a significant increase in mortality associated with heat, particularly in the female population and in age groups over 75. The research found that up to 68 deaths per summer could be attributed to high temperatures (Tong et al. 2014).

Similarly, green spaces have been found to be important for mental well-being, with access to and use of green space leading to reduced stress, improved mental health and behaviour and decreased psychological distress, particularly in children and adolescents (Engemann et al. 2019, Zhang et al. 2020). A nation-wide study in the USA, covering more than 900,000 people, found that children who grew-up with the lowest levels of green space had a 55% higher risk of developing a psychiatric disorder (Engemann et al. 2019). The benefits of green space are considered to be wide-ranging, with living near green space contributing to an increasing frequency of exercise, reduced perceptions of noise, increased social activity and relaxation (Douglas & Douglas 2021).

Creating innovative Green and Blue Spaces in Queensland urban developments provides an opportunity to mitigate the challenges that changing climate, increasing population and demand for housing pose on our region, while providing for improved community liveability, connectivity and resilience. The trends influencing our community, choices relating to where people live and what types of homes, they purchase are provided to give context for future development and neighbourhood design options.

This section focuses on Innovative and Aspirational Integrated Water Management (IWM) Design solutions, to support future developments, suburbs and cities to deal with issues, such as urban heat, water scarcity, flooding and droughts, while also responding to societal changes in energy use, water use and living patterns. Figure 6-1 below is from the IWM Framework for Victoria and provides a visual representation of how solutions can be applied across scales to achieve better outcomes for community and the environment.

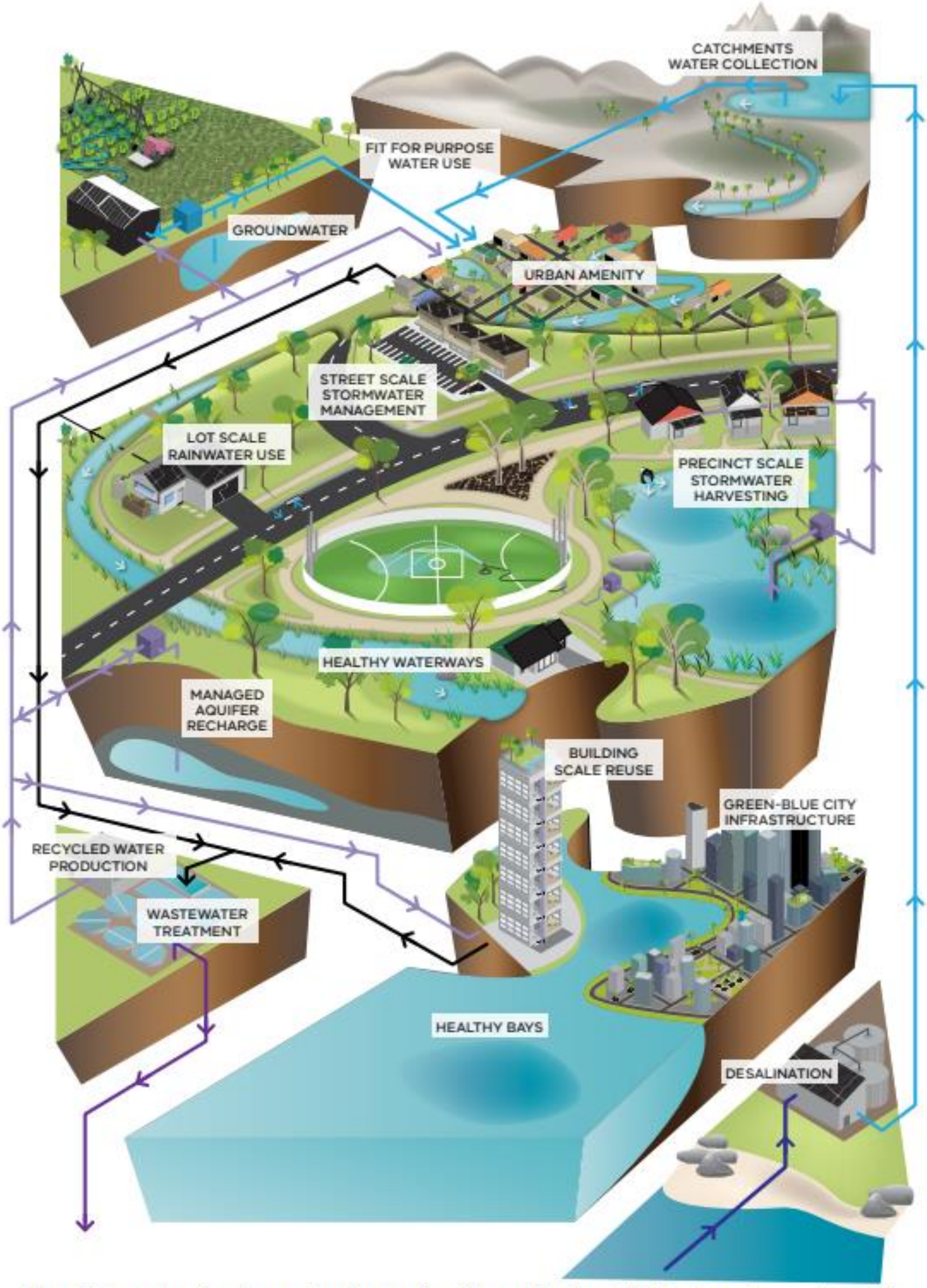


Figure 1: Examples of options and outcomes from the application of IWM in the urban environment.

Figure 6-1 IWM Framework for Victoria

Source: Government of Victoria

https://www.water.vic.gov.au/__data/assets/pdf_file/0022/81544/DELWP-IWM-Framework-FINAL-FOR-WEB.pdf

Some benefits of implementing these solutions are outlined below.

6.1 Benefits to Developers

- Client-centric housing designs that provide for changing needs of home buyers,
- Developments that are popular with future buyers,
- Affordable housing,
- Award-winning designs that will allow developers to build their national brand,
- Ease of approvals in providing what is important to Local Governments, and
- Flexible designs, with end products that cater for a range of future scenarios.

6.2 Benefits to Local Government

- Planning for climate changes,
- Creating desirable places to live,
- Improving community health,
- Reduction in lifecycle costs associated with assets,
- Creating cities and neighbourhoods that are cooler,
- Creating cities and neighbourhoods that are more resilient to extreme events,
- Improving carbon footprint,
- Creating green spaces and corridors for people to recreate,
- Preserving biodiversity,
- Ensuring human safety with respect to air quality and use of waterways,
- Developing agile, resilient infrastructure,
- Attractive to people moving from overseas and inter-state, and
- Revival of suburbs and neighbourhoods.

6.3 Benefits to Homeowners

- Affordable housing, with affordable water and energy costs,
- Sustainable homes, with modern designs and materials,
- Healthy living,
- Easy access to green and blue spaces for family activities and recreation,
- Friendly, safe neighbourhoods with a strong sense of community,
- Smart homes, neighbourhoods and digital services, with a range of real time data to make informed decisions,
- Walking & cycling friendly suburbs,

- Cool, green suburbs that are designed and built with droughts, floods, heat and bushfires in mind,
- Flexible home infrastructure options, enabling connection of the latest solar, battery, water and waste technology over time,
- Fast connectivity speeds and access to the latest technology, within homes, public transport and ride sharing opportunities,
- Work from home options and local co-working spaces for connecting with other remote team members and clients for meetings,
- Local maker-hubs, with shared access to 3D printers, graphic designers, tech expertise and other innovative thinkers,
- Access to fast, last mile delivery options for online shopping, and
- Local produce options, with access to community gardens, organic food and farmer's markets.

6.4 Planning for the Future

In 2020, everyone watched as the world changed overnight. The way that people use their homes, work remotely and connect with their neighbourhoods has fundamentally changed and will likely never return to post-covid patterns.

Many of the changes that we have seen in the last 12 months were underway prior to Covid, particularly changes relating to technology and the way we work. However, Covid has accelerated the speed of this change.

Given the lag time associated with planning timeframes and subsequent developments, it is important to look at the longer-term trends relating to how we live and work, to help design cities, suburbs, developments and homes that reflect the demand from consumers over the next decade.

With all this change around us, the concept of a home is changing, the way in which we use our homes and neighbourhoods is changing and the way in which homes are being constructed is changing. As described by AIA (2020), this is being influenced by a range of factors, including pandemics, population growth, shortage of affordable housing, sustainability and construction industry changes.

Table 6-1 below provides a summary of innovative IWM designs and the scales at which they can be applied to address the challenges we face in the future. The different innovations are discussed in more detail following sections.

Table 6-1 Implementation of Innovations at Lot, Precinct and Regional Scale

Ref	Innovation	Lot	Precinct	Regional
By Design				
6.5.1	Green Streets	✓	✓	✓
6.5.2	WSUD Street Trees		✓	
6.5.3	Combined Trenching/Trenchless Technology		✓	✓

Ref	Innovation	Lot	Precinct	Regional
6.5.4	Household first flush diversion	✓		
6.5.5	Stormwater harvesting – rainwater tanks	✓		
6.5.6	Stormwater Harvesting – large lots		✓	
6.5.7	Beyond Impervious Surfaces	✓	✓	✓
6.5.8	Sustainable Home/Building Ratings	✓		
6.5.9	On-site Use of Nutrients	✓		
6.5.10	Flood Resilient Building Design	✓		
6.5.11	Water Efficient Fixtures	✓		
6.5.12	Drainage & Green Space Easements		✓	
6.5.13	Bioretention Basins & Rain Gardens	✓	✓	
6.5.14	Swales		✓	
6.5.15	Vertical & Roof Top Gardens	✓		
6.5.16	Stormwater Offset & Water Quality Credits		✓	✓
6.5.17	Walkable & Water Enabled Neighbourhoods		✓	✓
6.5.18	Verge Gardens	✓	✓	
6.5.19	Gutter Guards	✓		
6.5.20	Rates & Levies	✓		
Aspirational				
11.5.1.7	Wastewater Treatment & Re-use Systems		✓	✓
	Digital Twins for System Optimisation & Flood Resilience	✓	✓	✓
11.5.1.8	Household Greywater Reuse Systems	✓	✓	
11.5.1.9	Sustainable Neighbourhoods – water energy share		✓	
11.5.1.10	Integrated Water Servicing – Smart Systems	✓	✓	✓
11.5.1.10	Recycled water distribution through stormwater drainage network	✓	✓	✓
11.5.1.12	Distributed storage and smart systems		✓	✓

Ref	Innovation	Lot	Precinct	Regional
11.5.1.13	Green waste reuse for energy/water generation		✓	✓
11.5.1.14	Biogas Generation from Wastewater for Energy			✓
11.5.1.15	Aquifer Storage & Recovery			✓
11.5.1.16	New Pipe Technology		✓	✓
11.5.1.17	Rapid Water Treatment Systems		✓	✓
11.5.1.18	End of Pipe Treatment Systems		✓	✓
0	Smart City/Monitoring Systems	✓	✓	✓
11.5.1.20	Integrated Flood Detention Systems		✓	✓
11.5.1.21	Integrated stormwater management – decentralised stormwater capture	✓	✓	✓

6.5 Innovation by Design

The opportunity to 'raise the bar' and set a new benchmark for the integrated management of water for the Ripley Valley PDA area through each time horizon is considered to exist via the collaboration with EDQ, developers and the Ipswich City Council. This is where options assessments are completed to determine the appropriate balance of local and or Sub-Regional water, sewer and stormwater infrastructure while implementing, where possible, the principles of IWM and TWCM.

Positioning Sub-Regional infrastructure within parks and open space areas increases the potential to consider stormwater harvesting and sewer mining as an opportunity for providing additional community benefits through integrated water management. Typically, these decentralized systems consist of the capture of non-potable water and use for irrigation in public open spaces such as parks and sports fields, providing dual benefits of reduced discharge of water to the environment and reduced potable water usage in irrigation of public open space. These opportunities will need to be explored further with individual developers and largely dependent upon the financial viability of the schemes.

In addition to local distributed recycled water supply opportunities the new Cedar Grove treatment plant is in the Southeast adjacent to the PDA and will treat the regions sewage. The plant will generate significant quantities of high-quality water that could also be recycled also for uses as identified above

Provided below are descriptions of innovations by design that currently exist within Australian urban communities. Examples are provided of locations that have implemented these innovations in place of business-as-usual infrastructure and provide developers and authorities with on the ground outcomes that they can duplicate in the local context.

Developers are encouraged to implement one or more of the design innovations in consultation with EDQ. Early consultation with EDQ, local governments and future asset owners is essential for realisation of benefits and to mitigate asset-ownership challenges.

6.5.1 Green Streets

Water sensitive urban design strategies that prioritise the retention of water and vegetation in urban areas have been demonstrated to provide cooling and improved human thermal comfort (Broadbent et.al., 2018; Bowler et.al., 2010),

Reducing areas of extreme heat and providing cool refuges in urban areas can be achieved through targeted water-sensitive urban design strategies at lot, street, precinct scale. These include:

- Passively irrigated street trees and green facades shade streetscapes and public areas,
- Porous surfaces (e.g. permeable paving) and waterbodies to provide surface cooling and evaporative cooling, and
- Irrigated public greenspace using stormwater harvesting/recycled water for surface cooling and evaporative cooling.

Figure 6-2 Illustration of Green Streets using WUSD features in Medium Density

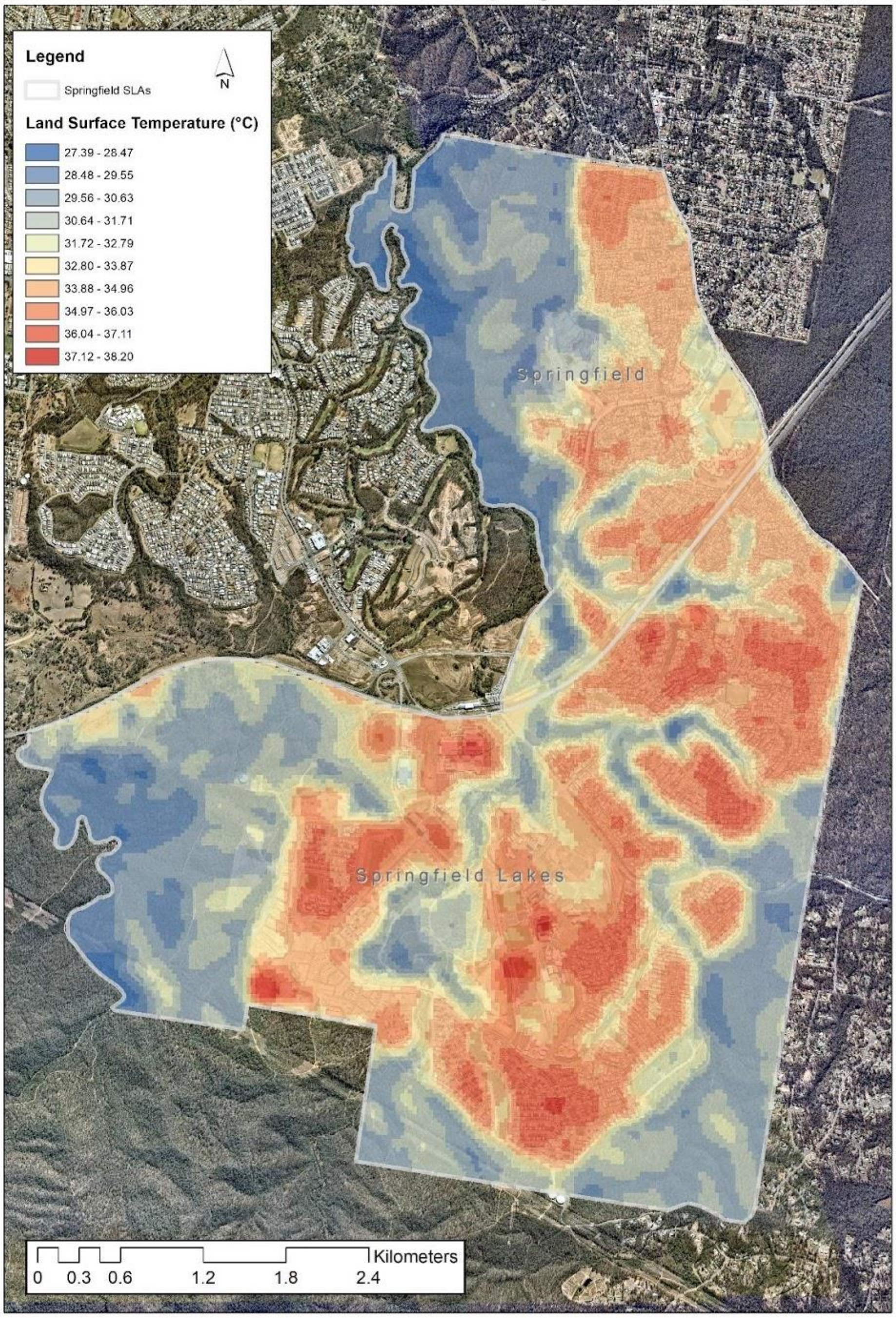
Source: Bligh Tanner

Technical Aspects

- Scenario modelling for greenfield precincts enables testing of proposed development typologies at lot/precinct scale. Modelling costs and methodologies vary depending on accuracy, precision, availability of climate data, and

- Images below show distribution in land surface temperature, measured at 15m grid resolution from Landsat 8 thermal infrared imagery at Springfield Lakes, a master-planned community in South-East Queensland on a hot day in 2018 (maximum daytime temperature 32 degrees). They demonstrate, even at a coarse resolution, the “cool island” effect of WSUD and vegetated elements within the urban fabric.

Land Surface Temperature - Greater Springfield (3/11/2018)



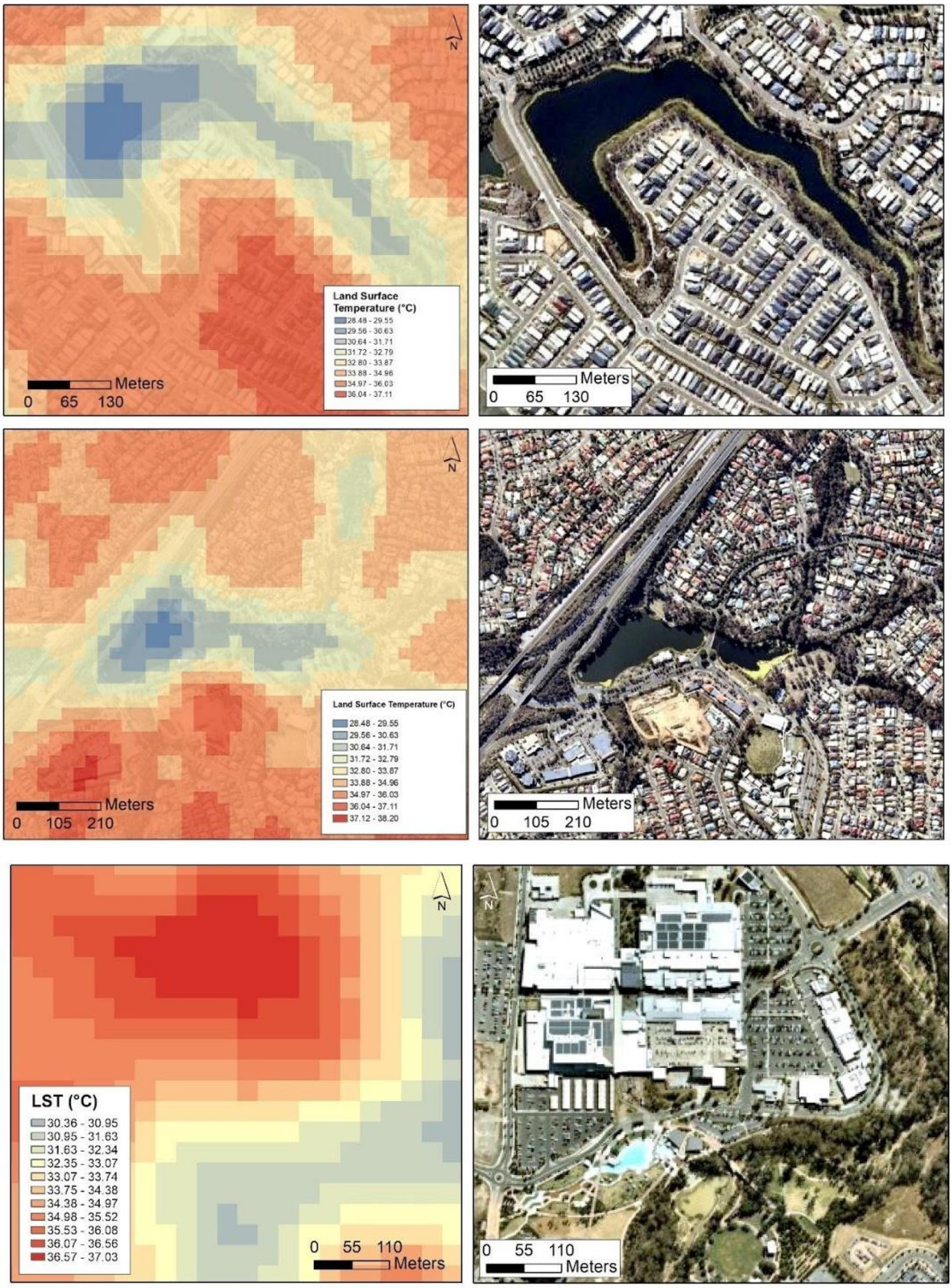


Figure 6-3 Heat Mapping Demonstrates Efficacy of WSUD

Source: Bligh Tanner

Benefits

- Multiple-benefit strategy, including stormwater water quality/quantity improvement, potable water demand reduction, streetscape amenity and climate sensitive building design) (Coutts et.al., 2012),
- Enables prioritisation of investment to maximise cooling and other benefits e.g. Dubbo Urban Heat Island Amelioration Project, CRCWSC ,
- https://watersensitivecities.org.au/wp-content/uploads/2019/04/190429_V7_CRCWSC-Dubbo-Case-Study.pdf,
- Health benefits associated with reduced heat related illness and morbidity/mortality during heatwave events,
- Economic benefits, including optimisation of electricity usage for cooling,
- Facilitates active transport in more shaded areas, and
- Improves streetscape and public amenity values.

Challenges

- High upfront cost, depending on resolution of mapping/modelling.

Application

The image below illustrates effective urban cooling strategies for humid sub-tropical climates, such as those experienced in South-East Queensland (Cooperative Research Centre for Low Carbon Living 2017). It shows shading, healthy canopies and high-albedo building materials.

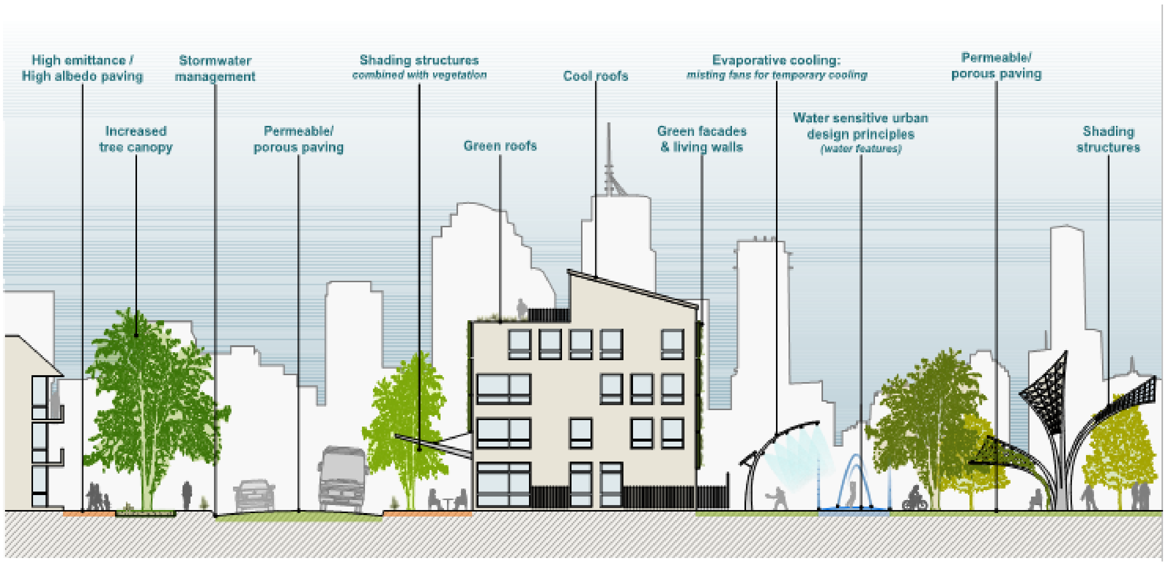


Figure 6-4 Cooling Strategies using WSUD Design

Source: CRC Low Carbon Living 2017

Melbourne's Quarter Sky Park, Docklands is one example of how green walls and rooftop gardens can be implemented (CRC WSC, 2020). In this location, Melbourne plans to provide 10ha of urban green infrastructure in high-density urban areas by 2021. Passive irrigation and adequate space for tree roots can facilitate growth of urban canopies, shading streetscape and public areas.

6.5.2 WSUD Street Trees

WSUD Street Trees are small biofiltration systems that are built into the footpath in place of traditional street trees. They are designed to receive stormwater from roads, providing a water supply for the tree over time, as well as providing some filtration of water from the road surface.

Figure 6-5 WSUD Street Trees

Images: Bligh Tanner

Technical Aspects

WSUD Street Trees are used widely by Local Governments across Australia, with designs being continually improved over time. Where monitoring has been undertaken, street tree growth has proven to be significantly better with the additional water supply and there is a reduced cost of tree watering for Councils.

Benefits

- Improved street tree establishment, growth and survival,
- Increased water efficiency and reduced cost of street tree watering,
- Some water quality filtration benefits,
- Useful bioretention option where there is constrained space, and
- Amenity and cooling.

Challenges

- Cost of design, installation and maintenance is higher than a traditional street trees, and

- Depending on design, debris blockages can occur in the curb inlets, reducing the water supply to trees.

Application

- Brisbane City Council Street Tree Program, and
- Healthy Land & Water – Water by Design – Water Wise Street Trees.

6.5.3 Combined Trenching and/or Trenchless Technology

Underground services like water, sewer, communications and electricity are able to be located in a common trench in community title developments. However, in public road reserves, these are often located in separate trenches due to different timing of construction and specific buffer requirements associated with each service. However, separate trenches lead to more expensive construction, less efficient use of the constrained footpath space and limited flexibility for future streetscape designs.

Figure 6-6 Trenchless technology cross section

Source: Bligh Tanner

Technical Aspects

- Common trenching is regularly used in the US and Canada, as well as being utilised in community title developments in Queensland for many years. Energex publishes a standard for common trenching in such developments,
- Utility providers in Sydney have agreed on a common trenching standard for Western Sydney,

- Directional drilling and trenchless technology are increasingly being utilised for installation of underground utilities, rather than open trenching, and
- Most utilities and local authorities publish standard alignments for underground services in road reserves. Approaches vary across locations and require each service provider to lodge their 'as constructed' plans in a central location. From a holistic perspective, common trenching would provide a more flexible long-term outcome for Local Governments.

Benefits

- Extension of asset life. Existing pipes and utilities will not need to be disturbed as frequently for other works to be undertaken. Modern pipe materials have a significant service life and rarely need to be excavated. New water, sewer and stormwater pipes are unlikely to need full replacement within 50 - 100 years. Currently, many old sewers are re-sleeved in-situ or replaced using trenchless technologies. With water and sewer pipes, repairs are typically needed at specific points along the pipe and not along the entire length. More frequently, excavations are needed across the service alignment and having services in a common trench makes this a simpler activity,
- Reduced excavation required. Communications and power are supplied in conduits, allowing new cable to be pulled through them without full excavation. This is how the NBN is mostly being delivered,
- Extra space within the verge can create greater root volume for street trees, which leads to healthier trees and less chance of future disturbance to root systems,
- Increased verge space for other urban benefits, such as at-source stormwater management (streetscape raingardens), thus minimising the problems associated with large end-of-pipe bioretention systems,
- Potential for reduction in verge widths, up to 1.9 m and 2.35 m on each side of the road, and
- Reduced likelihood of accidental damage to underground services if they are all installed in a single compact footprint.

Challenges

- The potential marginal future cost involved in replacing a service within a common trench—compared to in a separate trench—is far outweighed by the present-day benefits, and
- Current guidelines and standard drawings for each service would need to be reviewed, particularly the buffer requirements.

Application

- Energex Standard Drawing for Community Title Development, and
- New Trenchless Design Technology (Zilper Trenchless https://www.zilpertrenchless.com/).

6.5.4 Household First Flush Diversion

Downpipe diverters are a simple way of adapting existing downpipes, so that rainfall can be used to water gardens. This uses water that would otherwise create excess stormwater and instead provides irrigation and nutrients for gardens. Devices are low cost and have wide applicability in that they are easily retrofittable.

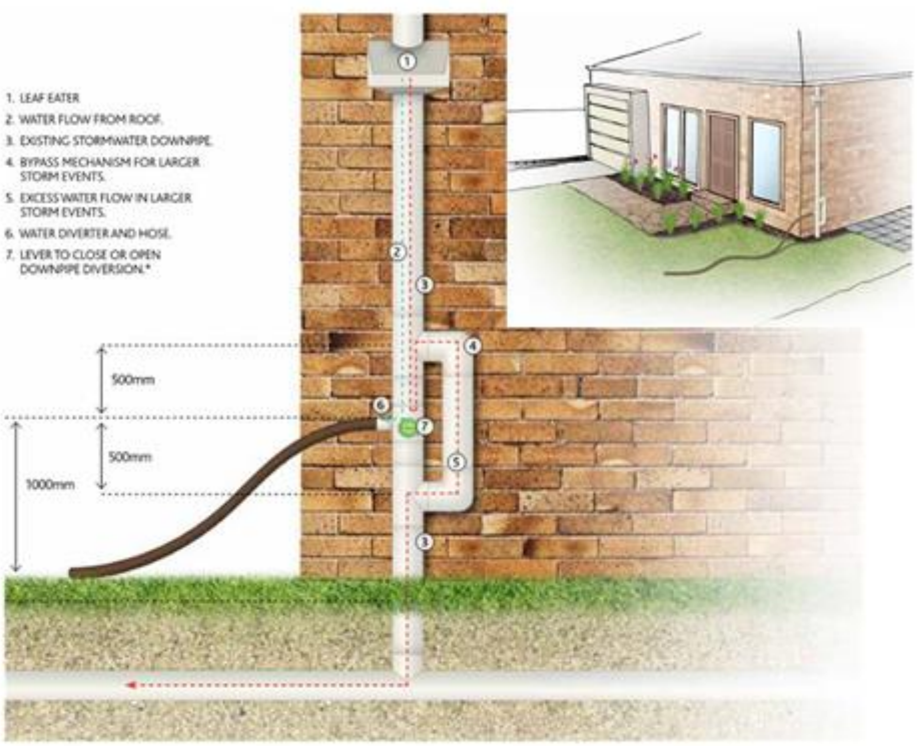


Figure 6-7 Typical First Flush Device in Residential Building

Source: City of Port Phillip

Runoff from minor rainfall events can add up to a significant portion of annual runoff volumes. Preventing this runoff from entering waterways helps preserve natural waterway hydrology and reduces overall pollutant loads into waterways. Downpipe diverters use this water as a form of passive irrigation.

Technical Aspects

A robust design has recently been developed by Melbourne Water and Master Plumbers, with system packages provided to residents via local government. The devices cost $135 each, with installation costs varying depending on whether devices are installed during initial house construction or as a retrofit. A number of these systems have been installed as part of a pilot project in Melbourne.

Alternative options include directly discharging downpipes to pervious areas or removing guttering altogether, which is a common practice in high rainfall areas like Darwin.

Benefits

- Low cost & simple to install,
- Good reuse of water for sustaining gardens, and
- Inbuilt overflow, so water is directed to stormwater pipes during large storms.

Challenges

- Depending on the diverter, these systems can block and require regular maintenance, and
- There is not a lot of data available on actual effectiveness of these systems for nutrient removal.

Application

- City of Port Phillip (https://www.portphillip.vic.gov.au/media/1tcd5vel/e27210-19-city-of-port-phillip-wsud_guidelines-final.pdf)

6.5.5 Stormwater Harvesting – Residential Rainwater Tanks with Smart Metering

Rainwater tank installation for each house, with smart meters to measure & monitor water levels and quality. Rainwater can be reused in the garden or filtered for reuse within the household (toilets, washing machine) or filtered for reuse as hot water.

Technical Aspects

Rainwater capture at the lot scale can increase drought resilience of each home, providing water for the garden and toilets on-site. It also reduces water flow to the stormwater network and can provide local water for bushfire management.

Roof rainwater harvesting can be treated and reused for hot water use on-site, reducing reliance on mains drinking water for hot water. For this purpose, rainwater is treated on site, undergoing screening, filtration, ultraviolet and heat treatment before supplying to showers, baths, laundry, and kitchen. The hot water system can be supplemented with drinking water when rainwater is not available. Where dual reticulation from a recycled water network is available, rainwater tanks are often not used.

Smart metering allows more effective measurement of individual water levels in each tank and ensures that water quality is appropriate for use on site. This can cost approximately $2,000/10,000L for a poly tank, with extra cost in sensors and software as a service. There can also be additional costs associated with energy use over time, so these integrated lifecycle costs should be included in any long-term cost comparisons.

Benefits

- Effective capture & reuse option at the household scale,
- Increases household climate resilience, and
- When implemented in conjunction with a recycled water scheme, this can reduce reliance on mains drinking water by up to 70%.

Challenges

- Additional cost to developers or householders,
- Ongoing maintenance and energy costs,
- Some poly tanks are not fire resistant, and

- Maintenance of the systems is ongoing to ensure that health requirements are met. In the Aquarevo development, Southeast Water simplify monitoring and maintenance of the systems by using smart technology.

Application

- Aquarevo, Rainwater hot water supply system (https://watersensitivecities.org.au/wp-content/uploads/2017/09/Case_Study_Aquarevo_FORWEB_170912.pdf) and
- Currumbin Ecovillage Rainwater Harvesting.

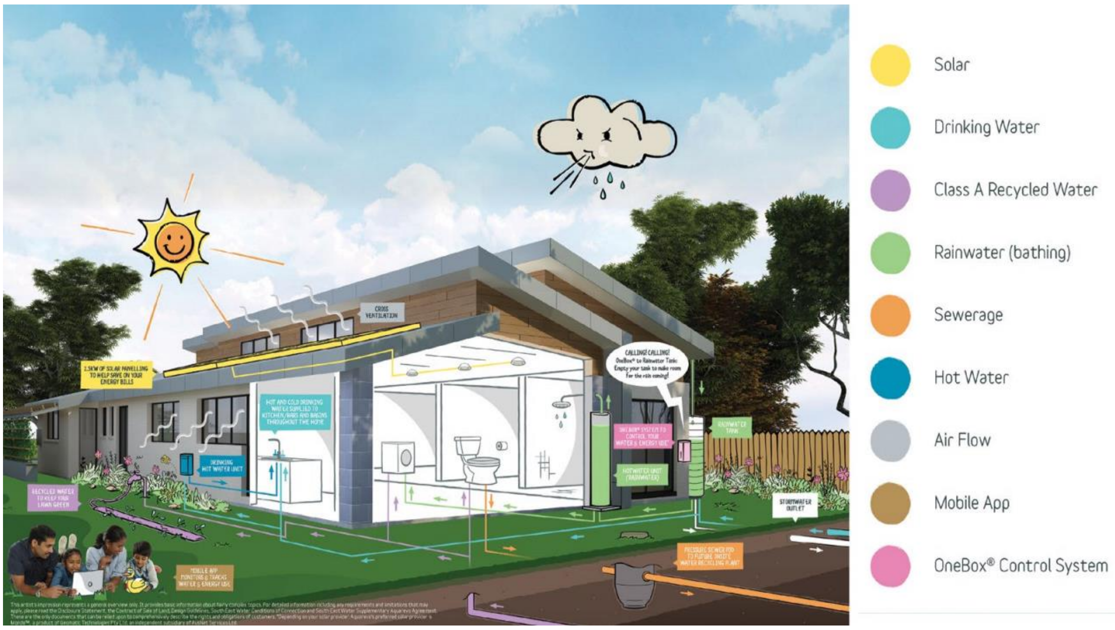


Figure 6-8 Residential Water & Energy Management

Source: Water Sensitive Cities

6.5.6 Stormwater Harvesting – Large Lots

Large Lot stormwater harvesting is the collection, storage and treatment of rainwater on a site for later reuse.

Technical Aspects

Larger scale stormwater harvesting can be undertaken on commercial or industrial sites, as well as large recreational areas like sporting fields. These systems can be diverse, ranging from harvesting of roof water, through to harvesting of overland flow or mining from stormwater pipes. Storage solutions can range from standard tanks, through to underground tanks or storage basins.

Benefits

- Effective capture & reuse option at the household scale,
- Increases household climate resilience, and
- When implemented in conjunction with a recycled water scheme, this can reduce reliance on mains drinking water by up to 70%.

Challenges

- Additional cost to developers or householders,
- Ongoing maintenance and energy costs,
- Some poly tanks are not fire resistant, and
- Maintenance of the systems is ongoing to ensure that health requirements are met. In the Aquarevo development, Southeast Water simplify monitoring and maintenance of the systems by using smart technology.

Application

- Aquarevo, Rainwater hot water supply system, and
- Currumbin Ecovillage Rainwater Harvesting.

Figure 6-9: Stormwater Harvesting, Fitzgibbon Chase, Brisbane

Source: Bligh Tanner

The Fitzgibbon Chase project is recognised internationally as a new model for hybrid centralised/decentralised water supply systems, estimated to achieve a 60% savings on normal mains water use. Bligh Tanner created an innovative new water management model for a 114-hectare housing community in Brisbane, allowing local water supply to grow as the population increases.

This project features a non-potable stormwater harvesting system (the FiSH) and potable roof water harvesting system (PotaRoo). The FiSH diverts, filters and disinfects urban stormwater runoff to supply non-potable water for irrigation, toilet flushing, laundry and outdoor uses. The PotaRoo harvests roof water from approximately 500 homes in Fitzgibbon Chase, which is pumped to a central water treatment plant to produce water of potable quality.

6.5.7 Beyond Impervious Surfaces

Impervious surfaces or hard surfaces directly increase stormwater runoff, contributing to flooding, waterway erosion and increased stormwater pollution. These surfaces can be minimised at the lot or suburb scale, through the use of porous pavement and green surfaces.

Permeable pavements can be designed with underdrainage systems that collect water for reuse or discharge, but more commonly, allow water to infiltrate into the subsoil. They can be designed for a range of traffic loadings, varying from pedestrian foot traffic through to trucks. Like any pavement, poor engineering design that fails to provide adequate structural support for heavy vehicles can lead to uneven subsidence.

There are a broad range of paving technologies that allow water to permeate through a trafficable surface. Four main categories of permeable paving are listed below:

- Porous asphalt (PA): Porous asphalt is similar to conventional asphalt, except the fines are removed to create greater void space. Additives and higher-grade binders are typically used to provide greater durability and prevent breakdown.
- Pervious concrete (PC): Pervious concrete is produced by reducing the fines in the mix to maintain interconnected void space. This has a coarser appearance than standard concrete.
- Permeable interlocking concrete pavement (PICP): PICP is made of interlocking concrete pavers that maintain drainage through aggregate-filled gaps between the pavers. The pavers themselves are not permeable.
- Grid pavement systems (plastic or concrete): Grid pavement systems are modular grids filled with turf and/or gravel. Open-celled concrete or plastic structural units are typically filled with small uniformly graded gravel that allows infiltration through the surface.
- Plastiphalt: sustainable asphalt product that incorporates waste plastics from used containers. It can be utilised in a number of asphalt mixes for range of solutions.

A number of Local Governments in Australia already manage the amount of impervious area at the large lot and/or suburb scale. Various trials of porous pavement are also underway in a number of Council areas across Australia and internationally. Many jurisdictions in the US have impervious area levies to provide a user-pays approach to stormwater management.

Technical Aspects

Impervious areas, like roofs, carparks, and concrete paths, can significantly increase nutrient flows to stormwater due to both a reduction in filtration capacity (from lack of grass and vegetation) and a build-up of nutrients and contaminants on the hard surfaces over time. When compared to green surfaces, there are also significantly higher temperatures associated with impervious surfaces.

Rainfall falling on the surface infiltrates into the voids between the pavement elements, allowing primary stormwater treatment by filtration at source. This can obviate the need for additional drainage or flood detention systems in some locations, hydrates soils in urban areas and leads to additional water supplies for street trees, and recharges local aquifers.

Permeable pavements are best suited for low traffic loads, which are subject to direct rainfall only, rather than receiving runoff from high sediment areas. As such, car parks, driveways, and pedestrian areas are well suited for this technology. Further discussion of traffic design can be found in Chapter 6 of the DCOP.

There is a large range of costs, depending on the paving system and sub-grade needed for a particular site ($5 - $430 /m2 depending on type of surface installed).

Benefits

- Reduction in hard surface decreases temperatures and limits urban heat island effects
- Additional filtration capacity leads to lower levels of sediment, nutrients and contaminants flowing to stormwater
- Reduced stormwater run-off volumes and increased flood mitigation
- Increased visual amenity and health benefits from additional green spaces
- Increased infiltration to aquifers, supporting low flows in local waterways
- Well suited to carparks, pedestrian areas

Challenges

- Some porous pavements can block over time, so have a limited life span
- Maintenance is essential to keep pores clear – vacuuming and sonication have been found to be very effective
- Current porous pavements are not as strong & durable as traditional hard options

Application

- Sydney Olympic Park
- Russell Family Park, Montville
- Sunshine Coast, Pervious Pavement Trials with Recycled Materials
- Brisbane City, Pervious Pavement Trials & Road Surface Trials with Recycled Materials

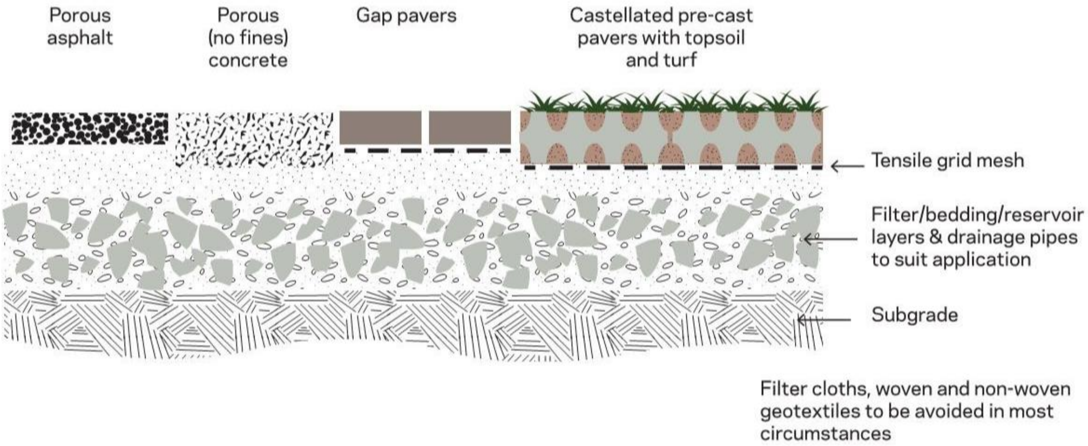


Figure 6-10: Porous Surfaces

Source: Bligh Tanner

6.5.8 Sustainable Home/Building Rating Systems

A sustainable home rating system for all homes and commercial buildings to ensure the highest quality energy, water, waste and sustainability outcomes within the development.

These rating systems have been used in a range of developments across diverse Local Government areas in Australia. The ratings allow for a base standard of sustainable building, as well as enabling buildings that go 'above and beyond' to achieve sustainable outcomes.

Technical Aspects

There are a range of existing rating systems including: NABERS (National Australian Built Environment Rating System), which is used for offices, shopping centres, hotels, data centres and apartment blocks; NatHERS (Nationwide House Energy Rating Scheme), which determines energy efficiency for a home; and Green Star, which captures features like interior fit-out and construction, precinct planning & development, and performance across categories like energy, transport, water, materials and land use.

Benefits

- Higher quality building and sustainability outcomes across the developments
- Lower energy use, water use and improved waste management over time
- Circular economy principles incorporated
- Improved visual amenity for residents
- Health benefits associated with reduced temperatures and increased green spaces for residents

Challenges

- Higher upfront building costs associated with meeting more stringent building code
- Ongoing maintenance costs usually borne by the landowners or body corporate

Application

- NABERS
- NatHERS
- Green Star
- BASIX (NSW)

6.5.9 On-site Use of Nutrients

Nutrients from green waste, such as lawn clippings, and excessive use of fertiliser in yards can contribute to increased nutrients in stormwater and local waterways. Options range from composting green waste at home, through to effective fertiliser management within each yard.

A number of Local Governments around Australia have a range of community programs associated with green waste management and effective use of fertilisers. Some Councils even provide rebates on the purchase of compost tumblers and worm farms.

Technical Aspects

There is an increasing number of people across Australia who are using home composting and sustainable gardening to reduce their organic waste and carbon footprints, while improving their own garden and local soils. The support for householders can include guidelines on how to design a sustainable garden, planting plans to assist with suitable species selection, composting and mulching instructions and pruning/mowing guidelines.

Costs of rebates can be up to $70 per household, usually providing for the purchase of worm farms, compost bins or other equipment for use on-site.

Benefits

- Low cost and simple
- Benefits to both waste and water management goals
- Negligible costs

Challenges

- Voluntary measure, so no guarantee that the measures will be implemented
- Neighbourhood outcomes are challenging, as each individual landholder may use different approaches

Application

- Brisbane City Council Compost Rebate Program (https://www.brisbane.qld.gov.au/clean-and-green/green-home-and-community/sustainable-gardening/compost-and-organic-waste-recycling/compost-rebate-program)
- Melbourne City Compost Revolution (https://compostrevolution.com.au/melbourne/)

6.5.10 Flood Resilient Building Design & Flood Preparedness

Flood resilient building design works on the principle that flooding can be expected on a floodplain, so buildings in flood zones should be designed with that in mind. It can include a range of community preparedness programs and building options, such as: building aspects in relation to flow, height of buildings, types of building materials, community education programs etc. I

Flood resilient building design and community preparedness can increase resilience and significantly decrease the cost of building repair after floods. A number of Local Governments across Australia are implementing this approach, with education programs and grants available to homeowners in some flood zones.

Technical Aspects

In Melbourne alone, it is estimated that flooding costs the ratepayers an average of $736M a year, in addition to the stress and disruption it causes (Melbourne Water 2021). Melbourne Water (2021) estimates that resilience and preparedness programs can reduce the impact of this flooding by up to 80%.

Preparedness programs can vary from retrofitting your home (e.g. raising power points, tilting floors, changing building materials in lower floors, reconfiguring your home, raising your home etc), creating an emergency plan for a community, developing community early warning programs, preparing emergency flood kits, providing sandbags for the community and working with insurers to support good outcomes in flood zone.

Benefits

- Enables building construction within some flood zone categories where building was previously prohibited
- Increases resilience of buildings and preparedness of residents in flood zones
- Can reduce insurance costs for homeowners who are implementing preventative measures
- Proactively increases community resilience to droughts, floods, bushfires and other natural disasters
- Reduces long-term flood damage to buildings and infrastructure
- Low cost of implementation

Challenges

- Costs are largely borne by homeowners
- Program is voluntary, so uptake across a local area can vary

Application

- Queensland Reconstruction Authority Flood Resilience Guideline (https://www.qra.qld.gov.au/resilient-homes/flood-resilient-building-guidance-queensland-homes)
- Brisbane City Council Flood Resilient Homes Program (https://www.citysmart.com.au/floodwise/)
- Melbourne Water Flood Resilience Program (https://www.melbournewater.com.au/water-data-and-education/water-facts-and-history/flooding/being-prepared-flooding
- Resilience NSW Program Grants (https://www.emergency.nsw.gov.au/grants)

6.5.11 Water Efficient Fixtures & Fittings

Water efficient fixtures can be installed in homes, commercial and industrial buildings and are usually a mandatory requirement of any sustainability rating system. These fixtures could include water efficient taps, dual flush toilets, smart metering and a range of other options.

Many Local Governments around Australia have water efficiency programs in place, with rebates available for retrofitting and most new homes constructed with all water efficiency measures in place.

Technical Aspects

In domestic buildings alone, water efficiency measures have been shown to save from $7,295 – 28,785 per building occupant in domestic buildings and can provide water savings of up to 78.5% (Tam & Brohier, 2013).

The Australian Government has estimated that Australians could save $2B by 2030 (an average saving of $175 per household per year). This saving is the result of combined savings from 65% of avoided water heating costs (from reduced electricity and gas costs) and 35% from reduced water bills (DISER 2021 - https://www.energy.gov.au/households/water-efficiency).

For industrial sites, up to 100% of water can be saved and reused on site (XXXX Brewery, Brisbane). This results in significant decreases in water costs, improved water quality for site reuse and can have additional energy benefits. In some cases, surplus water can also be available for sale or sharing to other water users in the local area.

Benefits

Minimising water use within buildings and lots can result in a significant reduction in water use, especially considering the cumulative effect across a whole town or city.

- Low cost
- Reduced water uses in homes

Challenges

- Reduction in water flow can be seen as problematic by local residents
- Under current legislation in some areas, sharing of surplus water with others can result in a business being viewed as a 'water provider', which triggers additional costs and licencing requirements.

Application

- City of Melbourne Council House 2 – Australia's first 6-star Green Star Building
- East Melbourne Library
- Lion Nathan XXXX Brewery, Brisbane

6.5.12 Drainage & Green Space Easements

Easements and covenants can be retained for sections of lots that serve a broader purpose, such as utility access, waterway movement, overland flow paths and valuable habitat areas.

Technical Aspects

Landscape and natural features that extend across lot boundaries (e.g. overland flow paths) can be challenging to manage as a system unless there is some control retained over what is constructed in those areas or how they are managed. Easements can provide access for Local Governments and can also enable stipulations relating to use of those areas. In designated easements and covenant areas, the local landholder has use of the land but Local Government and other designated organisations have the right to access that land.

Benefits

- Provides access and flexibility for managing utilities and drainage or wildlife corridors
- Allows for managing natural, inter-connected systems that require connection across lot boundaries

Challenges

- Creates restrictions on landholders who have the easements or covenants on their properties

- Can become common areas that are not maintained by any of the interested parties

Application

- Logan City Council, Brookhaven Development
- Designing Liveable Places – Water as an Enabler. CRC for Water Sensitive Cities, Brisbane.

6.5.13 Bioretention Basins & Rain Gardens

Bioretention Basins and rain gardens are used to filter nutrients, sediments and contaminants from overland flow before water from a site or roadway enters the stormwater system. These are regulatory design measures that are used widely by Local Governments across Australia. In some situations, they can be combined with flood detention.

Figure 6-11 Bioretention basins and rain gardens

Images: Bligh Tanner

Technical Aspects

Dedicated filtration basins & gardens are constructed at strategic locations within large lots, usually greater than 1000 or 2000m2.

There are a number of guidelines available for bioretention design in Australia, including Water-by-Design Guidelines (Healthy Land & Water 2019), WSUD guidelines (Melbourne Water 2013), Urban Typologies and Stormwater Solutions (Sydney Water 2019) and WSUD Engineering Procedures (CSIRO 2005).

Benefits

- Improved removal of nutrients, contaminants and sediments from stormwater
- Improved visual amenity, where systems are designed effectively
- Increase in urban habitat, when compared to traditional drainage options
- Benefit to urban cooling, from both vegetation and water within the landscape

Challenges

- Ongoing maintenance requirements
- If not designed or maintained effectively, these basins can provide reduced visual amenity, weed sources, mosquito and odour issues for local residents. However, if they are designed and maintained effectively, these issues can be minimised. For examples, mosquitos require very specific physio-chemical conditions and duration of water depths for breeding. If a bioretention system is designed correctly and maintained effectively, there will not be suitable conditions for mosquitos to breed. It is also recommended that the latest sensor technology be utilised within these systems to measure water depths and trigger maintenance when required rather than on a set time period.
- If not designed effectively, can be fenced off from community use, resulting in loss of functional green space
- If not designed at a suitable scale, can result in thousands of distributed gardens that become challenging to maintain
- If not accompanied by educational signage, can be misunderstood by the community and seen as a waste of space

Application

- Melbourne City Docklands
- Brisbane City Council Creek Filtration Program (https://waterbydesign.com.au/case-study/creek-filtration-systems-brisbane-city-council)

Figure 6-12 Creek filtration systems, Brisbane City Council

Source: Water by Design

6.5.14 Swales

Swales are shallow vegetation infiltration channels used to slow water flow and filter nutrients, sediments and contaminants from stormwater. They are a common design feature for managing overland flow and water quality in urban areas, often used as a regulatory design measure that are used widely by Local Governments across Australia.

Figure 6-13 Swales

Images: Bligh Tanner

Technical Aspects

There are numerous standard drawings and standards to support quality swale design. These include the Design & Construction Standards for Public Infrastructure (Melbourne 2013) and the Water-by-Design Guidelines (Healthy Land & Water 2019).

Benefits

- Low cost
- Improved infiltration of water
- Improved runoff water quality
- If carefully designed, can provide visual amenity and open space areas for local residents
- Added benefits of urban cooling and urban habitat

Challenges

- If not designed carefully and in the right location, can result in property access issues for landholders

- If not maintained well, can provide weed sources, odour and mosquitos for local residents
- If not accompanied by educational signage, can be misunderstood by the community and seen as a waste of space
- If not accompanied by educational programs, can be misunderstood by Council maintenance teams, who attempt to mow the swales and consequently create boggy areas for machinery

Application

- Townsville City Council – Swale Design
- Melbourne Water – Standards & Specifications

6.5.15 Vertical Gardens & Roof Top Gardens

Green walls (or vertical gardens) and roof top gardens are increasingly being used in cities around the world.

Figure 6-14 Vertical and roof top gardens

Images: Bligh Tanner

These gardens are utilised by a number of Local Governments across Australia and are a common feature of Sustainable building design to achieve Sustainability ratings.

Technical Aspects

These can be used in areas with limited space or to ensure multiple benefits from available space. Depending on the design and location, they can provide multiple benefits at a site, such as cooling, visual amenity, food production and nutrient removal.

Benefits

- Increased visual amenity
- Reduced impervious area and heat on roof tops
- Visual elements of green spaces like these are increasingly thought to have health benefits for local residents

Challenges

Plants in these systems require maintenance according to specifications in order to ensure plant survival. This maintenance is generally weekly during plant establishment and then less frequently as the plants become established. Overall, this maintenance regime is normal for any vegetated system and not considered ‘high maintenance’ when compared to traditional lawns and manicured gardens.

Application

- Melbourne Quarter Sky Park, Docklands
- Sydney Central Park Development

6.5.16 Stormwater Offsets & Water Quality Credit Programs

Offsets are a financial contribution provided by developers to Government Agencies to pool funds and undertake works in alternative location, in order to ‘offset’ stormwater impacts that are not treated within individual developments.

Offsets are being increasingly used in multiple jurisdictions across Australia and there are existing policies for Stormwater Offsets in Queensland. They are seen as an option for ensuring that nutrient targets are met, even for highly constrained sites, as well as providing a mechanism for combining funds and creating Sub-Regional solutions rather than attempting to reach water quality targets within each lot.

New water quality credit programs are also emerging, providing new incentive mechanisms for landholders to manage soil, vegetation, and waterways in high value catchments.

Technical Aspects

Many offset schemes operate as an all or nothing approach, whereby developers either meet their full stormwater treatment obligations on site or do no on-site works and pay an offset. The most economically efficient approach involves partial offsets, whereby developers undertake on site to the extent that it is economical to do so, and then use offsets to ‘top-up’ any residual shortfall.

Streambank rehabilitation is one type of offset being used by developers that are unable to meet nutrient & sediment targets at the lot scale. To implement these offsets, waterways can either be defined as trunk infrastructure via the LGIP or investment can be managed via a broader catchment management planning process.

Water Quality Credit programs are being used within the Great Barrier Reef catchments. These programs can be used as an offset, with landholders being paid according to the nutrients and/or sediment that they retain on their farm. Alternatively, they can be utilised within new agricultural business models whereby landholders can obtain economic benefits from the soil and vegetation on their property.

Benefits

- Provides a mechanism for achieving water quality targets, even on highly constrained sites
- Regional water quality targets and waterway health benefits can be achieved with investment of offset money in strategic waterway locations
- Mechanism for achieving least cost water quality management
- Avoids creating problematic single-function stormwater quality assets
- Offset projects can be designed to deliver a broader set of public interest outcomes, such as recreation or natural area restoration.

Challenges

- If the area where money is being invested is outside the catchment where the development impact occurs, there can be a local reduction in water quality near the development
- If all key water quality parameters are not considered in the assessment, only a few of the parameters will be offset, resulting in a local and overall reduction in water quality for parameters not being considered (e.g. metals)
- Investing offset money at the waterway equates to investing at the end of system, which is not the most effective location for dealing with cumulative catchment impacts
- Costs vary depending on local government pricing scheme and market supply and demand.

Application

- Melbourne Water Stormwater Quality Offset Scheme
- Ipswich City Council – Small Creek Rehabilitation Project
- Urban Utilities, Queensland – Logan River Rehabilitation Project
- Port of Brisbane – Laidley Creek Rehabilitation Project
- Reef Credits Program - Great Barrier Reef, Queensland

6.5.17 Walkable Neighbourhoods & Water Enabled Neighbourhoods

Designing future developments within a landscape context, considering important corridors, green spines, overland flow paths, urban heat and topographic features can enable more resilient and sustainable outcomes for the area.

A number of local Councils around Australia and globally are trialling different development footprints and lot layouts to increase long-term resilience and sustainability.

Technical Aspects

These neighbourhoods can include Sub-Regional scale design features, like nationally important vegetation corridors and development layouts, down to a precinct scale, with the incorporation of shade ways, boulevards and parks.

Buildings can be positioned on lots and designed in such a way to accommodate overland flow paths and improve overall sustainability outcomes.

Positioning buildings on a lot and across lots can be undertaken in such a way as to enable effective functioning of overland flow paths, maximise access to green spaces and shade, increase solar capture and minimise energy requirements.

It is more cost-effective to design with the landscape initially rather than attempting to retrofit suburbs to incorporate some of these landscape features at a later date.

Benefits

- Increased flood, drought and bushfire resilience across the new development area
- Improved ecological outcomes
- Reduction in urban heat island effects
- More accessible and connected green spaces for the community
- More cost-effective approach to managing natural systems across the landscape
- Increased resilience and sustainability of buildings
- Improved energy efficiency of buildings

Challenges

- This approach can reduce developable land and overall profit for developers
- Requires effective and early master planning
- Requires additional coordination for both the spatial and temporal aspects of developments
- Often requires construction staging and/or developers working across lot boundaries to create effective outcomes to be scaled

Application

- Logan City Council – Brookhaven/Bahrs Scrub Developments
- CRC for Water Sensitive Cities – 'Greening the Pipeline', Williams Landing, Melbourne

6.5.18 Verge Gardens

Verge land between the private property and the road can provide a valuable buffer between yards and the gutter.

Technical Aspects

This verge serves as a filter for nutrients and contaminants, provides some habitat for wildlife and creates green space for tree planting, cooling and other uses. A number of Local Governments across Australia have Verge Garden policies, enabling the adjoining landholder to plant community gardens, ranging from vegetable patches to bird habitats.

Benefits

- Multiple benefits, from community food production, through to urban cooling, urban habitat and nutrient filtration
- Low cost
- Builds local ownership of the verge space

Challenges

- Often not coordinated across boundaries, so can end up with visually and functionally contrasting gardens along each road
- Verge space is highly contested, with multiple utility services also provided within the verge. Gardens need to consider any potential impacts on power lines and the pipe network.

Application

- Brisbane City Council - Verge Garden Guidelines
- City of Melbourne - Street Garden Guidelines
- City of South Perth - Street Verge Landscape Guidelines

6.5.19 Gutter Guards

Gutter guards can be used on residential gutters to minimise leaf capture.

Technical Aspects

Gutters can capture and store leaf litter, resulting in a build-up of nutrients that are washed into either the stormwater system or into the rainwater tank. This leaf build-up can also increase fire susceptibility for the home.

Numerous Local Governments across Australia recommend the use of gutter guards. Costs can vary from $5-108/m, depending on solution selected.

Benefits

- Reduce leaf build-up in gutters
- Reduce nutrients to stormwater/rainwater
- Reduce fire susceptibility of home

Challenges

- Additional cost to homeowner for installing gutter guard
- Ongoing maintenance still required

Application

- The Southport School, Queensland – Reducing Costs, Decreasing Ceiling Flooding & Improving OHS (https://bluemountainmesh.com.au/field-notes/case-studies/case-study-reducing-costs-ohs-risks-with-gutter-mesh/)

6.5.20 Rates & Levies

A dedicated levy can form part of the rates paid by each individual landholder to Local Government. These levies can be for stormwater, environment or other important matter that requires dedicated funding.

Technical Aspects

Levies can be implemented proactively to increase funding for important environmental areas or improving stormwater management, or they can be used as a tax that is imposed according to the land use or impervious area on each lot. These mechanisms are used widely by Local Governments across Australia.

Benefits

- A good option for targeted funding, including innovation initiatives, with flexibility in how money is spent
- When used as a tax, it can be a powerful incentive for landowners to take specific management actions on a site, such as minimising impervious area

Challenges

- Requires political support, which requires strong support from the community to implement

Application

- Queensland Government Waste Levy
- Brisbane City Council Bushland Preservation Levy
- North Sydney Council Environmental Levy
- Melbourne Strategic Assessment (Environment Mitigation Levy)

7 Transport

7.1 Introduction

This chapter is intended to identify the interim and ultimate transport related elements of the Ripley Valley Priority Development Area (PDA). This chapter should be read in conjunction with all infrastructure reports that form the Infrastructure Planning and Background Report (IPBR) document, particularly the detail provided in the Active Transport report.

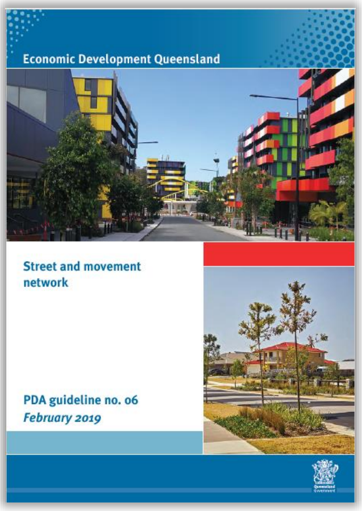
Specifically, this chapter details the transport related trunk infrastructure requirements and the timing of these items. To ensure a robust and connected transport network is provided within the Ripley Valley PDA, Ipswich City Council acting as delegate for the PDA should ensure the requirements of this chapter are reflected within development approvals.

The information contained within this chapter was current at the time of development (April 2020). Background information referenced was current as of December 2019 and does not account for new applications or changes to existing development applications and approvals.

7.2 Reference Standards

In developing the DCOP a number of existing reference standards were considered to ensure the requirements set out in the DCOP provided alignment with existing Economic Development Queensland (EDQ) policy and industry best practice. The standards that guided this document are summarised below.

Street and Movement Network PDA Guideline No. 06 | February 2019



EDQ's Street and Movement Network document provides the standards required for the planning and design of street and movement networks within PDAs.

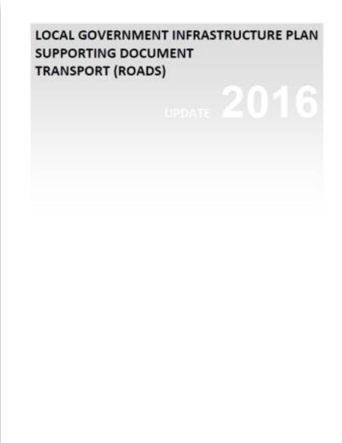
The specific standards used for this analysis were:

Street types and specifications
Corridor requirements
Carriageway requirements
Active transport requirements
The guideline encourages interconnectivity between communities and neighbourhoods.

A key requirement of the guideline is one-way 2.0m separated cycle tracks on both sides of the corridor for higher order roads.

Whilst all effort was made to maintain the requirements of this guideline, to overcome challenges associated with staging of the cycle provisions, some alternative outcomes have been adopted for Ripley Valley. This is detailed in Section 8.9.

Local Government Infrastructure Plan (LGIP) Support Document Transport (Roads) | Update 2016

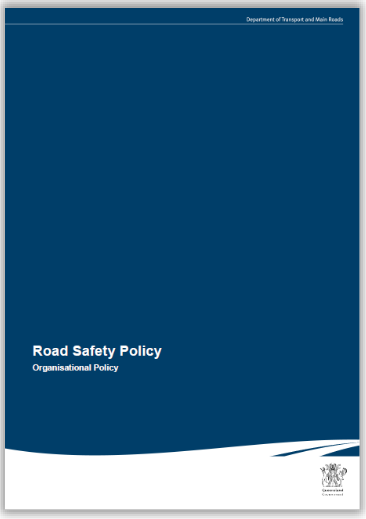


Ipswich City Council's (Council) LGIP Support Document (also referenced as extrinsic material) provides information to support the development of the trunk road network within Council's LGA.

It is noted that the current LGIP planning identifies the ultimate development year as aligned with 2041. Current projections for Ripley Valley anticipate an ultimate development year for the PDA of 2066 (25 years post the LGIP planning).

This document details the desired standard of service (DSS) requirements for the future trunk network. This is further referenced and discussed in Section **Error! Reference source not found.**.

Road Safety and Operational Policy | July 2017



The Road Safety Policy published by the Department of Transport and Main Roads (TMR) focuses on implementing Safe System principles, processes and practices that have the can contribute to better road safety outcomes. This is aimed to assist with the State Government's vision of zero road deaths and serious injuries. The policy assists with maximising the alignment with best practice road safety management.

The specific items within this policy that informed the analysis and intersection design were:

Provisions for vulnerable users and where demand exists or may develop, pedestrian crossings on all approaches at signalised intersections.

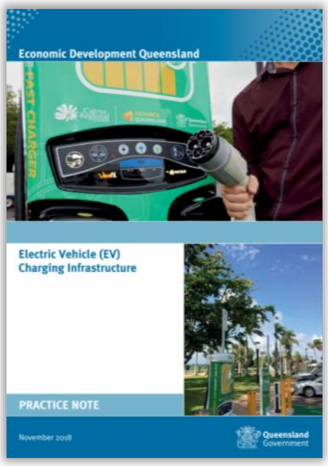
The requirement to avoid unsignalised left turn slip lanes at intersections.

Road Planning and Design Manual (RPDM) Edition 2 Part 3 | August 2014

The RPDM is a TMR document that is supplementary to the Austroads Guide to Road Design Part 4a. The purpose of the document is to provide additional information that is specific to intersection design for TMR's network.

It is acknowledged that the PDA's future asset ownership will likely sit with Ipswich City Council, however Austroads Part 4a is an industry accepted best practice guide, with reference given to the additional TMR requirements due to the Queensland context. It also gives guidance on the warrants for major road turn treatments. This has been used to inform the design of the unsignalized intersections on the trunk network of the PDA.

Economic Development Queensland's Electric Vehicle Charging Infrastructure Practice Note | November 2018



The Practice Note outlines the principles for planning electric vehicle (EV) charging infrastructure in Priority Development Areas (PDAs) in Queensland, to support the selection of the right type of infrastructure at the right location. It is intended to assist government authorities, town planners, developers and landholders looking at installing EV charging infrastructure. This Practice Note does not replace or override any applicable local planning laws, building codes and Australian standards.

7.3 Past Reports

The previous reports reviewed and used to inform the DCOP for transport are summarised in Table 7-1. A number of these documents will be superseded by the DCOP, this has been identified within the table.

Table 7-1 Ripley Valley Literature Review

Document title and author	Description	Will it be superseded by DCOP?
Draft ICOP (Aug 2019) *Department of State Development, Infrastructure, Local Government and Planning*	Sets out the infrastructure contributions that may be offset against the Ripley Valley Priority Development Area (PDA) charges.	Yes
Ripley Valley Urban Development Area Development Scheme (October 2011) *Urban Land Development Authority*	Establishes the vision, land use and infrastructure planning for the Ripley Valley Urban Development Area.	No (Amendment to Development Scheme required)
Demographic Analysis for Three Priority Development Areas (January 2020) *SGS Economic Planning*	The report provides land use projections for the Greater Flagstone, Yarrabilba and Ripley Valley Priority Development Areas (PDA).	Yes
Transport Modelling Report (May 2020) Jacobs	The purpose of the report is to review, update and apply the Ipswich Strategic Transport Model (ISTM) to enable assessment of development	No

Document title and author	Description	Will it be superseded by DCOP?
	applications and to aid in determining ultimate and interim road hierarchy and capacity requirements for the Ripley Valley PDA.	
Active Transport Plan (Feb 2019) *Jacobs*	Develop an active transport plan for the Ripley Valley PDA. Provide guidance to EDQ and Ipswich City Council (ICC) to ensure a consistent and high-quality approach is taken in delivering active transport facilities within the PDA.	Yes
iGO Active Transport Action Plan (Dec 2016) *Ipswich City Council*	The iGO ATAP guides the planning, delivery and promotion of quality facilities and programs for walking and cycling (and other active forms of travel) in Ipswich.	Yes
PDA Guideline No.6: Street and Movement Network (Feb 2019) *Economic Development Queensland*	This guideline sets out the standards for the planning and design of street and movement networks within Priority Development Areas (PDAs).	Yes
Bundamba Creek Corridor Plan (Jun 2016) Ipswich City Council	Bundamba Creek Corridor Plan addresses the range of complex issues facing the corridor development and provides a single vision for its transformation.	Yes
ICOP Extrinsic Material (Aug 2019) *Integran*	This extrinsic material report has been prepared to support the interpretation and implementation of the ICOP.	Yes
Local Infrastructure Plan Sub-Regional Infrastructure Plan (Jul 2016) *Cardno*	LIP and SRIP outlines the principle assumptions applied in the local transport plan for the proposed PDA.	Yes

7.4 Desired Standards of Service and Road Network Usage Allocations

The DSS requirements are provided to inform the performance of roads and intersections that will be accepted within the PDA. These requirements have been taken from EDQ's Guideline Number 06 and in the absence of EDQ policy, best practice.

These defined measures will ensure there is a resilient transport network that supports the PDA's growth. It is also intended to accept a certain level of congestion during peak times given the urban nature of the PDA.

7.4.1 DSS Requirements for Trunk Roads

A review of the EDQ and Council DSS requirements for roads was undertaken. As can be seen in Table 7-2 there are some disparities between the naming conventions and daily thresholds for the trunk network.

Table 7-2 Council's DSS Requirements for Trunk Roads

PDA Guideline no. 06			Council LGIP Extrinsic Material		
PDA street network	Number of lanes (both directions)	Daily traffic volume, vpd	Link function	Number of lanes (single direction)	Daily capacity threshold, vpd
Motorway / Highway	2 lanes	NA	Motorway / Highway	1 lane	14,000 - 15,600
	4 lanes	NA		2 lanes	30,300 - 33,700
Urban Arterial	2 lanes	NA	Arterial	1 lane	9,000 - 10,800
	4 lanes	NA		2 lanes	19,800 - 23,400
Trunk Connector	2 lanes	7,500 - 18,000	Sub-Arterial	1 lane	8,100 - 9,000
	4 lanes	18,001 - 30,000		2 lanes	17,100 - 19,800

To facilitate the delivery of a resilient transport network, trunk roads within the PDA will have the DSS standards applied as presented in Table 7-3:

Table 7-3 Ripley Valley PDA DSS Road Requirements

PDA Guideline no. 06		
PDA street network	**Number of Lanes (both directions)**	**Daily Traffic Volume, vpd**
Urban Arterial	2 lanes	7,500 – 23,500*
	4 lanes	23,500 – 40,000*
Trunk Connector	2 lanes	7,500 - 18,000
	4 lanes	18,001 - 30,000

*In the absence of EDQ Policy standard industry practice has been applied, these values are estimates of the range for maximum vpd

7.4.2 DSS Requirements for Trunk Intersections

In the absence of EDQ policy, best practice has been applied for the DSS requirements of trunk intersections within the PDA. These requirements are for maximum Degree of Saturation (DOS) thresholds of:

- 0.90 for traffic signals
- 0.85 for roundabout
- 0.80 for priority control.

It is noted that the ultimate year for the PDA is 2066 and that means there is some uncertainty around travel patterns and behaviours for this ultimate year. There may also be emerging technologies which will allow for more capacity to be gained out of existing infrastructure. Therefore, some consideration will be given for signalized intersections exceeding the DOS of 0.90 in the ultimate year of 2066. This will be considered and approved on a case-by-case basis.

7.5 Stakeholder Engagement

A key requirement of the DCOP process was collaborative engagement between EDQ and other key authority stakeholders. For Ripley Valley transport, this was TMR and Ipswich City Council (Council). The purpose of this engagement was to ensure the requirements set out in this report were aligned with the future demands and timings of both the PDA and external networks and drivers.

In addition to ongoing discussions, the two key workshops delivered are detailed in Table 7-4.

Table 7-4 Ripley Valley DCOP Workshops

Workshop	Date	Overview	Attendees
1	Tuesday, 10 December 2019	To detail and gain agreement on the DCOP transport scope and project path to success.	EDQ Council
2	Friday, 31 January 2020	Provide detail on: Review and consolidation of existing information Alignment of the PDA and DCOP requirements with other local and state policy Constraints and opportunities analysis Recommendations on updates to existing strategies	EDQ TMR Council

In addition to the above targeted stakeholder sessions discussions were held with Translink to discuss the future public transport requirements of the PDA. These discussions will continue to occur to ensure public transport services can be provided as the demand increases.

Ongoing engagement on the outcomes of the analysis has occurred to ensure the DCOP provisions as presented in this IPBR report are consistent with the intent of the PDA and aligned with stakeholder requirements.

Further engagement with both authority and developer stakeholders will continue as further revisions of the DCOP occur.

7.6 Innovation by Design

Innovation by design as previous defined includes approaches using proven, currently available technologies and/or construction methods to achieve innovative outcomes. These innovations currently exist within the Australian context of urban development and can be readily implemented within the Ripley Valley PDA.

Design Innovations enable new development and infrastructure in each PDA to showcase already tested innovations that are progressing to business as usual in other locations. These innovations require the development industry's desire to showcase leading design innovations as part of new urban development.

The following list of Design Innovations currently exist within Australian urban communities. These innovations provide examples of locations that have implemented these innovations in place of BAU infrastructure and provide developers, landowners and local governments with on the ground outcomes that they can duplicate in the local context of Ripley Valley. Developers are encouraged to implement one or more of the Design Innovations in consultation with EDQ and local government and help progress these innovations to business as usual.

7.6.1 Smart Poles

Smart poles have been installed in major cities to help local councils collect data. Smart poles can be used for public safety lighting, pedestrian and cyclist detection, traffic and construction noise monitoring, Wi-Fi, USB charging, general power outlets (E-bikes) and climate monitoring. The poles are approximately 8m tall and transmit collected data to a Central Management System (CMS). Brisbane City Council have a plan to install 20 smart poles, with a lifespan of 40 years, across Brisbane to collected data on how the city functions.

Image sourced: thedailytelegraph.com

Figure 7-1 Image example of a Smart Pole

Key considerations

Smart poles are primarily used to gather data for future planning and development. Smart poles must be placed in strategic locations, predominantly high trafficked areas (people and vehicles), to ensure data collected has maximin inputs from each location. Significant supporting infrastructure to manage and process data acquisition, related to monitoring, surveillance and user statistics/modelling is also required as without it, the source data has limited value. These inputs enable a network of data on travel systems, destination, route, services accessed, technology and connections. The costs associated with ongoing operation and maintenance of the infrastructure should also be considered.

Implementation recommendations

Moderate: Smart poles can perform various activities as they provide power, lighting, charging options, monitoring and Wi-Fi, hence their location must be well placed within the urban environment. Positions within activity centres, at PT hubs and Sub-Regional open space would maximise their return data and informational inputs.

Ownership and operation

Funded and owned by local government as landowner ongoing operations can be outsourced. For example, for over 2 years now Ipswich City Council has implemented smart poles in the form of streetlights and Brisbane City Council awarded Sydney- based company ENE HUB the contract for the supply and installation of the smart poles and 10 years of operation and maintenance.

Procurement complexity

High: Installation, operation and ongoing maintenance would remain with local government. Subject to local government policy position and budget allocation. Opportunities to trade data may offset costs.

Further information

- Ipswich: https://www.ipswichfirst.com.au/humble-street-light-heart-ipswichs-smart-city-evolution/
- Brisbane City Council: https://www.brisbane.qld.gov.au/about-council/governance-and-strategy/vision-and-strategy/smart-connected-brisbane/brisbane-smart-poles

7.6.2 Adaptive Signaling

Machine learning has been applied to traffic signalling to improve efficiencies. These signalised systems receive information from intersections at short intervals, allowing them to adjust split, offset and cycle times to suit the current conditions. Video detection also allows for speed and mode of transport to be identified, resulting in benefits such as the prioritisation of emergency vehicles. Arcadis' 'Smart Corridor' in Atlanta and the 'Scoot System' in Monterey are examples of where adaptive signalling is producing substantial results.

Image sourced: Arcadis.com

Figure 7-2 Example of adaptive signalling

Outcomes include more efficient signalised networks, which reduce waiting times, improve safety (35% collision reduction along the smart corridor) and result in less emissions from vehicles. Other innovations in signalling include changing the display of the signal itself, such as showing the time left of a certain signal.

Key considerations

Due to the highly autonomous nature of these systems, there is potential for harmful errors if not implemented properly. Therefore, expertise and experience of key personnel is critical for safe operations, including a regular monitoring and maintenance systems.

Implementation recommendations

Low: These automated systems are still evolving their mainstream application due to their interface with potentially hazards human activities and their artificial intelligence. Options for these solutions require significant engagement with state government road authorities as the ultimate owner and manager responsible for these assets.

Ownership and operation

As traffic lights remain a Department of Transport and Main Roads asset resource allocations into Adaptive signalling would need to be adopted by the state government. Both projects outlined were government funded, with each one's respective design firm tasked with supporting a local team in day-to-day operations.

Procurement complexity

High: Due to the risks associated with the application of this technology widespread implementation will be a long-term investment for the state government and will only be mainstreamed once associated risks are within acceptable levels.

Further information

- Smart corridor, Atlanta USA: https://www.arcadis.com/en/global/what-we-do/our-projects/north-america/united-states/creating-an-intelligent-transportation-system-for-atlanta-s-first-smart-corridor/
- Scoot system, Monterey USA: https://www.westernsystems-inc.com/project/scoot-adaptive-traffic-control/

7.6.3 Electric Vehicle Charging

Increase in electric vehicle (EV) use has created a demand for public EV charges to be supplied in on street and off-street parking locations. Public EV charging spaces have a varying price range depending on the location and time of day. At most, the cost of using a public charging station is typically less than the cost of charging the vehicle at home. Available chargers around the city can be found via apps which can also be used to make payment. Contactless payment is progressively being added to chargers.

Image sourced: Waverley Council

Figure 7-3 Electric vehicle charging

Public EV charging spots are usually in priority spaces, painted green or red with a white EV charging symbol and/or easily locatable by signage and large charging station. EV charging spots found in hotels and other commercial buildings may require drivers to bring their own charging cables and adapters and will only be charged that base parking rate for all car types.

Key considerations

For EV charging to be productive the position of the charger relative to the car parking space must be considered in the context of locational demand for EV charging. Engagement with surrounding stakeholders of parking infrastructure like hotels, shopping centres and local governments in also required as well as the BCR for installation.

Implementation recommendations

Moderate: Incentive packages in collaboration with solar and residential battery providers and manufacturers would assist in maximising opportunities for domestic EV charges to be provided within individual properties, and car parks. Public EV charging points should be provided in public car parks.

Ownership and operation

There are numerous Queensland examples including at the Northshore Hamilton PDA. The Bowen Hills development scheme requires EV readiness, as does Yeronga PDA. The Carseldine village design guidelines require all dwelling garages to be EV ready. The public EV charging stations in Waverly Council are supplied by JET Charge and were jointly funded by three councils (Waverly, Woollahra and Randwick), as part of their joint commitment to reduce carbon emissions. Users can book and pay for the charging stations via the Chargefox app.

In Brisbane the EV charging stations are in a privately-owned car park, where users of the stations pay half price (casual parking rates) for parking and charge for free during business hours.

Procurement complexity

Low: Where new public car parks are created, or existing parking areas refurbished local government can install charging stations as part of a sustainable approach to carbon reduction. Private car parking areas in shopping centres/activity centres could also be required to provide EV charging parks through planning policy and/or incentives.

Further information

EDQ's Electric Vehicle Charging Infrastructure Practice Note outlines the principles for planning electric vehicle (EV) charging infrastructure in Priority Development Areas (PDAs) in Queensland, to support the selection of the right type of infrastructure at the right location. It is intended to assist government authorities, town planners, developers and landholders looking at installing EV charging infrastructure: https://www.dsdmip.qld.gov.au/resources/guideline/pda/practice-note-electric-vehicle-charging.pdf

The Queensland Electric Super Highway charging stations use green energy either through direct green energy credits or offsets, making them a carbon-neutral and pollutant-free transport option: https://www.qld.gov.au/transport/projects/electricvehicles/future/super-highway

Waverley, Woollahra and Randwick Councils in Sydney's eastern suburbs have installed public on-street electric vehicle (EV) charging stations in key destination hotspots from Coogee to Double Bay. These are the first on-street public charging stations of this type in Sydney, and local government-backed on-street charging infrastructure in NSW. The charge stations allow for universal charging, meaning they will be accessible to all electric vehicle makes and models. EVs will need to adhere to normal parking restrictions that apply at each site: https://www.waverley.nsw.gov.au/environment/sustainable_transport/electric_vehicle_charging_station

In Brisbane CBD, free electric car recharge is available during business hours. King George Square Car Park is the only car park in the city with this facility, promoting the reduction of carbon dioxide and pollution. Specially marked bays are on Level B for this service: https://www.brisbane.qld.gov.au/traffic-and-transport/parking-in-brisbane/car-parks/king-george-square-car-park#electric

7.6.4 Recycled Paving

While there are several products on the market that provide the same benefits and methodologies of manufacturing, Fulton Hogan has begun conducting large scale trials of their product, Plastiphalt made from recycled plastic, that would otherwise go to landfill. This environmentally friendly asphalt has been successfully implemented in projects such as the Christchurch Airport Fire Station, where 3100 four-litre plastic oil containers were used. Like various other recycled goods, once used and showcased a greater demand for recycled products will arise from Plastiphalt wide scale adoption.

Image sourced: The Age

Figure 7-4 Plastiphalt ingredients

Key considerations

Currently the associated cost increase with using Plastiphalt compared to common asphalt is around 7%. Therefore, without the incentive of a government subsidy, wide scale implementation will be difficult.

Implementation recommendations

High: The opportunity to replace a standard well used product with an equally as good alternative that has a sustainable footprint should be pursued. The widespread use of asphalt for road construction and footpaths enables a straightforward replacement product to be widely implemented through new infrastructure.

Ownership and operation

Currently Fulton Hogan has patented the 'Plastiphalt' product but given its current success it is reasonable to assume that many similar products will be available to the market soon.

Procurement complexity

Moderate: As the product is more expensive than asphalt some financial incentives or concessions could be applied through government grants/subsidy to developers where use is implemented as part of their standard road construction. Subject to both local and state government road authority's acceptance of the 'Plastiphalt' surface as adequate for their road's capacity.

Further information

- Christchurch Airport, New Zealand: https://www.fultonhogan.com/trial-recycles-plastic-containers-asphalt/
- Castle Road, Glanville, South Australia:https://www.fultonhogan.com/plastic-recycled-into-asphalt-in-adelaide/
- St Kilda Road, Victoria: https://www.theage.com.au/national/victoria/recycled-plastic-hits-the-road-in-st-kilda-20190918-p52sjl.html

7.7 Planning Horizons and Adopted Demographics

The planning horizons and demographics used to inform the DCOP analysis are detailed at the transport zone level following, with a summary provided in Table 7-5.

These assumptions provide the best guidance at this time. As the progressive development of the PDA occurs, there will be natural movement of these numbers, particularly at the transport zone level.

When considering an ultimate horizon of 2066, consideration should be given to the emergence of new technologies including autonomous vehicles, personalised mobility solutions, Mobility as a Service (MaaS) and other new technologies and travel patterns. These changes in travel behaviours over the coming decades cannot be reflected in current modelling. As the progressive updates of the DCOPs occur, and more certainty will be known around these new technologies, these other factors will increasingly be included in the analysis.

Table 7-5 Ripley Valley planning horizons and adopted demographics[1]

Horizon	Dwellings	Population	Employment
2026	11,174	33,522	4,083
2031	18,913	56,740	6,405
2041	32,584	94,493	10,180
2046	37,971	110,116	11,743
2066	50,000	135,001	14,231

Source: SGS Forecasts Ripley Valley Travel Zones_201219

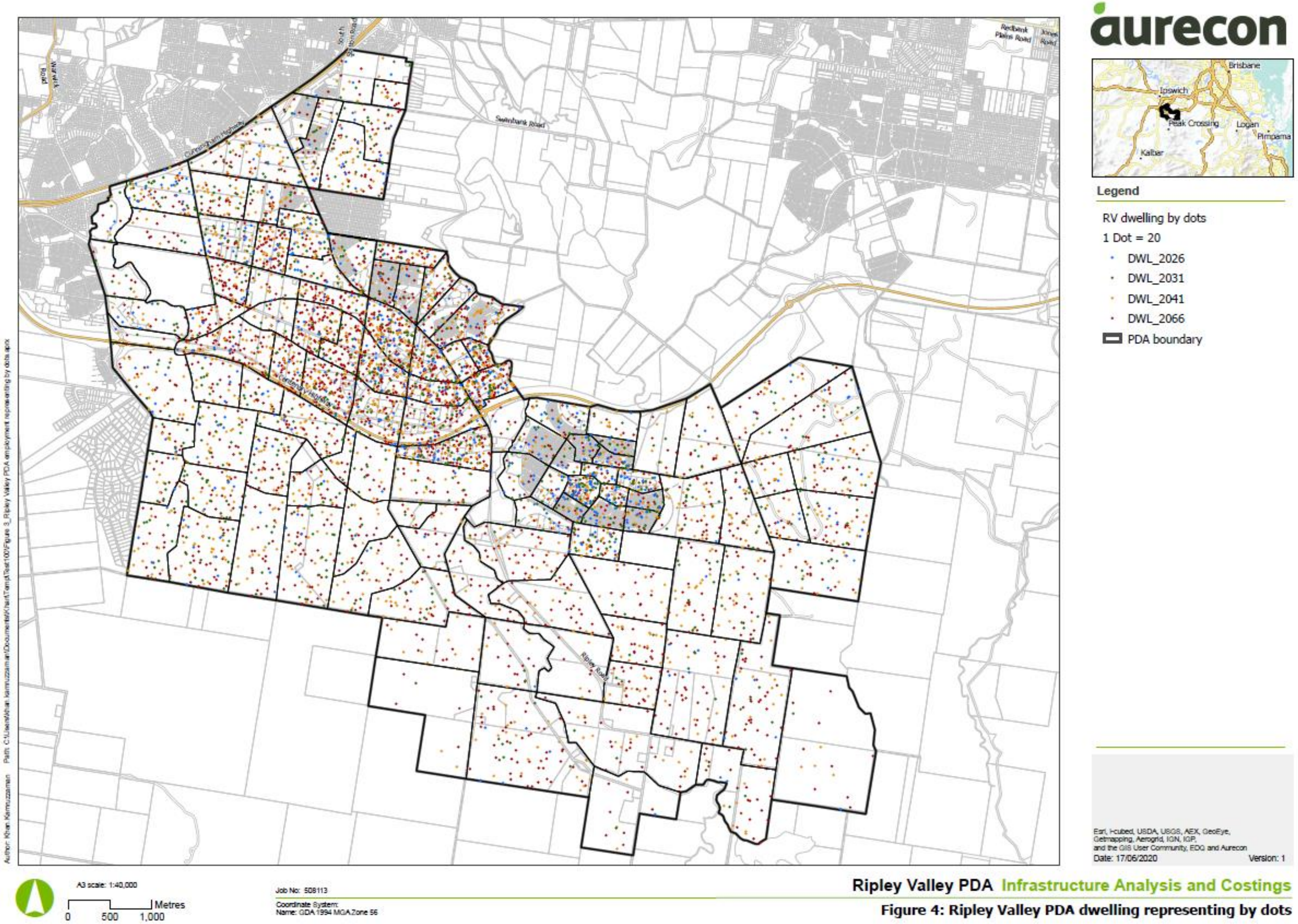


Figure 7-5 Ripley Valley PDA Demographics – Dwelling

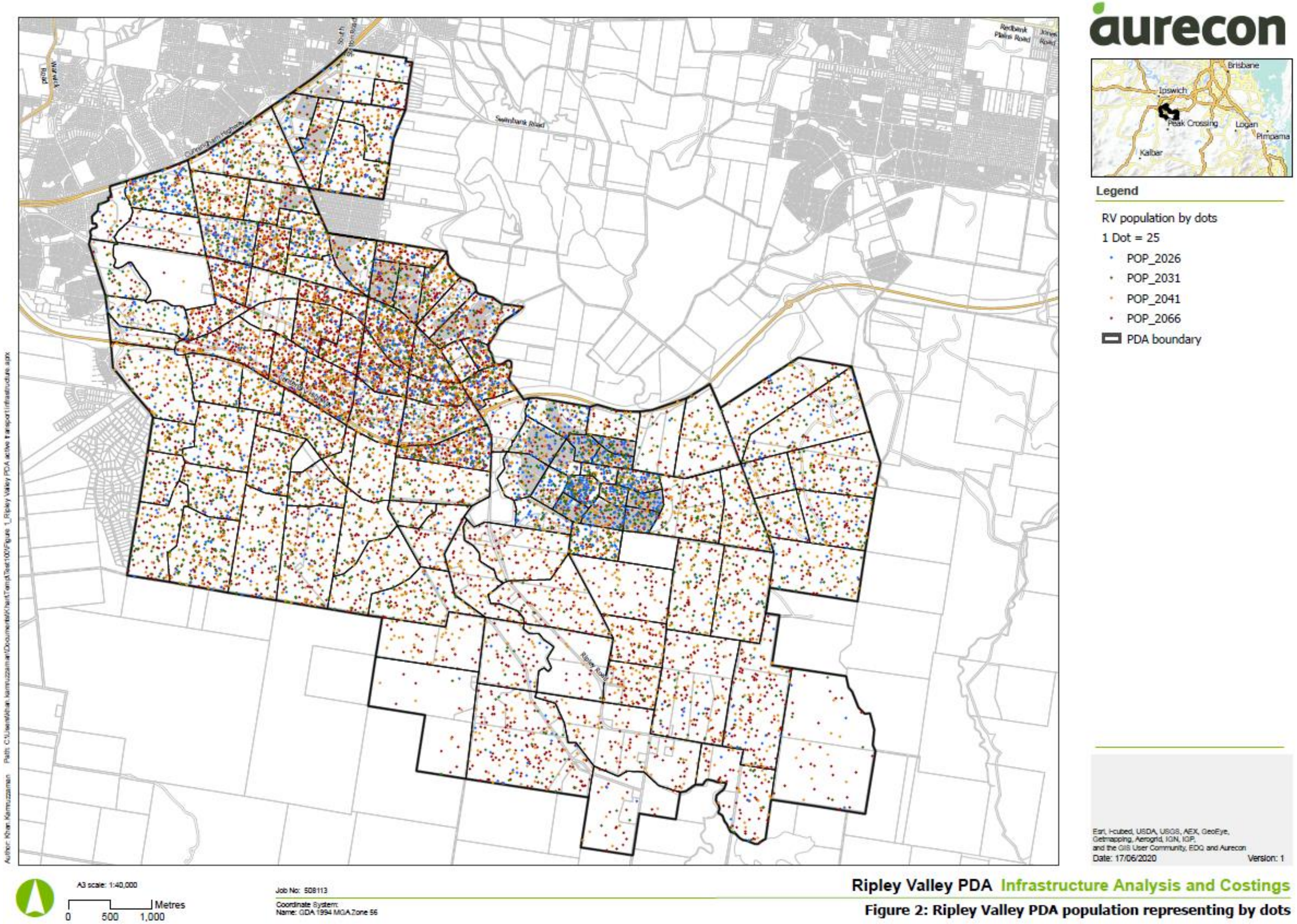


Figure 7-6 Ripley Valley PDA Demographics – Population

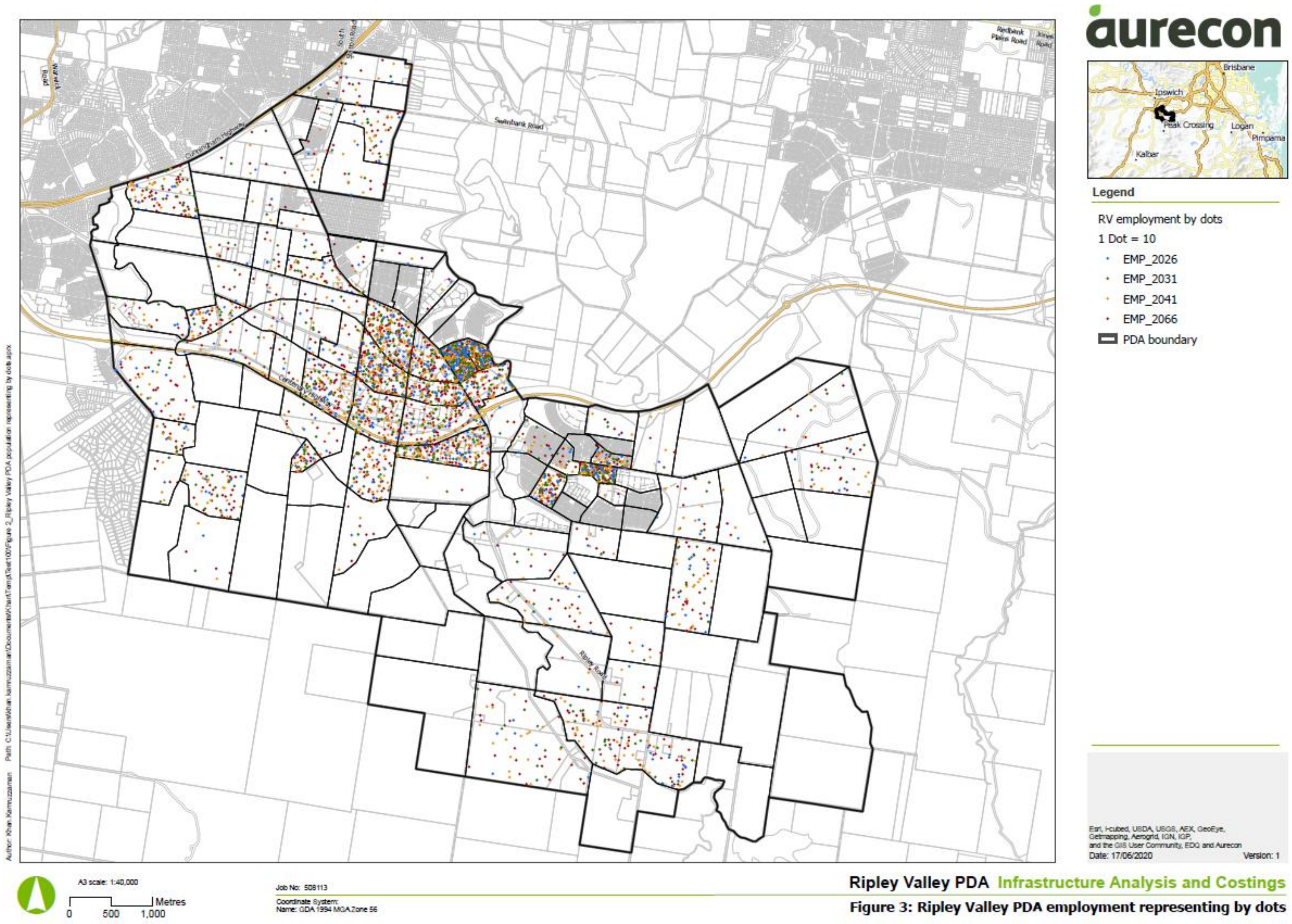


Figure 7-7 Ripley Valley PDA Demographics - Employment

7.8 Servicing Strategy

The trunk network road is presented below in Figure 7-8 and Figure 7-9. A review of the previous ICOP hierarchy confirmed that no changes to the hierarchy were required, with the relevant corridors sufficiently accommodating anticipated demand.

7.9 Adopted Road Network

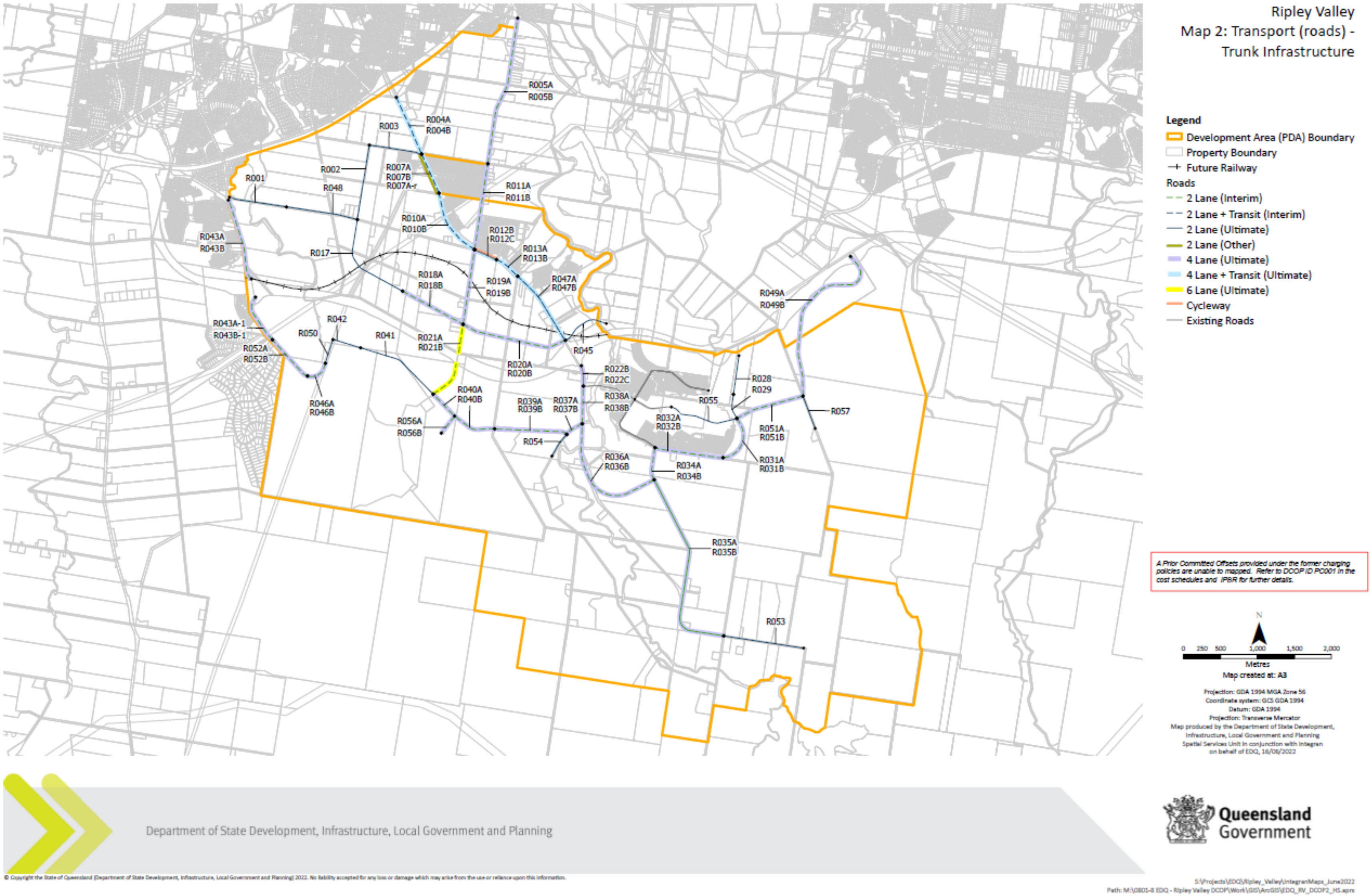


Figure 7-8 Ripley Valley PDA Adopted Trunk Road Network

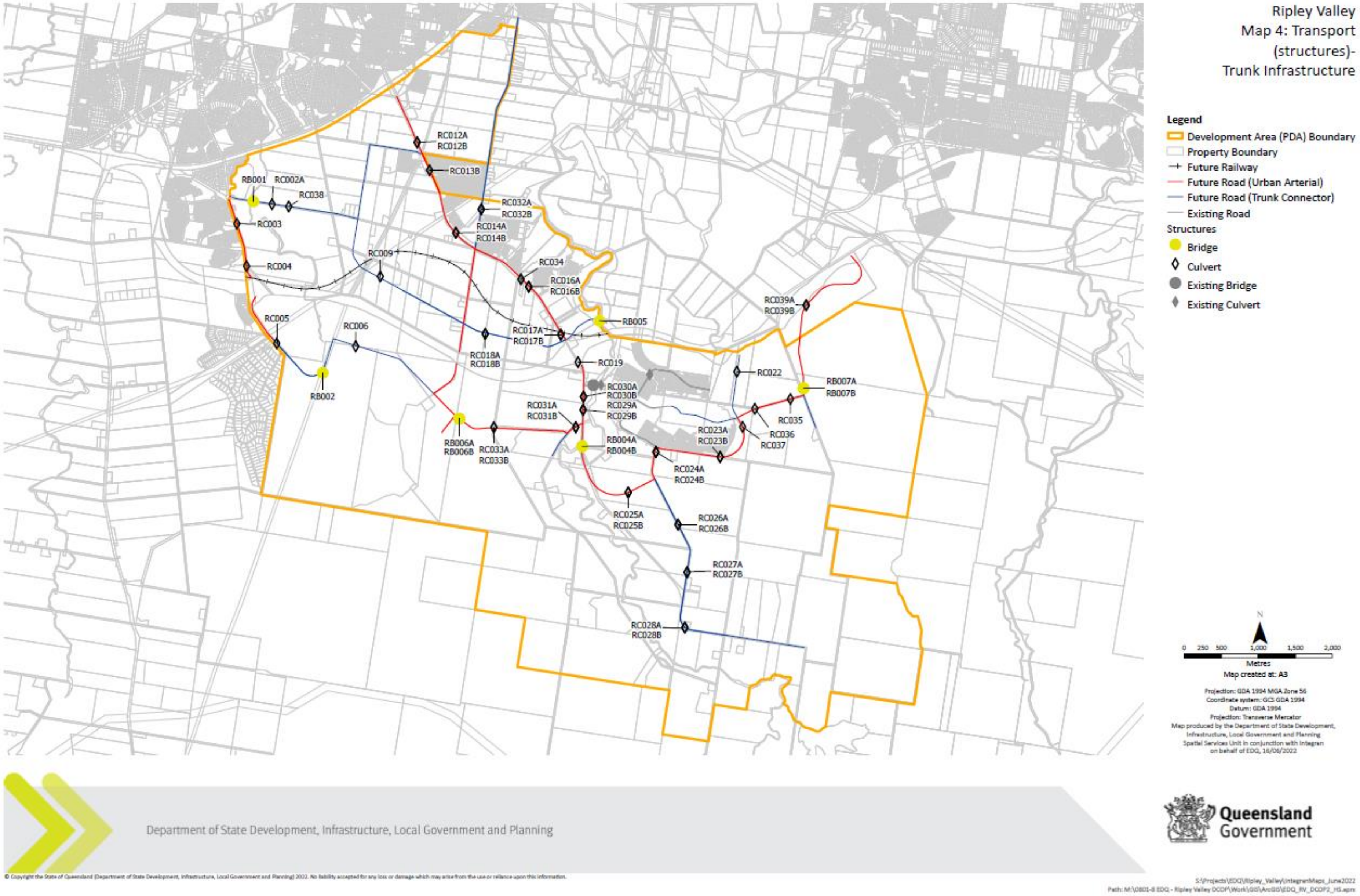


Figure 7-9 Ripley Valley PDA Adopted Trunk Road Bridge and Culverts

7.10 **Adopted Cross Sections**

When considering the mid-block cross section requirements of the PDA, alignment with Guideline No. 6 Movement Network was maintained where possible.

However, to minimise corridor impacts on adjacent land parcels and to provide efficient staging of roads that ultimately go to four lanes, a variation was made. This adjustment was made to the requirements of the four-lane trunk connector and urban arterial. Specifically, to accommodate a two-way 3m separated cycle track on one side in the interim, the clearance abutting the kerb used for tree planting and stormwater pits, was reduced from 2m to 1.5m. This allowed the ultimate corridor width to remain the same, even with the addition of 1m to one of the one-way cycle tracks. The proposed typical cross sections are shown in figures below.

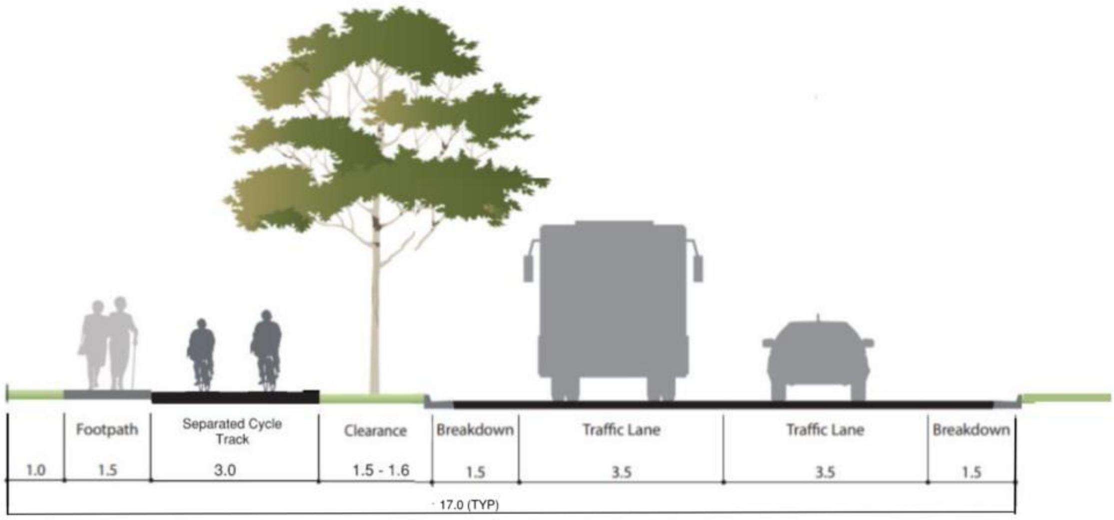


Figure 7-10 Interim Four-Lane Urban Arterial (two-lane no parking)

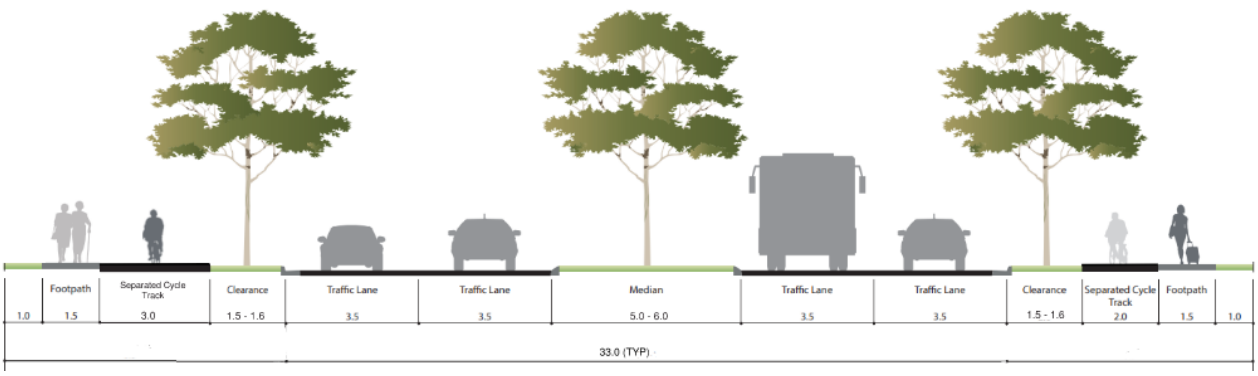


Figure 7-11 Ultimate Four-Lane Urban Arterial (no parking)

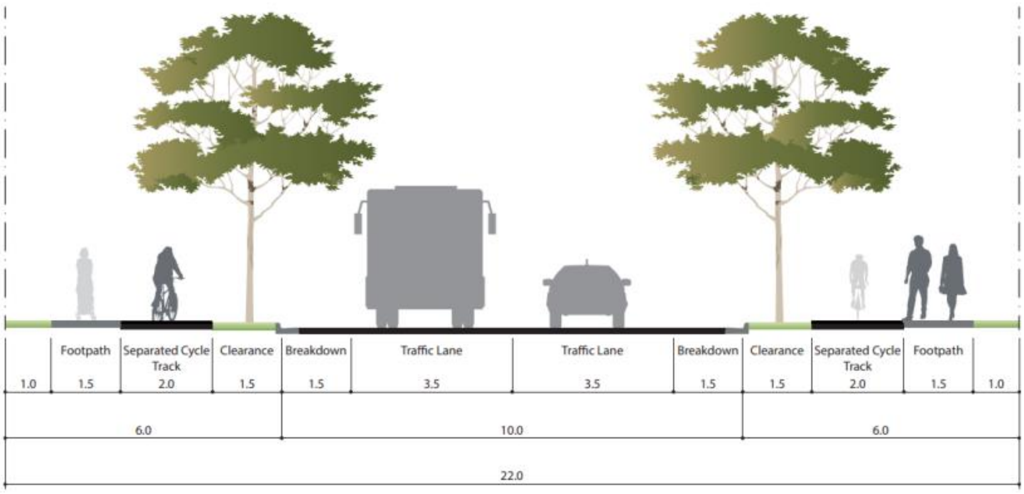


Figure 7-12 Ultimate Two-Lane Trunk Connector (no parking)

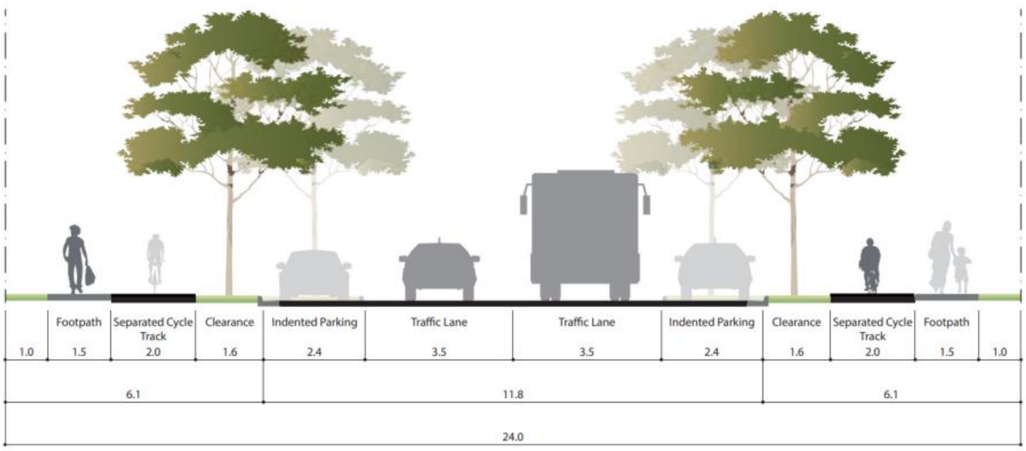


Figure 7-13 Ultimate Two-Lane Trunk Connector (with parking)

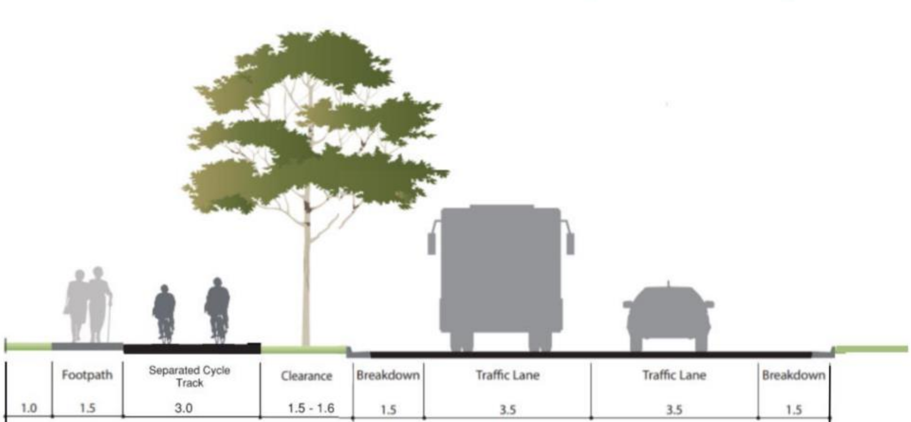


Figure 7-14 Interim Four-Lane Trunk Connector (two-lane no parking)

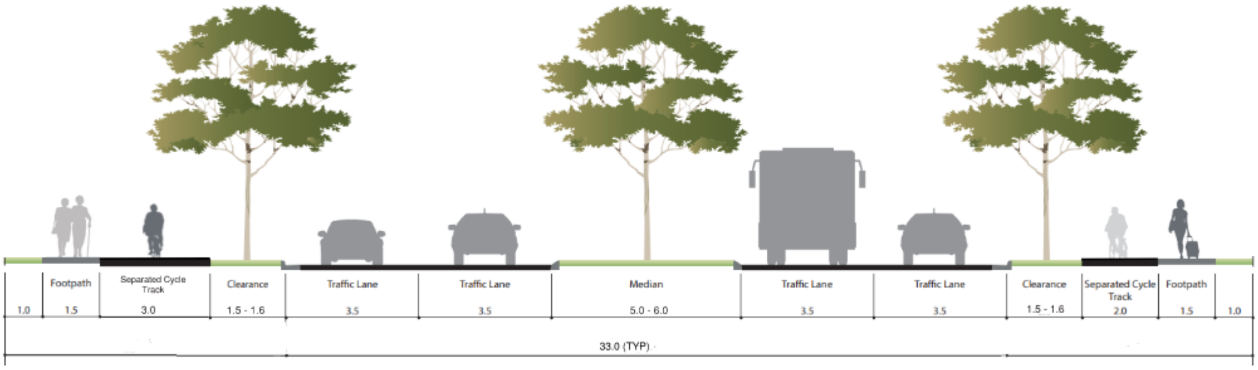


Figure 7-15 Ultimate Four-Lane Trunk Connector (no parking)

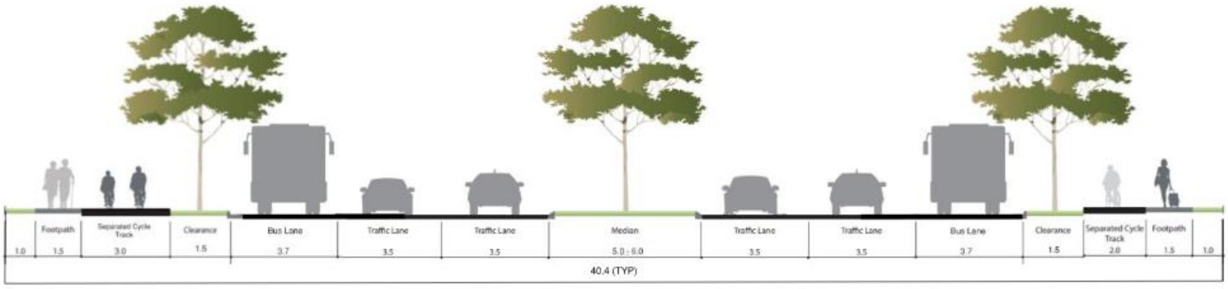


Figure 7-16: Ultimate Four-Lane Trunk Connector (with bus lane)

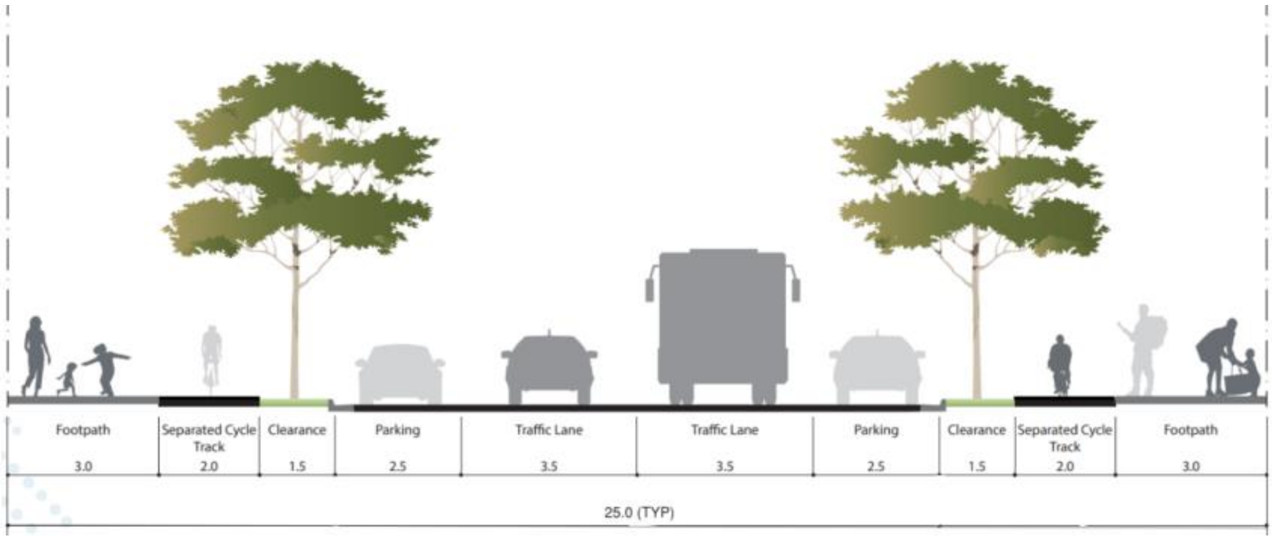


Figure 7-17 Ultimate Two-Lane Centre Connector (with parking)

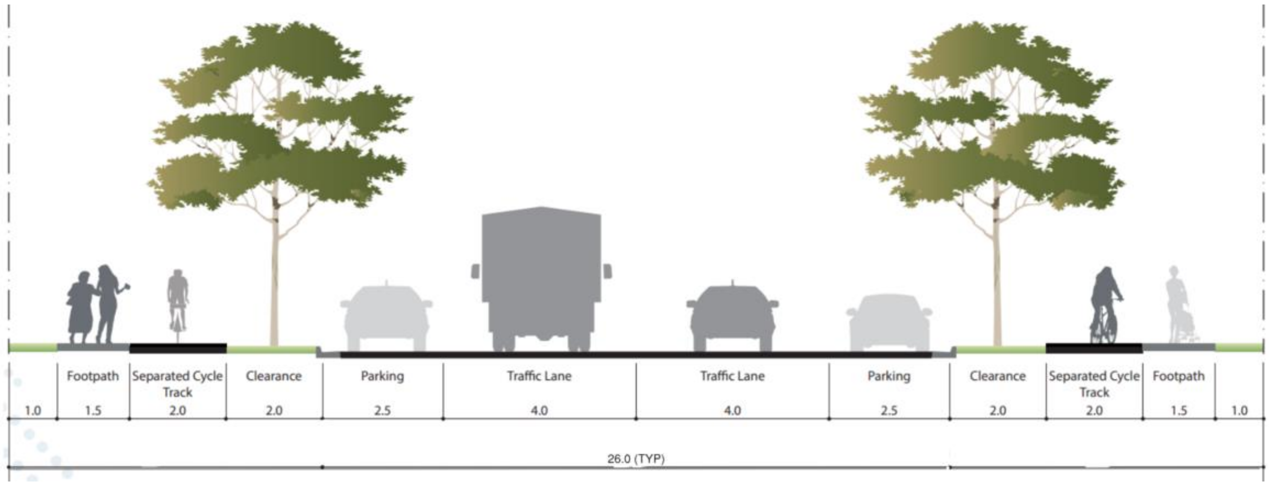


Figure 7-18 Ultimate Two-Lane Industrial Connector (with parking)

A number of trunk roads within the PDA have existing provision (either constructed or in Development Approvals) for on-road cycle lanes. For these locations, retrofitting of cycle lanes to become cycle tracks is required (see Figure 7-19 and Figure 7-20 and Active Transport Section for further details).

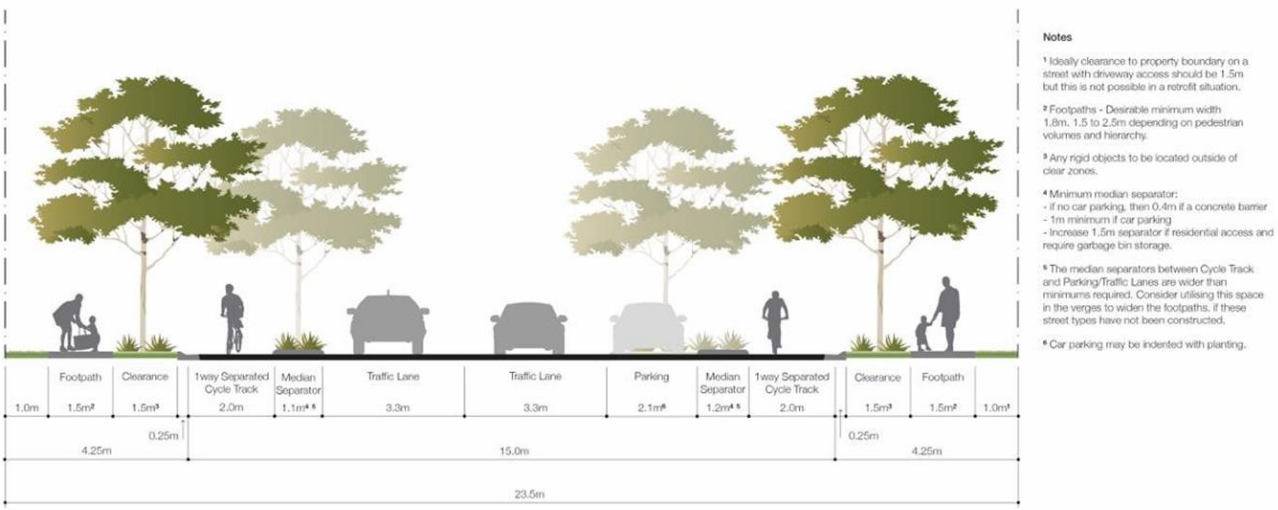


Figure 7-19 Ultimate Two-Lane Trunk Connector (with on-road cycling)

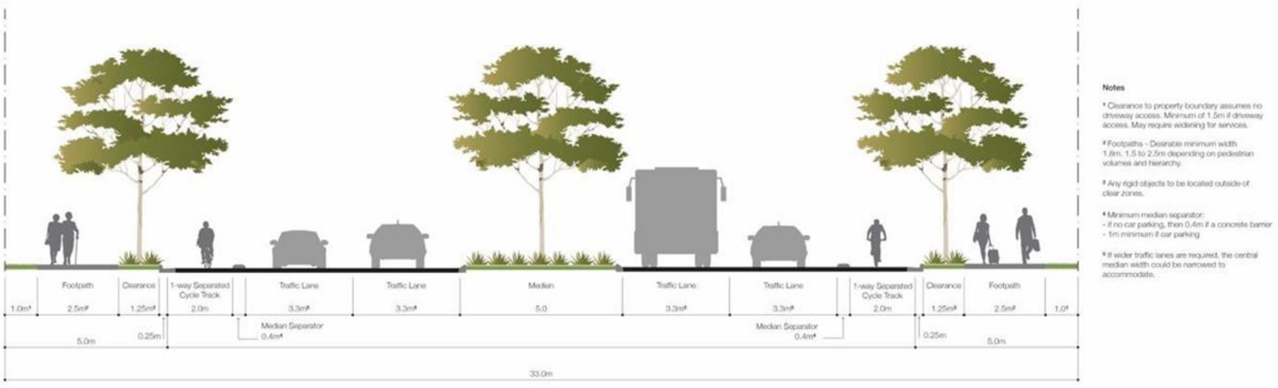


Figure 7-20 Ultimate Four-Lane Trunk Connector (with on-road cycling)

7.11 Adopted Intersection Requirements and Staging

The detailed intersection requirements can be found in the Transport Infrastructure Costings Tables. To minimise the cost of upgrades a maximum of three intersection upgrades has been allowed for at each intersection.

Should development occur out of sequence from what has been modelled (using the latest demographics), that may result in a change in intersection treatment and upgrade horizon.

A map of the form and sequencing of the trunk intersections is provided in Figure 7-22.

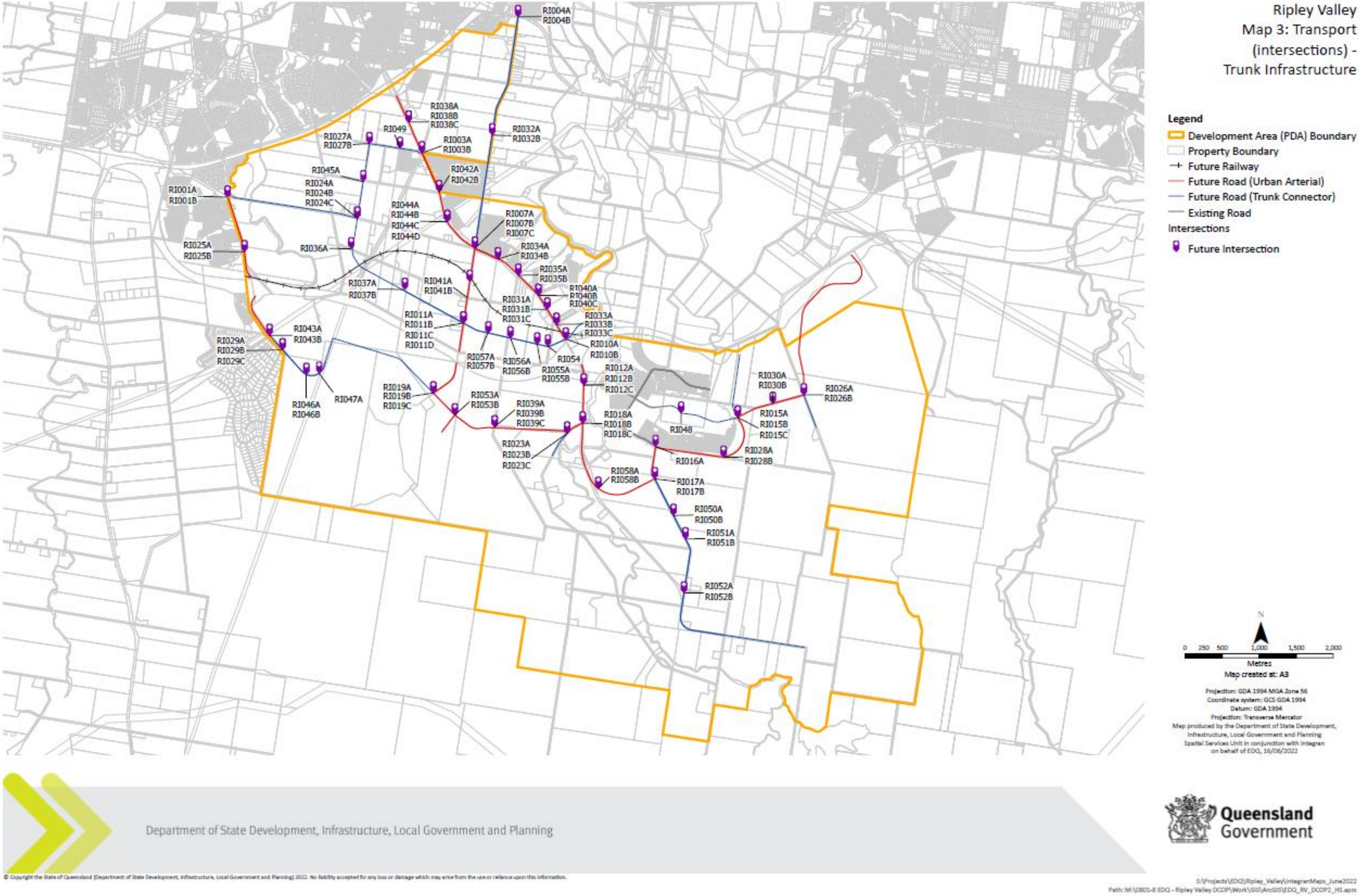


Figure 7-21 Ripley Valley PDA Adopted Trunk Intersections Staging

The SIDRA intersection layouts are provided in Appendix A. The turning volumes used for the SIDRA analysis were taken from the Jacobs' Aimsun transport model for each horizon. When undertaking the analysis, the following was implemented in SIDRA:

- In accordance with the latest TMR safety guideline, left turn slip lanes were avoided.
- Signalised intersections were analysed as isolated independent intersections.
- Cycle times were permitted to optimise to a maximum of 150 seconds.
- Staged pedestrian crossing was provided where excessive crossing distances exist.
- Filtered right turns were avoided at the majority of signalised intersections to improve safety.

DOS is defined as the ratio of demand to capacity at any given intersection. A DOS of 1.0 indicates the intersection is at full capacity, and above 1.0 is oversaturated, resulting in undesirable queuing and delays. In practice, a DOS of 1.0 would result in unstable flows, thus there is a practical DOS which represents the target maximum saturation dependant on the intersection type.

The practical DOS for different intersection types is summarised in Table 7-6.

Table 7-6 Practical Degree of Saturation

Intersection type	Practical DOS[2]
Signalised	0.90
Roundabout	0.85
Unsignalised	0.80

Table 7-7 reports the worst DOS and overall control delay for each intersection (see Figure 7-21 for map reference). Individual approaches or lanes may report better results than what is presented below. For unsignalised intersections, where SIDRA does not report an overall delay, the worst movement delay has been recorded. For all intersections both the AM and PM peaks have been modelled, however only the worst peak traffic measures have been presented.

Table 7-7 Summary of Ripley Valley PDA Trunk Intersection Requirements and Staging

Asset ID	Design year	Control	Intersection legs	Major flow through lanes	Degree of saturation	Control delay (s)	Protected active provisions	Bus provisions
RI001	2031	Signalised	4	2	0.891	32.7	Yes	No
	2041	Signalised	4	2	0.836	33.9	Yes	No
	2066	Signalised	4	4	0.79	31.1	Yes	No
RI003	2031	Signalised	4	4+2T2	0.886	34	Yes	Yes

[2] Source: Austroads Guide to Traffic Management Part 3, 2017

Asset ID	Design year	Control	Intersection legs	Major flow through lanes	Degree of saturation	Control delay (s)	Protected active provisions	Bus pro-visions
	2041	Signalised	4	4+2T2	0.886	48.4	Yes	Yes
	2066	Signalised	4	4+2T2	0.88	41.3	Yes	Yes
RI004	2031	Signalised	4	2	0.794	27.9	Yes	No
	2041	Signalised	4	2	0.86	34.8	Yes	No
	2066	Signalised	4	2	0.843	33.6	Yes	No
RI007	2031	Signalised	4	4	0.79	44.8	Yes	Yes
	2041	Signalised	4	4	0.869	53.8	Yes	Yes
	2066	Signalised	4	4	0.86	55.3	Yes	Yes
RI010	2031	Signalised	4	4+2T2	0.832	47.6	Yes	Yes
	2041	Signalised	4	4+2T2	0.964	51.7	Yes	Yes
	2066	Signalised	4	4+2T2	0.854	44.3	Yes	Yes
RI011	2031	Signalised	4	2	0.854	48	Yes	No
	2041	Signalised	4	4	0.846	50.1	Yes	No
	2066	Signalised	4	4	0.901	57.7	Yes	No
RI012	2031	Signalised	4	4	0.814	35.4	Yes	Yes
	2041	Signalised	4	4+2T2	0.897	52.7	Yes	Yes
	2066	Signalised	4	4+2T2	0.905	37.6	Yes	Yes
RI015	2031	Signalised	4	2	0.635	42.0	Yes	No
	2041	Signalised	4	4	0.785	42.3	Yes	No
	2066	Signalised	4	4	0.795	43.3	Yes	No
RI016	2031	Signalised	4	2	0.712	26.3	Yes	No
	2041	Signalised	4	2	0.714	27.4	Yes	No
	2066	Signalised	4	2	0.746	30.1	Yes	No
RI017	2031	Signalised	3	2	0.643	13.8	Yes	No
	2041	Signalised	3	2	0.694	17.2	Yes	No
	2066	Signalised	3	2	0.812	28	Yes	No

Asset ID	Design year	Control	Intersection legs	Major flow through lanes	Degree of saturation	Control delay (s)	Protected active provisions	Bus pro-visions
RI018	2031	Signalised	3	2	0.548	15.9	Yes	No
	2041	Signalised	3	4	0.74	27.5	Yes	No
	2066	Signalised	3	4	0.872	34.5	Yes	No
RI019	2031	Signalised	4	2	0.856	51.1	Yes	No
	2041	Signalised	4	2	0.903	57.6	Yes	No
	2066	Signalised	4	2	0.886	48.3	Yes	No
RI023	2031	Signalised	3	2	0.726	14.4	Yes	No
	2041	Signalised	3	4	0.655	16.3	Yes	No
	2066	Signalised	3	4	0.869	28.9	Yes	No
RI024	2031	Signalised	4	2	0.771	28.6	Yes	No
	2041	Signalised	4	2	0.879	25.8	Yes	No
	2066	Signalised	4	2	0.824	35.1	Yes	No
RI025	2031	Priority	4	2	0.299	3.9	Yes	No
	2041	Signalised	4	4	0.893	43.2	Yes	No
	2066	Signalised	4	4	0.873	39.7	Yes	No
RI026	2031	Signalised	4	2	0.787	22.1	Yes	No
	2041	Signalised	4	2	0.807	29.4	Yes	No
	2066	Signalised	4	2	0.795	35.3	Yes	No
RI027	2031	Priority	4	2	0.203	3.3	Yes	No
	2041	Signalised	4	2	0.857	33	Yes	No
	2066	Signalised	4	2	0.885	32	Yes	No
RI028	2031	Priority	3	2	0.163	5	Yes	No
	2041	Priority	3	2	0.18	5.2	Yes	No
	2066	Signalised	3	2	0.689	18	Yes	No
RI029	2031	Signalised	4	2	0.851	33.2	Yes	No
	2041	Signalised	4	4	0.68	27	Yes	No

Asset ID	Design year	Control	Intersection legs	Major flow through lanes	Degree of saturation	Control delay (s)	Protected active provisions	Bus pro-visions
	2066	Signalised	4	4	0.716	27.9	Yes	No
RI030	2031	Priority	4	2	0.519	5.5	Yes	No
	2041	Signalised	4	4	0.862	28.5	Yes	No
	2066	Signalised	4	4	0.809	31.8	Yes	No
RI031	2031	Signalised	4	4+2T2	0.792	33.4	Yes	Yes
	2041	Signalised	4	4+2T2	0.88	40.3	Yes	Yes
	2066	Signalised	4	4+2T2	0.688	25.7	Yes	Yes
RI032	2031	Signalised	3	2	0.692	12.9	Yes	No
	2041	Signalised	3	4	0.678	10.2	Yes	No
	2066	Signalised	3	4	0.623	10.1	Yes	No
RI033	2031	Signalised	4	2+2T2	0.86	40.4	Yes	Yes
	2041	Signalised	4	4+2T2	0.854	41.2	Yes	Yes
	2066	Signalised	4	4+2T2	0.879	45.7	Yes	Yes
RI034	2031	Signalised	4	2+2T2	0.876	24.9	Yes	Yes
	2041	Signalised	4	4+2T2	0.702	19.4	Yes	Yes
	2066	Signalised	4	4+2T2	0.842	24.6	Yes	Yes
RI035	2031	Signalised	4	2+2T2	0.846	39.3	Yes	Yes
	2041	Signalised	4	4+2T2	0.804	22.7	Yes	Yes
	2066	Signalised	4	4+2T2	0.798	25.3	Yes	Yes
RI036	2031	Priority	3	2	0.204	5.6	Yes	No
	2041	Priority	3	2	0.139	5.5	Yes	No
	2066	Priority	3	2	0.355	6.4	Yes	No
RI037	2031	Priority	3	2	0.186	1.2	Yes	No
	2041	Signalised	3	2	0.567	14	Yes	No
	2066	Signalised	3	2	0.586	14.1	Yes	No
RI038	2031	Signalised	4	4+2T2	1.177	104.6	Yes	Yes

Asset ID	Design year	Control	Intersection legs	Major flow through lanes	Degree of saturation	Control delay (s)	Protected active provisions	Bus pro-visions
	2041	Signalised	4	6+2T2	0.855	36	Yes	Yes
	2066	Signalised	4	6+2T2	0.9	41.8	Yes	Yes
RI039	2031	Signalised	4	2	0.799	30.3	Yes	No
	2041	Signalised	4	4	0.864	37.9	Yes	No
	2066	Signalised	4	4	0.951	66.7	Yes	No
RI040	2031	Signalised	4	2+2T2	0.832	35	Yes	Yes
	2041	Signalised	4	4+2T2	0.813	33.5	Yes	Yes
	2066	Signalised	4	4+2T2	0.891	37.5	Yes	Yes
RI041	2031	Priority	3	2	0.423	2.3	Yes	No
	2041	Signalised	3	4	0.743	14.7	Yes	No
	2066	Signalised	3	4	0.741	13.4	Yes	No
RI042	2031	Signalised	3	2+2T2	0.834	16.7	Yes	Yes
	2041	Signalised	3	4+2T2	0.682	11.1	Yes	Yes
	2066	Signalised	3	4+2T2	0.821	16.3	Yes	Yes
RI043	2031	Signalised	3	2	0.771	16.1	Yes	No
	2041	Signalised	3	4	0.776	20.5	Yes	No
	2066	Signalised	3	4	0.767	23.4	Yes	No
RI044	2031	Signalised	4	2+2T2	0.811	25.0	Yes	Yes
	2041	Signalised	4	4+2T2	0.797	25	Yes	Yes
	2066	Signalised	4	4+2T2	0.829	28.2	Yes	Yes
RI045	2031	Roundabout	4	2	0.273	6.1	Yes	No
	2041	Roundabout	4	2	0.292	6.3	Yes	No
	2066	Roundabout	4	2	0.293	6.3	Yes	No
RI046	2031	Roundabout	3	2	0.282	5.9	Yes	No
	2041	Roundabout	4	2	0.288	6.8	Yes	No
	2066	Roundabout	4	2	0.334	6.8	Yes	No

Asset ID	Design year	Control	Intersection legs	Major flow through lanes	Degree of saturation	Control delay (s)	Protected active provisions	Bus pro-visions
RI047	2031	Roundabout	4	2	0.279	7.1	Yes	No
	2041	Roundabout	4	2	0.359	7.4	Yes	No
	2066	Roundabout	4	2	0.387	7.6	Yes	No

The information provided in this section is to guide the sequencing and infrastructure requirements of the trunk intersections within the PDA. These requirements have been developed using a whole of PDA assessment. Any deviation from these provisions and timings should ensure that there are no negative impacts to the broader network.

7.12 Corridor Requirements and Staging

Table 7-8 presents the interim and ultimate mid-block staging requirements for the road network. The provisions are in accordance with the requirements detailed in the standard cross sections and the design information contained in Section 7.15. It also identifies the PT/bus provisions that have been accommodated within the road reserve (PT provisions are further detailed in the following section).

Should development occur out of sequence from what has been modelled (using the latest demographics), that may result in a change to the upgrade horizon.

The information provided in this section is to guide the sequencing and infrastructure requirements of the trunk roads within the PDA. These requirements have been developed using a whole of PDA assessment with special consideration given to PT and active transport provisions. Any deviation from these provisions and timings should ensure that there are no negative impacts to the broader networks and their integration with other facilities and key trip attractors.

Table 7-8 Summary of Ripley Valley PDA Trunk Mid-Block Requirements and Staging

Asset ID	Hierarchy	Clearance(m)	Footpath(m)	Cycle track(m) [3]	Clearance(m)	Breakdown(m)	Bus Lane width(m)	Travel Lane(m)	Median(m)	Travel Lane(m)	Bus Lane width(m)	Breakdown(m)	Clearance(m)	Cycle track(m)	Footpath(m)	Clearance(m)	Total corridor width (m)	No of bus stops	Bus stop type
R001	Trunk Connector	1	1.5	2	1.6	2.4		3.5		3.5		2.4	1.6	2	1.5	1	24	1	Int
R002	Trunk Connector	1		3	1.5	2		3.5		3.5		2	1.5		1.5	1	20.5		
R003	Trunk Connector	1		3	1.5	2		3.5		3.5		2	1.5		1.5	1	21.5		
R004A	Urban Arterial					1.5	3.7	3.5		3.5	3.7	1.5	1.5	3	1.5	1	24.4	1	Int
R004B	Urban Arterial	1	1.5	2	1.5		3.7	7 (3.5x2)	6	7 (3.5x2)	3.7		1.5	3	1.5	1	40.4	2	Int
R005A	Trunk Connector					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R005B	Trunk Connector	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33	2	Int

Asset ID	Hierarchy	Clearance(m)	Footpath(m)	Cycle track(m) 3	Clearance(m)	Breakdown(m)	Bus Lane width(m)	Travel Lane(m)	Median(m)	Travel Lane(m)	Bus Lane width(m)	Breakdown(m)	Clearance(m)	Cycle track(m)	Footpath(m)	Clearance(m)	Total corridor width (m)	No of bus stops	Bus stop type
R007A	Urban Arterial					1.5	3.7	3.5		3.5	3.7	1.5	1.5	3	1.5	1	24.4		
R007B	Urban Arterial	1	1.5	2	1.5		3.7	7 (3.5x2)	6	7 (3.5x2)	3.7		1.5	3	1.5	1	40.4	2	Int
R010A	Urban Arterial					1.5	3.7	3.5		3.5	3.7	1.5	1.5	3	1.5	1	24.4		
R010B	Urban Arterial	1	1.5	2	1.5		3.7	7 (3.5x2)	6	7 (3.5x2)	3.7		1.5	3	1.5	1	40.4	2	Int
R011A	Trunk Connector					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R011B	Trunk Connector	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)		-	1.5	3	1.5	1	33	2	Int
R012A	Urban Arterial	19				2.5		3.5		3.5		2.5	1.5		2.6	1.8	36.9	1	Int
R012B	Urban Arterial	1	1.5	2	1.5		3.7	7 (3.5x2)	6	7 (3.5x2)	3.7		1.5	3	1.5	1	40.4	1	Int
R013A	Urban Arterial					1.5	3.7	3.5		3.5	3.7	1.5	1.5	3	1.5	1	24.4		
R013B	Urban Arterial	1	1.5	2	1.5		3.7	7 (3.5x2)	6	7 (3.5x2)	3.7		1.5	3	1.5	1	40.4	2	Int

Asset ID	Hierarchy	Clearance(m)	Footpath(m)	Cycle track(m) 3	Clearance(m)	Breakdown(m)	Bus Lane width(m)	Travel Lane(m)	Median(m)	Travel Lane(m)	Bus Lane width(m)	Breakdown(m)	Clearance(m)	Cycle track(m)	Footpath(m)	Clearance(m)	Total corridor width (m)	No of bus stops	Bus stop type
R017	Trunk Connector	1	1.5	2	1.6	2.4		3.5		3.5		2.4	1.6	2	1.5	1	24	1	Int
R018A	Trunk Connector					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R018B	Trunk Connector	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33	1	Int
R019A	Urban Arterial					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R019B	Urban Arterial	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33	1	Int
R020A	Trunk Connector					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R020B	Trunk Connector	1	1.5	2	1.5	-		7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33		
R021A	Urban Arterial					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R021B	Urban Arterial	1	1.5	2	1.5			10.5 (3.5x3)	6	10.5 (3.5x3)			1.5	3	1.5	1	39		

Asset ID	Hierarchy	Clearance(m)	Footpath(m)	Cycle track(m) 3	Clearance(m)	Breakdown(m)	Bus Lane width(m)	Travel Lane(m)	Median(m)	Travel Lane(m)	Bus Lane width(m)	Breakdown(m)	Clearance(m)	Cycle track(m)	Footpath(m)	Clearance(m)	Total corridor width (m)	No of bus stops	Bus stop type
R022B	Urban Arterial	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33	1	1.5
R028	Trunk Connector	1	1.5	2	1.6	2.4		3.5		3.5		2.4	1.6	2	1.5	1	24		
R029	Trunk Connector	1	1.5	2	1.6	2.4		3.5		3.5		2.4	1.6	2	1.5	1	24		
R031A	Urban Arterial					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R031B	Urban Arterial	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33	1	Int
R032A	Urban Arterial					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R032B	Urban Arterial	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33	1	Int
R034A	Urban Arterial					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R034B	Urban Arterial	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33	1	Int

Asset ID	Hierarchy	Clearance(m)	Footpath(m)	Cycle track(m) 3	Clearance(m)	Breakdown(m)	Bus Lane width(m)	Travel Lane(m)	Median(m)	Travel Lane(m)	Bus Lane width(m)	Breakdown(m)	Clearance(m)	Cycle track(m)	Footpath(m)	Clearance(m)	Total corridor width (m)	No of bus stops	Bus stop type
R035A	Trunk Connector					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R035B	Trunk Connector	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33		
R036A	Urban Arterial					1.5		3.5 (3.5x2)		3.5 (3.5x2)		1.5	1.5	3	1.5	1	17		
R036B	Urban Arterial	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33		
R037A	Urban Arterial					1.5		3.5 (3.5x2)		3.5 (3.5x2)		1.5	1.5	3	1.5	1	17		
R037B	Urban Arterial	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33		
R038A	Urban Arterial					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R038B	Urban Arterial	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33		

Asset ID	Hierarchy	Clearance(m)	Footpath(m)	Cycle track(m) 3	Clearance(m)	Breakdown(m)	Bus Lane width(m)	Travel Lane(m)	Median(m)	Travel Lane(m)	Bus Lane width(m)	Breakdown(m)	Clearance(m)	Cycle track(m)	Footpath(m)	Clearance(m)	Total corridor width (m)	No of bus stops	Bus stop type
R039A	Urban Arterial					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R039B	Urban Arterial	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33	1	Int
R040A	Urban Arterial					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R040B	Urban Arterial	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33	1	Int
R041	Trunk Connector	1	1.5	2	1.6	2.4		3.5		3.5		2.4	1.6	2	1.5	1	24	1	Int
R042	Trunk Connector	1	1.5	2	1.6	2.4		3.5		3.5		2.4	1.6	2	1.5	1	24	1	Int
R043A	Urban Arterial					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17	1	Int
R043B	Urban Arterial	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33	1	Int
R045	Trunk Connector	1	1.5	2	1.6	2.4		3.5		3.5		2.4	1.6	2	1.5	1	24		

Asset ID	Hierarchy	Clearance(m)	Footpath(m)	Cycle track(m) 3	Clearance(m)	Breakdown(m)	Bus Lane width(m)	Travel Lane(m)	Median(m)	Travel Lane(m)	Bus Lane width(m)	Breakdown(m)	Clearance(m)	Cycle track(m)	Footpath(m)	Clearance(m)	Total corridor width (m)	No of bus stops	Bus stop type
R046A	Trunk Connector					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R046B	Trunk Connector	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)		-	1.5	3	1.5	1	33		
R047A	Urban Arterial					1.5	3.7	3.5		3.5	3.7	1.5	1.5	3	1.5	1	24.4		
R047B	Urban Arterial	1	1.5	2	1.5		3.7	7 (3.5x2)	6	7 (3.5x2)	3.7		1.5	3	1.5	1	40.4	1	Int
R048	Trunk Connector	1	1.5	2	1.6	2.4		3.5		3.5		2.4	1.6	2	1.5	1	24		
R049A	Urban Arterial					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R049B	Urban Arterial	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33	1	Int
R050	Trunk Connector	1	1.5		2	2.4		3.5		3.5		2.4	2	3		1	22.3		
R051A	Urban Arterial					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		

Asset ID	Hierarchy	Clearance(m)	Footpath(m)	Cycle track(m) 3	Clearance(m)	Breakdown(m)	Bus Lane width(m)	Travel Lane(m)	Median(m)	Travel Lane(m)	Bus Lane width(m)	Breakdown(m)	Clearance(m)	Cycle track(m)	Footpath(m)	Clearance(m)	Total corridor width (m)	No of bus stops	Bus stop type
R051B	Urban Arterial	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33		
R052A	Trunk Connector					1.5		3.5		3.5		1.5	1.5	3	1.5	1	17		
R052B	Trunk Connector	1	1.5	2	1.5			7 (3.5x2)	6	7 (3.5x2)			1.5	3	1.5	1	33	1	Int
R053	Trunk Connector	1		3	1.5	1.5		3.5		3.5		1.5	1.5		1.5	1	19.5		
R054	Trunk Connector	1		2.5	2	2.5		4		4		2.5	2		1.5	1	23		

7.13 **Civil Servicing Requirements**

The trunk servicing requirements needing to be accommodated within the road verges was considered. This was to confirm that the verge and corridor widths were sufficient to accommodate any service mains. The following provisions have been made:

- Where co-location of trunk services results in additional corridor width, location of services on opposite sides of the road will be accepted.
- Sewer main to be installed under the footpath concrete slab.
- Water main (non-trunk) to be installed within the 1.5m tree clearance zone.
- Trunk water main to be installed under the cycle track, whilst it is acknowledged the water utility owner usually prefers the potable water mains to be installed outside of the footpath /cycle track for ease of maintenance this is not achievable in the PDAs cross sections. However, in this constrained space, it is considered acceptable to install the trunk water main under the cycle track. All the trunk water main pit lids located within the cycle track will be designed to be cyclist safe.
- Communication mains to be installed within the 1m wide strip between the footpath and property boundary.
- Electricity main to be installed along each side of the verge and is no larger than:
    - Ø80mm for LV, 11kV
    - Ø100mm for HV, 33kV
- Communication main installed along each side of the verge and is no larger than:
    - Ø100mm communications in a combined trench with electricity in the verge on high side of the road
    - Multiple Ø100mm communication conduits in the verge on the low side of the road
- No overhead electricity provision has been made and street lighting poles are to be installed within the tree clearance zone.
- Lighting pole and tree centrelines are to be located nominally 0.75m from the nominal kerb face.
- Gas main to be located within the tree clearance zone, with the gas centreline located 0.6m from nominal kerb face (localised typical deflection of gas main may be required behind a lip in line stormwater gully).
- The above points are presented graphically in Figure 7-22 below.

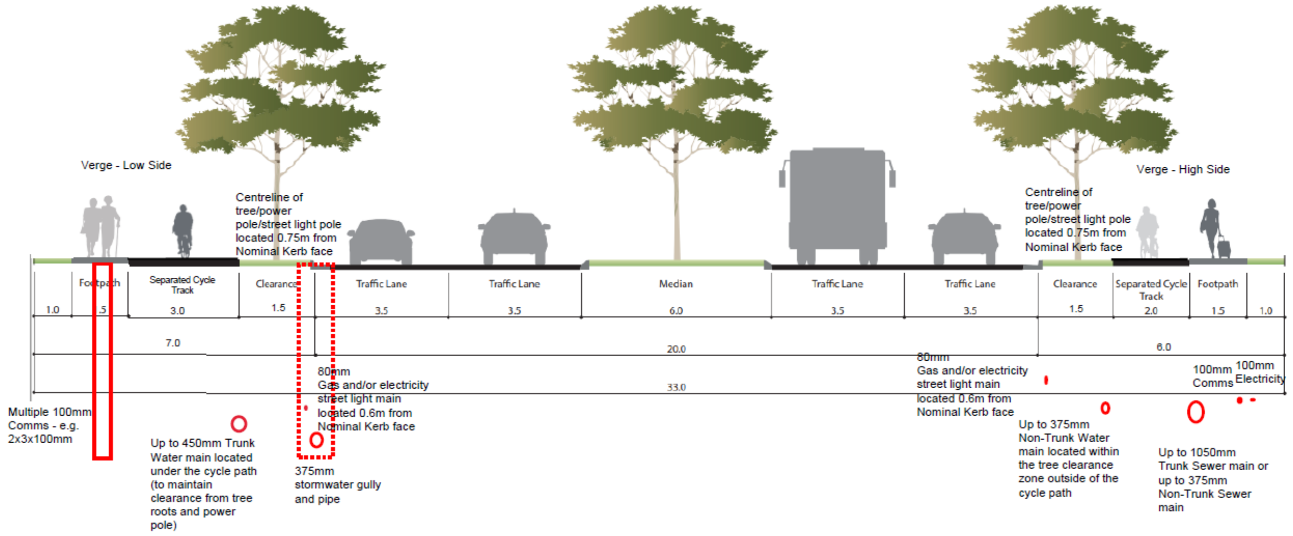


Figure 7-22 Trunk Servicing within Road Corridor

For a common trench, the typical minimum horizontal clearances between services must be maintained. Consultation with the utility owners (particularly water and sewer) may also need to be undertaken during the detailed design.

7.14 **Public Transport | Bus Servicing Requirements**

In reviewing the future bus requirements, consideration was first given to approvals that provided indicative bus stop locations along trunk routes. Once this was mapped the trip attractors (i.e. community facilities, centre precincts) were overlaid to identify any gaps in the network. Additional locations were then added adjacent to these attractors and generators whilst maintaining an approximate spacing of 400m between stops for the key corridors and 800m for other locations.

When considering the infrastructure requirements of the bus stops the following was applied:

- Infrastructure requirements to align with the Public Transport Infrastructure Manual Chapter 5 (Department of Transport and Main Roads, March 2016).
- Premium stops at the town centres – includes embayment, large shelter and hardstand.
- Intermediate stops along trunk routes – includes embayment, small shelter and hardstand.
- Regular stop not included – no embayment or shelter, more aligned with lower order roads located within residential areas.

The location of the PT / bus provisions is illustrated in Figure 7-23.

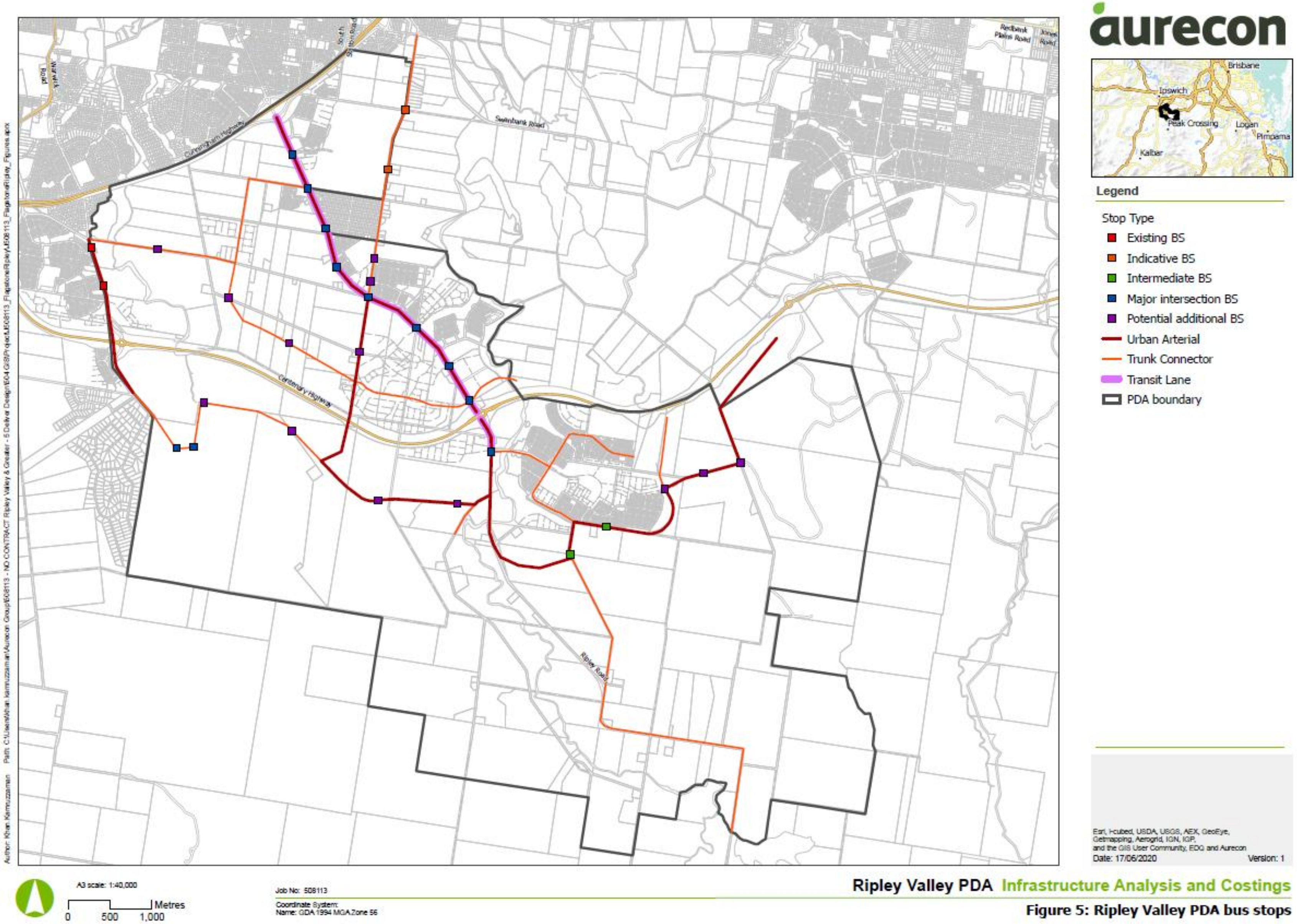


Figure 7-23 PT / Bus Trunk Provisions

7.15 Road and Interchange Design

Aurecon developed a high-level road and interchange design for the ultimate design configuration for each road in Ripley Valley. The process included:

- Develop 2d layouts in 12d software using existing road centrelines and typical sections for the nominated trunk roads using ultimate cross sections for existing roads
- Develop 2d layouts in 12d software using GIS alignments and typical sections for the nominated trunk roads using ultimate cross sections for new roads
- Develop road vertical alignments by fitting into the terrain
- Run cut and fill batters to generate volumes and the intersection lines with the natural surface

7.15.1 Design Parameters

The following table summarises the design parameters used for this road design task:

Table 7-9 Summary of Design Parameters

Design Element	Proposed Design Parameter/ Design Approach
Horizontal Alignment	
Existing Roads	Using existing road centreline Use ortho-corrected aerial images of the area for digitising the road centreline No curve widening applied Formation width only (no lane lines) No sightline checks including intersection sightlines
New Roads	Using GIS alignment of the roads Curve design using 70km/h design speed values No curve widening applied Formation width only (no lane lines) No sightline checks including intersection sightlines
Vertical Alignment	
Existing Roads	Fit into the existing terrain No sightline checks including intersection sightlines
New Roads	Fit into the existing terrain with proposed vertical grade of: 6% preferred max 10% absolute max 0.5% minimum No sightline checks including intersection sightlines Vertical design to fit to terrain
Vertical clearance	5.5m unless noted otherwise in a cross section

Design Element	Proposed Design Parameter/ Design Approach
Cross Section	
Existing and New Roads	Only using EDQ supplied ultimate cross sections for various trunk roads Batters cut/fill – 1 on 2 3% nominal crossfall/ superelevation Formation width only (no lane lines)
Buffer Zone – Brownfield areas	4m from the toe of batter
Buffer Zone – Greenfield areas	7.5m from the toe of batter
MISC	
Road surface	2 coat bitumen seal
Road pavement	400mm
Lighting	Only at intersections unless provided for in cross section(s)
Design speed	To be discussed

7.16 Opinion of Cost of Adopted Interim and Ultimate Planning Horizons

Rider Levett Bucknall (RLB) were engaged to develop an opinion of the cost of transport infrastructure to service the Ripley Valley PDA. The quantities of transport infrastructure were derived from the updated network plan developed as part of this study. Municipal costs for Ripley Valley PDA were then extracted from the RLB estimates and inserted into the Financial Offset Model per planning horizon, the summaries of which can be found within the Schedule of Works containing within the body of this Infrastructure Planning Background Report (IPBR).

8 Active Transport

This report is intended to inform the active transport related elements of development with the Ripley Valley Priority Development Area (PDA), for pedestrians and cyclist provisions. This report should be viewed in conjunction with all infrastructure reports that form the Infrastructure Planning and Background Report (IPBR) document.

8.1 Reference Standards

The reference standards that guided the analysis and development of the active transport requirements for the Ripley Valley PDA are summarised below.

Street and Movement Network PDA Guideline No. 06 | February 2019

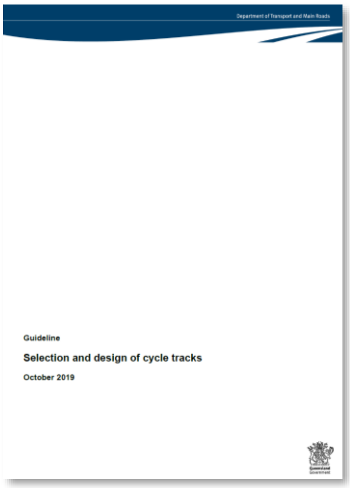
EDQ's Street and Movement Network document provides the standards required for the planning and design of street and movement networks within PDAs.

A key requirement of the guideline is one-way 2.0m minimum separated cycle tracks on both sides of the corridor for higher order roads. The typical requirement for pedestrians is a 1.5m minimum footpath on both sides of the road. For roads which are staged, a 3m cycle track on one side (interim) and 2m on the other side (ultimate) is required.

Local Government Infrastructure Plan (LGIP) | 2016

The desired standard of service (DSS) will be used in conjunction with the other reference documents as it outlines key planning and design standards for the movement network. The service requirements adopted are outlined in the next section.

Selection and Design of Cycle Tracks | October 2019



The Department of Transport and Main Roads' Guideline for the Selection and Design of Cycle Tracks outlines the standards required for the development of cycle tracks, particularly on where and how to separate bicycle traffic from general traffic at intersections and mid-block locations on urban roads in new and retrofit situations. This document supplements information provided in the Austroads guides to Road Design and Traffic Management.

The rationale behind the preference of individual infrastructure elements and their configuration is considered closely. In particular, this relates to the configuration for one-way and two-way cycle tracks at intersecting roads.

Cycling Aspects of Austroads Guides | June 2017

This publication contains key information that relates to the planning, design and traffic management of cycling facilities and is sourced from Austroads Guides, primarily the Guide to Road Design, the Guide to Traffic Management and the Guide to Road Safety.

8.2 Past Reports

Ripley Valley PDA Active Transport Plan Draft Report | February 2019

An active transport network has been developed for the PDA, considering trip generators and attractors, the existing and proposed road network, and topography. This also considered the latest information associated with developments and their status at the time. This study forms the basis for the active transport network to be developed in further detail as part of the IPBR.

The plan proposes a dense cycle and pedestrian network with an expanse of high-quality facilities. The majority of the network is made up of cycle tracks, shared paths and cycle lanes, with the majority in the trunk road network made up of cycle tracks. A preference to a one-way cycle track on both sides of the road is specified rather than a two-way track on a single side. This corresponds with providing a network that supports cyclists of all ages and abilities. However, on-road cycle facilities (i.e. cycle lanes) are included in the network, which typically raise stress levels for users. Generally, these have been proposed to be matched with an adjacent off-road facility, to give the user the option. It is proposed that most of the existing or approved cycle lanes be retrofitted to become protected from the traffic. Where cyclist only facilities are indicated, it assumes that a pedestrian network will be also be made available, which aligns with the requirements within PDA Guideline no.6 (EDQ, February 2019).

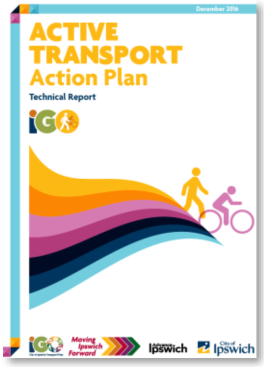
The Active Transport Plan forms the basis of this study and so emphasis on remaining aligned with this plan is prioritised.

Ripley Valley PDA ISTM Update Phase 1 Summary Model Report Revision 3 | November 2019

The purpose of the report is to review, update and apply the Ipswich Strategic Transport Model (ISTM) to enable assessment of development applications and to aid in determining ultimate and interim road hierarchy and capacity requirements for the Ripley Valley PDA. This is covered in more detail in the Transport section.

The modelling report was cross-referenced to the Active Transport Plan (Arup, February 2019), and since it is more recent, any changes to the road network could then be carried over to the active transport network for consistency.

iGO Active Transport Action Plan | December 2016



The iGO ATAP guides the planning, delivery and promotion of quality facilities and programs for walking and cycling (and other active forms of travel) in Ipswich. This plan identifies the target mode shares for the city for a population of 435,000 and identifies the future pedestrian and cyclist networks.

Draft Infrastructure Contribution Offset Plan (ICOP) | 2019

The Draft ICOP outlines the trunk road network and the major off-road shared path for the PDA. The majority of the active transport network proposed in the Bicycle Network Plan is within the road corridor, so it matches up well with the trunk road network in the ICOP. The trunk active transport network was developed based on this, to align with the trunk road network.

Additionally, the major off-road shared path is presented, which is located outside of the road corridor and follows the north-south linear parks. However, there does appear to be some inconstancy between the off-road shared path shown in the ICOP and that shown in the PDA Active Transport Plan. This is assessed further in the proceeding sections (see 8.9) with recommended measures to address this.

Infrastructure Master Plans (IMPs) | Various

To understand what planning has previously been done for the movement network, an assessment has been undertaken into what cycle and pedestrian facilities are proposed in the IMPs. A total of five IMPs were made available, and cover the developments outlined below:

- Goldfields
- Satterleys
- Stockland
- Sekisui House
- Amex Providence.

The level of consistency between the IMPs and the Active Transport Plan is summarised below in Figure 8-1. Overall, there is a poor alignment between both planning mechanisms. While the Active Transport Plan has a preference towards cycle tracks, the IMPs more often show on-road cycle lanes. As detailed above, the Active Transport Plan either recommends retrofit cycle lanes to be protected from traffic (forming cycle tracks) or to provide a parallel off-road option (shared path). Therefore, at the locations below where there is a conflict between the IMPs and the Active Transport Plan, the Active Transport Plan generally takes precedence. Where there is no red or green arrow, this is a location with no IMP that defines the active transport infrastructure.

It should be noted that DA applications also take precedence over the IMPs (see next section).

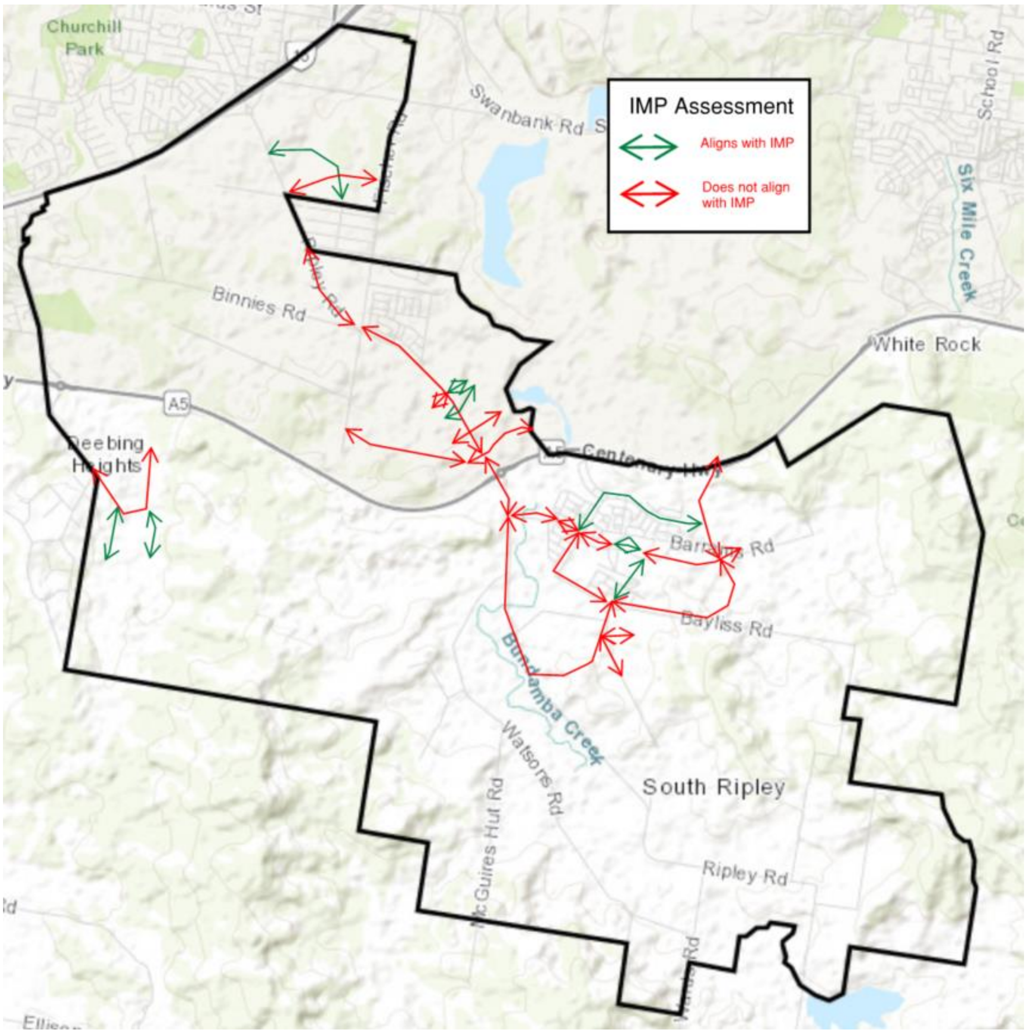


Figure 8-1 Assessment of Alignment with IMPs and Trunk Active Transport Network

8.3 Context Plans and DA applications

To understand the progress of development in the PDA, the Context Plans and DA applications for Reconfiguring A Lot (RAL) were compared with the active transport network planning. If any changes were to be made to what had been planned to date, it had to be understood how progressed this was. If an RAL was approved, there is little room to move in amending what was planned. However, retrofitting may still be possible. A lodged plan had more potential to make changes if necessary, and a context plan was still reasonable to expect changes. As shown in Figure 8-2, a substantial portion of the PDA has RALs approved. However, there is still a significant amount of development lodged for the RAL or context plan.

Figure 8-2 Application Status in PDA

(Based on information provided by Ipswich City Council, February 2020)

8.4 Desired Standards of Service

To develop an understanding for the standard of service which should be provided for the active transport infrastructure in the PDA, the Level of Traffic Stress (LTS) methodology has been applied.

The LTS methodology was developed by TMR and is a method for understanding the level of stress experienced by cyclists in different on-road and off-road environments. If the goal is for a transport network to facilitate and encourage cyclist trips for a high mode share, the transport infrastructure should not force cyclists into high stress environments. As such, LTS 1 or 2 is the desired standard of service. Each type and its characteristics are outlined in Table 8-1. As shown, LTS 3 and 4 are unlikely to attract a high number of cyclists.

Table 8-1 LTS Categories and Descriptions

LTS	Viability of cycling as a realistic mode choice	Proportion of people willing to cycle *
LTS 1	Minimal traffic stress and requires less attention, making this suitable for all bicycle riders. This includes children trained to safely cross the road unsupervised (typically a 10-year old), or younger children under supervision of parents.	63% to 75%
LTS 2	A little traffic stress that requires more attention than young children can handle. It is suitable for most teen and adult bicycle riders with adequate bicycle handling skill.	
LTS 3	Moderate traffic stress that would require higher levels of cycling skill and confidence to interact with traffic using cycle lanes on roads with lower traffic speeds or volumes.	12% to 28%
LTS 4	High level of traffic stress only suitable for very skilled bicycle riders with confidence to interact with traffic on busy roads with minimal or no on-road cycle facilities.	5% to 7%

(Source Draft Queensland LTS Method)

8.5 Stakeholder Engagement

A stakeholder workshop was undertaken to present the existing planning that had been undertaken to date for the active transport network in the PDA (31 January 2020). An understanding of Ipswich City Council's position on the proposed infrastructure from the Ripley Valley PDA Active Transport Plan (Arup, February 2019) was sought. Overall, there was support shown for the proposed cycle and pedestrian network, however there was some preference to consider rationalisation where possible.

8.6 Innovation by Design

Innovation by design as previous defined includes approaches using proven, currently available technologies and/or construction methods to achieve innovative outcomes. These innovations currently exist within the Australian context of urban development and can be readily implemented within the Ripley Valley PDA.

Design Innovations enable new development and infrastructure in each PDA to showcase already tested innovations that are progressing to business as usual in other locations. These innovations require the development industry's desire to showcase leading design innovations as part of new urban development.

The below provides a list of Design Innovations that currently exist within Australian urban communities. These innovations provide examples of locations that have implemented these innovations in place of BAU infrastructure and provide developers, landowners and local governments with on the ground outcomes that they can duplicate in the local context of Ripley Valley.

Developers are encouraged to implement one or more of the Design Innovations in consultation with EDQ and local government and help progress these innovations to business as usual.

8.6.1 Wayfinding

Wayfinding is an information system that guides people through cities and streets and are commonly implemented in complex built environments such as major airports, healthcare precincts, shopping centres and universities.

Generally, Wayfinding involves visual cues that assist people to navigate around, such as maps, street signage and information systems. These built environment features can assist people in high-stress and/or complex environments and can improve safety and security.

Image sourced: Sedg.org

Figure 8-3 Example of a wayfinding information sign

Very strong Wayfinding developed as part of the resurfacing of footpaths provides a positive experience for all users as it can incorporate images and distances along their chosen path, without the need to refer to a device.

Key considerations

Wayfinding is about assisting people to find a destination more seamlessly. To ensure it is effective, the following design principles are recommended to be considered:

- Establish signs/symbols at decision points
- Minimise the level of information, display necessary information - direction, distance etc.
- Incorporate landmarks into the imagery to provide orientation cues.

Implementation recommendations

High: Traditional Wayfinding (street signs) will be implemented in accordance with local government requirements; however, these systems can be enhanced through the addition of imagery and distance to destination. Footpath Wayfinding can also be incorporated to support residents and services and reinforce 'Living Local' community benefits.

Ownership and operation

Generally, minimal operation is required other than maintenance. However, if digital Wayfinding is used, then third party IT operators are required. Traditional Wayfinding in the public domain is owned by the local authority, while in private space, e.g. shopping centres, it is owned by the shopping centre owner.

Procurement complexity

Low: Subject to local government policies and budget. Additional imagery and distance information would require minimal additional cost to street signs. Wayfinding imagery on footpaths would add additional minimal cost to developer at installation. Wayfinding signage for activity centres, subject to size and complexity of centre, are not likely to be required until 10-15-year time frame.

Further information

- Legible London: http://appliedwayfinding.com/projects/legible-london/
- Indooroopilly Shopping Centre: https://www.indooroopillyshopping.com.au/wayfinding

8.6.2 Real-Time Bikeway Counters

Bicycle counters and speed monitors are used along trunk routes to assist with the planning of future active transport facilities. Bicycle counters use infrared sensors and an inductive loop in the bikeway or footpath to count the number of cyclists. The count is then displayed on the bikeways via electronic display boards. Displaying the number of bike riders, speed, their contribution to reduced traffic congestion and act as an incentive to keep participating in active transport options.

Image sourced: Brisbane City Council

Figure 8-4 Example of real-time bikeway counters

Key considerations

The usefulness of the data obtained from these devices depends on their placement. Counters are placed in strategic locations to track the usage of bikeways over time and to advise future active transport planning. Analysis of bikeway speeds informs councils of locations which would benefit from the installation of speed controlling measures or separation of cycling lanes or routes, such as commuter cyclists, versus recreational cyclists.

Implementation recommendations

Moderate: Subject to incorporation of bikeways within each development. As local streets support cyclists the use of bikeway counters would only be applicable where bikeways are created to facilitate quick and efficient paths into transport hubs or activity centres. Where access to PT is not within 1km bikeways should be implemented to ensure active transport habits support PT and use levels are recorded through bikeway counters to inform network decisions.

Ownership and operation

Bikeway counters are generally funded by local governments or state governments as the road authority and owner. They provide valuable data on road and cycle use, trip journey, desirable routes and destinations which inform strategic active transport network planning and assets.

Procurement complexity

High: Subject to bikeway locations, counters are only required where they are within a high use high activity area, such as along transport corridors (rail/arterials) or in commercial centres. A cost share approach between developers, local and state government would reduce costs and provide a good data source to support future active transport and PT decisions.

Further information

- Brisbane City Council: https://www.brisbane.qld.gov.au/traffic-and-transport/roads-infrastructure-and-bikeways/current-bikeway-and-pathway-projects/real-time-bikeway-counters

8.6.3 Active Transport Infrastructure

Active transport is a key focus for cities across the world looking to reduce traffic congestion and encourage an active and healthy lifestyle for their communities. Infrastructure which supports active transport includes:

- Bike or E-bike dockless sharing schemes
- Bike docking stations for share schemes. Including incorporated charging facilities for e-bikes
- Bike repair stations
- E-bike charging stations implemented at key traffic generators, including docks or end-of-trip facilities
- High quality end-of-trip facilities.

Image sourced: Brisbane City Council

Figure 8-5 Image of Brisbane's city cycle, an example of active transport

Brisbane’s bike sharing scheme, City Cycle, has 140 stations (each with 20 bikes). Most stations are in the road shoulder or behind the kerb and are serviced by a single pay station. For commuters who chose to use their own bike, public end-of-trip facilities can be provided at a varying cost to the user. End of trip facilities range from open or caged bike parking to facilities with showers, lockers, e-bike charging and laundry services.

The introduction of charging docks or services at end-of-trip facilities would potentially provide a location for E-bike charging, while bike repair stations are located along bikeways and paths to provide a variety of tools Allen keys, levers and a small pump to enable bike servicing.

Key considerations

Success of active transport infrastructure is dependent on location. To maximise use of facilities they must be in highly trafficked locations and activity centres. Regular maintenance needs to occur to ensure the infrastructure is operating adequately.

Ensuring enough docking stations are adequate along popular routes is essential for a successful bike sharing system. A balance of available bikes and parking spots must be decided based on demand at each station. Bike sharing schemes must abide by strict operating conditions imposed by local councils and road authorities.

Implementation recommendations

High: Subject to incorporation of bikeways and paths within each development. Where bikeways or paths are created in high amenity areas such as activity centres, and along river or nature-based corridors bike repair stations should be provided. End of trip facilities should be provided within activity centres and at PT hubs. Bike sharing schemes would be subject to demand within a local government area not just a PDA.

Ownership and operation

Active transport infrastructure is funded by local governments or state governments as the road authority and landowner. They provide valuable assets to the broader community supporting active lifestyles and wellbeing. Opportunities exist to incorporate with bikeway path construction by developers, however maintenance will remain with local government.

Procurement complexity

Moderate: Subject to bikeway locations, required where they are in high use corridors or activity centres. A cost share approach to construction between developers and local government would reduce costs. Ongoing maintenance would remain a cost to local government.

Further information

- Brisbane City Council: http://www.citycycle.com.au/index.php
- Lime Electric Assist Bikes in Sydney: https://www.li.me/electric-assist-bike
- https://www.timeout.com/sydney/news/will-the-new-lime-green-electric-bikes-survive-sydney-111318
- Bewegen in Summit County: https://bewegen.com/en/bike-share-case-studies/summit-county
- Cycle2City, King George Square, Brisbane: http://cycle2city.com.au

8.6.4 Glowing Cycle Paths for Self-Illumination

In locations with poor visibility, minerals which absorb ultraviolet light and emit a soft glow at night can be used to illuminate cycle and pedestrian paths. This innovation in wayfinding provides cyclists and pedestrians with a sustainable light source in an otherwise dark location and helps create a positive experience for the user. A notable example of this is the 'Van Gough' bike path in the Netherlands, which lights up like the 'Starry Night' attracting significant use and interest from the broader community.

Image sourced: Trendcity.org

Figure 8-6 Example of glowing cycle path

Key considerations

Engagement with local government and state government road authorities to implement this approach to lighting and illumination of their assets. Regular cleaning of these paths is required along with clearance from tree canopy and shade, to maintain enough light absorption during daylight hours to enable maximum after hours 'glow' during the evening.

Implementation recommendations

High: Subject to incorporation of bikeways and paths within each development. Where bikeways or paths traverse dark environments such as parks, open space networks and along corridors (natural or transport) glowing cycle paths should be provided to support 24-hour use of active transport assets, commuter cyclist activities and enhance safety and surveillance for pedestrians.

Ownership and operation

Footpaths and cycle paths are owned by local governments or state governments as the road authority and landowner. They provide valuable assets to the broader community supporting active lifestyles and wellbeing. Opportunities exist to incorporate within footpath and cycle path construction by developers, however maintenance will remain with local government.

Procurement complexity

Low: Subject to local government and state government policies, the addition of minerals to footpath and cycle paths would require minimal additional cost. Footpath and cycle path construction is required by each developer as part of their local infrastructure delivery this would add minimal additional cost to developers at installation. Ongoing cleaning maintenance, replacement and reconstruction would be incurred by local government and/or state government.

Further information

- TMR, Logan City Council, Brisbane City Council examples: https://moondeck.com.au/projects
- Gosford, NSW: https://www.trendingcity.org/glow-footpath-gosford
- Lidzbark Warminski, Poland: https://www.sustainability-times.com/clean-cities/a-sun-powered-bicycle-path-glows-in-the-dark-in-poland/
- Eindhoven, Netherlands: https://www.citylab.com/transportation/2014/11/this-dutch-city-built-a-glowing-van-gogh-bike-path-for-psychedelic-cyclists/382761/

8.6.5 Children's Bicycle Skills and Pump Track

Children's Skills Tracks typically consist of asphalt path circuits with pavement markings and signage simulating an urban traffic environment. This encourages youth to cycle (typically younger than 6 years of age) and develop their skills in a safe and confined environment.

Pump Tracks typically consists of circular loops with smooth dirt mounds and beams that cyclist can ride around in a pumping motion. This encourages people of all ages to cycle for recreational use.

Image sourced: Cityofswan.wa.gov.au

Figure 8-7 Example of children's bicycle track

Key considerations

High use is observed at these facilities if implemented at centrally located parks within suburban areas. High use has also resulted in community demand for supporting facilities such as toilets, shelter, water supply and parking, due to the destination nature of this infrastructure.

Implementation recommendations

High: Opportunities for specific playground experiences should be implemented at Sub-Regional or well-placed district level parks in association with other district level facilities. Access to these activity-based parks should be integrated within open space networks of each PDA so that bikeways, cycle paths and shared paths connect across suburbs to maximise community access and user experience.

Ownership and operation

Developer contributions can be collected in areas immediately surrounding facilities to contribute to capital costs, however nexus should be clearly defined given ability of activity to draw users from a district/Sub-Regional community. Ownership remains with local government along with ongoing operational costs.

Procurement complexity

Moderate: Installation may form part of a district or Sub-Regional level park within a PDA subject to local government catchment requirements for recreational facilities. Construction and installation may be required by a developer or through the DCOP as part of district park facilities. The Stratton Youth Space approximate capital cost was around $60k.

Further information

- Stratton Youth Space, Western Australia: https://www.swan.wa.gov.au/Your-Community/Kids/Sporting-facilities/Parks-with-bike-paths/Parks-with-bike-paths-list

8.7 Review and Comparison of Adopted Demographics

Extensive review of the demographics has been undertaken as part of Section 2. Since the majority of active transport network lies within the road network, this aligned with the outcomes in the Section 7.7of this Report.

8.8 Planning Horizons

The Ripley Valley PDA includes planning horizons of 2026, 2031, 2041 and 2066 (ultimate year). Demographics such as population, dwellings and employment are provided for these horizons for identifying future infrastructure requirements and analysis.

8.9 Adopted Interim and Ultimate Planning Horizon Analysis and Results

An analysis was undertaken initially for the ultimate planning horizon, which was then followed by the interim stages. The methodology for the assessment in this section is as outlined below:

- Assess the planned network for Level of Traffic Stress
- If any changes are required, cross-check with the status of approvals in the area, and update the ultimate network
- Detail individual elements for the cross-sections in line with the applicable guidelines (see Section 8.1)
- Stage for the interim horizons.

8.9.1 Level of Traffic Stress Assessment

To develop an understanding for the standard of service which should be provided for the active transport infrastructure in the PDA, the Level of Traffic Stress (LTS) methodology has been applied. A summarised form of the LTS tool is outlined in Table 8-2. This shows how infrastructure type, clearance from traffic, road function and traffic speed affect the LTS score. LTS 1 and 2 are acceptable for attracting higher proportions of cyclists, whereas LTS 3 and 4 are more act as barriers to choosing to cycle. It is noted that the LTS methodology considers additional variables to those summarised below.

Table 8-2 LTS Methodology (Summarised)

Type	Road function	Other features	Road speed (km/hr)					
			30	40	50	60	70	>70
1	Off-road (more than desirable clearance)	Separated path*	1	1	1	1	1	1
		Shared path	1	1	1	1	1	1
2	Off-road (less than desirable clearance)	Separated path*	1	1	1	2	2	3
		Shared path	1	1	1	2	2	3
3	Local road	Cycle lanes*** (<2000 AADT)	1	2	2	3	4	4
		Cycle street (<200 AADT	1	2	4	4	4	4
		Shared zone/ Bicycle Awareness Zone (<750 AADT)	1	2	3	4	4	4
		No cycling facility/mixed (<750 AADT)	1	2	3	4	4	4
4	Collector	Cycle lanes***	3	3	3	3	4	4
		Cycle street	4	4	4	4	4	4
		Shared zone/ BAZ	4	4	4	4	4	4
		No cycling facility (mixed)	4	4	4	4	4	4
5	Arterial	Cycle lanes***	4	4	4	4	4	4
		Cycle street	4	4	4	4	4	4
		Shared zone/ BAZ	4	4	4	4	4	4
		No cycling facility (mixed)	4	4	4	4	4	4

*Includes cycle track.

**If shared path is less than 3m then drops to LTS2.

***Cycle lanes are separated by a painted line.

The assessment was undertaken first for the trunk network, to understand if there were any shortcomings. The trunk network performed well with either LTS 1 or 2 due to it being mostly off-road infrastructure. Where on-road cycle lanes are shown, a 2.5 m or 3 m off-road shared path is also provided allowing it to be scored as LTS 1 or 2. Only one location shows cycle lanes with parking adjacent which creates a high stress environment for cyclists. Since this is part of the trunk network, we will be removing the parking for identified south east leg adjacent to cycle lane (see red circle below).

As indicated by the Active Transport Plan, a large portion of these cycle tracks will effectively be retrofits of previously approved or constructed cycle lanes. The process for retrofitting is outlined further in the following sections (see cross-sections) and involves providing a barrier between the cycle track / lane and the traffic lane. If done according to the appropriate guidance, this will provide for LTS 1.

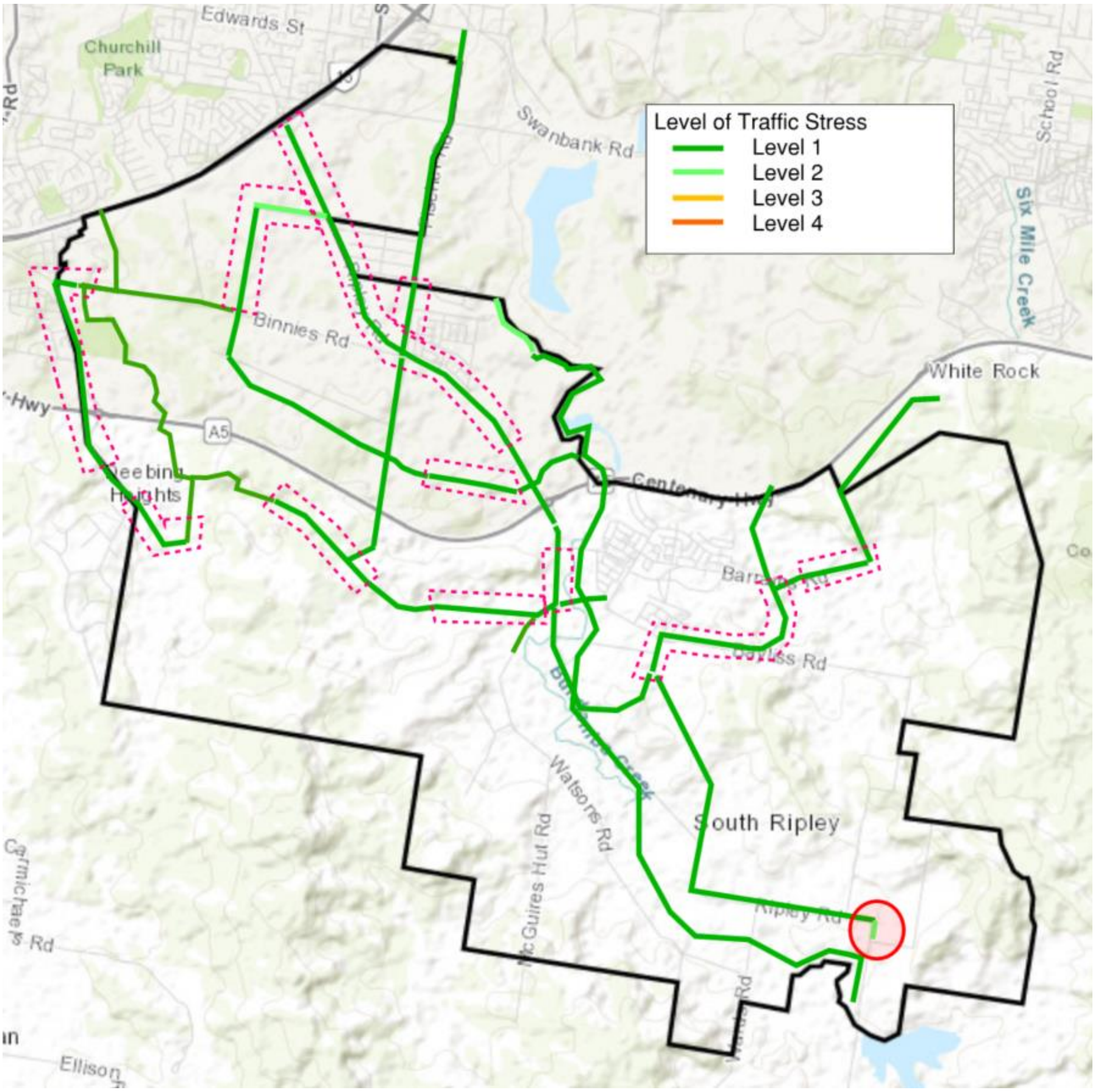


Figure 8-8 Trunk LTS Assessment and Areas Requiring Changes (see red circle) or Retrofitting (see dashed areas)

The local network also scored well, with the majority at LTS 1 or 2. There are locations which score at LTS 3 or 4, due to the presence of cycle lanes adjacent to parking, or where cyclists are mixed with traffic (in line with Active Transport Plan LTS assessment). Where there is potential to provide adjacent off-road, this has been shown. However, some locations are constrained due to the approval of some developments. For these locations, it is recommended to nominate these as locations that could include future investigation for off-road facilities or reduction in traffic speeds, as part of any maintenance (i.e., resealing, service upgrades) or Local Area Traffic Management (LATM) projects. This is particularly relevant for the long section of LTS 4 at the southern district centre (dark orange in Figure 8-8), and the long section of LTS 3 (yellow) at the south west side (see red circle below).

The final LTS scores are shown below. Since this was an iterative process, the changes based on the outcomes from the cross-sections, development and staging (see following sections). Given the focus of the LTS methodology, off-road infrastructure outside of the road corridors that is not part of the trunk network is not detailed below.

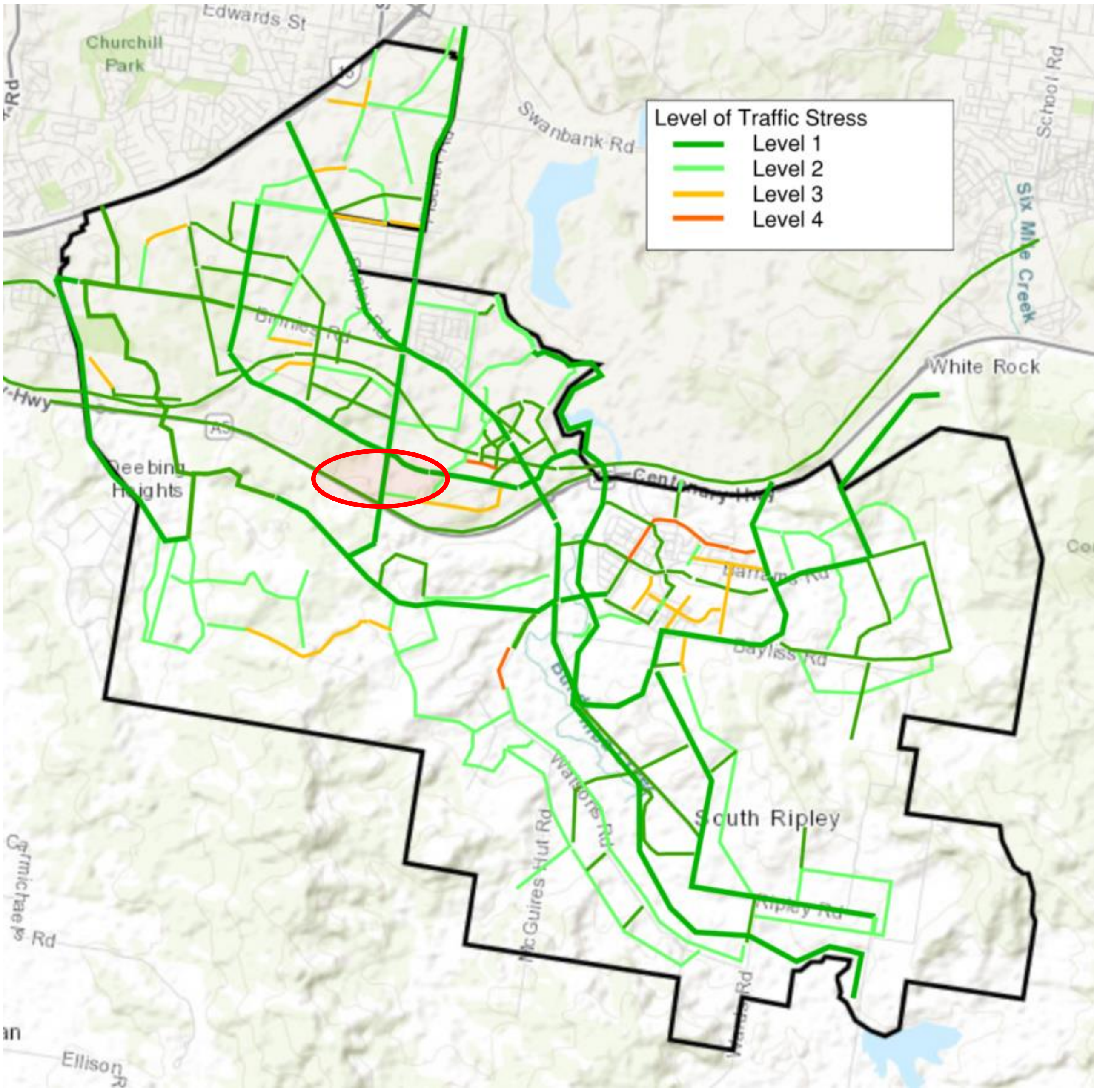


Figure 8-9 Final LTS Score for the PDA

8.10 Network Development

Some minor changes were also made to align the active transport with the latest road network (according to the latest Model Report and ICOP). Some changes and slight rationalisation were undertaken as part of this. In particular, the off-road shared path identified in the ICOP and Active Transport Plan appear to not align at some sections. This is outlined further below.

There are two major off-road shared paths in the PDA as per the ICOP. These travel along the two north-south linear parks, following the alignment of the adjacent creeks. The Active Transport Plan proposes that the section closest to the Town Centre is separated from pedestrians. Since this will be the location with the highest volumes, this is the best solution. A section at the northern end is also only shown as 2.5m wide with retro fitment required. However, a minimum 3m wide path is preferred, and 4m is desired. This is located adjacent to an approved development and so this constraint is likely limiting the opportunity to widen this further. To align with approved development, the path to the west along Deebing Creek is shown on the west side. For the path to the east along Bundamba Creek, this is shown along the east side (as per the ICOP).

The outcome is as per below:

- Provide separation between pedestrians and cyclists on Bundamba Creek path (east path shown below) for the section closest the town centre
- Investigate further widening of Bundamba Creek path at the northern extent.

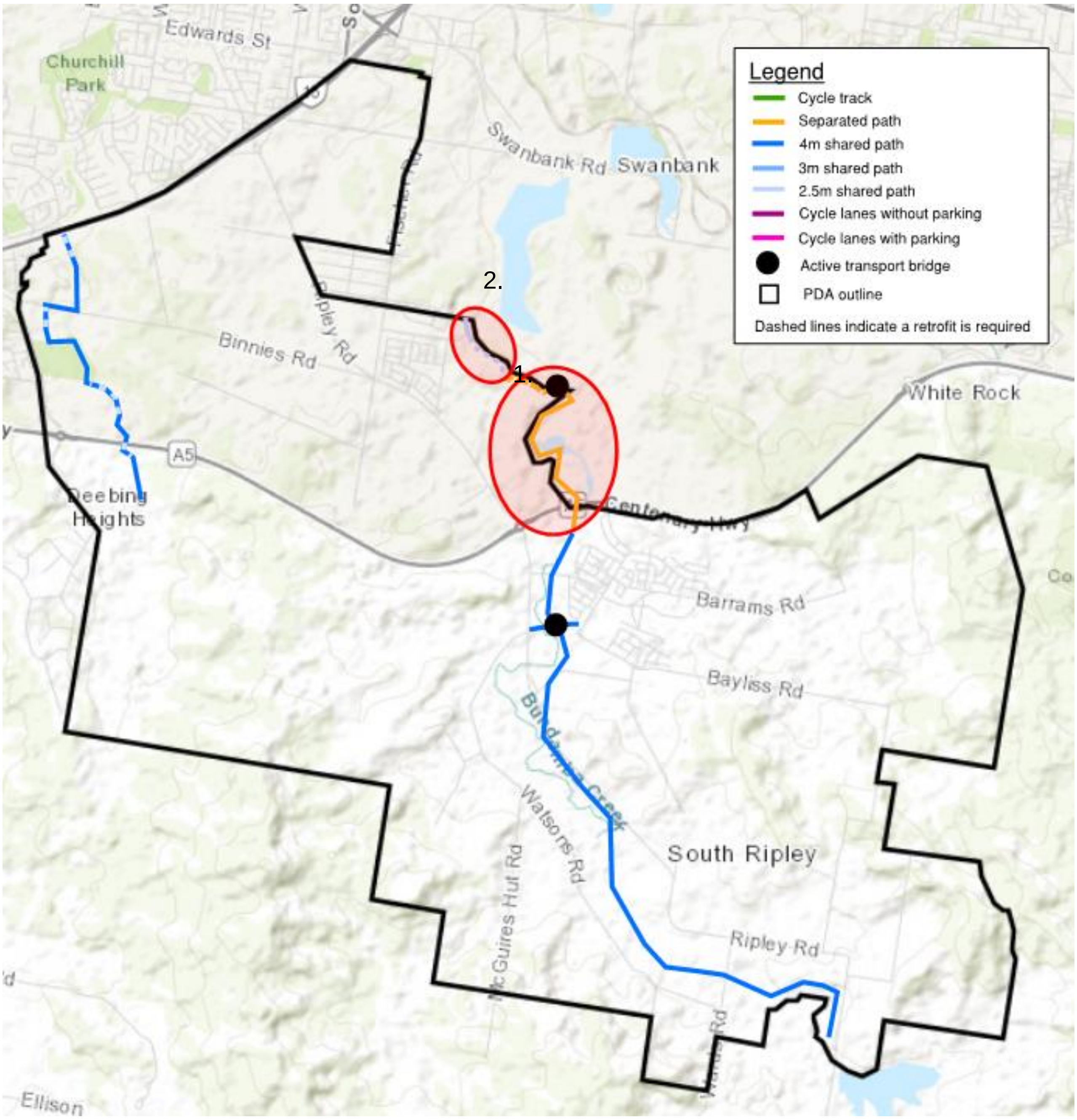


Figure 8-10 Required Amendments for Off-Road Shared Paths (see red circled)

The final trunk network is as per below Figure 8-11, made up of one-way cycle tracks, off-road separated and shared paths, and cycle lanes. Note that this does not show the local network, or infrastructure outside of the PDA (e.g. along the rail corridor). This is considered to be a high-quality active transport network, which provides strong connections between trip generators and attractors.

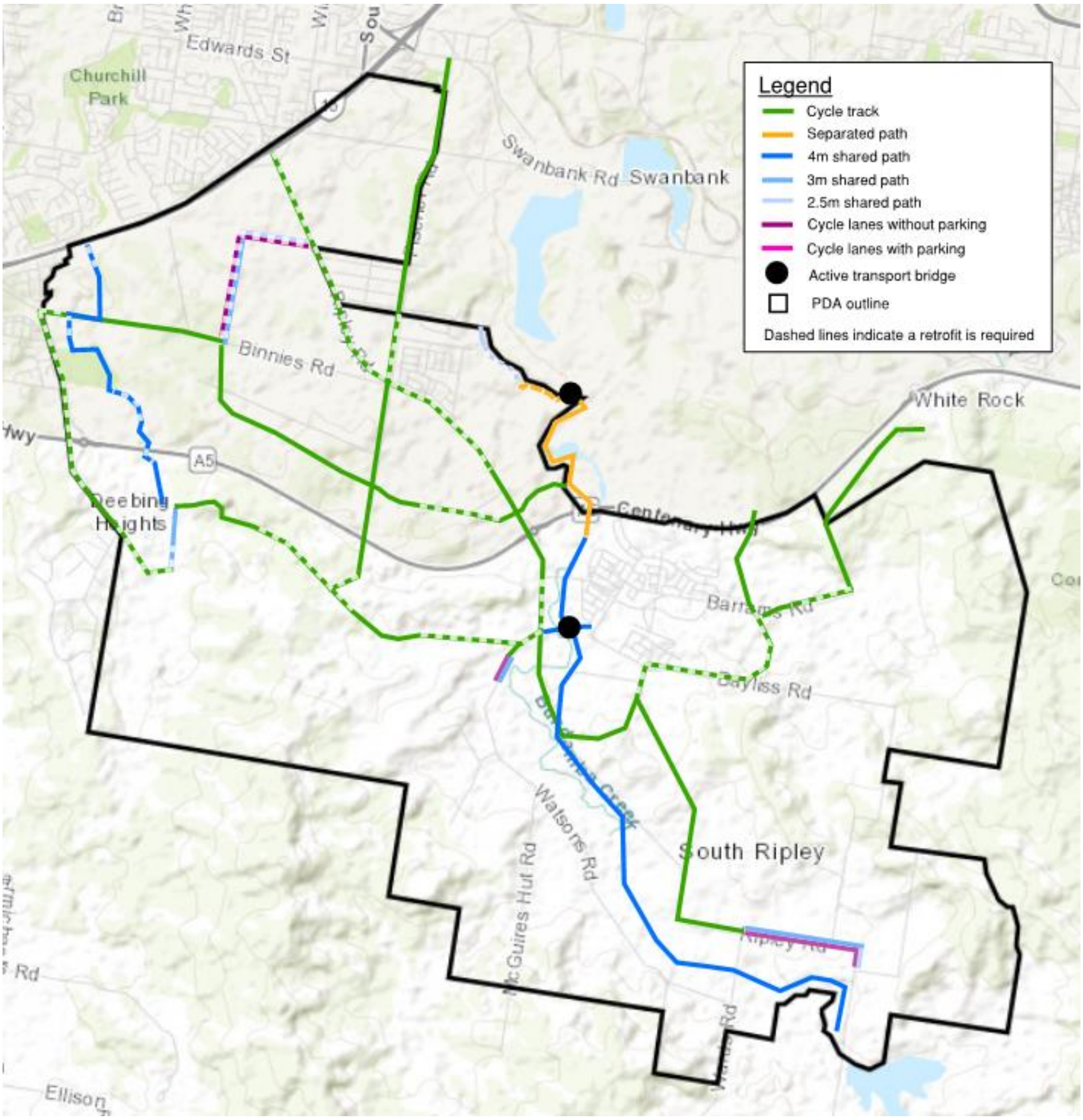


Figure 8-11 Final Trunk Cycle Network for the PDA

It should be noted that a cycle track is planned (retrofit) as part of the local network to be retrofitted to the road connecting from Ripley Road east to the southern district centre (Amex Providence), as per the Active Transport Plan (Arup, February 2019). This will improve connectivity in this area and support the wider trunk network. Therefore, this has also been costed.

8.11 Cross-Sections

Development of the cross-sections for the trunk network is detailed below for the roads and intersections. Further detail of the cross-sections is outlined in Appendix A.

8.11.1 Roads

The lateral clearance of cyclist and pedestrian infrastructure is provided in PDA Guideline No.6 according to street type and adjacent uses (e.g. parking, breakdown area etc). This is summarised in Table 8-3 in addition to the adjacent road elements. The minimum spatial requirements for the off-road active transport infrastructure are listed below:

- 3m shared path
- 2m one-way cycle track
- 3m two-way cycle track

Figure 8.12 below illustrates the proposed typical cross section for trunk collector roads.

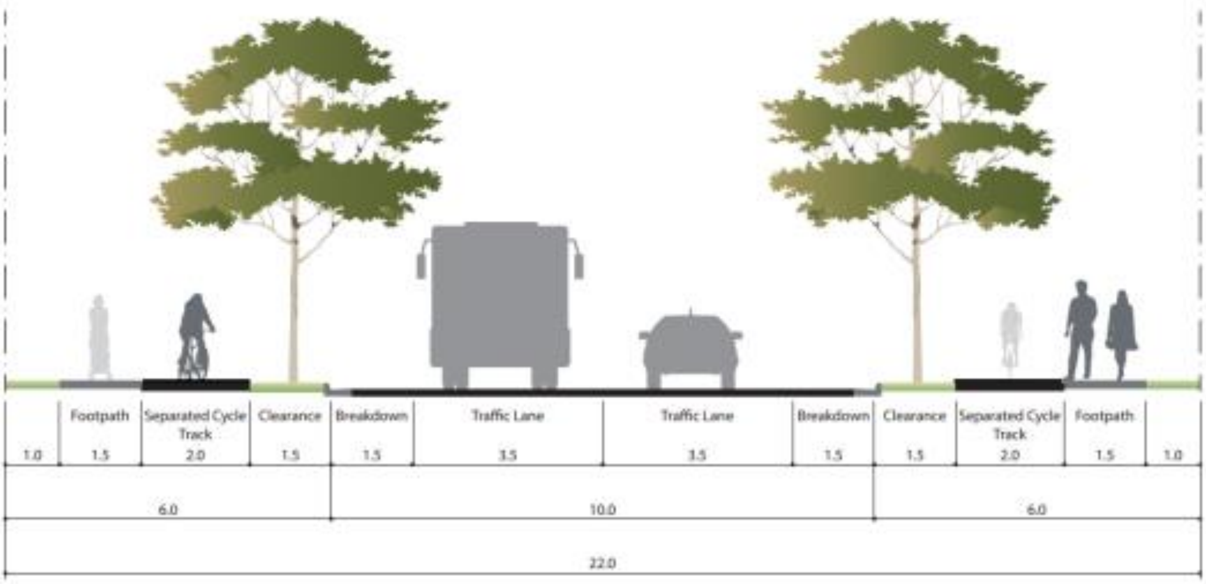


Figure 8-12 Example Road Cross Section for Trunk Connector

Table 8-3 PDA Guideline No.6 Spatial Requirements

Street type	Width				Vegetation clearance		
	Footpath (minimum)	Parking	Breakdown	Boundary	Indented parking	Traffic lane (with breakdown shoulder)	Traffic lane (without breakdown shoulder)
Trunk connector	1.5m	2.4m	1.5m	1	1.6m (cycle track) 2m (shared or footpath)**	1.5m (cycle track)	2m (cycle track)

Centre connector	3m	2.5m		0	1.5m (cycle track)		2m (cycle track)
Industrial connector	1.5m	2.5m		1	2m (cycle track) 2m (footpath)		
Urban arterial*	1.5m	2.5m		1	2m	1.5	2m (cycle track) 2m (footpath)**

** Not stipulated in PDA Guideline (assumed only)*
*** Applied to every location*

While urban arterials are not outlined in the guideline, the above requirements were assumed and applied, relating to the worst cases outlined. The above rationale has been applied to develop the cross-section for the trunk network.

With alignment to current guidance, no separation is required between cycle and pedestrian infrastructure. However, some current delineation methods may cause a trip hazard, and so alternative methods to vertical methods is explored later in this section (see edge treatment methods).

Cycle lanes were previously constructed or approved along some of the trunk network. For these situations, to achieve an appropriate LTS, retrofitting this to become cycle tracks is required (see LTS section). There are a number of options available for how this may be undertaken. The typical preference is to locate the cycle tracks in the verge (see below – refer to PDA Guideline No. 6), however if this is not possible due to the constraints, a retrofit solution should be investigated (outlined below – refer to Active Transport Plan (Arup, February 2019) and Selection and Design of Cycle Tracks (October 2019). The most relevant example here is for along Ripley Road (see Figure 8-11), which previously indicated a shared bus and cycle lane.

Locate cycle track in verge (preferred solution)

Requires adequate space in verge including:

- 2m one-way cycle track both sides
- 1.5 to 2m vegetation clearance
- 1.5m footpath (minimum)

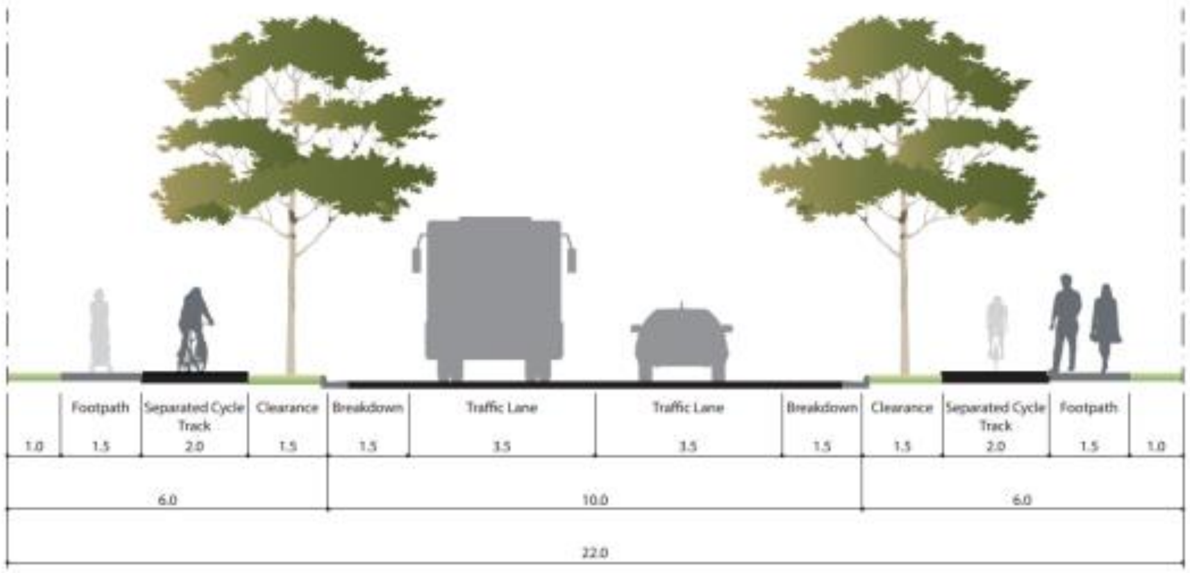


Figure 8-13 Cycle Track in Verge Two-Lane Trunk Connector

(Refer Figure 5A in PDA Guideline No. 6)

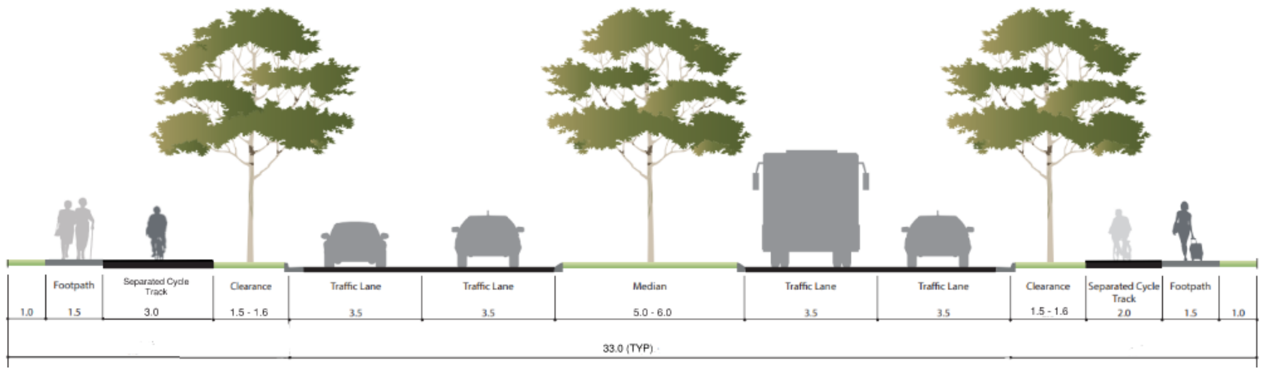


Figure 8-14 Cycle Track in Verge Four-Lane Trunk Connector

(Refer Figure 5A in PDA Guideline no.6)

Whilst a 1.5m minimum is detailed for pedestrian provisions for both sides of Urban Arterials, Trunk Connectors, Neighbourhood Connectors and Industrial Connectors, where space permits, a minimum 1.8m should be considered for provision.

Locate cycle track on road pavement (retrofit solution)

Requires additional space made on road, typical options include:

- Remove one side of parking
- Reducing traffic lane widths or narrow median
- 2m one-way cycle track both sides
- 0.4m to 1.5m vegetation clearance (see below). 1m to 1.5m is preferred to achieve a higher LTS on trunk roads (Selection and Design of Cycle Tracks, TMR).
- 1.5 m footpath (minimum).

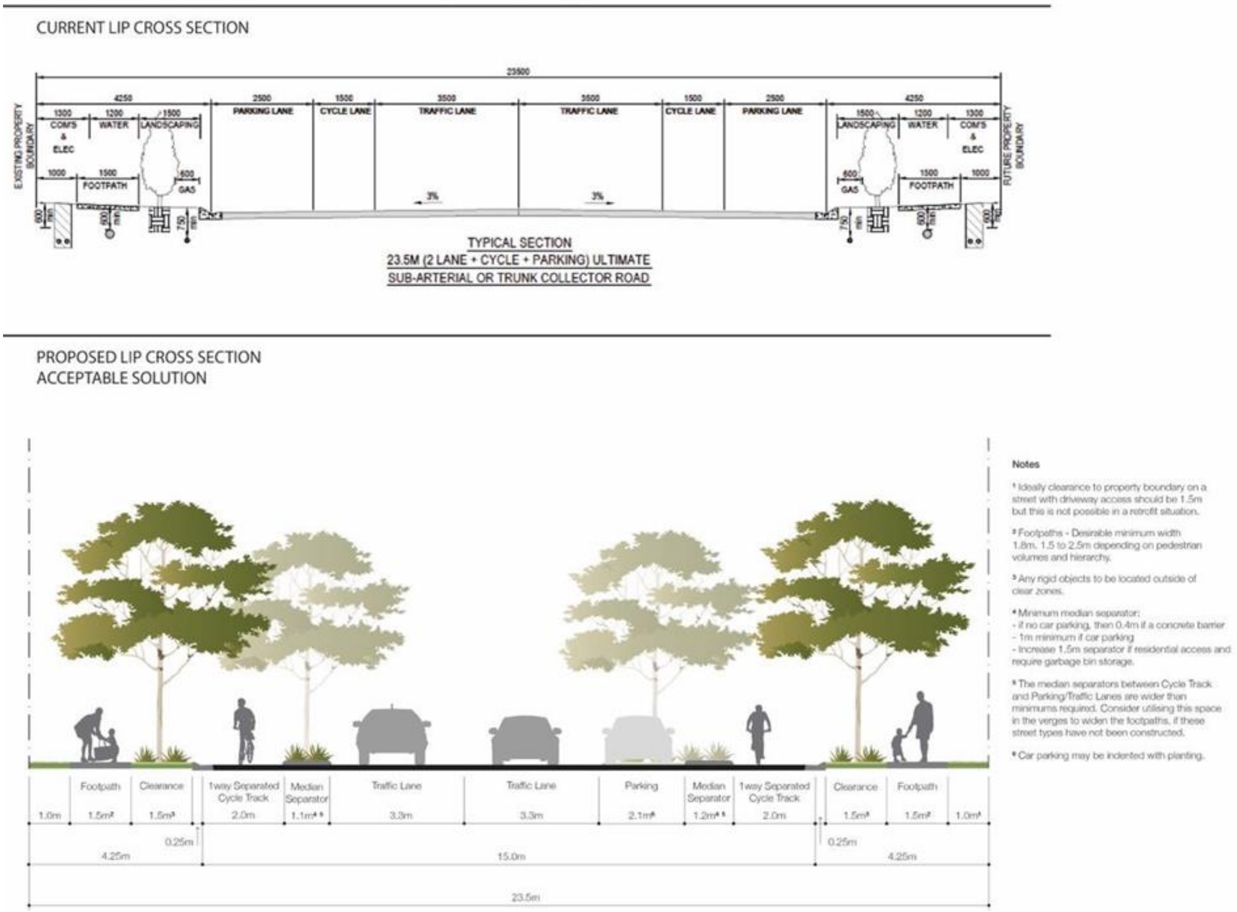


Figure 8-15 Retrofit Cycle Track with Trunk Connector

(Refer Figure 7 in Appendix H, Active Transport Plan)

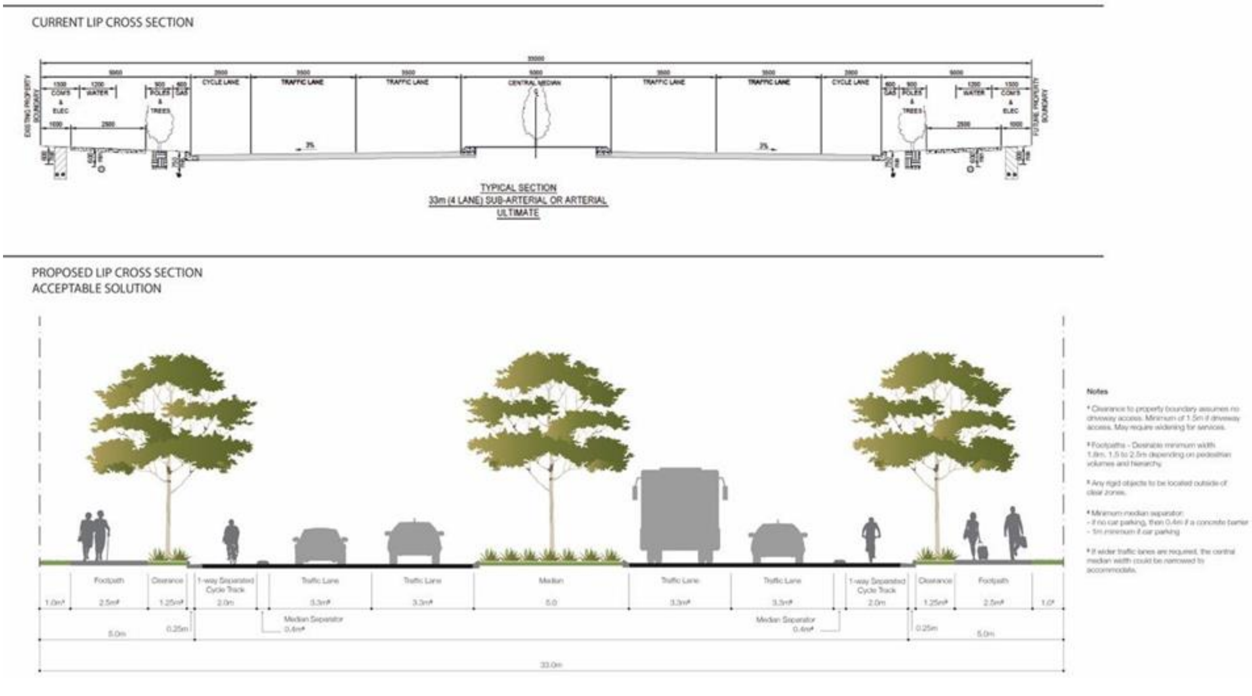


Figure 8-16 Retrofit Cycle Track with Arterial

(Refer Figure 6 in Appendix H, Active Transport Plan)

For locations with cycle lanes, a minimum width of 2m is recommended without adjacent parking, as per the Active Transport Plan (Arup, February 2019). Line marking, pavement painting and markings should be included to clearly identify the cycle lanes for other road users. Detailed guidance for the provision of cycle lanes is included in Austroads Guide to Traffic Management Part 6: Intersection, Interchanges and Crossings (2017).

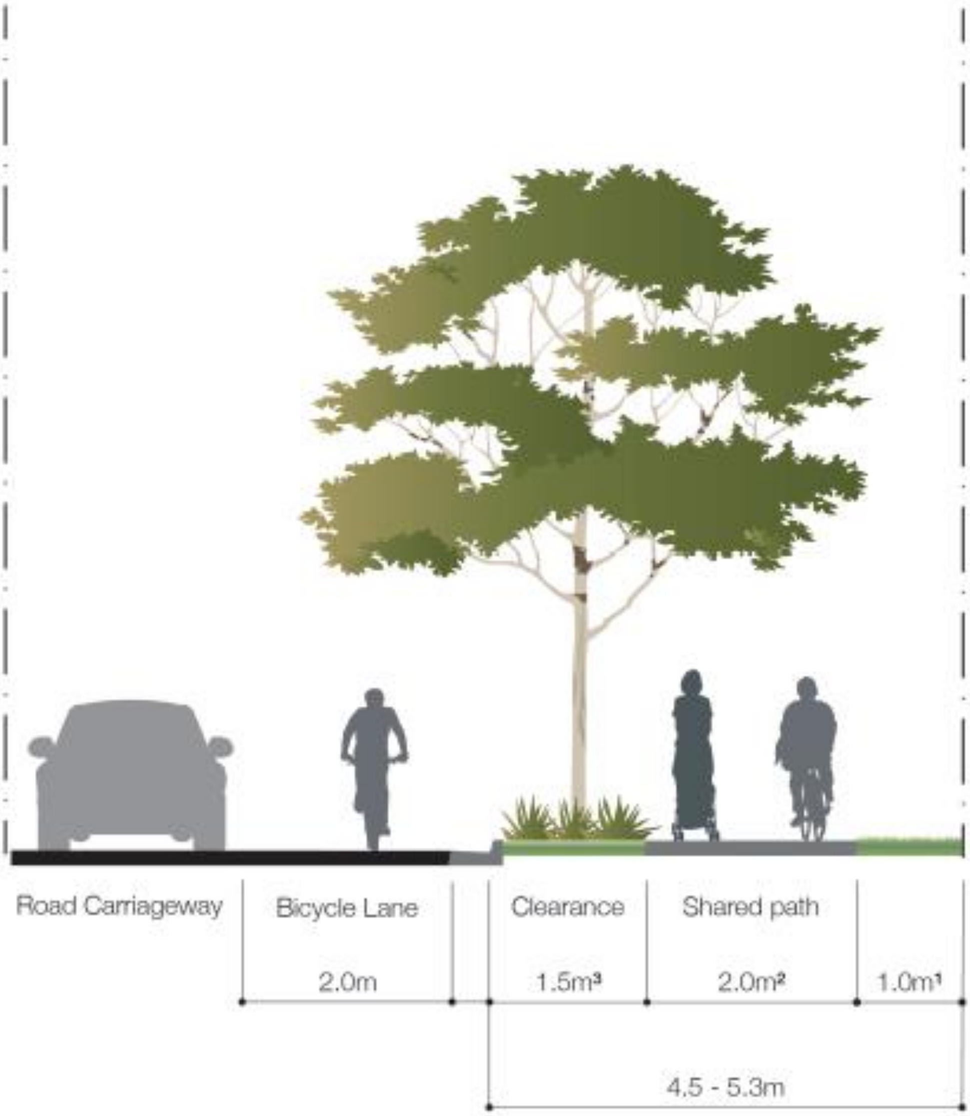


Figure 8-17 Separated On-road Bicycle Lane and Shared Path

8.11.2 Intersections

Selection and Design of Cycle Tracks (TMR, October 2019) outlines the most relevant requirements for off-road infrastructure at intersections, to be applied to the trunk network. This outlines suitable options for each intersection type, in addition to retrofit examples.

A typical intersection for one and two-way cycle infrastructure and pedestrian facilities at a signalised intersection is shown below. The locations of signalised intersections are detailed in the Transport Section and Appendix A. As per below, a 2m storage is desirable for pedestrians and cyclists waiting to cross. This is also desirable along the entire approach and so is adopted, however it can be reduced if constrained (i.e. tapered).

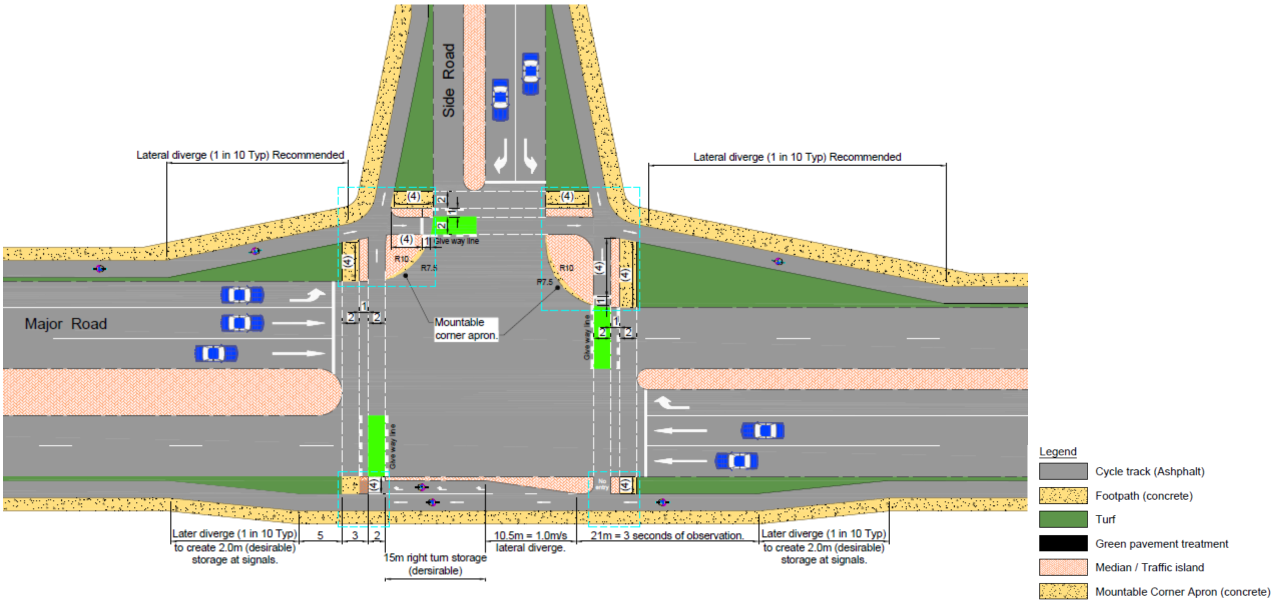


Figure 8-18 Typical Layout at Signalised T-Intersection

(Figure B4.01 – Selection and Design of Cycle Tracks, TMR)

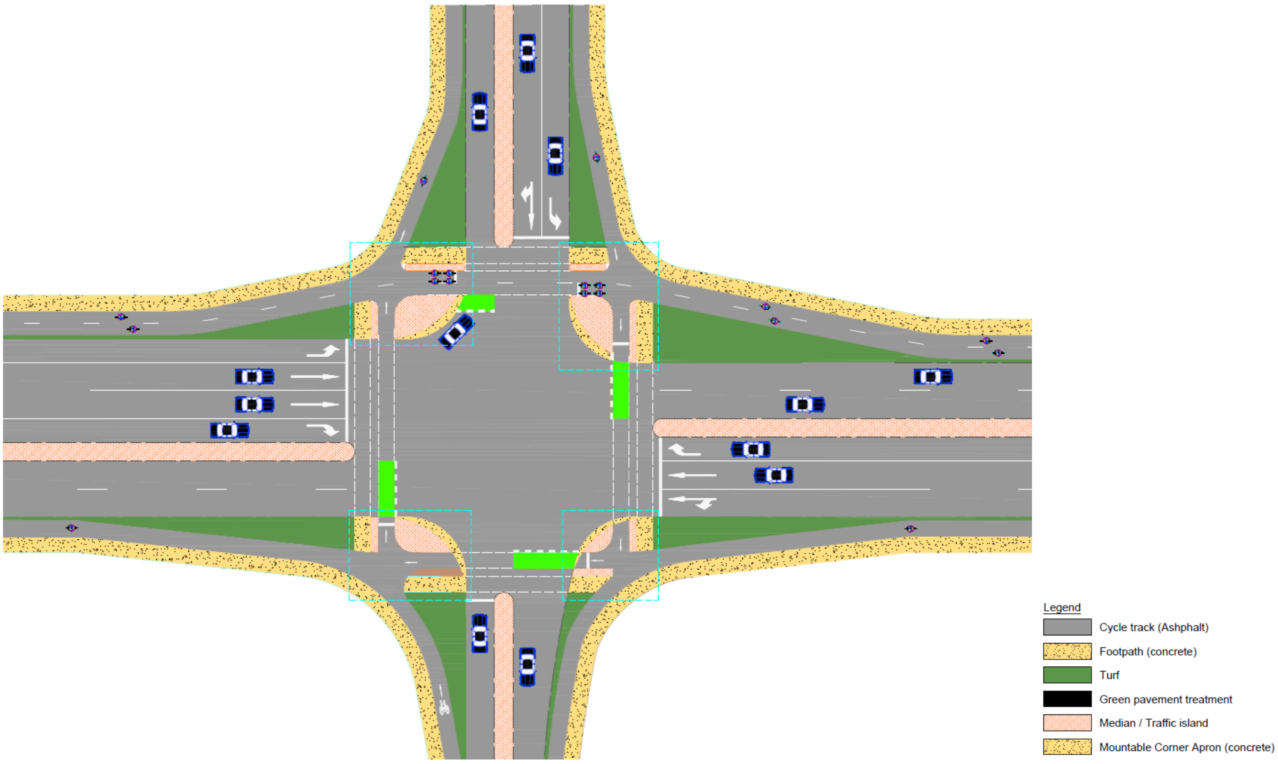


Figure 8-19 Typical Layout at Signalised 4-way Intersection

(Figure B4.02 – Selection and Design of Cycle Tracks, TMR)

A typical roundabout configuration that accommodates cycle and pedestrian infrastructure is as per below. The location of roundabouts is also established in the Transport Section (Adopted Intersection Requirements and) and Transport Infrastructure Costings Tables.

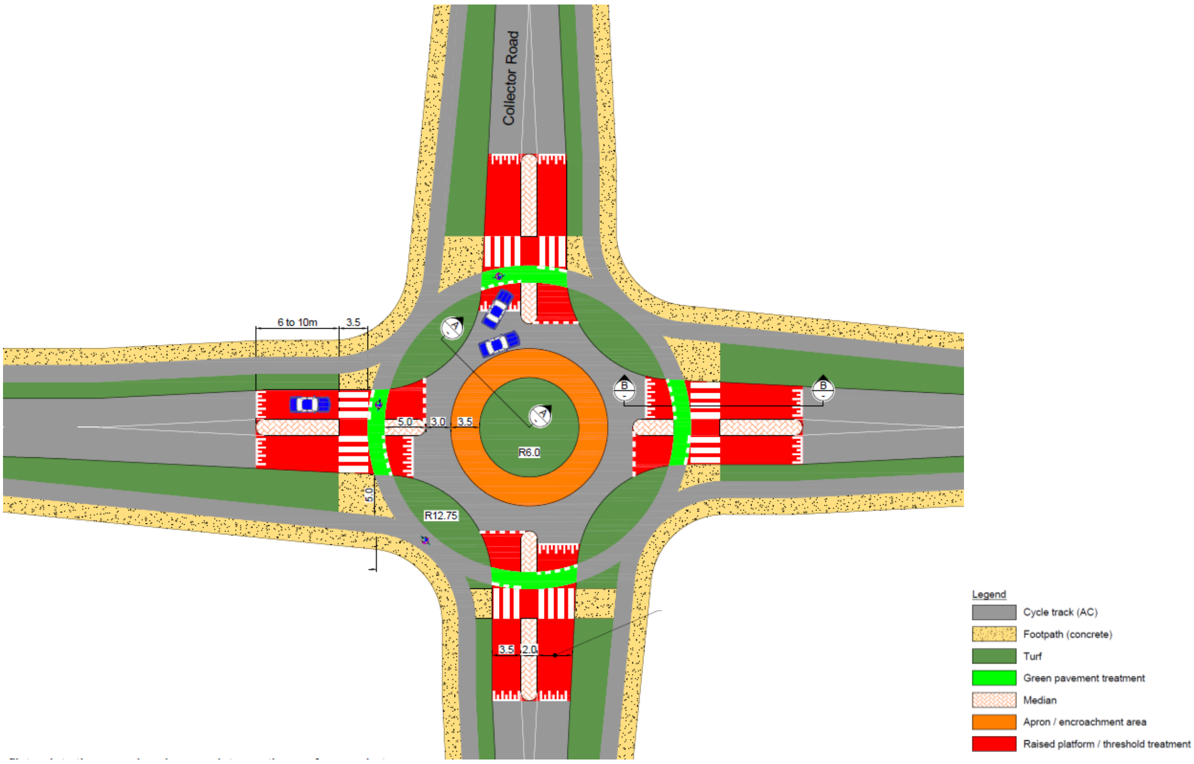


Figure 8-20 One-Way Cycle Track and Footpath at a Single Lane Roundabout

(Figure B3.02 – Selection and Design of Cycle Tracks, TMR)

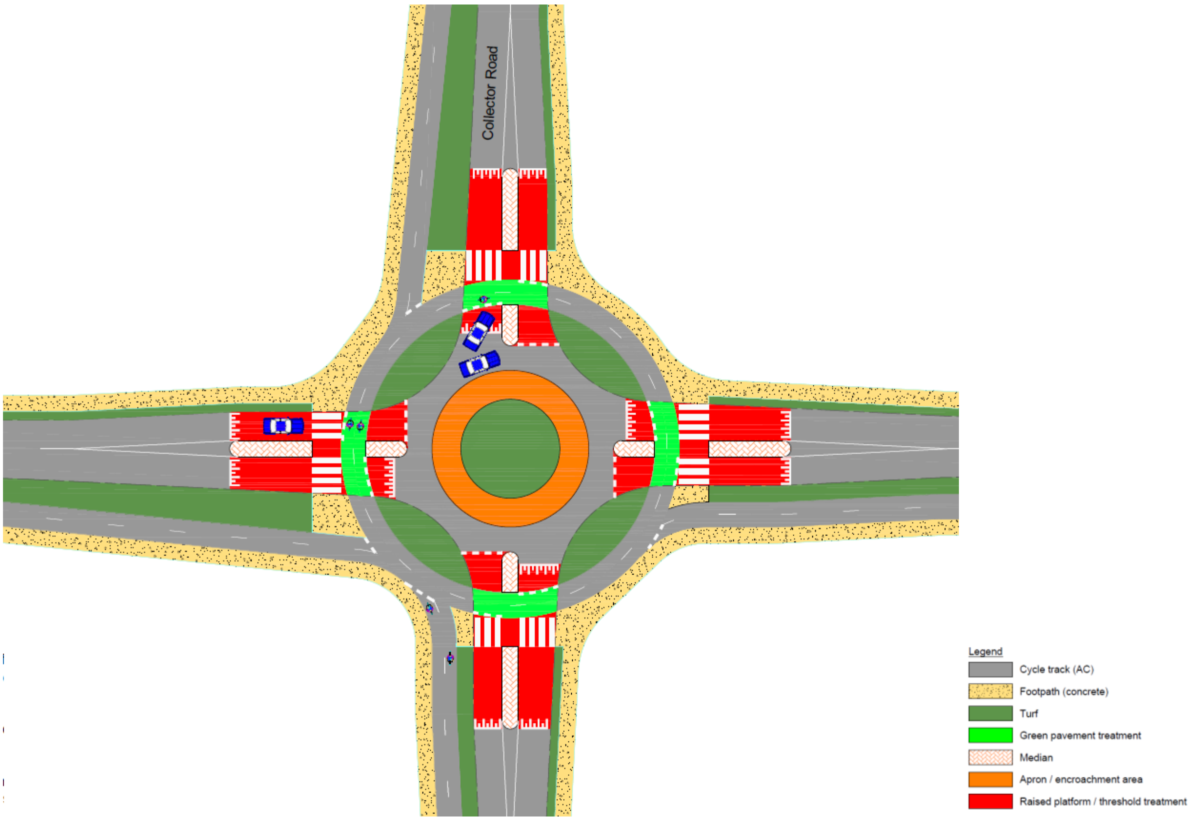


Figure 8-21 Two-Way Cycle Track and Footpath at a Single Lane Roundabout

(Figure B3.03 – Selection and Design of Cycle Tracks, TMR)

Typical priority control intersections also make up part of the trunk network as part of the interim stages. These intersections will be upgraded to roundabouts or signalised intersections in future stages, as established in the Transport Section and Appendix A. For the intersecting lower order roads, it is recommended that cyclists have priority alongside the through moving traffic. For these situations, in addition to other lower order side roads, a treatment should be implemented with an arrangements like below (see Figure 8-22 and Figure 8-23). The pedestrian and cyclists crossing provisions should be constructed at the time of the intersecting / side road being constructed. For side roads which are not part of the trunk network, and are hence not offsetable, this infrastructure is not included in Appendix A.

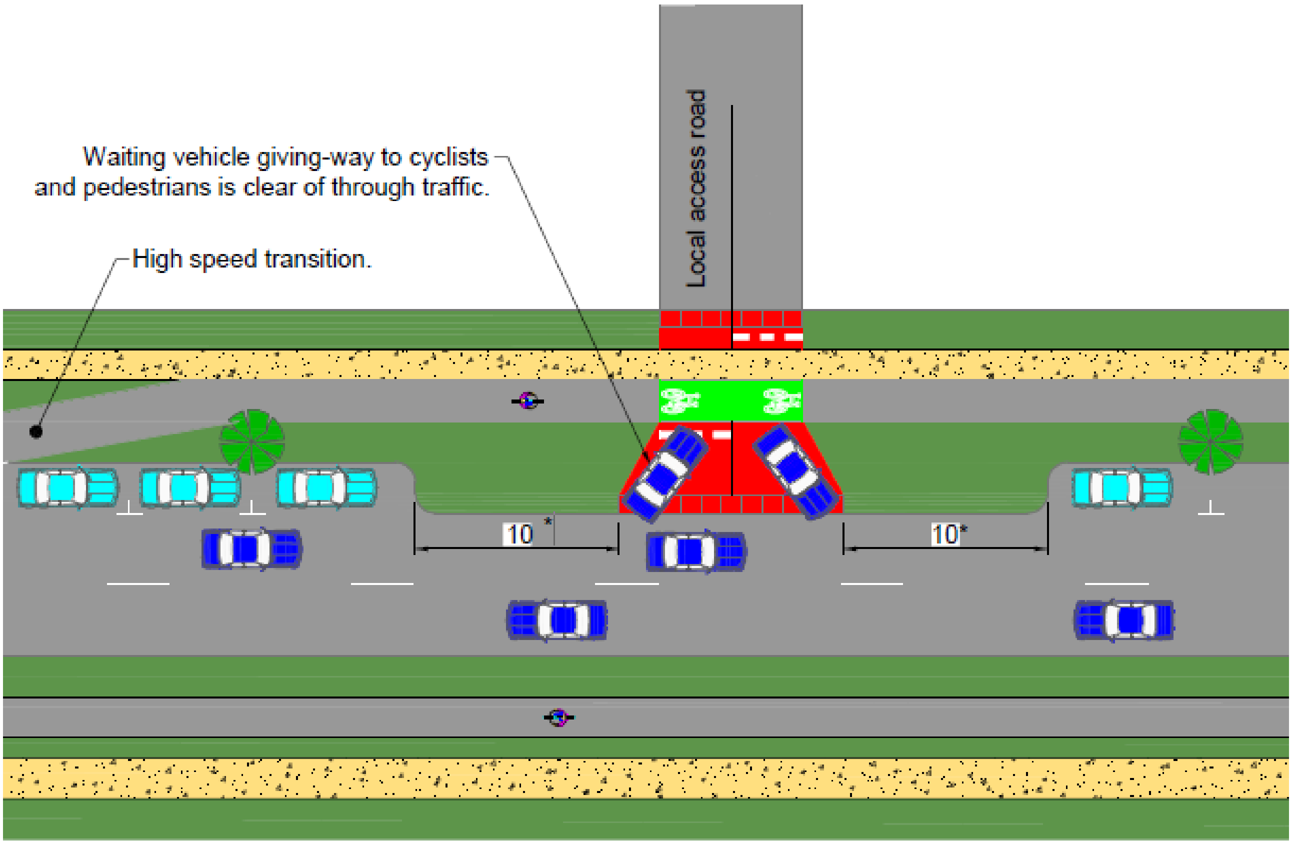


Figure 8-22 One-Way Cycle Track and Footpath at Side Road

(Figure B2.01 – Selection and Design of Cycle Tracks, TMR)

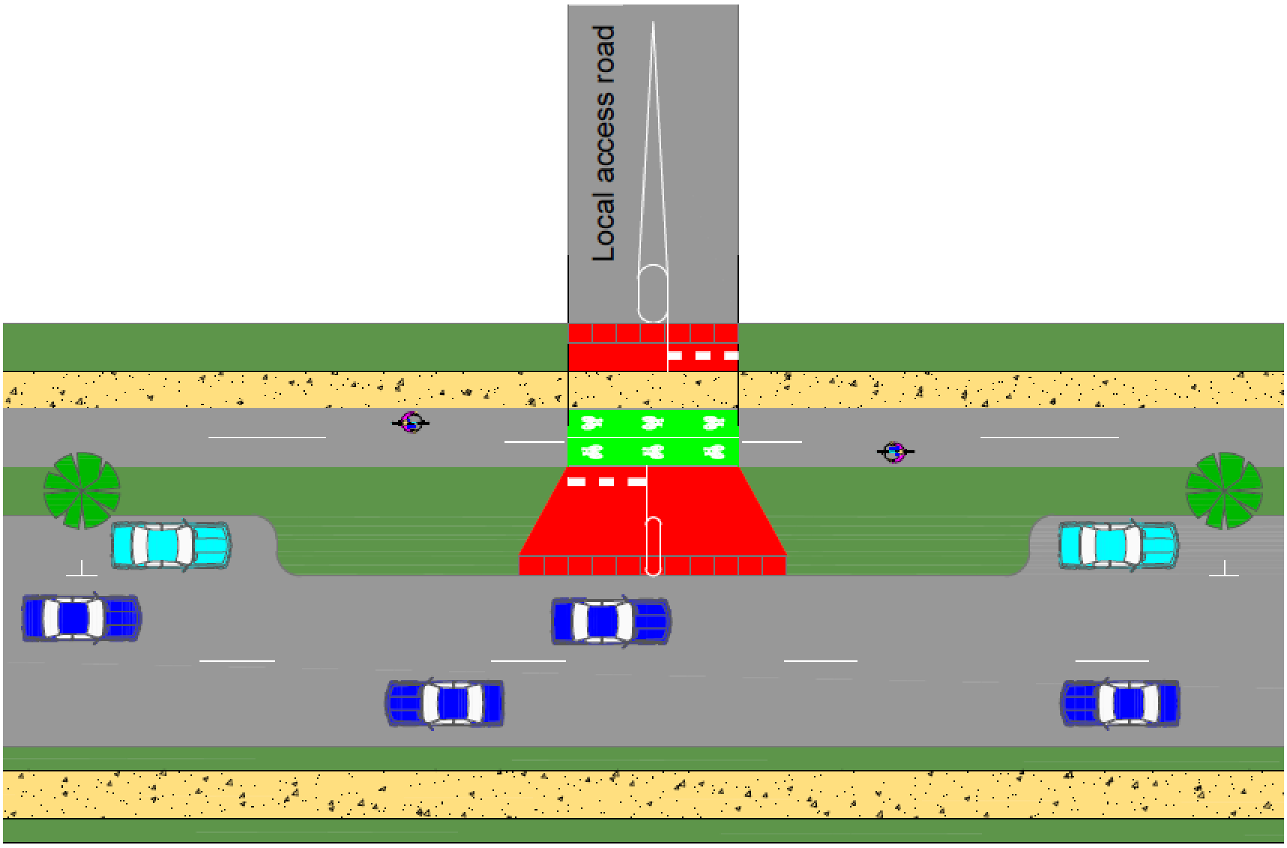


Figure 8-23 Two-Way Cycle Track and Footpath at Side Road

(Figure B2.01 – Selection and Design of Cycle Tracks, TMR)

For on-road cycle provisions at intersection, refer to Austroads Guide to Traffic Management Part 6: Intersection, Interchanges and Crossings (2017) or as summarised in Cycling Aspects of Austroads Guides, June 2017. On-road facilities are generally high stress for cyclists at roundabouts and so off-road solutions should be provided like above.

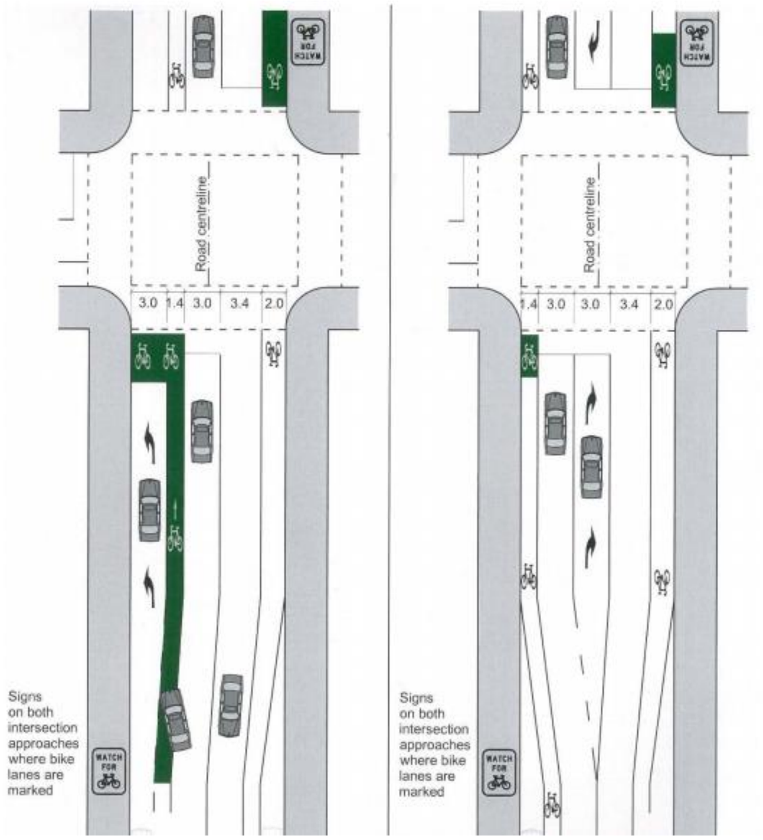


Figure 8-24 Bicycle Lane Through Signalised Intersection

(Refer to Figure 5.4 of Cycling Aspects of Austroads Guides, June 2017)

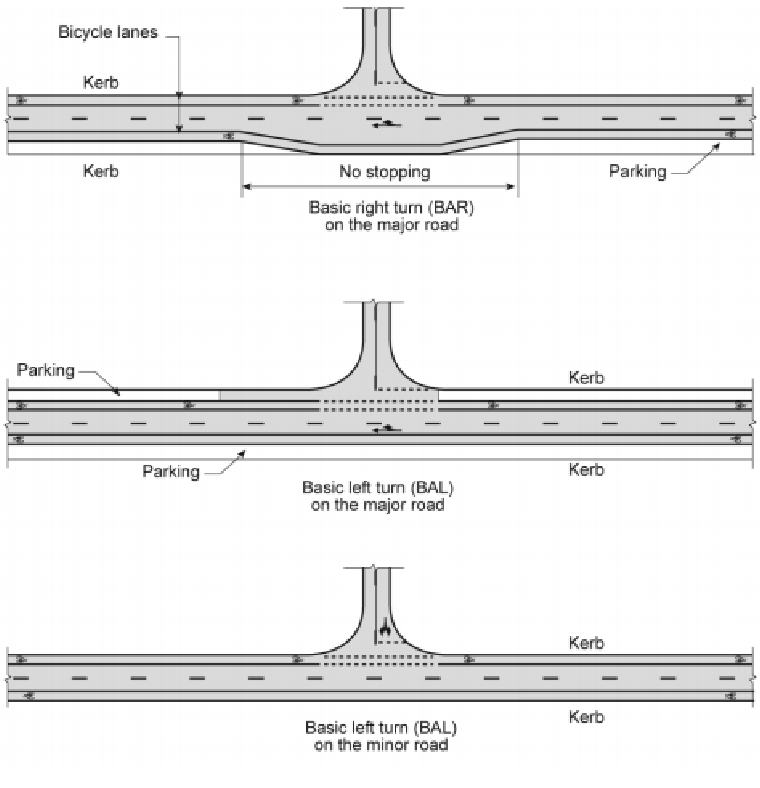


Figure 8-25 Urban Basic Intersection Turn Treatments

(Refer to Figure 5.14 of Cycling Aspects of Austroads Guides, June 2017)

8.11.3 Staging

The above cross-sections also need to consider the staging requirements for the network. Future upgrades to road infrastructure need to be considered closely to optimise the amount of land take and redundant infrastructure. For consistency and ease of construction (minimise construction disruption and lower costs), it is recommended that the active transport infrastructure be built at the time of the trunk road infrastructure. If this is built after travel behaviours of the residents are ingrained, it may be difficult to encourage a mode shift to active modes.

A network-wide approach has been undertaken for establishing the active transport network at each time horizon, so a consistent type of infrastructure is provided along each route. This is particularly relevant for Ripley Valley Road.

Cycle Track Network

With the majority of the trunk road network proposed to have cycle tracks on both sides of the road, the following methodology has been applied for when there will be an interim stage before the ultimate road is constructed (typical scenario is a two-lane road that is upgraded to four-lane road).

Interim

- **Roadside 1**:
  - 1.5m footpath (minimum)
  - 3m two-way cycle track on single side of road
  - 1.5m vegetation clearance
- **Roadside 2:**
  - No infrastructure

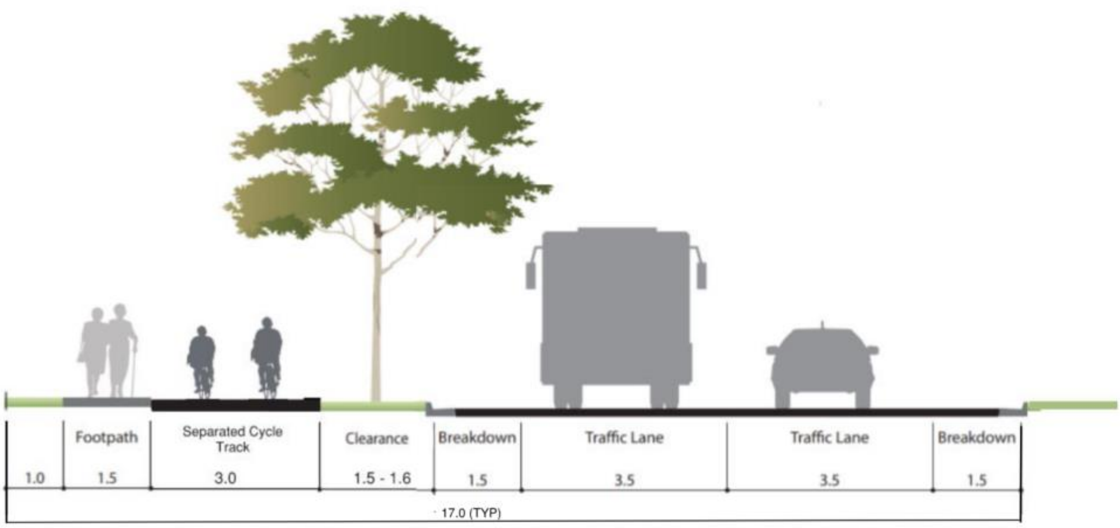


Figure 8-26 Interim Staging of Active Transport Infrastructure in Verges

Ultimate

- **Roadside 1:**
    - Interim infrastructure remains
    - Convert 3m two-way cycle track to 3m one-way cycle track. If a level edge between the footpath and cycle track is used (see Edge Treatment Method below), there may be opportunity to redistribute some of the space for pedestrians, if the pedestrian volumes are substantial (i.e. 2m one-way cycle track and 2.5m footpath).
- **Roadside 2:**
    - 1.5m footpath (minimum)
    - 2m one-way cycle track
    - 1.5m vegetation clearance

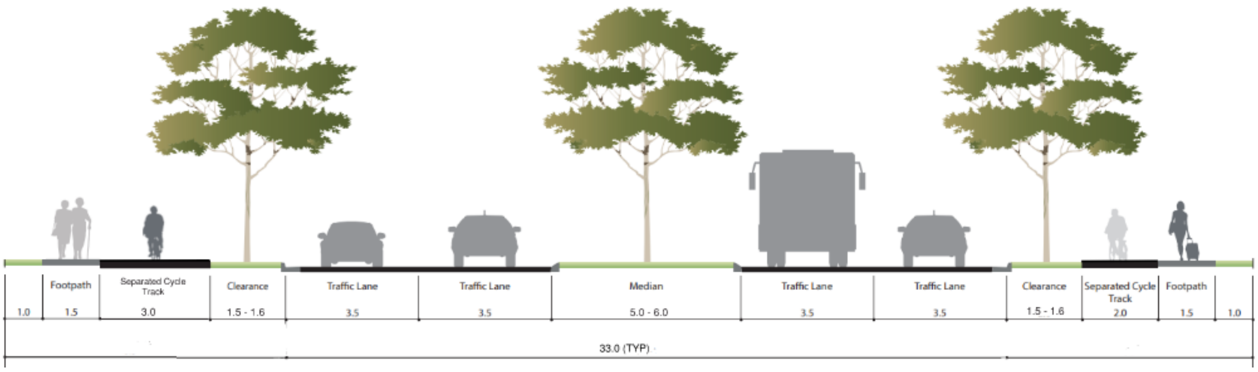


Figure 8-27 Ultimate Staging of Active Transport Infrastructure in Verges

For shared paths, it is recommended that is built in the interim on the side that will also be applicable to the ultimate stage (i.e. roadside 1 from above).

While the guideline does indicate a 2m minimum clearance for higher order roads, a 1.5m clearance was adopted for the above scenarios where cycle tracks are staged. To support this, reference has been made to the Selection and Design of Cycle Tracks Guideline (TMR, October 2019) and the clearance requirements from static objects. As shown in Table 8-4, a maximum of 1m clearance is required. In addition to this, where there is on-street parking or vehicle speeds are above 60 km/h adjacent to the cycle track, a 1.0m separator is recommended (TMR, October 2019).

Table 8-4 Clearance requirements for cycle infrastructure and static objects

Source: (TMR, October 2019)

Feature	Minimum clearance	Desirable clearance
One-way cycle track with no car parking adjacent	0 m	1.0 m desirable for arterial roads
Parked cars adjacent to one-way cycle track	0 m	0.75 m desirable
Parked cars adjacent to two-way cycle track	0 m	0.40 m desirable
Bus stop, railing, crash barrier, poles, bollards, street tree, wall or fence	Refer to Austroads *Guide to Road Design* Part 6A Section 7.7	

It has been assumed that a one-way cycle track is to be constructed along both sides of Binnies Road (to correlate with the Active Transport Plan, Arup February 2019) as part of the road construction currently underway.

The staging of the active transport infrastructure is largely to correspond with the road network. If there are locations which currently do not have appropriate active transport infrastructure, it is not the purpose of this report to address these problems. This report identifies where further infrastructure should go as part of the expansion of the area (i.e. new developments and road upgrades). However, if works happen earlier in the vicinity of these locations, then an interim should be considered.

Off-Road Shared Path

Staging for the off-road shared path has been undertaken with consideration to the timing of the surrounding trip attractors. This includes schools, parks and open space, commercial precincts and other community facilities (Urbis, May 2020). Where the time horizon does not show trips attractors which would drive the need for the section of the off-road shared path, this section has been nominated for a following period when these facilities are present. This information is outlined in Transport Infrastructure Costings Tables.

Edge Treatment Methods

With reference to the Dutch study "Road safety of curbs follow-up research" (Ministry of Infrastructure and Environment, March 2017) there are three typical treatments to consider for edge treatments. A vertical edge, a gradual edge, or no edge (i.e. no vertical difference). According to the study, it concludes that except for high vertical edges, every kerb type below is sufficient in achieving cycle and pedestrian safety, with consideration to the following.

- Vertical edge: Can create a tripping hazard for pedestrians and cyclists. Typically, not preferred for high pedestrian traffic (greater than 200 pedestrians per hour).
- Diagonal edge: must be sufficiently slanting to be forgiving (such as below 45 degrees but extra research is required to confirm precise angle).
- No edge (no vertical difference): requires a distinctive edge by means of single line marking and used of different materials to distinguish each path. Pedestrians are more likely to walk on cycle track. Signage does not contribute to more separation or safety.

It is noted that the research states that the preferred option is highly dependent on local circumstances.

As such, there appears to be merit in considering a forgiving diagonal edge (below left), or no edge with line marking and distinguishable surfacing (below right). Therefore, consider both the diagonal edge and gradual edge treatments, and the balance between the trip hazard risk vs the conflict risk. Remain up to date with the latest guidance on the matter. TMR's latest guidance has 1:8 grade across 150mm on the footpath side to minimise pedal strike and reduce trip hazards.

Figure 8-28 Diagonal edge and no edge treatment for pedestrian path/cycle track transition

8.12 **Adopted Active Transport Network**

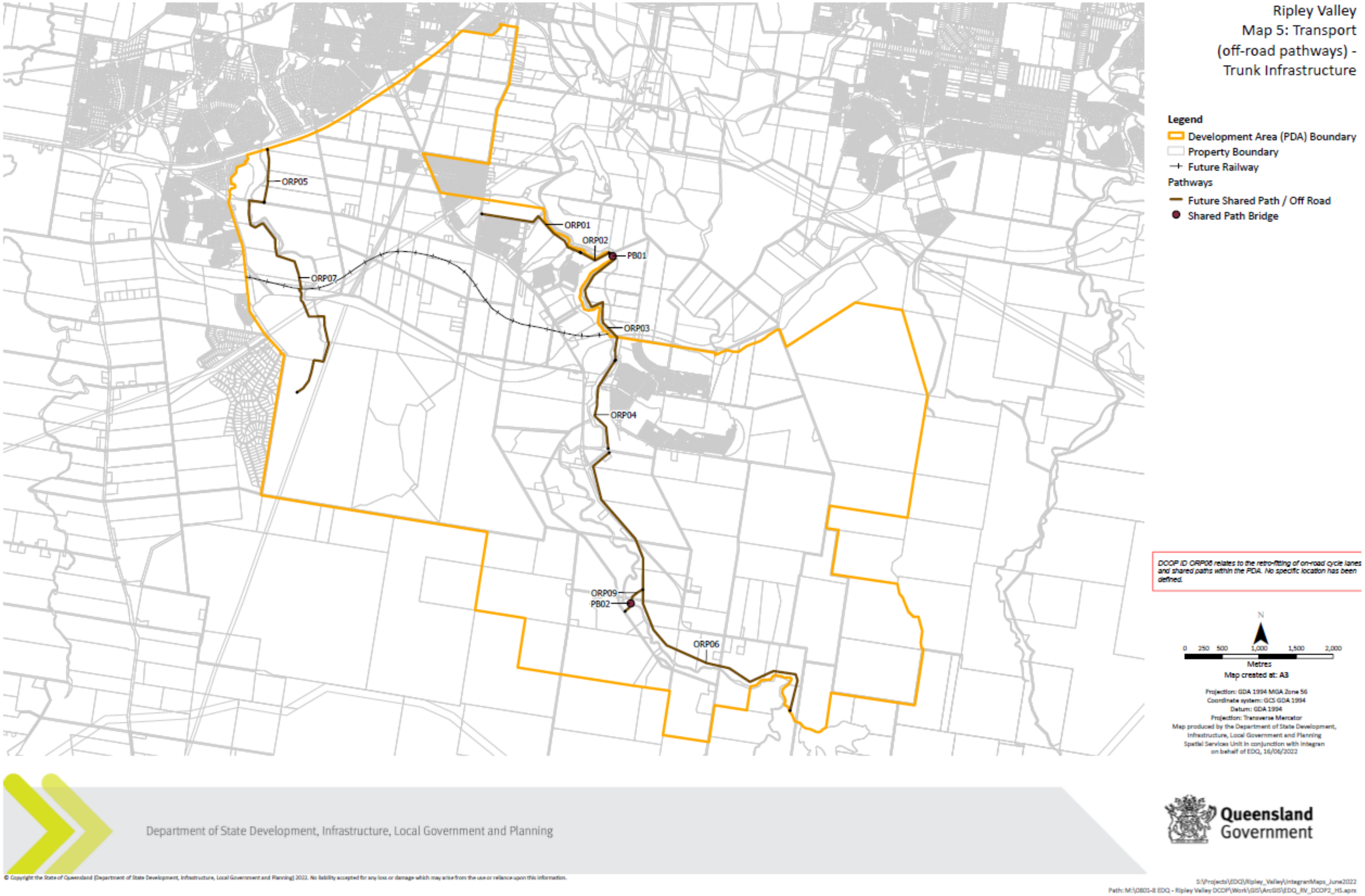


Figure 8-29: Adopted Active Transport Network

8.13 **Opinion of Cost**

Rider Levett Bucknall (RLB) were engaged to develop an opinion of the cost of active transport infrastructure to service the Ripley Valley PDA. The quantities of active transport infrastructure, which is located outside of the trunk road corridor, and instead within the PDA's linear parks were derived from the updated network plan developed as part of this study. To avoid duplication with the costing for Parks and Open Spaces, the equivalent paths lengths have been removed from the specific linear parks. Municipal costs for Ripley Valley PDA were then extracted from the RLB estimates and inserted into the Financial Offset Model per planning horizon, the summaries of which can be found within the Schedule of Works containing within the body of this Infrastructure Planning Background Report (IPBR).

9 Parks and Open Space

9.1 Introduction

A key basis for the development of the Development Charges and Offset Plan (DCOP) was a demographic study as outlined in Chapter 1. The study found:

- Ripley Valley Priority Development Area (PDA) would be fully developed by 2066, with 50,000 dwellings and 135,000 people
- This is in increase in population from the 120,000 people and 50,000 dwellings anticipated in the Ripley Valley Urban Development Area Development Scheme (the Development Scheme).

This chapter outlines the research and consultation undertaken to review the Infrastructure Charges and Offset Plan (ICOP, June 2020) Ripley Valley Priority Development Area (hereafter referred to as the ICOP) with respect to Parks and Open Space., This process involved:

- Consideration of the demand imposed by revised population projections, estimated using the Desired Standards of Service (DSS) in Economic Development Queensland's (EDQ) Park Planning and Design PDA Guideline No. 12 (referred to hereafter as Guideline 12)
- Consideration of stakeholder input, including feedback from state and local government as well as the development industry
- Consideration of emerging policy trends with respect to Parks and Open Space planning.

This chapter provides:

- A review of the amended population growth figures against Guideline 12 to identify Open Space network impacts
- Preliminary review of Guideline 12 standards through a comparative benchmarking assessment to identify which standards remain valid and which may warrant updating in the new DCOP
- Consideration of workshop and consultation feedback on current shortcomings and areas for improvement for this network
- Development of recommendations with respect to Guideline 12 benchmarks that remain valid and those that may benefit from updating
- Provision of advice on a revised Open Space Network, including sequence, innovation and cost.

9.2 Reference Standards

9.2.1 Sampling Open Space Provision

Research on emerging practice in open space provision revealed trends towards the provision of open space on qualitative, rather than quantitative, measures. This is discussed in further detail below. Therefore, acknowledging the distinction between guideline no. 12 and ICC DSS provision, a wider sample of open space provision rates from other Queensland locations was undertaken. DSS rates used included those from:

- Brisbane City Council,
- Redlands City Council,
- Sunshine Coast Regional Council,
- Logan City Council,
- Ipswich City Council,
- Moreton Bay Regional Council, and
- EDQ guideline no. 12.

Results of this comparison are summarised below in Table 9-1. While the categorisation, size and description of parks in the hierarchy did vary, it was possible to categorise parks in a manner that aligned with the Guideline 12 parks to some degree and enable an aggregate area of park provision to be calculated.

Analysis of aggregate open space provision in benchmarked DSS served to identify the relatively high provision of open space that EDQ Guideline 12 requires.

Emerging policy from other states identifying that accessibility and service provision should drive open space design, rather than quantitative provision alone. Therefore, the review started with accessibility to derive required park numbers. By considering accessibility, development constraints in the PDA and comparison with other DSS, an aggregate rate of provision of open space of 3ha/1000people was considered appropriate.

Table 9-1: DSS Comparison

Comparison DSS	Moreton Bay Regional Council	Redland City Council	Logan City Council	Ipswich City Council	Sunshine Coast Council	Brisbane City Council	EDQ Guideline 12
Aggregate area provision ha/1000popn	3.8	4.3	3.9	2.4	4	2.8	4.6

In developing recommendations, the comparison DSS parameters formed a key element of consideration to form a view on any revisions to current open space new benchmarks. Review of emerging state level policy identified that open space provision should be designed on user needs and service quality taking priority over quantitative measures. This review sought to balance this emerging practice with current policy approach by highlighting accessibility as a key driver.

9.3 Desired Standards of Service

The assessment and stakeholder discussion relating to parks and open space involved consideration of the quantity of parks and area that would be required for the projected population of 135,000 people by the DSS in guideline no. 12. considering a revised rate of overall provision. The overall rate of open space provision was split across the parks hierarchy at the same proportions as the existing EDQ Guideline 12. This quantitative analysis is provided below

Table 9-2: Desired Standards of Service (DSS)

Park Type	DCOP	
	Qty	Area (ha)
District/Major Recreation Parks		
District recreation	15	78
Town centre plaza	3	1.5
Major recreation	4	52
Sub-total	***21***	***131.5***
Sports Parks		
District sport park	11	90
Regional sport park	4	68
Sub-total	***15***	***158***
Major linear park	N/A	45
Sub-total	***N/A***	***45***
Local Parks		
Local recreation park		Not creditable
Neighbourhood recreation park	84	89.5
Local linear park	N/A	19
Sub-total	***84***	***108.5***
TOTAL	**120**	**443**

9.4 Review of Emerging Policy

Research into open space policy applicable in other states in Australia has provide further perspective on the considerations of open space provision for the DCOP. State level policy documents that were examined were published by New South Wales[4][5], Victoria[6][7] and Western

[4] *Open Space for Recreation Guide*: Government Architect NSW. Draft for Discussion.2018

[5] *Greener Places,* Government Architect NSW. Draft for Discussion

[6] *Metropolitan Open Space Network Portal*, Victorian Planning Authority

[7] *Creating liveable open space-case studies,* July 2013, Dept of Transport, Planning, and Local Infrastructure

Australia[8][9]. These policies provide guidance and frameworks for local governments and practitioners about the provision of open space networks. In summary, consistent themes included:

- A shift away from providing a specific quantum of land for open space, in the face of declining land supply and increasing density
- Indication that quantitative provision may work against opportunities for multiple use and innovative solutions
- Recommendations and policy that aims to provide an appropriate amount of open space to cater for a range of community uses
- Policy that facilitates the delivery of a network of open space types (pocket, neighbourhood, community, district, Municipal and Sub-Regional parks) that provide for a range of uses, functions and differing levels of amenity. The open space network should provide a diverse range of spaces that vary in size and function, and responds to community needs
- Consider accessibility based on quality of footpaths and presence of barriers in addition to distribution of parks spatially
- In some cases, advocating for co-locating schools with public open space, enabling joint use and shared maintenance.

Policies reviewed do provide guidance on other quantitative elements of open space, such as accessibility catchments and park size, as identified below at Table 9-3.

Table 9-3 State Policy Quantitative Characteristics

State	Accessibility catchment	Park size
Western Australia	Small Open Space: 300m Local Open Space: 400m Neighbourhood Open Space: 800m District Open Space: 2km Regional Open Space: one or more geographical/social regions. Likely to attract users from outside any one LGA	Small Open Space: <0.4ha Local Open Space: 0.4-1ha Neighbourhood Open Space: 1-5ha District Open Space: 5ha-15+ha Regional Open Space: 20ha +
New South Wales	Distance from dwellings Local open space (high density area): 200m; Local open space: 400m; District open space: 2km Regional open space: 5-10km	Local open space (high density area): as small as 0.15ha, where no more efficient provision available, or opportunities for re use of small spaces arises. Local open space: 0.3ha min; District open space: 2-5ha

[8] *Liveable Neighbourhoods,* Draft 2015, Department of Planning WA Planning Commission

[9] *Classification Framework for public open space*, 2012, Department of Sport and Recreation

State	Accessibility catchment	Park size
		Regional open space: >5ha
Victoria	Local network Pocket:200m-400m Neighbourhood: 400m Community:800m District:1200m Regional network Municipal: 0-5km Metropolitan: Up to 15km	Local network Pocket: <0.2ha Neighbourhood:0.2-1ha Community:1-5ha District:5-15ha Regional network Municipal:15-50ha Metropolitan:>50ha

This review identifies that across various policy documents, park sizes vary within a range that is generally comparable for different park types, and with which the park sizes used in guideline no. 12 are broadly consistent. An emphasis on the importance of open space provision that is tailored to the specific community is relevant and validates the consultative process undertaken to develop the benchmarks proposed

9.5 Consolidation of Existing Information

The research process included consideration of park and open space locations previously allocated in the draft ICOP, as well as locations identified in context plans and Infrastructure Master Plans in development approvals. This review process allowed an identification of park and open space locations that should be considered already allocated by developers and Ipswich City Council development assessment team, when developing DCOP network maps.

Although a review of park types and quantities in IMPs/context plans was undertaken, this was not based on a formal database, such as a formal GIS, and the assessment may have had some margin of error.

It is also noted that while existing parks and open space may exist near the Priority Development Area, these have not been considered as able to meet the demand for parks and open space imposed by development within the Priority Development Area.

9.6 Review and Comparison of Adopted Demographics

Initial investigation, prior to the engagement with stakeholders involved a preliminary comparison of current infrastructure to be provided under the ICOP, with that required by the projected population for 2066, as determined by the SGS Demographic analysis. Demographic Projection Requirements below summarises this comparison.

It should be noted EDQ guideline no. 12 was used to make these comparisons. The process of recommending park quantities, areas and locations was the result of a PDA specific benchmarking process identifying specific options for this PDA.

Table 9-4 Demographic Projection Requirements[10]

Park Type	ICOP		Projected Requirement	
	Land area (ha)	Qty	Land area (ha)	Qty
Major recreation	10	1	68-135	7
District recreation	48	13	68-135	9-11
District sport	65	13	101-162	7-14
Major sport park	70	7	68-135	5.4
Major linear	312	17	0-68	N/A
Local linear	113	17	0-108	N/A

This initial measure indicated that:

For the projected 135,000 people living in the Ripley Valley PDA, the existing ICOP may have oversupplied quantities of sport and recreational parks in the following ways:

- A greater number of District Recreation parks, but at a smaller average size, under delivering on the minimum, total area required
- A greater number of District Sport parks, but a smaller average size, under delivering on the minimum, total area required
- A greater number of Major Sport parks, but at a smaller average size
- Major recreation parks (akin to Regional Parks and Gardens) had been undersupplied
- Linear parks accounted for approximately 60% of total open space under the ICOP

9.7 Stakeholder Engagement

A key requirement of the DCOP process was collaborative engagement between EDQ and other key stakeholders. For Parks and Open Space network, key stakeholders included Ipswich City Council and development industry participants. The purpose of this engagement was to consider the needs of other parties involved in delivery of the network. In addition to ad-hoc discussions, two key workshops between EDQ and Ipswich City Council were undertaken as outlined below

- Workshop 1, 31 January 2020: A workshop to introduce findings of initial investigation of projected demand for parks and open space and comparison with the network previously anticipated.
- Workshop 2, 18 March 2020: A workshop to present recommended network changes, based on feedback from participants of Workshop 1. Feedback received included:

[10] These are requirements projected to be required based on the SGS demographic analysis. Recommendations proposed for the DCOP were derived from these projections, as well as by forming a considered view based on discussions with stakeholders and emerging policy.

- Only one 'Regional parks and gardens' typology is required,
- Town centre plazas should remain as presented in ICOP - a total of three,
- Expansion of the PDA to the east should be considered in order to provide a Major Sports Park. This would allow the PDA to overcome some constraints at the eastern margin near the town centre,
- The co-location of parks and community facilities may be acceptable, if agreements can be reached regarding management of facilities and land is available for each to meet the required DSS,
- Feedback about the extent to which local recreation parks of less than 5,000m2 and local linear parks and should be creditable, given their potential maintenance burden, and
- Ongoing engagement on the outcomes of the analysis has occurred to ensure the DCOP provisions as presented in this IPBR report are consistent with the intent of the PDA and aligned with stakeholder requirements.

9.8 Innovation by Design

Innovation by design includes approaches using proven, currently available technologies and/or construction methods to achieve innovative outcomes. These innovations currently exist within the Australian context of urban development and can be readily implemented within the Ripley Valley PDA.

Design Innovations enable new development and infrastructure in each PDA to showcase already tested innovations that are progressing to business as usual in other locations. These innovations require the development industry's desire to showcase leading design innovations as part of new urban development.

9.8.1 General Observations

Engagement with stakeholders indicated an aspiration for innovation in design across all park types and noted that the co-location, or close proximity, of parks and community facilities is acceptable when agreements regarding the management of facilities is reached. It is also noted that:

- Sharing of public open space and school facilities was identified as an emerging trend in policy,
- Stakeholders' desire to ensure that if public open space and community facilities were to share space, that appropriate facilities and area for both users is accommodated is compatible with emerging trends to provide open space in qualitative rather than quantitative ways. By carefully considering how close proximity to co-location benefits each interest, and imposes some limitations, it is necessary to take a qualitative and tailored approach, and
- Close proximity and/or co-location can inherently leverage active travel infrastructure and quality of transport routes.

9.8.2 Innovation Case Studies

The below provides a list of Design Innovations that currently exist within Australian urban communities. These innovations provide examples of locations that have implemented these innovations in place of BAU infrastructure and provide developers, landowners and local governments with on the ground outcomes that they can duplicate in the local context of Ripley Valley.

Developers are encouraged to implement one or more of the Design Innovations in consultation with EDQ and local government and help progress these innovations to business as usual.

9.8.3 Urban Water Infrastructure

'Water Squares' such as the one in Benthamian, Rotterdam, have established a new benchmark for innovation in open space design. During heavy rainfall events these squares fill up in a controlled manner, acting as water storage by collecting runoff, and preventing flooding in surrounding streets. Water then drains away into surrounding permeable surfaces or the nearby river, while during dry periods they act as a multi-purpose recreational space. The success of Rotterdam's Water Square is largely the result of the high degree of public consultation during the design phase. The outcome resulting in an attractive and innovative solution for water in a built-up urban environment.

Image sourced: Publicspace.org

Figure 9-1 Example of urban water infrastructure

Other examples of efficient water infrastructure are green roofs and multifunctional water storage carparks. They help to regulate and disperse the intensified water cycle process that is the product of highly urbanised environments. In Australia this process is referred to as, Total Water Cycle Management (TWCM) and is being implemented in areas such as Moreton Bay.

Key considerations

As the square transforms into a temporary water tank during rainfall events, appropriate safety barriers and structures need to be installed in the urban space. Information on the dual function and potential risks associated with the space during rainfall events also needs to be part of the interpretation of the space and its signage.

Implementation recommendations

High: TWCM comes in various forms from urban spaces, open spaces and streetscapes. Options for these solutions require significant engagement with local government as the ultimate owner and manager of the asset. State government subsidies, capital incentives and urban capacity limitations have proven effective in achieving adoption of water sensitive infrastructure.

Ownership and operation

As part of the public realm they are owned and managed by local governments. The Benthamian Square was a government funded project, which is managed by the local council. Opportunities exist to incorporate TWCM within urban spaces and streetscape construction by developers, however this requires asset design beyond BAU and the acceptance of all parties.

Procurement complexity

High: Installation may form part of a TWCM solution for a location or site that is constructed by a developer. Operation and ongoing maintenance would remain with local government. Subject to local government policy position and budget allocation.

Further information

- Orion Lagoon, Springfield Central: https://www.brisbanekids.com.au/orion-lagoon-robelle-domain-parklands/
- Square, Rotterdam: https://www.publicspace.org/works/-/project/h034-water-square-in-benthemplein
- Green Roof Initiative, Rotterdam: https://www.resilientrotterdam.nl/en/initiatives/green-roof-harvests-1
- TWCM, Moreton Bay: https://www.moretonbay.qld.gov.au/files/assets/public/services/publications/planning-strategies/twcm-strategy.pdf

9.8.4 Co-location of Open Space

Co-located open space that integrates schools, community facilities and or infrastructure such as wetlands/flood storage provide dual use and maximise land assets. Through co-location, or proximity, frequency of park use is increased and a reduction in land consumption is achieved. Proximity and/or co-location of open space to community facilities and services, can increase the frequency of active transport and enhance the lifestyle of the local community.

Key considerations

This approach requires acceptable agreements between local government, state government and service authorities for the management of open space assets and a shift in policy to accept shared uses and at times encumbered land (e.g. land subject to inundation). Sharing of public open space and school facilities is an emerging trend in Queensland and PDA stakeholders are keen to ensure that if open space and community facilities co-locate appropriate area for each user is accommodated. Acknowledging the focus is on providing quality open space and user experience, rather than a quantity of land. Due to the proximity or overlapping of open space requirements, co-location benefits for each interest must be protected via a tailored approach.

Image sourced: Central Road Drysdale Developer Contributions

Figure 9-2 Landscape Masterplan

Implementation recommendations

High: Opportunities for co-location and shared use facilities should be implemented across all PDA as part of an integrated planning approach. The social, environmental and economic benefits to co-located open space and facilities is widely acknowledged as a sustainable approach to urban development and growth area planning and is used broadly in other Australian states.

Ownership and operation

Public open space, infrastructure and community facilities are owned by a combination of local and state governments and service authorities. Land and developer contributions are required to ensure the provision of adequate open space based on population projections. Ownership and ongoing operational costs will remain with government.

Procurement complexity

Low: Public open space is required to support a growing community within a PDA. Opportunities to co-locate open space and facilities including infrastructure, provide numerous community benefits. Land and financial contributions will be required from developers through the DCOP.

Further information

- Central Road Drysdale Draft Developer Contributions Plan, Drysdale, Victoria: https://www.geelongaustralia.com.au/common/public/documents/amendments/8d71f19e754e98

9.8.5 Adventure Playgrounds

These facilities increase the time children spend in unstructured play outdoors and in nature. It is founded on the understanding that unstructured play outdoors - nature play - is fundamental to a full and healthy childhood.

Through co-location, or proximity, frequency of park use is increased due to the ease of use and access to these facilities.

There is a strong awareness of the benefits of children's contact with nature and it is ever growing. These benefits include:

- Developing strong connections with nature.
- Engaging and enchanting children in outdoor play for longer periods of time.
- Improving overall wellbeing.
- Developing physical literacy.
- Keeping children physically and mentally active.
- Increasing resilience.
- Building risk assessment awareness.
- Growing social and emotional capacities.
- Enabling problem solving skills to develop.

Key considerations

Many organisations are embracing the idea of developing nature play spaces within their setting. This could be in a local park, school grounds, church grounds, early childhood centre or a kindergarten, sports club or community centre.

Appropriate planning helps create cohesive and connected communities that support children's outdoor free play and independent mobility and contribute to the physical and psychological health of neighbourhoods. Good design enables safe movement through and between areas and provides varied spaces to gather, walk and play in.

Implementation recommendations

High: Opportunities for creation of Adventure Playgrounds should be implemented across all PDA as part of an integrated planning approach for other communities' outdoor facilities. The social, and environmental benefits to implementing these facilities is widely acknowledged as a sustainable approach to urban development and growth area planning

Ownership and operation

Developer contributions can be collected in areas immediately surrounding facilities to contribute to capital costs, however nexus should be clearly defined given ability of activity to draw users from a district/Sub-Regional community. Ownership remains with local government along with ongoing operational costs.

Procurement complexity

Low: Installation may form part of a district or Sub-Regional level park within a PDA subject to local government catchment requirements for recreational facilities. Construction and installation may be required by a developer or through the DCOP as part of district park facilities.

Further information

- https://www.natureplayqld.org.au/
- Example of successful implementation and development: https://www.natureplayqld.org.au/places/underwood-park

9.8.6 Smart Sports Precincts

These facilities optimise ease of use and interaction of users, ensuring that community engagement and use is increased over typical sports fields. Through co-location, or proximity, frequency of other communities' facilities use is increased

Components that differentiate Smart Sports Fields to typical Sports Fields are LED lighting combined with booking and locking systems:

- LED Lighting - Carseldine Village has installed leading edge LED lighting technologies in its parks, public areas, roads, sports fields and courts, including 14 light towers. The choice of highly efficient LED lighting will provide the local sporting clubs with substantially lower electricity costs, better lighting, and longer life luminaires.
- Smart remote lighting control - Carseldine Village has integrated eSwitch technology into The Green. eSwitch, developed by an entrepreneurial start-up business in Southeast Queensland and is quickly becoming a market leader in remote sports lighting control systems, enabling sports clubs and associations to securely, safely and sustainably control their sports field lights via their smart phones.
- Integrated booking, lighting and smart remote locks - The Green also uses the BrightSport booking app, developed by eSwitch in partnership with the Queensland Government. This system benefits the sporting clubs, facility managers and users by making the facilities more accessible, convenient to book and enables better utilization and asset management. EDQ facilitated end-to-end digital hiring system that's revolutionary. Combining smart locks, which uses Bluetooth technology, allows people to make end to end bookings through the BrightSport App. This means a user can Book, Pay and Play.

Key considerations

Many organisations are embracing the idea implementing smart technologies into sporting fields. It should also be considered that the expansion of these technologies to other services and the co-location of other community facilities within the surrounding precinct, this could be in a local park, school grounds, church grounds, early childhood centre or a kindergarten, sports club or community centre.

Appropriate planning helps create cohesive and connected communities that support children's outdoor free play and independent mobility and contribute to the physical and psychological health of neighbourhoods. Good design enables safe movement through and between areas and provides varied spaces to gather, walk and play in.

Implementation recommendations

High: Opportunities for creation of Smart Sports Precincts should be implemented across all PDA as part of an integrated planning approach into other community outdoor facilities. The social, environmental and health benefits to implementing these facilities is widely acknowledged as a sustainable approach to urban development and growth area planning

Ownership and operation

Developer contributions can be collected in areas immediately surrounding facilities to contribute to capital costs, however nexus should be clearly defined given ability of activity to draw users from a district/Sub-Regional community. Ownership remains with local government along with ongoing operational costs.

Procurement complexity

Medium: Installation may form part of a district or Sub-Regional level sport fields within a PDA subject to local government catchment requirements for recreational facilities. Construction and installation may be required by a developer or through the DCOP as part of district park facilities.

Further information

- EDQ has recently delivered the following at Carseldine Village 'The Green Sports precinct' https://www.carseldinevillage.com.au/village-information/the-green/

9.9 Sequencing Strategy (Interim and Ultimate)

Indicative sequencing of open space has been determined having regard to:

- Population projections and the timing of when population benchmarks are likely to be reached
- A balanced delivery of park typologies and uses in line with the DSS
- This ratio of delivery is often organically achieved and controlled through the context planning approval process and the construction delivery phasing determined through conditional development approvals
- The projected areas of population density and establishing what catchments within the open space network will be most utilised
- The surrounding road network, acknowledging that access to the site will need to be provided before parks can be operational
- Areas with topography restrictions and access constraints may trigger earlier, indirect park location sequencing.

9.10 Sequencing and Geographical Analysis

Parks and open space are types of infrastructure that generally reflect development of land, and therefore demand, in close sequence. Applicants provide Open Space Master Plans, with agreed rates of park provision for their development, and after that, Plans of Development that reflect these.

When acting upon approvals, the design and embellishment of a park is agreed by compliance assessment, and delivery is typically required to occur as lots are developed so that open space is provided to meet expected demand. In this way, locations and numbers of parks are confirmed by approvals, and design is confirmed post-approval.

Under more fragmented ownership, additional coordination by assessment managers will be required to ensure, conditions of approval requiring delivery of trunk parks consider demand. Co-ordination is also required to ensure that open space supply occurring in other developments is also considered.

9.11 Network Analysis and Changes

As a result of all the background research, stakeholder engagements, benchmarking, testing and alignment with approved Infrastructure Master Plans (IMPs), Table 9-5 provides the recommended network for parks and open space, specific to the Ripley PDA site. Figure 9-3 provides mapping of recommended parks and open space.

Table 9-5 Adopted Parks Under DCOP

Park type	DCOP		Difference compared to ICOP[11]	
	Qty	Area (ha)	Qty	Area (ha)
District/Major Recreation Parks				
District recreation	14	70	+1	+22
Town centre plaza	3	1.5	NA	NA
Major recreation (inc Regional Park and garden)	3	30	+2	+20
Sub-total	**20**	**101.5**	**+3**	**+42**
Sports Parks				
District sport park	11	79	-2	+14
Regional sport park	5	60	-2	-10
Sub-total	**16**	**139**	**-4**	**4**
Linear Parks				

[11] Difference highlights the proposed change relative to the draft ICOP. For example, 1 additional regional recreation park is proposed under the DCOP.

Park type	DCOP		Difference compared to ICOP[11]	
	Qty	Area (ha)	Qty	Area (ha)
Major Linear Park	N/A	54	N/A	-258
Sub-total	**N/A**	**54**	**N/A**	**-258**
Local Parks				
Local recreation park	Not creditable			
Neighbourhood recreation park	76	54	-42	+4.5
Local linear park	N/A	48	N/A	-65
Environmental / Rehabilitation / Biodiversity	N/A	232	N/A	+232
Sub-total	**76**	**334**	**-42**	**+171.5**
TOTAL	**112**	**628.5**	**-43**	**-40.5**

9.11.1 Policy Changes

Key departures from EDQ Guideline 12 include:

- Consideration of accessibility rather than a population as a driver for park quantities
- Accessibility of each park type was mapped across the PDA to derive numbers of park, considering benchmarking against other Local Government Areas and emerging policy

Park size was derived by considering the parks and areas anticipated in endorsed IMPs as well as considering benchmarking against other Local Government Areas and emerging policy

New Neighbourhood recreation parks were increased in size to 1ha.

9.11.2 Design Changes

The following principles would contribute to high quality and holistic open space outcome. Elements could be implemented regardless of the ultimate quantities and areas achievable in practice:

- Build a greater network connection of open space. Consideration of how parks fit within a greater network will increase pedestrian and environmental movements and increase efficiencies in maintenance and asset protection. This should also include Nature Play Spaces within the network of parks,
- Consider proximity of parks with schools. The efficiencies of children being able to visit parks during and outside of school hours, whether for sport or recreation reduces travel time, risks to children on streets and promotes a healthy, active lifestyle. The nearby association between schools and parks can contribute to passive surveillance and safety,

- Utilise park spaces for natural permeation. Parks and landscape are the biggest asset our urban environment has for controlling water scouring waterways, by absorption of water flows. This also provides passive irrigation of parks,
- Limiting embellishments for creditable parks. Codifying limits would ensure EDQ and Council are receiving a fair value of open space amenities and facilities for the credit amounts and minimising the maintenance burden. Codification should seek that quantity and quality of park embellishments should be commensurate with the overall size of the park, and
- Parks to follow natural features in the landscape. Identifying natural creek lines, valleys, ridges or conservation areas that may accommodate recreational parks adjacent could increase the greater value of the park space as well as create an additional buffer layer to protect the natural habitat and environment. Reduced fragmentation may benefit maintenance costs.

9.12 **Adopted Parks and Open Space Network**

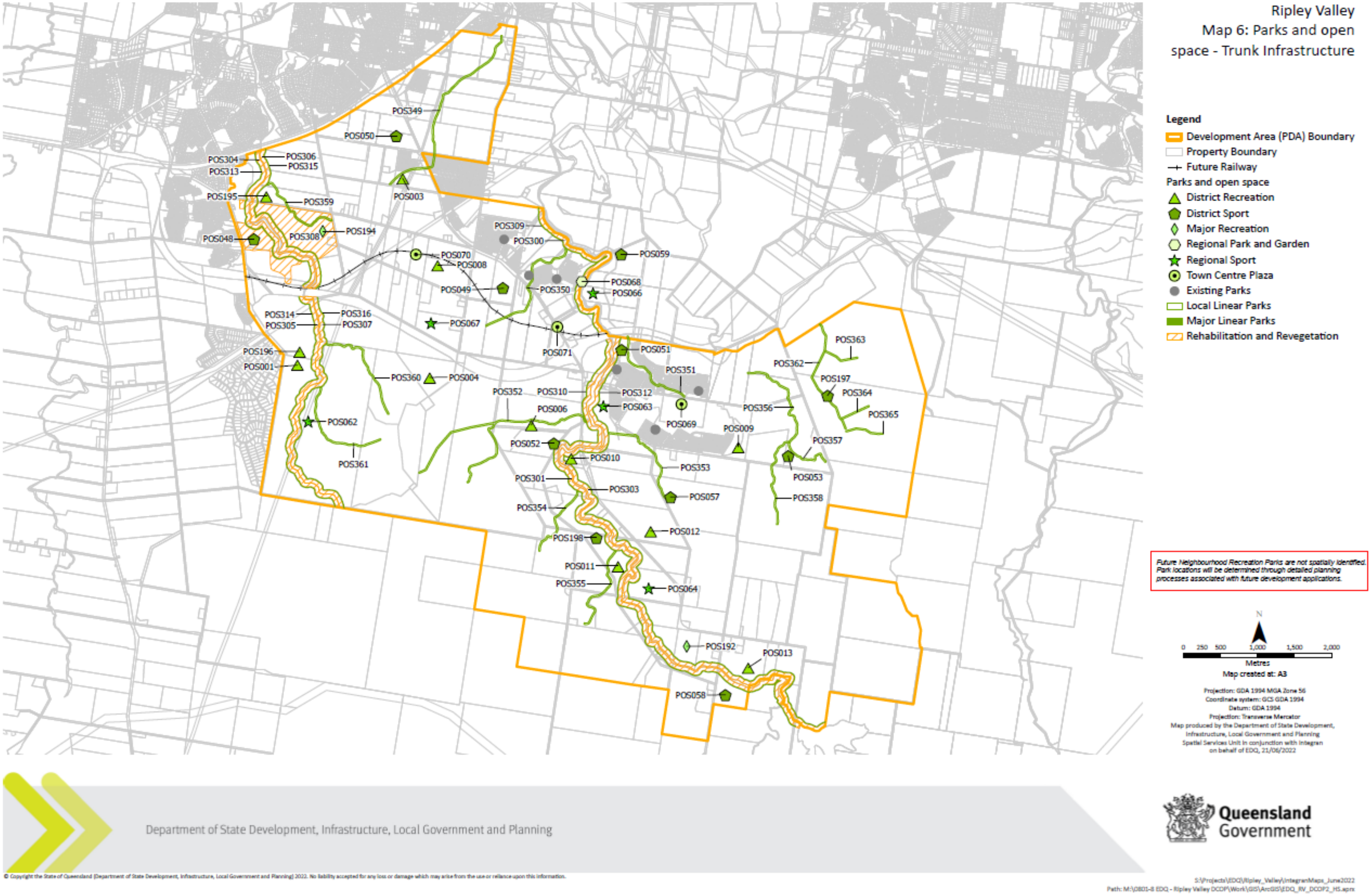


Figure 9-3 Valley PDA Parks and Open Space Network

9.13 **Opinion of Cost**

Rider Levett Bucknall (RLB) were engaged to develop an opinion of the cost of parks and open space infrastructure to service the Ripley Valley PDA. The quantities of parks and open space infrastructure were derived from the updated network plan developed as part of this study. Municipal costs for Ripley Valley PDA were then extracted from the RLB estimates and inserted into the Financial Offset Model per planning horizon, the summaries of which can be found within the Schedule of Works containing within the body of this Infrastructure Planning Background Report (IPBR).

10 Community Facilities

10.1 Introduction

A key basis for the development of the Development Charges and Offset plan (DCOP) was a demographic study outlined in Chapter 1. The study found:

- Ripley Valley would be fully developed by 2066, with 50,000 dwellings and 135,000 people
- This was in increase in population from the 120,000 people anticipated in the Ripley Valley Urban Development Area Development Scheme

This chapter outlines the research and consultation undertaken to review the Draft Infrastructure Charges and Offset Plan (ICOP) Ripley Valley Priority Development Area (hereafter referred to as the ICOP) with respect to State Community Facilities and compares that with the anticipated demands imposed by the new future population projections described above. This process involved:

- Consideration of the demand imposed by revised population projections, estimated using the Desired Standards of Service (DSS) in Economic Development Queensland's (EDQ) Community Facilities PDA Guideline No. 11 (referred to hereafter as Guideline 11)
- Consideration of stakeholder needs, including feedback from state and local government as well as the development industry
- Consideration of emerging policy trends for community facilities.

This chapter provides:

- A Review of the amended population growth figures against Guideline 11 to identify impacts on the delivery of Community Facilities in the PDA
- Preliminary review of Guideline 11 standards through a comparative benchmarking assessment to identify which standards remain valid and which may warrant updating in the new DCOP
- Consideration of workshop and consultation feedback on current shortcomings and areas for improvement for this network
- Development of recommendations, following this PDA specific assessment, with respect to Guideline 11 benchmarks that remain valid and those that may benefit from updating
- Provision of advice on a revised Community Facilities network, including sequence, innovation and cost
- Consideration of emerging policy trends.

10.2 Reference Standards

Initially, the proposed facilities within the ICOP were reviewed against the DSS outlined within section 8.9.2. The first review utilised the original population projection which was defined within the Ripley Valley Urban Development Area Development Scheme ('Development Scheme') dated October 2011.

This review outlined there is a deficit in both State and Local facilities when utilising Guideline 11 and Local Government rate of provisions for community facilities required for the projected population. Table 10-1 below shoes there is a deficit in emergency service provision (police, ambulance and fire) of approximately 3- 4 facilities across the PDA. Further, there is also a requirement to increase the number of proposed high and primary schools by approximately 5 additional schools.

Ipswich City Council is delegated by the Minister for Economic Development Queensland to assess PDA applications and enact EDQ polices and guidelines.

As such reference is made to local community facilities within Ripley Valley PDA, of which there is a deficit.

Table 10-1 Projected Facility Requirements

Community Facilities	
State Community Facilities	**QTY**
District Police Station	- 3.00
Local Police Station	- 4.00
Health Precinct	+ 0.40
Health Centre	- 2.80
Ambulance Station	- 3.80
Urban Fire and Rescue	- 3.80
State High School	- 1.25
State Primary School	- 3.67
TOTAL	**- 21.92**
Local Community Facilities	
Citywide	- 0.60
District	- 0.43
Local	- 5.00
TOTAL	**- 6.03**

This deficit was presented to required agencies through the workshopping exercise to ascertain if these numbers are reflective of the requirements for each of the service operators within the PDA. Each agency also provided further context of the quantum of facilities required to service the PDA. The result of these workshops is provided in the subsequent sections.

10.3 Desired Standards of Service

Review of the rates of provision for community facilities within the ICOP were for both for State and Local Government facilities. The Desired Standards of Service (DSS) in EDQ's Community Facilities PDA Guideline No. 11 (referred to hereafter as Guideline 11) and Ipswich City Council's DSS within the Local Government Infrastructure Plan (LGIP) were used as references for benchmarking facility requirements for the projected population of the PDA. Both guidelines were utilised as each provided rates of provision for different types of facilities i.e. Emergency services (State) and Community centre (Local Facility).

Community facilities differ from the provision of parks and open space due to the split between State provided facilities and Local Government facilities. The DSS for both State and Local Government (Ipswich City Council) is outlined in Table 10-2 and Table 10-3.

The main differences between State and Local facilities are that State facilities provide for larger community facilities which serve a large population on a large site. Local facilities are finer grain facilities which have a range of hierarchy from Local (lower order) to Metro (higher order).

Table 10-2 EDQ DSS – Guideline 11 For State Facilities

Facilities	Hierarchy of Provision	No. of Facilities (pop. Triggers)	Indicative site/ facility area
Ambulance	District – depends on a range of factors including current and projected population, planned future development, hazard and risk assessment, road network, incident profile for area.	1:25,000 Consider response time profile, case load per day, proximity to existing ambulance stations and health services.	Site: 3,000 m2
Fire & Rescue	Depends on response time and incident history, proximity to existing facilities and population forecasts.	Over 25,000 people	Site: 3,000-4,000 m2 (auxiliary station) 3,000-6,000 m2 (permanent station) 10,000-20,000 m2 (permanent with specialist facilities)
Health Care Centre	Community Health Centre	1:20,000 – 30,000	GFA: 2,000 – 4,000 m2 Site: up to 1.6 ha
	Community Care Hub	1:30,000 – 100,000	GFA: 4,000 – 8,000 m2 Site: 1.6 – 3.2 ha
	Community Care Precinct	1:100,000 – 300,000	GFA: 8,000 – 10,000 m2 Site: 3.2 – 4 ha (including parking)
Hospital – Public	Based on local planning and need analysis	Likely to serve a catchment of over 100,000 people	10-15 ha depending on level of service
Police	Main road location preferred by ingress and egress must offer left & right turns. Security important. Best location in town centre/shopping centre	1:20,000 – 30,000	Police Station Site: 4,000-5,000 m2 GFA varies according to local needs –

Facilities	Hierarchy of Provision	No. of Facilities (pop. Triggers)	Indicative site/ facility area
			shopfronts, rented space, stations
Primary School – State		1:3,000 dwellings	6.5 ha -7 ha GFA: 5,500 m2 for 625 p-7 students12
Secondary School - State		1:8,000 dwellings	12 ha GFA: 16,870 m2 for 1,500 students

Source: Community Facilities PDA Guideline No. 11, EDQ

Table 10-3 Ipswich City Council DSS for Local Facilities

Scale	Facility	Land Area
City Wide Facilities **(1:130,000 – 150,000)**	Central Library	6,900 m2
	Cultural/Performing Arts Centre	8,200 m2
	Art Galley	2,000 m2
	Multi-Purpose Meeting Space	2,500 m2
	Outdoor Space	400 m2
	Total (integrated facility)	2 ha
District Facilities **(1:30,000 – 50,000)**	Branch Library	2,100 m2
	Performance/Theatre Space (Auditorium) and General Display Area	9,550 m2
	Multi-Purpose Meeting Space	2,250 m2
	Outdoor Space	100 m2
	Total (Integrated Facility)	1.4 ha
Local Facilities **(1:10,000 – 15,000)**	Multi-Purpose Meeting Space	1,950 m2
	Outdoor Space	50 m2
	Total (Integrated Facility)	0.2 ha

Source: Ipswich City Council, LGIP Community Facilities

[12] Department of Education advice

10.4 Consolidation of Existing Information

To demonstrate the proposed ICOP facilities in the context of the surrounds of the Ripley Valley PDA, a map was (Appendix A) produced in order to represent the PDA spatially. Furthermore, to ensure accuracy, the approved context maps were overlayed with the ICOP and discrepancies were highlighted.

10.5 Other Observations

10.5.1 Rates of Provision

- Rates of provision of lesser importance for types of community facility types (i.e. provision is based on more qualitative measures and/ or response timeframes for ambulance, police and fire and rescue).
- Lesser rate of provision being applied for health, ambulance, fire and police in both Ripley Valley. In some cases this is due to existing facilities located outside of the PDA but servicing the PDA population.

10.5.2 Site Location Criteria

- Updates required to site location criteria in some cases. For example, DoE's 'Site Selection Minimum Criteria' policy document (now endorsed) should be reviewed to determine potential updates required to EDQ Guideline 13.
- Once site location criteria are further developed, it should be used in initial site selection processes (e.g. whole of PDA sieving mapping exercise using GIS analysis) to determine land suitability for certain community facility types. This could be done prior to development of an ICOP (i.e. for new PDAs).

10.5.3 Site Standards

- Minimum site area requirements may not reflect contemporary models of delivery, or the classification of facilities used by relevant agency. The classification of health facilities used by EDQ and QH currently do not align (for example, QH does not use the term 'health precinct'), and
- Further guidance from agencies would be beneficial around when a reduced site allocation and colocation opportunities may be considered. There is a concern that acceptance of lesser site areas can establish a precedent that other developers will seek to follow.

10.5.4 Timing of Provision

- The timing of provision is important to ensure facilities are provided in line with population growth. The actual timing of the land dedication will be based on a demand threshold being reached as reviewed within the 5 yearly DCOP updates, and

- The experience of QAS, as expressed by QAS at the State Agency workshops, is that it has been difficult to secure sites that can be delivered within the required timeframe. Consequently, QAS has needed to purchase its own sites to service Ripley Valley and not utilize the ICOP allocated site

10.6 Stakeholder Engagement

A number of workshops were held to ensure key agencies and Ipswich City Council were able to provide feedback to the ICOP, the updated demographics and any shortfalls or oversupply for each facility type.

The phases of engagement are outlined as follow:

- **Review Phase** – Within this phase, an overview was provided of the DSS based on Guideline 11 for State facilities and the Local Government Infrastructure Strategy for local facilities (which has been provided in the previous sections of this report). This initial review phase involved several meetings with EDQ and CHaPs representatives leading up to a workshop held on 30 January 2020 with State Agency representatives. During this phase of work, each department was given the opportunity to comment on the original ICOP allocations and the analysis undertaken to compare these allocations with Guideline 11 DSS rate of provision for state facilities.
- **Analysis Phase** – Once each respective agency was given the chance to comment on the review of the DSS rate of provision, mapping was produced displaying the facilities outlined in the ICOP compared against any approvals that included allocations for State facilities. Further a review was undertaken of the adopted DCOP demographic data and the DSS applied to the updated population projections. These figures are outlined above. Additional meetings were held separately with Community Hubs and Partnerships (CHaPs), EDQ and various State Agencies as required over February to further understand their requirements. The feedback obtained from this round of engagement is outlined in Table 10-4 below.
- **Preliminary Recommendations** - After feedback was obtained, recommendations were proposed and then subsequently reviewed by each department at a two-hour workshop held on 24 March 2020.

Feedback received has been broken up by each agency and provide in the Table 10-4 below and outlines the requirements for the PDA identified by each relevant agency.

Table 10-4 Feedback by Each Agency

	Queensland Health (West Moreton Health)
	• 3 x Community Health Facilities are required
	  ○ By 2032 – HE001 health centre: 3.2ha site – opportunity for co-located aged care/integrated with NGO is desirable: expansion to 3.8ha is to be considered; Location TBC
	  ○ By 2024 – HE002 health centre: 3.2ha site negotiated to 2.7ha with developer. Future stages including residential care. Location within Oaklands/AMEX
	  ○ New site required – 3.2 ha in north/north-west of PDA, not currently in ICOP
	• 1 x Health Precinct is required

	o By 2030 – HE003 Health Precinct – 4ha site anticipated by masterplan, but not agreement.
	Emergency Services & Ambulance • Predictions have been made on moving existing the Ipswich Station to Ripley 2022/3 • QAS recently purchased land at 399 Ripley Road to service PDA – site will however struggle to accommodate ultimate resourcing in single storey – will trigger multi-storey building • PDA allocated land will fall short – a larger site or two separate sites should be considered • Two locations should be considered: o 399 Ripley Valley Road – existing purchased land - stage 1 required 2022/3, stage 2 +5-10 years o Second to north of South Ripley on proposed gifted lade (ICOP) – stage 1 2027/8, final stage TBC. Depending on size of above, may require larger site.
	Fire Services • Area serviced by Ripley Fire and Rescue Station, 350 Ripley Road, Ripley • The allocation of 4000sqm in the PDA should be retained for a 2nd QFES station in the PDA • Currently Ripley Fire and Rescue Station supported by surrounding auxiliary and rural fire stations. Any future growth would require assessment of these existing facilities including their upgrade/replacement.
	Police • 1 district police station (2 street frontages, minimum 40m, 1ha site area) is required • 2 smaller stations (potentially police beats, 3,000sqm site area each) • Stations outside the PDA – QPS/PSBA currently negotiating with a developer for land for a district police station to replace Yamanto Police Station, with scope for Ripley policing division • Timing for land release for station sites in the PDA cannot be determined as demographics and social factors still developing • QPS open to shared sites with other appropriate services.

	Education - Department of Education (DoE)
	• Primary Schools:
	  ○ Current allocated School sites to be delivered by 2026 – 4
	  ○ Additional School sites required by 2031 – 5
	  ○ Additional School sites required by 2041 – 3
	  ○ Future School sites required after 2041 - 6
	• Secondary Schools
	  ○ Current allocated School sites to be delivered by 2026 – 1
	  ○ Additional School sites required by 2031 – 1
	  ○ Additional School sites required by 2041 - 2
	  ○ Future School sites required after 2041 - 3

	Neighbourhood Centres - Department of Communities, Disability Services and Seniors (DCDSS) • Short term (this financial year) – 1 x neighbourhood centre (site area 2,500sqm); could be co-located with a primary school (subject to negotiation with DoE) (removed as understood this is no longer an option) • Long term (20 years) – 1 x neighbourhood centre (site area 2,5000sqm).

	Local Government – Ipswich City Council (ICC)
	• The DCOP is to consider the current and expected community facilities network across the entire Ipswich LGA to ensure there is equitability
	• ICC expressed a view that there is an oversupply of community facilities planned under the ICOP (i.e. the ICOP provision is higher than the ICC rate of provision)
	• Colocation is supported based on 2 criteria
	  ○ The facility co-location results in improved synergy of facility uses
	  ○ Agencies involved can make early agreements that clearly outlines and supports equitable and adequate uses that benefit the community.

Source: Stakeholder Workshop 2019/20

10.7 Innovation by Design

Innovation by design includes approaches using proven, currently available technologies and/or construction methods to achieve innovative outcomes. These innovations currently exist within the Australian context of urban development and can be readily implemented within the Ripley Valley PDA.

Design Innovations enable new development and infrastructure in each PDA to showcase already tested innovations that are progressing to business as usual in other locations. These innovations require the development industry’s desire to showcase leading design innovations as part of new urban development.

10.7.1 Best Practices

Research into best practices for Innovation by Design outcomes has outlined the following principles:

Fit for Purpose

- Type of service delivery and function are of critical importance
- Land location, size and other key attributes are to be considered early for land suitability

Land Efficiencies

- Land allocation is to be undertaken early acknowledging high demand and competition for sites
- Alternative designs and models of delivery should be considered including integrated facilities (discussed further at point 4) and vertical models for facilities such as schools. However, DoE has noted that vertical state primary and secondary schools will only be considered on a case-by-case basis and confirmed through a master-planning process.

Timely Provision

- Provision of facilities to align with population growth and demand
- Undertake needs assessment planning early as to accommodate planning and development lead time.

Continuum of Integrated Service Delivery (see Figure 10-1 below)

- The integrated service delivery model recognises the benefits and efficiencies (from both the customer and the service delivery perspectives) to be gained from integrated rather than separated service delivery
- Integrated service delivery can range from a 'co-location' model through to an 'integration' model as depicted in Figure 10-1
- It involves:
  - Multiple service agencies providing coordinated support services
  - Services are delivered through shared facilities and community hubs (not stand-alone facilities).

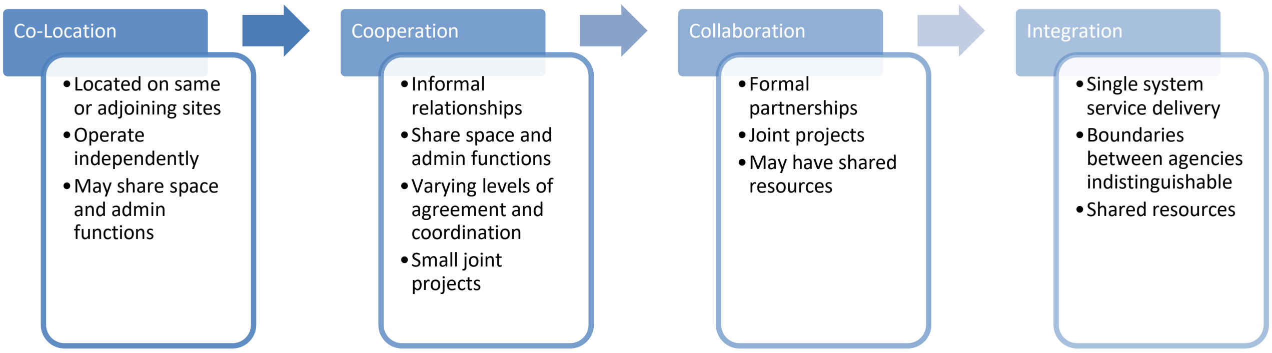


Figure 10-1 Integrated Service Delivery
Source: Urbis, 2020

10.7.2 Guiding Principles

Considerations relating to the built form of community facilities

Co-Location – more than one facility on the same or adjoining sites

- State high schools and primary schools, although DoE note that due to operational reasons, it is not the preferred approach to provide P-12 campus models, with focus and intention to continue providing separate schools or to current policy,
- State schools with general community facilities (e.g. community centres),
- States schools with sporting fields and open space,
- Health facilities and ambulance stations,
- Ambulance with a range of other community facility types (not just health and emergency services),
- Police stations with fire and rescue stations, and
- Community facilities within retail precincts (Yarrabilba Hive example).

Shared Use – multiple agencies or groups using a single facility

- Community use of school facilities,
- School use of community facilities (incl performance spaces, sporting grounds, parks), and
- Shared car parking (e.g. schools and sporting fields).

Community Hubs – a collection of facilities clustered together on the same or adjoining sites as a focal point of programs or activities around a common focus or

- an arts and entertainment precinct or education and technology precinct
- Schools located near higher education and vocational education facilities would be an example of this

10.7.3 Case Studies

The below provides a list of Design Innovations that currently exist within Australian urban communities. These innovations provide examples of locations that have implemented these innovations in place of BAU infrastructure and provide developers, landowners and local governments with on the ground outcomes that they can duplicate in the local context of Ripley Valley.

Developers are encouraged to implement one or more of the Design Innovations in consultation with EDQ and local government and help progress these innovations to business as usual.

Co-locating of community facilities

Image sourced: Cox Architecture

Figure 10-2 Victorian Cricket and Community Centre

Integrated community facilities play a critical role in supporting healthy communities, enhancing wellbeing, building networks and providing a resource for training, employment and personal development. Activities supported by shared facilities are wide ranging and can consist of more than one facility on the same or adjoining sites. These facilities can include neighbourhood houses, community centres, youth groups, public meeting spaces, performance spaces, emergency services, community health services, libraries, schools and recreational facilities. Services are delivered through Shared use (multiple agencies or groups using a single facility), Community hubs (a collection of facilities on the same or adjoining sites around a common focus of programs or activities, e.g. arts or education precincts) or Co-location on a single site to share external facilities such as carparking, access arrangements and infrastructure.

Key considerations

The function and form of service delivery are of vital importance to co-location as land size and location are key attributes in the integrated planning process. Land allocation for government services such as schools, pre-school and Maternal and Child Health need to be undertaken early to ensure early access for a growing community, when site competition is paramount.

Alternative designs and delivery models should be considered that respond to population growth and demand. Needs assessment planning that incorporates surrounding facilities to a PDA must take place early to accommodate opportunities for co-location with existing and future facilities.

Governing shared community facilities and integrated services can be challenging often requiring different management strategies from those traditionally used. Successful management and coordination of these complex arrangements requires good governance, and clearly defined documentation, as multiple service agencies can provide coordinated support services when the governance system is appropriate.

Implementation recommendations

High: Opportunities for co-location and shared use facilities should be implemented across all PDA in association with current needs assessment for adjoining and adjacent suburbs. Easy access to shared and/or co-located facilities reduces land consumption, construction costs, asset management, resource allocation and vehicle trip generation. It encourages walkability, social networks, supports mental health and wellbeing and retail/commercial services, where facilities are grouped with neighbourhood or activity centres. Upgrades to existing facilities that may be adjoining a PDA also provides land and resource efficiency while connecting new and established communities and networks across suburbs.

Ownership and operation

Community hubs, libraries, recreational centres, health services, schools and emergency services are all provided and owned by a combination of local and state government authorities. Developer contributions can be collected to contribute to the provision of these services' capital costs based on population projections. However, nexus should be clearly defined given some large integrated facilities will provide services that draw users from a district or Sub-Regional community. Ownership will remain with government along with ongoing operational costs.

Procurement complexity

Low: Community facilities are required to support a growing community within a PDA. Opportunities to co-locate or share facilities provide numerous land and construction cost savings, as well as significant community benefits in the form of social connections, community interactions and local employment. Financial contributions may be required by a developer through the DCOP. Approximate capital cost for Yarrabilba Hive was $3.6million.

Further information

- Yarrabilba Hive, Queensland: https://www.statedevelopment.qld.gov.au/projects/chaps/facilitating-projects
- Victorian Cricket and Community Centre, Melbourne: https://www.coxarchitecture.com.au/project/victorian-cricket-and-community-centre/

10.8 Review and Comparison of Adopted Demographics

To summarise, the previous sections have outlined a review of State and Local DSS with the population forecasted in the Development Scheme. This review outlined there is a deficit in the provision of State Facilities namely emergency services (ambulatory and police) and State Schools (primary and high schools).

Following on from this, a review of approved Context Maps and existing facilities was conducted to provide accuracy in the adopted mapping.

SGS Economics and Planning reviewed the demographics of Ripley Valley PDA which included updated developer dwellings forecasts. Table 10-5 illustrates the original population projection compared to the adopted DCOP demographic analysis.

Table 10-5 Comparison of Recent Population Projections with Original Assumptions

	Development Scheme October, 2011	SGS Demographic Analysis
	Ripley Valley PDA Population 120,000	Ripley Valley PDA Population 135,000
	Total Dwellings 50,000	Total Dwellings 50,000
	Average Person per Household 2.4	Average Person per Household 2.7

The adopted demographic figures were reviewed against EDQ Guideline 11 DSS and the impacts have been summarised in Figure 10-3 below. The analysis shows the increase in population projections results in an additional shortfall of facilities for the Ripley Valley PDA. Primary and Secondary Schools are in further shortfall due to the increase of total number dwellings in the PDA. As noted earlier, a shortfall in some facility types existed under the ICOP, therefore, the shortfall indicated in Figure 10-3 below is not solely a result of the increase in population forecasts.

In relation to future trends for service delivery, these are described at section 8.9.6 and 8.9.10.1.

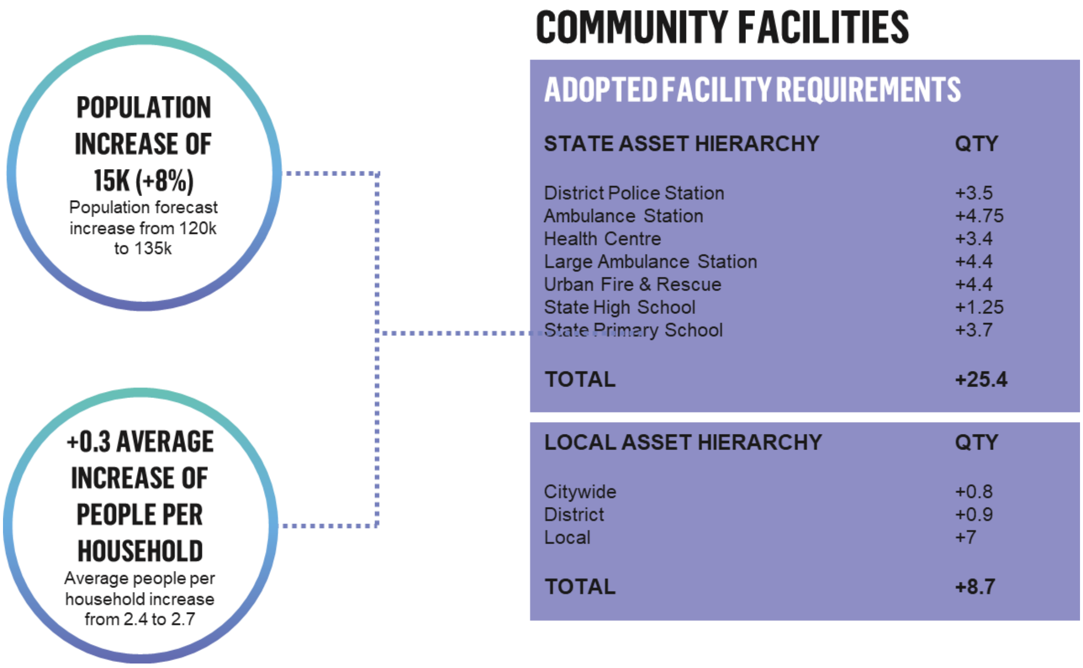


Figure 10-3 Ripley Valley Demographic Analysis

Source: SGS, Jan 2020 & EDQ, May 2015

10.9 Sequencing Strategy (Interim and Ultimate)

Indicative sequencing for community facilities has been determined having to:

- Population projections and the timing for when population benchmarks are likely to be reached (NB: this is only relevant where the recommended provision is consistent with the DSS rate of provision)
- Feedback from State Agencies regarding when the need for a facility is likely to occur
- The surrounding road network, acknowledging that access to the site will need to be provided before a facility can commence operation.

In some instances, sequencing has not been assigned to community facilities. This has occurred where:

- The PDA planning horizon (2066) is substantially longer than the responsible State Agency's planning horizon, which in some instances does not extend beyond a 10-year timeframe, and as a result, the State Agency was unable to provide an indication of timing
- The relevant DSS rate of provision was not adopted for the community facility based on the State Agency advice.

Where the DSS rate of provision for a facility is not adopted for the PDA, the State Agency feedback is considered the most authoritative source of information in relation to infrastructure sequencing.

In instances where the State Agency indicated a sequencing that does not align to the sequencing years being used by EDQ (i.e. 2026, 2031, 2036, 2041 etc), the sequencing has been brought forward to the nearest EDQ timeframe. For example, if the State Agency indicated a facility is required by 2038, for the purpose of the DCOP the sequencing is indicated as 2036. This approach was used to avoid lags in infrastructure provision if a later timeframe is adopted.

10.10 Sequencing and Geographical Analysis

Research and experience relating the delivery model of community facilities has outlined facilities usually come online as the population grows. Due to this model, population growth may arrive at a 'critical' point before some facilities are delivered, as such there is a lag in delivery and population.

As each agency reviews their own networks, population projections and service delivery may not match the delivery program of the state agency.

Agencies are then required to negotiate separately with developers and acquire additional land to push forward service delivery. These sites which are provided to agencies can be unsuitable for several reasons including size, typography or accessibility.

For facilities which have not been allocated, further investigations will be required as a part of the DCOP.

Schools are an exception to this timing; these are allocated based on the roll out of trunk infrastructure such as road networks. Additionally, workshops held with EDQ, and stakeholders identified shortfalls in school provision independent of the DSS and Guideline 11 requirements. Information on factors such as future catchments, population growth and topography were used to inform potential additional school locations for the DCOP. These are identified in Section 10.12.

Identification of timing is primarily based on assumed road sequencing. It is acknowledged that in practice during the early phases of development a slower rate of population growth typically occurs which accelerates in the later life of a new community. Accordingly, school provision and timing can similarly align with this ramp up in line with future population. Such an approach represents a prudent balance and there may be future opportunities to accelerate delivery of schools over the longer term. The delivery of schools in the early years of the new communities should ultimately align with areas of greatest need, and service a wider area as population density across the PDA increases.

10.11 Network Analysis and Timeframes

Through the investigation of spatial data and feedback received from the key agencies, the adopted network has been consolidated in the Table 10-6 below.

Table 10-6 Consolidated Recommendation

	Queensland Health (West Moreton Health) • 2024 – retain ICOP allocated HE002 health centre (2.7ha) • 2030 – retain ICOP allocated HE003 health precinct (4ha) • 2032 – retain ICOP allocated HE001 health centre (3.2ha) • 2036 – additional health centre identified in the north / northwest (3.2ha) NB: ICC would be interested in investigating opportunities to co-locate health services and local community facilities.

	Emergency Services & Ambulance
	• Site 1
	  o 2022/23 – Site purchased by QAS at 399 Ripley Road, Ripley (stage 1)
	  o 2027/32 – Site purchased by QAS at 399 Ripley Road, Ripley (stage 2)
	• Sites 2 and 3
	  o 2027/28 - ICOP allocation AM001 (0.6ha)
	  o Timing unknown - Additional site in a location towards the southern part of the PDA. QAS had previously suggested somewhere near CF018.
	NB: It is critical that sites can be delivered within the timeframes specified. If not, alternative locations need to be sought.

	Fire Services • Site 1 - ICOP allocation FR001 (0.6ha) constructed and operational • Site 2 - Additional station to service the south.
	Police • Based on the DSS and advice from QPS, the ICOP allocation of 1 x district police station appears adequate. QPS has not requested any additional facilities to meet updated population projections.

	Education - Department of Education (DoE)
	• Based on consideration of accessibility via projected road networks, initial sequencing appears to be logical as follows, noting more factors may be considered for detailed sequencing:
	  o 4 primary schools and 1 secondary school to be delivered by 2026 (excluding the existing site),
	  o 5 primary schools and 1 secondary school to be delivered by 2031,
	  o 3 primary schools and 2 secondary school to be delivered by 2041, and
	  o 4 primary schools and 3 secondary schools to be delivered after 2041.

Neighbourhood Centres - Department of Communities, Disability Services and Seniors (DCDSS)

- Potential to locate with:
    - District community centres at CF002 and/or CF003 (for discussion with ICC).
    - The existing co-located primary school (CF010) and high school (CF010) within Providence development (Okeland landholding) (for discussion with DoE).

Local Government – Ipswich City Council (ICC)

- The review is to consider the current and expected community facilities network across the entire Ipswich LGA to ensure there is equitability
- There is a current view there is an oversupply of community facilities
- Colocation is supported based on two criteria
- The facility co-location results in improved synergy of facility uses; and
- Agencies involved can make early agreements that clearly outlines and supports equitable and adequate uses that benefit the community.

Source: Stakeholder Workshop 2019/20, Urbis 2020

Table 10-7 Community Facilities Proposed Infrastructure

Year	Facility	Agency
2021 - 2026	AM001 - Site 1, 399 Ripley Rd, Ripley. Stage 1	Queensland Ambulance Service
	HE002	Queensland Health
	PO002	Queensland Police Service
	CF001	Department of Education-primary school
	CF002	Department of Education-primary school
	CF008	Department of Education-primary school
2026 - 2031	AM001 - Site 1, 399 Ripley Rd, Ripley. Stage 2	Queensland Ambulance Service
	AM002	Queensland Ambulance Service
	HE003	Queensland Health
	PO003	Queensland Police Service

	CF004	Department of Education-primary school
	CF005	Department of Education-primary school
	CF006	Department of Education-primary school
	CF009	Department of Education-primary school
	CF011	Department of Education-primary school
	CF014	Department of Education-secondary school
2031 - 2041	AM003	Queensland Ambulance Service
	FR002	Fire and Rescue
	HE001	Queensland Health
	HE004	Queensland Health
	PO001	Queensland Police Service
	CF003	Department of Education-primary school
	CF012	Department of Education-primary school
	CF013	Department of Education-primary school
	CF015	Department of Education-secondary school
	CF016	Department of Education-secondary school
EXISTING FACILITIES	CF010	Department of Education-primary school
	CF017	Department of Education-secondary school
	FR001	Queensland Fire and Emergency Service
Post 2041	CF007	Department of Education-primary school

	APS01	Department of Education-primary school
	APS02	Department of Education-primary school
	APS03	Department of Education-primary school
	APS04	Department of Education-primary school
	APS05	Department of Education-primary school
	CF018	Department of Education-secondary school
	AHS01	Department of Education-secondary school
	AHS02	Department of Education-secondary school

10.12 Adopted Community Facilities Networks

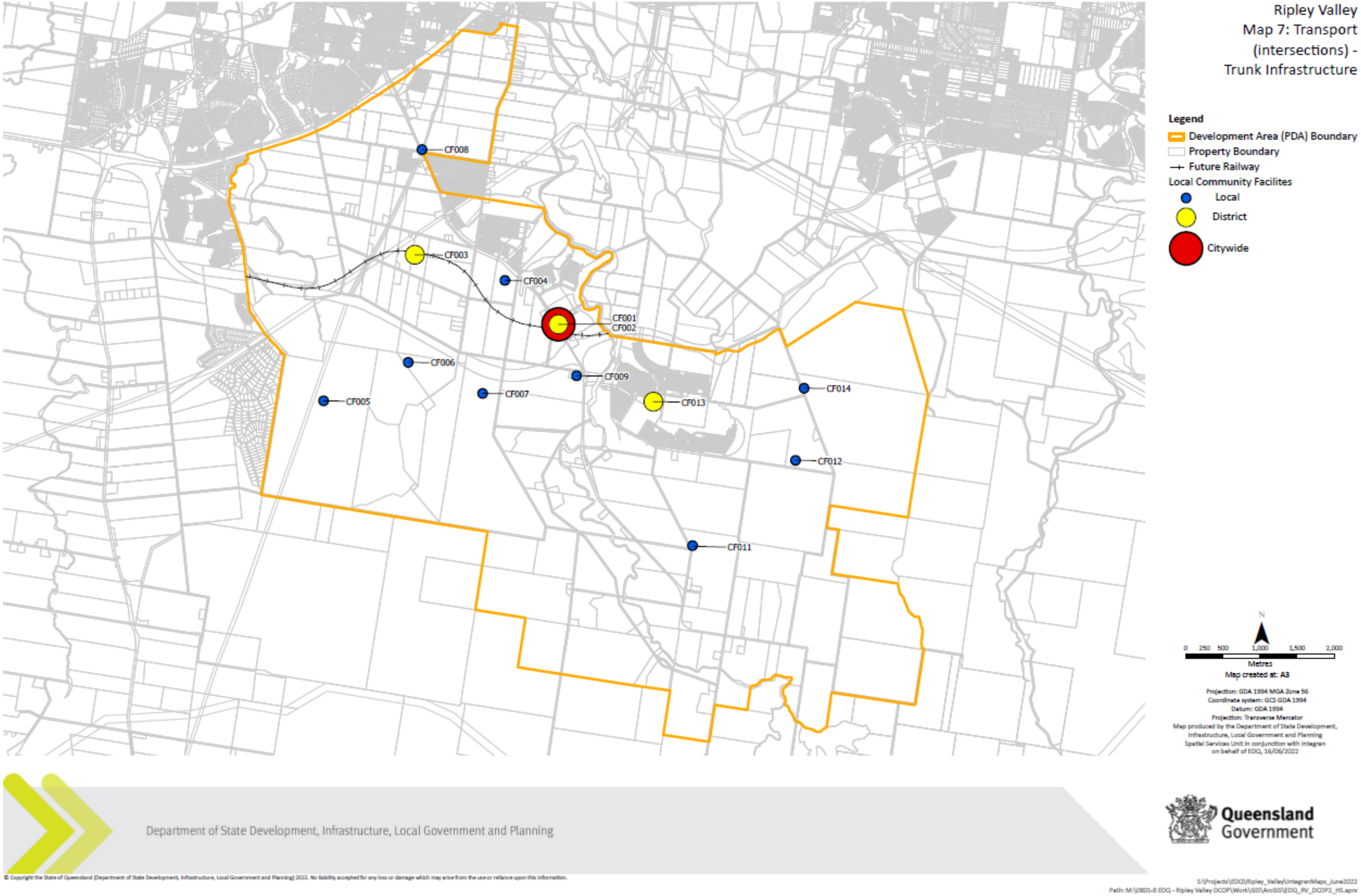


Figure 10-4 Ripley Valley PDA Adopted Local Community Facilities

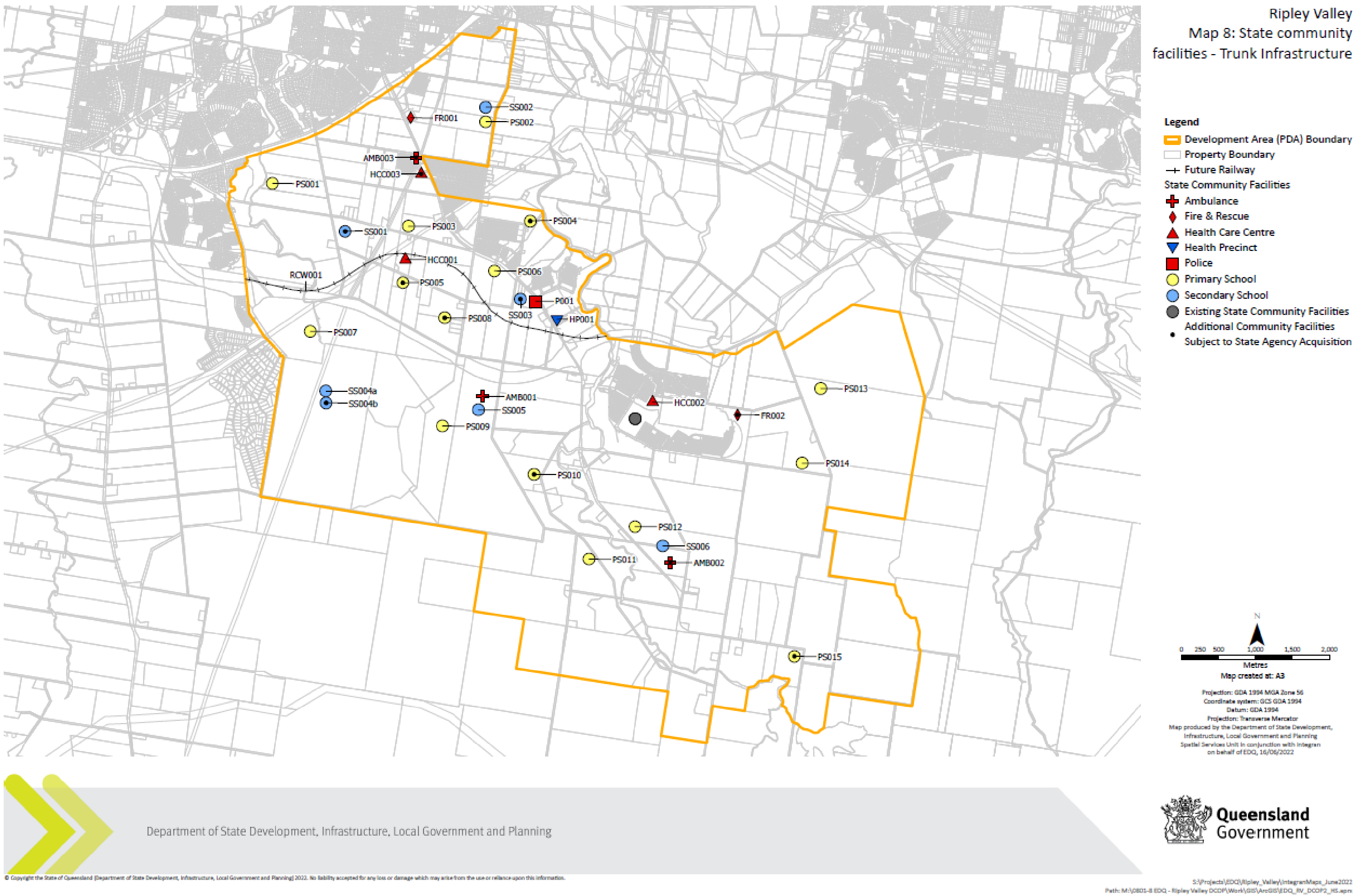


Figure 10-5 Ripley Valley PDA Adopted State Community Facilities

10.13 Opinion of Cost

Rider Levett Bucknall (RLB) were engaged to develop an opinion of the cost of community facilities infrastructure to service the Ripley Valley PDA. The quantities of community facilities infrastructure were derived from the updated network plan developed as part of this study. Municipal costs for Ripley Valley PDA were then extracted from the RLB estimates and inserted into the Financial Offset Model per planning horizon, the summaries of which can be found within the Schedule of Works containing within the body of this Infrastructure Planning Background Report (IPBR).

11 Design and Aspirational Innovation

11.1 Introduction

There are two streams of thought that addresses current innovation practises – by design and emerging innovations – by aspiration. These terms are defined as follows:

Innovation by design: approaches using proven, currently available technologies and/or construction methods to achieve innovative outcomes (e.g. provision for charging stations of electric cars, like the Tesla models, incorporated into street, carparking and building infrastructure).

Innovation by aspiration: approaches using conceptual or cutting-edge technologies and/or construction methods to achieve innovative outcomes (e.g. preparing for autonomous vehicles by installing conduit or similar in road infrastructure).

Based on these two definitions the innovations within the document are grouped under Design Innovation with the expectation that these innovations will be implemented at some point through the development of the PDA, and Aspirational Innovation to be explored and tested in association with EDQ support in the form of test beds. The innovations discussed and outlined provide a variety of solutions and samples as Use cases with actual existing examples, where available.

11.2 Methodology

As the innovations discussed in this document are both currently existing within our urban environment and soon to exist, the prioritising of innovations for the PDA is based on a triple bottom line approach to achieving sustainability by considering the social (people), environmental (place) and economic (price) benefits of each innovation. By using the triple bottom line approach, the Implementation Rating for each innovation can be rated as High, Moderate or Low. This rating when combined with Procurement ratings of High, Moderate or Low provides a basic performance criterion from which to judge each innovation. Such that where an Implementation Rating is High or Moderate for sustainability and Procurement is Moderate or Low for cost, that innovation should be implemented within the PDA, with the expectation that costs will continue to reduce over time as innovations transition to Business as Usual (BAU).

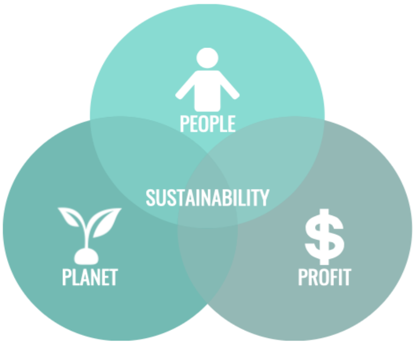


Figure 11-1 Triple Bottom Line

(Image sourced from Red Lab Experience 2019)

The consideration of the triple bottom line approach to innovations in infrastructure must have regard to the context in which they are being in applied. Specifically, the Greenfields growth areas of Southeast Queensland and the urban expansion of south-west Brisbane. The ability to achieve sustainability in infrastructure in Greenfield areas is maximised because of the general rural/farming nature of the land and the opportunity to remediate and restore the often-degraded natural systems as part of its conversion to urban and creation of open spaces and protection of habitats. The target of Shaping SEQ - Southeast Queensland Regional Plan 2017 of 70% developable area and 30% for non-developable will include environmental corridors, open space, transport networks, sports, education and health facilities to ensure a sustainable community can be supported.

However, the edge or fringe nature of growth area development, that forms the development front extending from suburban areas, means that historically services generally follow the new community's occupation. The provision of services, whether they be transport, health, educational or commercial all relies on population targets or a critical mass of people to sustain cost effective service provision. Consequently, early occupants of growth areas, the community demographic (predominately young families and couples), can often feel isolated and disconnected due to distance to local services and support networks, and often become reliant and habitual on inefficient and unsustainable means of private transport due to the scheduling of public transport (PT) implementation.

Consequently, the innovations outlined below that support active transport and transport options beyond BAU and/or form part of a broader transport network system rate High on sustainability under Implementation Rating as they support both people (through health and wellbeing) and the planet (through reduced carbon emissions, in accordance with Queensland Climate Transition Strategy) at a minimal additional price. Similarly, the provision of co-located community services, educational and health facilities, open space and stormwater infrastructure also rate High on sustainability. Due to their intrinsic value to support people (mothers and children's health, education, social networks and mental health) the planet (reduced building footprint, reduced heat island effect, increased permeability and increased greening,) and price (reduced land and construction costs, increased amenity and value creation).

Beyond the triple bottom line approach to sustainability, the fourth consideration for implementation is governance. Within the context of growth area planning the local government areas that will ultimately govern these newly developed suburbs will also manage and maintain most of the required and constructed infrastructure.

Consequently, the approach to rating Procurement includes the consideration of local councils' approach to infrastructure maintenance, budget and resource allocation. Management and ongoing maintenance of infrastructure are significant consumers of local government resources and the establishment of new or alterative infrastructure solutions require significant input from the future owner of this infrastructure. Where the innovations discussed below incorporate minor changes or additions to BAU infrastructure then additional costs will be minimal and are rated as Low or Moderate.

However, where these innovations require changes to planning policy, management policy, budget and resource allocations these innovations are rated High as they are likely to be perceived as complex or costly to local councils and will require ongoing collaboration, education and state government support to achieve a BAU approach. Examples of this are innovations that require significant populations or critical mass of users to see benefits, such as electronic data collection that requires a broad network of installation to receive quantifiable data that is useful, increased complexity in maintenance regimes, or increased perceived risks for staff, users or governance.

The Procurement rating also considers the nature of nexus for core infrastructure delivery, as innovations in infrastructure while desirable, may be considered beyond the basic needs of the residential community. The development industry in their provision of required infrastructure will deliver those clearly defined and benchmarked infrastructure requirements. However, innovations that incur additional costs without a clear line to nexus, financial benefits or value add, are likely to struggle to achieve implementation and therefore have also been rated as High, due to their legitimacy as core infrastructure.

11.3 An Implementation Framework – Incentives

The DCOP provides the actual mechanism through which infrastructure is delivered as part of new urban development. This is based on the need's assessment for the projected population, across health services, open space, community and sports facilities etc. and minimum standard requirements for utilities and infrastructure (sewer, stormwater, road widening, intersection capacity, etc.) to support the future community. These infrastructure requirements are based on the nexus between the population (numbers of people) and the required service (generated need) to ensure development can proceed and therefore are generally supplied at a basic level of service and cost.

The DCOP provides a practical framework and well-defined approach to land requirements, construction costs, staged delivery and the implementation of assets to be transferred to local government or service authorities once works are complete, based on BAU practises that are well established, known and implementation ready. This detailed and cost focused nature of the DCOP without augmentation by an innovation mechanism provides limited opportunities for innovations to be explored as their costs, maintenance, ownership or policy position are yet to be resolved or clearly defined.

To enable and facilitate innovation and evolve infrastructure delivery beyond BAU, Design Innovations need to be reinforced through the DCOP and supported by planning policy so that implementation of these innovations can be mainstreamed. Through the DCOP and the state government planning framework in association with education and agreement with local government, innovations need to be mandated into policy to enable their transition to BAU. Through consistent planning policy and implementation mechanisms, a level playing field is created for the development industry regardless of location or council area. This requires the development of standardised costs and construction that enables those innovations to be implemented in an efficient and effective manner, such that they are automatically factored into developer costs as part of any future project. The DCOP provides the framework for a top-down policy approach and a bottom up showcasing of innovations to progress to construction ready infrastructure, supporting widespread implementation over time.

Similarly, as Aspirational Innovations evolve over time through test beds and research and development, they will become Design Innovations that are implemented in a confined or locational manner, unless they are adopted and endorsed holistically by state governments (e.g., Adaptive Signalling for traffic lights) and rolled out across the state, accordingly. However, as this top-down approach is yet to be created opportunities for implementation of Design Innovations and ultimately Aspirational Innovations remain at the discretion of the development industry, subject to their estates marketing approach and their desire to create a point of difference.

This Innovation Report provides EDQ and developers with illustrative examples of use cases that they can review and investigate as potential implementable innovations within current or future estates in the PDA. In this regard developers are encouraged to implement one or more of the Design Innovations, or the Aspirational Innovations when they become implementable, in consultation with EDQ and the applicable local council.

Opportunities for joint ventures, state government grants, collaborative test beds, state government land development, investment funding and development concessions (reduced car parking rates, increased residential densities and/or Floor Space Ratios) could all be explored with local government and developers as part of facilitating actual innovation within the PDA.

Alternatively, EDQ in association with the local council may actively select and require specific innovations within the PDA, that will create the greatest benefit for the broader future community and achieve the desired triple bottom line approach to development. Through innovation by example, EDQ will set the tone and raise the bar for development within the PDA, to achieve sustainable communities.

11.4 **Innovation Proposal Assessment**

In accordance with the Ripley Valley PDA Development Scheme goal to "become a model new community embracing or even exceeding 'best practice' in ecological sustainability", sustainability is the core criteria in assessing innovation proposals.

The Development Scheme defines Ecological Sustainability as a balance that integrates:

- Protection of ecological processes and natural systems
- Economic development
- Maintenance of the cultural economic physical and social wellbeing of people and communities.

Sustainability provides a guiding principle to the pursuit of innovation and incentivises the delivery of infrastructure which is optimised across multiple criteria, capturing the interests or challenges of present and future stakeholders, minimising externalised costs and maximising intangible social and environmental benefits.

This approach recognises the synergistic advantages which are realised when taking a truly integrated approach, where the outcome/benefits achieved can be more than the sum of its parts if each function/challenge were to be considered and addressed individually. This is particularly important in maximising the positive impact or Return on Investment to EDQ, local government and the community from the Development Charges offset. Innovation Project Selection and Evaluation Criteria

Innovation project proposals must demonstrate a high degree of sustainability and target best practice across the following sustainability themes. Reporting against all criteria is mandatory, unless it can be demonstrated that the criteria is not material to the project proposal (including secondary interactions with related development designs/assets).

11.4.1 Infrastructure Sustainability Themes

- Governance (Integrating Sustainability into Leadership & Management, Knowledge Sharing)
- Sustainable Procurement (Supply Chain and Supplier Assessment)
- Resilience (Resilience Strategy, Natural Hazard and Climate Risks)
- Economic Business Case (Valuing Externalities, Equity, Financial Sustainability)
- Economic Benefits (Benefits Mapping, Post Project Evaluation)
- Energy & Carbon (Energy Efficiency, Renewable Energy, Offsetting)
- Green Infrastructure
- Environmental Impacts (Water/Air Quality, Noise, Vibration, Light Pollution)
- Resource Efficiency (Resource Recovery, Adaptability, Material Life cycle, Sustainability Labelling)
- Water (Water efficiency, Appropriate use of Water Sources)
- Ecology (Ecological Assessment and Risk Management, Ecological Monitoring)
- Stakeholder Engagement (Strategy and Implementation)
- Heritage (Assessment and Monitoring

- Workforce Sustainability (Workforce Planning, Workforce Culture and Wellbeing, Jobs and Skills).

Further guidance on infrastructure sustainability reporting may be taken from recognised industry peak bodies, government and non-government policy and guidance documents and the United Nations Sustainable Development Goals (SDGs).

Third party verification/assurance and obtaining independent infrastructure sustainability ratings is strongly encouraged. Innovation proposal acceptance will give preference to projects for which infrastructure sustainability ratings are sought, particularly on proposals representing larger capital expenditure, high complexity, higher risk elements or involving multiple stakeholders/developers.

11.4.2 Innovation Project Inspiration

EDQ currently focuses on innovation around four themes, which will necessarily shift over time and be revised in subsequent revisions to the DCOP

- Clean energy
- Sustainability and planning innovation
- Transport and mobility
- Digital

As of June 2020, EDQ is believes the following are to be considered as innovation projects:

- Disruptive infrastructure planning
- Smarter building materials (lower carbon, lower waste)
- Circular economy
- Blue-green infrastructure
- Water Sensitive Urban Design
- Sustainability rating schemes
- EV charging provisions
- Shared mobility
- Waste to energy
- Renewable energy (residential/industrial)
- District energy generation / storage
- Virtual power stations
- Internet of things, digital communications
- Innovation education partnerships

Further guidance may be taken from the following resources

- PDA Guideline No. 14 – Environmental Values and Sustainable Resource Use (2015)
- PDA Practice Note. 04 – Integrating Sustainable Principles into Residential Subdivisions (2014)
- Overarching Site Strategies (OSSs) or Infrastructure Master Plans (IMPs) approved for each master development approval which detail environmental and sustainability goals

11.4.3 Government Policy Imperatives

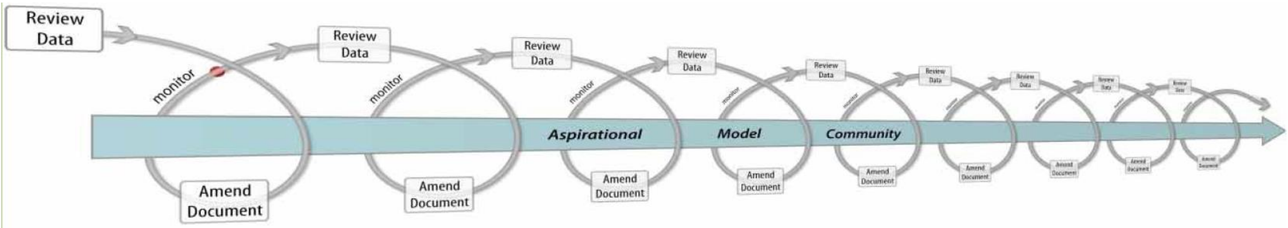
Innovation proposals which facilitate the advancement of non-mandatory State Government or Federal Government policy goals are encouraged. Examples:

- Advancing Queensland's Priorities - Reducing Queensland's contribution to climate change - 'A 30% reduction in 2005 net greenhouse gas emissions by 2030'.
- Queensland Climate Transition Strategy - Action 2.3 - 'Integrate zero net emissions goals into state infrastructure planning'
- COAG - Phasing out exports of waste plastic, paper, glass and tyres - Response strategy to implement the August 2019 agreement of the Council of Australian Governments

11.4.4 Innovation Project Eligibility Criteria

To be eligible for the Innovation development charge offset the proposed infrastructure project/proponent must meet the following criteria:

- **Project Benefits** - The proposed infrastructure innovation must generate, facilitate or accelerate economic, social and environmental benefit.
- **Project Forms** - Projects will likely take the form of transport infrastructure works, communication technology, water supply, sewerage transport/treatment, stormwater infrastructure, energy technology, or innovation in the design of open space assets. However, other proposals will be considered provided they meet the eligibility criteria, including other categories of infrastructure, precinct/catchment planning instruments, proposals for non-mandatory environmental protection/rehabilitation or construction management proposals.
- **Demonstration of Need** - There is demonstrated need for the infrastructure innovation proposal to enhance the development outcome and facilitate the achievement of the economic and sustainable development goals for the PDA, or to address a present or future barrier to the achievement of these goals (i.e. resource shortages, climate change etc).
- **Improvement on BAU** - The Innovation proposal must represent a material and quantifiable improvement over BAU (proof of "additionality"), with the definition of BAU to be necessarily revised over time and evaluated at the time of assessment, following industry and technology trends.
- **Eligible infrastructure** – Incorporation of recycled or innovative construction materials or methods which represents an Australian, State or PDA first adoption, or which is a known innovation which is currently under-utilized, and the proposal advances the development of the material/method for broader adoption.
  Examples: water mining from sewer infrastructure to supply non-potable water to open space or community assets. Grid-connected battery storage, quarry pumped hydro or floating solar which provide electricity network services that reduce overall infrastructure costs and electricity bills.
- **Ineligible infrastructure** – Incorporation of recently developed technology such as LED post lighting for roads and sports parks which represents Business and Usual or is approaching business-as-usual within the State/PDA.



- **Verification/Assurance –** Proposal benefit representations are to be independently verified unless otherwise agreed by EDQ. EDQ further reserves the right to request independent verification where necessary. Projects are encouraged to seek independent sustainability ratings. Where the implementation of a rating is in itself an innovation (rating scheme is novel or at present underutilised), this may be lodged as a standalone innovation proposal.
- **Technical Evidence** - Projects are supported by robust technical evidence that the proposal meets relevant standards, and that present and future risks are mitigated. The degree of evidence required is proportional to the extent of prior adoption of the design/technology, the significance departures from standards and assessment of risk. For example, should designs or specifications differ from Australian Standards the proposal must be supported by evidence to the satisfaction of EDQ and relevant stakeholders, such as independent field/laboratory testing and a performance-based specification, with appropriate certification by a suitably qualified person.
- **Development Integration and Asset Handover** - Proposals must integrate with the development such that the implementation does not compromise the ability to satisfy conditions approval and other relevant approvals or standards, unless agreed by EDQ or other relevant authority. Non-compliance with conditions/standards arising as a result of the proposal must be identified prior to implementation and specifically addressed such that the proposal holistically enhances the development outcome.
- **Financial Viability and Maintenance** - The project is financially sound, including demonstrated value-for-money and a plan for the viability of the project (such as local government capacity to manage, operate and maintain the infrastructure following construction). Depending on the nature of the proposal, whole of life cost evaluation, return on investment or consideration for a modified maintenance period may be required.
- **Project Proponent Capacity** - The proponent has the capability to deliver the project including appropriate staff, expertise and capacity to manage the project. Required to demonstrate the financial capability to deliver the project.
- **Innovation Adoption Strategy** - Projects incorporate elements which facilitate industry adoption, including mechanisms for ongoing measurement/capture of data, industry education and capacity building opportunities. Preference will be given to proposals which produce an Innovation Adoption Strategy that details how the innovation will be incorporated into the subject development and strategies for maximising the potential for broader industry adoption. This Innovation Adoption Strategy plan is to incorporate the following: -
    - Open-Source data capture and sharing approach (insofar as allowable by copyright and IP) to maximise opportunities for wider innovation adoption.
    - Strategies to facilitate standardisation of successful innovations across PDAs, and to promote and encourage innovations for wider adoption.

- Partnerships with educational institutions or industry peak bodies to leverage case study production are strongly encouraged.

- **Innovative Planning Proposals** - Innovations may focus on the drafting or implementation of infrastructure planning solutions which seek to break down the siloed approach historically driven by fragmented land ownership, such that “artificial” cadastral development boundaries do not drive the delivery of costly, inefficient and suboptimal infrastructure designs and rather result in a best for community outcome which minimises long term costs.
- Eligible planning proposals - Includes the creation of a multi-stakeholder precinct frameworks (where otherwise not required by Development Approvals) such as catchment approaches to total water cycle management, precinct urban heat island or climate resilience/adaptation plans, precinct earthworks plan that eliminate the requirement for cut-fill balance within limited parcels, or plans that create integrated open space and environmental protection outcomes
- Planning solutions may address the “growing pains” of Greenfield development, such as development of decentralised of strategies to facilitate the delivery of otherwise “out of sequence” development. Examples include the adoption of decentralised technology for provision of water or energy supply which is required based on a network analysis that demonstrates that the existing network and service model is constraining development and the achievement of economic, social and environmental goals.
- Development Application Approvals and Change Applications - It is noted that innovation proposals may necessitate the alteration of ancillary development infrastructure for the proposal to be adequately integrated. Innovation proposals must be submitted either prior to the approval of the relevant development application, i.e. Material Change of Use, Realignment of a Lot or Operational Works, or a change to approval must be obtained to facilitate the approval of the proposal.

11.4.5 Innovation Project Identification

Innovations are constantly evolving to respond to emerging changes in our urban environment, declining resources and increasing community expectations. The need to build resilient suburbs and cities that can accommodate climate change, natural hazards, transport modernisations and evolving social norms, require flexible approaches to urban infrastructure delivery.

However, the means in which urban infrastructure is delivered is defined by catchment analysis and associated unit cost, to enable infrastructure costs to be transferred to the ultimate purchaser of the land, the future resident. The provision of basic services and facilities that enable urban, particularly residential, development to occur are well established and can be easily quantified. To change these known costs through innovations in infrastructure, beyond BAU, requires clearly defined state planning policy, along with adopted and consistent implementation at the local government level. To enable innovations to transition to BAU and achieve sustainable outcomes that create liveable communities.

EDQ is leading by example as they focus their efforts on innovations in infrastructure through the DCOP that will achieve sustainable communities. While many of the innovations within this report could be applied the methodology focuses on sustainable outcomes that are contextual to place, given the Greenfields nature of the PDA, and the opportunity to minimise additional costs to current BAU infrastructure.

To achieve sustainability within the PDA Design Innovations that are rated as High or Moderate under Implementation Recommendation and Moderate or Low under Procurement should be pursued through discussions with both local government and the development industry to ensure that practical implementation and ongoing maintenance is achievable within the PDA. For innovations to progress to BAU infrastructure they must be endorsed by the ultimate asset owner, generally local government, through a bottom-up test bed approach, to enact change and champion sustainability within these emerging communities.

Aspirational Innovations will continue to evolve over the development life of the PDA until they become Design Innovations that are implemented in urban environments. Just as Design Innovations will mainstream into urban developments as BAU infrastructure or become superseded by Aspirational Innovations (e.g. AV removing the need for public car parking) as they mainstream. Regardless of the timing a holistic view to innovations in infrastructure delivery is required within the PDA, which should incorporate a top-down state government planning approach, supported by a bottom-up local government practical implementation program. This provides clear and defined direction to the development industry on achieving sustainable urban development within SEQ.

Potential Sustainability and Innovation offset projects will be identified:

- Through the submission of a proposal using the preliminary information form on EDQ's website,
- Through identification of a target project by EDQ in conjunction with local governments and/or proponents and via direct contact by a proponent with EDQ; or
- In identifying potential Innovation Offset projects, EDQ or local governments may identify strategic infrastructure sustainability and innovation priorities through Sub-Regional/infrastructure planning documents. Local governments are also encouraged to engage with development proponents and other relevant organisations as part of this process. Further information may be requested during the assessment process.

11.5 **Good Ideas – Yet to be Tangible**

Aspirational innovation as previously defined are approaches using conceptual or cutting-edge technologies and/or construction methods to achieve innovative outcomes. These innovations conceptualise current thinking into tangible technologies or infrastructure that pre-empt future development. Avoiding the need to retrofit or replace expensive and complex infrastructure in the future when these innovations become reality.

Aspirational Innovation is the ultimate approach to future proofing new and emerging communities in SEQ growth areas. Providing cost efficiency in current infrastructure and maximising returns for service authorities, infrastructure managers, local councils and ultimately striving for sustainability and housing affordability for the future community.

However Aspirational Innovations are still undergoing tests and refinement on their path to implementation and consequently presently unresolved matters related to government policy, legislative requirements, risk, governance, ownership and cost implications must be addressed. As these innovations evolve over time clarity and resolution of these matters will follow and mechanisms that will facilitate their broad scale implantation will rolled out through appropriate governance.

11.5.1 Illustrative Examples

The following provides a list of Aspirational Innovations that are currently emerging across Australian urban communities. These innovations provide several examples that can be considered, explored and implemented by future and existing developers, landowners and local government, developing land within the Ripley Valley PDA.

Provided as a snapshot of future innovations, in the form of Use cases, this list is not exhaustive and future innovations will continue to evolve over time. However, this list is provided to inform and lead the development industry in its implementation of innovative solutions through development within the PDAs.

Developers are encouraged to review the Aspirational Innovations listed below in consultation with EDQ and local governments to future proof current infrastructure delivery, as Aspirational Innovations seek to move to Design Innovations. Opportunities exist to form part of a broader government approach to showcase innovations through joint ventures, test beds, case studies, grants, developer incentives and funding mechanisms as part of facilitating actual innovation within these growing communities.

11.5.1.1 Autonomous vehicles

Autonomous Vehicles (AVs) have the potential to completely disrupt the way people use and consume transport. Moving away from ownership to usership models (akin to buying CDs to paying a monthly fee for music streaming), changing the need for parking at private residences or requiring the construction of drop off bays at commercial premises, as the need for static parking is removed. AVs could fundamentally change the way in which people go about their lives.

Image sourced: Sedg.org

Figure 11-2 Artist's impression

While these vehicles are 2 to 8 years away from commercial (freight or taxis) and up to 20 years away for private use, they have the potential to facilitate travel without human input and in doing so would free individuals to use their time traveling to do other activities. This may see the AVs built in the form of mini gyms, meeting or conference rooms, hotels, and many other potential uses. There has been significant talk about the need for AV only traffic lanes to be constructed to allow the operation of these vehicles, but this is considered by most to be unnecessary.

Key considerations

Buildings and transport hubs should be designed with this innovation in mind. Buildings without flexibility in their design to accommodate these foreseen changes would be costly and inefficient, for example car parking structures being designed to enable enclosure and adequate floor to ceiling heights to be converted for commercial or housing uses. However, the road network and infrastructure requirements are unknown or not yet standardised, with complimentary operational infrastructure expected to be built as needed, as legal matters related to road use and licencing of AVs need to be addressed through government regulation.

Implementation recommendations

Low: AV require sophisticated technologies that can provide diagnostic and predictive tools to understand and interpret human behaviour of other drivers. Such technology will increase the bandwidth demand on the internet and global location data.

Ownership and operation

Currently, AV business models can involve ownership by individuals, businesses and organisations.

Procurement complexity

Moderate: As infrastructure requirements are yet to be defined costs associated with AVs are unknown. However, as they will be using the existing local street and road network retrofitting of streets and roads will fall to the owners of this infrastructure, local and state governments. Mechanisms for cost recovery are likely to come through broadscale fees such as licensing and rates.

Further information

- Local Queensland examples EZ10 Driverless shuttle Ipswich: https://www.ipswichsmartcity.com.au/projects/
- Cooperative and Automated Vehicle Initiative – CAVI: https://www.tmr.qld.gov.au/About-us/News-and-media/News-and-media-frequently-asked-questions/Cooperative-and-Automated-Vehicle-Initiative-CAVI

11.5.1.2 Mobility as a service (MaaS)

Mobility as a Service (MaaS) is a new system which looks to integrate all modes of transport and provide multi-phased options for a traveller's journey. Here, the customer can choose their preferred option (based on timing, connections, and cost), arrange and pay for it through a single interface or app. One potential avenue of MaaS is the subscription model, where a traveller would buy a subscription to mobility services (combination of micro-mobility, public transport, parking, ridesharing) for a price that suits their needs. Currently the implementation of MaaS in Australia is low, with some trials taking place around the country. Apps such as UbiGo and Whim in Europe have seen commercial success.

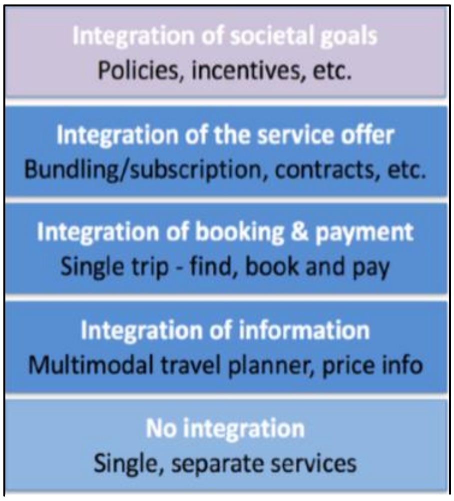


Image sourced: Sarasini, S. (2017)

Figure 11-4 Example of mobility as a service framework

Key considerations

Various factors must be considered before the implementation of a MaaS system such as who the target market is, how payments will be processed and how the public sector will incentivise the services.

Implementation recommendations

High: The opportunity to provide an interactive approach to transport service delivery provides both variety in transport modes and convenience at the users' fingertips as choice and cost can be determined by the user. In a Greenfields situation access to transport may be limited in the short term so any alternative transport options that can help to connect and support the community while PT is being established provides a sustainable outcome and should be pursued.

Ownership and operation

Will require integration across transport services in relation to payments. Existing ownership and operation models for the various forms of transport would remain the same.

Procurement complexity

Low: Given trials are currently underway in Australia and all transport modes are currently available, systems related to the processing of payments and the accepted use of the app would incur some cost as part of MaaS implementation. However, the opportunity to increase demand for services would ultimately offset that cost.

Further information

- Sarasini, S. "A topical approach to mobility as a service: A proposed tool for understanding requirements and effects" (2017)

11.5.1.3 Automated Public Transport

Automated busses are also experiencing trials across Australia. Adelaide's 'Olli" bus trial, which is a driverless shuttle bus that runs along a fixed route, poses a possible solution to the first mile/last mile issue that PT has difficulty enabling due to catchment-based transport planning. Automation of public transport would result in considerable financial benefits to its respective operators' state governments and transport authorities as it eliminates the cost of driver training and labour issues.

Image sourced: Transport.nsw.qld.gov.au

Figure 11-5 Example of automated public transport

Key considerations

Given that this technology is in its early stages, care must be taken to properly implement and operate it within the existing public transport network. Safety measures and risk mitigation must be thoroughly employed.

Implementation recommendations

High: Continued development and testing are ongoing within current trials, before this technology can be completely mainstreamed as part of all PT systems. However, this approach to driverless vehicles within controlled PT environments, namely vehicles on rails or acting as a shuttle (only two-point destinations), is highly desirable and cost effective for PT operators.

Ownership and operation

PT ownership and operations would not change, only the technology within the vehicle or the type of vehicle used to enable it to operate autonomously (LIDAR, GPS technology and emergency brakes).

Procurement complexity

High: Current trials consist of a combination of partners including a motor company, an automation company, an AI company with IoT technology and local and state governments. The South Australian Government previously invested $2.8 million in driverless shuttle buses trials at the Adelaide airport in 2017.

Further information

- Adelaide Olli bus: https://www.zdnet.com/article/south-australia-kicks-off-six-month-driverless-shuttle-trial/
- Sydney Metro: https://www.transport.nsw.gov.au/sydney-metro

11.5.1.4 Demand Responsive Transport/Ride Share

Demand Responsive Transport (DRT) is a shared transport service that offers flexibility for trips where PT such as buses and trains are not available. It is most effective in the first and last mile of a journey, connecting people to more rapid transit or local attractors.

DRT typically operates as an area wide service, connecting customers from nearby suburbs to a destination and/or attraction. It is intended to replace short private vehicle trips. The service operates with the customer notifying the operator of their desire to travel to a specific destination. The customer will then proceed to a predetermined location to minimise delay along the route for other customers onboard. The customer may be expected to walk a distance from their home (not more than 400 m) to the pickup location. This is determined by an algorithm optimising the journey, which has 'preferred' virtual stops along the route from which pick up and drop off would typically take place.

A DRT service could also be supplied specifically to a residential development, as a complementary service offering. This is an emerging use, which has the potential to offset the need for a second vehicle at each household.

Key considerations

DRT is considered relevant for trips where public transport, such as a bus service, is not considered financially viable, due to low passenger demand, industrial or rural areas. DRT services can be designed for any location. Setup generally involves vehicles, commonly small minibuses, and a booking system for customers to book a transport service.

Implementation recommendations

High: Subject to staging of developments. Where access to PT (train or trunk bus route) is not within 1km. DRT should be implemented to ensure PT use habits are established from early occupation until PT implementation replaces or supports ongoing use of DRT. Reduces community isolation at development front.

Ownership and operation

DRTs pilots may be fully or partially funded by developers and transit authorities for specific estates with limited access to PT.

Procurement complexity

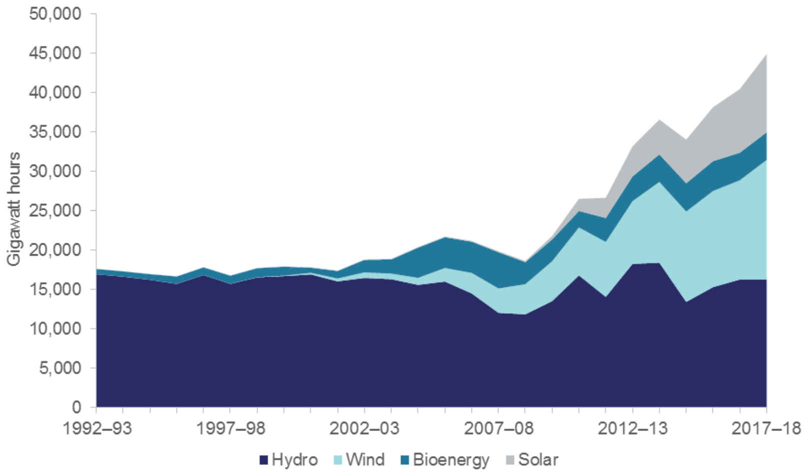
Moderate: Subject to area covered by service, significant cost investment is required given Queensland Government Translink is subsiding transport fares. A shared approach between developers, local and state government would reduce costs and provide a reliable data source to support future PT decisions and investments in growing communities.

Further information

- TfNSW the Ponds and Northern Beaches: https://transportnsw.info/travel-info/ways-to-get-around/on-demand/ponds-on-demand-service
- https://transportnsw.info/travel-info/ways-to-get-around/on-demand/northern-beaches
- Kan-go, Toowoomba: https://translink.com.au/travel-with-us/taxi-and-community-transport/kan-go

11.5.1.5 Renewable Energy

According to the Australian Government's Renewable Energy Agency (ARENA), renewable energy is produced using natural resources that are constantly replaced and never run out. Renewable energy types include common technologies like solar, wind power and hydropower. Energy harnessing technologies include geothermal energy, bioenergy and ocean energy. Grid strengthening technologies include battery storage and smart technology, which predicts when and where electricity is required Businesses can manage their energy costs better and Australia can move towards a low emissions economy by enhanced technological development and innovation.



Renewable energy sources accounted for 6% of Australian energy consumption in 2017-2018, comprising mainly biomass, hydro and wind energy. Renewable energy has diversified significantly as wind and solar capacity came online, generation has doubled over the past decade.

Figure 11-6: Australian electricity generation renewable sources

(Source: Department of the Environment and Energy (2019) Australian Energy Statistics)

An excellent example of bioenergy is demonstrated by the Logan City Biosolids Gasification Project. The biosolids gasification facility processes sewage sludge by dewatering it in a centrifuge, drying it in a paddle dryer, and treating it with high temperatures in a gasifier to produce biogas. Recovered energy in the biogas is used to power the drying and heating processes.

The gasification facility is energy neutral, with 70 per cent of the energy in biosolids recovered and reused, and the remaining energy requirements met by an onsite solar array. The gasification facility reduces the volume of biosolids by 90 per cent and produces a 'biochar' containing carbon, phosphorus and potassium

In another project, Water Corporation will provide biogas to technology company Hazer Group as feedstock for the Australian-first commercial demonstration project. The operation will produce 100 tonnes of fuel-grade hydrogen and 380 tonnes of graphite each year. The project capitalises on the waste product of biogas – mainly composed of methane and carbon dioxide – that is released during the wastewater treatment process as biosolids breaks down.

There is also the opportunity in the PDA to utilise Smart Grid technology to enable improved communication between parties involved with energy to support new and increased renewable technologies and enhance supply and demand reliability, information, response and efficiency, from both the supplier and consumer aspect. It does this through implementing information and communication technologies into the electric power system to enhance data available.

Key considerations

Developers and local government can play an active role in reducing energy demand and supporting the growth of distributed renewable energy sources in electricity networks. Accordingly, the Office of Clean Energy will assist all new and refurbished master planned communities, large - scale commercial developments and government infrastructure services to develop Clean Energy Plans. These plans will encompass demand side management, energy conservation and renewable energy options aimed at speeding up the deployment of clean energy technologies in major population growth hot spots. This initiative will align with the Queensland Government's Green Door and Cleaner, Greener Buildings initiatives (The Queensland Renewable Energy Plan (June 2009)). The Ripley Valley PDA will therefore be in an ideal position to harness the benefits of these initiatives. The unique environmental conditions of the Ripley Valley PDA should be well understood to determine which renewable energy sources are most like to yield efficient results.

While the technology that underpins this is readily available, the reasoning why this innovation is not included as by design, is due to the change in business model necessary to facilitate it. It is not the current 'business as usual' model and the traditional cost/benefit assessment when it comes to systems like this doesn't include the benefits that this can realised, such as environmental, community perspective and quantification of data quality increase.

- Origin Energy's Smart Grid: https://www.originenergy.com.au/blog/what-makes-a-smart-grid-so-smart/
- US Department of Energy Smart Grids: https://www.smartgrid.gov/the_smart_grid/smart_grid.html

Implementation recommendations

Moderate: Key considerations with the new Ripley Valley PDA can include focussing on the following four key interventions (www.energycommunity.org):

- Solar Water Heaters/Solar Power Heat Pumps
- Energy Efficient Lighting
- Energy Efficient Buildings
- Transport (Modal shift from private to public)

Victoria's Renewable Energy Action Plan focusses on supporting sector growth, empowering communities and consumers and modernising their energy system. For the Ripley Valley PDA, the relevant sector will be to empower and engage households and businesses. Industrial developments can be constructed with a targeted focus on renewable energy as well as the performance of daily operations. The transportation sector can also embark on innovative and sustainable choices to modernise their vehicles and decrease the carbon emissions.

Ownership and operation

Some initiatives will be led by public sector involvement while others will be completely managed by the individual. Solar power and energy efficient lighting can be the responsibility of the landowners while the transport shift is shared between public organs of state and the individual. Large scale renewable energy projects will mostly be managed by state jurisdictions.

Procurement complexity

Medium to High: In instances where privately owned initiatives are developed, the procurement will be simpler than large-scale state projects. According to The Queensland Renewable Energy Plan (June 2009) a regulatory reform package was to be delivered aimed at simplifying the business, regulatory and planning environment in Queensland for renewable energy projects. A Renewable

Energy Regulatory Taskforce were to examine existing legislation and provide options to remove or reduce impediments and streamline planning processes for renewable energy projects. For example, the project was to examine the best mechanisms for facilitating access to land for renewable energy, which may have included acquisitions, land designations or declaration of State Development Areas.

Further information

- Logan City Biosolids Gasification Project:
- https://arena.gov.au/projects/logan-city-biosolids-gasification-project/Veolia Biogas recovery:
- https://www.veolia.com/anz/our-services/our-services/energy-services/waste-energy/biogas/biogas-wastewater-treatment-plants Biogas opportunities for Australia: https://www.energynetworks.com.au/resources/reports/biogas-opportunities-for-australia-enea-consulting/Water Corporation: https://watersource.awa.asn.au/technology/innovation/water-corporation-fuelling-an-australian-first-hydrogen-project/

11.5.1.6 Heat Island Effect and Street Greening

The term "heat island" describes built up areas that are hotter than nearby rural areas. The annual mean air temperature of a city with 1 million people or more can be 1–3°C warmer than its surroundings. In the evening, the difference can be as high as 12°C. Heat islands can affect communities by increasing summertime peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and water pollution. A green street is a stormwater management approach that incorporates vegetation (perennials, shrubs, trees), soil, and engineered systems (e.g., permeable pavements) to slow, filter, and cleanse stormwater runoff from impervious surfaces (e.g., streets, sidewalks).

Given the long history of hot weather in Australia and particularly this PDA, the increasing frequency and severity of extreme heat events will only amplify the Urban Heat Island Effect However, there are some simple and effective nature-based solutions for cooling our cities that deliver heaps of other benefits besides.

Key considerations

There are a few cooling strategies that could be utilised in the PDA such as:

- increasing tree and vegetation cover (increased tree and vegetation cover lowers surface and air temperatures by providing shade and cooling through evapotranspiration),
- installing green roofs (growing a vegetative layer on a rooftop reduces temperatures)
- cool, mainly reflective roofs (with materials or coatings that reflect sunlight and heat away)
- using cool pavements either reflective or permeable (cooler due to reflecting more solar energy and enhancing water evaporation
- Utilizing smart growth practices (range of development and conservation strategies).

Efforts can either be voluntary or policy driven. Voluntary efforts include demonstration projects, incentives, urban forestry programs, weatherization, outreach and education programs. Policy efforts include procurement, resolutions, tree and landscape ordinances, comprehensive plans and design guidelines, zoning codes, green building programs and standards, building codes, and air quality requirements.

An example of Street Greening can be seen with Sydney streets being transformed with more plant life making it more pleasant and safer for residents, workers and visitors to move around the local area, under 2 City of Sydney improvement programs. Standard footpath improvements under the greening Sydney plan are improved, with new garden beds, trees and shrubs to soften and enhance the appearance of streets and public places. More than $75 million have been committed to the footpath renewal and public domain landscaping programs over the next 10 years.

Implementation recommendations

Moderate: It is recommended to support both voluntary efforts as well as policy efforts to promote street greening and decrease the heat island effect. In Australia several projects are underway including the following:

- Nature in Cities program (strategically planting trees and other vegetation in built-up areas),
- Our Park, Our Place (working on Noongar country with four of Perth's lowest-canopy council areas to regenerate some local parks),
- Adelaide Green Cities project (engage local communities in practical demonstrations about how plants can help create a carbon neutral city),
- Cooling the Schools project (working with schools and their communities to add plants to public parks and playgrounds across Sydney, prioritised by their vulnerability to the Urban Heat Island Effect),
- For Penrith City Council, the following policy and planning controls were identified:
    - Planning controls for new developments specifying requirements such as reflective surfaces, porous pavements, WSUD, open/green space,
    - Procurement of cool products – e.g. reflective roofing, porous pavement, sustainable building products,
    - Target setting – e.g. % of canopy cover, open space, heat reduction, reflective roof surfaces,
    - Tree and landscape rules and standards,
    - Stormwater project design,
    - Comprehensive plans and design guidelines, and
    - Green building standards.

Ownership and operation

Voluntary efforts to be owned and operated by individuals and policy efforts to be driven by the public sector. The Yarra City Council developed the Embedding Green Infrastructure Best Practice Toolkit. It also provides a resource manual to help the implementation of green infrastructure become streamlined, cost effective, and business as usual. The Self-assessment Tool uses the Best Practice Framework to set out three stages (Organisation culture and structure, Internal systems and Delivery) and twelve aspects for evaluation by Councils to determine current strengths and weakness. The traffic-light assessment helps to identify key areas requiring further development to truly embed green infrastructure into Council operations as business-as-usual.

Procurement complexity

Medium to High: Procurement of voluntary efforts can be quite simple whereas procurement related to the policy efforts can be more complex and time-consuming. It is recommended that the council and state development schemes and codes be expanded to include guidelines and how to gradually transform built-up areas towards heat reduction and a greener environment. As time passes by these measures can be refined to become more stringent and include monitoring KPI's and the like.

Further information

- Greening Australia – Tackling Heat Island Effect: https://www.greeningaustralia.org.au/how-can-nature-help-tackle-the-urban-heat-island-effect
- City of Sydney Greening Sydney Plan: https://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0009/135882/GreeningSydneyPlan.pdfhttps://www.cityofsydney.nsw.gov.au/vision/better-infrastructure/streets-and-public-places/completed-works/greening-our-streets
- Urban Heat Island effect: https://watersource.awa.asn.au/environment/built-environment/losing-our-cool-how-water-can-help-combat-urban-heat/
- City of Yarra Green Infrastructure Best Practice Toolkit: https://www.yarracity.vic.gov.au/about-us/sustainability-initiatives/embedding-green-infrastructure-toolkit
- Cooperative Research Centre for Water Sensitive Cities – Ideas for Fisherman's Bend: https://watersensitivecities.org.au/wp-content/uploads/2016/04/Ideas-for-FishermansBend-REPORT.pdf
- Yarra Council Toolkit – practical options: http://www.wdc.govt.nz/PlansPoliciesandBylaws/Plans/State-of-the-Environment/Pages/Blue-Green-Network-Strategy.aspx
- Heat Island Effect – Penrith City Council: Cooling the City:
- https://www.yoursaypenrith.com.au/25909/widgets/192402/documents/151999
- US EPA – Heat Islands: https://www.epa.gov/heatislands
- CoolSeal Pavement: https://guardtop.com/coolseal/
- https://www.charlessturt.sa.gov.au/environment/climate-change/coolseal

11.5.1.7 Wastewater Treatment & Reuse Systems

Wastewater is treated at local treatment plants to supply class A recycled water back to homes.

Figure 11-7 Precinct-scale water recycling

(Source: Southeast Water & Villawood Properties)

https://southeastwater.com.au/residential/upgrades-and-projects/projects/aquarevo/)

Localised wastewater treatment provides an alternate source of water for irrigation, cold water washing machines and toilet flushing. The pressure sewer system enhances cost-effectiveness of precinct scale wastewater recycling.

Key considerations

Water quality management – network(s) need to be sized for fireflows; however, water demand can be much lower. The lower water demand can mean that there is less water moving through the system at slower rates, leading to water age becoming an issue. However, if recycled water is increasingly treated and utilised, water turnover in pipes will be faster, eliminating any water age issues.

The potential for cross connections into drinking water systems need to be carefully managed.

Implementation recommendations

Medium: This solution can save up to 35% reliance on mains drinking water. Local treatment closes the loop, minimising impact of the development on broader water infrastructure, while avoiding the need for waste-water to be transferred substantial distances

Intelligent pressurised sewers enhance the cost-effectiveness of this solution by eliminating water ingress during wet weather and reducing peak dry-weather loads and discharge of wastewater to the environment is reduced.

Ownership and operation

Utility/local authority. Maintenance of the system to ensure it meets health requirements is ongoing. In the Aquarevo development, South-East Water monitor and maintain the systems, using smart technology to control flows and detect issues

Procurement complexity

Medium to **High** Current costs associated with these systems essentially double network maintenance costs – 2 x pipe networks for conveying the same volume of water. This cost is continually improving though, with rapid advancing technology advances.

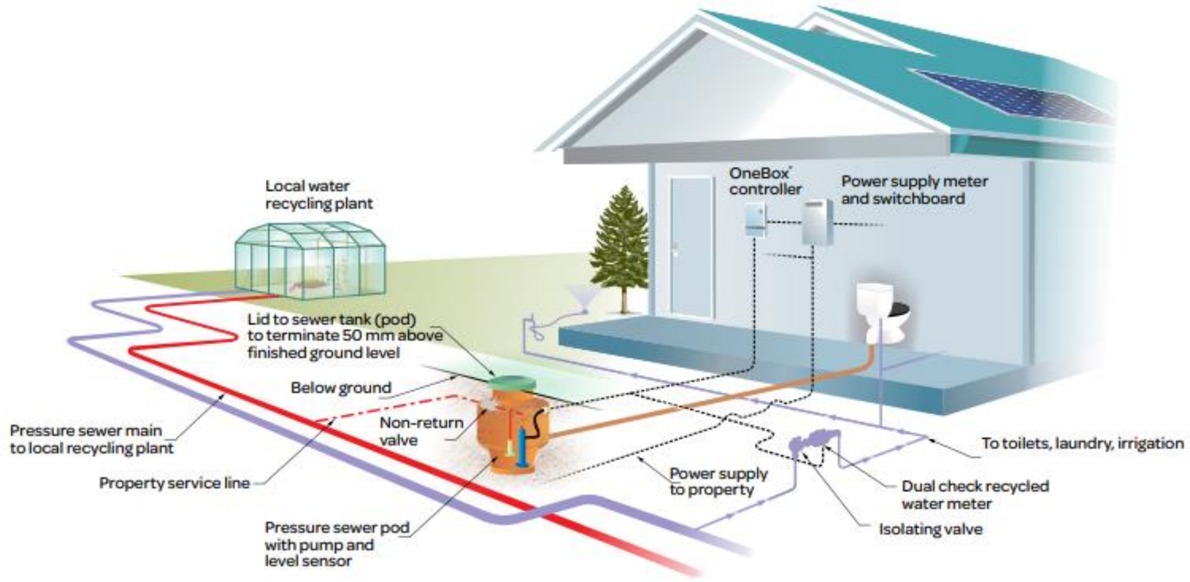


Figure 11-8 Pressure sewer systems

(Source: Southeast Water & Villawood Properties)

https://southeastwater.com.au/residential/upgrades-and-projects/projects/aquarevo/

11.5.1.8 Household Greywater Reuse Systems

Greywater is treated at a household scale for reuse at either the household or neighbourhood scale using the latest filtration technology. An example is the Hydraloop filtration systems, used in the Netherlands.

Key Considerations

Creation of self-sustaining homes can reduce water requirements for a home, development or precinct by up to 85%, increasing drought resilience, sustainability and adaptability. These systems have been installed and are currently being scaled-up in several European countries.

Benefits include:

- Improved water efficiency as new household scale greywater filtration systems can enable reuse of up to 85% of household water
- Reduction in system water losses from storage evaporation & long-distance pipe networks
- Mains water supplementation only required during peak use periods

- Smart water quality monitoring systems can track the household filtration system function and water quality, automatically transferring to mains water if there is a system malfunction
- Implements circular economy principles within local precincts

Implementation recommendations

Medium: The potential for cross connections into drinking water systems need to be carefully managed.

Ownership and operation

Ownership is generally at the household level, with cost of system repairs borne by the householder, unless different business models are considered at either the precinct or Sub-Regional scale.

Current utility business models would need to be redesigned, as mains water use would be significantly reduced.

Procurement complexity

Medium: Household systems are $3-4k for installation, plus ongoing maintenance, which is currently in the range of $200 per year.

Figure 11-9 Household greywater reuse

(Source: C.Thrupp, WaterInnov8)

11.5.1.9 Sustainable Neighbourhoods, with ability to Store and Share Water and Energy

Neighbourhood micro-grids for energy and/or water, usually consisting of household solar or water reuse/generation systems, with infrastructure to connect multiple homes in a local area and/or infrastructure to capture excess energy and peak water for later use in the neighbourhood.

Some examples include:

- Solshare - Village Solar Sharing Project https://me-solshare.com/
- Sustainable neighbourhood with hydropanels for water supply, hydraloop reuse & tank storage

Key Considerations

Sustainable homes and neighbourhoods are increasingly being sought after by climate conscious homeowners, with a range of different designs and scales currently being developed around the world. Creating these sustainable neighbourhoods can combine a range of new technology for energy, water and waste management. Trials are still exploring the scales at which such neighbourhoods are most cost effective.

Energy micro-grids are being developed in many countries around the world, with some of the more advanced approaches enabling new business models for local residents to earn an income from their local infrastructure. Water micro-grids are in early-stage development, usually combined with solar panels for electricity supply and incorporating various household air-water converters and/or water reuse technology.

Implementation recommendations

Medium to high: More sustainable homes and neighbourhoods will minimise the overall water and energy requirements for a development and region.

Ownership and operation

Utilities/ local authorities: new business models will need to be considered for utilities, Councils and landholders. Software-as-a-service platforms now exist to enable effective coordination, monitoring and management of numerous smaller systems.

Procurement complexity

Managing multiple individual systems across each household requires additional coordination and can be more expensive to maintain at larger scales

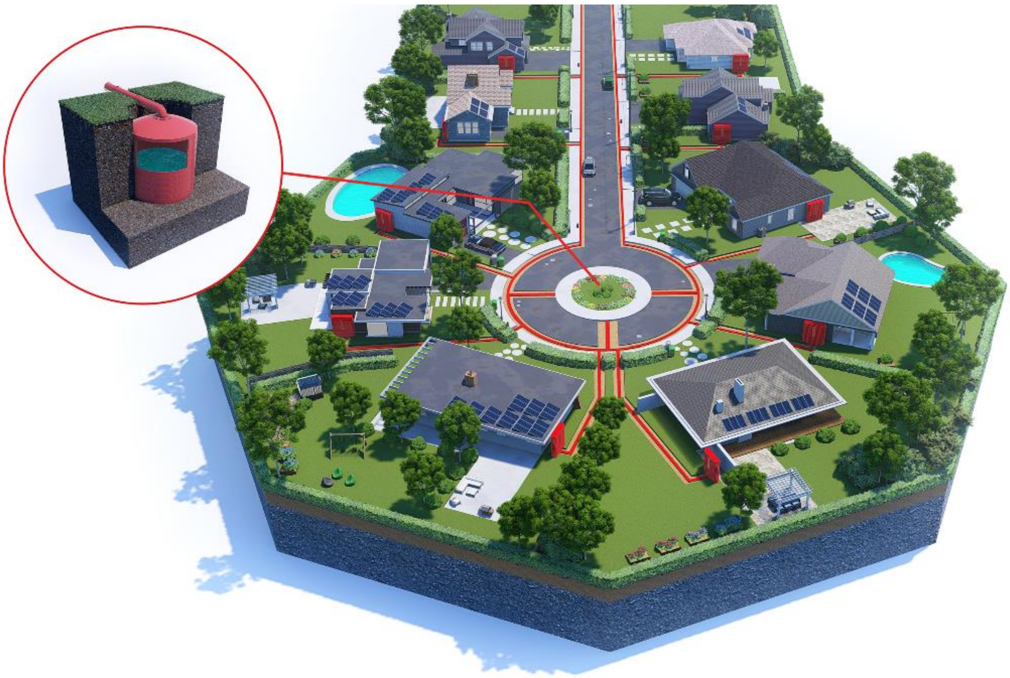


Figure 11-10 Neighbourhood water sharing

(Source: C. Thrupp, WaterInnov8)

11.5.1.10 Integrated Water Servicing – Smart Systems to Manage the Water Cycle

Intelligent utilisation of multiple water resources (e.g. drinking water, recycled water, stormwater) to provide increased water security and reduce environmental impacts. An example is the Aquarevo, Rainwater Tank Smart Monitoring System

Key Considerations

The traditional approach to water management in urban developments is a linear one. Clean water is produced, imported and used (i.e. made dirty) and is then removed, treated to some degree, and disposed. A key limitation of this approach is that all water is treated to a drinking water standard at a high cost, as there is no ability to provide a lower quality water for non-drinking uses.

An integrated water servicing strategy allows the introduction of additional water resources, with the ability to utilise each for different purposes (and potentially even at different times), based on demand, availability, and quality.

Examples include local capture of rainwater for non-drinking but close contact uses (e.g. supplying laundry, hot water systems), recycled wastewater for non-drinking, low contact uses (e.g. toilet flushing, lawn/garden watering) and drinking water for other domestic purposes. Drinking water can also be plumbed to rainwater tanks to provide a top-up during periods of low rainfall and rainwater tanks can be equipped with smart sensors to drain before a storm; thereby reducing the peak stormwater load during the event.

For community green space, stormwater can be harvested locally and provided as an irrigation water source, backed up by recycled wastewater for irrigation during dry periods.

Typically, harvested rainwater would still require treatment on-site as there is a risk of faecal contamination (bird, vermin etc) or direct vermin entry to the tank. This necessitates on-site treatment, including some type of disinfection.

Further information

- https://www.fishermansbend.vic.gov.au/framework

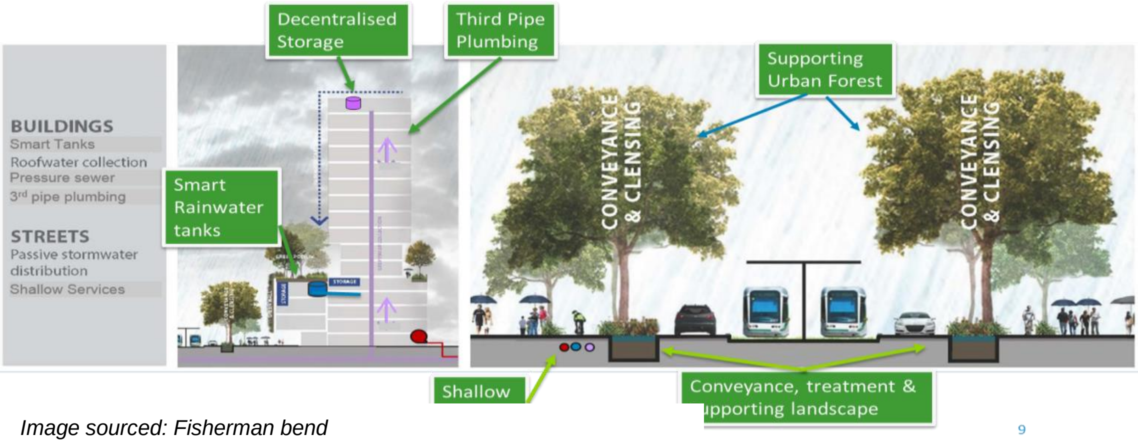


Image sourced: Fisherman bend

Figure 11-11 Example of integrated water supply

Implementation recommendations

Medium. The benefits of integrated water servicing using smart systems include:

- Significant savings in drinking water demand can be achieved
- Stormwater flow reduction (environmental benefit)
- Reduced environmental release of wastewater (and potential benefits of recycled nutrients on irrigated areas)
- Multiple sources of irrigation water to keep community open space green

Ownership and operation

Utility/ local authorities, however onsite treatment and monitoring equipment requires maintenance and Utilities are typically averse to this level of complexity/risk

There is no control or visibility over plumbing works on private property, which could lead to cross-connections or inappropriate water use.

Multiple pipe networks can lead to confusion and any cross-connection of a drinking water supply with another water source can potentially lead to health impacts and/or significant negative reputation impacts

11.5.1.11 Recycled Water Distribution through Stormwater Drainage Network

One of the significant costs in recycled water supply is the cost of distribution and reticulation pipes. An alternative is to use the stormwater drainage system in dry weather when the pipe capacity is unused. The recycled water supply pipe can then be run up the ridge of development with remotely controlled valves to release water into the drain. Water would then run along the drain to the point of demand where it is extracted for use. This maximises the drain's capacity as it is used for dual purposes (stormwater and recycled water) and reduces the cost of recycled water distribution.

Image sourced: Utility Magazine, 2020

Figure 11-12 Illustrative image of water

Key considerations

Key considerations for these examples include topographical constraints, local government appetite, state government support, responsible water authority support, strong customer base and co-location.

Implementation recommendations

Moderate: Opportunity to enhance water recycling and stormwater harvesting resilience, by supplying recycled water into the drainage system to deliver water on demand to the downstream user. Requires a significant downstream irrigation water user(s) as the customer of the scheme. Including regulatory approval and control mechanisms to ensure all recycle water is captured.

Ownership and operation

As the system is an interconnected network it requires centralised management and control. It is logical that the system is operated by local government or the local water authority. However, some assets like extraction pumps and tanks may be privately owned and centrally controlled. Customers would then be able to purchase recycled water directly from the local authority.

Procurement complexity

High: The system could be part of a water security or discharge reduction strategy saving major head works provided by the water authority. The system could also be delivered by the developer in accordance with water authority infrastructure requirements, to be provided to the water authority.

11.5.1.12 Distributed Storage and Smart Systems

Traditional water, sewer and drainage systems are sized for a theoretical worst-case event which occurs rarely. Peak demand for water is 1 in 20 years, design flows for sewer typically are a 1 in 5-year storm event, and peak stormwater for drainage design are a 1 in 100-year flood.

Distributed storages can store these extreme peaks and balance the piped flows in the networks. This is the principal used with retarding basins and water transfer systems, however with a level of conservatism because they are uncontrolled. With an overlay live control on the systems moderating for circumstance, these systems can be worked even harder. For example, providing for future balancing, storage can halve the size of sewage pump stations (from 6* to 3*ADWF), reduce the size of rising mains and impacts on the downstream network, reducing sewage age and odour. In greenfield developments, storage does not need to be built until the catchment is substantially developed and concurrent if the system is monitored for performance. Pressure sewers take this concept to another level. Pump stations poll and wait to share the use of the collection network, so a pipe that services 5 pumps at once, can service 50 pumps overall.

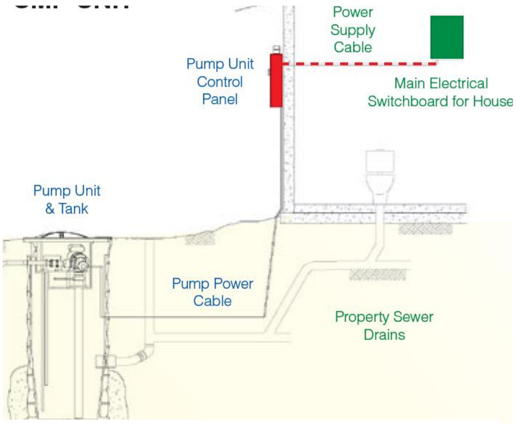


Image sourced: River Shield Southeast Water

Figure 11-13 Example of a distributed storage and smart system

Key considerations

Key considerations for these examples include topographical constraints, local government appetite, state government support, responsible water authority support, strong customer base and co-location.

Implementation recommendations

High: to actively control the operation to the live circumstance. Opportunities currently exist to incorporate this IWM sewer solution. Locations that include high cost long transfer pipes will benefit from the use of storage to smooth peak flows rather than build larger pipes for an occasional peak event. To mitigate the risks smart control is proposed

Ownership and operation

The distributed system and smart control would be owned and operated by the responsible water authority.

Procurement complexity

Moderate: The system requirements and management would be defined by the water authority and delivered either by the water authority or a developer, as part of infrastructure works to be provided to the water authority.

Further information

Kansas City, Missouri: https://www.smartcitiesworld.net/special-reports/special-reports/smart-sewers-smart-cities-start-eight-feet-below-the-ground

11.5.1.13 Green Waste Reuse for Energy/Water Generation

Instead of sending green waste to landfill, emerging technology can be used to reuse green waste at a local scale for the production of energy and water.

Australian households throw out approximately 2.6 million tonnes of food waste every year, which combines with garden waste to comprise 50% of the total waste from households annually. This organic waste is currently going to landfills, where it is untreated, releasing methane gas to the atmosphere (estimated at 15.3kg methane gas per household per year) (www.metropolitantransferstation.com.au).

An example is the WeDew Sustainable Energy-Water Generator https://www.skysource.org/wedew

Key Considerations

There is new technology available, which is being trialled at differing scales in America and Africa. It uses biomass gasification to create both renewable energy and water for a local neighbourhood. The system is designed at a shipping container scale, capable of creating 25kWh of energy and 2000L of potable water every 24 hours (at a production cost of $0.02 USD per litre).

Implementation recommendations

- Effective reuse of organic material, reduction in volume of waste to landfills and decrease in methane production from landfills
- Cost effective means of producing energy and water
- Smart monitoring systems track the system operation and notify if there is a system malfunction
- Use of circular economy principles to create sustainable neighbourhoods
- Increased drought resilience and sustainability in local communities

Ownership and operation

Current utility business models would need to be redesigned to accommodate the way that waste, water and energy is being managed at this local scale, as well as ensuring coordination across neighbourhoods

Effective neighbourhood scales would need to be trialled to optimise system efficiency and coordination.

11.5.1.14 Biogas Generation from Wastewater for Energy

Urban wastewater is becoming recognised less as a waste product and more as a potential resource. Not only can biosolids be utilised beneficially on farms but wastewater sludge can be broken down to produce biogas, which in turn can be utilised to produce energy. The gas production process is referred to as anaerobic digestion and involves breakdown of organic matter by microorganisms in the absence of oxygen (e.g. in a sealed vessel or reactor). As the organic matter is digested, biogas is produced. The biogas will consist of a relatively high proportion of methane, which is a gas that can be utilised as a fuel for energy production.

An example is the Sydney Water – Malabar Wastewater Treatment Plant

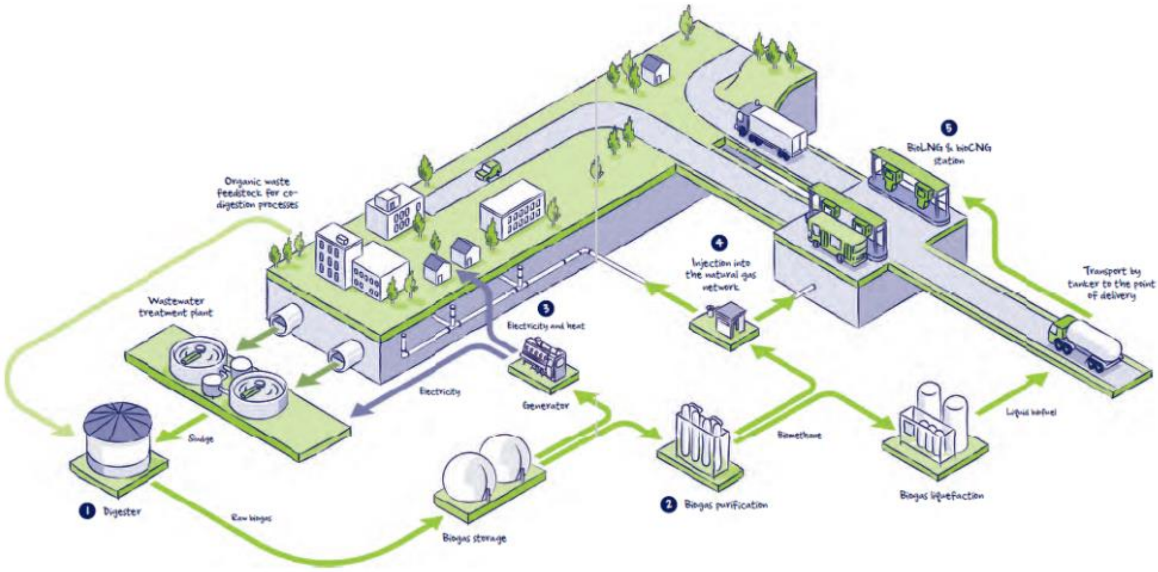


Figure 11-14 Biogas generation loop

(Source: Suez)

https://www.suez.com.au/-/media/suez-au/files/publication-docs/products-and-services/suez_anz_switching_on_biogas_resource.pdf

Key Considerations

Wastewater treatment is an energy intensive process and is becoming increasingly so as environmental regulation increases and pollutant release limits become more stringent. The cost of energy is also increasing, which is often a significant proportion of a wastewater treatment plant's operational cost.

Biogas production and onsite utilisation can help to reduce the overall energy footprint of a wastewater treatment plant. It can be beneficial in both reducing the long-term operational costs of the plant but also play a role in mitigation of energy related climate change impacts.

Where decentralised systems are being proposed, engineering a wastewater treatment plant that is partially or fully self-powered through renewable energy may also increase the appeal when it comes to identifying and securing a long-term Operator.

Implementation recommendations

Medium. The benefits of this type of system include:

- Source of energy to offset cost of operating wastewater treatment plant
- Sewage sludge is a reliable resource for renewable energy production (i.e. not dependant on sun or wind)
- Lower CO2 footprint for the wastewater treatment plant as lower external energy inputs are required (assuming existing energy supply involves fossil fuel consumption)
- Reduces wastewater sludge that needs to be disposed of to landfill
- Potential to accept other wastes for a fee (where beneficial to the digestion process)
- A key challenge is that gas production significantly benefits from external/ imported carbon inputs (e.g. food processing waste).

Ownership and operation

Utility/ local authority due to operations and maintenance requirements – this is a high-tech process requiring ongoing oversight and management.

Procurement complexity

Medium to **high** – While the costs of this approach are still being determined via trial programs, the costs are expected to be relatively high. This is not only for the additional infrastructure at the wastewater treatment plant but also the expertise required in the design, build, operation and maintenance of the infrastructure. Although there are a number of successful case studies abroad, the technology is not yet widespread in Australia. Yield may also be highly dependent on the external inputs that can be sourced. All of these factors mean that it may be difficult to prepare a reliable business case at the moment but this will improve with time.

Existing projects are predominantly large scale (i.e. city scale); smaller scale projects are relatively rare and may be difficult to justify economically

11.5.1.15 Aquifer Storage & Recovery

Water is stored in underground aquifers during rainfall and flood events or from recycled water for later use, especially during droughts. Examples include:

- Water Corporation in Western Australia https://www.watercorporation.com.au/Our-water/Groundwater/Groundwater-replenishment
- Austin, Texas – Aquifer Storage Program http://austintexas.gov/department/water-forward-drought-supplies .

Key Considerations

Aquifer storage is being increasingly used in dry areas around the world. If designed well, this strategy can capture some of the peak flows, reduce water loss from evaporation in surface water storages and reduce distances from water storage to point of use.

Implementation recommendations

Low to Medium: The aquifer recharge potential in the PDA is not well understood due to limited data. Porosity of aquifers would need to be understood to ensure that water losses through the soil profile were minimised. However, the benefits of these systems include:

- Reduction in peak flows
- Less water loss from evaporation
- Smaller distances for transport of water to point of use
- Less energy required for water supply

Ownership and operation

Utility/ local authority due to careful management of environmental requirements.

Procurement complexity

Medium to High: considerable research would need to be undertaken of the aquifer as well as trials/pilots to understand impacts and manage the process.

11.5.1.16 New Pipe Technology

There are a range of new in-pipe technologies that can ensure that maximum benefit is obtained from pipe infrastructure. These include in-pipe water filtration and energy generation. Examples include:

- In-Pipe Energy Generation https://www.cleantechconcepts.com/2017/02/lucid-energy-has-a-creative-use-for-water-pipes/
- Wastewater biopipe treatment systems https://www.biopipe.co/

Key Considerations

Water and sewer pipes have traditionally been considered for one purpose; however, new technology enables these pipes to have multiple purposes. Where this new technology has been applied in other areas of the world, it has been used for a range of reasons, from reducing the ongoing maintenance costs across the lifecycle of the pipe network, improving water quality, through to supplementation of local energy supply.

Implementation recommendations

Medium - the benefits include:

- Improved water efficiency
- Energy generation
- Improved water quality at water treatment plants and/or overflows to the environment
- Multiple benefit pipes

Ownership and operation

Utility/ local authority

Procurement complexity

Medium to **High** - Depending on technology being implemented, initial cost of pipe installation is likely to be higher than traditional methods. Given the early stage of some of these technologies, ongoing maintenance costs of these pipes are not fully understood yet. However, other countries are implementing these solutions, so data will be rapidly building up to address any gaps in knowledge.

11.5.1.17 Rapid Water Treatment Systems

New technology is enabling faster, high level water treatment, with treatment times down to 30 minutes. This is particularly useful for sewer or combined sewer overflows during a storm event. Examples include:

- Rapid Radicals Technology – Wastewater Treatment, Wisconsin https://www.rapidradicals.com/

Key Considerations

Wastewater treatment plants are unable to cope with peak flows during a storm event, so sewer and combined systems are designed to overflow to the natural environment during storms. This results in untreated wastewater and stormwater flowing into local creeks, rivers and the ocean. The ability to treat water quickly provides the opportunity for high level treatment of this water during storms prior to release into local waterways.

Implementation recommendations

Low: This is early-stage technology just being implemented in the USA, so costs and retrofit design options are still being fully understood. However benefits include:

- Improved water quality being released to creeks, rivers and oceans
- Improved treatment efficiency
- Reduction in human health risks associated with use of recreational waters
- Reduction in back-up of water within pipes during storms

Ownership and operation

Utility/ local authority

Procurement complexity

High: this is early-stage technology and implementation costs are expected to be high.

11.5.1.18 End of Pipe Treatment Systems

Emerging technology is enabling filtration of water at the end of pipe. This will enable better water quality being released into local creeks, rivers and the ocean. Examples include:

- Carbon Fibre Aerogel https://www.ecoworth-tech.com/what-is-cfa

Key Considerations

Untreated stormwater and wastewater overflows are released to the natural environment during storms. This results in a release of pollutants to the environment and deterioration of water quality in local creeks, rivers and the ocean. The ability to screen or treat water prior to release into the natural environment would improve waterway health, reduce plastics in the ocean and improve recreational water quality for swimmers.

Implementation Recommendations

Low to **medium**: This is early-stage technology just being implemented in Singapore, so costs and design options are still being fully understood. Benefits include:

- Improved water quality being released to creeks, rivers and oceans
- Reduction in human health risks associated with use of recreational waters
- Reduction in plastic release to waterways and the ocean

Ownership and operation

Utility/ local authority due to operations and maintenance requirements.

Procurement complexity

High: this is early-stage technology and implementation costs are expected to be high.

11.5.1.19 Smart City/Smart Monitoring Systems

Sensors embedded into stormwater, sewer and other networks to track real-time performance, with data captured in cloud-based software-as-a-service programs to provide graphic dashboards for managers to action. Examples include:

- Stormsensor, USA https://www.stormsensor.io/
- Io Tank, San Francisco https://www.iotank.org/
- Data Technics, Bermingham http://datatecnics.com/

Key Considerations

Traditional monitoring has been undertaken manually at the end of pipe or via in-pipe cameras being used to look at the condition of pipes. This monitoring is usually retrospective, often triggered when there is a leak or release of contaminants to the environment. It can be expensive and is not effectively scalable to entire pipe networks.

New technology allows for sensors to be built into the pipe network to create real-time data on pipe condition, water quality, flow and other key measures. This enables rapid response teams to fix a problem before contamination or water loss occurs. It also enables optimisation of the water network management & maintenance.

Implementation recommendations

Medium to **High** – the benefits include:

- Real time data for improved management of water supply and water quality
- Retrofitting of sensors is possible
- Proactive management of the water network across the asset lifecycle
- Adaptable embedded sensors can be effectively built into all new developments, if considered early in the design phase

Ownership and operation

Utility/ local authority

Procurement complexity

Medium – recommended to be designed for co-installation during installation of infrastructure as it can be capital intensive to install sensors retrospectively.

11.5.1.20 Integrated Flood Detention Systems

Flood detention is commonly provided in urban developments and is often designed to ensure no increase in flooding at the development boundary. In many cases, a site-by-site basis to flood detention, using only site-specific design storms, may result in poor outcomes such as increased flooding due to disparate flood detention systems causing coincidence of flood peaks. Examples include:

- CRC for Water Sensitive Cities – Sponge City Innovation Park, China
- CRC for Water Sensitive Cities – Forest Park Ecological Wetland

Key Considerations

Flood detention is typically provided on a site-by-site basis, with the generally accepted objective of ensuring no worsening of flood peaks at the development boundary, for one set of specific design storm temporal patterns. Such detention is rarely designed with regard to the wider catchment context.

A catchment-wide coordinated approach to flood detention is most likely approach to ensure that flood detention is delivered in the most efficient and effective manner.

Note a Sub-Regional approach might entail:

- Having a small number of larger Sub-Regional detention basins sited at catchment outlets,
- A distributed approach where a large number of smaller basins are planned and designed to deliver a clear overall purpose.

A study by Ronalds and Zhang (2019) used a probabilistic Monte Carlo analysis to evaluate various flood detention approaches and assess how flood detention performs in various parts of a catchment. It found that detention can reduce the chance of increased runoff from 99% to less than 8% when a land parcel is in the upper reaches of a catchment. In the lower portion of the same catchment, the same detention has a 72% chance of increasing runoff, compared to a 58% chance without.

Implementation recommendations

Medium – development would require coordination by developers and regulators. Benefits include:

- Beneficial flood management outcomes
- More efficient land use with less land dedicated to flood detention with low effectiveness.

Ownership and operation

Utility/ local authority.

Procurement complexity

Medium to **high** - Costs of these systems will vary depending on catchment hydrology and ultimate development scenarios. Typical costs for on-site underground stormwater detention systems range from \$300 - \$1000/m³. A contribution scheme would need to be established to ensure equitable contributions to Sub-Regional detention basins.

Further information

- Greening Australia – Tackling Heat Island Effect: https://www.greeningaustralia.org.au/how-can-nature-help-tackle-the-urban-heat-island-effect
- City of Sydney Greening Sydney Plan: https://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0009/135882/GreeningSydneyPlan.pdf
- https://www.cityofsydney.nsw.gov.au/vision/better-infrastructure/streets-and-public-places/completed-works/greening-our-streets
- Urban Heat Island effect: https://watersource.awa.asn.au/environment/built-environment/losing-our-cool-how-water-can-help-combat-urban-heat/

- City of Yarra Green Infrastructure Best Practice Toolkit: https://www.yarracity.vic.gov.au/about-us/sustainability-initiatives/embedding-green-infrastructure-toolkit
- Cooperative Research Centre for Water Sensitive Cities – Ideas for Fisherman's Bend: https://watersensitivecities.org.au/wp-content/uploads/2016/04/Ideas-for-FishermansBend-REPORT.pdf
- Yarra Council Toolkit – practical options: http://www.wdc.govt.nz/PlansPoliciesandBylaws/Plans/State-of-the-Environment/Pages/Blue-Green-Network-Strategy.aspx
- Heat Island Effect – Penrith City Council: Cooling the City:
- https://www.yoursaypenrith.com.au/25909/widgets/192402/documents/151999
- US EPA – Heat Islands: https://www.epa.gov/heatislands
- CoolSeal Pavement: https://guardtop.com/coolseal/
- https://www.charlessturt.sa.gov.au/environment/climate-change/coolseal

11.5.1.21 Integrated Stormwater Management – Decentralised Stormwater Capture

Householders in a catchment are provided with smart rainwater tanks that can be controlled from a central location so that they act as decentralised storage. Each tank's drain valve is centrally controlled to release water to the central drainage system. When the customer requires water there is a controlled release of water to the drain system to meet the customer needs, who then draws from the downstream drain. This system is like irrigation modernisation where the farmer orders water from the dam and it is delivered via irrigation channels. The Smart Water Victoria trial did this with household tanks, but it could also be applied to upstream community storages or even controlled wetlands.

Key considerations

Key considerations for these examples include topographical constraints, local government appetite, state government support, responsible water authority support, strong customer base and co-location.

Implementation recommendations

Moderate: Opportunity to enhance stormwater harvesting, retardation and nutrient reduction by using upstream storage to deliver water on demand to the downstream users requires a significant downstream irrigation water user(s) as the customer base of the scheme. Using decentralised storage systems and tanks to hold the available water source also requires customer education.

Ownership and operation

Given the system is an interconnected network that requires centralised management and control it is logical it be operated by local government. However, some assets like rainwater tanks may be privately owned and controlled, resulting in customers then having to purchase alternative water from the council.

Procurement complexity

Moderate: Has the potential to form part of an alternative flood mitigation and nutrient reduction strategy saving downstream works and therefore should be provided by the developer as part of required drainage solutions. Alternatively, it may form part of a water supply scheme delivered by the developer with additional costs funded by the alternative water supply. Subject to local government policy position and resource allocations.

Further information

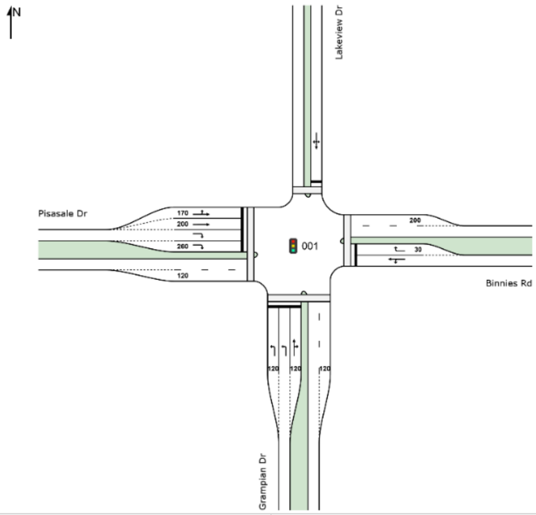
- https://www.stormwater.asn.au/images/Conference_Papers/Stormwater12/McGrath_Jonathan_et_al_-_Non_Refereed_Paper.pdf

Appendix A - SIDRA intersection layouts

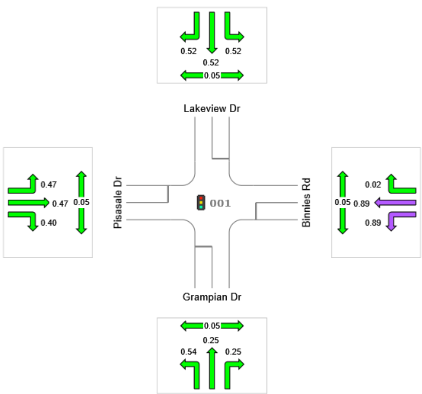
1 Intersection R1001

2031

SITE LAYOUT – R1001 – 2031



DEGREE OF SATURATION AM



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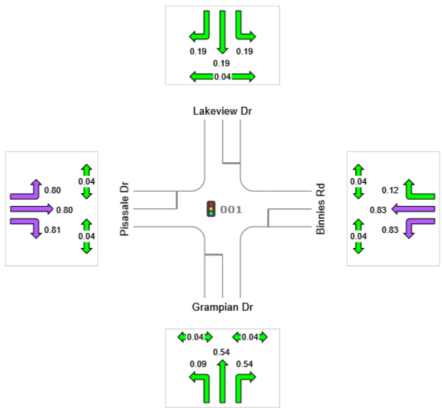

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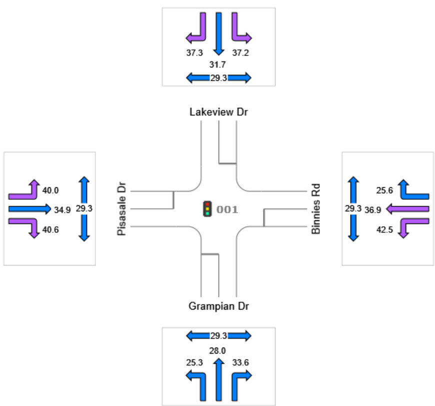

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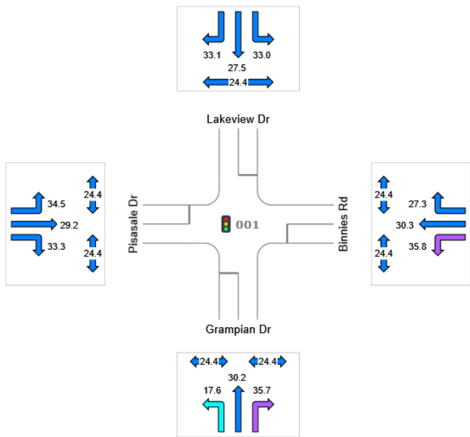


Intersection R1001 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 001 [2031 AM FINAL]

R1001
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Grampian Dr													
Lane 1	222	1.1	632	0.351	65 [6]	24.3	LOS C	5.7	40.5	Short	120	0.0	NA
Lane 2	340	1.1	632	0.538	100	25.9	LOS C	9.5	67.3	Full	500	0.0	0.0
Lane 3	78	1.4	317	0.246	100	33.1	LOS C	2.4	16.9	Short	120	0.0	NA
Approach	639	1.2		0.538		26.2	LOS C	9.5	67.3				
East: Binnies Rd													
Lane 1	472	0.2	529 [1]	0.891	100	38.0	LOS D	19.2	134.6	Full	500	0.0	0.0
Lane 2	11	0.0	504	0.021	100	25.6	LOS C	0.3	1.8	Short	30	0.0	NA
Approach	482	0.2		0.891		37.7	LOS D	19.2	134.6				
North: Lakeview Dr													
Lane 1	126	2.5	245	0.515	100	36.5	LOS D	4.2	30.3	Full	500	0.0	0.0
Approach	126	2.5		0.515		36.5	LOS D	4.2	30.3				
West: Pisasale Dr													
Lane 1	84	0.6	180	0.465	100	35.7	LOS D	2.9	20.4	Short	170	0.0	NA
Lane 2	77	0.7	166	0.465	100	35.4	LOS D	2.7	19.1	Short	200	0.0	NA
Lane 3	42	1.0	158	0.264	67 [6]	40.2	LOS D	1.4	10.1	Full	500	0.0	0.0
Lane 4	63	1.0	158	0.396	100	40.8	LOS D	2.2	15.4	Short	260	0.0	NA
Approach	265	0.8		0.465		37.5	LOS D	2.9	20.4				
Intersection	1513	0.9		0.891		32.7	LOS C	19.2	134.6				

Intersection R1001 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 001 [2031 PM FINAL]

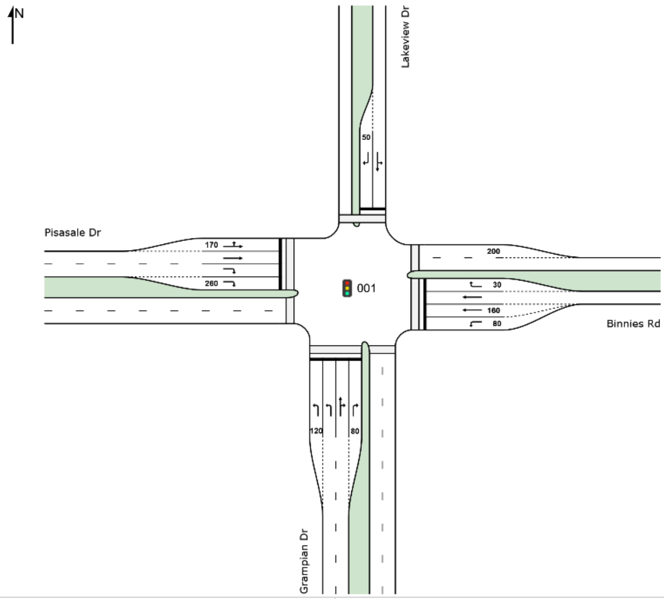
R1001
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

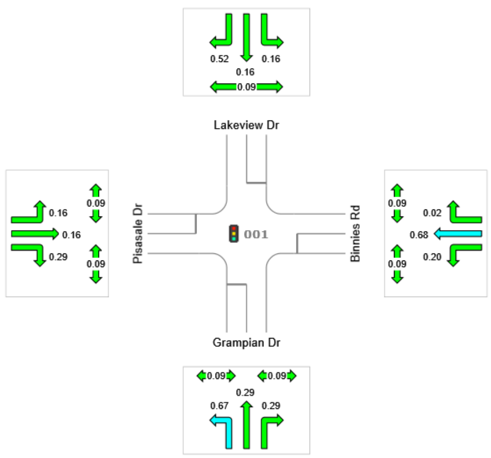
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Grampian Dr													
Lane 1	43	0.0	743	0.058	65[6]	17.5	LOS B	0.8	5.4	Short	120	0.0	NA
Lane 2	66	0.0	743	0.088	100	17.6	LOS B	1.2	8.4	Full	500	0.0	0.0
Lane 3	101	0.0	186	0.543	100	35.4	LOS D	3.1	21.5	Short	120	0.0	NA
Approach	209	0.0		0.543		26.2	LOS C	3.1	21.5				
East: Binnies Rd													
Lane 1	335	0.3	402[1]	0.833	100	32.2	LOS C	11.0	77.0	Full	500	0.0	0.0
Lane 2	44	0.0	371	0.119	100	27.3	LOS C	1.1	7.7	Short	30	0.0	NA
Approach	379	0.3		0.833		31.6	LOS C	11.0	77.0				
North: Lakeview Dr													
Lane 1	39	0.0	203	0.192	100	32.5	LOS C	1.1	7.7	Full	500	0.0	0.0
Approach	39	0.0		0.192		32.5	LOS C	1.1	7.7				
West: Pisasale Dr													
Lane 1	322	0.1	401	0.803	100	30.1	LOS C	10.3	72.1	Short	170	0.0	NA
Lane 2	313	0.2	390	0.803	100	29.5	LOS C	10.0	70.1	Short	200	0.0	NA
Lane 3	191	5.9	356	0.536	67[6]	30.0	LOS C	5.3	38.7	Full	500	0.0	0.0
Lane 4	287	5.9	356	0.805	100	35.6	LOS D	9.3	68.2	Short	260	0.0	NA
Approach	1113	2.6		0.805		31.3	LOS C	10.3	72.1				
Intersection	1740	1.8		0.833		30.8	LOS C	11.0	77.0				

Intersection R1001-2041

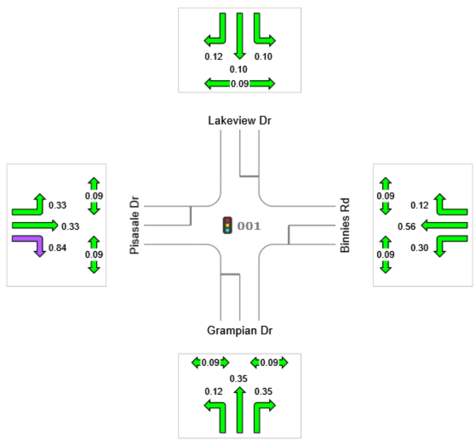
SITE LAYOUT – R1001 – 2041



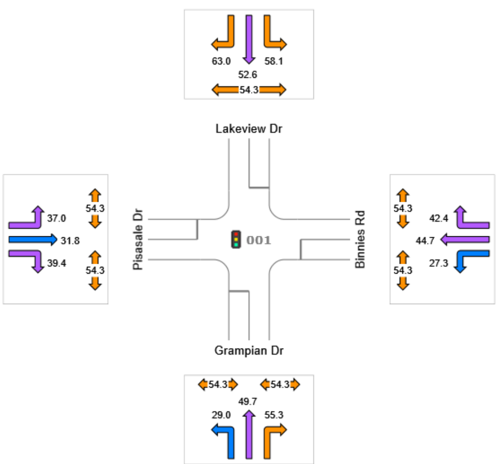
DEGREE OF SATURATION AM



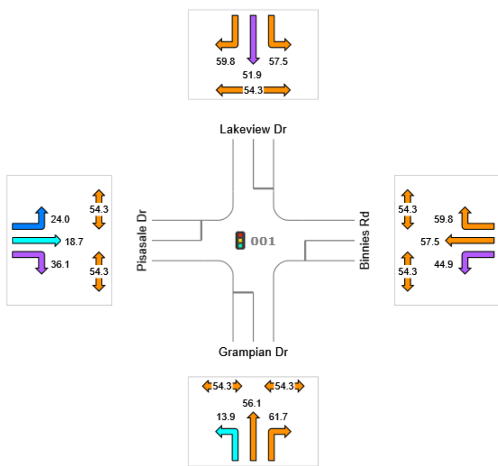
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1001 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 001 [2041 AM FINAL]

R1001
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Grampian Dr													
Lane 1	633	0.1	943	0.671	100	29.0	LOS C	27.3	191.3	Short	120	0.0	NA
Lane 2	633	0.1	943	0.671	100	29.0	LOS C	27.3	191.3	Full	500	0.0	0.0
Lane 3	81	0.6	280	0.291	100	54.3	LOS D	4.3	30.3	Full	500	0.0	0.0
Lane 4	81	0.7	277	0.291	100	55.3	LOS E	4.3	30.1	Short	80	0.0	NA
Approach	1427	0.1		0.671		31.9	LOS C	27.3	191.3				
East: Binnies Rd													
Lane 1	161	1.3	813	0.198	100	27.3	LOS C	5.7	40.2	Short	80	0.0	NA
Lane 2	319	0.3	470	0.679	100	44.8	LOS D	17.1	120.0	Short	160	0.0	NA
Lane 3	313	0.3	461 [1]	0.679	100	44.6	LOS D	16.7	117.2	Full	500	0.0	0.0
Lane 4	11	0.0	449	0.023	100	42.4	LOS D	0.5	3.2	Short	30	0.0	NA
Approach	804	0.5		0.679		41.2	LOS D	17.1	120.0				
North: Lakeview Dr													
Lane 1	34	0.0	209	0.161	100	54.6	LOS D	1.8	12.7	Full	500	0.0	0.0
Lane 2	96	0.0	186	0.516	100	63.0	LOS E	5.5	38.8	Short	50	0.0	NA
Approach	129	0.0		0.516		60.8	LOS E	5.5	38.8				
West: Pisasale Dr													
Lane 1	94	0.0	604	0.155	100	32.8	LOS C	3.9	27.4	Short	170	0.0	NA
Lane 2	93	0.0	601	0.155	100	32.1	LOS C	3.9	27.6	Full	500	0.0	0.0
Lane 3	166	0.0	573	0.290	100	39.4	LOS D	7.4	51.6	Full	500	0.0	0.0
Lane 4	166	0.0	573	0.290	100	39.4	LOS D	7.4	51.6	Short	260	0.0	NA
Approach	520	0.0		0.290		36.9	LOS D	7.4	51.6				
Intersection	2881	0.2		0.679		36.7	LOS D	27.3	191.3				

Intersection R1001 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 001 [2041 PM FINAL]

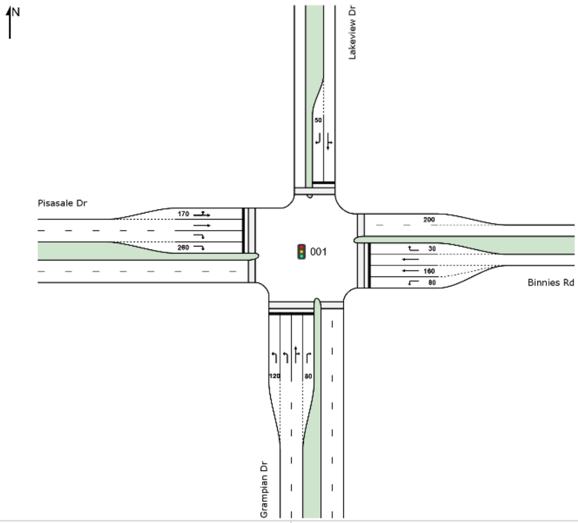
R1001
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

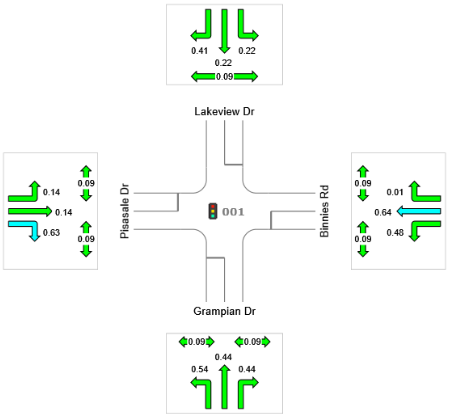
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Grampian Dr													
Lane 1	145	0.0	1207	0.120	100	13.9	LOS B	3.1	22.0	Short	120	0.0	NA
Lane 2	145	0.0	1207	0.120	100	13.9	LOS B	3.1	22.0	Full	500	0.0	0.0
Lane 3	65	0.6	189	0.347	100	59.3	LOS E	3.7	26.0	Full	500	0.0	0.0
Lane 4	64	1.0	184	0.347	100	61.8	LOS E	3.6	25.6	Short	80	0.0	NA
Approach	420	0.3		0.347		28.3	LOS C	3.7	26.0				
East: Binnies Rd													
Lane 1	139	0.0	464	0.299	100	44.9	LOS D	6.6	46.3	Short	80	0.0	NA
Lane 2	108	1.0	194	0.557	100	57.5	LOS E	6.3	44.1	Short	160	0.0	NA
Lane 3	108	1.0	194	0.557	100	57.5	LOS E	6.3	44.1	Full	500	0.0	0.0
Lane 4	22	0.0	186	0.119	100	59.8	LOS E	1.2	8.5	Short	30	0.0	NA
Approach	377	0.6		0.557		53.0	LOS D	6.6	46.3				
North: Lakeview Dr													
Lane 1	21	0.0	211	0.100	100	54.2	LOS D	1.1	7.9	Full	500	0.0	0.0
Lane 2	22	0.0	186	0.119	100	59.8	LOS E	1.2	8.5	Short	50	0.0	NA
Approach	43	0.0		0.119		57.1	LOS E	1.2	8.5				
West: Pisasale Dr													
Lane 1	317	0.1	972	0.326	100	19.8	LOS B	10.8	75.4	Short	170	0.0	NA
Lane 2	318	0.2	974	0.326	100	19.0	LOS B	10.9	76.6	Full	500	0.0	0.0
Lane 3	766	1.9	916	0.836	100	36.1	LOS D	40.2	286.1	Full	500	0.0	0.0
Lane 4	766	1.9	916	0.836	100	36.1	LOS D	40.2	286.1	Short	260	0.0	NA
Approach	2167	1.4		0.836		31.2	LOS C	40.2	286.1				
Intersection	3007	1.1		0.836		33.9	LOS C	40.2	286.1				

Intersection R1001-2066

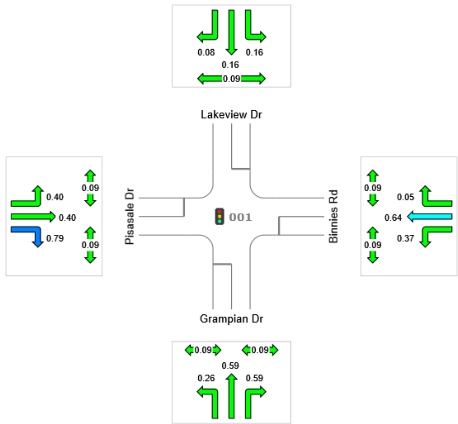
SITE LAYOUT – R1001 – 2066



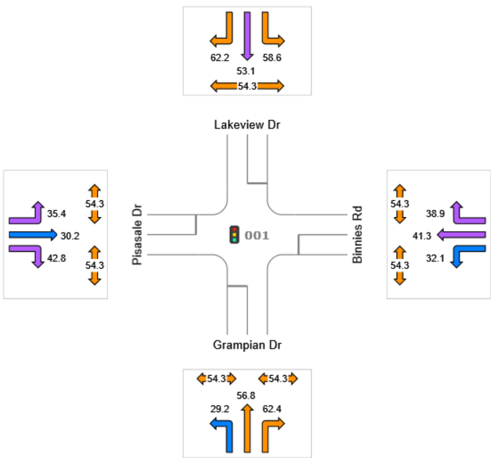
DEGREE OF SATURATION AM



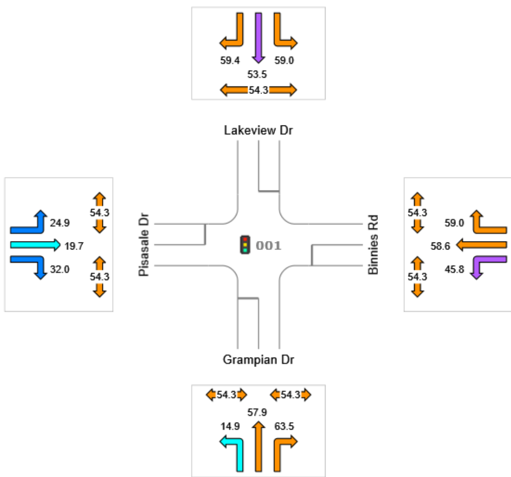
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1001 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 001 [2066 AM FINAL]

R1001
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Grampian Dr													
Lane 1	476	0.3	880	0.541	100	29.2	LOS C	19.5	136.8	Short	120	0.0	NA
Lane 2	476	0.3	880	0.541	100	29.2	LOS C	19.5	136.8	Full	500	0.0	0.0
Lane 3	81	1.2	185	0.437	100	61.8	LOS E	4.6	32.7	Full	500	0.0	0.0
Lane 4	80	1.4	184	0.437	100	62.4	LOS E	4.6	32.6	Short	80	0.0	NA
Approach	1114	0.5		0.541		34.0	LOS C	19.5	136.8				
East: Binnies Rd													
Lane 1	375	0.8	785	0.478	100	32.1	LOS C	15.7	110.6	Short	80	0.0	NA
Lane 2	343	0.6	534	0.642	100	41.4	LOS D	17.7	124.9	Short	160	0.0	NA
Lane 3	340	0.6	529 [1]	0.642	100	41.3	LOS D	17.5	123.5	Full	500	0.0	0.0
Lane 4	5	0.0	511	0.010	100	38.9	LOS D	0.2	1.5	Short	30	0.0	NA
Approach	1063	0.7		0.642		38.1	LOS D	17.7	124.9				
North: Lakeview Dr													
Lane 1	45	0.0	209	0.216	100	55.1	LOS E	2.5	17.3	Full	500	0.0	0.0
Lane 2	77	0.0	186	0.414	100	62.2	LOS E	4.4	30.7	Short	50	0.0	NA
Approach	122	0.0		0.414		59.6	LOS E	4.4	30.7				
West: Pisasale Dr													
Lane 1	90	2.0	627	0.144	100	31.0	LOS C	3.7	26.1	Short	170	0.0	NA
Lane 2	90	2.6	623	0.144	100	30.5	LOS C	3.7	26.3	Full	500	0.0	0.0
Lane 3	359	8.9	567	0.633	100	42.8	LOS D	17.9	135.1	Full	500	0.0	0.0
Lane 4	359	8.9	567	0.633	100	42.8	LOS D	17.9	135.1	Short	260	0.0	NA
Approach	899	7.6		0.633		40.4	LOS D	17.9	135.1				
Intersection	3198	2.5		0.642		38.1	LOS D	19.5	136.8				

LANE SUMMARY 2066 PM

Site: 001 [2066 PM FINAL]

R1001
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

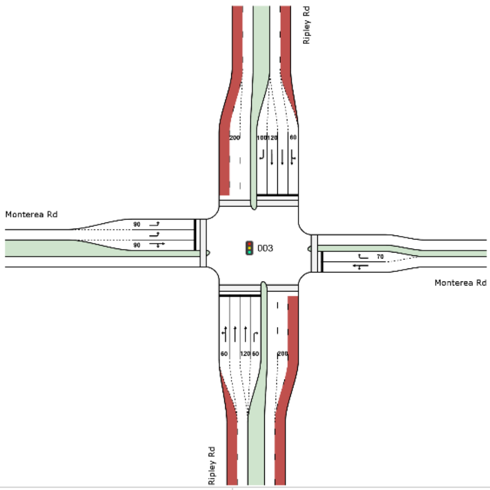
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Grampian Dr													
Lane 1	317	0.8	1200	0.264	100	14.9	LOS B	7.7	54.1	Short	120	0.0	NA
Lane 2	317	0.8	1200	0.264	100	14.9	LOS B	7.7	54.1	Full	500	0.0	0.0
Lane 3	111	1.0	188	0.589	100	61.3	LOS E	6.5	45.6	Full	500	0.0	0.0
Lane 4	109	0.0	186	0.589	100	63.6	LOS E	6.4	44.7	Short	80	0.0	NA
Approach	854	0.7		0.589		27.1	LOS C	7.7	54.1				
East: Binnies Rd													
Lane 1	174	0.0	464	0.374	100	45.8	LOS D	8.4	59.1	Short	80	0.0	NA
Lane 2	123	2.1	192	0.640	100	58.6	LOS E	7.3	51.8	Short	160	0.0	NA
Lane 3	123	2.1	192	0.640	100	58.6	LOS E	7.3	51.8	Full	500	0.0	0.0
Lane 4	9	0.0	186	0.051	100	59.0	LOS E	0.5	3.6	Short	30	0.0	NA
Approach	429	1.2		0.640		53.4	LOS D	8.4	59.1				
North: Lakeview Dr													
Lane 1	32	0.0	202	0.156	100	54.8	LOS D	1.7	12.0	Full	500	0.0	0.0
Lane 2	15	0.0	186	0.079	100	59.4	LOS E	0.8	5.6	Short	50	0.0	NA
Approach	46	0.0		0.156		56.3	LOS E	1.7	12.0				
West: Pisasale Dr													
Lane 1	392	0.6	969	0.405	100	20.2	LOS C	14.0	98.5	Short	170	0.0	NA
Lane 2	393	0.4	972	0.405	100	19.9	LOS B	14.2	99.9	Full	500	0.0	0.0
Lane 3	728	0.9	922	0.790	100	32.0	LOS C	34.9	246.2	Full	500	0.0	0.0
Lane 4	728	0.9	922	0.790	100	32.0	LOS C	34.9	246.2	Short	260	0.0	NA
Approach	2242	0.8		0.790		27.8	LOS C	34.9	246.2				
Intersection	3572	0.8		0.790		31.1	LOS C	34.9	246.2				

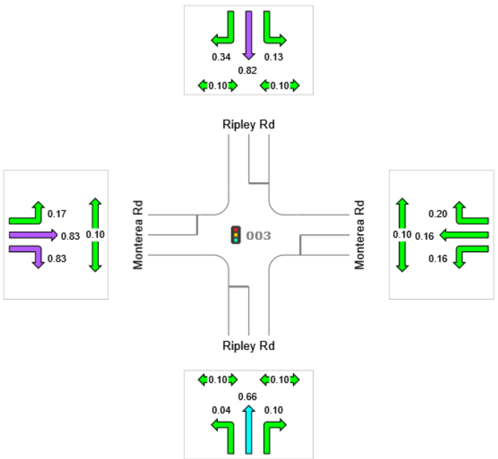
2 Intersection R1003

2031

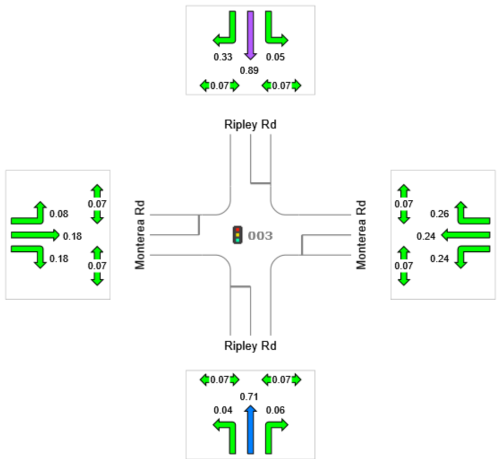
SITE LAYOUT – R1003 – 2031



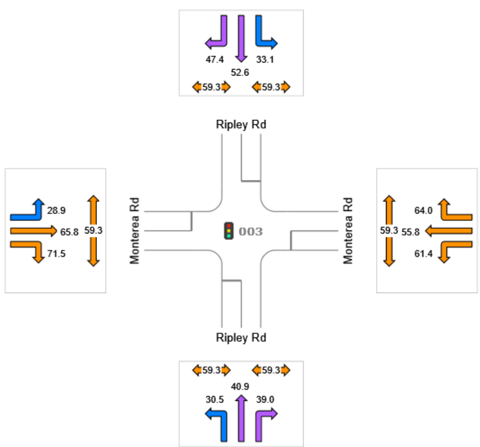
DEGREE OF SATURATION AM



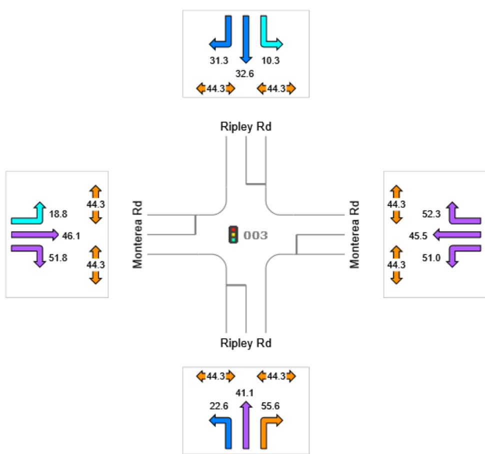
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1003 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 003 [2031 AM FINAL]

R1003
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 130 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Ripley Rd													
Lane 1	25	12.5	701	0.036	100	29.3	LOS C	1.0	7.4	Two Seg [10]	500	0.0	0.0
Lane 2	392	2.9	591 [1]	0.663	100	41.1	LOS D	21.3	152.8	Full	500	0.0	0.0
Lane 3	382	2.9	576 [1]	0.663	100	40.8	LOS D	20.7	148.2	Short	120	0.0	NA
Lane 4	58	1.8	578	0.100	100	39.0	LOS D	2.6	18.2	Short	60	0.0	NA
Approach	857	3.1		0.663		40.5	LOS D	21.3	152.8				
East: Monterea Rd													
Lane 1	37	0.0	226	0.163	100	58.2	LOS E	2.1	14.9	Full	500	0.0	0.0
Lane 2	40	2.6	196	0.204	100	64.0	LOS E	2.4	17.0	Short	70	0.0	NA
Approach	77	1.4		0.204		61.2	LOS E	2.4	17.0				
North: Ripley Rd													
Lane 1	82	12.8	654	0.126	100	32.5	LOS C	3.3	25.8	Two Seg [10]	500	0.0	0.0
Lane 2	367	6.9	448 [1]	0.818	100	52.4	LOS D	22.9	169.6	Full	500	0.0	0.0
Lane 3	399	6.9	488 [1]	0.818	100	52.9	LOS D	25.3	187.2	Short	120	0.0	NA
Lane 4	164	0.0	486	0.338	100	47.4	LOS D	8.4	59.0	Short	100	0.0	NA
Approach	1012	6.2		0.818		50.2	LOS D	25.3	187.2				
West: Monterea Rd													
Lane 1	136	0.4	812	0.167	100	28.9	LOS C	5.1	36.0	Short	90	0.0	NA
Lane 2	136	0.4	812	0.167	100	28.9	LOS C	5.1	36.0	Full	500	0.0	0.0
Lane 3	207	1.5	251	0.826	100	66.4	LOS E	13.9	98.8	Short	90	0.0	NA
Approach	479	0.9		0.826		45.1	LOS D	13.9	98.8				
Intersection	2424	3.9		0.826		46.1	LOS D	25.3	187.2				

LANE SUMMARY 2031 PM

Site: 003 [2031 PM FINAL]

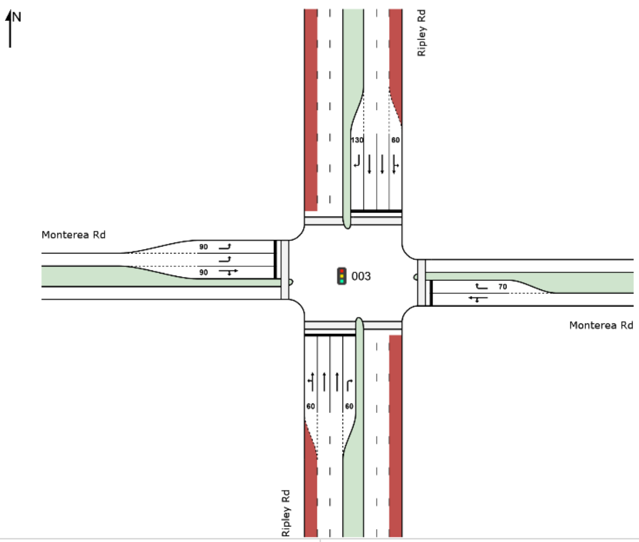
R1003
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

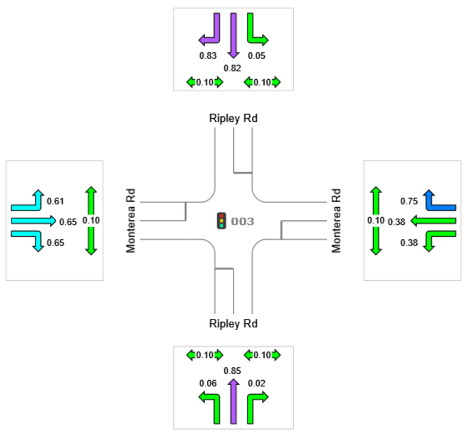
	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Ripley Rd													
Lane 1	20	21.1	448	0.045	100	20.7	LOS C	0.5	4.2	Two Seg [10]	500	0.0	0.0
Lane 2	289	1.5	406	0.714	100	41.3	LOS D	13.7	96.8	Full	500	0.0	0.0
Lane 3	289	1.5	406	0.714	100	41.3	LOS D	13.7	96.8	Short	120	0.0	NA
Lane 4	6	0.0	111	0.057	100	55.6	LOS E	0.3	2.1	Short	60	0.0	NA
Approach	605	2.1		0.714		40.8	LOS D	13.7	96.8				
East: Monterea Rd													
Lane 1	49	0.0	203	0.244	100	46.7	LOS D	2.3	16.0	Full	500	0.0	0.0
Lane 2	48	0.0	186	0.261	100	52.3	LOS D	2.3	15.9	Short	70	0.0	NA
Approach	98	0.0		0.261		49.4	LOS D	2.3	16.0				
North: Ripley Rd													
Lane 1	51	8.3	1041	0.049	100	9.5	LOS A	0.6	4.3	Two Seg [10]	500	0.0	0.0
Lane 2	769	2.2	868 [1]	0.886	100	32.7	LOS C	37.2	265.3	Full	500	0.0	0.0
Lane 3	755	2.2	853 [1]	0.886	100	32.7	LOS C	36.3	259.0	Short	120	0.0	NA
Lane 4	217	0.5	648	0.335	100	31.3	LOS C	7.8	54.7	Short	100	0.0	NA
Approach	1792	2.2		0.886		31.9	LOS C	37.2	265.3				
West: Monterea Rd													
Lane 1	77	0.0	947	0.081	100	18.8	LOS B	1.9	13.2	Short	90	0.0	NA
Lane 2	77	0.0	947	0.081	100	18.8	LOS B	1.9	13.2	Full	500	0.0	0.0
Lane 3	34	3.1	188	0.179	100	47.7	LOS D	1.6	11.2	Short	90	0.0	NA
Approach	187	0.6		0.179		24.0	LOS C	1.9	13.2				
Intersection	2682	2.0		0.886		34.0	LOS C	37.2	265.3				

Intersection R1003-2041

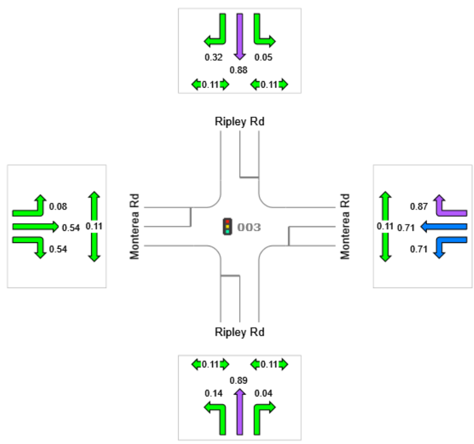
SITE LAYOUT – R1003 – 2041



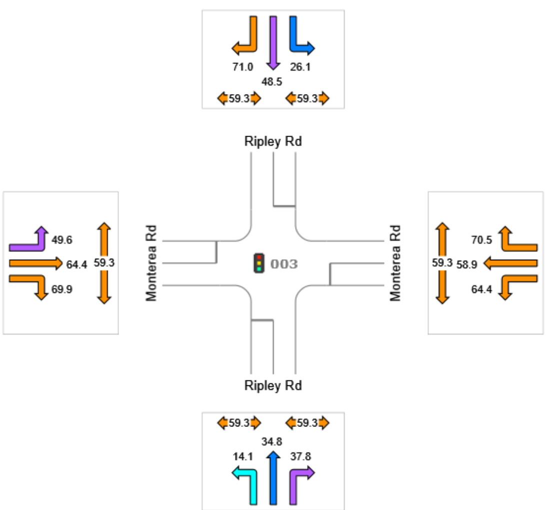
DEGREE OF SATURATION AM



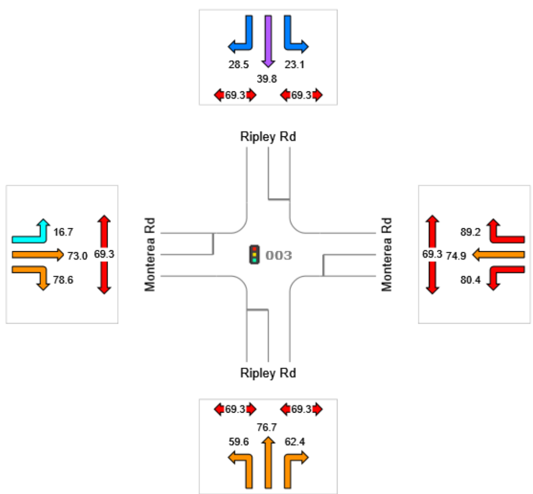
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1003 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 003 [2041 AM FINAL]

R1003
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 130 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Rd													
Lane 1	54	29.4	827	0.065	100	12.0	LOS B	0.9	7.8	Two Seg [10]	500	0.0	0.0
Lane 2	734	2.9	863 [1]	0.850	100	34.8	LOS C	41.6	298.8	Full	500	0.0	0.0
Lane 3	767	2.9	903 [1]	0.850	100	35.2	LOS D	44.4	318.6	Full	500	0.0	0.0
Lane 4	11	0.0	586	0.018	100	37.8	LOS D	0.4	3.1	Short	60	0.0	NA
Approach	1565	3.8		0.850		34.2	LOS C	44.4	318.6				
East: Monterea Rd													
Lane 1	80	2.6	210	0.381	100	59.7	LOS E	4.8	34.5	Full	500	0.0	0.0
Lane 2	148	0.7	199	0.746	100	70.5	LOS E	9.7	68.5	Short	70	0.0	NA
Approach	228	1.4		0.746		66.7	LOS E	9.7	68.5				
North: Ripley Rd													
Lane 1	24	52.2	454	0.053	100	22.3	LOS C	0.8	7.8	Two Seg [10]	500	0.0	0.0
Lane 2	449	4.6	550 [1]	0.816	100	48.8	LOS D	27.6	200.9	Full	500	0.0	0.0
Lane 3	464	4.6	568	0.816	100	49.0	LOS D	28.7	208.8	Full	500	0.0	0.0
Lane 4	213	0.0	257	0.827	100	71.0	LOS E	14.3	100.1	Short	130	0.0	NA
Approach	1149	4.8		0.827		52.4	LOS D	28.7	208.8				
West: Monterea Rd													
Lane 1	313	0.0	514	0.609	100	49.6	LOS D	17.3	121.1	Short	90	0.0	NA
Lane 2	313	0.0	514	0.609	100	49.6	LOS D	17.3	121.1	Full	500	0.0	0.0
Lane 3	116	0.0	177	0.653	100	66.1	LOS E	7.4	52.1	Short	90	0.0	NA
Approach	742	0.0		0.653		52.2	LOS D	17.3	121.1				
Intersection	3685	3.2		0.850		45.5	LOS D	44.4	318.6				

Intersection R1003 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 003 [2041 PM FINAL]

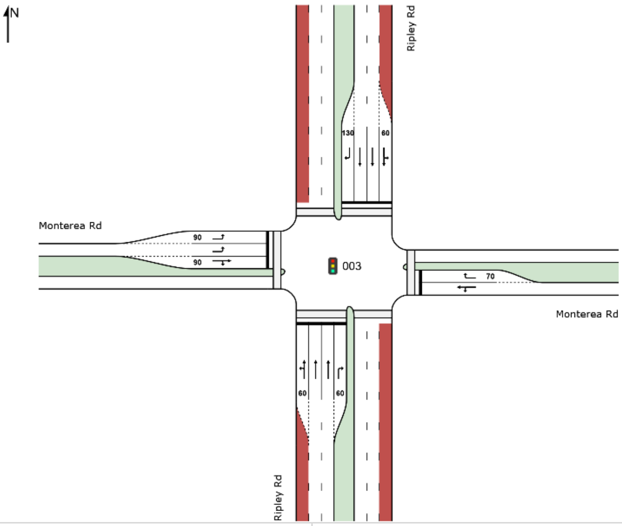
R1003
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

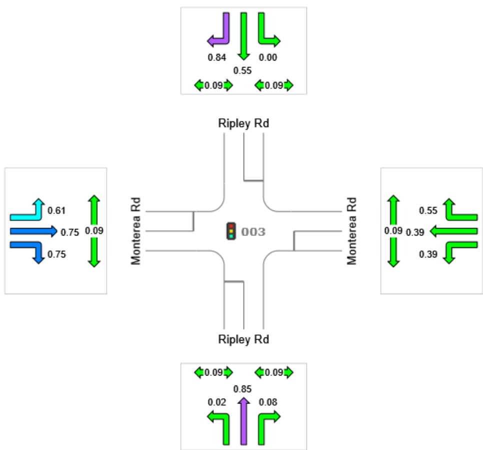
	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Ripley Rd													
Lane 1	44	28.6	313	0.141	100	57.1	LOS E	2.7	23.4	Two Seg [10]	500	0.0	0.0
Lane 2	263	1.6	296 [1]	0.886	100	77.1	LOS E	20.8	147.8	Full	500	0.0	0.0
Lane 3	271	1.6	306 [1]	0.886	100	77.3	LOS E	21.6	153.2	Full	500	0.0	0.0
Lane 4	11	0.0	297	0.035	100	62.4	LOS E	0.6	4.5	Short	60	0.0	NA
Approach	588	3.6		0.886		75.4	LOS E	21.6	153.2				
East: Monterea Rd													
Lane 1	126	0.0	177	0.715	100	76.5	LOS E	9.4	66.0	Full	500	0.0	0.0
Lane 2	139	1.5	159	0.873	100	89.2	LOS F	11.2	79.2	Short	70	0.0	NA
Approach	265	0.8		0.873		83.1	LOS F	11.2	79.2				
North: Ripley Rd													
Lane 1	39	32.4	843	0.046	100	20.4	LOS C	1.3	11.9	Two Seg [10]	500	0.0	0.0
Lane 2	835	0.9	943 [1]	0.885	100	39.8	LOS D	56.1	395.8	Full	500	0.0	0.0
Lane 3	869	0.9	982	0.885	100	40.2	LOS D	59.7	421.1	Full	500	0.0	0.0
Lane 4	297	0.4	939	0.316	100	28.5	LOS C	12.5	87.7	Short	260	0.0	NA
Approach	2040	1.4		0.885		37.9	LOS D	59.7	421.1				
West: Monterea Rd													
Lane 1	98	2.2	1158	0.085	100	16.7	LOS B	2.7	19.2	Short	90	0.0	NA
Lane 2	98	2.2	1158	0.085	100	16.7	LOS B	2.7	19.2	Full	500	0.0	0.0
Lane 3	89	1.2	165	0.541	100	74.4	LOS E	6.5	45.8	Short	90	0.0	NA
Approach	285	1.8		0.541		34.8	LOS C	6.5	45.8				
Intersection	3179	1.8		0.886		48.4	LOS D	59.7	421.1				

Intersection R1003-2066

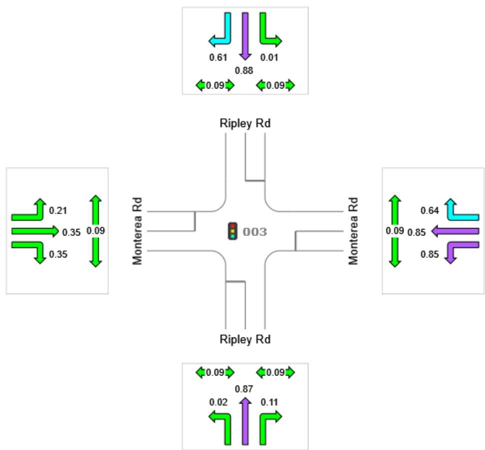
SITE LAYOUT – R1003 – 2066



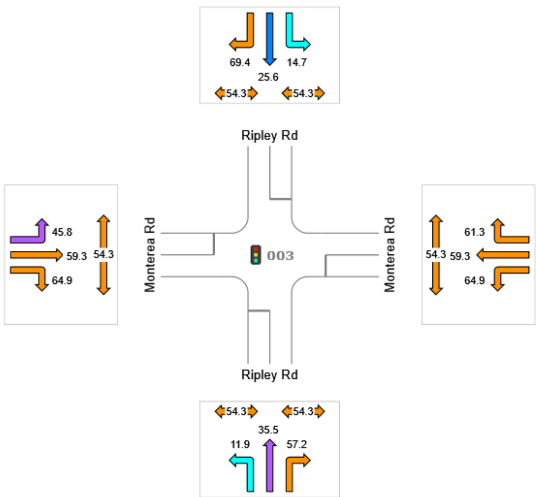
DEGREE OF SATURATION AM



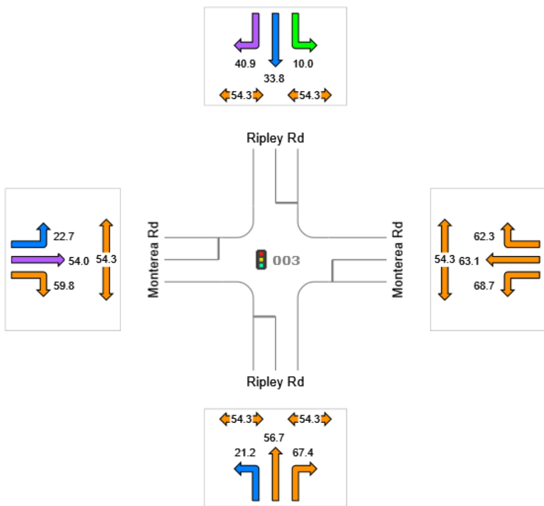
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1003 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 003 [2066 AM FINAL - LT lane]

R1003
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Rd													
Lane 1	22	19.0	927	0.024	100	11.9	LOS B	0.3	2.4	Short	30	0.0	NA
Lane 2	11	100.0	532	0.020	100	19.4	LOS B	0.3	4.4	Full	500	0.0	0.0
Lane 3	739	1.3	870	0.849	100	35.7	LOS D	40.9	289.7	Full	500	0.0	0.0
Lane 4	726	1.3	856 [1]	0.849	100	35.6	LOS D	40.0	282.9	Full	500	0.0	0.0
Lane 5	17	0.0	217	0.078	100	57.2	LOS E	0.9	6.2	Short	60	0.0	NA
Approach	1515	2.2		0.849		35.4	LOS D	40.9	289.7				
East: Monterea Rd													
Lane 1	89	1.2	231	0.387	100	60.5	LOS E	4.5	31.7	Full	500	0.0	0.0
Lane 2	117	1.8	214	0.546	100	61.3	LOS E	6.7	47.5	Short	70	0.0	NA
Approach	206	1.5		0.546		61.0	LOS E	6.7	47.5				
North: Ripley Rd													
Lane 1	5	0.0	1145	0.005	100	14.7	LOS B	0.1	0.8	Short	30	0.0	NA
Lane 2	13	100.0	532	0.024	100	19.5	LOS B	0.4	5.3	Full	500	0.0	0.0
Lane 3	464	5.1	849	0.547	100	25.6	LOS C	19.6	143.4	Full	500	0.0	0.0
Lane 4	464	5.1	849	0.547	100	25.6	LOS C	19.6	143.4	Full	500	0.0	0.0
Lane 5	180	1.8	214	0.841	100	69.4	LOS E	11.5	81.4	Short	130	0.0	NA
Approach	1126	5.6		0.841		32.5	LOS C	19.6	143.4				
West: Monterea Rd													
Lane 1	320	0.3	525	0.610	100	45.8	LOS D	16.3	114.3	Short	90	0.0	NA
Lane 2	320	0.3	525	0.610	100	45.8	LOS D	16.3	114.3	Full	500	0.0	0.0
Lane 3	168	0.0	224	0.751	100	60.9	LOS E	10.2	71.2	Short	90	0.0	NA
Approach	808	0.3		0.751		48.9	LOS D	16.3	114.3				
Intersection	3656	2.8		0.849		39.0	LOS D	40.9	289.7				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Intersection R1003 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 003 [2066 PM FINAL - LT lane]

R1003
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

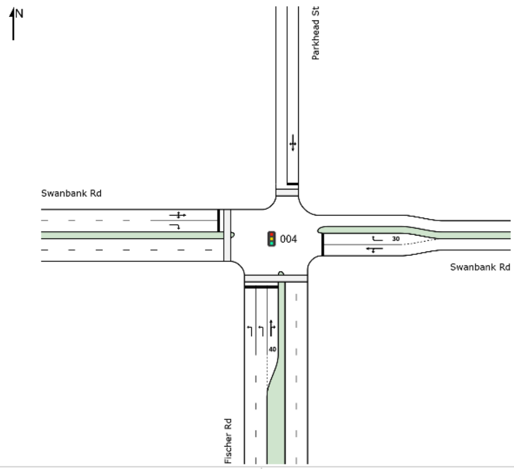
Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Ripley Rd													
Lane 1	14	0.0	635	0.022	100	21.2	LOS C	0.4	2.5	Short	30	0.0	NA
Lane 2	13	100.0	266	0.048	100	39.5	LOS D	0.6	7.6	Full	500	0.0	0.0
Lane 3	373	3.3	430	0.868	100	57.0	LOS E	23.5	169.4	Full	500	0.0	0.0
Lane 4	368	3.3	425 [1]	0.868	100	56.9	LOS E	23.2	167.1	Full	500	0.0	0.0
Lane 5	11	0.0	93	0.113	100	67.4	LOS E	0.6	4.3	Short	60	0.0	NA
Approach	778	4.7		0.868		56.2	LOS E	23.5	169.4				
East: Monterea Rd													
Lane 1	204	0.0	240	0.850	100	65.1	LOS E	13.0	91.3	Full	500	0.0	0.0
Lane 2	138	0.0	217	0.636	100	62.3	LOS E	8.0	56.2	Short	70	0.0	NA
Approach	342	0.0		0.850		64.0	LOS E	13.0	91.3				
North: Ripley Rd													
Lane 1	17	0.0	1176	0.014	100	10.0	LOS A	0.2	1.5	Short	30	0.0	NA
Lane 2	13	100.0	611	0.021	100	15.0	LOS B	0.4	4.6	Full	500	0.0	0.0
Lane 3	880	1.2	1000	0.880	100	34.2	LOS C	50.1	354.3	Full	500	0.0	0.0
Lane 4	764	1.2	867 [1]	0.880	100	33.6	LOS C	40.7	287.6	Full	500	0.0	0.0
Lane 5	387	0.5	632	0.613	100	40.9	LOS D	18.9	132.6	Short	130	0.0	NA
Approach	2061	1.6		0.880		34.9	LOS C	50.1	354.3				
West: Monterea Rd													
Lane 1	199	0.0	944	0.211	100	22.7	LOS C	6.3	44.1	Short	90	0.0	NA
Lane 2	199	0.0	944	0.211	100	22.7	LOS C	6.3	44.1	Full	500	0.0	0.0
Lane 3	77	2.7	220	0.349	100	55.5	LOS E	4.3	30.5	Short	90	0.0	NA
Approach	475	0.4		0.349		28.0	LOS C	6.3	44.1				
Intersection	3656	2.0		0.880		41.3	LOS D	50.1	354.3				

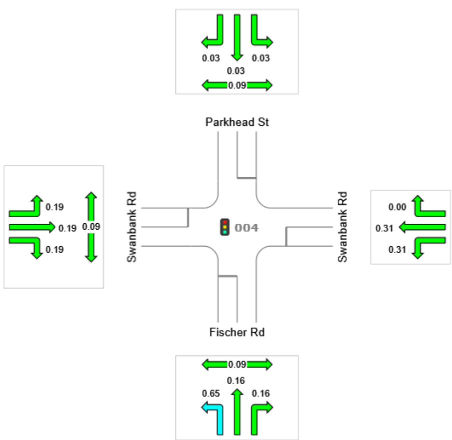
3 Intersection R1004

2031

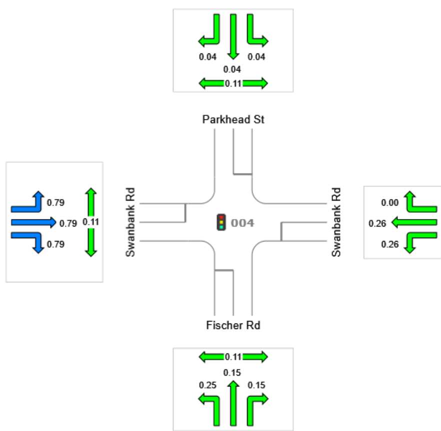
SITE LAYOUT – R1004 – 2031



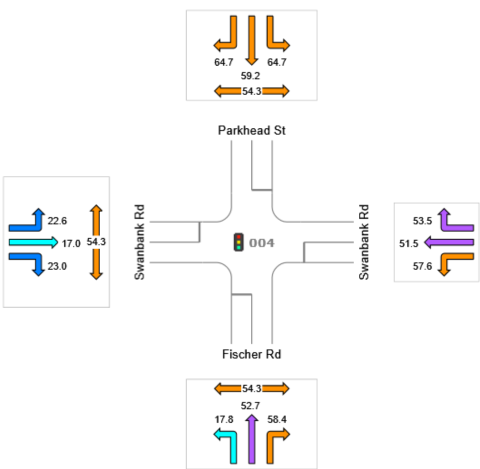
DEGREE OF SATURATION AM



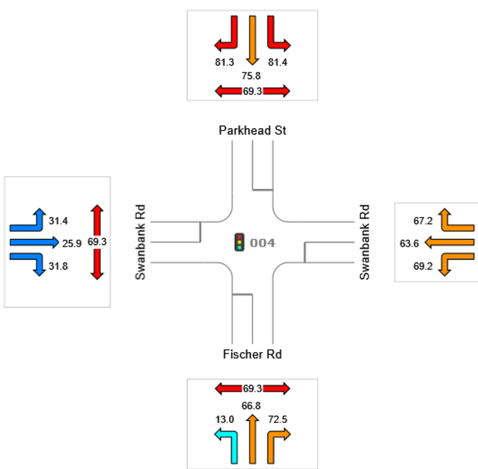
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1004 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 004 [2031 AM - FINAL same as 2036]

R1004
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Lane Use and Performance

	Demand Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total	HV						Veh	Dist				
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Fischer Rd													
Lane 1	796	0.5	1233	0.646	100	17.9	LOS B	26.8	188.5	Full	500	0.0	0.0
Lane 2	766	0.5	1186 [1]	0.646	100	17.6	LOS B	25.1	176.2	Full	500	0.0	0.0
Lane 3	33	12.9	199	0.164	100	58.2	LOS E	1.8	13.7	Short	40	0.0	NA
Approach	1595	0.8		0.646		18.6	LOS B	26.8	188.5				
East: Swanbank Rd													
Lane 1	62	45.8	201	0.310	100	51.7	LOS D	3.4	32.9	Full	500	0.0	0.0
Lane 2	1	0.0	248	0.004	100	53.5	LOS D	0.1	0.4	Short	30	0.0	NA
Approach	63	45.0		0.310		51.7	LOS D	3.4	32.9				
North: Parkhead St													
Lane 1	3	0.0	109	0.029	100	62.9	LOS E	0.2	1.3	Full	500	0.0	0.0
Approach	3	0.0		0.029		62.9	LOS E	0.2	1.3				
West: Swanbank Rd													
Lane 1	173	9.8	893	0.194	100	20.1	LOS C	5.4	41.2	Full	500	0.0	0.0
Lane 2	178	1.2	921	0.194	100	23.1	LOS C	5.7	40.2	Full	500	0.0	0.0
Approach	352	5.4		0.194		21.6	LOS C	5.7	41.2				
Intersection	2013	3.0		0.646		20.2	LOS C	26.8	188.5				

Intersection R1004 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 004 [2031 PM - FINAL same as 2026]

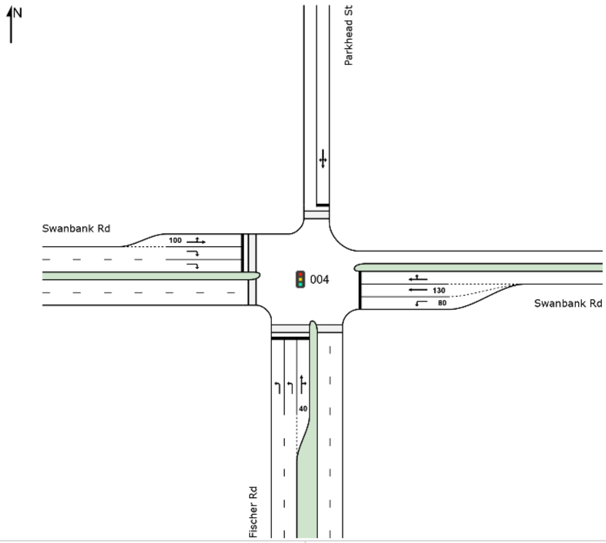
R1004
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Lane Use and Performance

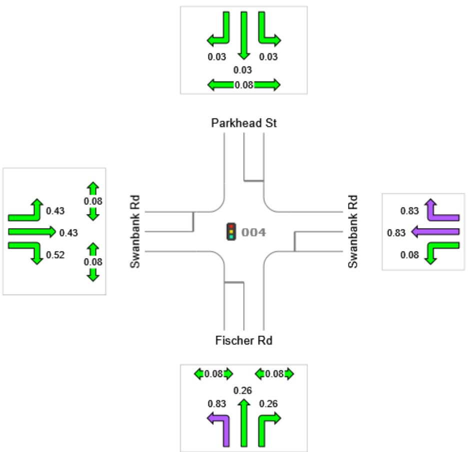
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Fischer Rd													
Lane 1	323	2.0	1319	0.245	100	13.0	LOS B	7.8	55.6	Full	500	0.0	0.0
Lane 2	323	2.0	1319	0.245	100	13.0	LOS B	7.8	55.6	Full	500	0.0	0.0
Lane 3	27	15.4	179	0.153	100	72.3	LOS E	1.9	14.7	Short	40	0.0	NA
Approach	674	2.5		0.245		15.4	LOS B	7.8	55.6				
East: Swanbank Rd													
Lane 1	61	5.2	237	0.258	100	65.8	LOS E	4.1	29.7	Full	500	0.0	0.0
Lane 2	1	0.0	223	0.005	100	67.2	LOS E	0.1	0.5	Short	30	0.0	NA
Approach	62	5.1		0.258		65.8	LOS E	4.1	29.7				
North: Parkhead St													
Lane 1	3	0.0	87	0.036	100	79.5	LOS E	0.2	1.6	Full	500	0.0	0.0
Approach	3	0.0		0.036		79.5	LOS E	0.2	1.6				
West: Swanbank Rd													
Lane 1	843	1.0	1063	0.794	100	30.9	LOS C	47.1	332.6	Full	500	0.0	0.0
Lane 2	840	0.9	1058	0.794	100	32.0	LOS C	47.2	332.8	Full	500	0.0	0.0
Approach	1683	0.9		0.794		31.5	LOS C	47.2	332.8				
Intersection	2422	1.5		0.794		27.9	LOS C	47.2	332.8				

Intersection R1004-2041

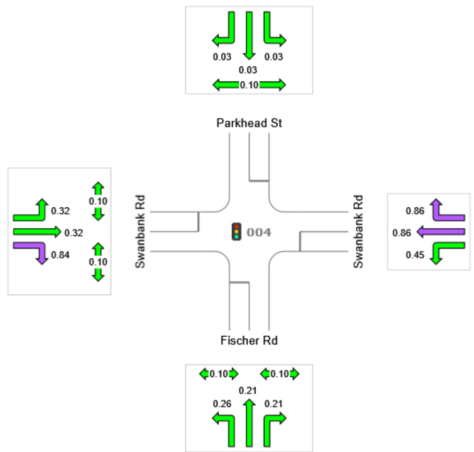
SITE LAYOUT – R1004 – 2041



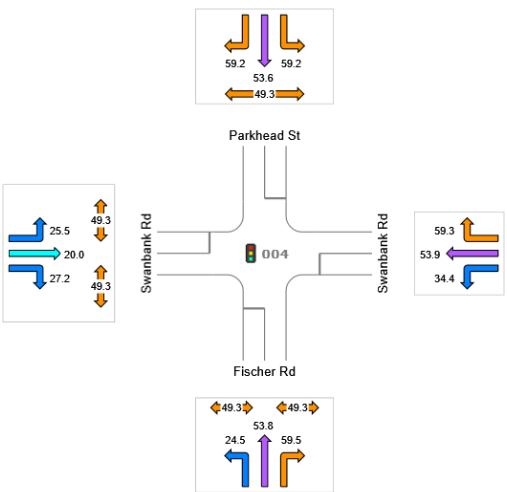
DEGREE OF SATURATION AM



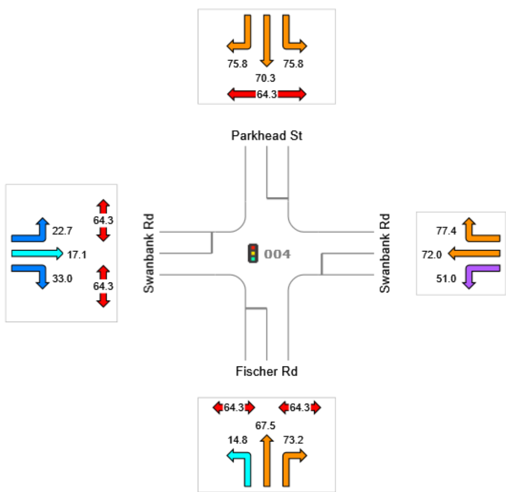
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1004 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 004 [2041 AM - FINAL]

R1004
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Fischer Rd													
Lane 1	926	1.2	1121	0.826	100	24.6	LOS C	39.5	279.6	Full	500	0.0	0.0
Lane 2	893	1.2	1081 [1]	0.826	100	24.4	LOS C	37.1	262.7	Full	500	0.0	0.0
Lane 3	36	17.6	135	0.265	100	59.4	LOS E	1.9	15.3	Short	40	0.0	NA
Approach	1855	1.5		0.826		25.2	LOS C	39.5	279.6				
East: Swanbank Rd													
Lane 1	41	12.8	526	0.078	100	34.4	LOS C	1.5	12.0	Short	80	0.0	NA
Lane 2	265	8.2	320	0.829	100	53.9	LOS D	15.2	113.7	Short	130	0.0	NA
Lane 3	265	8.1	320	0.829	100	53.9	LOS D	15.2	113.6	Full	500	0.0	0.0
Approach	572	8.5		0.829		52.5	LOS D	15.2	113.7				
North: Parkhead St													
Lane 1	3	0.0	119	0.026	100	57.3	LOS E	0.2	1.1	Full	500	0.0	0.0
Approach	3	0.0		0.026		57.3	LOS E	0.2	1.1				
West: Swanbank Rd													
Lane 1	308	43.3	719	0.429	100	20.0	LOS B	10.8	103.5	Short	100	0.0	NA
Lane 2	449	1.2	871	0.516	100	27.2	LOS C	16.7	117.8	Full	500	0.0	0.0
Lane 3	449	1.2	871	0.516	100	27.2	LOS C	16.7	117.8	Full	500	0.0	0.0
Approach	1206	12.0		0.516		25.3	LOS C	16.7	117.8				
Intersection	3636	6.1		0.829		29.5	LOS C	39.5	279.6				

Intersection R1004 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 004 [2041 PM - FINAL]

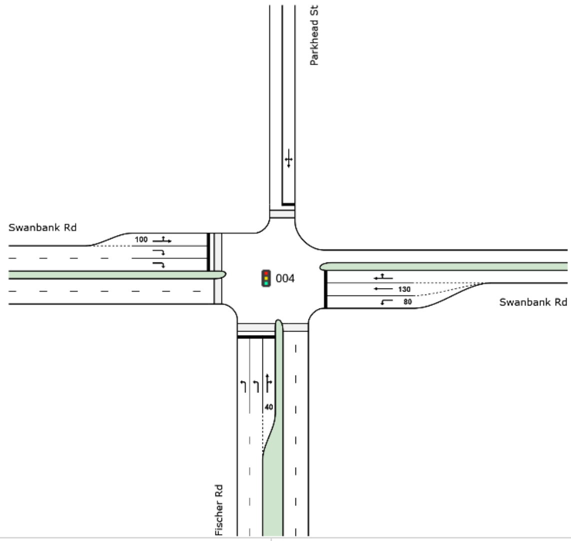
R1004
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

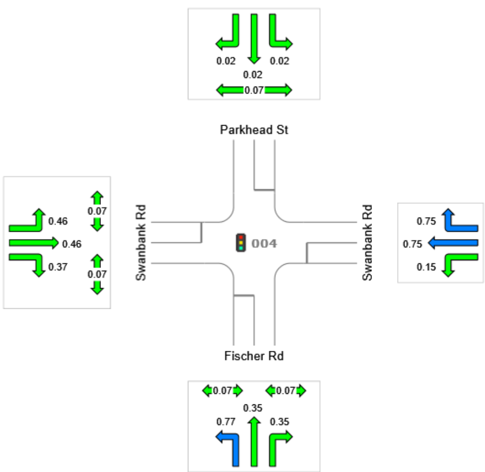
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Fischer Rd													
Lane 1	323	2.0	1243	0.260	100	14.8	LOS B	8.4	59.7	Full	500	0.0	0.0
Lane 2	323	2.0	1243	0.260	100	14.8	LOS B	8.4	59.7	Full	500	0.0	0.0
Lane 3	27	15.4	132	0.208	100	73.0	LOS E	1.8	14.4	Short	40	0.0	NA
Approach	674	2.5		0.260		17.1	LOS B	8.4	59.7				
East: Swanbank Rd													
Lane 1	226	0.5	502	0.450	100	51.0	LOS D	12.8	89.9	Short	80	0.0	NA
Lane 2	224	18.8	261	0.860	100	72.0	LOS E	16.6	134.8	Short	130	0.0	NA
Lane 3	224	18.7	261	0.860	100	72.0	LOS E	16.6	134.8	Full	500	0.0	0.0
Approach	675	12.6		0.860		64.9	LOS E	16.6	134.8				
North: Parkhead St													
Lane 1	3	0.0	94	0.034	100	74.0	LOS E	0.2	1.5	Full	500	0.0	0.0
Approach	3	0.0		0.034		74.0	LOS E	0.2	1.5				
West: Swanbank Rd													
Lane 1	331	10.2	1019	0.324	100	17.2	LOS B	11.8	89.7	Short	100	0.0	NA
Lane 2	729	0.9	867 [1]	0.841	100	32.6	LOS C	37.8	266.5	Full	500	0.0	0.0
Lane 3	865	0.9	1028	0.841	100	33.4	LOS C	48.8	344.3	Full	500	0.0	0.0
Approach	1925	2.5		0.841		30.3	LOS C	48.8	344.3				
Intersection	3277	4.6		0.860		34.8	LOS C	48.8	344.3				

Intersection R1004-2066

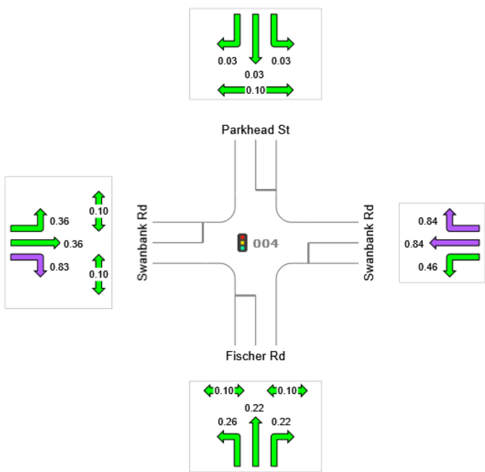
SITE LAYOUT – R1004 – 2066



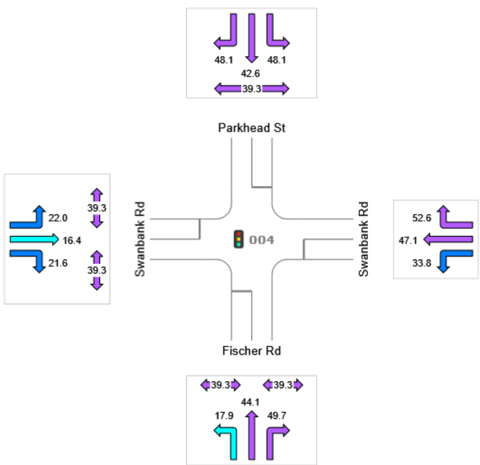
DEGREE OF SATURATION AM



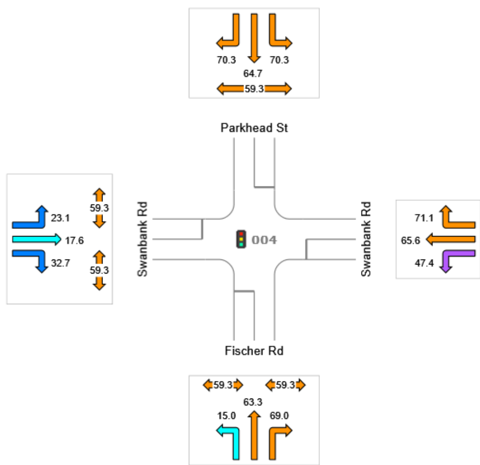
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1004 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 004 [2066 AM_BASE - FINAL same as 2041]

R1004
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 90 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Fischer Rd													
Lane 1	894	2.1	1159	0.771	100	18.2	LOS B	28.0	199.2	Full	500	0.0	0.0
Lane 2	849	2.1	1101 [1]	0.771	100	17.6	LOS B	25.3	180.3	Full	500	0.0	0.0
Lane 3	55	7.7	157	0.349	100	49.6	LOS D	2.4	17.9	Short	40	0.0	NA
Approach	1798	2.2		0.771		18.9	LOS B	28.0	199.2				
East: Swanbank Rd													
Lane 1	67	9.4	445	0.151	100	33.8	LOS C	2.3	17.5	Short	80	0.0	NA
Lane 2	135	11.7	181	0.746	100	47.1	LOS D	6.4	48.9	Short	130	0.0	NA
Lane 3	135	11.6	181	0.746	100	47.2	LOS D	6.4	48.9	Full	500	0.0	0.0
Approach	338	11.2		0.746		44.5	LOS D	6.4	48.9				
North: Parkhead St													
Lane 1	3	0.0	146	0.022	100	46.3	LOS D	0.1	0.9	Full	500	0.0	0.0
Approach	3	0.0		0.022		46.3	LOS D	0.1	0.9				
West: Swanbank Rd													
Lane 1	355	33.8	764	0.464	100	16.4	LOS B	10.3	93.2	Short	100	0.0	NA
Lane 2	327	1.6	877	0.373	100	21.6	LOS C	9.1	64.6	Full	500	0.0	0.0
Lane 3	327	1.6	877	0.373	100	21.6	LOS C	9.1	64.6	Full	500	0.0	0.0
Approach	1009	12.9		0.464		19.8	LOS B	10.3	93.2				
Intersection	3148	6.6		0.771		22.0	LOS C	28.0	199.2				

Intersection R1004 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 004 [2066 PM_BASE - FINAL same as 2041]

R1004
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.

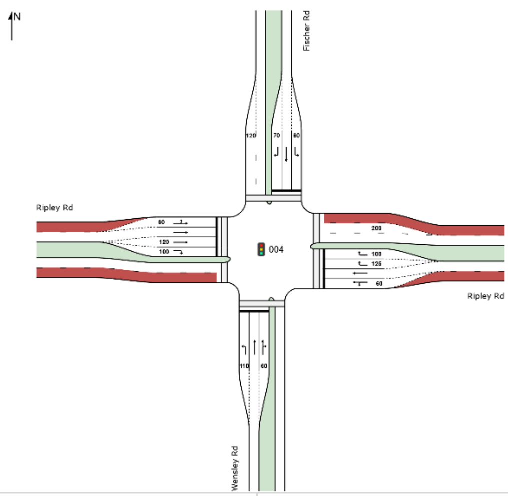
Lane Use and Performance

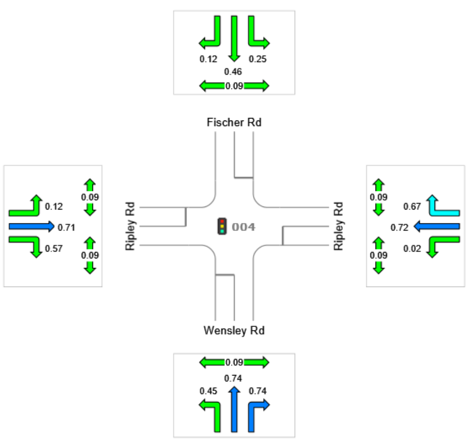
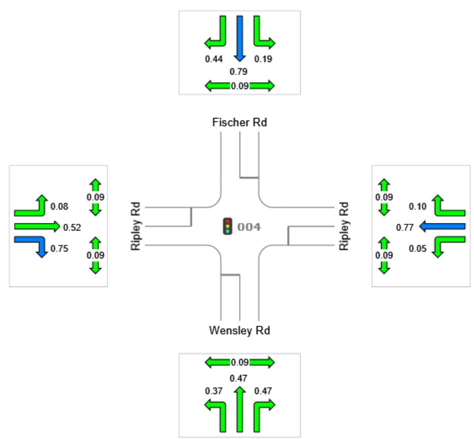
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Fischer Rd													
Lane 1	315	2.2	1210	0.261	100	15.0	LOS B	8.0	56.9	Full	500	0.0	0.0
Lane 2	315	2.2	1210	0.261	100	15.0	LOS B	8.0	56.9	Full	500	0.0	0.0
Lane 3	28	14.8	129	0.220	100	68.8	LOS E	1.8	13.9	Short	40	0.0	NA
Approach	659	2.7		0.261		17.3	LOS B	8.0	56.9				
East: Swanbank Rd													
Lane 1	234	0.5	513	0.456	100	47.4	LOS D	12.3	86.1	Short	80	0.0	NA
Lane 2	226	18.2	268	0.843	100	65.6	LOS E	15.4	124.7	Short	130	0.0	NA
Lane 3	226	18.1	268	0.843	100	65.7	LOS E	15.4	124.7	Full	500	0.0	0.0
Approach	686	12.1		0.843		59.4	LOS E	15.4	124.7				
North: Parkhead St													
Lane 1	3	0.0	101	0.031	100	68.4	LOS E	0.2	1.4	Full	500	0.0	0.0
Approach	3	0.0		0.031		68.4	LOS E	0.2	1.4				
West: Swanbank Rd													
Lane 1	351	11.1	979	0.358	100	17.6	LOS B	12.3	94.4	Short	100	0.0	NA
Lane 2	705	0.8	849 [1]	0.831	100	32.2	LOS C	34.7	244.8	Full	500	0.0	0.0
Lane 3	826	0.8	995	0.831	100	33.1	LOS C	43.9	309.2	Full	500	0.0	0.0
Approach	1882	2.7		0.831		29.9	LOS C	43.9	309.2				
Intersection	3231	4.7		0.843		33.6	LOS C	43.9	309.2				

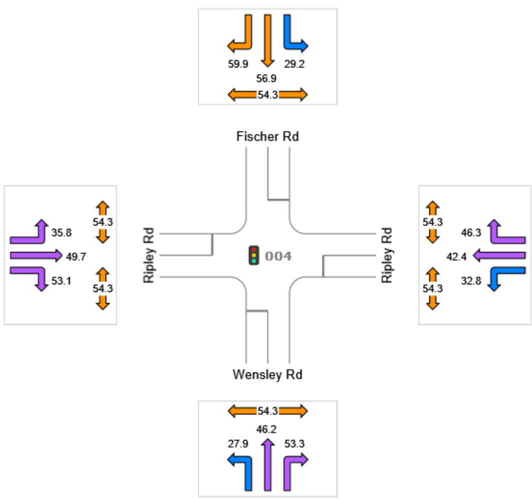
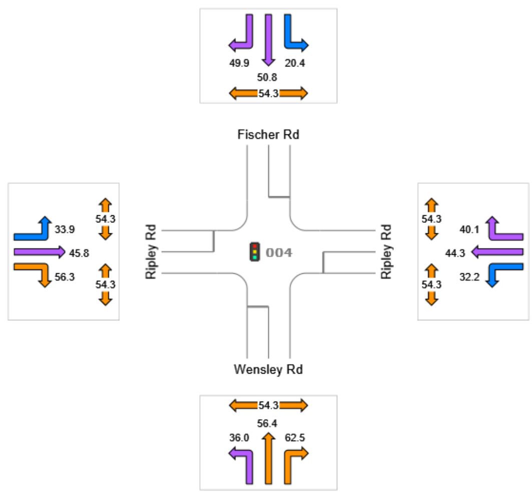
4 Intersection R1007

2031

SITE LAYOUT – R1007 – 2031



DEGREE OF SATURATION AM	DEGREE OF SATURATION PM
	

DELAY CONTROL (seconds) AM	DELAY CONTROL (seconds) PM
	

Intersection R1007 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 007 [2031 AM FINAL]

R1007
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Wensley Rd													
Lane 1	380	4.7	853	0.445	100	27.9	LOS C	14.6	106.7	Short	110	0.0	NA
Lane 2	227	0.8	436	0.521	71 [6]	44.3	LOS D	11.8	82.9	Full	500	0.0	0.0
Lane 3	300	0.8	408 [1]	0.735	100	48.0	LOS D	16.6	117.3	Short	60	0.0	NA
Approach	907	2.4		0.735		38.6	LOS D	16.6	117.3				
East: Ripley Rd													
Lane 1	11	40.0	522	0.020	100	30.9	LOS C	0.4	3.7	Two Seg [10]	500	0.0	0.0
Lane 2	378	1.1	528 [1]	0.716	100	42.5	LOS D	20.1	141.8	Full	500	0.0	0.0
Lane 3	233	0.2	510	0.456	68 [6]	44.5	LOS D	11.3	79.4	Short	125	0.0	NA
Lane 4	343	0.2	510	0.673	100	47.5	LOS D	18.0	125.9	Short	100	0.0	NA
Approach	964	1.0		0.716		44.6	LOS D	20.1	141.8				
North: Fischer Rd													
Lane 1	199	1.6	780	0.255	100	29.2	LOS C	7.4	52.6	Short	60	0.0	NA
Lane 2	87	3.6	191	0.459	100	56.9	LOS E	5.0	36.1	Full	500	0.0	0.0
Lane 3	23	0.0	186	0.125	100	59.9	LOS E	1.3	8.9	Short	70	0.0	NA
Approach	309	2.0		0.459		39.3	LOS D	7.4	52.6				
West: Ripley Rd													
Lane 1	67	4.7	581	0.116	100	35.3	LOS D	2.7	19.9	Two Seg [10]	500	0.0	0.0
Lane 2	265	6.7	372 [1]	0.713	100	49.8	LOS D	14.9	110.4	Full	500	0.0	0.0
Lane 3	266	6.7	374	0.713	100	49.8	LOS D	15.0	111.1	Short	120	0.0	NA
Lane 4	202	7.3	353	0.572	100	53.1	LOS D	10.9	80.8	Short	100	0.0	NA
Approach	801	6.7		0.713		49.4	LOS D	15.0	111.1				
Intersection	2982	3.1		0.735		43.6	LOS D	20.1	141.8				

Intersection R1007 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 007 [2031 PM FINAL]

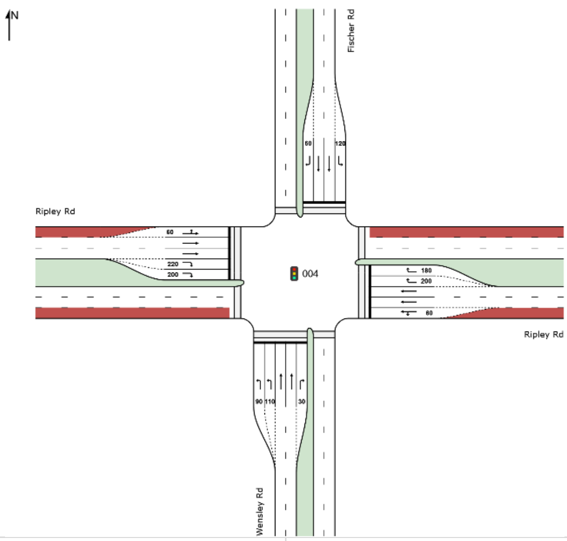
R1007
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

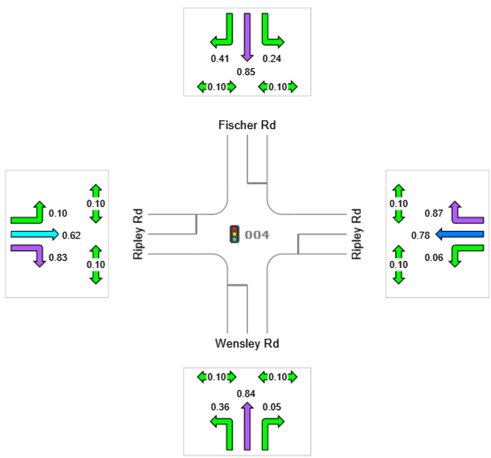
	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Wensley Rd													
Lane 1	243	1.3	659	0.369	100	36.0	LOS D	10.5	74.0	Short	110	0.0	NA
Lane 2	64	0.8	194	0.332	71 [6]	55.9	LOS E	3.6	25.6	Full	500	0.0	0.0
Lane 3	90	0.6	192	0.469	100	58.0	LOS E	5.2	36.4	Short	60	0.0	NA
Approach	398	1.1		0.469		44.2	LOS D	10.5	74.0				
East: Ripley Rd													
Lane 1	33	12.9	622	0.052	100	30.9	LOS C	1.2	9.6	Two Seg [10]	500	0.0	0.0
Lane 2	396	1.3	517 [1]	0.765	100	44.5	LOS D	21.8	154.4	Full	500	0.0	0.0
Lane 3	36	0.0	511	0.071	68 [6]	39.9	LOS D	1.5	10.8	Short	125	0.0	NA
Lane 4	53	0.0	511	0.104	100	40.3	LOS D	2.3	16.2	Short	100	0.0	NA
Approach	518	1.8		0.765		42.9	LOS D	21.8	154.4				
North: Fischer Rd													
Lane 1	193	0.5	1002	0.192	100	20.4	LOS C	5.7	39.8	Short	60	0.0	NA
Lane 2	301	0.0	381 [1]	0.790	100	50.8	LOS D	17.4	121.6	Full	500	0.0	0.0
Lane 3	179	0.0	402	0.445	100	49.9	LOS D	9.2	64.2	Short	70	0.0	NA
Approach	673	0.2		0.790		41.9	LOS D	17.4	121.6				
West: Ripley Rd													
Lane 1	46	11.4	598	0.077	100	33.0	LOS C	1.8	13.9	Two Seg [10]	500	0.0	0.0
Lane 2	209	2.8	399	0.525	100	45.9	LOS D	11.0	79.0	Full	500	0.0	0.0
Lane 3	209	2.8	399	0.525	100	45.9	LOS D	11.0	79.0	Short	120	0.0	NA
Lane 4	286	2.6	380	0.754	100	56.3	LOS E	16.5	117.9	Short	100	0.0	NA
Approach	752	3.2		0.754		49.1	LOS D	16.5	117.9				
Intersection	2340	1.7		0.790		44.8	LOS D	21.8	154.4				

Intersection R1007-2041

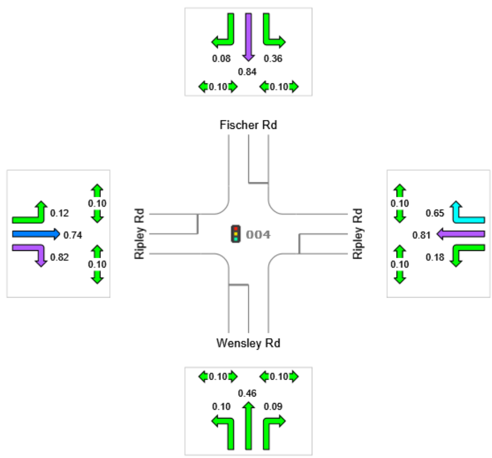
SITE LAYOUT – R1007 – 2041



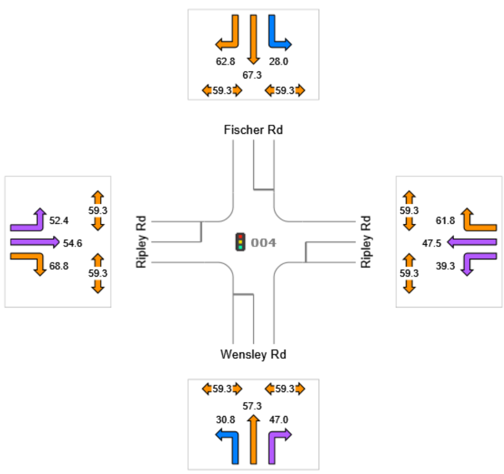
DEGREE OF SATURATION AM



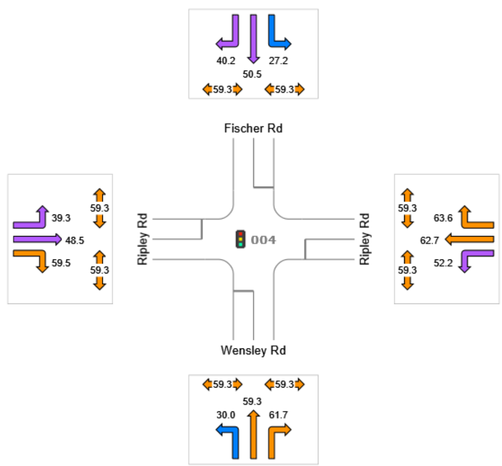
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1007 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 007 [2041 AM FINAL]

R1007
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 130 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Wensley Rd													
Lane 1	297	0.9	823	0.361	100	30.8	LOS C	12.3	86.4	Short	90	0.0	NA
Lane 2	297	0.9	823	0.361	100	30.8	LOS C	12.3	86.4	Short	110	0.0	NA
Lane 3	376	0.9	448	0.840	100	57.4	LOS E	24.6	173.5	Full	500	0.0	0.0
Lane 4	362	0.9	431 [1]	0.840	100	57.2	LOS E	23.6	166.2	Full	500	0.0	0.0
Lane 5	20	0.0	429	0.047	100	47.0	LOS D	1.0	6.8	Short	30	0.0	NA
Approach	1352	0.9		0.840		45.5	LOS D	24.6	173.5				
East: Ripley Rd													
Lane 1	25	45.8	452	0.056	100	35.8	LOS D	1.1	10.9	Two Seg [10]	500	0.0	0.0
Lane 2	406	4.7	522 [1]	0.778	100	47.6	LOS D	24.2	176.4	Full	500	0.0	0.0
Lane 3	419	4.7	538	0.778	100	47.9	LOS D	25.1	183.1	Full	500	0.0	0.0
Lane 4	455	1.3	524	0.869	100	61.8	LOS E	30.5	215.7	Short	200	0.0	NA
Lane 5	455	1.3	524	0.869	100	61.8	LOS E	30.5	215.7	Short	180	0.0	NA
Approach	1761	3.5		0.869		54.8	LOS D	30.5	215.7				
North: Fischer Rd													
Lane 1	204	2.1	845	0.242	100	28.0	LOS C	7.7	55.0	Short	120	0.0	NA
Lane 2	215	1.0	253	0.847	100	67.3	LOS E	14.6	103.4	Full	500	0.0	0.0
Lane 3	215	1.0	253	0.847	100	67.3	LOS E	14.6	103.4	Full	500	0.0	0.0
Lane 4	100	0.0	243	0.412	100	62.8	LOS E	6.0	41.7	Short	60	0.0	NA
Approach	734	1.1		0.847		55.7	LOS E	14.6	103.4				
West: Ripley Rd													
Lane 1	31	41.4	293	0.104	100	49.2	LOS D	1.6	15.2	Two Seg [10]	500	0.0	0.0
Lane 2	198	5.9	318	0.622	100	54.9	LOS D	11.9	87.1	Full	500	0.0	0.0
Lane 3	198	5.9	318	0.622	100	54.9	LOS D	11.9	87.1	Full	500	0.0	0.0
Lane 4	257	2.7	308	0.834	100	68.8	LOS E	17.2	123.5	Short	220	0.0	NA
Lane 5	257	2.7	308	0.834	100	68.8	LOS E	17.2	123.5	Short	200	0.0	NA
Approach	941	5.3		0.834		62.3	LOS E	17.2	123.5				
Intersection	4787	2.7		0.869		53.8	LOS D	30.5	215.7				

Intersection R1007 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 007 [2041 PM FINAL]

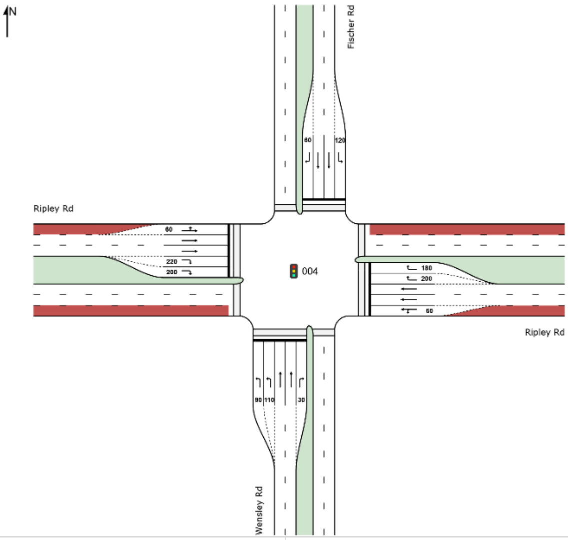
R1007
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 130 seconds (Site User-Given Cycle Time)

Lane Use and Performance

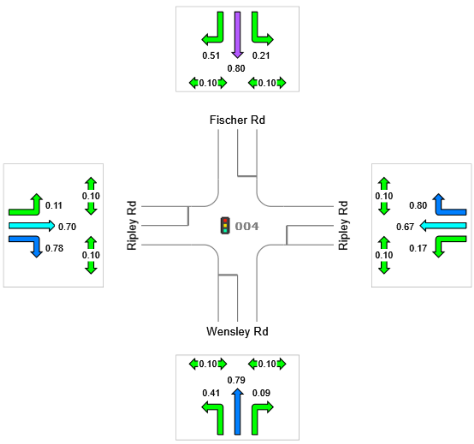
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Wensley Rd													
Lane 1	79	0.0	771	0.103	100	30.0	LOS C	3.0	21.1	Short	90	0.0	NA
Lane 2	79	0.0	771	0.103	100	30.0	LOS C	3.0	21.1	Short	110	0.0	NA
Lane 3	103	0.0	225	0.458	100	59.3	LOS E	6.3	43.9	Full	500	0.0	0.0
Lane 4	103	0.0	225	0.458	100	59.3	LOS E	6.3	43.9	Full	500	0.0	0.0
Lane 5	19	0.0	214	0.088	100	61.7	LOS E	1.1	7.6	Short	30	0.0	NA
Approach	384	0.0		0.458		47.3	LOS D	6.3	43.9				
East: Ripley Rd													
Lane 1	61	20.7	340	0.179	100	50.3	LOS D	3.2	26.6	Two Seg [10]	500	0.0	0.0
Lane 2	225	3.3	279	0.805	100	63.1	LOS E	14.8	106.6	Full	500	0.0	0.0
Lane 3	225	3.3	279	0.805	100	63.1	LOS E	14.8	106.6	Full	500	0.0	0.0
Lane 4	174	2.4	267	0.653	100	63.6	LOS E	10.7	76.6	Short	200	0.0	NA
Lane 5	174	2.4	267	0.653	100	63.6	LOS E	10.7	76.6	Short	180	0.0	NA
Approach	859	4.2		0.805		62.4	LOS E	14.8	106.6				
North: Fischer Rd													
Lane 1	329	1.3	906	0.364	100	27.2	LOS C	12.7	90.0	Short	120	0.0	NA
Lane 2	489	0.3	584	0.838	100	50.7	LOS D	31.0	217.5	Full	500	0.0	0.0
Lane 3	468	0.3	558 [1]	0.838	100	50.4	LOS D	29.4	206.0	Full	500	0.0	0.0
Lane 4	44	0.0	557	0.079	100	40.2	LOS D	2.0	13.9	Short	60	0.0	NA
Approach	1331	0.6		0.838		44.4	LOS D	31.0	217.5				
West: Ripley Rd													
Lane 1	62	20.3	530	0.117	100	37.4	LOS D	2.8	22.8	Two Seg [10]	500	0.0	0.0
Lane 2	346	0.9	467 [1]	0.742	100	48.6	LOS D	20.3	143.4	Full	500	0.0	0.0
Lane 3	365	0.9	492	0.742	100	49.0	LOS D	21.6	152.7	Full	500	0.0	0.0
Lane 4	383	1.2	467	0.819	100	59.5	LOS E	24.4	172.6	Short	220	0.0	NA
Lane 5	383	1.2	467	0.819	100	59.5	LOS E	24.4	172.6	Short	200	0.0	NA
Approach	1539	1.8		0.819		53.7	LOS D	24.4	172.6				
Intersection	4113	1.7		0.838		51.9	LOS D	31.0	217.5				

Intersection R1007-2066

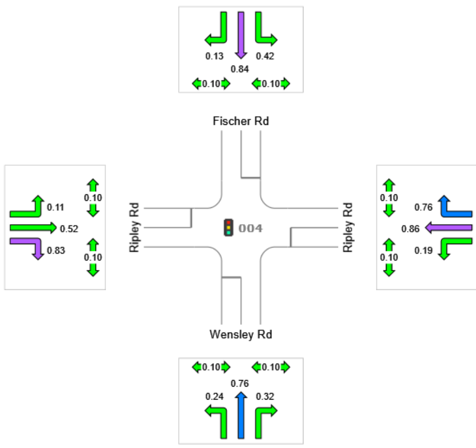
SITE LAYOUT – R1007 – 2066



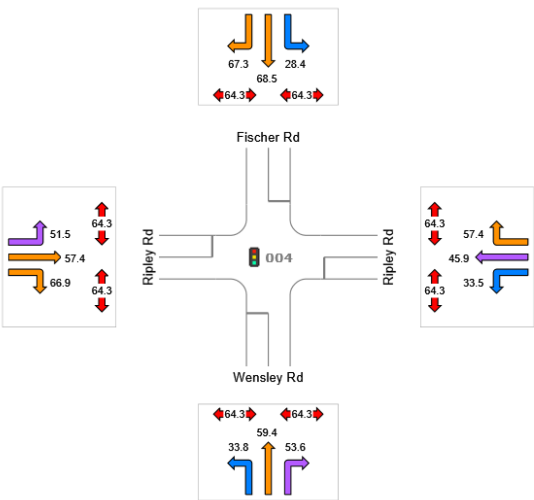
DEGREE OF SATURATION AM



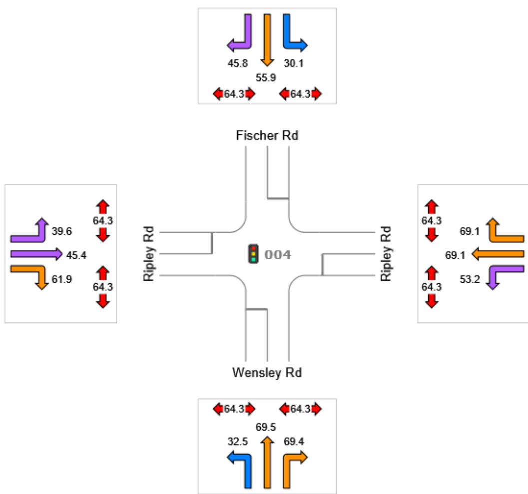
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1007 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 004 [2066 AM FINAL]

R1007
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Wensley Rd													
Lane 1	337	1.6	813	0.415	100	33.8	LOS C	15.5	109.9	Short	90	0.0	NA
Lane 2	337	1.6	813	0.415	100	33.8	LOS C	15.5	109.9	Short	110	0.0	NA
Lane 3	317	0.2	403	0.787	100	59.7	LOS E	21.4	150.1	Full	500	0.0	0.0
Lane 4	295	0.2	375 [1]	0.787	100	59.2	LOS E	19.7	138.3	Full	500	0.0	0.0
Lane 5	35	0.0	385	0.090	100	53.6	LOS D	1.9	13.3	Short	30	0.0	NA
Approach	1322	0.9		0.787		46.2	LOS D	21.4	150.1				
East: Ripley Rd													
Lane 1	124	10.2	720	0.172	100	32.6	LOS C	5.3	40.5	Two Seg [10]	500	0.0	0.0
Lane 2	338	2.7	503 [1]	0.671	100	45.5	LOS D	19.7	141.2	Full	500	0.0	0.0
Lane 3	377	2.7	561	0.671	100	46.7	LOS D	22.6	161.7	Full	500	0.0	0.0
Lane 4	426	2.5	534	0.798	100	57.4	LOS E	27.8	198.9	Short	200	0.0	NA
Lane 5	426	2.5	534	0.798	100	57.4	LOS E	27.8	198.9	Short	180	0.0	NA
Approach	1692	3.1		0.798		50.8	LOS D	27.8	198.9				
North: Fischer Rd													
Lane 1	181	1.7	865	0.209	100	28.4	LOS C	7.1	50.5	Short	120	0.0	NA
Lane 2	209	2.5	260	0.804	100	68.5	LOS E	14.8	106.1	Full	500	0.0	0.0
Lane 3	209	2.5	260	0.804	100	68.5	LOS E	14.8	106.1	Full	500	0.0	0.0
Lane 4	128	0.0	252	0.510	100	67.3	LOS E	8.3	58.2	Short	60	0.0	NA
Approach	728	1.9		0.804		58.3	LOS E	14.8	106.1				
West: Ripley Rd													
Lane 1	40	31.6	359	0.112	100	48.8	LOS D	2.2	19.2	Two Seg [10]	500	0.0	0.0
Lane 2	246	7.9	351 [1]	0.700	100	57.6	LOS E	15.9	118.6	Full	500	0.0	0.0
Lane 3	250	7.9	358	0.700	100	57.7	LOS E	16.2	121.2	Full	500	0.0	0.0
Lane 4	272	3.5	349	0.779	100	66.9	LOS E	18.5	133.5	Short	220	0.0	NA
Lane 5	272	3.5	349	0.779	100	66.9	LOS E	18.5	133.5	Short	200	0.0	NA
Approach	1080	6.5		0.779		62.0	LOS E	18.5	133.5				
Intersection	4822	3.1		0.804		53.2	LOS D	27.8	198.9				

Intersection R1007 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 004 [2066 PM FINAL]

R1007
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

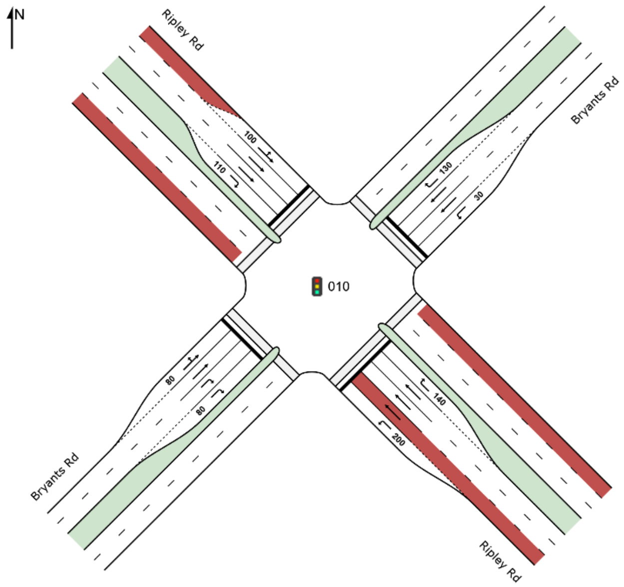
Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Wensley Rd													
Lane 1	186	2.5	782	0.238	100	32.5	LOS C	7.9	56.8	Short	90	0.0	NA
Lane 2	186	2.5	782	0.238	100	32.5	LOS C	7.9	56.8	Short	110	0.0	NA
Lane 3	158	0.7	208	0.758	100	69.6	LOS E	11.1	78.0	Full	500	0.0	0.0
Lane 4	143	0.7	189 [1]	0.758	100	69.3	LOS E	10.0	70.5	Full	500	0.0	0.0
Lane 5	62	3.4	194	0.320	100	69.4	LOS E	4.0	29.0	Short	30	0.0	NA
Approach	735	1.9		0.758		50.8	LOS D	11.1	78.0				
East: Ripley Rd													
Lane 1	69	19.7	369	0.188	100	51.4	LOS D	3.9	31.6	Two Seg [10]	500	0.0	0.0
Lane 2	258	3.2	300 [1]	0.860	100	69.5	LOS E	18.7	134.6	Full	500	0.0	0.0
Lane 3	270	3.2	314	0.860	100	69.7	LOS E	19.7	141.7	Full	500	0.0	0.0
Lane 4	229	1.6	302	0.761	100	69.1	LOS E	15.7	111.2	Short	200	0.0	NA
Lane 5	229	1.6	302	0.761	100	69.1	LOS E	15.7	111.2	Short	180	0.0	NA
Approach	1056	3.6		0.860		68.2	LOS E	19.7	141.7				
North: Fischer Rd													
Lane 1	371	2.0	889	0.417	100	30.1	LOS C	16.0	114.2	Short	120	0.0	NA
Lane 2	456	0.0	543	0.839	100	56.2	LOS E	31.2	218.3	Full	500	0.0	0.0
Lane 3	425	0.0	507 [1]	0.839	100	55.7	LOS E	28.7	200.8	Full	500	0.0	0.0
Lane 4	65	0.0	517	0.126	100	45.8	LOS D	3.3	23.1	Short	60	0.0	NA
Approach	1317	0.6		0.839		48.2	LOS D	31.2	218.3				
West: Ripley Rd													
Lane 1	64	19.7	569	0.113	100	37.8	LOS D	3.0	24.4	Two Seg [10]	500	0.0	0.0
Lane 2	276	1.3	529 [1]	0.522	100	45.6	LOS D	15.8	111.8	Full	500	0.0	0.0
Lane 3	281	1.3	539	0.522	100	45.7	LOS D	16.1	114.2	Full	500	0.0	0.0
Lane 4	426	1.7	511	0.834	100	61.9	LOS E	29.2	207.4	Short	220	0.0	NA
Lane 5	426	1.7	511	0.834	100	61.9	LOS E	29.2	207.4	Short	200	0.0	NA
Approach	1474	2.4		0.834		54.7	LOS D	29.2	207.4				
Intersection	4581	2.0		0.860		55.3	LOS E	31.2	218.3				

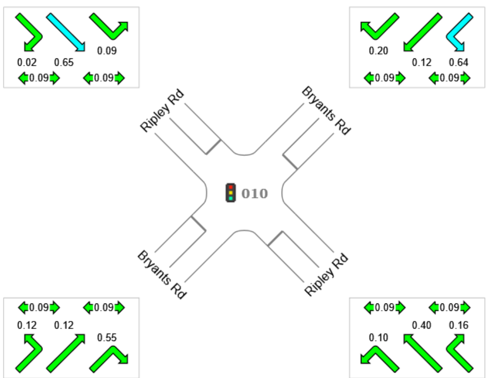
5 Intersection R1010

2031

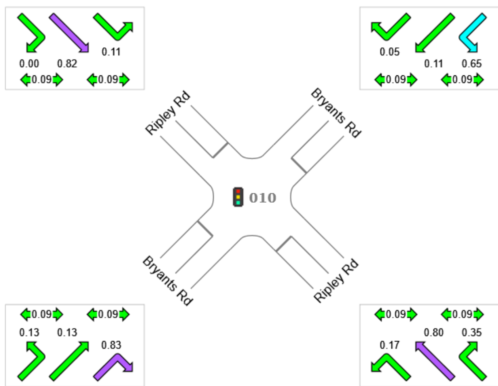
SITE LAYOUT – R10010 – 2031



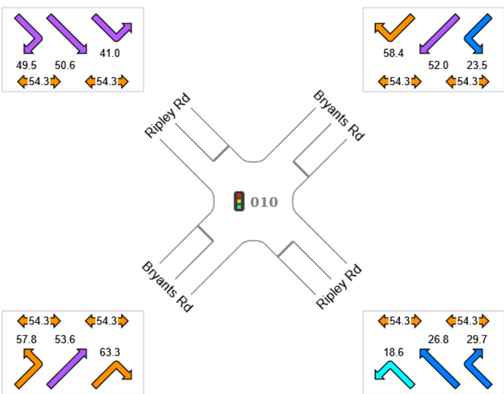
DEGREE OF SATURATION AM



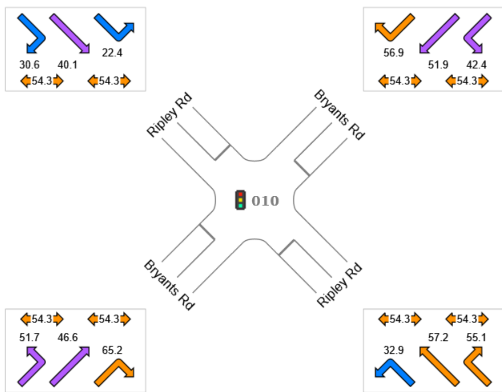
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1010 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 010 [2031 AM - FINAL]

R1010
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Rd													
Lane 1	105	1.0	1030	0.102	100	18.6	LOS B	2.8	19.9	Short	200	0.0	NA
Lane 2	2	100.0	483	0.004	100	22.2	LOS C	0.1	0.9	Full	500	0.0	0.0
Lane 3	321	0.7	793	0.405	100	26.8	LOS C	13.2	92.8	Full	500	0.0	0.0
Lane 4	321	0.7	793	0.405	100	26.8	LOS C	13.2	92.8	Full	500	0.0	0.0
Lane 5	105	18.0	672	0.157	100	29.7	LOS C	3.9	31.1	Short	140	0.0	NA
Approach	855	3.1		0.405		26.1	LOS C	13.2	92.8				
NorthEast: Bryants Rd													
Lane 1	657	1.6	1021 [1]	0.644	100	23.5	LOS C	25.1	178.0	Short	30	0.0	NA
Lane 2	27	0.0	228	0.120	100	52.0	LOS D	1.5	10.2	Full	500	0.0	0.0
Lane 3	27	0.0	228	0.120	100	52.0	LOS D	1.5	10.2	Full	500	0.0	0.0
Lane 4	43	0.0	217	0.199	100	58.4	LOS E	2.3	16.4	Short	130	0.0	NA
Approach	755	1.4		0.644		27.5	LOS C	25.1	178.0				
NorthWest: Ripley Rd													
Lane 1	32	56.7	364	0.087	100	39.5	LOS D	1.4	14.3	Two Seg [10]	500	0.0	0.0
Lane 2	213	7.4	326	0.653	100	50.7	LOS D	11.8	88.2	Full	500	0.0	0.0
Lane 3	213	7.4	326	0.653	100	50.7	LOS D	11.8	88.2	Full	500	0.0	0.0
Lane 4	7	0.0	325	0.023	100	49.5	LOS D	0.4	2.5	Short	110	0.0	NA
Approach	464	10.7		0.653		49.9	LOS D	11.8	88.2				
SouthWest: Bryants Rd													
Lane 1	23	12.9	197	0.117	100	54.6	LOS D	1.2	9.7	Short	80	0.0	NA
Lane 2	20	21.9	171	0.117	100	54.5	LOS D	1.1	9.1	Full	500	0.0	0.0
Lane 3	101	1.6	184	0.547	100	63.3	LOS E	5.8	41.4	Full	500	0.0	0.0
Lane 4	101	1.6	184	0.547	100	63.3	LOS E	5.8	41.4	Short	80	0.0	NA
Approach	244	4.3		0.547		61.7	LOS E	5.8	41.4				
Intersection	2318	4.2		0.653		35.1	LOS D	25.1	178.0				

Intersection R1010 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 010 [2031 PM - FINAL]

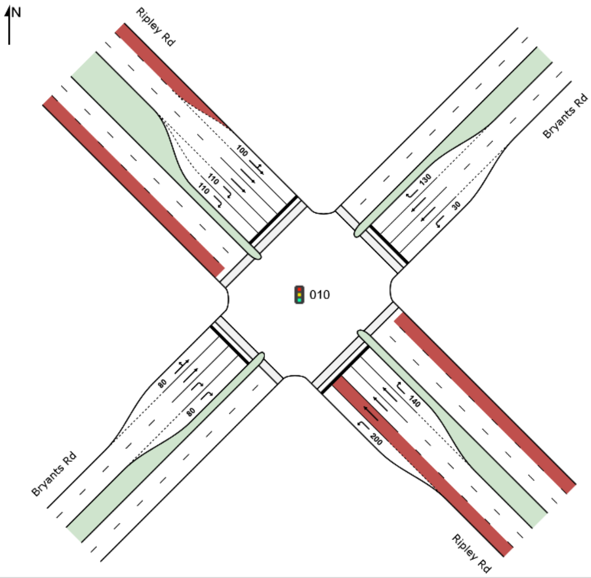
R1010
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

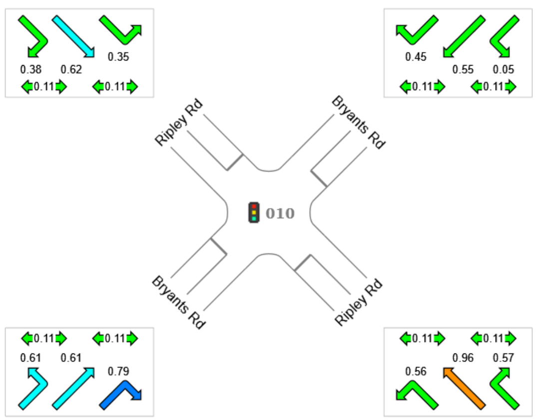
	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Rd													
Lane 1	118	0.0	681	0.173	100	32.9	LOS C	4.6	32.3	Short	200	0.0	NA
Lane 2	4	100.0	187	0.023	100	46.5	LOS D	0.2	2.7	Full	500	0.0	0.0
Lane 3	246	0.6	307	0.801	100	57.3	LOS E	14.9	105.2	Full	500	0.0	0.0
Lane 4	246	0.6	307	0.801	100	57.3	LOS E	14.9	105.2	Full	500	0.0	0.0
Lane 5	97	7.6	279	0.347	100	55.1	LOS E	5.2	38.4	Short	140	0.0	NA
Approach	712	2.1		0.801		52.9	LOS D	14.9	105.2				
NorthEast: Bryants Rd													
Lane 1	366	2.3	567 [1]	0.646	100	42.4	LOS D	18.1	129.3	Short	30	0.0	NA
Lane 2	25	0.0	228	0.109	100	51.9	LOS D	1.3	9.2	Full	500	0.0	0.0
Lane 3	25	0.0	228	0.109	100	51.9	LOS D	1.3	9.2	Full	500	0.0	0.0
Lane 4	12	0.0	217	0.053	100	56.9	LOS E	0.6	4.3	Short	130	0.0	NA
Approach	427	2.0		0.646		43.9	LOS D	18.1	129.3				
NorthWest: Ripley Rd													
Lane 1	91	12.8	856	0.106	100	21.9	LOS C	2.7	21.3	Two Seg [10]	500	0.0	0.0
Lane 2	565	1.2	687 [1]	0.823	100	40.1	LOS D	31.3	221.1	Full	500	0.0	0.0
Lane 3	583	1.2	709 [1]	0.823	100	40.4	LOS D	32.6	230.5	Full	500	0.0	0.0
Lane 4	1	0.0	681	0.002	100	30.6	LOS C	0.0	0.3	Short	110	0.0	NA
Approach	1240	2.0		0.823		38.9	LOS D	32.6	230.5				
SouthWest: Bryants Rd													
Lane 1	40	0.0	310	0.128	100	46.6	LOS D	2.0	13.9	Short	80	0.0	NA
Lane 2	39	0.0	309	0.128	100	47.0	LOS D	2.0	14.0	Full	500	0.0	0.0
Lane 3	243	0.9	292	0.832	100	65.2	LOS E	15.2	106.9	Full	500	0.0	0.0
Lane 4	243	0.9	292	0.832	100	65.2	LOS E	15.2	106.9	Short	80	0.0	NA
Approach	565	0.7		0.832		62.6	LOS E	15.2	106.9				
Intersection	2944	1.8		0.832		47.6	LOS D	32.6	230.5				

Intersection R1010-2041

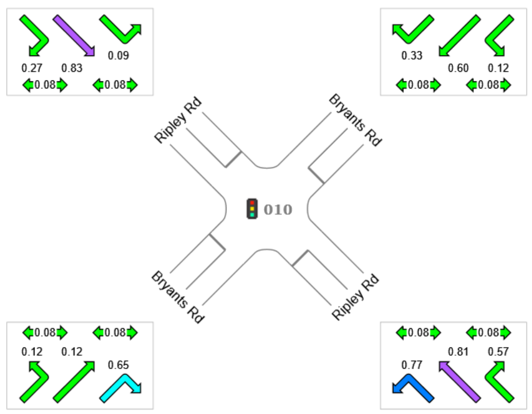
SITE LAYOUT – R10010 – 2041



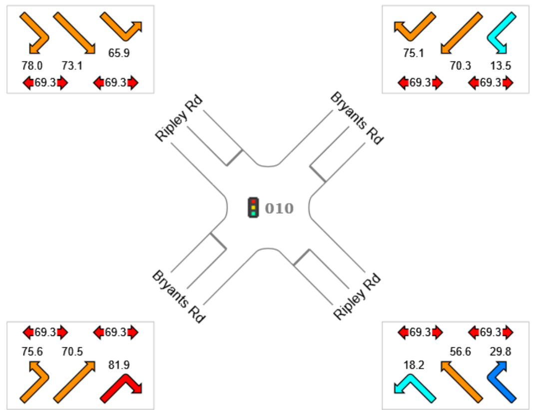
DEGREE OF SATURATION AM



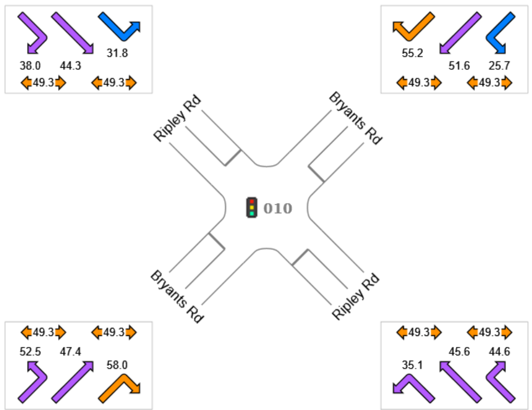
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1010 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 010 [2041 AM - FINAL]

R1010
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total	HV						Veh	Dist				
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Rd													
Lane 1	678	7.0	1215	0.558	100	18.2	LOS B	24.6	182.6	Short	200	0.0	NA
Lane 2	13	100.0	638	0.020	100	16.8	LOS B	0.4	5.4	Full	500	0.0	0.0
Lane 3	1002	2.0	1039	0.964	100	57.3	LOS E	84.0	598.3	Full	500	0.0	21.3
Lane 4	782	2.0	811 [1]	0.964	100	56.3	LOS E	57.7	410.7	Full	500	0.0	0.0
Lane 5	547	5.8	963	0.568	100	29.8	LOS C	26.1	191.6	Short	140	0.0	NA
Approach	3022	4.2		0.964		43.1	LOS D	84.0	598.3				
NorthEast: Bryants Rd													
Lane 1	58	3.6	1243	0.047	100	13.5	LOS B	1.3	9.6	Short	30	0.0	NA
Lane 2	99	15.1	181 [1]	0.545	100	70.1	LOS E	7.0	55.6	Full	500	0.0	0.0
Lane 3	103	15.1	189	0.545	100	70.4	LOS E	7.4	58.3	Full	500	0.0	0.0
Lane 4	85	6.2	190	0.449	100	75.1	LOS E	6.0	44.3	Short	130	0.0	NA
Approach	345	11.0		0.545		61.9	LOS E	7.4	58.3				
NorthWest: Ripley Rd													
Lane 1	95	21.1	271	0.350	100	64.7	LOS E	6.2	51.3	Two Seg [10]	500	0.0	0.0
Lane 2	103	3.1	166	0.619	100	73.8	LOS E	7.5	54.1	Full	500	0.0	0.0
Lane 3	103	3.1	166	0.619	100	73.8	LOS E	7.5	54.1	Full	500	0.0	0.0
Lane 4	54	17.6	143	0.375	100	78.0	LOS E	3.8	31.0	Short	110	0.0	NA
Lane 5	54	17.6	143	0.375	100	78.0	LOS E	3.8	31.0	Short	110	0.0	NA
Approach	407	11.1		0.619		72.8	LOS E	7.5	54.1				
SouthWest: Bryants Rd													
Lane 1	122	7.9	200	0.611	100	70.6	LOS E	8.7	65.2	Short	80	0.0	NA
Lane 2	120	8.7	197	0.611	100	70.8	LOS E	8.6	65.0	Full	500	0.0	0.0
Lane 3	154	3.4	193	0.795	100	81.9	LOS F	11.8	84.7	Full	500	0.0	0.0
Lane 4	154	3.4	193	0.795	100	81.9	LOS F	11.8	84.7	Short	80	0.0	NA
Approach	549	5.6		0.795		77.0	LOS E	11.8	84.7				
Intersection	4324	5.6		0.964		51.7	LOS D	84.0	598.3				

Intersection R1010 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 010 [2041 PM - FINAL]

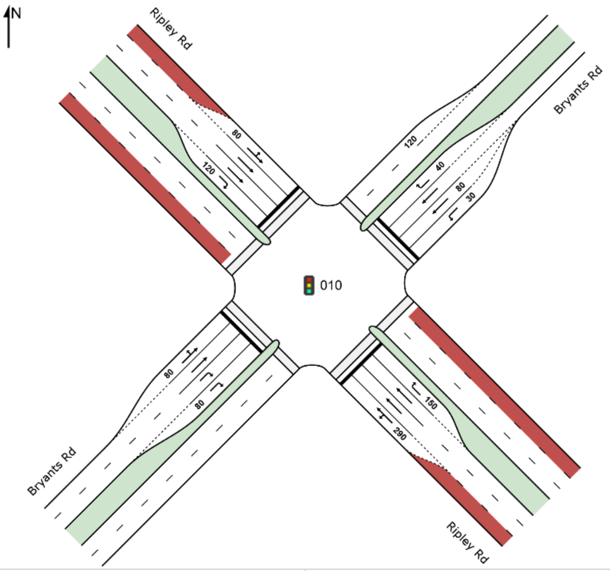
R1010
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

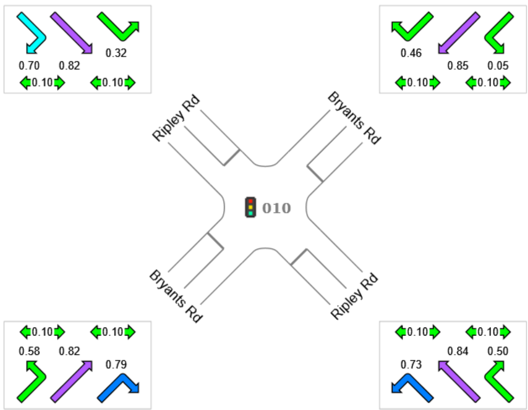
	Demand Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total	HV						Veh	Dist				
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Rd													
Lane 1	588	5.0	766	0.768	100	35.1	LOS D	27.2	198.7	Short	200	0.0	NA
Lane 2	12	100.0	301	0.038	100	33.4	LOS C	0.5	6.1	Full	500	0.0	0.0
Lane 3	397	1.7	491	0.810	100	45.8	LOS D	21.5	152.8	Full	500	0.0	0.0
Lane 4	397	1.7	491	0.810	100	45.8	LOS D	21.5	152.8	Full	500	0.0	0.0
Lane 5	259	6.5	452	0.573	100	44.6	LOS D	12.3	90.7	Short	140	0.0	NA
Approach	1654	4.3		0.810		41.7	LOS D	27.2	198.7				
NorthEast: Bryants Rd													
Lane 1	91	3.5	774	0.117	100	25.7	LOS C	2.9	20.8	Short	30	0.0	NA
Lane 2	129	10.2	216	0.599	100	51.6	LOS D	6.9	52.3	Full	500	0.0	0.0
Lane 3	129	10.2	216	0.599	100	51.6	LOS D	6.9	52.3	Full	500	0.0	0.0
Lane 4	69	4.5	213	0.327	100	55.2	LOS E	3.5	25.7	Short	130	0.0	NA
Approach	419	7.8		0.599		46.6	LOS D	6.9	52.3				
NorthWest: Ripley Rd													
Lane 1	47	40.0	517	0.092	100	29.4	LOS C	1.7	16.1	Two Seg [10]	500	0.0	0.0
Lane 2	472	0.2	566	0.833	100	44.6	LOS D	25.8	180.7	Full	500	0.0	0.0
Lane 3	472	0.2	566	0.833	100	44.6	LOS D	25.8	180.7	Full	500	0.0	0.0
Lane 4	143	4.8	522	0.274	100	38.0	LOS D	5.9	43.2	Short	110	0.0	NA
Lane 5	143	4.8	522	0.274	100	38.0	LOS D	5.9	43.2	Short	110	0.0	NA
Approach	1277	2.7		0.833		42.5	LOS D	25.8	180.7				
SouthWest: Bryants Rd													
Lane 1	26	14.0	212	0.122	100	47.2	LOS D	1.3	9.9	Short	80	0.0	NA
Lane 2	26	14.6	211	0.122	100	47.9	LOS D	1.3	10.0	Full	500	0.0	0.0
Lane 3	141	1.5	217	0.647	100	58.0	LOS E	7.6	53.6	Full	500	0.0	0.0
Lane 4	141	1.5	217	0.647	100	58.0	LOS E	7.6	53.6	Short	80	0.0	NA
Approach	333	3.5		0.647		56.4	LOS E	7.6	53.6				
Intersection	3682	4.1		0.833		43.9	LOS D	27.2	198.7				

Intersection R1010-2066

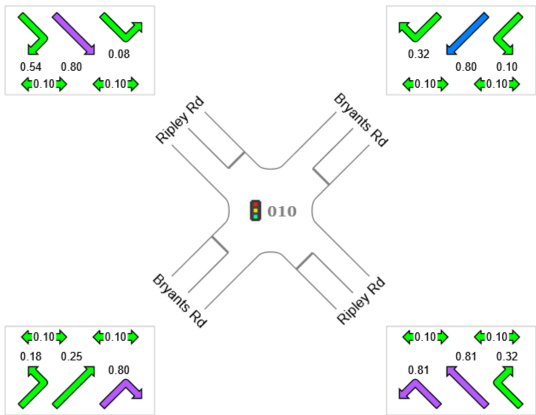
SITE LAYOUT – R10010 – 2066



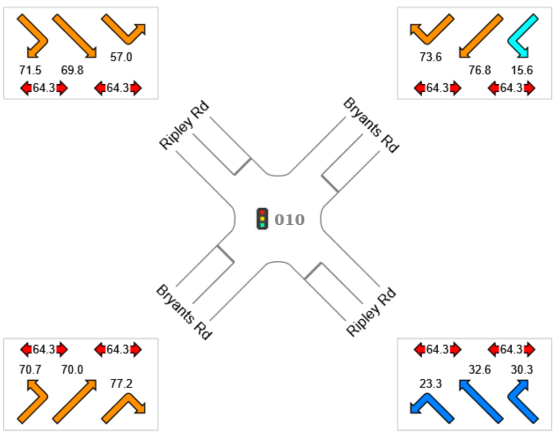
DEGREE OF SATURATION AM



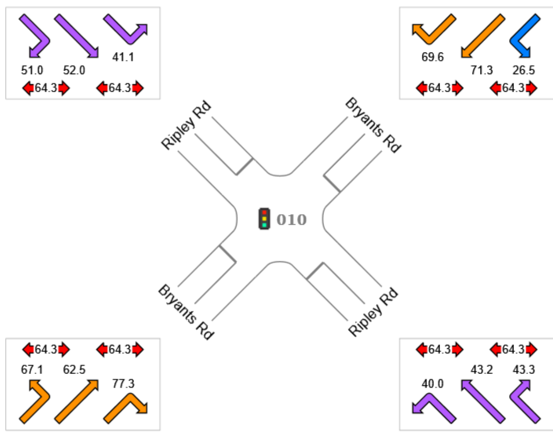
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1010 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 010 [2066 AM - FINAL]

R1010
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Rd													
Lane 1	823	6.9	1134	0.726	100	23.1	LOS C	36.9	273.8	Two Seg [10]	500	0.0	0.0
Lane 2	806	2.2	961	0.839	100	33.0	LOS C	47.5	339.0	Full	500	0.0	0.0
Lane 3	732	2.2	873 [1]	0.839	100	32.3	LOS C	41.3	294.8	Full	500	0.0	0.0
Lane 4	457	1.8	917	0.498	100	30.3	LOS C	20.4	145.3	Short	150	0.0	NA
Approach	2819	3.5		0.839		29.5	LOS C	47.5	339.0				
NorthEast: Bryants Rd													
Lane 1	57	5.6	1136	0.050	100	15.6	LOS B	1.4	10.4	Short	30	0.0	NA
Lane 2	120	19.0	141 [1]	0.854	100	76.7	LOS E	8.9	72.7	Short	80	0.0	NA
Lane 3	134	19.0	157 [1]	0.854	100	76.9	LOS E	10.0	81.7	Full	500	0.0	0.0
Lane 4	65	30.6	142	0.461	100	73.6	LOS E	4.4	39.0	Short	40	0.0	NA
Approach	377	19.0		0.854		67.0	LOS E	10.0	81.7				
NorthWest: Ripley Rd													
Lane 1	104	31.3	322	0.324	100	55.8	LOS E	6.1	54.2	Two Seg [10]	500	0.0	0.0
Lane 2	202	3.4	245	0.822	100	70.3	LOS E	14.5	104.3	Full	500	0.0	0.0
Lane 3	202	3.4	245	0.822	100	70.3	LOS E	14.5	104.3	Full	500	0.0	0.0
Lane 4	154	11.6	220	0.697	100	71.5	LOS E	10.5	80.7	Short	120	0.0	NA
Approach	661	9.7		0.822		68.3	LOS E	14.5	104.3				
SouthWest: Bryants Rd													
Lane 1	119	7.5	204	0.581	71 [6]	66.4	LOS E	7.9	58.9	Short	80	0.0	NA
Lane 2	161	9.5	197	0.820	100	72.8	LOS E	11.7	88.8	Full	500	0.0	0.0
Lane 3	149	7.4	189	0.791	100	77.2	LOS E	10.7	79.8	Full	500	0.0	0.0
Lane 4	149	7.4	189	0.791	100	77.2	LOS E	10.7	79.8	Short	80	0.0	NA
Approach	579	8.0		0.820		73.8	LOS E	11.7	88.8				
Intersection	4436	6.3		0.854		44.3	LOS D	47.5	339.0				

Intersection R1010 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 010 [2066 PM - FINAL]

R1010
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

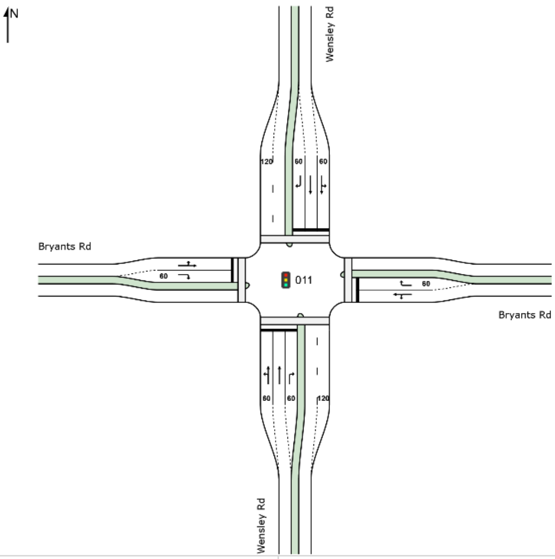
Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Rd													
Lane 1	672	5.3	833	0.806	100	39.8	LOS D	38.9	285.0	Two Seg [10]	500	0.0	0.0
Lane 2	424	3.1	628	0.675	100	43.4	LOS D	24.8	178.3	Full	500	0.0	0.0
Lane 3	424	3.1	628	0.675	100	43.4	LOS D	24.8	178.3	Full	500	0.0	0.0
Lane 4	187	5.6	587	0.319	100	43.3	LOS D	9.5	69.8	Short	150	0.0	NA
Approach	1706	4.3		0.806		41.9	LOS D	38.9	285.0				
NorthEast: Bryants Rd													
Lane 1	87	0.0	889	0.098	100	26.5	LOS C	3.2	22.3	Short	30	0.0	NA
Lane 2	131	10.1	164 [1]	0.797	100	71.0	LOS E	9.3	70.7	Short	80	0.0	NA
Lane 3	151	10.1	190 [1]	0.797	100	71.5	LOS E	10.8	82.3	Full	500	0.0	0.0
Lane 4	59	10.7	185	0.319	100	69.6	LOS E	3.8	29.2	Short	40	0.0	NA
Approach	428	8.1		0.797		61.9	LOS E	10.8	82.3				
NorthWest: Ripley Rd													
Lane 1	37	51.4	451	0.082	100	38.1	LOS D	1.7	17.5	Two Seg [10]	500	0.0	0.0
Lane 2	433	0.5	538 [1]	0.804	100	52.2	LOS D	28.2	197.9	Full	500	0.0	0.0
Lane 3	446	0.5	555	0.804	100	52.4	LOS D	29.2	205.6	Full	500	0.0	0.0
Lane 4	272	6.6	507	0.536	100	51.0	LOS D	15.6	115.5	Short	120	0.0	NA
Approach	1187	3.5		0.804		51.6	LOS D	29.2	205.6				
SouthWest: Bryants Rd													
Lane 1	35	12.4	194	0.178	71 [6]	61.8	LOS E	2.2	16.9	Short	80	0.0	NA
Lane 2	49	12.8	193	0.252	100	63.2	LOS E	3.1	24.2	Full	500	0.0	0.0
Lane 3	159	0.3	199	0.801	100	77.3	LOS E	11.4	80.2	Full	500	0.0	0.0
Lane 4	159	0.3	199	0.801	100	77.3	LOS E	11.4	80.2	Short	80	0.0	NA
Approach	401	2.9		0.801		74.3	LOS E	11.4	80.2				
Intersection	3723	4.3		0.806		50.8	LOS D	38.9	285.0				

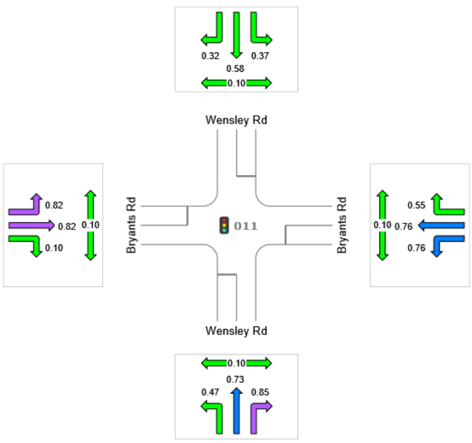
6 Intersection R1011

2031

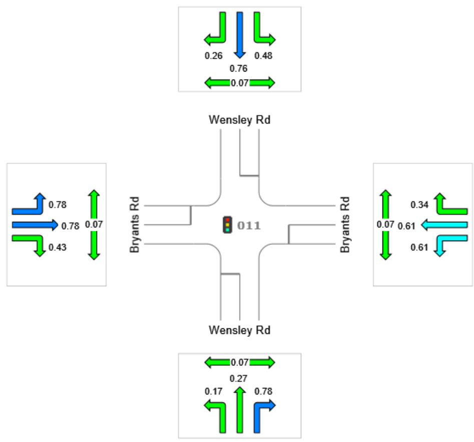
SITE LAYOUT – R10011 – 2031



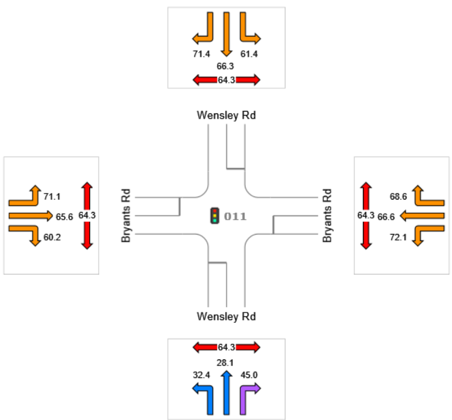
DEGREE OF SATURATION AM



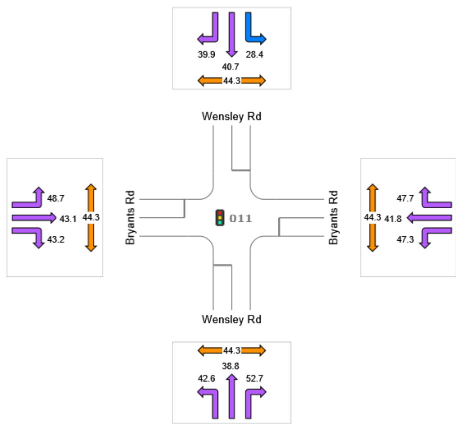
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1011 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 011 [2031 AM - FINAL]

R1011
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Wensley Rd													
Lane 1	356	1.6	762 [1]	0.468	64 [6]	28.0	LOS C	16.0	113.6	Short	60	0.0	NA
Lane 2	433	1.6	592 [1]	0.731	100	28.9	LOS C	20.6	146.5	Full	500	0.0	0.0
Lane 3	500	0.4	586 [1]	0.854	100	45.0	LOS D	28.9	202.8	Short	60	0.0	NA
Approach	1289	1.1		0.854		34.9	LOS C	28.9	202.8				
East: Bryants Rd													
Lane 1	197	0.0	258	0.764	100	68.2	LOS E	13.7	95.6	Full	500	0.0	0.0
Lane 2	129	1.6	236	0.549	100	68.6	LOS E	8.5	60.2	Short	60	0.0	NA
Approach	326	0.6		0.764		68.4	LOS E	13.7	95.6				
North: Wensley Rd													
Lane 1	112	5.4	303	0.369	64 [6]	60.7	LOS E	6.8	50.1	Short	60	0.0	NA
Lane 2	101	5.5	175	0.576	100	67.8	LOS E	6.8	50.1	Full	500	0.0	0.0
Lane 3	54	2.0	170	0.316	100	71.4	LOS E	3.5	25.1	Short	60	0.0	NA
Approach	266	4.7		0.576		65.5	LOS E	6.8	50.1				
West: Bryants Rd													
Lane 1	260	0.0	318 [1]	0.817	100	68.2	LOS E	18.3	128.0	Full	500	0.0	0.0
Lane 2	27	7.7	277	0.099	100	60.2	LOS E	1.6	12.0	Short	60	0.0	NA
Approach	287	0.7		0.817		67.4	LOS E	18.3	128.0				
Intersection	2169	1.5		0.854		48.0	LOS D	28.9	202.8				

Intersection R1011 – 2031 Cont.

LANE SUMMARY 2031 PM

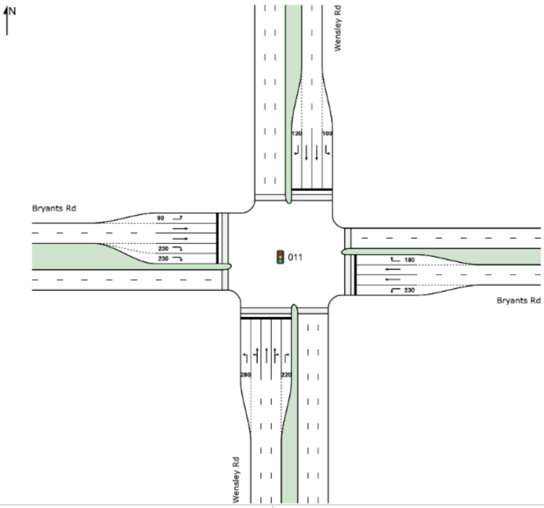
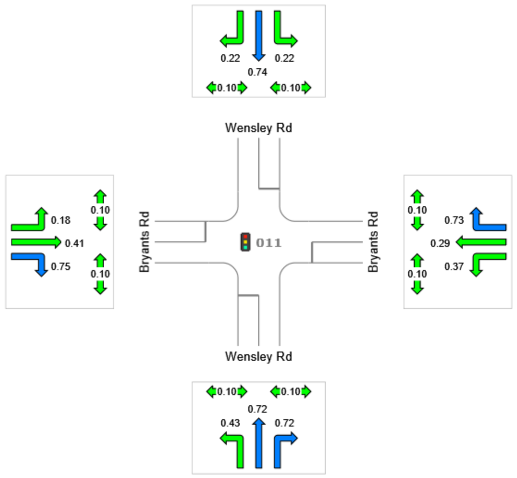
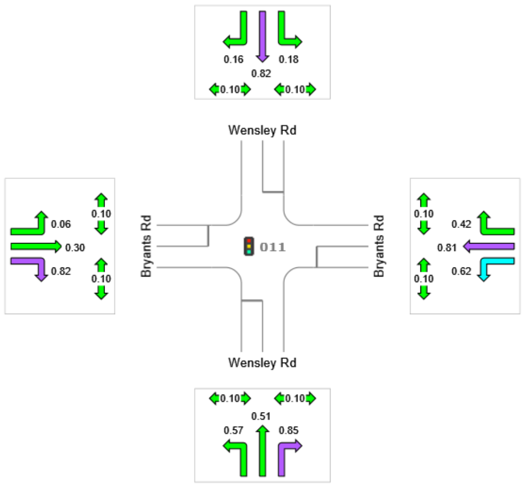
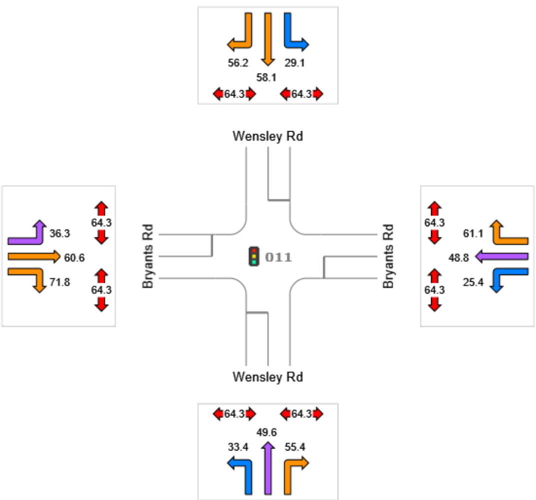
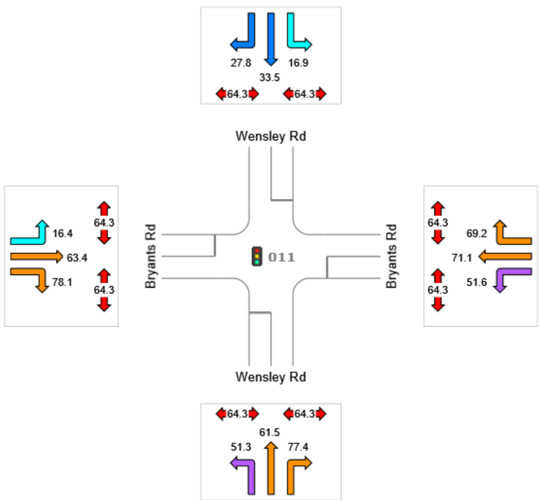
Site: 011 [2031 PM - FINAL]

R1011
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total	HV						Veh	Dist				
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Wensley Rd													
Lane 1	59	2.1	343	0.171	64 [6]	39.1	LOS D	2.4	17.3	Short	60	0.0	NA
Lane 2	87	3.4	324	0.267	100	39.6	LOS D	3.8	27.0	Full	500	0.0	0.0
Lane 3	245	0.4	315	0.779	100	52.7	LOS D	12.4	87.1	Short	60	0.0	NA
Approach	391	1.3		0.779		47.7	LOS D	12.4	87.1				
East: Bryants Rd													
Lane 1	202	0.0	331	0.611	100	44.9	LOS D	9.3	65.3	Full	500	0.0	0.0
Lane 2	96	0.0	279	0.344	100	47.7	LOS D	4.3	30.2	Short	60	0.0	NA
Approach	298	0.0		0.611		45.8	LOS D	9.3	65.3				
North: Wensley Rd													
Lane 1	382	1.4	790	0.484	64 [6]	28.3	LOS C	13.6	96.5	Short	60	0.0	NA
Lane 2	329	0.3	435 [1]	0.757	100	41.1	LOS D	15.7	110.4	Full	500	0.0	0.0
Lane 3	113	0.0	427	0.264	100	39.9	LOS D	4.6	31.9	Short	60	0.0	NA
Approach	824	0.8		0.757		35.0	LOS C	15.7	110.4				
West: Bryants Rd													
Lane 1	322	0.0	414	0.778	100	44.2	LOS D	15.9	111.0	Full	500	0.0	0.0
Lane 2	166	2.5	383	0.434	100	43.2	LOS D	7.2	51.4	Short	60	0.0	NA
Approach	488	0.9		0.778		43.9	LOS D	15.9	111.0				
Intersection	2001	0.8		0.779		41.2	LOS D	15.9	111.0				

Intersection R1011-2041

SITE LAYOUT – R10011 – 2041	
	
DEGREE OF SATURATION AM	DEGREE OF SATURATION PM
	
DELAY CONTROL (seconds) AM	DELAY CONTROL (seconds) PM
	

Intersection R1011 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 011 [2041 AM - FINAL]

R1011
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Wensley Rd													
Lane 1	358	0.6	832	0.430	60[5]	33.4	LOS C	16.4	115.5	Short	280	0.0	NA
Lane 2	378	0.9	526	0.719	100	49.6	LOS D	23.4	164.7	Full	500	0.0	0.0
Lane 3	378	0.9	526	0.719	100	49.6	LOS D	23.4	164.7	Full	500	0.0	0.0
Lane 4	355	4.8	495	0.719	100	53.7	LOS D	22.0	160.3	Full	500	0.0	0.0
Lane 5	346	6.6	481	0.719	100	55.5	LOS E	21.4	158.5	Short	220	0.0	NA
Approach	1816	2.7		0.719		48.3	LOS D	23.4	164.7				
East: Bryants Rd													
Lane 1	353	5.4	958	0.368	100	25.4	LOS C	13.7	100.0	Short	230	0.0	NA
Lane 2	121	6.6	414	0.291	100	48.8	LOS D	6.8	50.6	Full	500	0.0	0.0
Lane 3	121	6.6	414	0.291	100	48.8	LOS D	6.8	50.6	Full	500	0.0	0.0
Lane 4	298	0.4	410	0.726	100	61.1	LOS E	19.2	134.8	Short	180	0.0	NA
Approach	892	4.0		0.726		43.7	LOS D	19.2	134.8				
North: Wensley Rd													
Lane 1	185	1.1	855	0.217	100	29.1	LOS C	7.4	52.2	Short	100	0.0	NA
Lane 2	285	1.3	387	0.738	100	58.1	LOS E	18.7	132.5	Full	500	0.0	0.0
Lane 3	285	1.3	387	0.738	100	58.1	LOS E	18.7	132.5	Full	500	0.0	0.0
Lane 4	81	2.6	365	0.222	100	56.2	LOS E	4.6	33.2	Short	120	0.0	NA
Approach	837	1.4		0.738		51.5	LOS D	18.7	132.5				
West: Bryants Rd													
Lane 1	128	0.8	699	0.184	100	36.3	LOS D	5.8	40.6	Short	90	0.0	NA
Lane 2	109	0.0	265	0.414	100	60.6	LOS E	7.0	48.7	Full	500	0.0	0.0
Lane 3	109	0.0	265	0.414	100	60.6	LOS E	7.0	48.7	Full	500	0.0	0.0
Lane 4	185	2.3	248	0.747	100	71.8	LOS E	12.8	91.2	Short	230	0.0	NA
Lane 5	185	2.3	248	0.747	100	71.8	LOS E	12.8	91.2	Short	230	0.0	NA
Approach	718	1.3		0.747		62.0	LOS E	12.8	91.2				
Intersection	4262	2.5		0.747		50.3	LOS D	23.4	164.7				

Intersection R1011 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 011 [2041 PM - FINAL]

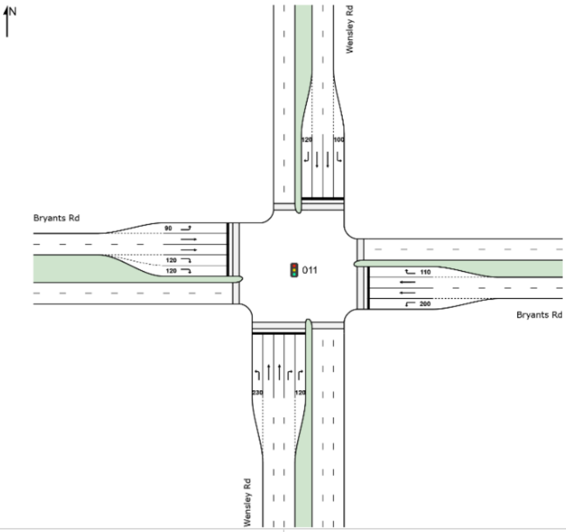
R1011
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

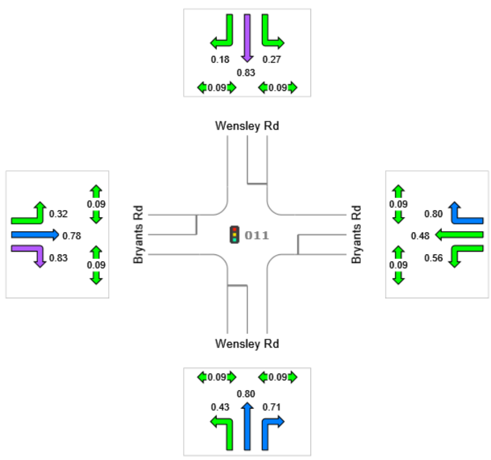
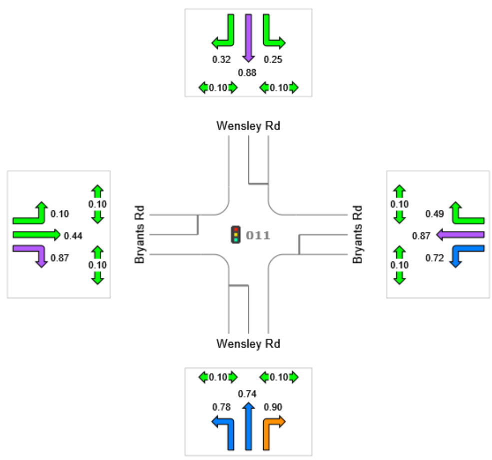
Lane Use and Performance

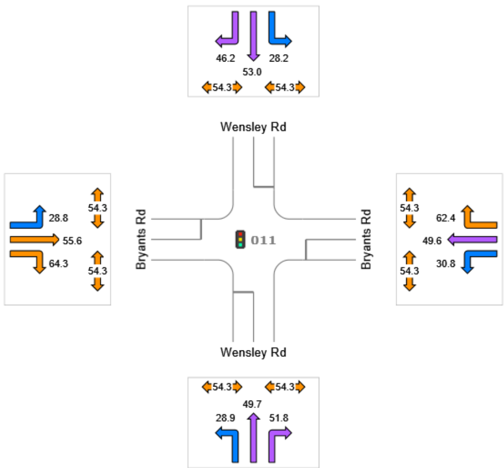
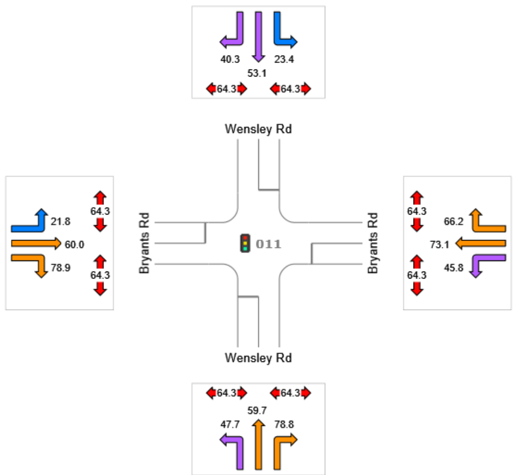
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Wensley Rd													
Lane 1	301	0.0	531	0.567	67 [5]	51.3	LOS D	17.5	122.4	Short	280	0.0	NA
Lane 2	134	0.4	264	0.506	60 [5]	61.5	LOS E	8.6	60.6	Full	500	0.0	0.0
Lane 3	134	0.4	264	0.506	60 [5]	61.5	LOS E	8.6	60.6	Full	500	0.0	0.0
Lane 4	208	3.3	246	0.846	100	77.4	LOS E	15.2	109.7	Full	500	0.0	0.0
Lane 5	208	3.3	246	0.846	100	77.4	LOS E	15.2	109.7	Short	220	0.0	NA
Approach	985	1.5		0.846		65.1	LOS E	17.5	122.4				
East: Bryants Rd													
Lane 1	335	1.9	537	0.624	100	51.6	LOS D	19.7	140.4	Short	230	0.0	NA
Lane 2	181	0.3	222	0.812	100	71.1	LOS E	13.0	90.9	Full	500	0.0	0.0
Lane 3	181	0.3	222	0.812	100	71.1	LOS E	13.0	90.9	Full	500	0.0	0.0
Lane 4	88	1.2	210	0.420	100	69.2	LOS E	5.8	40.7	Short	180	0.0	NA
Approach	784	1.1		0.812		62.6	LOS E	19.7	140.4				
North: Wensley Rd													
Lane 1	205	1.0	1159	0.177	100	16.9	LOS B	5.7	40.3	Short	100	0.0	NA
Lane 2	669	0.4	813 [1]	0.823	100	33.3	LOS C	37.3	261.9	Full	500	0.0	0.0
Lane 3	713	0.4	867 [1]	0.823	100	33.7	LOS C	40.7	286.0	Full	500	0.0	0.0
Lane 4	136	0.8	871	0.156	100	27.8	LOS C	5.2	36.5	Short	120	0.0	NA
Approach	1723	0.5		0.823		31.1	LOS C	40.7	286.0				
West: Bryants Rd													
Lane 1	74	0.0	1154	0.064	100	16.4	LOS B	1.9	13.5	Short	90	0.0	NA
Lane 2	63	0.0	209	0.302	100	63.4	LOS E	4.1	28.5	Full	500	0.0	0.0
Lane 3	63	0.0	209	0.302	100	63.4	LOS E	4.1	28.5	Full	500	0.0	0.0
Lane 4	161	1.0	198	0.815	100	78.1	LOS E	11.7	82.3	Short	230	0.0	NA
Lane 5	161	1.0	198	0.815	100	78.1	LOS E	11.7	82.3	Short	230	0.0	NA
Approach	522	0.6		0.815		65.8	LOS E	11.7	82.3				
Intersection	4015	0.9		0.846		50.1	LOS D	40.7	286.0				

Intersection R1011-2066

SITE LAYOUT – R10011 – 2066



DEGREE OF SATURATION AM	DEGREE OF SATURATION PM
	

DELAY CONTROL (seconds) AM	DELAY CONTROL (seconds) PM
	

Intersection R1011 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 011 [2066 AM - FINAL]

R1011
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Wensley Rd													
Lane 1	364	0.3	849	0.429	100	28.9	LOS C	14.2	99.7	Short	230	0.0	NA
Lane 2	376	0.3	470	0.799	100	49.7	LOS D	21.9	153.5	Full	500	0.0	0.0
Lane 3	376	0.3	470	0.799	100	49.7	LOS D	21.9	153.5	Full	500	0.0	0.0
Lane 4	303	8.0	425	0.714	100	51.8	LOS D	16.7	124.6	Full	500	0.0	0.0
Lane 5	303	8.0	425	0.714	100	51.8	LOS D	16.7	124.6	Short	120	0.0	NA
Approach	1722	3.0		0.799		46.0	LOS D	21.9	153.5				
East: Bryants Rd													
Lane 1	449	7.5	808	0.556	100	30.8	LOS C	19.0	141.3	Short	200	0.0	NA
Lane 2	152	4.2	316	0.479	100	49.6	LOS D	8.2	59.3	Full	500	0.0	0.0
Lane 3	152	4.2	316	0.479	100	49.6	LOS D	8.2	59.3	Full	500	0.0	0.0
Lane 4	243	2.2	305	0.798	100	62.4	LOS E	14.7	105.1	Short	110	0.0	NA
Approach	996	5.2		0.798		44.3	LOS D	19.0	141.3				
North: Wensley Rd													
Lane 1	216	4.9	793	0.272	100	28.2	LOS C	7.9	57.7	Short	100	0.0	NA
Lane 2	359	1.2	435	0.826	100	53.0	LOS D	21.7	153.1	Full	500	0.0	0.0
Lane 3	359	1.2	435	0.826	100	53.0	LOS D	21.7	153.1	Full	500	0.0	0.0
Lane 4	74	4.3	405	0.182	100	46.2	LOS D	3.5	25.4	Short	120	0.0	NA
Approach	1008	2.2		0.826		47.2	LOS D	21.7	153.1				
West: Bryants Rd													
Lane 1	265	0.4	818	0.324	100	28.8	LOS C	10.0	70.2	Short	90	0.0	NA
Lane 2	253	1.0	323	0.783	100	55.6	LOS E	15.1	106.6	Full	500	0.0	0.0
Lane 3	253	1.0	323	0.783	100	55.6	LOS E	15.1	106.6	Full	500	0.0	0.0
Lane 4	251	3.2	303	0.828	100	64.3	LOS E	15.5	111.8	Short	120	0.0	NA
Lane 5	251	3.2	303	0.828	100	64.3	LOS E	15.5	111.8	Short	120	0.0	NA
Approach	1272	1.7		0.828		53.4	LOS D	15.5	111.8				
Intersection	4998	2.9		0.828		47.8	LOS D	21.9	153.5				

Intersection R1011 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 011 [2066 PM - FINAL]

R1011
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

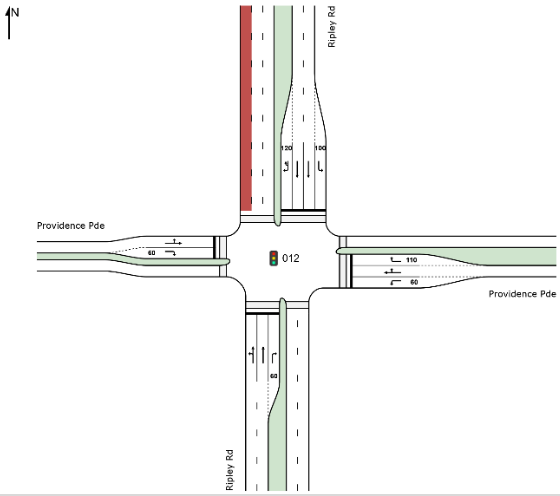
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Wensley Rd													
Lane 1	539	0.2	689	0.782	100	47.7	LOS D	32.6	228.7	Short	230	0.0	NA
Lane 2	267	0.0	362	0.738	100	59.7	LOS E	17.7	124.0	Full	500	0.0	0.0
Lane 3	267	0.0	362	0.738	100	59.7	LOS E	17.7	124.0	Full	500	0.0	0.0
Lane 4	304	2.9	338	0.901	100	78.8	LOS E	23.2	166.5	Full	500	0.0	0.0
Lane 5	304	2.9	338	0.901	100	78.8	LOS E	23.2	166.5	Short	120	0.0	NA
Approach	1682	1.1		0.901		62.8	LOS E	32.6	228.7				
East: Bryants Rd													
Lane 1	487	2.2	679	0.717	100	45.8	LOS D	28.3	201.9	Short	200	0.0	NA
Lane 2	243	0.7	277	0.875	100	73.1	LOS E	18.0	126.9	Full	500	0.0	0.0
Lane 3	243	0.7	277	0.875	100	73.1	LOS E	18.0	126.9	Full	500	0.0	0.0
Lane 4	128	0.8	264	0.487	100	66.2	LOS E	8.2	58.0	Short	110	0.0	NA
Approach	1101	1.3		0.875		60.2	LOS E	28.3	201.9				
North: Wensley Rd													
Lane 1	251	0.8	1002	0.250	100	23.4	LOS C	8.9	62.4	Short	100	0.0	NA
Lane 2	531	0.5	601 [1]	0.883	100	52.9	LOS D	36.0	253.0	Full	500	0.0	0.0
Lane 3	573	0.5	648 [1]	0.883	100	53.3	LOS D	39.6	278.1	Full	500	0.0	0.0
Lane 4	211	0.0	663	0.317	100	40.3	LOS D	10.3	72.1	Short	120	0.0	NA
Approach	1564	0.5		0.883		46.6	LOS D	39.6	278.1				
West: Bryants Rd													
Lane 1	104	1.0	1001	0.104	100	21.8	LOS C	3.4	23.7	Short	90	0.0	NA
Lane 2	123	0.4	278	0.443	100	60.0	LOS E	7.8	54.9	Full	500	0.0	0.0
Lane 3	123	0.4	278	0.443	100	60.0	LOS E	7.8	54.9	Full	500	0.0	0.0
Lane 4	223	4.7	257	0.869	100	78.9	LOS E	16.6	121.0	Short	120	0.0	NA
Lane 5	223	4.7	257	0.869	100	78.9	LOS E	16.6	121.0	Short	120	0.0	NA
Approach	797	2.9		0.869		65.6	LOS E	16.6	121.0				
Intersection	5144	1.2		0.901		57.7	LOS E	39.6	278.1				

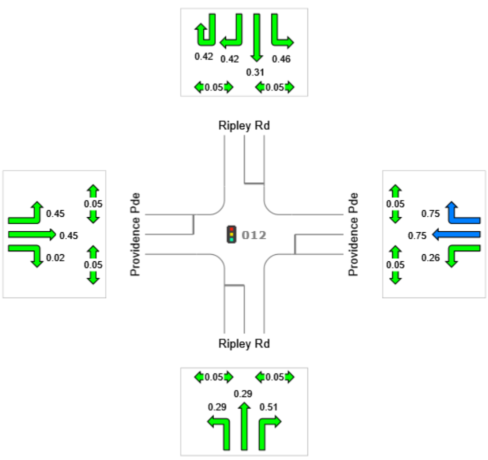
7 Intersection R1012

2031

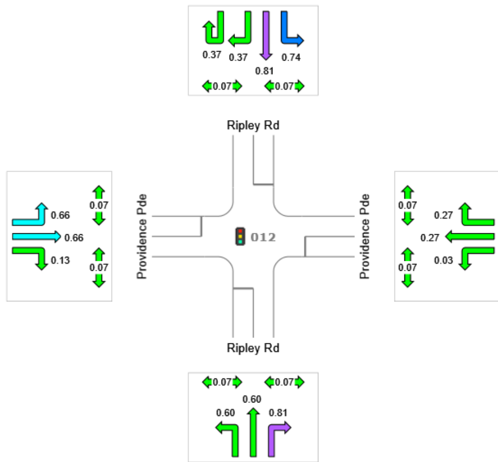
SITE LAYOUT – R10012– 2031



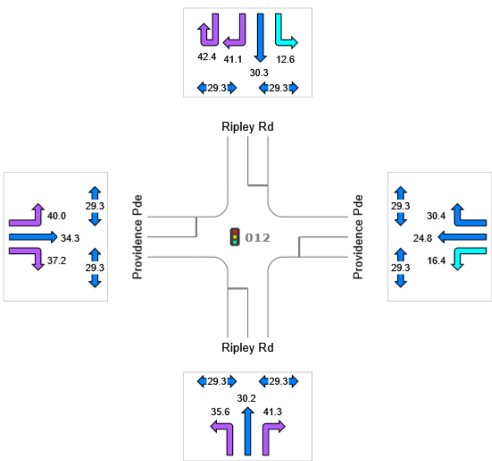
DEGREE OF SATURATION AM



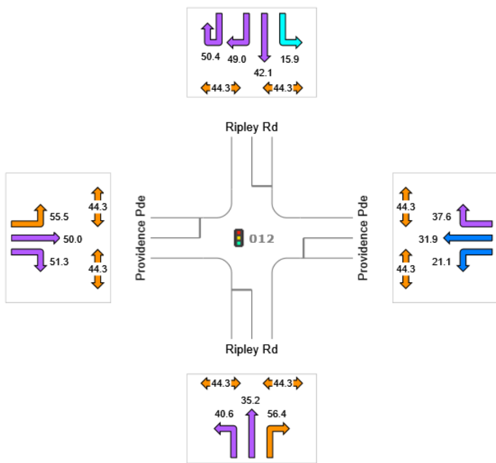
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1012 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 012 [2031 AM - FINAL]

R1012
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Ripley Rd													
Lane 1	77	4.5	269	0.285	100	30.7	LOS C	2.4	17.8	Full	500	0.0	0.0
Lane 2	77	5.1	270	0.285	100	30.2	LOS C	2.5	17.9	Full	500	0.0	0.0
Lane 3	81	0.0	159	0.509	100	41.3	LOS D	2.9	20.1	Short	60	0.0	NA
Approach	235	3.1		0.509		34.2	LOS C	2.9	20.1				
East: Providence Pde													
Lane 1	242	0.0	929	0.261	100	16.4	LOS B	4.8	33.3	Short	60	0.0	NA
Lane 2	455	0.7	610	0.747	100	30.0	LOS C	14.9	104.6	Full	500	0.0	0.0
Lane 3	453	0.7	607	0.747	100	30.4	LOS C	14.8	104.3	Short	110	0.0	NA
Approach	1151	0.5		0.747		27.3	LOS C	14.9	104.6				
North: Ripley Rd													
Lane 1	398	2.4	861	0.462	100	12.6	LOS B	5.1	36.1	Short	100	0.0	NA
Lane 2	84	3.8	272	0.310	100	30.3	LOS C	2.7	19.5	Full	500	0.0	0.0
Lane 3	84	3.8	272	0.310	100	30.3	LOS C	2.7	19.5	Full	500	0.0	0.0
Lane 4	64	3.3	152	0.424	100	41.2	LOS D	2.3	16.2	Short	120	0.0	NA
Approach	631	2.8		0.462		20.3	LOS C	5.1	36.1				
West: Providence Pde													
Lane 1	82	5.1	181	0.453	100	38.4	LOS D	2.8	20.8	Full	500	0.0	0.0
Lane 2	4	0.0	186	0.023	100	37.2	LOS D	0.1	0.9	Short	60	0.0	NA
Approach	86	4.9		0.453		38.4	LOS D	2.8	20.8				
Intersection	2102	1.7		0.747		26.4	LOS C	14.9	104.6				

Intersection R1012 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 012 [2031 PM - FINAL]

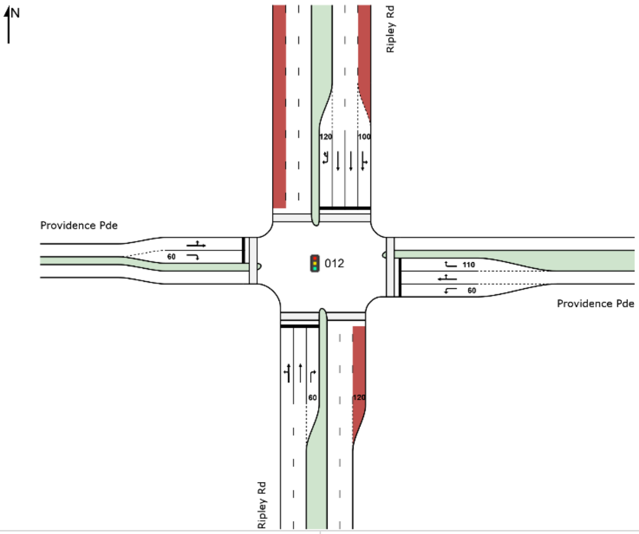
R1012
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Lane Use and Performance

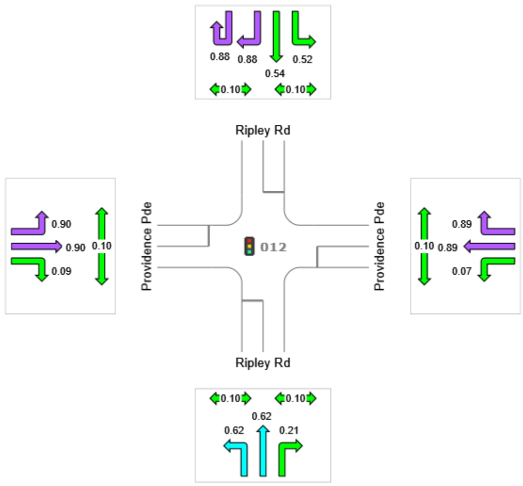
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Rd													
Lane 1	294	3.8	493	0.597	100	35.5	LOS D	12.6	91.4	Full	500	0.0	0.0
Lane 2	297	2.6	499	0.597	100	35.3	LOS D	12.9	92.1	Full	500	0.0	0.0
Lane 3	211	0.0	260	0.810	100	56.4	LOS E	11.0	77.1	Short	60	0.0	NA
Approach	802	2.4		0.810		40.9	LOS D	12.9	92.1				
East: Providence Pde													
Lane 1	27	0.0	854	0.032	100	21.1	LOS C	0.7	5.0	Short	60	0.0	NA
Lane 2	127	3.6	472	0.268	100	37.1	LOS D	5.0	35.7	Full	500	0.0	0.0
Lane 3	126	3.9	470	0.268	100	37.6	LOS D	4.9	35.6	Short	110	0.0	NA
Approach	280	3.4		0.268		35.8	LOS D	5.0	35.7				
North: Ripley Rd													
Lane 1	711	0.6	962	0.739	100	15.9	LOS B	15.0	105.2	Short	100	0.0	NA
Lane 2	407	2.1	500	0.814	100	42.1	LOS D	20.3	144.6	Full	500	0.0	0.0
Lane 3	410	1.0	504	0.814	100	42.1	LOS D	20.4	144.2	Full	500	0.0	0.0
Lane 4	92	1.1	250	0.366	100	49.1	LOS D	4.2	29.6	Short	120	0.0	NA
Approach	1619	1.1		0.814		31.0	LOS C	20.4	144.6				
West: Providence Pde													
Lane 1	124	0.8	187	0.665	100	54.1	LOS D	6.2	44.0	Full	500	0.0	0.0
Lane 2	24	0.0	186	0.130	100	51.3	LOS D	1.1	7.8	Short	60	0.0	NA
Approach	148	0.7		0.665		53.7	LOS D	6.2	44.0				
Intersection	2849	1.7		0.814		35.4	LOS D	20.4	144.6				

Intersection R1012-2041

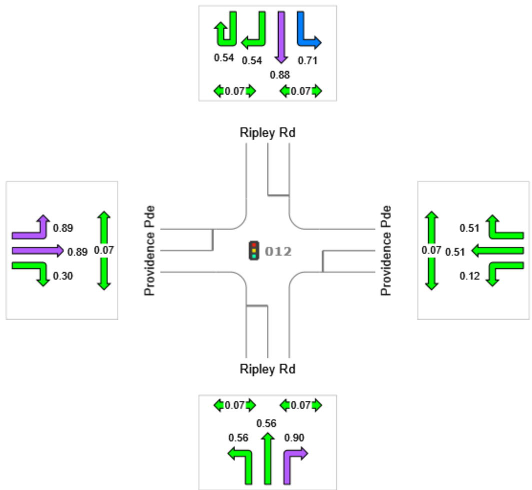
SITE LAYOUT – R10012 – 2041



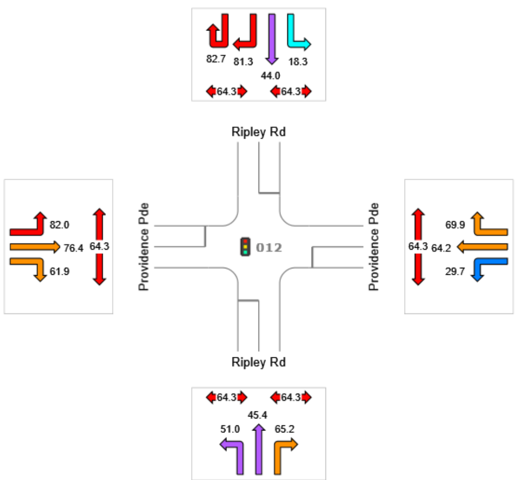
DEGREE OF SATURATION AM



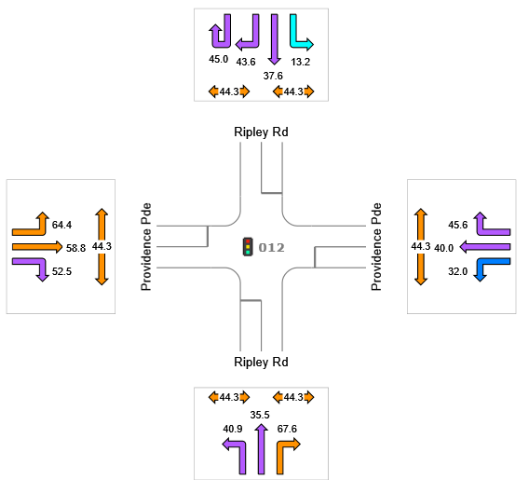
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1012 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 012 [2041 AM - FINAL]

R1012
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Ripley Rd													
Lane 1	343	5.8	549	0.625	100	45.8	LOS D	20.0	146.9	Full	500	0.0	0.0
Lane 2	330	2.3	528 [1]	0.625	100	45.3	LOS D	19.1	136.7	Full	500	0.0	0.0
Lane 3	49	0.0	239	0.207	100	65.2	LOS E	3.1	21.5	Short	60	0.0	NA
Approach	722	3.8		0.625		46.9	LOS D	20.0	146.9				
East: Providence Pde													
Lane 1	60	0.0	809	0.074	100	29.7	LOS C	2.3	16.3	Short	60	0.0	NA
Lane 2	410	0.8	460 [1]	0.891	100	69.2	LOS E	30.0	211.2	Full	500	0.0	0.0
Lane 3	426	0.9	478 [1]	0.891	100	70.1	LOS E	31.4	221.9	Short	110	0.0	NA
Approach	896	0.8		0.891		67.0	LOS E	31.4	221.9				
North: Ripley Rd													
Lane 1	465	6.3	899	0.518	100	18.0	LOS B	12.0	88.5	Two Seg [10]	500	0.0	0.0
Lane 2	302	4.5	555	0.545	100	44.6	LOS D	17.3	125.7	Full	500	0.0	0.0
Lane 3	302	4.5	555	0.545	100	44.6	LOS D	17.3	125.7	Full	500	0.0	0.0
Lane 4	196	4.3	223	0.877	100	81.5	LOS F	14.8	107.2	Short	120	0.0	NA
Approach	1265	5.2		0.877		40.5	LOS D	17.3	125.7				
West: Providence Pde													
Lane 1	229	5.0	256 [1]	0.897	100	81.3	LOS F	17.5	128.0	Full	500	0.0	0.0
Lane 2	24	0.0	265	0.091	100	61.9	LOS E	1.4	10.1	Short	60	0.0	NA
Approach	254	4.6		0.897		79.4	LOS E	17.5	128.0				
Intersection	3137	3.6		0.897		52.7	LOS D	31.4	221.9				

Intersection R1012 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 012 [2041 PM - FINAL]

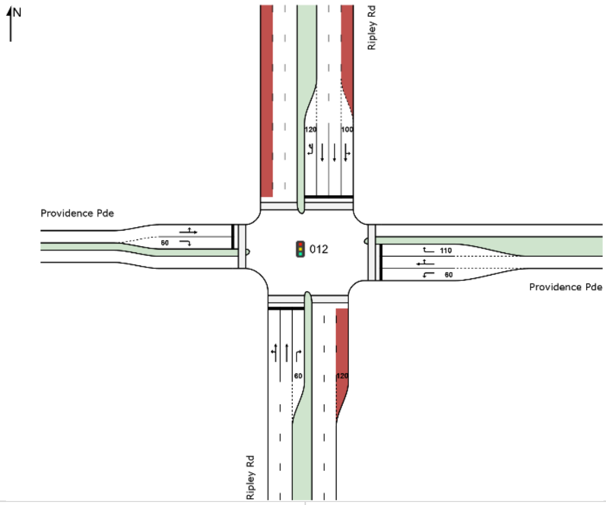
R1012
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Lane Use and Performance

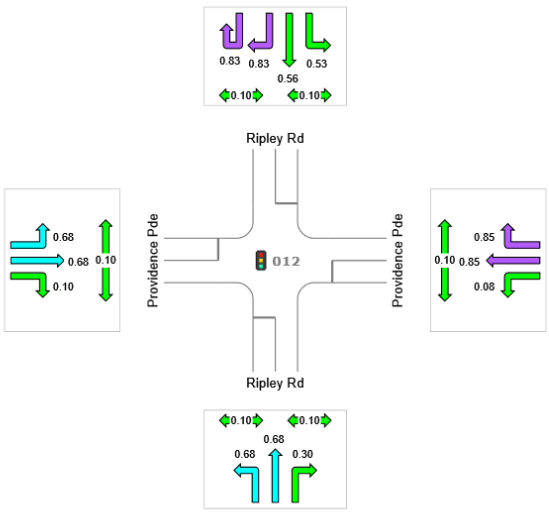
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Ripley Rd													
Lane 1	260	6.3	466	0.557	100	35.8	LOS D	11.1	81.9	Full	500	0.0	0.0
Lane 2	269	1.7	482	0.557	100	35.6	LOS D	11.6	82.1	Full	500	0.0	0.0
Lane 3	100	0.0	111	0.897	100	67.6	LOS E	5.7	39.9	Short	60	0.0	NA
Approach	628	3.4		0.897		40.8	LOS D	11.6	82.1				
East: Providence Pde													
Lane 1	67	0.0	576	0.117	100	32.0	LOS C	2.3	16.4	Short	60	0.0	NA
Lane 2	182	0.3	355	0.513	100	44.6	LOS D	8.2	57.3	Full	500	0.0	0.0
Lane 3	181	0.3	352	0.513	100	45.6	LOS D	8.1	56.9	Short	110	0.0	NA
Approach	431	0.2		0.513		43.0	LOS D	8.2	57.3				
North: Ripley Rd													
Lane 1	766	2.5	1087	0.705	100	13.1	LOS B	14.2	101.5	Two Seg [10]	500	0.0	0.0
Lane 2	609	0.9	692 [1]	0.879	100	37.6	LOS D	30.2	213.4	Full	500	0.0	0.0
Lane 3	689	0.9	784	0.879	100	38.1	LOS D	35.6	250.8	Full	500	0.0	0.0
Lane 4	209	4.5	386	0.543	100	43.7	LOS D	9.2	67.2	Short	120	0.0	NA
Approach	2274	1.8		0.879		30.1	LOS C	35.6	250.8				
West: Providence Pde													
Lane 1	161	4.6	182	0.885	100	63.0	LOS E	9.0	65.8	Full	500	0.0	0.0
Lane 2	56	0.0	186	0.300	100	52.5	LOS D	2.6	18.5	Short	60	0.0	NA
Approach	217	3.4		0.885		60.3	LOS E	9.0	65.8				
Intersection	3549	2.0		0.897		35.4	LOS D	35.6	250.8				

Intersection R1012-2066

SITE LAYOUT – R10012 – 2066



DEGREE OF SATURATION AM



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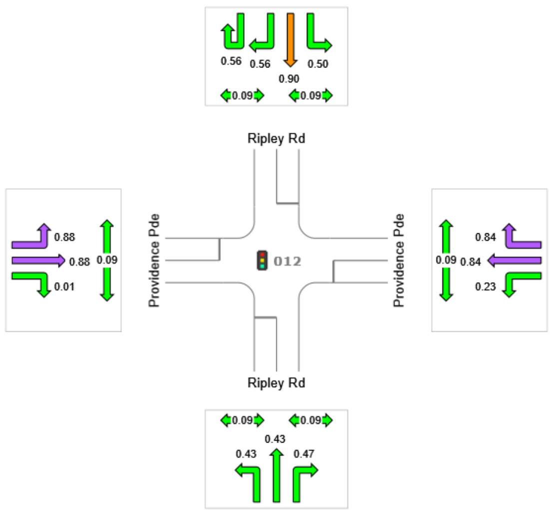
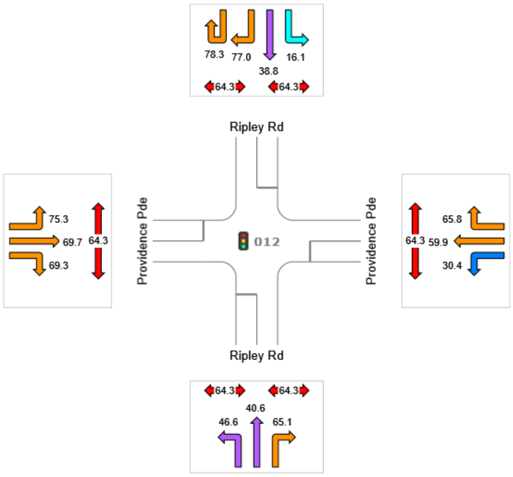
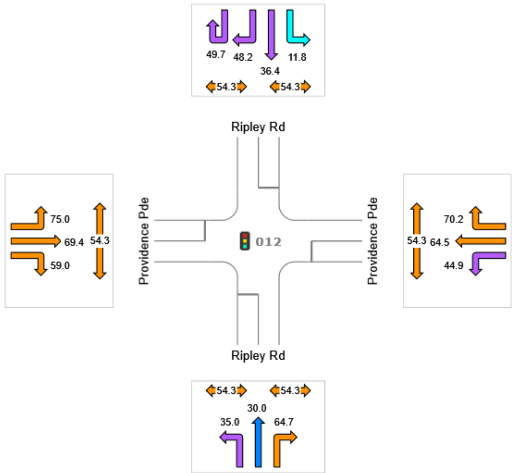


DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1012 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 012 [2066 AM - FINAL]

R1012
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Rd													
Lane 1	450	4.6	661	0.680	100	41.3	LOS D	25.7	187.2	Full	500	0.0	0.0
Lane 2	410	1.9	603 [1]	0.680	100	40.1	LOS D	22.9	163.3	Full	500	0.0	0.0
Lane 3	75	0.0	252	0.297	100	65.1	LOS E	4.7	32.7	Short	60	0.0	NA
Approach	935	3.0		0.680		42.7	LOS D	25.7	187.2				
East: Providence Pde													
Lane 1	63	0.0	796	0.079	100	30.4	LOS C	2.5	17.4	Short	60	0.0	NA
Lane 2	368	1.1	435 [1]	0.847	100	64.6	LOS E	25.6	181.0	Full	500	0.0	0.0
Lane 3	389	1.4	460	0.847	100	66.0	LOS E	27.4	194.0	Short	110	0.0	NA
Approach	821	1.2		0.847		62.6	LOS E	27.4	194.0				
North: Ripley Rd													
Lane 1	531	5.8	1000	0.531	100	15.9	LOS B	11.6	84.8	Two Seg [10]	500	0.0	0.0
Lane 2	375	4.1	665	0.564	100	39.3	LOS D	20.6	149.1	Full	500	0.0	0.0
Lane 3	375	4.1	665	0.564	100	39.3	LOS D	20.6	149.1	Full	500	0.0	0.0
Lane 4	189	10.0	227	0.833	100	77.2	LOS E	13.8	105.1	Short	120	0.0	NA
Approach	1471	5.4		0.833		35.7	LOS D	20.6	149.1				
West: Providence Pde													
Lane 1	116	2.7	170	0.682	100	74.8	LOS E	8.1	57.7	Full	500	0.0	0.0
Lane 2	17	0.0	172	0.098	100	69.3	LOS E	1.1	7.5	Short	60	0.0	NA
Approach	133	2.4		0.682		74.1	LOS E	8.1	57.7				
Intersection	3359	3.6		0.847		45.8	LOS D	27.4	194.0				

Intersection R1012 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 012 [2066 PM - FINAL]

R1012
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Phase Times)

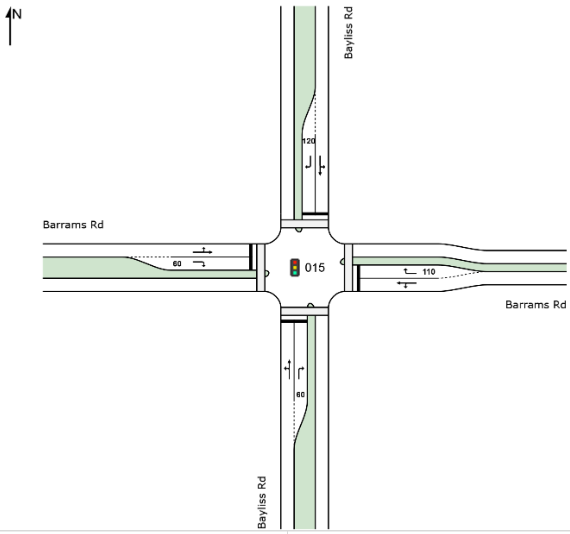
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Rd													
Lane 1	295	5.7	689	0.428	100	30.0	LOS C	12.6	92.6	Full	500	0.0	0.0
Lane 2	303	1.7	707	0.428	100	30.5	LOS C	13.2	93.9	Full	500	0.0	0.0
Lane 3	73	0.0	155	0.469	100	64.7	LOS E	4.2	29.7	Short	60	0.0	NA
Approach	671	3.3		0.469		34.0	LOS C	13.2	93.9				
East: Providence Pde													
Lane 1	101	0.0	449	0.225	100	44.9	LOS D	4.7	33.2	Short	60	0.0	NA
Lane 2	169	1.9	201	0.842	100	68.6	LOS E	10.8	76.9	Full	500	0.0	0.0
Lane 3	166	2.5	198	0.842	100	70.3	LOS E	10.6	76.1	Short	110	0.0	NA
Approach	437	1.7		0.842		63.8	LOS E	10.8	76.9				
North: Ripley Rd													
Lane 1	589	3.2	1168	0.505	100	11.6	LOS B	9.9	71.3	Two Seg [10]	500	0.0	0.0
Lane 2	722	0.5	798 [1]	0.905	100	36.7	LOS D	38.7	272.1	Full	500	0.0	0.0
Lane 3	820	0.5	907 [1]	0.905	100	36.5	LOS D	46.0	323.1	Full	500	0.0	0.0
Lane 4	249	3.0	447	0.558	100	48.2	LOS D	12.8	92.1	Short	120	0.0	NA
Approach	2381	1.4		0.905		31.6	LOS C	46.0	323.1				
West: Providence Pde													
Lane 1	144	7.3	163	0.884	100	74.0	LOS E	9.6	71.1	Full	500	0.0	0.0
Lane 2	1	0.0	170	0.006	100	59.0	LOS E	0.1	0.4	Short	60	0.0	NA
Approach	145	7.2		0.884		73.9	LOS E	9.6	71.1				
Intersection	3634	2.0		0.905		37.6	LOS D	46.0	323.1				

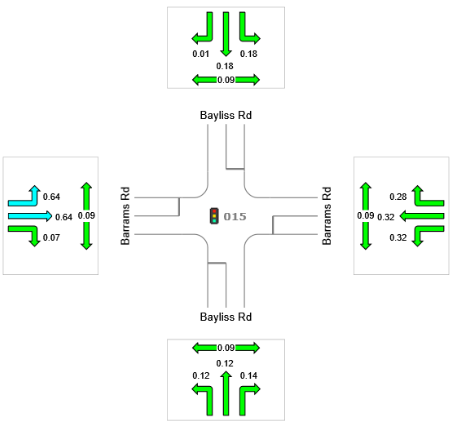
8 Intersection R1015

2031

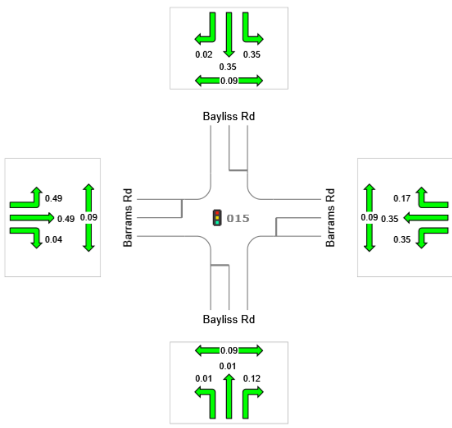
SITE LAYOUT – R10015 – 2031



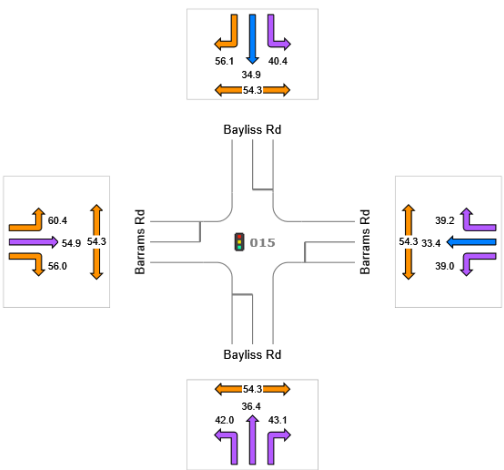
DEGREE OF SATURATION AM



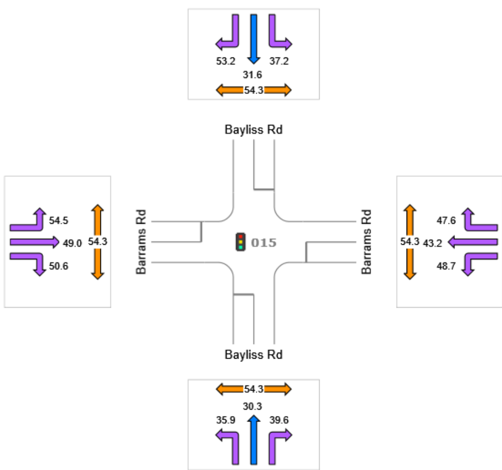
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1015 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 015 [2031 AM - FINAL]

R1015
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Phase Times)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bayliss Rd													
Lane 1	60	0.0	495	0.121	100	38.3	LOS D	2.7	18.7	Full	500	0.0	0.0
Lane 2	66	0.0	464	0.143	100	43.1	LOS D	3.0	21.1	Short	60	0.0	NA
Approach	126	0.0		0.143		40.8	LOS D	3.0	21.1				
East: Barrams Rd													
Lane 1	195	0.0	602	0.324	100	34.2	LOS C	8.6	60.5	Full	500	0.0	0.0
Lane 2	160	0.0	573	0.279	100	39.2	LOS D	7.1	49.4	Short	110	0.0	NA
Approach	355	0.0		0.324		36.4	LOS D	8.6	60.5				
North: Bayliss Rd													
Lane 1	95	0.0	514	0.184	100	40.0	LOS D	4.2	29.2	Full	500	0.0	0.0
Lane 2	3	0.0	217	0.015	100	56.1	LOS E	0.2	1.1	Short	120	0.0	NA
Approach	98	0.0		0.184		40.5	LOS D	4.2	29.2				
West: Barrams Rd													
Lane 1	155	0.7	244	0.635	100	55.1	LOS E	8.9	62.5	Full	500	0.0	0.0
Lane 2	16	0.0	232	0.068	100	56.0	LOS E	0.8	5.8	Short	60	0.0	NA
Approach	171	0.6		0.635		55.2	LOS E	8.9	62.5				
Intersection	749	0.1		0.635		42.0	LOS D	8.9	62.5				

Intersection R1015 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 015 [2031 PM - FINAL]

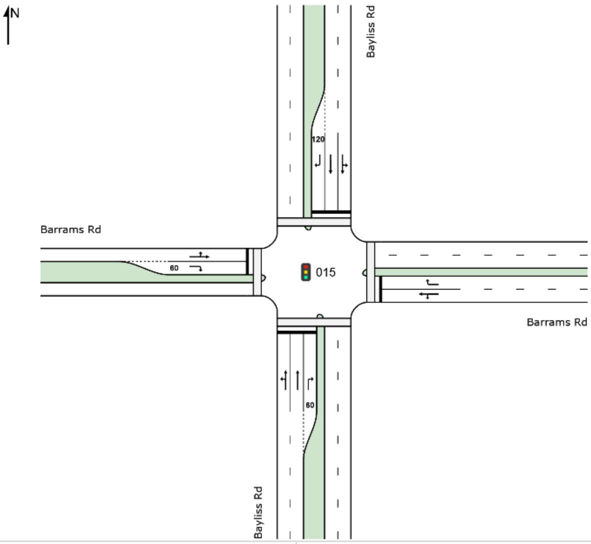
R1015
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Phase Times)

Lane Use and Performance

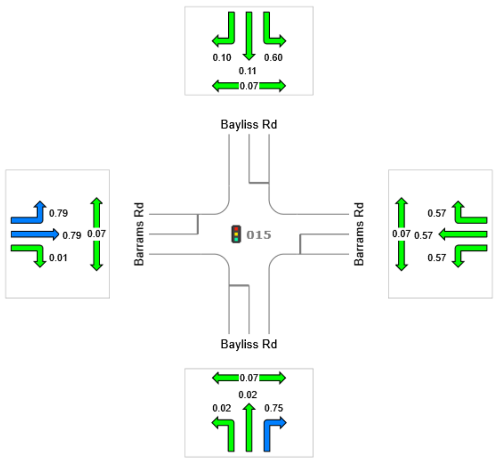
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bayliss Rd													
Lane 1	7	0.0	577	0.013	100	33.5	LOS C	0.3	2.1	Full	500	0.0	0.0
Lane 2	64	0.0	526	0.122	100	39.6	LOS D	2.8	19.4	Short	60	0.0	NA
Approach	72	0.0		0.122		39.0	LOS D	2.8	19.4				
East: Barrams Rd													
Lane 1	142	1.5	405	0.351	100	44.1	LOS D	7.1	50.4	Full	500	0.0	0.0
Lane 2	64	1.6	382	0.168	100	47.6	LOS D	3.1	22.0	Short	110	0.0	NA
Approach	206	1.5		0.351		45.2	LOS D	7.1	50.4				
North: Bayliss Rd													
Lane 1	220	0.0	627	0.351	100	37.0	LOS D	9.6	67.1	Full	500	0.0	0.0
Lane 2	5	0.0	263	0.020	100	53.2	LOS D	0.3	1.9	Short	120	0.0	NA
Approach	225	0.0		0.351		37.4	LOS D	9.6	67.1				
West: Barrams Rd													
Lane 1	159	1.3	322	0.493	100	49.0	LOS D	8.6	60.5	Full	500	0.0	0.0
Lane 2	12	0.0	310	0.037	100	50.6	LOS D	0.6	4.0	Short	60	0.0	NA
Approach	171	1.2		0.493		49.1	LOS D	8.6	60.5				
Intersection	674	0.8		0.493		42.9	LOS D	9.6	67.1				

Intersection R1015-2041

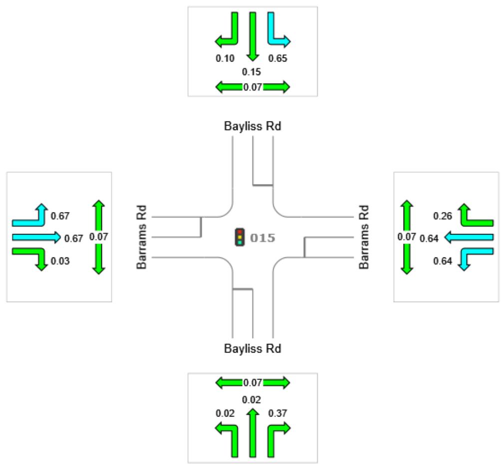
SITE LAYOUT – R10015 – 2041



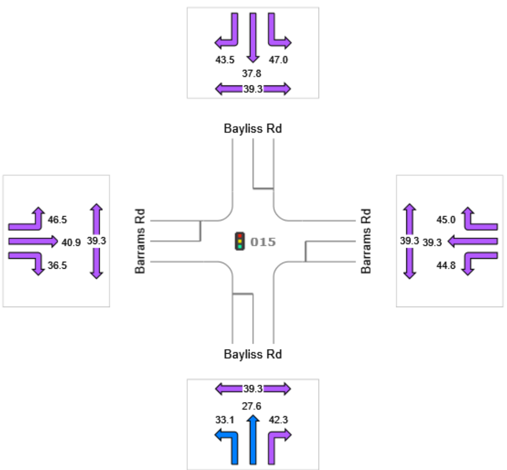
DEGREE OF SATURATION AM



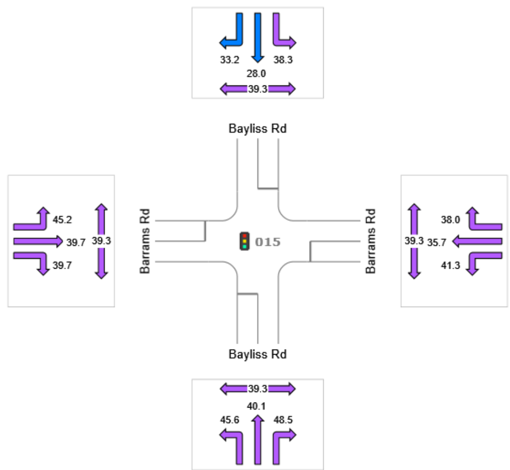
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1015 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 015 [2041 AM - FINAL]

R1015
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 90 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bayliss Rd													
Lane 1	8	5.4	455	0.018	100	29.0	LOS C	0.3	2.0	Full	500	0.0	0.0
Lane 2	8	7.1	456	0.018	100	27.6	LOS C	0.3	2.1	Full	500	0.0	0.0
Lane 3	340	0.9	451	0.754	100	42.3	LOS D	14.7	104.0	Short	60	0.0	NA
Approach	357	1.2		0.754		41.6	LOS D	14.7	104.0				
East: Barrams Rd													
Lane 1	172	1.2	299	0.573	100	39.8	LOS D	7.2	51.2	Full	500	0.0	0.0
Lane 2	164	1.3	286	0.574	100	45.0	LOS D	6.9	49.1	Full	500	0.0	0.0
Approach	336	1.3		0.574		42.3	LOS D	7.2	51.2				
North: Bayliss Rd													
Lane 1	148	0.0	248	0.599	100	47.0	LOS D	6.4	45.1	Full	500	0.0	0.0
Lane 2	28	0.0	260	0.109	18 [5]	37.8	LOS D	1.1	7.9	Full	500	0.0	0.0
Lane 3	23	4.5	240	0.097	100	43.5	LOS D	0.9	6.7	Short	120	0.0	NA
Approach	200	0.5		0.599		45.3	LOS D	6.4	45.1				
West: Barrams Rd													
Lane 1	303	1.0	386	0.785	100	41.3	LOS D	13.7	97.1	Full	500	0.0	0.0
Lane 2	5	0.0	371	0.014	100	36.5	LOS D	0.2	1.3	Short	60	0.0	NA
Approach	308	1.0		0.785		41.2	LOS D	13.7	97.1				
Intersection	1201	1.1		0.785		42.3	LOS D	14.7	104.0				

Intersection R1015 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 015 [2041 PM - FINAL]

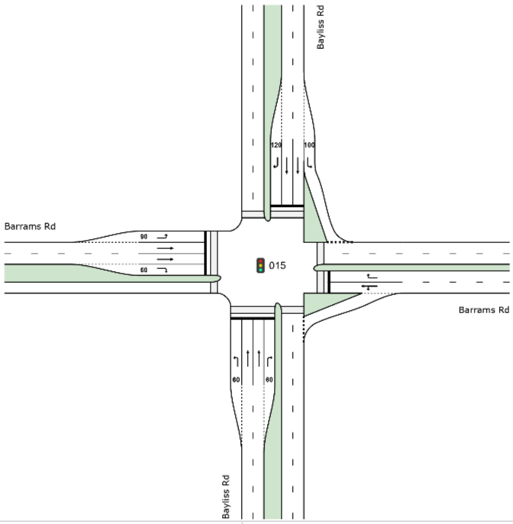
R1015
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 90 seconds (Site User-Given Cycle Time)

Lane Use and Performance

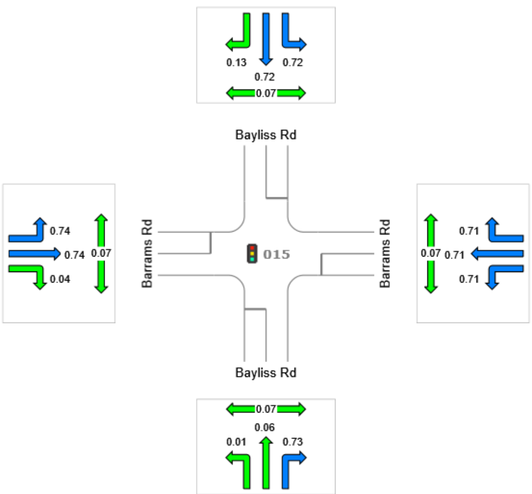
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bayliss Rd													
Lane 1	4	0.0	192	0.019	100	41.7	LOS D	0.1	1.0	Full	500	0.0	0.0
Lane 2	4	0.0	195	0.019	100	40.1	LOS D	0.1	1.0	Full	500	0.0	0.0
Lane 3	69	0.0	186	0.374	100	48.5	LOS D	3.0	21.0	Short	60	0.0	NA
Approach	77	0.0		0.374		47.7	LOS D	3.0	21.0				
East: Barrams Rd													
Lane 1	260	0.0	406	0.640	100	37.2	LOS D	10.7	74.8	Full	500	0.0	0.0
Lane 2	100	0.0	392	0.255	100	38.0	LOS D	3.7	26.1	Full	500	0.0	0.0
Approach	360	0.0		0.640		37.4	LOS D	10.7	74.8				
North: Bayliss Rd													
Lane 1	307	0.0	475	0.648	100	38.3	LOS D	12.3	85.9	Full	500	0.0	0.0
Lane 2	74	0.0	498	0.148	23 [5]	28.0	LOS C	2.5	17.6	Full	500	0.0	0.0
Lane 3	49	0.0	475	0.104	100	33.2	LOS C	1.7	11.7	Short	120	0.0	NA
Approach	431	0.0		0.648		36.0	LOS D	12.3	85.9				
West: Barrams Rd													
Lane 1	217	0.0	325	0.667	100	39.7	LOS D	9.3	65.4	Full	500	0.0	0.0
Lane 2	11	0.0	310	0.034	100	39.7	LOS D	0.4	2.7	Short	60	0.0	NA
Approach	227	0.0		0.667		39.7	LOS D	9.3	65.4				
Intersection	1095	0.0		0.667		38.1	LOS D	12.3	85.9				

Intersection R1015-2066

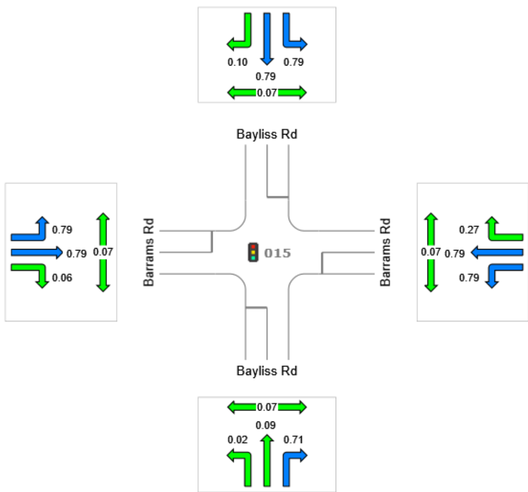
SITE LAYOUT – R10015 – 2066



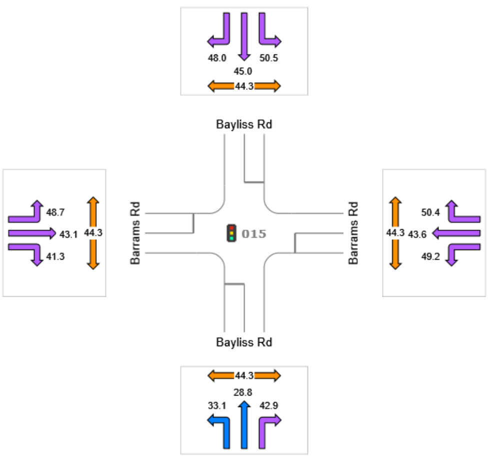
DEGREE OF SATURATION AM



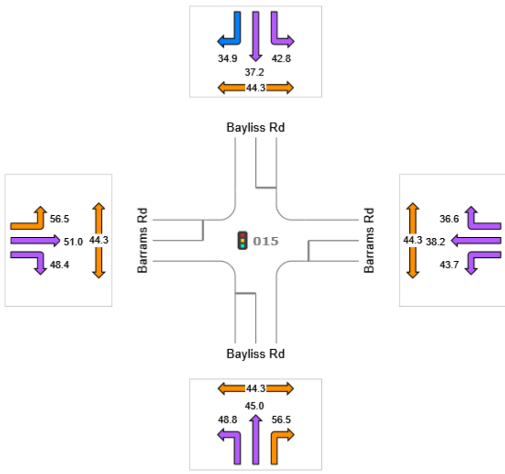
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1015 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 015 [2066 AM - FINAL]

R1015
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bayliss Rd													
Lane 1	7	0.0	529	0.013	20 [6]	28.4	LOS C	0.2	1.7	Full	500	0.0	0.0
Lane 2	34	0.0	527	0.065	100	29.0	LOS C	1.2	8.6	Full	500	0.0	0.0
Lane 3	360	1.5	493 [1]	0.730	100	42.9	LOS D	16.5	117.3	Short	60	0.0	NA
Approach	401	1.3		0.730		41.4	LOS D	16.5	117.3				
East: Barrams Rd													
Lane 1	243	0.0	344	0.707	100	45.5	LOS D	11.7	81.7	Full	500	0.0	0.0
Lane 2	223	1.4	313	0.714	100	50.4	LOS D	10.9	77.0	Full	500	0.0	0.0
Approach	466	0.7		0.714		47.8	LOS D	11.7	81.7				
North: Bayliss Rd													
Lane 1	225	0.9	313	0.720	100	48.6	LOS D	11.0	77.6	Full	500	0.0	0.0
Lane 2	32	0.0	241	0.131	100	48.0	LOS D	1.4	9.8	Short	120	0.0	NA
Approach	257	0.8		0.720		48.6	LOS D	11.0	77.6				
West: Barrams Rd													
Lane 1	272	1.6	368	0.737	100	43.5	LOS D	13.1	93.3	Full	500	0.0	0.0
Lane 2	16	0.0	353	0.045	100	41.3	LOS D	0.6	4.4	Short	60	0.0	NA
Approach	287	1.5		0.737		43.4	LOS D	13.1	93.3				
Intersection	1412	1.0		0.737		45.2	LOS D	16.5	117.3				

Intersection R1015 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 015 [2066 PM - FINAL]

R1015
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

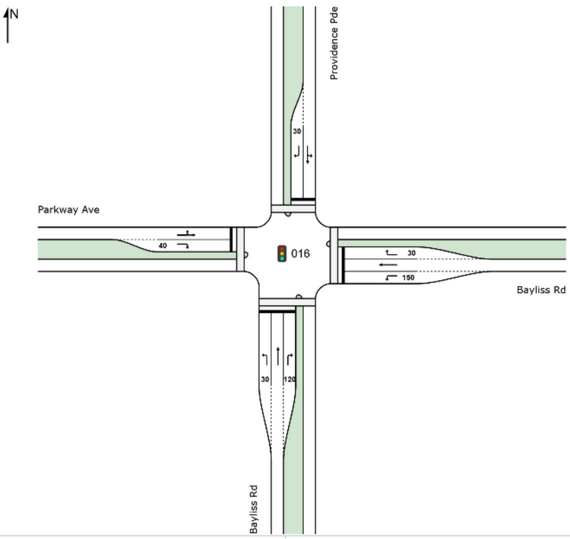
Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bayliss Rd													
Lane 1	4	0.0	206	0.019	20 [6]	44.8	LOS D	0.2	1.2	Full	500	0.0	0.0
Lane 2	18	0.0	195	0.094	100	45.3	LOS D	0.8	5.8	Full	500	0.0	0.0
Lane 3	133	0.0	186	0.714	100	56.5	LOS E	6.8	47.4	Short	60	0.0	NA
Approach	155	0.0		0.714		54.9	LOS D	6.8	47.4				
East: Barrams Rd													
Lane 1	445	0.0	560	0.795	100	41.4	LOS D	21.4	149.7	Full	500	0.0	0.0
Lane 2	134	0.0	501	0.267	100	36.6	LOS D	5.2	36.1	Full	500	0.0	0.0
Approach	579	0.0		0.795		40.3	LOS D	21.4	149.7				
North: Bayliss Rd													
Lane 1	449	1.2	569	0.790	100	40.8	LOS D	21.4	151.2	Full	500	0.0	0.0
Lane 2	49	0.0	501	0.099	100	34.9	LOS C	1.8	12.7	Short	120	0.0	NA
Approach	499	1.1		0.790		40.2	LOS D	21.4	151.2				
West: Barrams Rd													
Lane 1	184	1.7	232	0.793	100	51.2	LOS D	9.6	68.2	Full	500	0.0	0.0
Lane 2	14	0.0	223	0.061	100	48.4	LOS D	0.6	4.2	Short	60	0.0	NA
Approach	198	1.6		0.793		51.0	LOS D	9.6	68.2				
Intersection	1431	0.6		0.795		43.3	LOS D	21.4	151.2				

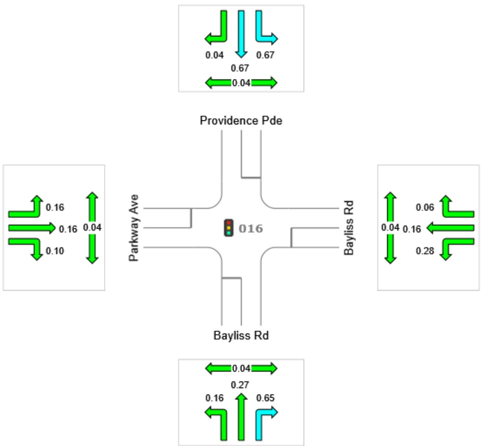
9 Intersection R1016

2031

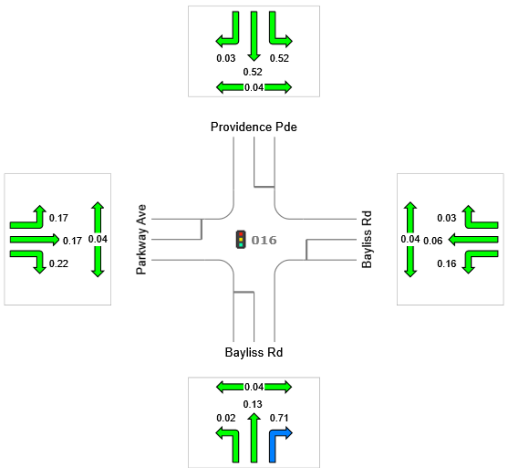
SITE LAYOUT – R10016 – 2031



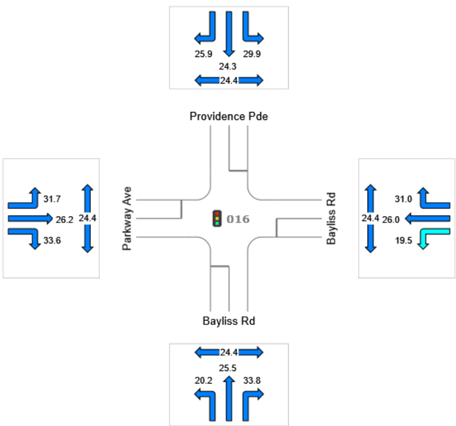
DEGREE OF SATURATION AM



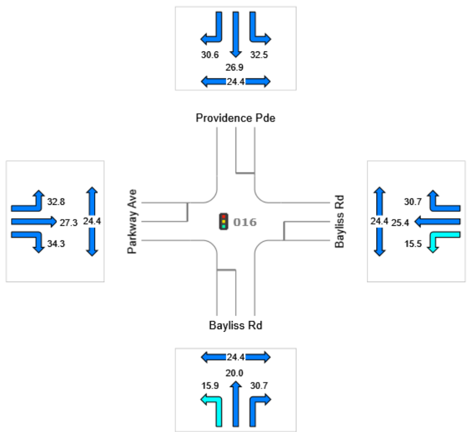
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1016 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 016 [2031 AM - FINAL same as 2026]

R1016
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bayliss Rd													
Lane 1	101	0.0	650	0.155	100	20.2	LOS C	2.1	14.4	Short	30	0.0	NA
Lane 2	78	0.0	293	0.266	100	25.5	LOS C	2.1	14.9	Full	500	0.0	0.0
Lane 3	181	0.0	279	0.650	100	33.8	LOS C	5.4	38.0	Short	120	0.0	NA
Approach	360	0.0		0.650		28.2	LOS C	5.4	38.0				
East: Bayliss Rd													
Lane 1	202	0.0	712	0.284	100	19.5	LOS B	4.2	29.1	Short	150	0.0	NA
Lane 2	42	0.0	260	0.162	100	26.0	LOS C	1.1	8.0	Full	500	0.0	0.0
Lane 3	15	0.0	248	0.060	100	31.0	LOS C	0.4	2.7	Short	30	0.0	NA
Approach	259	0.0		0.284		21.2	LOS C	4.2	29.1				
North: Providence Pde													
Lane 1	286	0.0	425 [1]	0.674	100	24.7	LOS C	8.2	57.2	Full	500	0.0	0.0
Lane 2	17	0.0	402	0.042	100	25.9	LOS C	0.4	2.8	Short	30	0.0	NA
Approach	303	0.0		0.674		24.8	LOS C	8.2	57.2				
West: Parkway Ave													
Lane 1	39	0.0	237	0.165	100	28.6	LOS C	1.1	7.5	Full	500	0.0	0.0
Lane 2	18	0.0	186	0.096	100	33.6	LOS C	0.5	3.5	Short	40	0.0	NA
Approach	57	0.0		0.165		30.2	LOS C	1.1	7.5				
Intersection	979	0.0		0.674		25.4	LOS C	8.2	57.2				

Intersection R1016 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 016 [2031 PM - FINAL same as 2026]

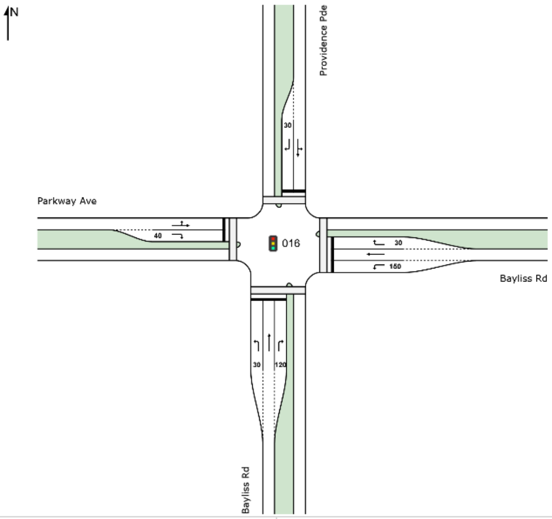
R1016
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

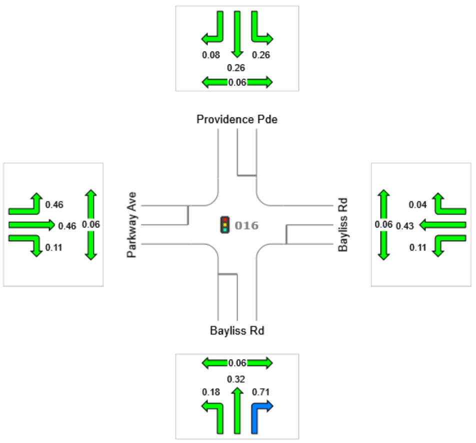
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bayliss Rd													
Lane 1	19	0.0	805	0.024	100	15.9	LOS B	0.3	2.2	Short	30	0.0	NA
Lane 2	59	0.0	455	0.130	100	20.0	LOS C	1.4	9.8	Full	500	0.0	0.0
Lane 3	308	0.0	433	0.712	100	30.7	LOS C	9.0	63.2	Short	120	0.0	NA
Approach	386	0.0		0.712		28.3	LOS C	9.0	63.2				
East: Bayliss Rd													
Lane 1	135	0.0	867	0.155	100	15.5	LOS B	2.3	15.9	Short	150	0.0	NA
Lane 2	16	0.0	260	0.061	100	25.4	LOS C	0.4	2.9	Full	500	0.0	0.0
Lane 3	7	0.0	248	0.030	100	30.7	LOS C	0.2	1.4	Short	30	0.0	NA
Approach	158	0.0		0.155		17.2	LOS B	2.3	15.9				
North: Providence Pde													
Lane 1	139	0.0	269	0.516	100	27.8	LOS C	4.0	27.9	Full	500	0.0	0.0
Lane 2	6	0.0	248	0.026	100	30.6	LOS C	0.2	1.2	Short	30	0.0	NA
Approach	145	0.0		0.516		27.9	LOS C	4.0	27.9				
West: Parkway Ave													
Lane 1	37	0.0	216	0.170	100	28.9	LOS C	1.0	7.2	Full	500	0.0	0.0
Lane 2	41	0.0	186	0.221	100	34.3	LOS C	1.2	8.3	Short	40	0.0	NA
Approach	78	0.0		0.221		31.7	LOS C	1.2	8.3				
Intersection	767	0.0		0.712		26.3	LOS C	9.0	63.2				

Intersection R1016-2041

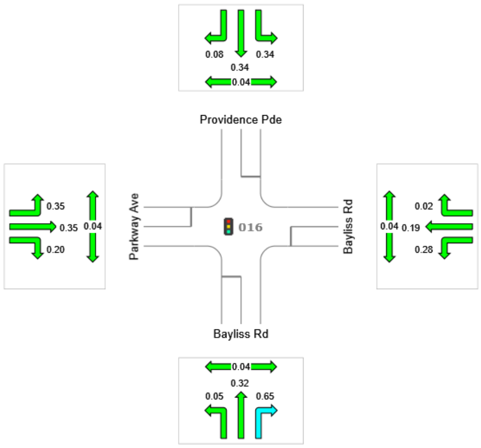
SITE LAYOUT – R10016 – 2041



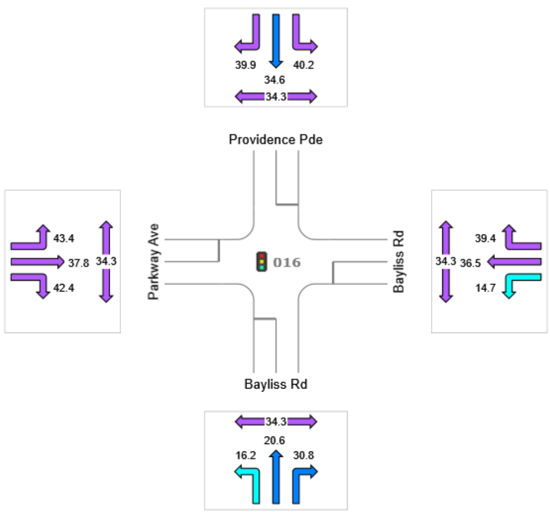
DEGREE OF SATURATION AM



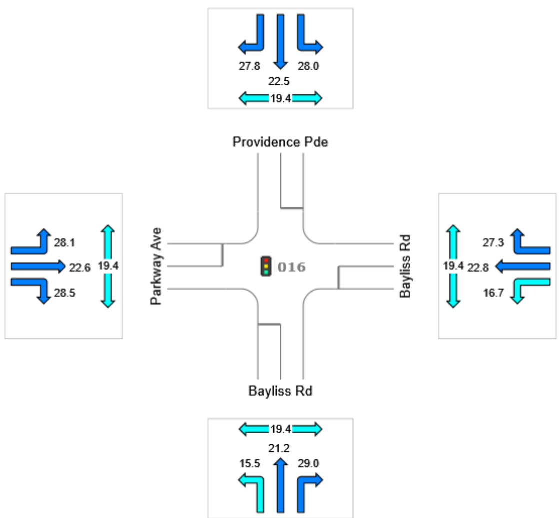
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1016 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 016 [2041 AM - FINAL same as 2026]

R1016
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bayliss Rd													
Lane 1	178	0.0	975	0.182	100	16.2	LOS B	3.6	25.3	Short	30	0.0	NA
Lane 2	219	0.0	683	0.321	100	20.6	LOS C	6.3	44.1	Full	500	0.0	0.0
Lane 3	462	0.7	647	0.714	100	30.8	LOS C	16.1	113.6	Short	120	0.0	NA
Approach	859	0.4		0.714		25.2	LOS C	16.1	113.6				
East: Bayliss Rd													
Lane 1	107	0.0	1021	0.105	100	14.7	LOS B	2.0	13.8	Short	150	0.0	NA
Lane 2	105	0.0	244	0.432	100	36.5	LOS D	4.0	27.9	Full	500	0.0	0.0
Lane 3	8	0.0	232	0.036	100	39.4	LOS D	0.3	2.1	Short	30	0.0	NA
Approach	221	0.0		0.432		26.0	LOS C	4.0	27.9				
North: Providence Pde													
Lane 1	65	0.0	250	0.261	100	35.5	LOS D	2.4	16.6	Full	500	0.0	0.0
Lane 2	19	0.0	232	0.082	100	39.9	LOS D	0.7	4.7	Short	30	0.0	NA
Approach	84	0.0		0.261		36.5	LOS D	2.4	16.6				
West: Parkway Ave													
Lane 1	96	0.0	209	0.459	100	39.3	LOS D	3.7	25.9	Full	500	0.0	0.0
Lane 2	20	0.0	186	0.108	100	42.4	LOS D	0.7	5.2	Short	40	0.0	NA
Approach	116	0.0		0.459		39.8	LOS D	3.7	25.9				
Intersection	1280	0.2		0.714		27.4	LOS C	16.1	113.6				

Intersection R1016 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 016 [2041 PM - FINAL same as 2026]

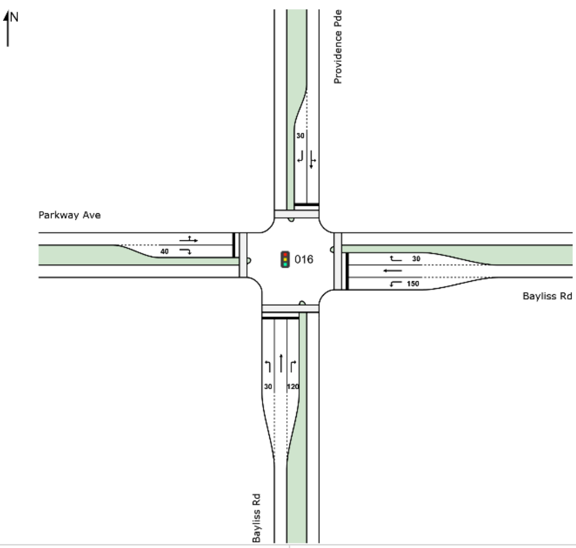
R1016
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

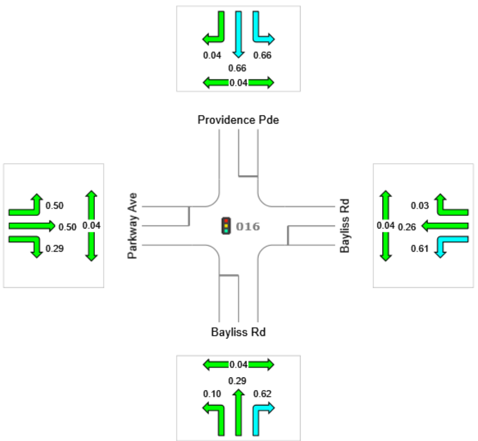
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bayliss Rd													
Lane 1	40	0.0	743	0.054	100	15.5	LOS B	0.6	4.2	Short	30	0.0	NA
Lane 2	100	0.0	312	0.321	100	21.2	LOS C	2.3	16.1	Full	500	0.0	0.0
Lane 3	193	0.0	297	0.648	100	29.0	LOS C	4.8	33.9	Short	120	0.0	NA
Approach	333	0.0		0.648		25.0	LOS C	4.8	33.9				
East: Bayliss Rd													
Lane 1	207	0.0	743	0.279	100	16.7	LOS B	3.5	24.4	Short	150	0.0	NA
Lane 2	45	0.0	234	0.193	100	22.8	LOS C	1.1	7.5	Full	500	0.0	0.0
Lane 3	4	0.0	223	0.019	100	27.3	LOS C	0.1	0.7	Short	30	0.0	NA
Approach	257	0.0		0.279		17.9	LOS B	3.5	24.4				
North: Providence Pde													
Lane 1	84	0.0	248	0.339	100	23.5	LOS C	2.0	14.0	Full	500	0.0	0.0
Lane 2	17	0.0	223	0.076	100	27.8	LOS C	0.4	2.7	Short	30	0.0	NA
Approach	101	0.0		0.339		24.2	LOS C	2.0	14.0				
West: Parkway Ave													
Lane 1	84	0.0	241	0.350	100	23.1	LOS C	2.0	14.0	Full	500	0.0	0.0
Lane 2	44	0.0	223	0.198	100	28.5	LOS C	1.0	7.3	Short	40	0.0	NA
Approach	128	0.0		0.350		25.0	LOS C	2.0	14.0				
Intersection	819	0.0		0.648		22.7	LOS C	4.8	33.9				

Intersection R1016-2066

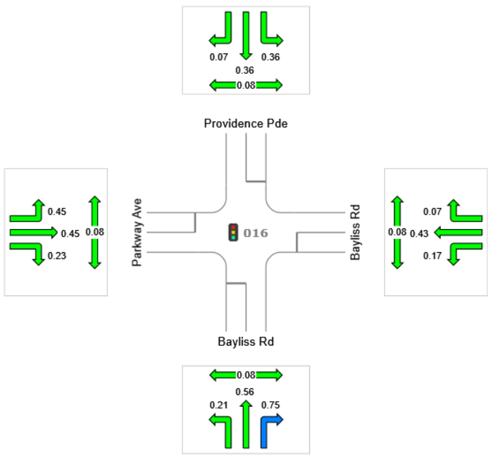
SITE LAYOUT – R10016 – 2066



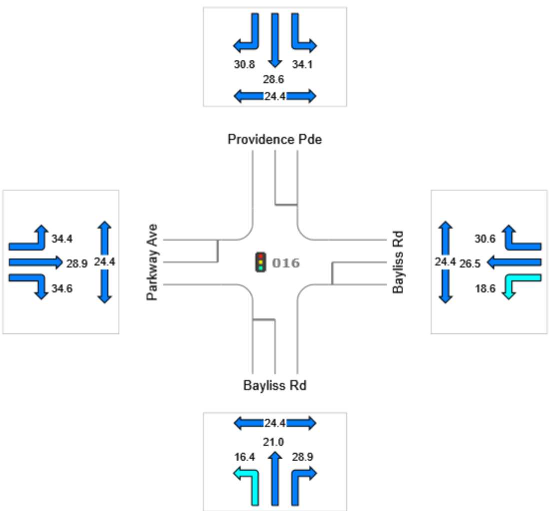
DEGREE OF SATURATION AM



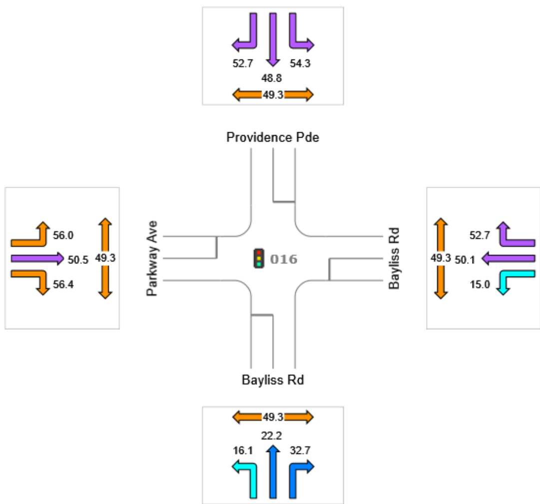
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1016 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 016 [2066 AM - FINAL same as 2026]

R1016
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bayliss Rd													
Lane 1	81	0.0	805	0.101	100	16.4	LOS B	1.4	9.9	Short	30	0.0	NA
Lane 2	129	1.6	450	0.288	100	21.0	LOS C	3.2	22.8	Full	500	0.0	0.0
Lane 3	268	0.0	433	0.619	100	28.9	LOS C	7.4	51.8	Short	120	0.0	NA
Approach	479	0.4		0.619		24.6	LOS C	7.4	51.8				
East: Bayliss Rd													
Lane 1	528	0.0	867	0.610	100	18.6	LOS B	11.7	82.0	Short	150	0.0	NA
Lane 2	67	0.0	260	0.259	100	26.5	LOS C	1.9	13.1	Full	500	0.0	0.0
Lane 3	6	0.0	248	0.026	100	30.6	LOS C	0.2	1.2	Short	30	0.0	NA
Approach	602	0.0		0.610		19.6	LOS B	11.7	82.0				
North: Providence Pde													
Lane 1	176	0.0	265	0.664	100	29.1	LOS C	5.3	37.3	Full	500	0.0	0.0
Lane 2	9	0.0	248	0.038	100	30.8	LOS C	0.3	1.8	Short	30	0.0	NA
Approach	185	0.0		0.664		29.1	LOS C	5.3	37.3				
West: Parkway Ave													
Lane 1	105	1.0	209	0.503	100	30.1	LOS C	3.1	22.0	Full	500	0.0	0.0
Lane 2	54	0.0	186	0.289	100	34.6	LOS C	1.6	11.0	Short	40	0.0	NA
Approach	159	0.7		0.503		31.6	LOS C	3.1	22.0				
Intersection	1425	0.2		0.664		23.9	LOS C	11.7	82.0				

Intersection R1016 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 016 [2066 PM - FINAL same as 2026]

R1016
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

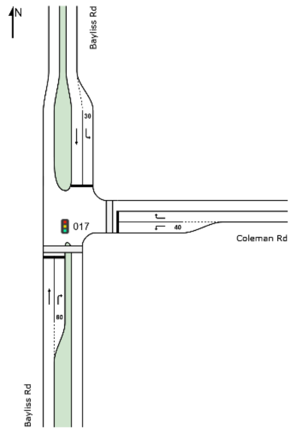
Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bayliss Rd													
Lane 1	231	0.0	1114	0.207	100	16.1	LOS B	5.5	38.8	Short	30	0.0	NA
Lane 2	366	0.6	654 [1]	0.560	100	22.2	LOS C	13.3	93.6	Full	500	0.0	0.0
Lane 3	613	1.0	821	0.746	100	32.7	LOS C	27.2	192.0	Short	120	0.0	NA
Approach	1209	0.7		0.746		26.4	LOS C	27.2	192.0				
East: Bayliss Rd													
Lane 1	192	0.5	1144	0.168	100	15.0	LOS B	4.3	30.2	Short	150	0.0	NA
Lane 2	98	1.1	229	0.428	100	50.1	LOS D	5.0	35.6	Full	500	0.0	0.0
Lane 3	15	0.0	219	0.067	100	52.7	LOS D	0.7	5.0	Short	30	0.0	NA
Approach	304	0.7		0.428		28.1	LOS C	5.0	35.6				
North: Providence Pde													
Lane 1	83	1.3	231	0.360	100	49.3	LOS D	4.2	29.8	Full	500	0.0	0.0
Lane 2	15	0.0	219	0.067	100	52.7	LOS D	0.7	5.0	Short	30	0.0	NA
Approach	98	1.1		0.360		49.8	LOS D	4.2	29.8				
West: Parkway Ave													
Lane 1	94	2.2	209	0.449	100	52.6	LOS D	4.9	34.7	Full	500	0.0	0.0
Lane 2	43	0.0	186	0.232	100	56.4	LOS E	2.2	15.5	Short	40	0.0	NA
Approach	137	1.5		0.449		53.8	LOS D	4.9	34.7				
Intersection	1748	0.8		0.746		30.1	LOS C	27.2	192.0				

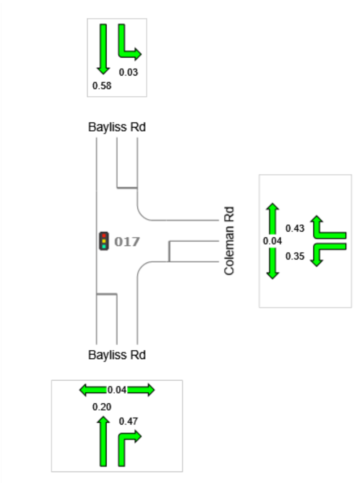
10 Intersection R1017

2031

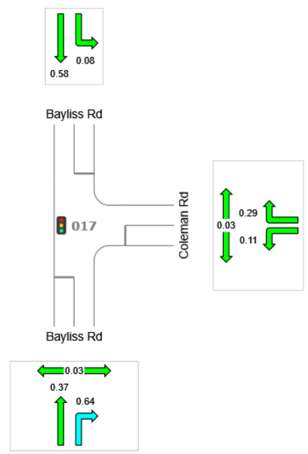
SITE LAYOUT – R10017 – 2031



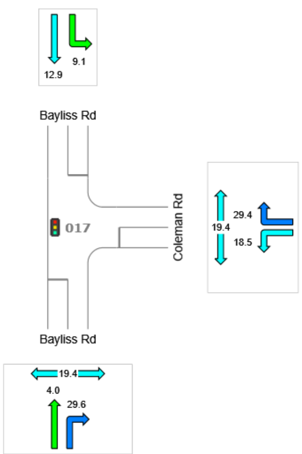
DEGREE OF SATURATION AM



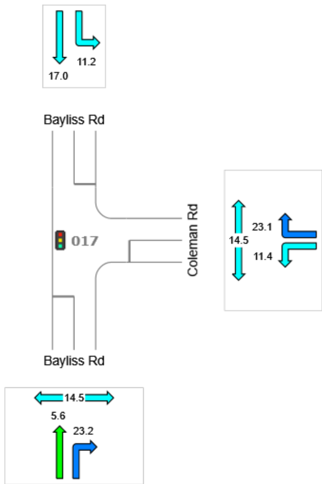
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1017 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 017 [2031 AM - FINAL]

R1017
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bayliss Rd													
Lane 1	244	0.9	1241	0.197	100	4.0	LOS A	2.5	17.3	Full	500	0.0	0.0
Lane 2	102	3.1	218	0.468	100	29.6	LOS C	2.5	18.2	Short	60	0.0	NA
Approach	346	1.5		0.468		11.5	LOS B	2.5	18.2				
East: Coleman Rd													
Lane 1	231	1.8	660	0.349	100	18.5	LOS B	4.2	30.1	Short	40	0.0	NA
Lane 2	97	0.0	223	0.435	100	29.4	LOS C	2.4	16.7	Full	500	0.0	0.0
Approach	327	1.3		0.435		21.7	LOS C	4.2	30.1				
North: Bayliss Rd													
Lane 1	39	0.0	1189	0.033	100	9.1	LOS A	0.3	2.4	Short	30	0.0	NA
Lane 2	446	0.0	771 [1]	0.579	100	12.9	LOS B	8.7	60.9	Full	500	0.0	0.0
Approach	485	0.0		0.579		12.6	LOS B	8.7	60.9				
Intersection	1159	0.8		0.579		14.9	LOS B	8.7	60.9				

LANE SUMMARY 2031 PM

Site: 017 [2031 PM - FINAL]

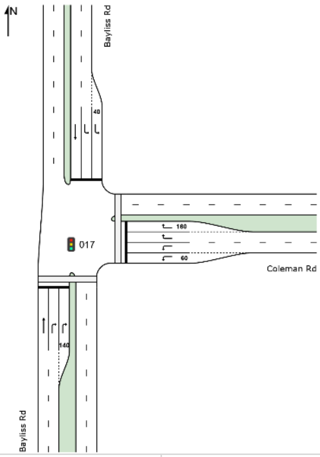
R1017
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

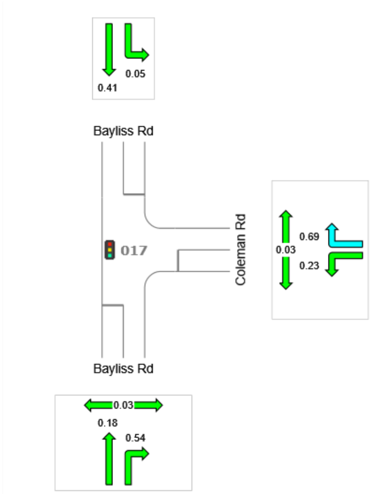
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bayliss Rd													
Lane 1	395	0.3	1071	0.369	100	5.6	LOS A	4.4	31.1	Full	500	0.0	0.0
Lane 2	236	1.8	367	0.643	100	23.2	LOS C	4.7	33.3	Short	60	0.0	NA
Approach	631	0.8		0.643		12.2	LOS B	4.7	33.3				
East: Coleman Rd													
Lane 1	99	7.4	882	0.112	100	11.4	LOS B	1.0	7.8	Short	40	0.0	NA
Lane 2	80	0.0	279	0.287	100	23.1	LOS C	1.5	10.5	Full	500	0.0	0.0
Approach	179	4.1		0.287		16.7	LOS B	1.5	10.5				
North: Bayliss Rd													
Lane 1	71	0.0	929	0.076	100	11.2	LOS B	0.7	5.1	Short	30	0.0	NA
Lane 2	227	0.5	389	0.585	100	17.0	LOS B	4.4	30.6	Full	500	0.0	0.0
Approach	298	0.4		0.585		15.6	LOS B	4.4	30.6				
Intersection	1107	1.2		0.643		13.8	LOS B	4.7	33.3				

Intersection R1017-2041

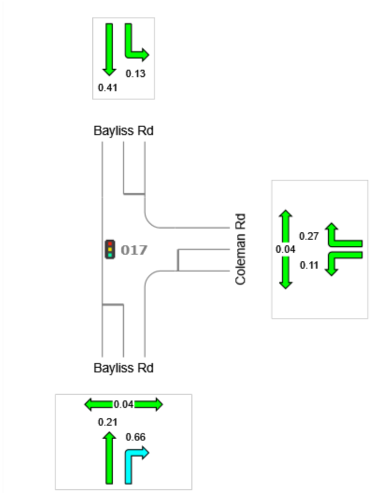
SITE LAYOUT – R10017 – 2041



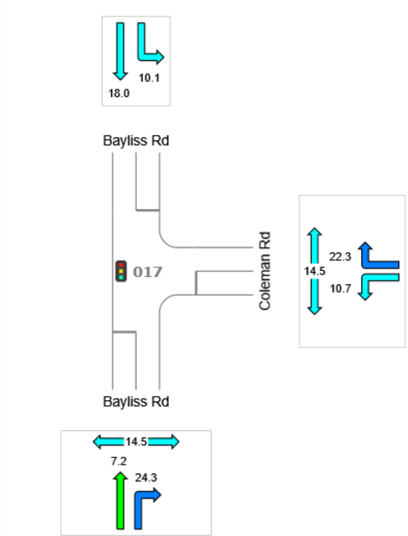
DEGREE OF SATURATION AM



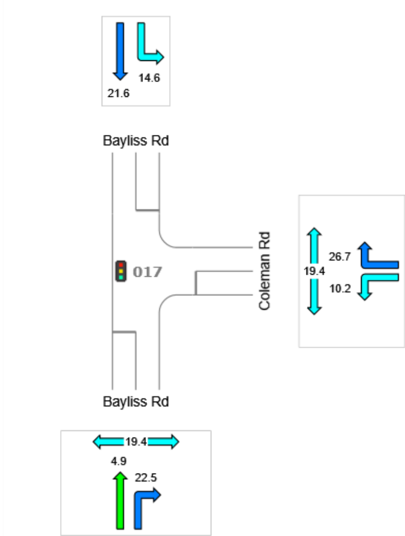
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



LANE SUMMARY 2041 AM

Site: 017 [2041 AM - FINAL]

R1017
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bayliss Rd													
Lane 1	160	0.0	877	0.182	100	7.2	LOS A	1.9	13.4	Full	500	0.0	0.0
Lane 2	145	4.3	270	0.538	100	24.3	LOS C	2.9	21.0	Full	500	0.0	0.0
Lane 3	145	4.3	270	0.538	100	24.3	LOS C	2.9	21.0	Short	140	0.0	NA
Approach	451	2.8		0.538		18.2	LOS B	2.9	21.0				
East: Coleman Rd													
Lane 1	236	1.8	1009	0.234	100	10.7	LOS B	2.4	17.2	Short	60	0.0	NA
Lane 2	236	1.8	1009	0.234	100	10.7	LOS B	2.4	17.2	Full	500	0.0	0.0
Lane 3	321	0.5	463	0.694	100	22.3	LOS C	6.4	44.8	Full	500	0.0	0.0
Lane 4	321	0.5	463	0.694	100	22.3	LOS C	6.4	44.8	Short	160	0.0	NA
Approach	1114	1.0		0.694		17.4	LOS B	6.4	44.8				
North: Bayliss Rd													
Lane 1	52	0.0	1021	0.051	100	10.1	LOS B	0.5	3.3	Short	40	0.0	NA
Lane 2	52	0.0	1021	0.051	100	10.1	LOS B	0.5	3.3	Full	500	0.0	0.0
Lane 3	119	0.0	293	0.407	100	18.0	LOS B	2.3	16.0	Full	500	0.0	0.0
Approach	223	0.0		0.407		14.3	LOS B	2.3	16.0				
Intersection	1787	1.4		0.694		17.2	LOS B	6.4	44.8				

Intersection R1017 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 017 [2041 PM - FINAL]

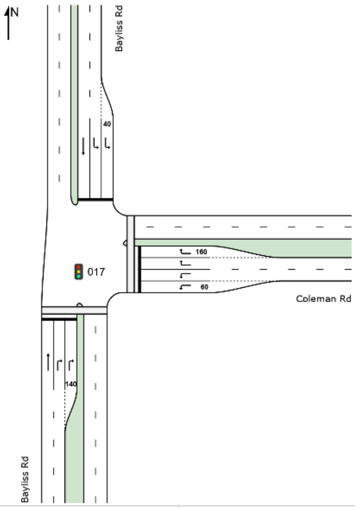
R1017
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

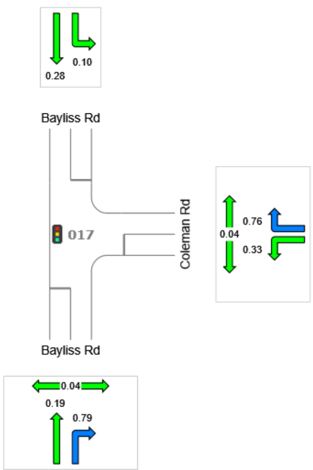
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bayliss Rd													
Lane 1	242	0.0	1170	0.207	100	4.9	LOS A	2.7	19.0	Full	500	0.0	0.0
Lane 2	388	0.9	590	0.657	100	22.5	LOS C	8.6	61.0	Full	500	0.0	0.0
Lane 3	388	0.9	590	0.657	100	22.5	LOS C	8.6	61.0	Short	140	0.0	NA
Approach	1018	0.7		0.657		18.3	LOS B	8.6	61.0				
East: Coleman Rd													
Lane 1	123	1.7	1101	0.112	100	10.2	LOS B	1.3	9.2	Short	60	0.0	NA
Lane 2	123	1.7	1101	0.112	100	10.2	LOS B	1.3	9.2	Full	500	0.0	0.0
Lane 3	81	0.0	297	0.271	100	26.7	LOS C	1.8	12.8	Full	500	0.0	0.0
Lane 4	81	0.0	297	0.271	100	26.7	LOS C	1.8	12.8	Short	160	0.0	NA
Approach	407	1.0		0.271		16.7	LOS B	1.8	12.8				
North: Bayliss Rd													
Lane 1	103	0.0	817	0.126	100	14.6	LOS B	1.5	10.6	Short	40	0.0	NA
Lane 2	103	0.0	817	0.126	100	14.6	LOS B	1.5	10.6	Full	500	0.0	0.0
Lane 3	128	0.0	312	0.412	100	21.6	LOS C	3.0	21.0	Full	500	0.0	0.0
Approach	335	0.0		0.412		17.3	LOS B	3.0	21.0				
Intersection	1760	0.7		0.657		17.7	LOS B	8.6	61.0				

Intersection R1017-2066

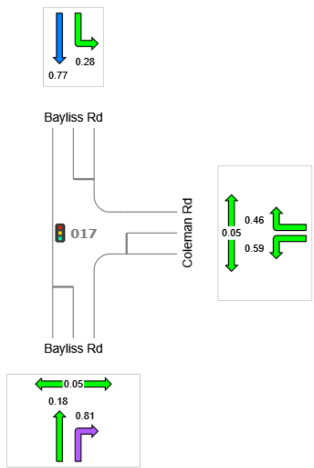
SITE LAYOUT – R10017 – 2066



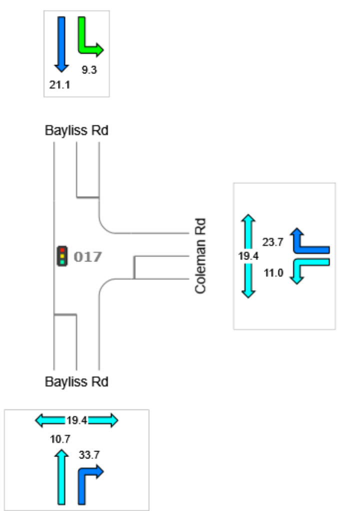
DEGREE OF SATURATION AM



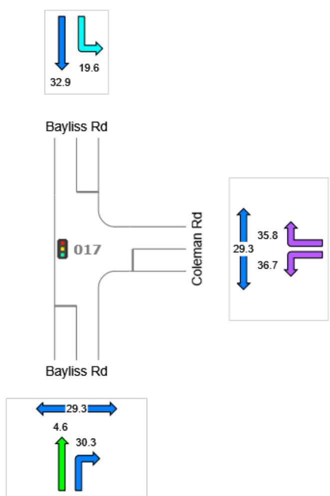
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1017– 2066 Cont.

LANE SUMMARY 2066 AM

Site: 017 [2066 AM - FINAL same as 2041]

R1017
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bayliss Rd													
Lane 1	148	0.0	780	0.190	100	10.7	LOS B	2.4	16.7	Full	500	0.0	0.0
Lane 2	169	5.9	214	0.792	100	33.7	LOS C	4.7	34.8	Full	500	0.0	0.0
Lane 3	169	5.9	214	0.792	100	33.7	LOS C	4.7	34.8	Short	140	0.0	NA
Approach	487	4.1		0.792		26.7	LOS C	4.7	34.8				
East: Coleman Rd													
Lane 1	365	1.4	1103	0.331	100	11.0	LOS B	4.5	31.8	Short	60	0.0	NA
Lane 2	365	1.4	1103	0.331	100	11.0	LOS B	4.5	31.8	Full	500	0.0	0.0
Lane 3	505	0.6	666	0.759	100	23.7	LOS C	12.2	86.1	Full	500	0.0	0.0
Lane 4	505	0.6	666	0.759	100	23.7	LOS C	12.2	86.1	Short	160	0.0	NA
Approach	1740	1.0		0.759		18.3	LOS B	12.2	86.1				
North: Bayliss Rd													
Lane 1	115	0.5	1185	0.097	100	9.3	LOS A	1.1	7.5	Short	40	0.0	NA
Lane 2	115	0.5	1185	0.097	100	9.3	LOS A	1.1	7.5	Full	500	0.0	0.0
Lane 3	88	0.0	312	0.283	100	21.1	LOS C	2.0	14.1	Full	500	0.0	0.0
Approach	318	0.3		0.283		12.5	LOS B	2.0	14.1				
Intersection	2545	1.5		0.792		19.2	LOS B	12.2	86.1				

Intersection R1017– 2066 Cont.

LANE SUMMARY 2066 PM

Site: 017 [2066 PM - FINAL same as 2041]

R1017
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

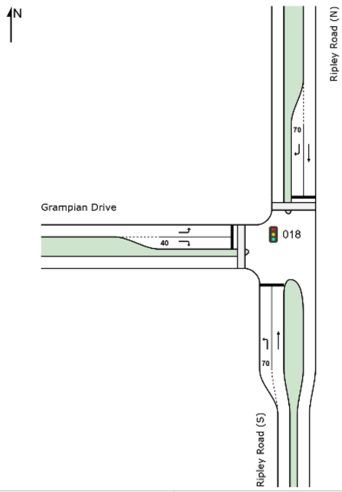
Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bayliss Rd													
Lane 1	235	0.0	1309	0.179	100	4.6	LOS A	3.0	20.7	Full	500	0.0	0.0
Lane 2	599	1.0	738	0.812	100	30.3	LOS C	20.6	145.0	Full	500	0.0	0.0
Lane 3	599	1.0	738	0.812	100	30.3	LOS C	20.6	145.0	Short	140	0.0	NA
Approach	1433	0.8		0.812		26.1	LOS C	20.6	145.0				
East: Coleman Rd													
Lane 1	171	0.9	290	0.590	100	36.7	LOS D	5.7	40.5	Short	60	0.0	NA
Lane 2	171	0.9	290	0.590	100	36.7	LOS D	5.7	40.5	Full	500	0.0	0.0
Lane 3	135	0.0	292	0.462	100	35.8	LOS D	4.4	30.7	Full	500	0.0	0.0
Lane 4	135	0.0	292	0.462	100	35.8	LOS D	4.4	30.7	Short	160	0.0	NA
Approach	612	0.5		0.590		36.3	LOS D	5.7	40.5				
North: Bayliss Rd													
Lane 1	219	0.0	796	0.275	100	19.6	LOS B	4.9	34.1	Short	40	0.0	NA
Lane 2	219	0.0	796	0.275	100	19.6	LOS B	4.9	34.1	Full	500	0.0	0.0
Lane 3	278	0.0	362	0.767	100	32.9	LOS C	10.0	69.7	Full	500	0.0	0.0
Approach	716	0.0		0.767		24.7	LOS C	10.0	69.7				
Intersection	2760	0.5		0.812		28.0	LOS C	20.6	145.0				

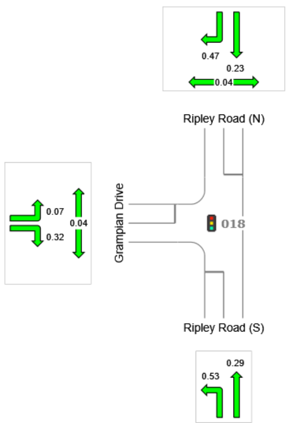
11 Intersection R1018

2031

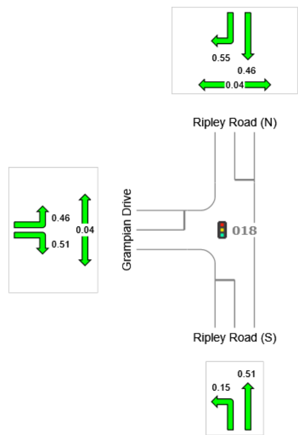
SITE LAYOUT – R10018 – 2031



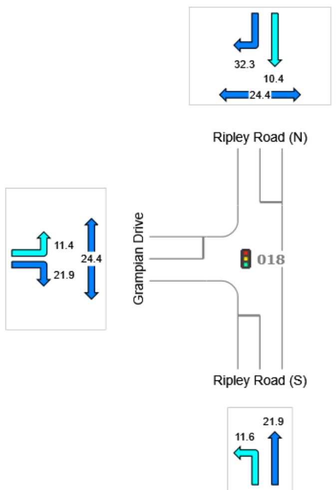
DEGREE OF SATURATION AM



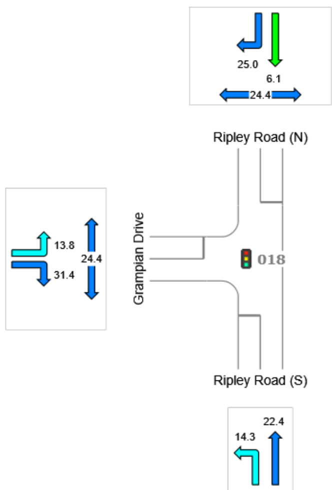
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1018 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 018 [2031 AM - FINAL]

R1018

Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road (S)													
Lane 1	637	0.0	1207	0.528	100	11.6	LOS B	10.0	69.8	Short	70	0.0	NA
Lane 2	118	3.6	413	0.286	100	21.9	LOS C	3.0	21.5	Full	500	0.0	0.0
Approach	755	0.6		0.528		13.2	LOS B	10.0	69.8				
North: Ripley Road (N)													
Lane 1	205	3.1	892	0.230	100	10.4	LOS B	3.6	26.0	Full	500	0.0	0.0
Lane 2	126	5.8	267	0.472	100	32.3	LOS C	3.6	26.5	Short	70	0.0	NA
Approach	332	4.1		0.472		18.7	LOS B	3.6	26.5				
West: Grampian Drive													
Lane 1	74	2.9	1062	0.069	100	11.4	LOS B	0.9	6.7	Full	500	0.0	0.0
Lane 2	194	1.1	614	0.315	100	21.9	LOS C	4.3	30.5	Short	40	0.0	NA
Approach	267	1.6		0.315		19.0	LOS B	4.3	30.5				
Intersection	1354	1.6		0.528		15.7	LOS B	10.0	69.8				

LANE SUMMARY 2031 PM

Site: 018 [2031 PM - FINAL]

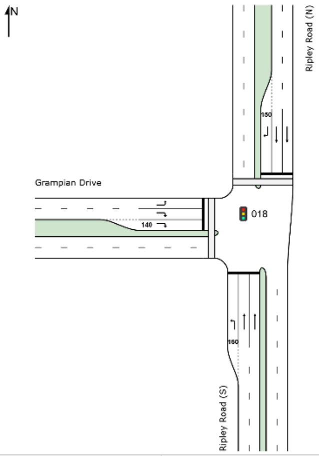
R1018
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site User-Given Cycle Time)

Lane Use and Performance

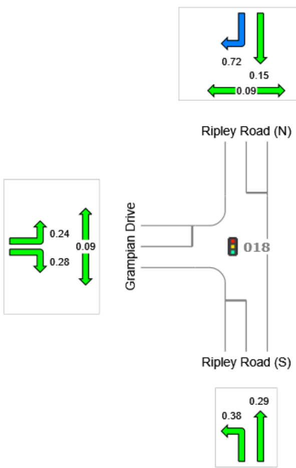
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road (S)													
Lane 1	141	0.0	929	0.152	100	14.3	LOS B	2.2	15.7	Short	70	0.0	NA
Lane 2	227	3.2	446	0.510	100	22.4	LOS C	6.0	43.3	Full	500	0.0	0.0
Approach	368	2.0		0.510		19.3	LOS B	6.0	43.3				
North: Ripley Road (N)													
Lane 1	563	0.7	1229	0.458	100	6.1	LOS A	8.5	60.1	Full	500	0.0	0.0
Lane 2	302	1.4	552	0.548	100	25.0	LOS C	7.6	54.1	Short	70	0.0	NA
Approach	865	1.0		0.548		12.7	LOS B	8.5	60.1				
West: Grampian Drive													
Lane 1	480	1.5	1041	0.461	100	13.8	LOS B	8.3	58.9	Full	500	0.0	0.0
Lane 2	158	0.7	308	0.513	100	31.4	LOS C	4.5	31.4	Short	40	0.0	NA
Approach	638	1.3		0.513		18.2	LOS B	8.3	58.9				
Intersection	1872	1.3		0.548		15.9	LOS B	8.5	60.1				

Intersection R1018-2041

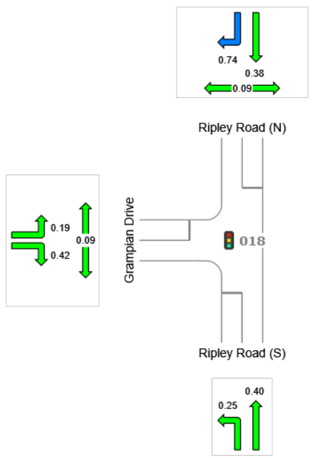
SITE LAYOUT – R10018 – 2041



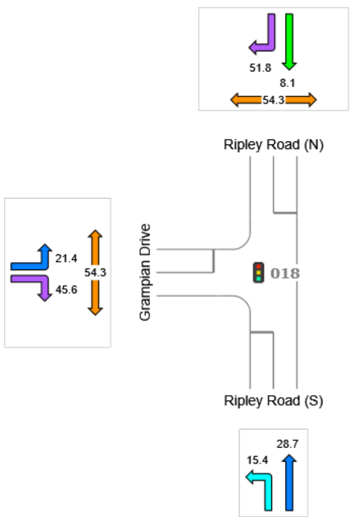
DEGREE OF SATURATION AM



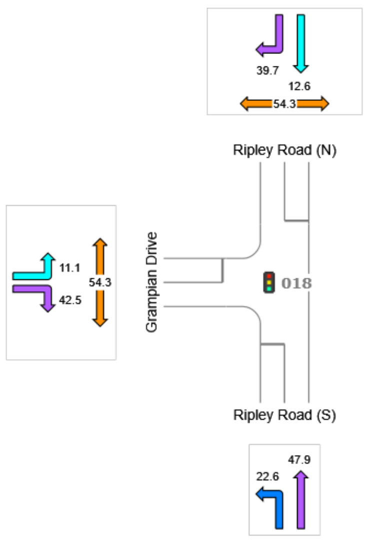
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



LANE SUMMARY 2041 AM

Site: 018 [2041 AM - FINAL]

R1018

Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Phase Times)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Ripley Road (S)													
Lane 1	463	0.7	1217	0.381	100	15.4	LOS B	12.1	85.3	Short	160	0.0	NA
Lane 2	205	2.6	703	0.291	100	28.7	LOS C	8.4	60.2	Full	500	0.0	0.0
Lane 3	205	2.6	703	0.291	100	28.7	LOS C	8.4	60.2	Full	500	0.0	0.0
Approach	873	1.6		0.381		21.7	LOS C	12.1	85.3				
North: Ripley Road (N)													
Lane 1	184	3.7	1253	0.147	100	8.1	LOS A	4.0	28.7	Full	500	0.0	0.0
Lane 2	184	3.7	1253	0.147	100	8.1	LOS A	4.0	28.7	Full	500	0.0	0.0
Lane 3	314	4.0	436	0.719	100	51.8	LOS D	17.3	125.0	Short	150	0.0	NA
Approach	682	3.9		0.719		28.2	LOS C	17.3	125.0				
West: Grampian Drive													
Lane 1	238	1.8	978	0.243	100	21.4	LOS C	7.3	52.1	Full	500	0.0	0.0
Lane 2	127	0.4	447	0.285	100	45.6	LOS D	6.1	42.8	Full	500	0.0	0.0
Lane 3	127	0.4	447	0.285	100	45.6	LOS D	6.1	42.8	Short	140	0.0	NA
Approach	493	1.1		0.285		33.9	LOS C	7.3	52.1				
Intersection	2047	2.2		0.719		26.8	LOS C	17.3	125.0				

Intersection R1018 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 018 [2041 PM - FINAL]

R1018

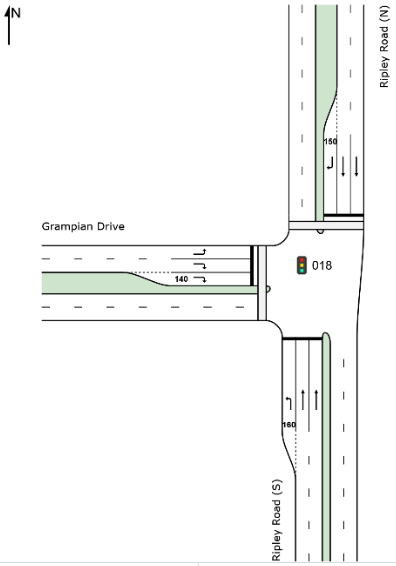
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Phase Times)

Lane Use and Performance

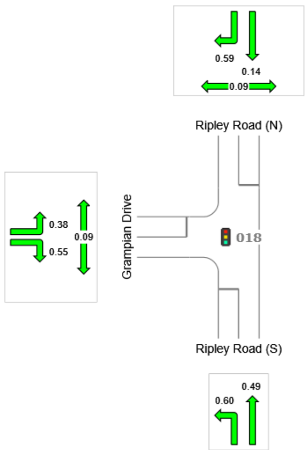
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road (S)													
Lane 1	242	0.4	957	0.253	100	22.6	LOS C	7.7	54.4	Short	160	0.0	NA
Lane 2	133	2.8	335	0.397	100	47.9	LOS D	7.0	50.2	Full	500	0.0	0.0
Lane 3	133	2.8	335	0.397	100	47.9	LOS D	7.0	50.2	Full	500	0.0	0.0
Approach	508	1.7		0.397		35.9	LOS D	7.7	54.4				
North: Ripley Road (N)													
Lane 1	448	1.1	1178	0.381	100	12.6	LOS B	13.1	92.7	Full	500	0.0	0.0
Lane 2	448	1.1	1178	0.381	100	12.6	LOS B	13.1	92.7	Full	500	0.0	0.0
Lane 3	525	0.4	710	0.740	100	39.7	LOS D	26.4	185.3	Short	150	0.0	NA
Approach	1422	0.8		0.740		22.6	LOS C	26.4	185.3				
West: Grampian Drive													
Lane 1	258	0.8	1339	0.193	100	11.1	LOS B	4.7	33.2	Full	500	0.0	0.0
Lane 2	227	0.2	541	0.420	100	42.5	LOS D	10.7	75.4	Full	500	0.0	0.0
Lane 3	227	0.2	541	0.420	100	42.5	LOS D	10.7	75.4	Short	140	0.0	NA
Approach	713	0.4		0.420		31.1	LOS C	10.7	75.4				
Intersection	2643	0.9		0.740		27.5	LOS C	26.4	185.3				

Intersection R1018-2066

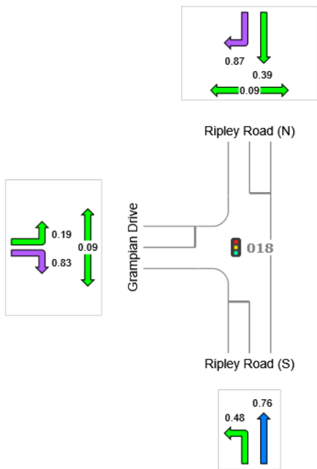
SITE LAYOUT – R10018 – 2066



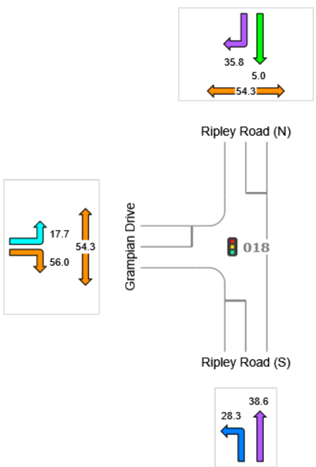
DEGREE OF SATURATION AM



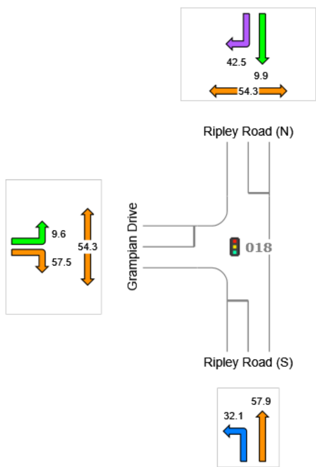
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



LANE SUMMARY 2066 AM

Site: 018 [2066 AM - FINAL same as 2041]

R1018

Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road (S)													
Lane 1	549	1.0	922	0.596	100	28.3	LOS C	22.6	159.8	Short	160	0.0	NA
Lane 2	268	2.2	545	0.492	100	38.6	LOS D	13.1	93.2	Full	500	0.0	0.0
Lane 3	268	2.2	545	0.492	100	38.6	LOS D	13.1	93.2	Full	500	0.0	0.0
Approach	1085	1.6		0.596		33.4	LOS C	22.6	159.8				
North: Ripley Road (N)													
Lane 1	202	3.9	1395	0.145	100	5.0	LOS A	3.4	24.8	Full	500	0.0	0.0
Lane 2	202	3.9	1395	0.145	100	5.0	LOS A	3.4	24.8	Full	500	0.0	0.0
Lane 3	424	3.5	725	0.585	100	35.8	LOS D	19.3	139.5	Short	150	0.0	NA
Approach	828	3.7		0.585		20.8	LOS C	19.3	139.5				
West: Grampian Drive													
Lane 1	433	1.5	1133	0.382	100	17.7	LOS B	12.5	88.3	Full	500	0.0	0.0
Lane 2	167	1.9	305	0.546	100	56.0	LOS E	9.1	65.0	Full	500	0.0	0.0
Lane 3	167	1.9	305	0.546	100	56.0	LOS E	9.1	65.0	Short	140	0.0	NA
Approach	766	1.6		0.546		34.4	LOS C	12.5	88.3				
Intersection	2680	2.2		0.596		29.8	LOS C	22.6	159.8				

LANE SUMMARY 2066 PM

Site: 018 [2066 PM - FINAL same as 2041]

R1018

Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

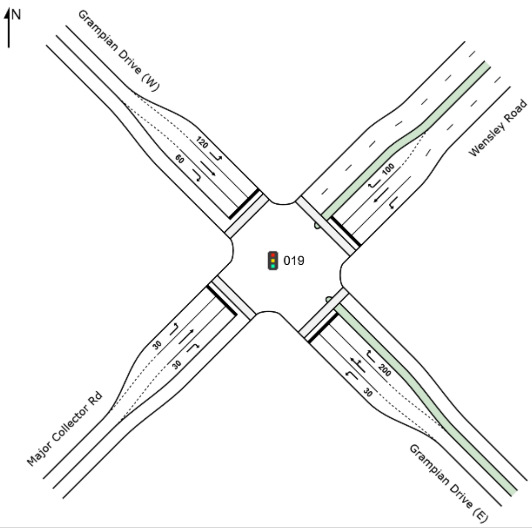
Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Ripley Road (S)													
Lane 1	377	0.0	789	0.477	100	32.1	LOS C	15.8	110.4	Short	160	0.0	NA
Lane 2	195	2.2	256	0.760	100	57.9	LOS E	11.7	83.4	Full	500	0.0	0.0
Lane 3	195	2.2	256	0.760	100	57.9	LOS E	11.7	83.4	Full	500	0.0	0.0
Approach	766	1.1		0.760		45.2	LOS D	15.8	110.4				
North: Ripley Road (N)													
Lane 1	493	0.6	1278	0.386	100	9.9	LOS A	12.9	91.1	Full	500	0.0	0.0
Lane 2	493	0.6	1278	0.386	100	9.9	LOS A	12.9	91.1	Full	500	0.0	0.0
Lane 3	745	0.1	854 [1]	0.872	100	42.5	LOS D	42.5	297.5	Short	150	0.0	NA
Approach	1732	0.4		0.872		23.9	LOS C	42.5	297.5				
West: Grampian Drive													
Lane 1	271	0.4	1420	0.191	100	9.6	LOS A	4.2	29.6	Full	500	0.0	0.0
Lane 2	368	0.7	447	0.825	100	57.5	LOS E	22.1	155.9	Full	500	0.0	0.0
Lane 3	368	0.7	447	0.825	100	57.5	LOS E	22.1	155.9	Short	140	0.0	NA
Approach	1007	0.6		0.825		44.6	LOS D	22.1	155.9				
Intersection	3505	0.6		0.872		34.5	LOS C	42.5	297.5				

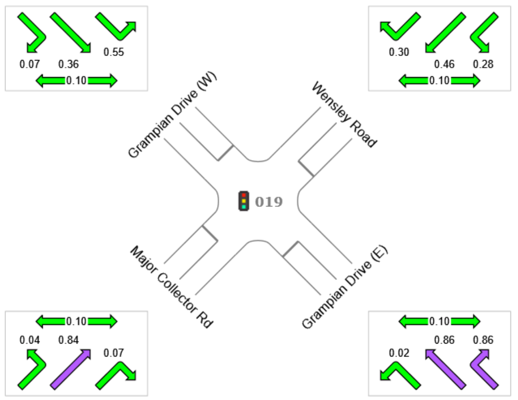
12 Intersection R1019

2031

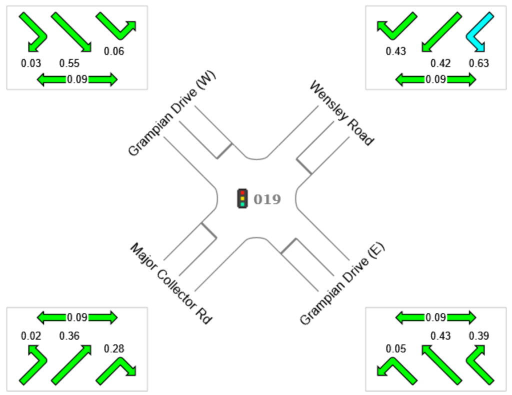
SITE LAYOUT – R1019 – 2031



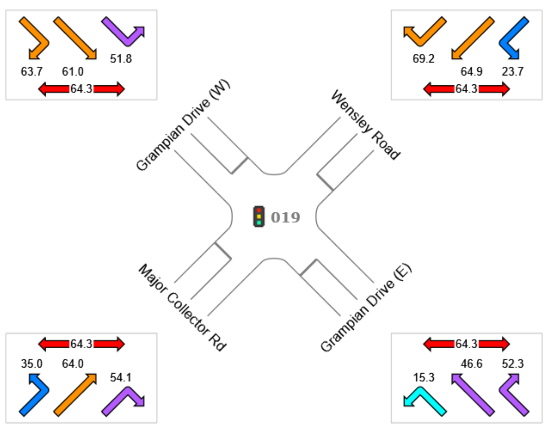
DEGREE OF SATURATION AM



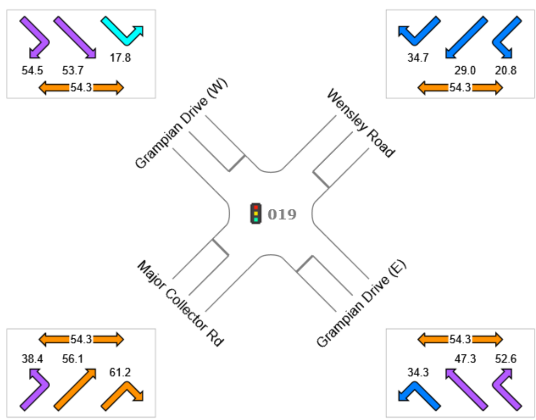
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1019 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 019 [2031 AM - FINAL]

R1019

Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Grampian Drive (E)													
Lane 1	25	0.0	1181	0.021	100	15.3	LOS B	0.6	4.3	Short	30	0.0	NA
Lane 2	606	0.3	708 [1]	0.856	100	51.4	LOS D	39.9	279.8	Full	500	0.0	0.0
Lane 3	623	0.4	728	0.856	100	52.5	LOS D	41.4	291.0	Short	200	0.0	NA
Approach	1255	0.3		0.856		51.2	LOS D	41.4	291.0				
NorthEast: Wensley Road													
Lane 1	276	1.1	1000	0.276	100	23.7	LOS C	9.9	70.0	Full	500	0.0	0.0
Lane 2	94	5.6	202	0.465	100	64.9	LOS E	6.2	45.3	Full	500	0.0	0.0
Lane 3	59	1.8	196	0.300	100	69.2	LOS E	3.8	27.0	Short	100	0.0	NA
Approach	428	2.2		0.465		39.0	LOS D	9.9	70.0				
NorthWest: Grampian Drive (W)													
Lane 1	285	0.0	517	0.551	100	51.8	LOS D	16.6	116.0	Short	120	0.0	NA
Lane 2	89	0.0	251	0.357	100	61.0	LOS E	5.7	39.7	Full	500	0.0	0.0
Lane 3	18	0.0	239	0.075	100	63.7	LOS E	1.1	7.6	Short	60	0.0	NA
Approach	393	0.0		0.551		54.4	LOS D	16.6	116.0				
SouthWest: Major Collector Rd													
Lane 1	24	0.0	690	0.035	100	35.0	LOS C	1.0	7.2	Short	30	0.0	NA
Lane 2	311	0.0	369 [1]	0.841	100	64.0	LOS E	21.8	152.9	Full	500	0.0	0.0
Lane 3	26	0.0	371	0.071	100	54.1	LOS D	1.4	10.1	Short	30	0.0	NA
Approach	361	0.0		0.841		61.3	LOS E	21.8	152.9				
Intersection	2437	0.6		0.856		51.1	LOS D	41.4	291.0				

Intersection R1019 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 019 [2031 PM - FINAL]

R1019

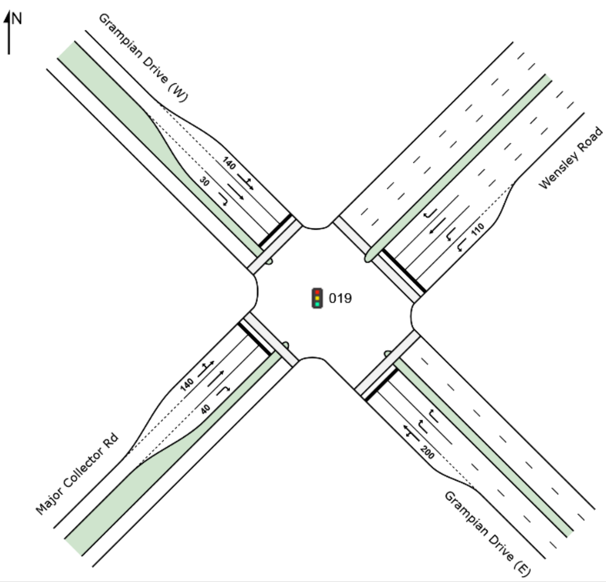
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

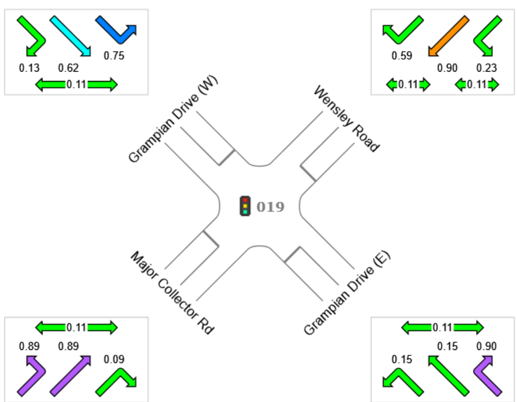
	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Grampian Drive (E)													
Lane 1	34	0.0	619	0.054	100	34.3	LOS C	1.3	9.2	Short	30	0.0	NA
Lane 2	153	0.0	353 [1]	0.433	100	47.3	LOS D	8.0	56.1	Full	500	0.0	0.0
Lane 3	134	0.0	340	0.393	91 [5]	52.6	LOS D	7.0	48.9	Short	200	0.0	NA
Approach	320	0.0		0.433		48.2	LOS D	8.0	56.1				
NorthEast: Wensley Road													
Lane 1	718	0.1	1144	0.628	100	20.8	LOS C	25.9	181.2	Full	500	0.0	0.0
Lane 2	314	0.3	746	0.421	100	29.0	LOS C	13.4	94.0	Full	500	0.0	0.0
Lane 3	305	0.0	712	0.429	100	34.7	LOS C	13.1	91.7	Short	100	0.0	NA
Approach	1337	0.2		0.628		25.9	LOS C	25.9	181.2				
NorthWest: Grampian Drive (W)													
Lane 1	63	0.0	1052	0.060	100	17.8	LOS B	1.6	11.3	Short	120	0.0	NA
Lane 2	141	0.7	259	0.545	100	53.7	LOS D	7.9	55.8	Full	500	0.0	0.0
Lane 3	8	0.0	248	0.034	100	54.5	LOS D	0.4	3.0	Short	60	0.0	NA
Approach	213	0.5		0.545		43.1	LOS D	7.9	55.8				
SouthWest: Major Collector Rd													
Lane 1	13	0.0	526	0.024	100	38.4	LOS D	0.5	3.7	Short	30	0.0	NA
Lane 2	71	0.0	195	0.362	100	56.1	LOS E	4.0	27.9	Full	500	0.0	0.0
Lane 3	51	2.1	183	0.276	100	61.2	LOS E	2.8	20.2	Short	30	0.0	NA
Approach	134	0.8		0.362		56.4	LOS E	4.0	27.9				
Intersection	2003	0.2		0.628		33.3	LOS C	25.9	181.2				

Intersection R1019-2041

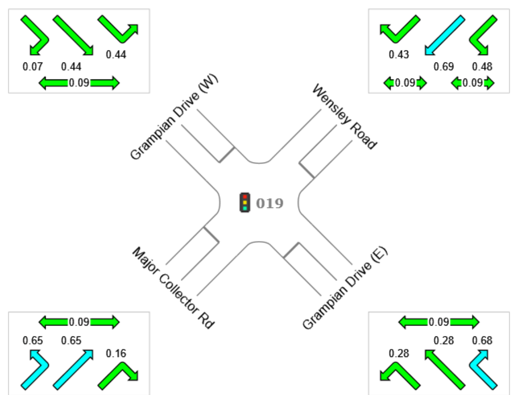
SITE LAYOUT – R1019 – 2041



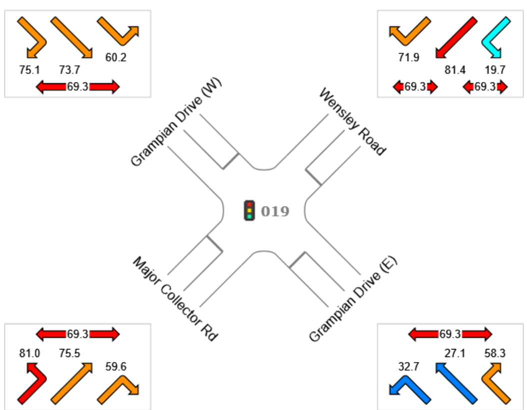
DEGREE OF SATURATION AM



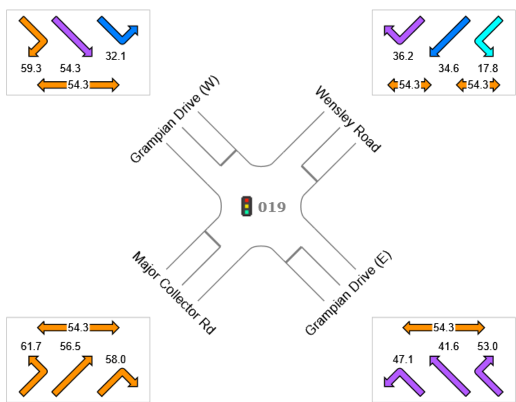
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1019 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 019 [2041 AM - FINAL]

R1019

Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Grampian Drive (E)													
Lane 1	127	0.0	830	0.153	100	28.7	LOS C	5.5	38.7	Short	200	0.0	NA
Lane 2	708	0.9	787	0.899	100	58.3	LOS E	53.2	375.2	Full	500	0.0	0.0
Lane 3	708	0.9	787	0.899	100	58.3	LOS E	53.2	375.2	Full	500	0.0	0.0
Approach	1543	0.8		0.899		55.9	LOS E	53.2	375.2				
NorthEast: Wensley Road													
Lane 1	262	1.4	1115	0.235	100	19.7	LOS B	8.6	60.7	Short	110	0.0	NA
Lane 2	262	1.4	1115	0.235	100	19.7	LOS B	8.6	60.7	Full	500	0.0	0.0
Lane 3	245	0.9	271	0.903	100	81.4	LOS F	19.9	140.7	Full	500	0.0	0.0
Lane 4	149	3.5	254	0.589	100	71.9	LOS E	10.4	75.3	Full	500	0.0	0.0
Approach	919	1.6		0.903		44.7	LOS D	19.9	140.7				
NorthWest: Grampian Drive (W)													
Lane 1	366	1.4	490	0.747	100	60.2	LOS E	24.7	175.0	Short	140	0.0	NA
Lane 2	104	0.0	169	0.617	83 [5]	73.7	LOS E	7.6	53.4	Full	500	0.0	0.0
Lane 3	21	0.0	161	0.131	100	75.1	LOS E	1.5	10.2	Short	30	0.0	NA
Approach	492	1.1		0.747		63.7	LOS E	24.7	175.0				
SouthWest: Major Collector Rd													
Lane 1	325	0.2	364	0.894	100	75.6	LOS E	26.1	182.7	Short	140	0.0	NA
Lane 2	307	0.2	343 [1]	0.894	100	75.5	LOS E	24.4	170.9	Full	500	0.0	0.0
Lane 3	32	0.0	347	0.091	100	59.6	LOS E	1.9	13.3	Short	40	0.0	NA
Approach	664	0.2		0.894		74.8	LOS E	26.1	182.7				
Intersection	3618	0.9		0.903		57.6	LOS E	53.2	375.2				

Intersection R1019 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 019 [2041 PM - FINAL]

R1019

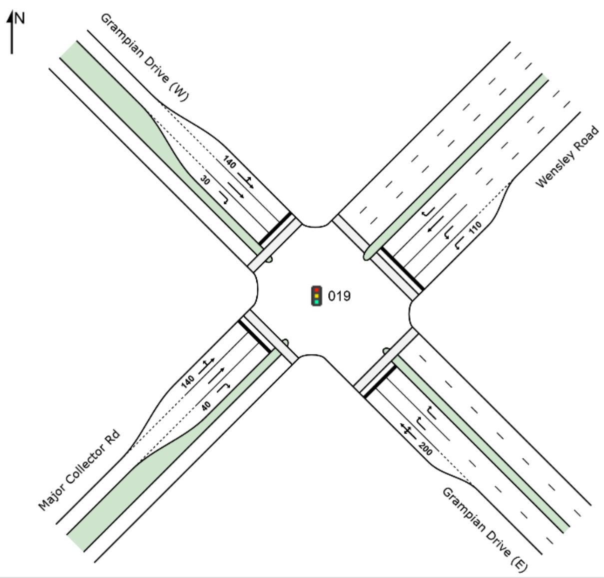
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

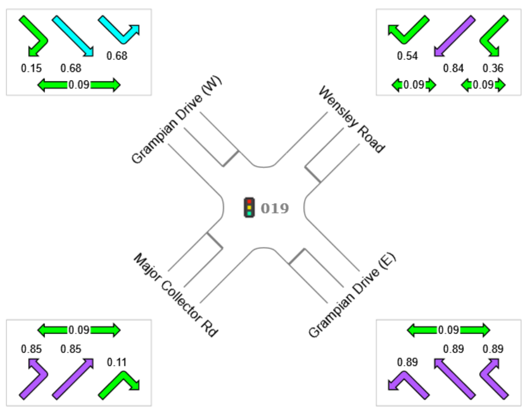
	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Grampian Drive (E)													
Lane 1	120	0.0	426	0.282	100	42.7	LOS D	5.8	40.9	Short	200	0.0	NA
Lane 2	274	1.0	400	0.685	100	53.0	LOS D	15.0	105.8	Full	500	0.0	0.0
Lane 3	274	1.0	400	0.685	100	53.0	LOS D	15.0	105.8	Full	500	0.0	0.0
Approach	667	0.8		0.685		51.1	LOS D	15.0	105.8				
NorthEast: Wensley Road													
Lane 1	564	0.4	1173	0.481	100	17.8	LOS B	17.1	119.9	Short	110	0.0	NA
Lane 2	564	0.4	1173	0.481	100	17.8	LOS B	17.1	119.9	Full	500	0.0	0.0
Lane 3	493	1.1	710	0.694	100	34.6	LOS C	24.4	172.3	Full	500	0.0	0.0
Lane 4	292	0.4	679	0.429	100	36.2	LOS D	12.8	89.6	Full	500	0.0	0.0
Approach	1912	0.6		0.694		24.9	LOS C	24.4	172.3				
NorthWest: Grampian Drive (W)													
Lane 1	327	0.6	748	0.438	100	31.9	LOS C	13.5	94.9	Short	140	0.0	NA
Lane 2	85	0.0	195	0.438	100	56.7	LOS E	4.9	34.1	Full	500	0.0	0.0
Lane 3	13	0.0	186	0.068	100	59.3	LOS E	0.7	4.8	Short	30	0.0	NA
Approach	425	0.5		0.438		37.7	LOS D	13.5	94.9				
SouthWest: Major Collector Rd													
Lane 1	149	0.3	228	0.654	100	56.6	LOS E	8.7	61.0	Short	140	0.0	NA
Lane 2	148	0.4	227	0.654	100	56.9	LOS E	8.7	60.8	Full	500	0.0	0.0
Lane 3	34	0.0	217	0.155	100	58.0	LOS E	1.8	12.7	Short	40	0.0	NA
Approach	332	0.3		0.654		56.8	LOS E	8.7	61.0				
Intersection	3336	0.6		0.694		35.0	LOS C	24.4	172.3				

Intersection R1019-2066

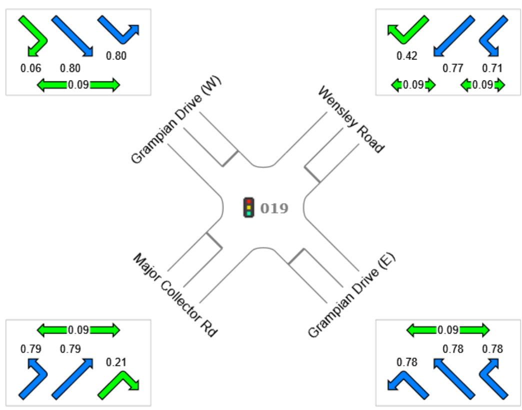
SITE LAYOUT – R1019 – 2066



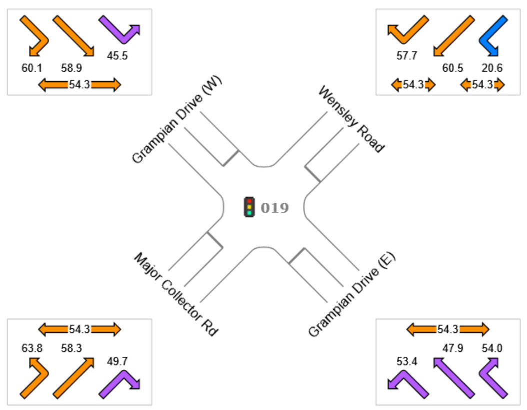
DEGREE OF SATURATION AM



DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



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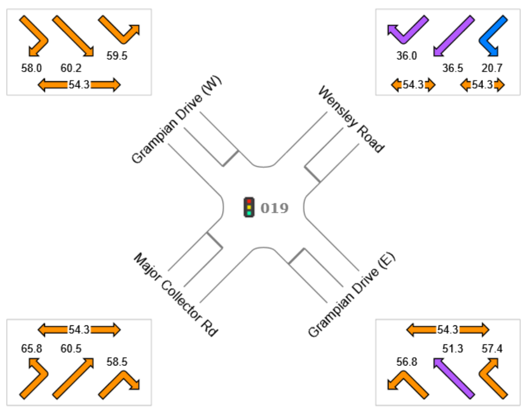


Intersection R1019 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 019 [2066 AM - FINAL same as 2041]

R1019

Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Grampian Drive (E)													
Lane 1	610	0.6	688	0.886	100	52.3	LOS D	38.1	268.0	Short	200	0.0	NA
Lane 2	600	0.9	677	0.886	100	54.1	LOS D	37.5	264.7	Full	500	0.0	0.0
Lane 3	600	0.9	677	0.886	100	54.1	LOS D	37.5	264.7	Full	500	0.0	0.0
Approach	1809	0.8		0.886		53.5	LOS D	38.1	268.0				
NorthEast: Wensley Road													
Lane 1	372	3.4	1028	0.362	100	20.6	LOS C	11.7	84.1	Short	110	0.0	NA
Lane 2	372	3.4	1028	0.362	100	20.6	LOS C	11.7	84.1	Full	500	0.0	0.0
Lane 3	242	2.2	288	0.839	100	60.5	LOS E	15.2	108.2	Full	500	0.0	0.0
Lane 4	147	3.6	272	0.542	100	57.7	LOS E	8.2	59.0	Full	500	0.0	0.0
Approach	1134	3.2		0.839		33.9	LOS C	15.2	108.2				
NorthWest: Grampian Drive (W)													
Lane 1	365	1.2	538	0.679	100	45.4	LOS D	18.9	133.5	Short	140	0.0	NA
Lane 2	132	0.0	195	0.679	100	59.2	LOS E	7.9	55.2	Full	500	0.0	0.0
Lane 3	27	0.0	186	0.147	100	60.1	LOS E	1.5	10.5	Short	30	0.0	NA
Approach	525	0.8		0.679		49.7	LOS D	18.9	133.5				
SouthWest: Major Collector Rd													
Lane 1	302	1.2	355	0.850	100	58.5	LOS E	19.0	134.1	Short	140	0.0	NA
Lane 2	286	1.3	337 [1]	0.850	100	58.3	LOS E	17.8	126.0	Full	500	0.0	0.0
Lane 3	38	0.0	340	0.111	100	49.7	LOS D	1.9	13.0	Short	40	0.0	NA
Approach	626	1.2		0.850		57.9	LOS E	19.0	134.1				
Intersection	4095	1.5		0.886		48.3	LOS D	38.1	268.0				

Intersection R1019 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 019 [2066 PM - FINAL same as 2041]

R1019

Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

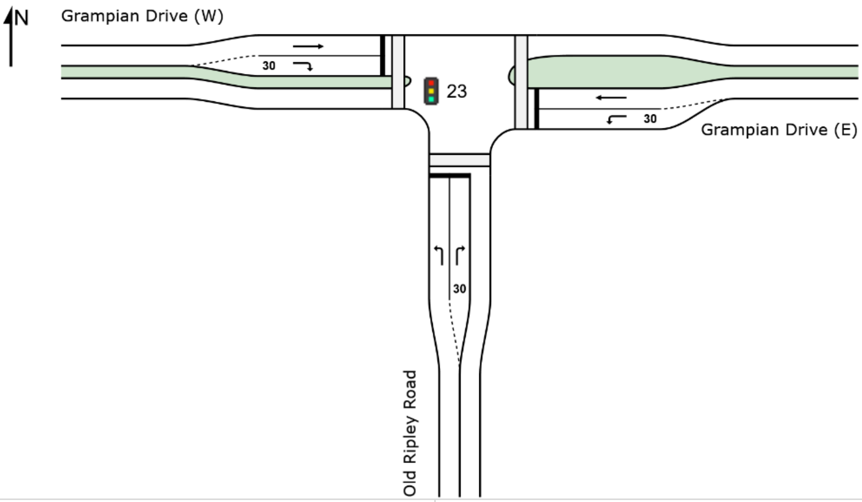
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Grampian Drive (E)													
Lane 1	308	0.4	394	0.780	100	55.1	LOS E	18.0	126.3	Short	200	0.0	NA
Lane 2	300	0.7	385	0.780	100	57.5	LOS E	17.6	123.9	Full	500	0.0	0.0
Lane 3	300	0.7	385	0.780	100	57.5	LOS E	17.6	123.9	Full	500	0.0	0.0
Approach	908	0.6		0.780		56.7	LOS E	18.0	126.3				
NorthEast: Wensley Road													
Lane 1	758	0.6	1065 [1]	0.712	100	20.7	LOS C	27.8	195.5	Short	110	0.0	NA
Lane 2	758	0.6	1065 [1]	0.712	100	20.7	LOS C	27.8	195.5	Full	500	0.0	0.0
Lane 3	549	0.2	714	0.769	100	36.5	LOS D	28.6	200.3	Full	500	0.0	0.0
Lane 4	283	0.0	681	0.416	100	36.0	LOS D	12.3	86.2	Full	500	0.0	0.0
Approach	2349	0.4		0.769		26.2	LOS C	28.6	200.3				
NorthWest: Grampian Drive (W)													
Lane 1	288	0.7	361	0.799	100	58.6	LOS E	17.3	121.6	Short	150	0.0	NA
Lane 2	166	0.0	208 [1]	0.799	100	61.9	LOS E	10.3	72.1	Full	500	0.0	0.0
Lane 3	12	0.0	201	0.058	100	58.0	LOS E	0.6	4.3	Short	30	0.0	NA
Approach	466	0.5		0.799		59.8	LOS E	17.3	121.6				
SouthWest: Major Collector Rd													
Lane 1	182	0.5	230	0.791	100	61.0	LOS E	11.2	78.6	Short	140	0.0	NA
Lane 2	178	0.6	226 [1]	0.791	100	60.7	LOS E	11.0	77.2	Full	500	0.0	0.0
Lane 3	45	0.0	217	0.209	100	58.5	LOS E	2.5	17.2	Short	40	0.0	NA
Approach	405	0.5		0.791		60.6	LOS E	11.2	78.6				
Intersection	4129	0.5		0.799		40.1	LOS D	28.6	200.3				

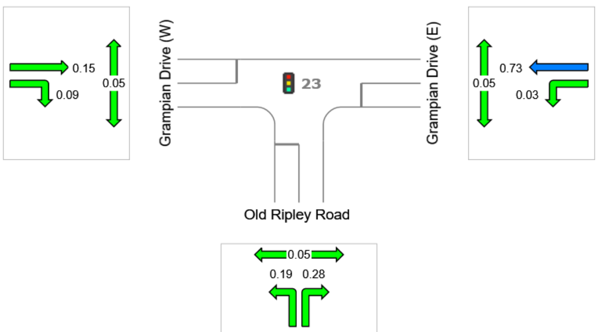
13 Intersection R1023

2031

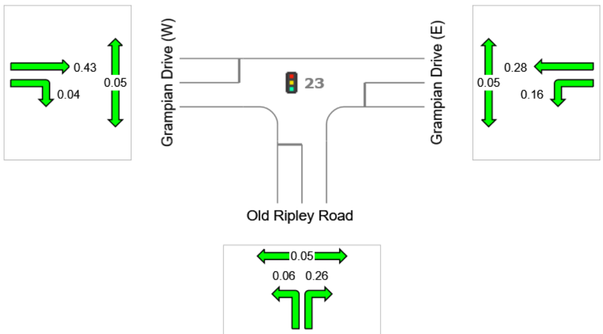
SITE LAYOUT – R1023 – 2031



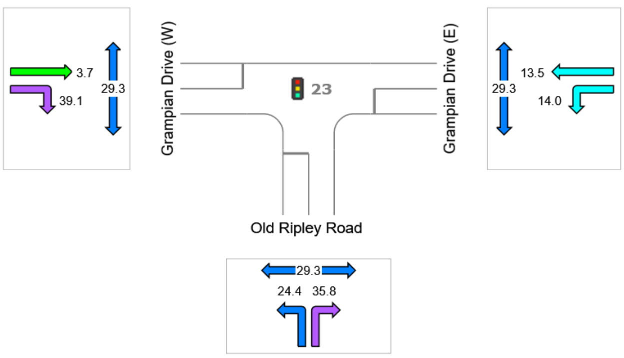
DEGREE OF SATURATION AM



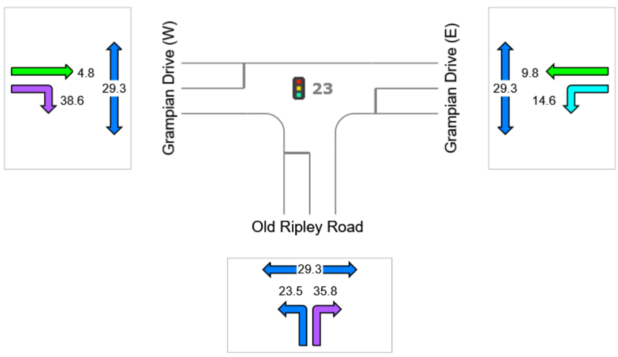
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1023 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 23 [2031 AM - FINAL]

R1023
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Old Ripley Road													
Lane 1	104	0.0	557	0.187	100	24.4	LOS C	2.7	18.7	Full	500	0.0	0.0
Lane 2	66	1.6	236	0.281	100	35.8	LOS D	2.2	15.3	Short	30	0.0	NA
Approach	171	0.6		0.281		28.8	LOS C	2.7	18.7				
East: Grampian Drive (E)													
Lane 1	34	0.0	982	0.034	100	14.0	LOS B	0.5	3.8	Short	30	0.0	NA
Lane 2	722	1.0	995 [1]	0.726	100	13.5	LOS B	18.7	131.8	Full	500	0.0	0.0
Approach	756	1.0		0.726		13.5	LOS B	18.7	131.8				
West: Grampian Drive (W)													
Lane 1	200	1.6	1351	0.148	100	3.7	LOS A	2.3	16.0	Full	500	0.0	0.0
Lane 2	15	0.0	159	0.093	100	39.1	LOS D	0.5	3.4	Short	30	0.0	NA
Approach	215	1.5		0.148		6.2	LOS A	2.3	16.0				
Intersection	1141	1.0		0.726		14.4	LOS B	18.7	131.8				

LANE SUMMARY 2031 PM

Site: 23 [2031 PM - FINAL]

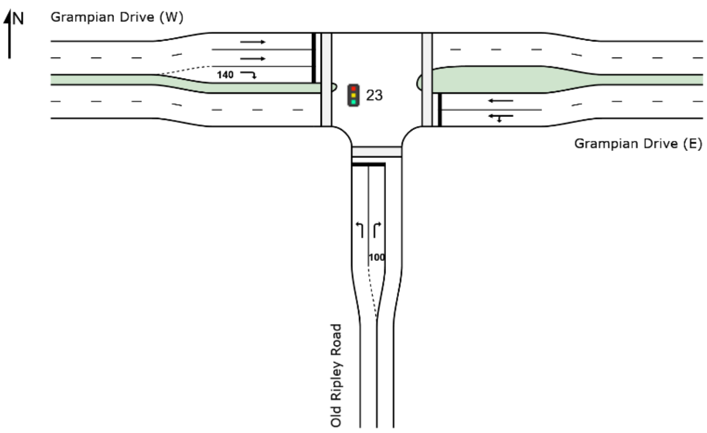
R1023
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site User-Given Cycle Time)

Lane Use and Performance

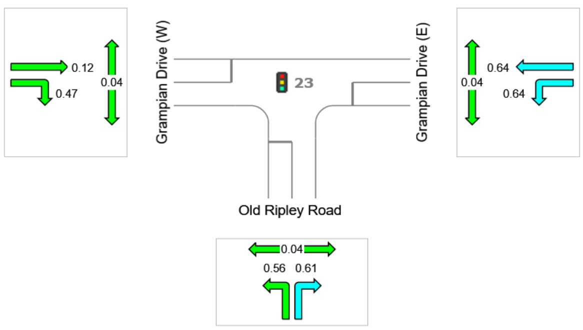
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Old Ripley Road													
Lane 1	35	0.0	557	0.062	100	23.5	LOS C	0.9	6.0	Full	500	0.0	0.0
Lane 2	60	3.5	233	0.258	100	35.8	LOS D	1.9	14.0	Short	30	0.0	NA
Approach	95	2.2		0.258		31.3	LOS C	1.9	14.0				
East: Grampian Drive (E)													
Lane 1	157	0.0	982	0.160	100	14.6	LOS B	2.7	19.2	Short	30	0.0	NA
Lane 2	289	1.5	1021	0.284	100	9.8	LOS A	5.5	38.8	Full	500	0.0	0.0
Approach	446	0.9		0.284		11.5	LOS B	5.5	38.8				
West: Grampian Drive (W)													
Lane 1	577	1.1	1343 [1]	0.430	100	4.8	LOS A	8.4	59.1	Full	500	0.0	0.0
Lane 2	6	0.0	159	0.040	100	38.6	LOS D	0.2	1.5	Short	30	0.0	NA
Approach	583	1.1		0.430		5.2	LOS A	8.4	59.1				
Intersection	1124	1.1		0.430		9.9	LOS A	8.4	59.1				

Intersection R1023-2041

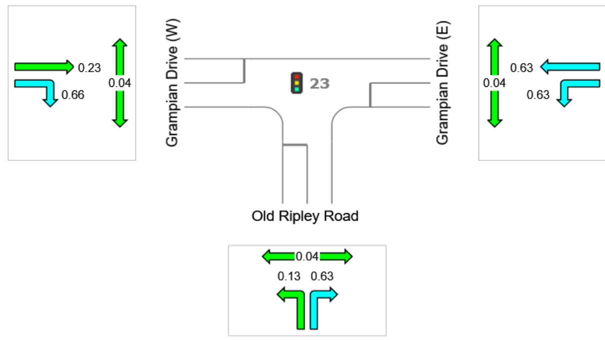
SITE LAYOUT – R1023 – 2041



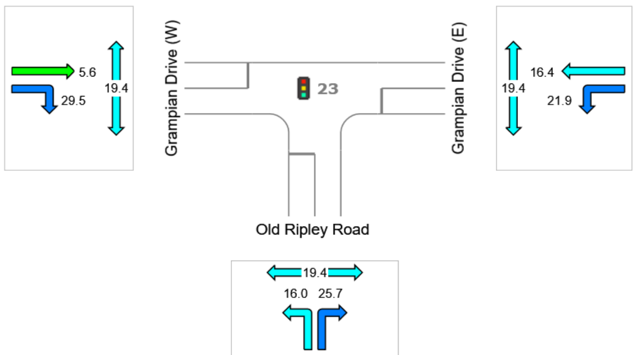
DEGREE OF SATURATION AM



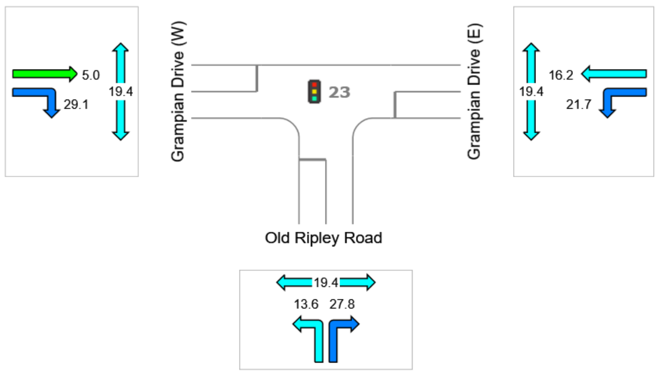
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1023 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 23 [2041 AM - FINAL]

R1023
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Old Ripley Road													
Lane 1	455	0.0	817	0.556	100	16.0	LOS B	8.4	59.0	Full	500	0.0	0.0
Lane 2	222	1.9	366	0.606	100	25.7	LOS C	5.3	37.7	Short	100	0.0	NA
Approach	677	0.6		0.606		19.2	LOS B	8.4	59.0				
East: Grampian Drive (E)													
Lane 1	380	2.8	595	0.639	100	19.4	LOS B	8.2	58.9	Full	500	0.0	0.0
Lane 2	395	1.3	619	0.639	100	16.4	LOS B	8.6	61.1	Full	500	0.0	0.0
Approach	776	2.0		0.639		17.9	LOS B	8.6	61.1				
West: Grampian Drive (W)													
Lane 1	135	0.4	1089	0.124	100	5.6	LOS A	1.6	11.0	Full	500	0.0	0.0
Lane 2	135	0.4	1089	0.124	100	5.6	LOS A	1.6	11.0	Full	500	0.0	0.0
Lane 3	104	0.0	223	0.468	100	29.5	LOS C	2.6	18.0	Short	140	0.0	NA
Approach	375	0.3		0.468		12.3	LOS B	2.6	18.0				
Intersection	1827	1.2		0.639		17.2	LOS B	8.6	61.1				

LANE SUMMARY 2041 PM

Site: 23 [2041 PM - FINAL]

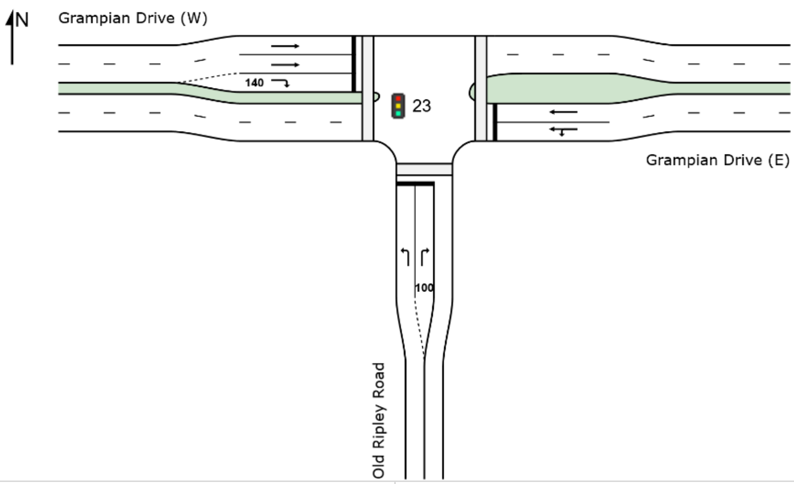
R1023
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

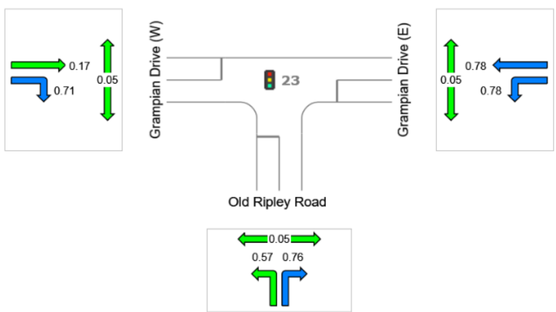
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Old Ripley Road													
Lane 1	105	0.0	817	0.129	100	13.6	LOS B	1.5	10.8	Full	500	0.0	0.0
Lane 2	185	1.1	295	0.629	100	27.8	LOS C	4.6	32.7	Short	100	0.0	NA
Approach	291	0.7		0.629		22.7	LOS C	4.6	32.7				
East: Grampian Drive (E)													
Lane 1	374	0.6	597	0.627	100	20.7	LOS C	8.0	56.4	Full	500	0.0	0.0
Lane 2	391	0.2	623	0.627	100	16.2	LOS B	8.4	59.3	Full	500	0.0	0.0
Approach	765	0.4		0.627		18.4	LOS B	8.4	59.3				
West: Grampian Drive (W)													
Lane 1	264	0.2	1168	0.226	100	5.0	LOS A	3.0	21.0	Full	500	0.0	0.0
Lane 2	264	0.2	1168	0.226	100	5.0	LOS A	3.0	21.0	Full	500	0.0	0.0
Lane 3	195	0.0	297	0.655	100	29.1	LOS C	4.9	34.4	Short	140	0.0	NA
Approach	722	0.1		0.655		11.5	LOS B	4.9	34.4				
Intersection	1778	0.4		0.655		16.3	LOS B	8.4	59.3				

Intersection R1023-2066

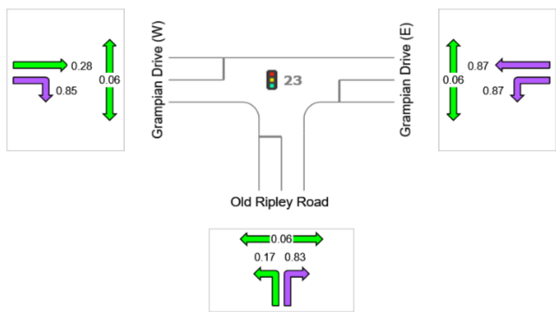
SITE LAYOUT – R1023 – 2066



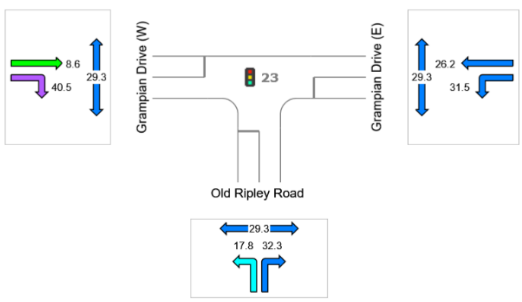
DEGREE OF SATURATION AM



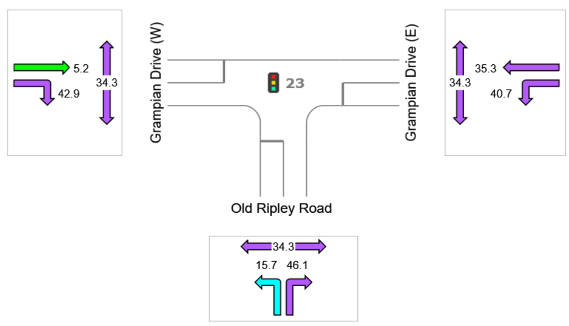
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1023 – 2066Cont.

LANE SUMMARY 2066 AM

Site: 23 [2066 AM - FINAL same as 2041]

R1023
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Old Ripley Road													
Lane 1	527	0.8	923	0.571	100	17.8	LOS B	12.7	89.4	Full	500	0.0	0.0
Lane 2	401	1.3	526	0.763	100	32.3	LOS C	13.7	96.9	Short	100	0.0	NA
Approach	928	1.0		0.763		24.1	LOS C	13.7	96.9				
East: Grampian Drive (E)													
Lane 1	477	2.3	610	0.783	100	29.8	LOS C	16.0	114.0	Full	500	0.0	0.0
Lane 2	496	1.8	633	0.783	100	26.2	LOS C	16.8	119.5	Full	500	0.0	0.0
Approach	973	2.1		0.783		28.0	LOS C	16.8	119.5				
West: Grampian Drive (W)													
Lane 1	181	1.7	1047	0.172	100	8.6	LOS A	3.1	22.0	Full	500	0.0	0.0
Lane 2	181	1.7	1047	0.172	100	8.6	LOS A	3.1	22.0	Full	500	0.0	0.0
Lane 3	163	4.5	231	0.705	100	40.5	LOS D	5.9	42.7	Short	140	0.0	NA
Approach	524	2.6		0.705		18.5	LOS B	5.9	42.7				
Intersection	2425	1.8		0.783		24.4	LOS C	16.8	119.5				

LANE SUMMARY 2066 PM

Site: 23 [2066 PM - FINAL same as 2041]

R1023
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site User-Given Cycle Time)

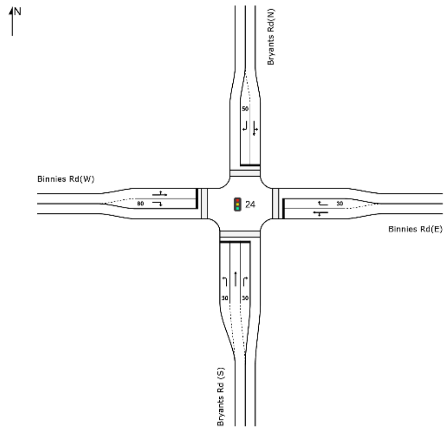
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Old Ripley Road													
Lane 1	165	0.6	947	0.174	100	15.7	LOS B	3.4	24.1	Full	500	0.0	0.0
Lane 2	249	0.4	301	0.829	100	46.1	LOS D	10.7	75.5	Short	100	0.0	NA
Approach	415	0.5		0.829		34.0	LOS C	10.7	75.5				
East: Grampian Drive (E)													
Lane 1	547	0.2	629	0.869	100	40.1	LOS D	23.4	163.9	Full	500	0.0	0.0
Lane 2	572	0.0	658	0.869	100	35.3	LOS D	24.7	173.1	Full	500	0.0	0.0
Approach	1119	0.1		0.869		37.7	LOS D	24.7	173.1				
West: Grampian Drive (W)													
Lane 1	379	0.7	1335	0.284	100	5.2	LOS A	5.7	40.0	Full	500	0.0	0.0
Lane 2	379	0.7	1335	0.284	100	5.2	LOS A	5.7	40.0	Full	500	0.0	0.0
Lane 3	436	0.0	511	0.853	100	42.9	LOS D	18.8	131.4	Short	140	0.0	NA
Approach	1195	0.4		0.853		18.9	LOS B	18.8	131.4				
Intersection	2728	0.3		0.869		28.9	LOS C	24.7	173.1				

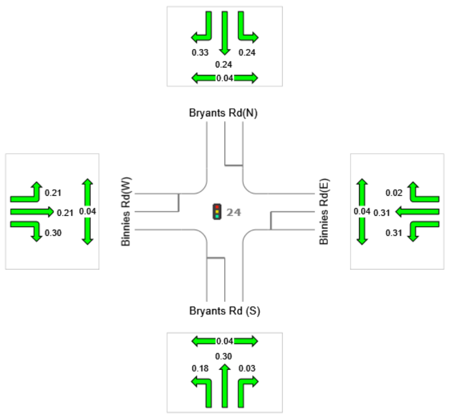
14 Intersection R1024

2031

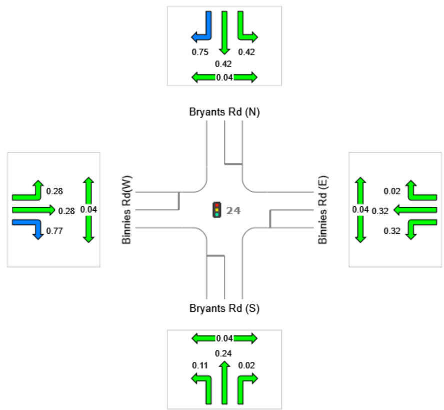
SITE LAYOUT – R1024 – 2031



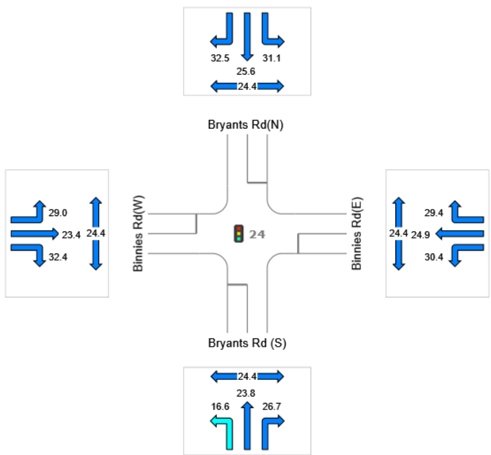
DEGREE OF SATURATION AM



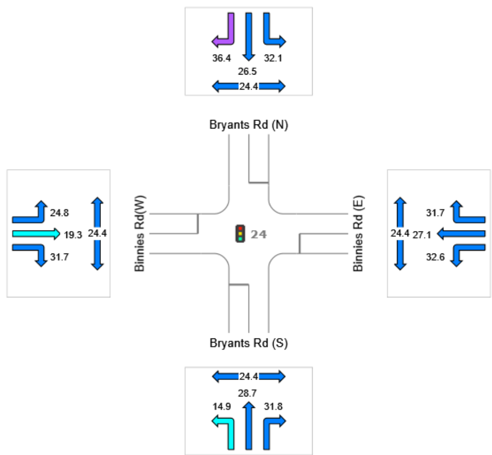
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1024 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 24 [2031 AM - FINAL]

R1024
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bryants Rd (S)													
Lane 1	140	0.0	774	0.181	100	16.6	LOS B	2.6	18.3	Short	30	0.0	NA
Lane 2	108	0.0	358	0.303	100	23.8	LOS C	2.9	20.0	Full	500	0.0	0.0
Lane 3	11	0.0	340	0.031	100	26.7	LOS C	0.3	1.8	Short	30	0.0	NA
Approach	259	0.0		0.303		20.0	LOS B	2.9	20.0				
East: Binnies Rd(E)													
Lane 1	89	0.0	293	0.305	100	25.0	LOS C	2.4	17.0	Full	500	0.0	0.0
Lane 2	4	0.0	279	0.015	100	29.4	LOS C	0.1	0.8	Short	30	0.0	NA
Approach	94	0.0		0.305		25.2	LOS C	2.4	17.0				
North: Bryants Rd(N)													
Lane 1	64	0.0	262	0.245	100	25.9	LOS C	1.8	12.3	Full	500	0.0	0.0
Lane 2	82	0.0	248	0.332	100	32.5	LOS C	2.3	16.2	Short	50	0.0	NA
Approach	146	0.0		0.332		29.6	LOS C	2.3	16.2				
West: Binnies Rd(W)													
Lane 1	65	3.2	316	0.207	100	26.4	LOS C	1.7	12.2	Full	500	0.0	0.0
Lane 2	74	1.4	245	0.301	100	32.4	LOS C	2.1	14.7	Short	80	0.0	NA
Approach	139	2.3		0.301		29.6	LOS C	2.1	14.7				
Intersection	638	0.5		0.332		25.0	LOS C	2.9	20.0				

Intersection R1024 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 24 [2031 PM - FINAL]

R1024
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site User-Given Cycle Time)

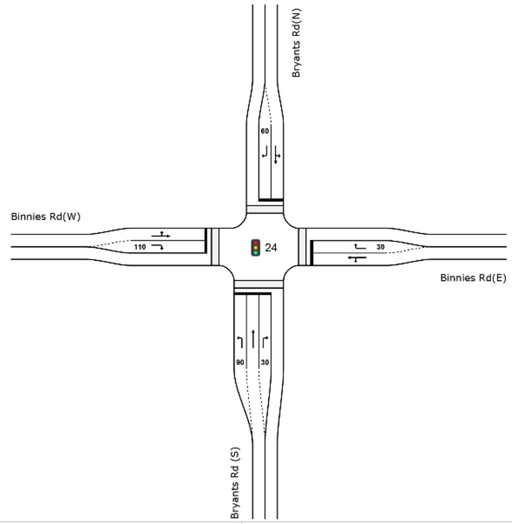
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bryants Rd (S)													
Lane 1	91	0.0	836	0.108	100	14.9	LOS B	1.5	10.8	Short	30	0.0	NA
Lane 2	46	0.0	195	0.238	100	28.7	LOS C	1.3	9.4	Full	500	0.0	0.0
Lane 3	3	0.0	186	0.017	100	31.8	LOS C	0.1	0.6	Short	30	0.0	NA
Approach	140	0.0		0.238		19.8	LOS B	1.5	10.8				
East: Binnies Rd (E)													
Lane 1	74	0.0	228	0.323	100	27.2	LOS C	2.1	14.6	Full	500	0.0	0.0
Lane 2	4	0.0	217	0.019	100	31.7	LOS C	0.1	0.8	Short	30	0.0	NA
Approach	78	0.0		0.323		27.4	LOS C	2.1	14.6				
North: Bryants Rd (N)													
Lane 1	108	1.9	259	0.419	100	26.7	LOS C	3.1	21.8	Full	500	0.0	0.0
Lane 2	185	0.0	248	0.748	100	36.4	LOS D	5.9	41.2	Short	50	0.0	NA
Approach	294	0.7		0.748		32.8	LOS C	5.9	41.2				
West: Binnies Rd(W)													
Lane 1	141	0.0	504	0.280	100	20.9	LOS C	3.4	23.5	Full	500	0.0	0.0
Lane 2	358	0.0	464	0.771	100	31.7	LOS C	10.9	76.5	Short	80	0.0	NA
Approach	499	0.0		0.771		28.7	LOS C	10.9	76.5				
Intersection	1011	0.2		0.771		28.6	LOS C	10.9	76.5				

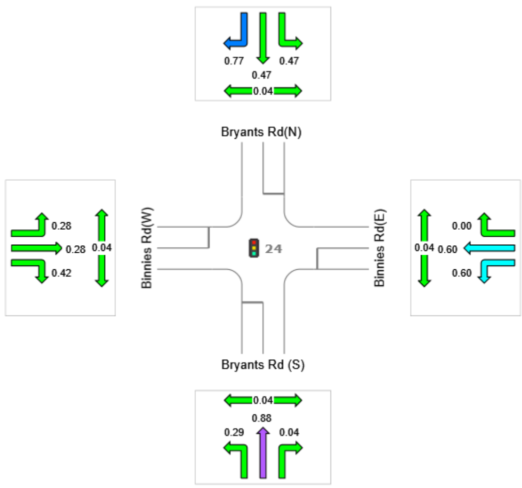
Intersection R1024-2041

SITE LAYOUT – R1024 – 2041	

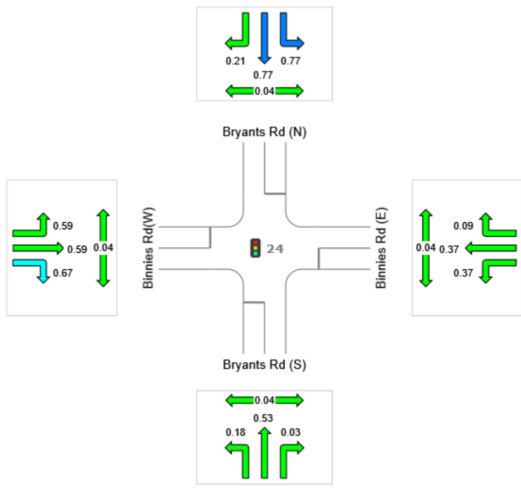
SITE LAYOUT – R1024 – 2041



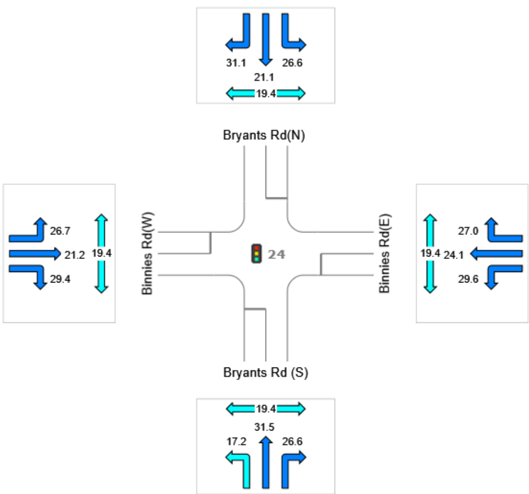
DEGREE OF SATURATION AM



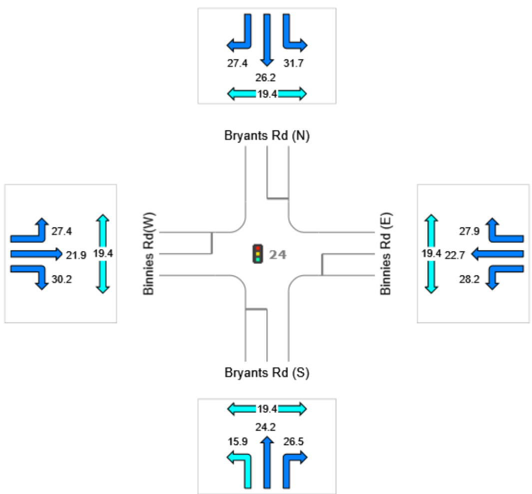
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1024 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 24 [2041 AM - FINAL]

R1024
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bryants Rd (S)													
Lane 1	197	0.0	669	0.294	100	17.2	LOS B	3.5	24.7	Short	90	0.0	NA
Lane 2	204	1.0	232	0.879	100	31.5	LOS C	6.1	43.1	Full	500	0.0	0.0
Lane 3	8	0.0	223	0.038	100	26.6	LOS C	0.2	1.3	Short	30	0.0	NA
Approach	409	0.5		0.879		24.5	LOS C	6.1	43.1				
East: Binnies Rd(E)													
Lane 1	142	0.0	236	0.603	100	24.3	LOS C	3.6	25.2	Full	500	0.0	0.0
Lane 2	1	0.0	223	0.005	100	27.0	LOS C	0.0	0.2	Short	30	0.0	NA
Approach	143	0.0		0.603		24.3	LOS C	3.6	25.2				
North: Bryants Rd(N)													
Lane 1	148	0.0	318	0.467	100	21.6	LOS C	3.5	24.2	Full	500	0.0	0.0
Lane 2	227	0.0	297	0.765	100	31.1	LOS C	6.1	42.7	Short	60	0.0	NA
Approach	376	0.0		0.765		27.4	LOS C	6.1	42.7				
West: Binnies Rd(W)													
Lane 1	79	0.0	285	0.277	100	23.6	LOS C	1.8	12.6	Full	500	0.0	0.0
Lane 2	93	1.1	221	0.419	100	29.4	LOS C	2.3	16.1	Short	110	0.0	NA
Approach	172	0.6		0.419		26.7	LOS C	2.3	16.1				
Intersection	1100	0.3		0.879		25.8	LOS C	6.1	43.1				

Intersection R1024 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 24 [2041 PM - FINAL]

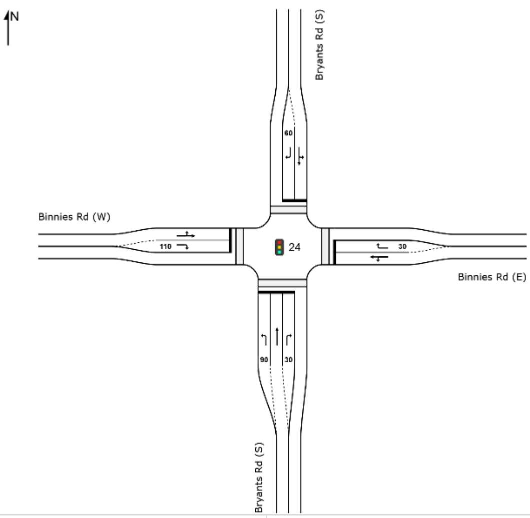
R1024
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

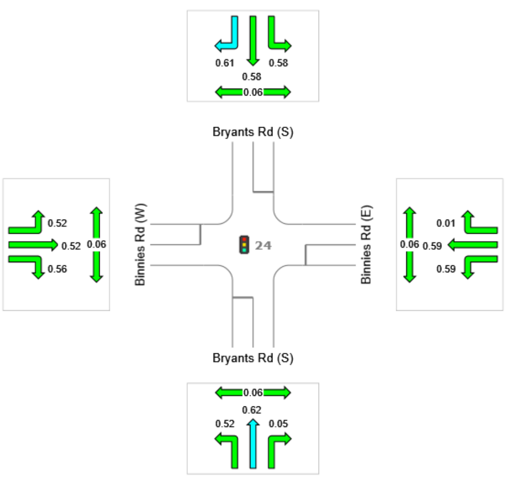
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bryants Rd (S)													
Lane 1	128	0.0	706	0.182	100	15.9	LOS B	2.1	14.9	Short	90	0.0	NA
Lane 2	123	0.0	234	0.526	100	24.2	LOS C	3.1	21.5	Full	500	0.0	0.0
Lane 3	7	0.0	223	0.033	100	26.5	LOS C	0.2	1.2	Short	30	0.0	NA
Approach	259	0.0		0.526		20.1	LOS C	3.1	21.5				
East: Binnies Rd (E)													
Lane 1	88	3.6	238	0.371	100	23.4	LOS C	2.1	15.3	Full	500	0.0	0.0
Lane 2	21	0.0	223	0.094	100	27.9	LOS C	0.5	3.4	Short	30	0.0	NA
Approach	109	2.9		0.371		24.3	LOS C	2.1	15.3				
North: Bryants Rd (N)													
Lane 1	211	1.5	272	0.774	100	26.3	LOS C	5.7	40.7	Full	500	0.0	0.0
Lane 2	55	0.0	260	0.211	100	27.4	LOS C	1.3	8.8	Short	60	0.0	NA
Approach	265	1.2		0.774		26.5	LOS C	5.7	40.7				
West: Binnies Rd(W)													
Lane 1	187	0.0	319	0.588	100	24.2	LOS C	4.5	31.7	Full	500	0.0	0.0
Lane 2	175	0.0	260	0.672	100	30.2	LOS C	4.5	31.6	Short	110	0.0	NA
Approach	362	0.0		0.672		27.1	LOS C	4.5	31.7				
Intersection	996	0.6		0.774		24.8	LOS C	5.7	40.7				

Intersection R1024-2066

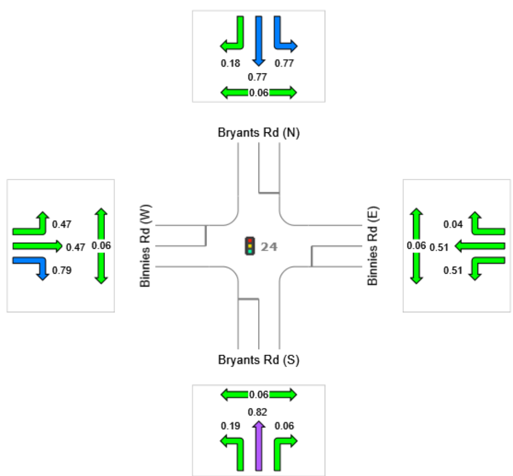
SITE LAYOUT – R1024 – 2066



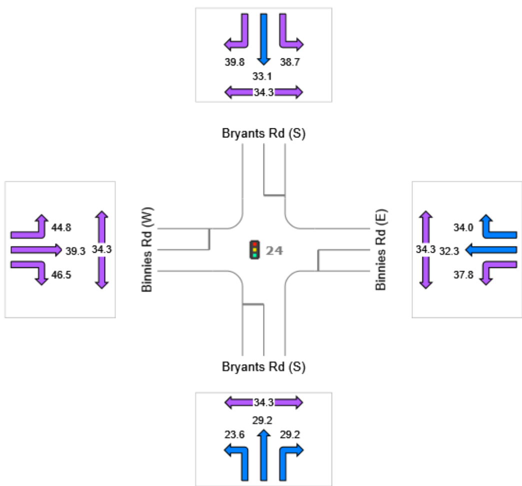
DEGREE OF SATURATION AM



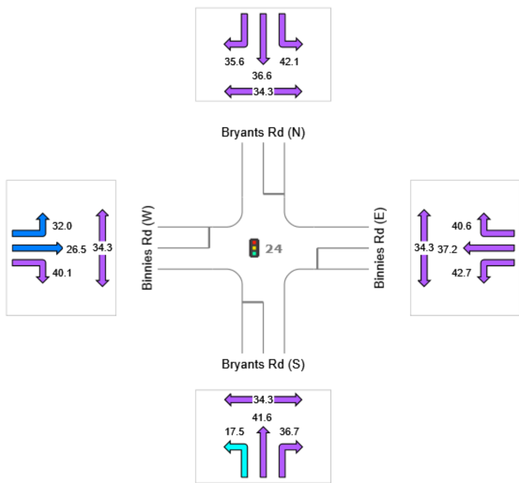
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1024 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 24 [2066 AM - FINAL same as 2041]

R1024
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bryants Rd (S)													
Lane 1	400	0.3	765	0.523	100	23.6	LOS C	11.8	82.6	Short	90	0.0	NA
Lane 2	297	0.4	476 [1]	0.623	100	29.2	LOS C	10.5	73.6	Full	500	0.0	0.0
Lane 3	22	0.0	464	0.048	100	29.2	LOS C	0.7	4.6	Short	30	0.0	NA
Approach	719	0.3		0.623		26.1	LOS C	11.8	82.6				
East: Binnies Rd (E)													
Lane 1	213	1.5	363 [1]	0.586	100	32.5	LOS C	7.8	55.2	Full	500	0.0	0.0
Lane 2	4	0.0	348	0.012	100	34.0	LOS C	0.1	0.9	Short	30	0.0	NA
Approach	217	1.5		0.586		32.5	LOS C	7.8	55.2				
North: Bryants Rd (S)													
Lane 1	198	0.5	342	0.578	100	33.5	LOS C	7.3	51.3	Full	500	0.0	0.0
Lane 2	197	1.6	321	0.613	100	39.8	LOS D	7.4	52.6	Short	60	0.0	NA
Approach	395	1.1		0.613		36.7	LOS D	7.4	52.6				
West: Binnies Rd (W)													
Lane 1	95	7.8	181	0.523	100	41.1	LOS D	3.7	28.0	Full	500	0.0	0.0
Lane 2	86	8.5	153	0.563	100	46.5	LOS D	3.5	26.3	Short	110	0.0	NA
Approach	181	8.1		0.563		43.7	LOS D	3.7	28.0				
Intersection	1512	1.6		0.623		31.9	LOS C	11.8	82.6				

Intersection R1024 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 24 [2066 PM - FINAL same as 2041]

R1024
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site User-Given Cycle Time)

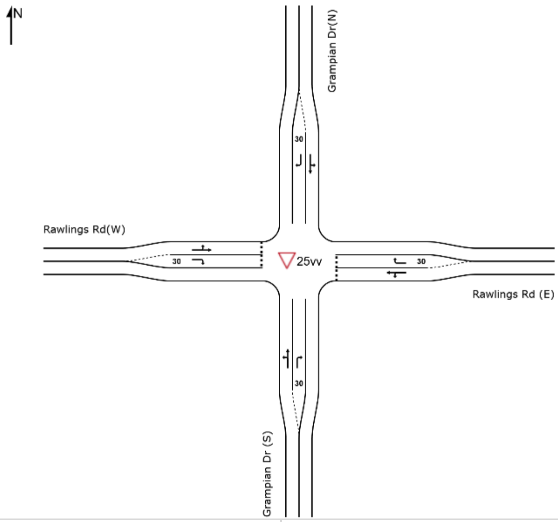
Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bryants Rd (S)													
Lane 1	163	0.6	878	0.186	100	17.5	LOS B	3.6	25.7	Short	90	0.0	NA
Lane 2	236	1.3	286 [1]	0.824	100	41.6	LOS D	10.1	71.5	Full	500	0.0	0.0
Lane 3	18	0.0	279	0.064	100	36.7	LOS D	0.6	4.3	Short	30	0.0	NA
Approach	417	1.0		0.824		32.0	LOS C	10.1	71.5				
East: Binnies Rd (E)													
Lane 1	113	2.8	222	0.507	100	38.0	LOS D	4.3	31.1	Full	500	0.0	0.0
Lane 2	8	0.0	209	0.040	100	40.6	LOS D	0.3	2.1	Short	30	0.0	NA
Approach	121	2.6		0.507		38.2	LOS D	4.3	31.1				
North: Bryants Rd (N)													
Lane 1	282	0.0	366	0.771	100	36.6	LOS D	11.4	80.0	Full	500	0.0	0.0
Lane 2	63	0.0	348	0.181	100	35.6	LOS D	2.1	14.9	Short	60	0.0	NA
Approach	345	0.0		0.771		36.4	LOS D	11.4	80.0				
West: Binnies Rd (W)													
Lane 1	241	1.7	512	0.471	100	29.2	LOS C	8.0	56.7	Full	500	0.0	0.0
Lane 2	368	0.0	464	0.794	100	40.1	LOS D	14.9	104.1	Short	110	0.0	NA
Approach	609	0.7		0.794		35.8	LOS D	14.9	104.1				
Intersection	1493	0.8		0.824		35.1	LOS D	14.9	104.1				

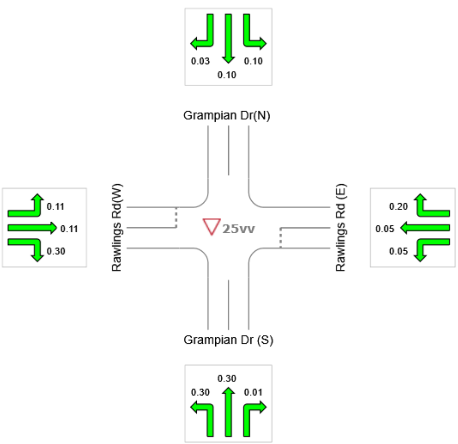
15 Intersection R1025

2031

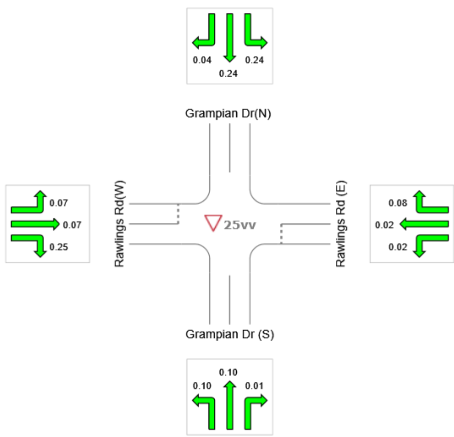
SITE LAYOUT – R1025 – 2031



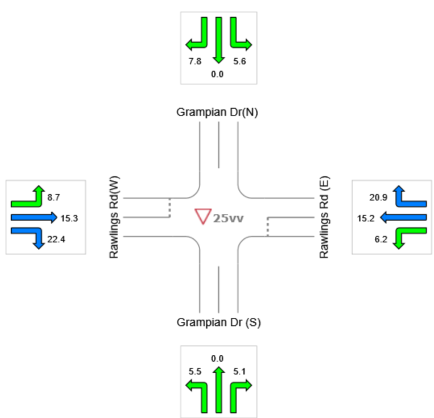
DEGREE OF SATURATION AM



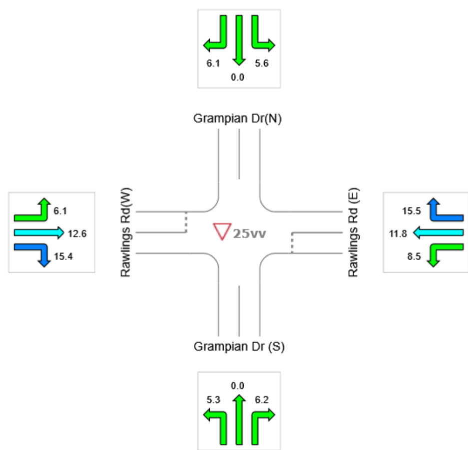
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1025 – 2031 Cont.

MOVEMENT SUMMARY 2031 AM

Site: 25vv [2031 AM - FINAL same as 2026]

R1025
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
South: Grampian Dr (S)												
10	L2	28	0.0	0.297	5.5	LOS A	0.0	0.0	0.00	0.03	0.00	57.6
2	T1	545	1.2	0.297	0.0	LOS A	0.0	0.0	0.00	0.03	0.00	59.2
12	R2	16	0.0	0.010	5.1	LOS A	0.0	0.3	0.29	0.51	0.29	48.9
Approach		589	1.1	0.297	0.4	NA	0.0	0.3	0.01	0.04	0.01	58.8
East: Rawlings Rd (E)												
1	L2	48	0.0	0.046	6.2	LOS A	0.2	1.2	0.28	0.57	0.28	49.2
2	T1	1	0.0	0.046	15.2	LOS C	0.2	1.2	0.28	0.57	0.28	53.1
6	R2	46	0.0	0.199	20.9	LOS C	0.7	4.9	0.80	0.93	0.83	43.6
Approach		96	0.0	0.199	13.4	LOS B	0.7	4.9	0.53	0.74	0.54	46.4
North: Grampian Dr(N)												
7	L2	16	0.0	0.101	5.6	LOS A	0.0	0.0	0.00	0.05	0.00	57.9
8	T1	175	4.2	0.101	0.0	LOS A	0.0	0.0	0.00	0.05	0.00	59.5
9	R2	28	0.0	0.029	7.8	LOS A	0.1	0.8	0.53	0.68	0.53	51.6
Approach		219	3.4	0.101	1.4	NA	0.1	0.8	0.07	0.13	0.07	58.2
West: Rawlings Rd(W)												
10	L2	72	1.5	0.107	8.7	LOS A	0.4	2.6	0.52	0.76	0.52	51.1
8	T1	2	0.0	0.107	15.3	LOS C	0.4	2.6	0.52	0.76	0.52	51.4
9	R2	72	0.0	0.299	22.4	LOS C	1.2	8.1	0.81	0.96	0.96	40.4
Approach		145	0.7	0.299	15.5	LOS C	1.2	8.1	0.67	0.86	0.74	45.2
All Vehicles		1049	1.4	0.299	3.9	NA	1.2	8.1	0.16	0.24	0.17	55.0

Intersection R1025 – 2031 Cont.

MOVEMENT SUMMARY 2031 PM

Site: 25vv [2031 PM - FINAL same as 2026]

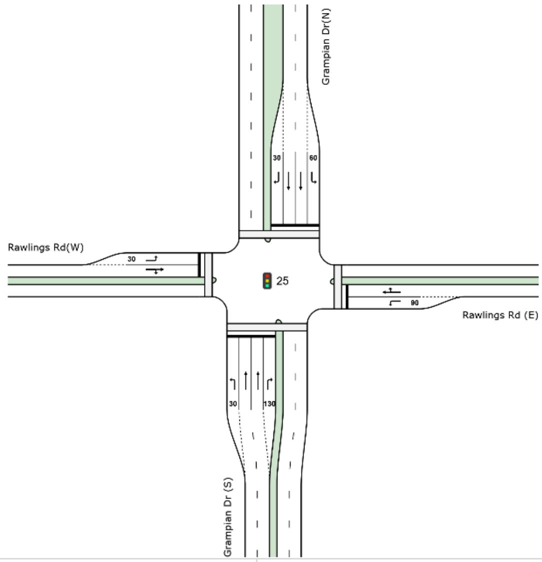
R1025
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

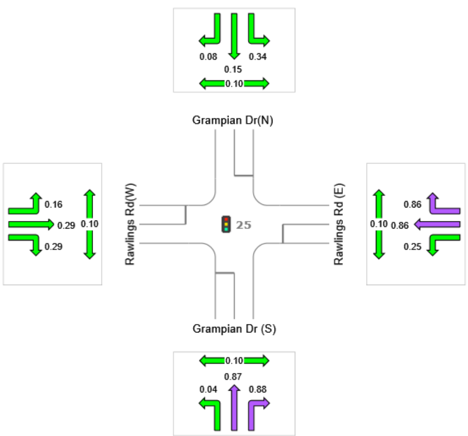
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Grampian Dr (S)												
10	L2	53	0.0	0.099	5.3	LOS A	0.0	0.0	0.00	0.16	0.00	54.7
2	T1	137	0.8	0.099	0.0	LOS A	0.0	0.0	0.00	0.16	0.00	55.9
12	R2	14	0.0	0.012	6.2	LOS A	0.0	0.3	0.47	0.58	0.47	48.4
Approach		203	0.5	0.099	1.8	NA	0.0	0.3	0.03	0.19	0.03	55.0
East: Rawlings Rd (E)												
1	L2	9	33.3	0.016	8.5	LOS A	0.1	0.5	0.48	0.65	0.48	47.5
2	T1	1	0.0	0.016	11.8	LOS B	0.1	0.5	0.48	0.65	0.48	51.7
6	R2	25	0.0	0.081	15.5	LOS C	0.3	2.0	0.70	0.88	0.70	46.6
Approach		36	8.8	0.081	13.5	LOS B	0.3	2.0	0.63	0.81	0.63	47.0
North: Grampian Dr(N)												
7	L2	56	0.0	0.240	5.6	LOS A	0.0	0.0	0.00	0.07	0.00	57.7
8	T1	407	0.0	0.240	0.0	LOS A	0.0	0.0	0.00	0.07	0.00	59.3
9	R2	60	0.0	0.040	6.1	LOS A	0.2	1.2	0.29	0.56	0.29	52.5
Approach		523	0.0	0.240	1.3	NA	0.2	1.2	0.03	0.13	0.03	58.3
West: Rawlings Rd(W)												
10	L2	55	0.0	0.071	6.1	LOS A	0.3	1.8	0.27	0.57	0.27	52.5
8	T1	9	0.0	0.071	12.6	LOS B	0.3	1.8	0.27	0.57	0.27	52.8
9	R2	85	0.0	0.245	15.4	LOS C	1.0	6.8	0.70	0.90	0.77	43.8
Approach		149	0.0	0.245	11.8	LOS B	1.0	6.8	0.52	0.76	0.56	47.2
All Vehicles		912	0.5	0.245	3.6	NA	1.0	6.8	0.14	0.27	0.14	54.9

Intersection R1025-2041

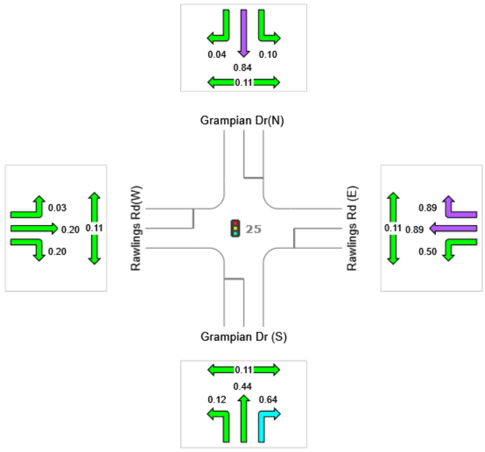
SITE LAYOUT – R1025 – 2041



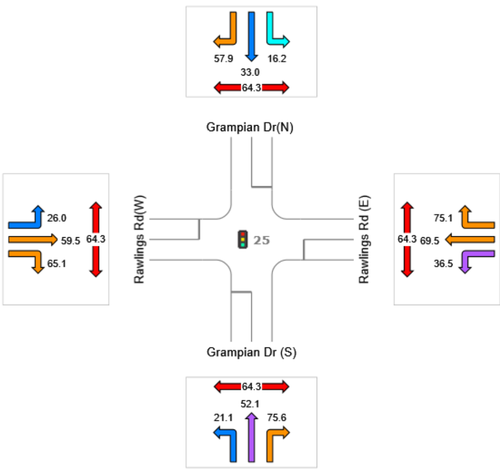
DEGREE OF SATURATION AM



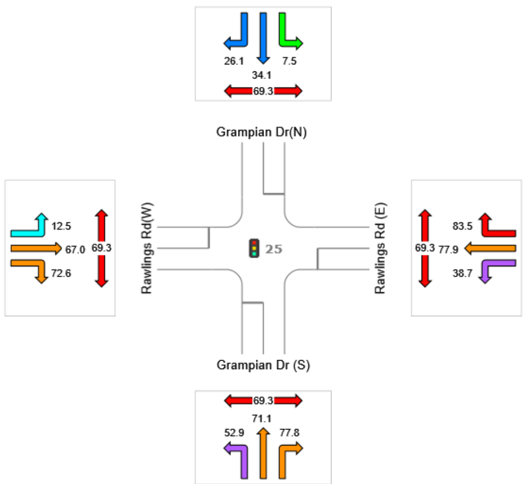
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1025 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 25 [2041 AM - FINAL]

R1025
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Grampian Dr (S)													
Lane 1	36	0.0	982	0.036	100	21.1	LOS C	1.1	8.0	Short	30	0.0	NA
Lane 2	564	0.2	648 [1]	0.870	100	52.1	LOS D	38.4	269.2	Full	500	0.0	0.0
Lane 3	550	0.2	632 [1]	0.870	100	52.0	LOS D	37.3	261.2	Full	500	0.0	0.0
Lane 4	279	0.0	318	0.876	100	75.6	LOS E	20.7	145.0	Short	130	0.0	NA
Approach	1428	0.1		0.876		55.9	LOS E	38.4	269.2				
East: Rawlings Rd (E)													
Lane 1	177	0.0	716	0.247	100	36.5	LOS D	8.1	56.5	Short	90	0.0	NA
Lane 2	275	0.0	319	0.862	100	74.9	LOS E	20.1	140.8	Full	500	0.0	0.0
Approach	452	0.0		0.862		59.9	LOS E	20.1	140.8				
North: Grampian Dr(N)													
Lane 1	334	0.0	968	0.345	100	16.2	LOS B	7.3	50.9	Short	60	0.0	NA
Lane 2	100	1.6	676	0.148	100	33.0	LOS C	4.6	32.7	Full	500	0.0	0.0
Lane 3	100	1.6	676	0.148	100	33.0	LOS C	4.6	32.7	Full	500	0.0	0.0
Lane 4	25	0.0	318	0.079	100	57.9	LOS E	1.4	10.1	Short	30	0.0	NA
Approach	559	0.6		0.345		24.1	LOS C	7.3	50.9				
West: Rawlings Rd(W)													
Lane 1	91	1.2	566	0.160	100	26.0	LOS C	2.9	20.2	Short	30	0.0	NA
Lane 2	73	1.4	252	0.289	100	64.1	LOS E	4.5	32.1	Full	500	0.0	0.0
Approach	163	1.3		0.289		43.0	LOS D	4.5	32.1				
Intersection	2602	0.3		0.876		48.9	LOS D	38.4	269.2				

Intersection R1025 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 25 [2041 PM - FINAL]

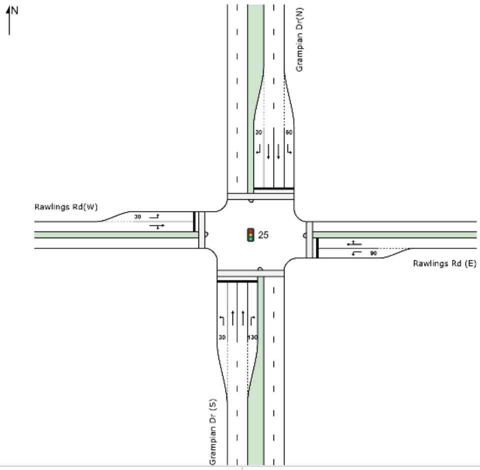
R1025
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site User-Given Phase Times)

Lane Use and Performance

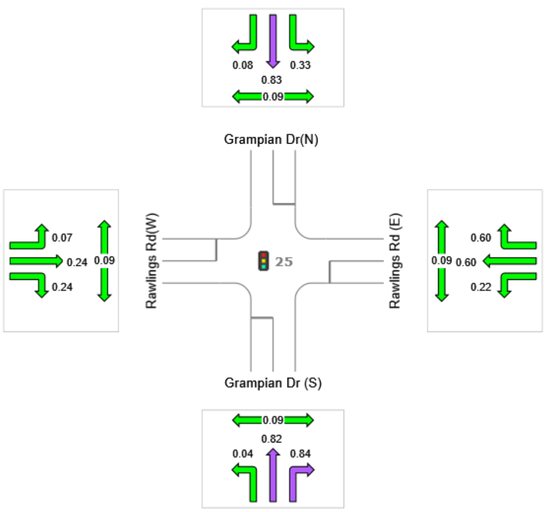
	Demand Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total	HV						Veh	Dist				
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Grampian Dr (S)													
Lane 1	51	0.0	433	0.117	100	52.9	LOS D	2.9	20.2	Short	30	0.0	NA
Lane 2	81	0.7	181	0.444	100	71.1	LOS E	5.7	40.3	Full	500	0.0	0.0
Lane 3	81	0.7	181	0.444	100	71.1	LOS E	5.7	40.3	Full	500	0.0	0.0
Lane 4	111	0.0	173	0.638	100	77.8	LOS E	8.1	56.7	Short	130	0.0	NA
Approach	322	0.3		0.638		70.6	LOS E	8.1	56.7				
East: Rawlings Rd (E)													
Lane 1	240	1.3	478	0.502	100	38.7	LOS D	11.6	82.2	Short	90	0.0	NA
Lane 2	277	0.0	310	0.893	100	83.4	LOS F	22.3	155.9	Full	500	0.0	0.0
Approach	517	0.6		0.893		62.6	LOS E	22.3	155.9				
North: Grampian Dr(N)													
Lane 1	152	0.0	1572	0.096	100	7.5	LOS A	1.8	12.5	Short	60	0.0	NA
Lane 2	689	1.9	824 [1]	0.837	100	33.8	LOS C	40.4	287.6	Full	500	0.0	0.0
Lane 3	761	1.9	910 [1]	0.837	100	34.4	LOS C	46.4	330.1	Full	500	0.0	0.0
Lane 4	38	2.8	898	0.042	100	26.1	LOS C	1.4	10.0	Short	30	0.0	NA
Approach	1640	1.7		0.837		31.5	LOS C	46.4	330.1				
West: Rawlings Rd(W)													
Lane 1	29	0.0	1114	0.026	100	12.5	LOS B	0.5	3.8	Short	30	0.0	NA
Lane 2	39	2.7	195	0.200	100	72.2	LOS E	2.6	19.0	Full	500	0.0	0.0
Approach	68	1.5		0.200		46.4	LOS D	2.6	19.0				
Intersection	2547	1.3		0.893		43.2	LOS D	46.4	330.1				

Intersection R1025-2066

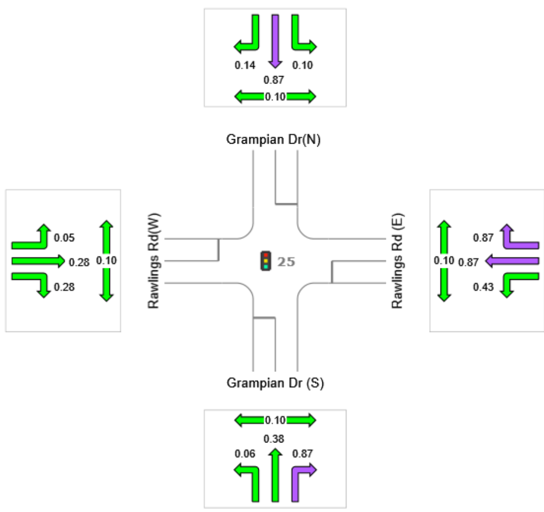
SITE LAYOUT – R1025 – 2066



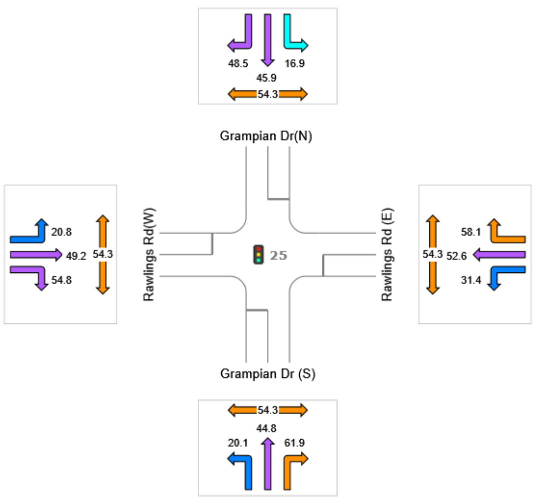
DEGREE OF SATURATION AM



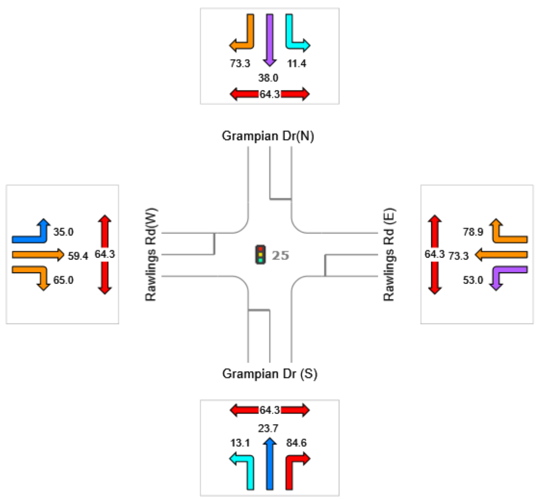
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1025 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 25 [2066 AM - FINAL same as 2041]

R1025
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Grampian Dr (S)													
Lane 1	39	0.0	944	0.041	100	20.1	LOS C	1.1	7.8	Short	30	0.0	NA
Lane 2	461	0.6	564[1]	0.817	100	44.6	LOS D	26.1	183.4	Full	500	0.0	0.0
Lane 3	490	0.6	599	0.817	100	45.0	LOS D	28.1	197.4	Full	500	0.0	0.0
Lane 4	299	0.0	356	0.840	100	61.9	LOS E	18.6	129.9	Short	130	0.0	NA
Approach	1288	0.4		0.840		48.0	LOS D	28.1	197.4				
East: Rawlings Rd (E)													
Lane 1	157	0.7	724	0.217	100	31.4	LOS C	6.0	42.5	Short	90	0.0	NA
Lane 2	167	0.0	279	0.600	100	58.0	LOS E	9.4	65.7	Full	500	0.0	0.0
Approach	324	0.3		0.600		45.1	LOS D	9.4	65.7				
North: Grampian Dr(N)													
Lane 1	277	0.0	851	0.325	100	16.9	LOS B	5.7	40.1	Short	60	0.0	NA
Lane 2	386	7.4	465[1]	0.830	100	45.4	LOS D	21.7	161.6	Full	500	0.0	0.0
Lane 3	455	7.4	548[1]	0.830	100	46.2	LOS D	26.4	196.6	Full	500	0.0	0.0
Lane 4	27	3.8	346	0.079	100	48.5	LOS D	1.3	9.5	Short	30	0.0	NA
Approach	1145	5.5		0.830		38.9	LOS D	26.4	196.6				
West: Rawlings Rd(W)													
Lane 1	47	0.0	635	0.075	100	20.8	LOS C	1.2	8.2	Short	30	0.0	NA
Lane 2	65	1.6	277	0.236	100	54.1	LOS D	3.4	24.3	Full	500	0.0	0.0
Approach	113	0.9		0.236		40.1	LOS D	3.4	24.3				
Intersection	2871	2.5		0.840		43.8	LOS D	28.1	197.4				

Intersection R1025 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 25 [2066 PM - FINAL same as 2041]

R1025
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

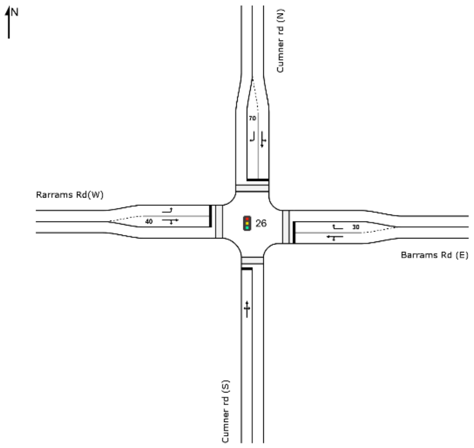
Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Grampian Dr (S)													
Lane 1	69	0.0	1234	0.056	100	13.1	LOS B	1.6	11.2	Short	30	0.0	NA
Lane 2	323	1.1	853[1]	0.379	100	23.4	LOS C	13.3	94.3	Full	500	0.0	0.0
Lane 3	356	1.1	941	0.379	100	24.0	LOS C	15.0	106.2	Full	500	0.0	0.0
Lane 4	116	0.0	133	0.873	100	84.6	LOS F	8.8	61.5	Short	130	0.0	NA
Approach	864	0.9		0.873		31.0	LOS C	15.0	106.2				
East: Rawlings Rd (E)													
Lane 1	201	0.0	464	0.433	100	53.0	LOS D	11.5	80.8	Short	90	0.0	NA
Lane 2	219	0.0	253	0.867	100	78.6	LOS E	16.2	113.7	Full	500	0.0	0.0
Approach	420	0.0		0.867		66.4	LOS E	16.2	113.7				
North: Grampian Dr(N)													
Lane 1	113	0.0	1154	0.098	100	11.4	LOS B	1.8	12.4	Short	60	0.0	NA
Lane 2	739	1.1	850[1]	0.869	100	37.7	LOS D	45.1	318.3	Full	500	0.0	0.0
Lane 3	800	1.1	920[1]	0.869	100	38.3	LOS D	50.5	356.5	Full	500	0.0	0.0
Lane 4	19	0.0	133	0.143	100	73.3	LOS E	1.3	8.8	Short	30	0.0	NA
Approach	1671	1.0		0.869		36.6	LOS D	50.5	356.5				
West: Rawlings Rd(W)													
Lane 1	20	0.0	385	0.052	100	35.0	LOS C	0.8	5.7	Short	30	0.0	NA
Lane 2	68	3.1	248	0.276	100	64.3	LOS E	4.3	30.6	Full	500	0.0	0.0
Approach	88	2.4		0.276		57.7	LOS E	4.3	30.6				
Intersection	3043	0.9		0.873		39.7	LOS D	50.5	356.5				

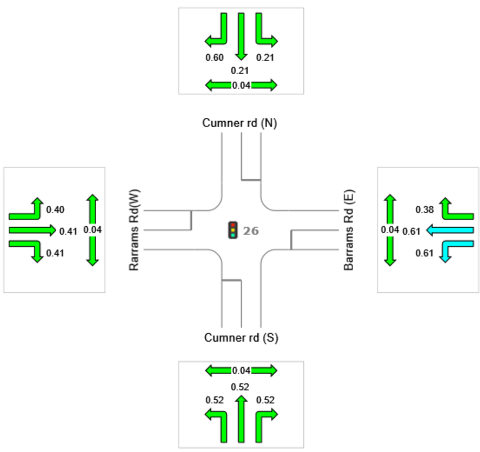
16 Intersection R1026

2031

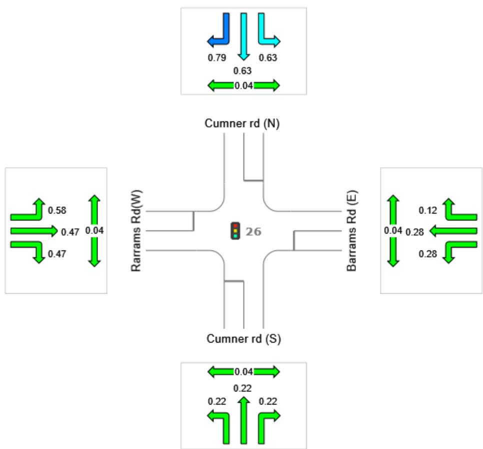
SITE LAYOUT – R1026 – 2031



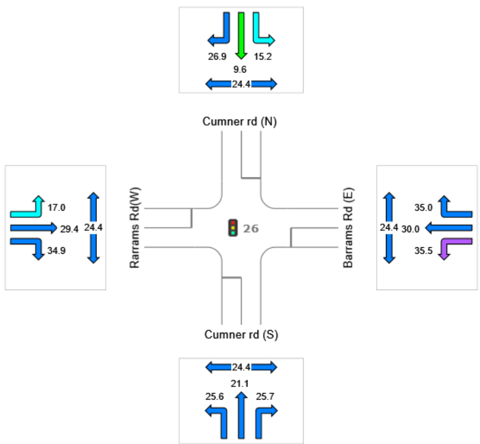
DEGREE OF SATURATION AM



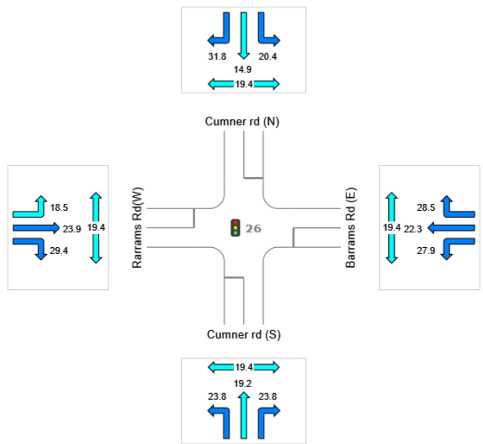
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1026 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 26 [2031 AM - FINAL same as 2026]

R1026
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Cumner rd (S)													
Lane 1	145	0.7	281	0.517	100	22.8	LOS C	3.4	23.7	Full	500	0.0	0.0
Approach	145	0.7		0.517		22.8	LOS C	3.4	23.7				
East: Barrams Rd (E)													
Lane 1	120	0.0	196	0.613	100	30.1	LOS C	3.7	25.8	Full	500	0.0	0.0
Lane 2	68	3.1	182	0.377	100	35.0	LOS C	2.0	14.6	Short	30	0.0	NA
Approach	188	1.1		0.613		31.9	LOS C	3.7	25.8				
North: Cumner rd (N)													
Lane 1	111	6.7	534	0.207	100	12.2	LOS B	1.5	10.8	Full	500	0.0	0.0
Lane 2	293	1.1	491	0.595	100	26.9	LOS C	7.7	54.7	Short	70	0.0	NA
Approach	403	2.6		0.595		22.9	LOS C	7.7	54.7				
West: Rarrams Rd(W)													
Lane 1	337	2.5	851	0.396	100	17.0	LOS B	6.5	46.7	Full	500	0.0	0.0
Lane 2	80	0.0	195	0.411	100	29.5	LOS C	2.4	16.6	Short	40	0.0	NA
Approach	417	2.0		0.411		19.4	LOS B	6.5	46.7				
Intersection	1154	1.9		0.613		23.1	LOS C	7.7	54.7				

LANE SUMMARY 2031 PM

Site: 26 [2031 PM - FINAL same as 2026]

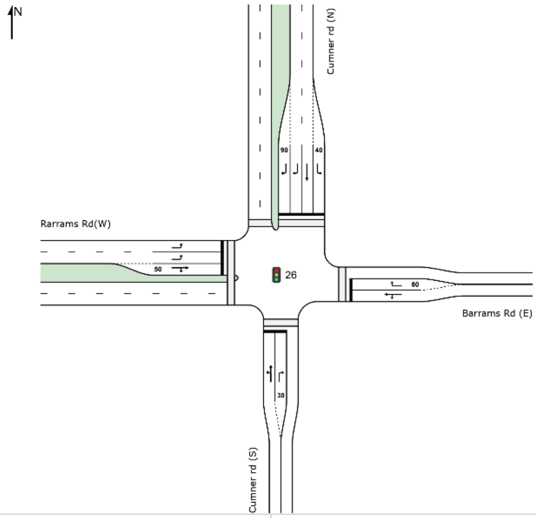
R1026
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

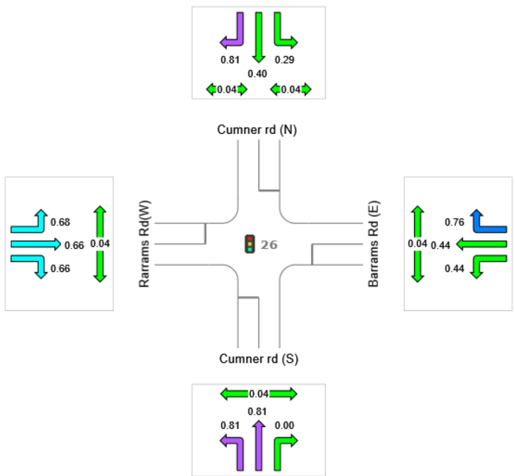
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Cumner rd (S)													
Lane 1	53	0.0	242	0.218	100	20.0	LOS B	1.0	6.9	Full	500	0.0	0.0
Approach	53	0.0		0.218		20.0	LOS B	1.0	6.9				
East: Barrams Rd (E)													
Lane 1	66	0.0	237	0.280	100	22.6	LOS C	1.6	10.9	Full	500	0.0	0.0
Lane 2	23	18.2	197	0.117	100	28.5	LOS C	0.5	4.4	Short	30	0.0	NA
Approach	89	4.7		0.280		24.1	LOS C	1.6	10.9				
North: Cumner rd (N)													
Lane 1	234	0.9	371	0.629	100	17.7	LOS B	3.9	27.6	Full	500	0.0	0.0
Lane 2	232	1.4	294	0.787	100	31.8	LOS C	6.3	44.8	Short	70	0.0	NA
Approach	465	1.1		0.787		24.7	LOS C	6.3	44.8				
West: Rarrams Rd(W)													
Lane 1	427	0.7	739	0.578	100	18.5	LOS B	8.4	59.0	Full	500	0.0	0.0
Lane 2	109	0.0	233	0.469	100	24.2	LOS C	2.7	18.9	Short	40	0.0	NA
Approach	537	0.6		0.578		19.7	LOS B	8.4	59.0				
Intersection	1144	1.1		0.787		22.1	LOS C	8.4	59.0				

Intersection R1026-2041

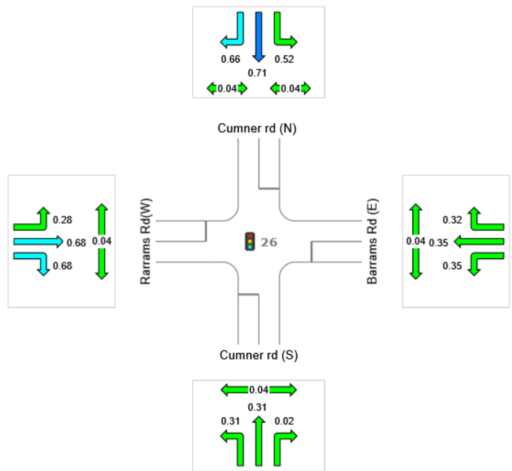
SITE LAYOUT – R1026 – 2041



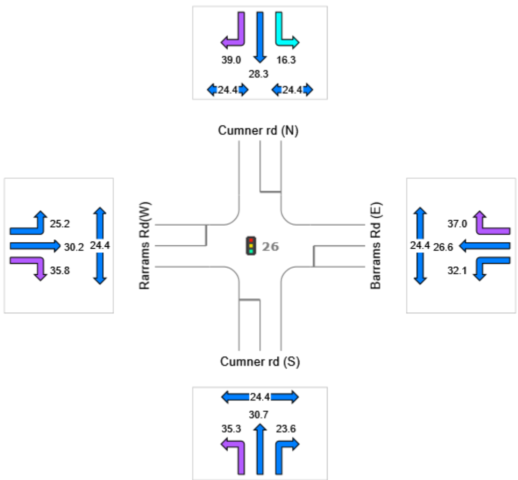
DEGREE OF SATURATION AM



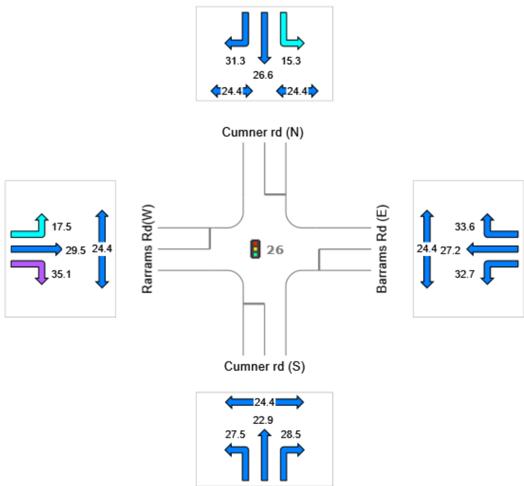
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



LANE SUMMARY 2041 AM

Site: 26 [2041 AM - FINAL]

R1026
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Cumner rd (S)													
Lane 1	369	0.6	458	0.807	100	31.2	LOS C	11.6	81.6	Full	500	0.0	0.0
Lane 2	2	0.0	433	0.005	100	23.6	LOS C	0.0	0.3	Short	30	0.0	NA
Approach	372	0.6		0.807		31.1	LOS C	11.6	81.6				
East: Barrams Rd (E)													
Lane 1	114	0.0	261	0.436	100	26.7	LOS C	3.2	22.6	Full	500	0.0	0.0
Lane 2	186	2.3	244	0.765	100	37.0	LOS D	6.0	42.7	Short	60	0.0	NA
Approach	300	1.4		0.765		33.1	LOS C	6.0	42.7				
North: Cumner rd (N)													
Lane 1	132	2.4	456	0.288	100	16.3	LOS B	1.9	13.8	Short	40	0.0	NA
Lane 2	88	3.6	222	0.398	100	28.3	LOS C	2.6	18.5	Full	500	0.0	0.0
Lane 3	172	2.5	213	0.806	100	39.0	LOS D	5.7	40.7	Full	500	0.0	0.0
Lane 4	172	2.5	213	0.806	100	39.0	LOS D	5.7	40.7	Short	90	0.0	NA
Approach	563	2.6		0.806		32.0	LOS C	5.7	40.7				
West: Rarrams Rd(W)													
Lane 1	418	1.0	615	0.680	100	25.2	LOS C	11.1	78.2	Full	500	0.0	0.0
Lane 2	418	1.0	615	0.680	100	25.2	LOS C	11.1	78.2	Full	500	0.0	0.0
Lane 3	149	0.7	225	0.663	100	30.6	LOS C	4.6	32.5	Short	50	0.0	NA
Approach	985	1.0		0.680		26.0	LOS C	11.1	78.2				
Intersection	2220	1.4		0.807		29.4	LOS C	11.6	81.6				

Intersection R1026 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 26 [2041 PM - FINAL]

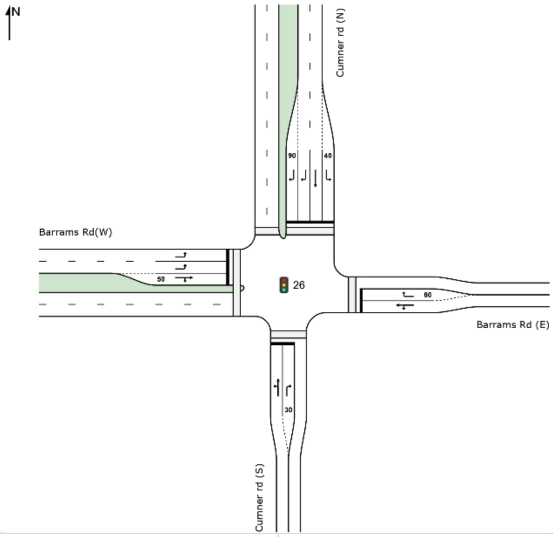
R1026
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

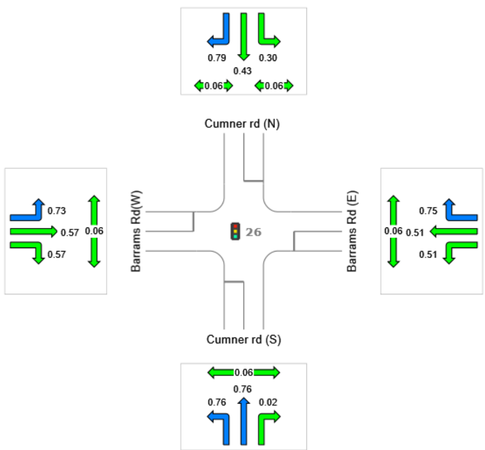
	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Cumner rd (S)													
Lane 1	92	1.1	300	0.306	100	23.7	LOS C	2.1	15.2	Full	500	0.0	0.0
Lane 2	4	0.0	279	0.015	100	28.5	LOS C	0.1	0.8	Short	30	0.0	NA
Approach	96	1.1		0.306		23.9	LOS C	2.1	15.2				
East: Barrams Rd (E)													
Lane 1	80	0.0	230	0.349	100	27.4	LOS C	2.3	15.9	Full	500	0.0	0.0
Lane 2	68	0.0	217	0.316	100	33.6	LOS C	2.0	13.8	Short	60	0.0	NA
Approach	148	0.0		0.349		30.2	LOS C	2.3	15.9				
North: Cumner rd (N)													
Lane 1	305	0.7	585	0.522	100	15.3	LOS B	4.1	28.8	Short	40	0.0	NA
Lane 2	278	0.0	390	0.713	100	26.6	LOS C	8.3	57.9	Full	500	0.0	0.0
Lane 3	242	1.1	369	0.657	100	31.3	LOS C	7.0	49.5	Full	500	0.0	0.0
Lane 4	242	1.1	369	0.657	100	31.3	LOS C	7.0	49.5	Short	90	0.0	NA
Approach	1067	0.7		0.713		25.5	LOS C	8.3	57.9				
West: Rarrams Rd(W)													
Lane 1	227	0.7	801	0.284	100	17.5	LOS B	4.4	30.6	Full	500	0.0	0.0
Lane 2	227	0.7	801	0.284	100	17.5	LOS B	4.4	30.6	Full	500	0.0	0.0
Lane 3	175	0.6	257	0.680	100	30.3	LOS C	5.4	37.7	Short	50	0.0	NA
Approach	629	0.7		0.680		21.0	LOS C	5.4	37.7				
Intersection	1941	0.7		0.713		24.3	LOS C	8.3	57.9				

Intersection R1026-2066

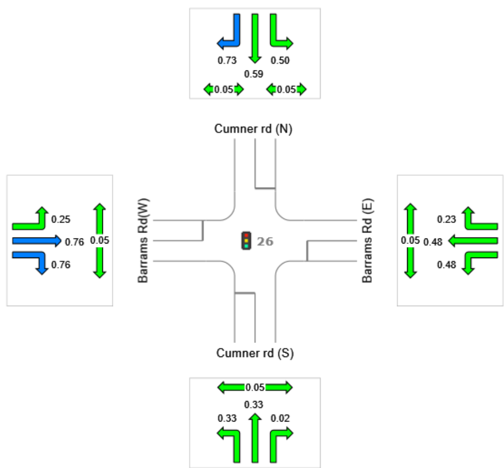
SITE LAYOUT – R1026 – 2066



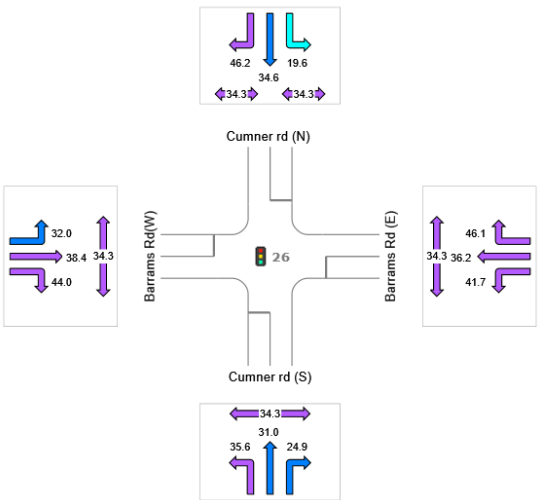
DEGREE OF SATURATION AM



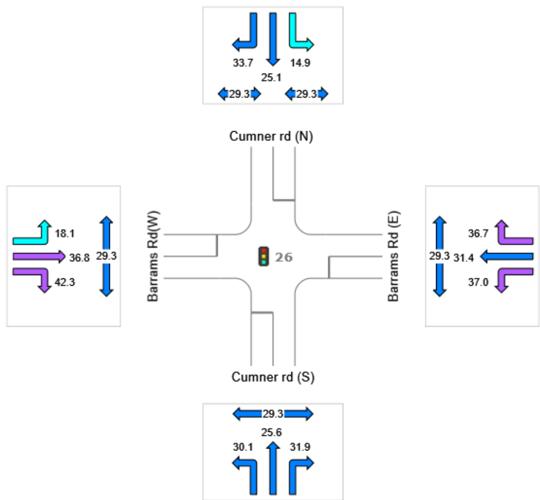
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1026 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 26 [2066 AM - FINAL same as 2041]

R1026
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Cumner rd (S)													
Lane 1	463	0.0	608 [1]	0.761	100	31.6	LOS C	17.1	119.5	Full	500	0.0	0.0
Lane 2	14	0.0	580	0.024	100	24.9	LOS C	0.4	2.6	Short	30	0.0	NA
Approach	477	0.0		0.761		31.4	LOS C	17.1	119.5				
East: Barrams Rd (E)													
Lane 1	124	0.0	244	0.508	100	36.3	LOS D	4.7	33.1	Full	500	0.0	0.0
Lane 2	172	1.2	230	0.746	100	46.1	LOS D	7.1	50.3	Short	60	0.0	NA
Approach	296	0.7		0.746		42.0	LOS D	7.1	50.3				
North: Cumner rd (N)													
Lane 1	146	5.0	493	0.297	100	19.6	LOS B	3.0	22.2	Short	40	0.0	NA
Lane 2	124	1.7	289	0.429	100	34.6	LOS C	4.6	32.5	Full	500	0.0	0.0
Lane 3	218	1.9	275	0.795	100	46.2	LOS D	9.2	65.5	Full	500	0.0	0.0
Lane 4	218	1.9	275	0.795	100	46.2	LOS D	9.2	65.5	Short	90	0.0	NA
Approach	707	2.5		0.795		38.6	LOS D	9.2	65.5				
West: Barrams Rd(W)													
Lane 1	453	1.7	619	0.731	100	32.2	LOS C	16.3	115.5	Full	500	0.0	0.0
Lane 2	406	1.7	556 [1]	0.731	100	31.7	LOS C	14.2	101.2	Full	500	0.0	0.0
Lane 3	125	0.0	219	0.572	100	38.7	LOS D	4.9	34.4	Short	50	0.0	NA
Approach	984	1.5		0.731		32.8	LOS C	16.3	115.5				
Intersection	2464	1.4		0.795		35.3	LOS D	17.1	119.5				

Intersection R1026 – 2066Cont.

LANE SUMMARY 2066 PM

Site: 26 [2066 PM - FINAL same as 2041]

R1026
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site User-Given Cycle Time)

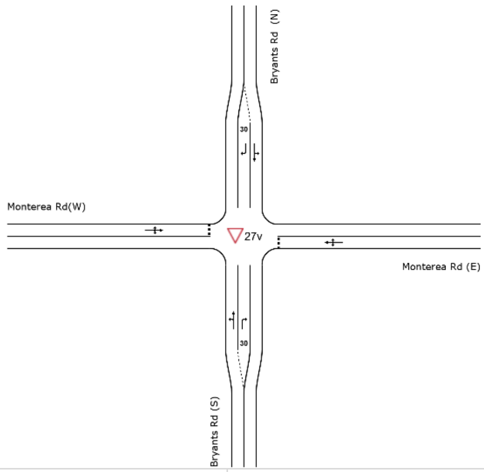
Lane Use and Performance

	Demand Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total	HV						Veh	Dist				
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Cumner rd (S)													
Lane 1	104	0.0	316	0.329	100	26.5	LOS C	2.8	19.7	Full	500	0.0	0.0
Lane 2	6	0.0	292	0.022	100	31.9	LOS C	0.2	1.3	Short	30	0.0	NA
Approach	111	0.0		0.329		26.8	LOS C	2.8	19.7				
East: Barrams Rd (E)													
Lane 1	122	0.0	253	0.483	100	31.7	LOS C	4.1	28.4	Full	500	0.0	0.0
Lane 2	54	5.9	229	0.234	100	36.7	LOS D	1.7	12.8	Short	60	0.0	NA
Approach	176	1.8		0.483		33.2	LOS C	4.1	28.4				
North: Cumner rd (N)													
Lane 1	352	1.5	709	0.496	100	14.9	LOS B	5.3	37.2	Short	40	0.0	NA
Lane 2	294	0.0	501	0.586	100	25.1	LOS C	9.0	63.1	Full	500	0.0	0.0
Lane 3	348	0.6	475	0.732	100	33.7	LOS C	11.7	82.4	Full	500	0.0	0.0
Lane 4	348	0.6	475	0.732	100	33.7	LOS C	11.7	82.4	Short	120	0.0	NA
Approach	1341	0.7		0.732		26.9	LOS C	11.7	82.4				
West: Barrams Rd(W)													
Lane 1	210	1.5	840	0.250	100	18.1	LOS B	4.4	31.3	Full	500	0.0	0.0
Lane 2	210	1.5	840	0.250	100	18.1	LOS B	4.4	31.3	Full	500	0.0	0.0
Lane 3	167	0.6	220	0.760	100	37.6	LOS D	6.2	43.6	Short	50	0.0	NA
Approach	587	1.3		0.760		23.7	LOS C	6.2	43.6				
Intersection	2215	0.9		0.760		26.5	LOS C	11.7	82.4				

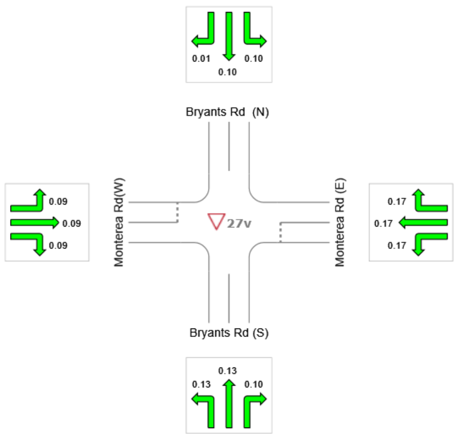
17 Intersection R1027

2031

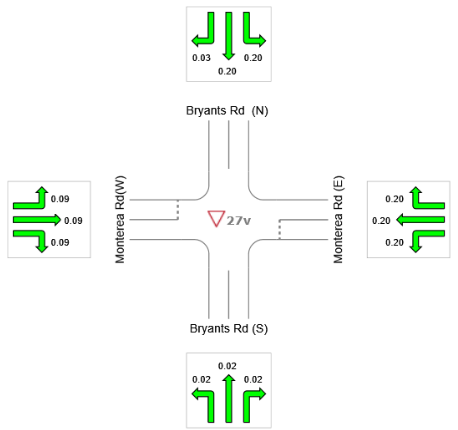
SITE LAYOUT – R1027– 2031



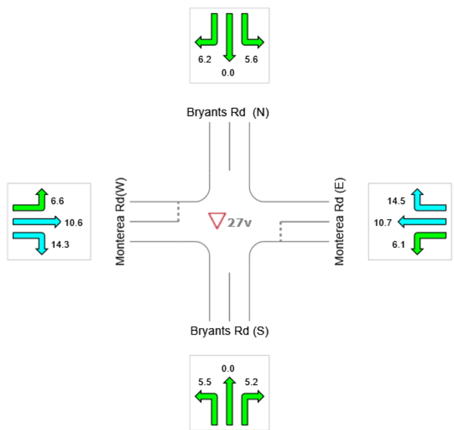
DEGREE OF SATURATION AM



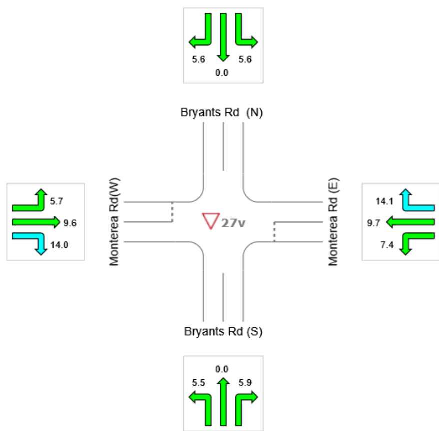
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1027 – 2031 Cont.

MOVEMENT SUMMARY 2031 AM

Site: 27v [2031 AM - FINAL same as 2026]

R1027
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
South: Bryants Rd (S)												
10	L2	1	0.0	0.130	5.5	LOS A	0.0	0.0	0.00	0.00	0.00	58.3
2	T1	248	0.8	0.130	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
12	R2	147	0.0	0.098	5.2	LOS A	0.5	3.2	0.31	0.55	0.31	48.6
Approach		397	0.5	0.130	2.0	NA	0.5	3.2	0.12	0.21	0.12	55.1
East: Monterea Rd (E)												
1	L2	121	0.0	0.170	6.1	LOS A	0.7	4.6	0.28	0.59	0.28	48.6
2	T1	1	0.0	0.170	10.7	LOS B	0.7	4.6	0.28	0.59	0.28	52.4
6	R2	24	0.0	0.170	14.5	LOS B	0.7	4.6	0.28	0.59	0.28	51.9
Approach		146	0.0	0.170	7.5	LOS A	0.7	4.6	0.28	0.59	0.28	49.2
North: Bryants Rd (N)												
7	L2	67	1.6	0.104	5.6	LOS A	0.0	0.0	0.00	0.20	0.00	56.6
8	T1	129	0.8	0.104	0.0	LOS A	0.0	0.0	0.00	0.20	0.00	58.2
9	R2	20	0.0	0.014	6.2	LOS A	0.1	0.4	0.34	0.57	0.34	52.2
Approach		217	1.0	0.104	2.3	NA	0.1	0.4	0.03	0.24	0.03	57.1
West: Monterea Rd(W)												
10	L2	38	0.0	0.090	6.6	LOS A	0.3	2.4	0.45	0.66	0.45	51.6
8	T1	24	0.0	0.090	10.6	LOS B	0.3	2.4	0.45	0.66	0.45	51.9
9	R2	1	0.0	0.090	14.3	LOS B	0.3	2.4	0.45	0.66	0.45	48.0
Approach		63	0.0	0.090	8.2	LOS A	0.3	2.4	0.45	0.66	0.45	51.6
All Vehicles		823	0.5	0.170	3.5	NA	0.7	4.6	0.15	0.32	0.15	54.2

Intersection R1027 – 2031 Cont.

MOVEMENT SUMMARY 2031 PM

Site: 27v [2031 PM - FINAL same as 2026]

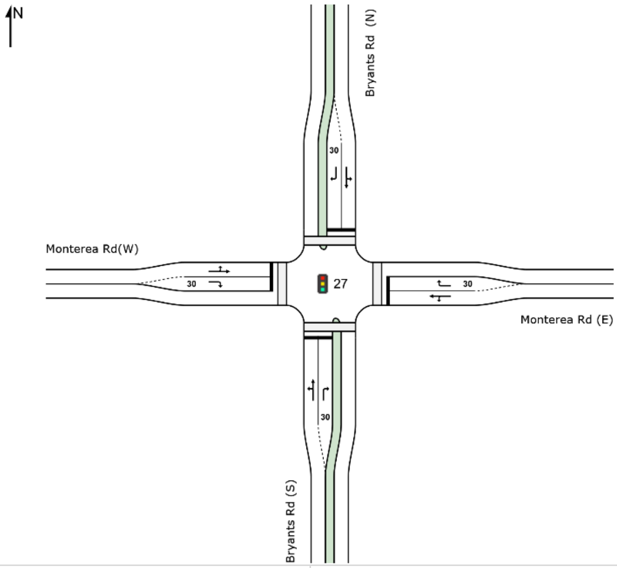
R1027
Site Category: (None)
Giveway / Yield (Two-Way)

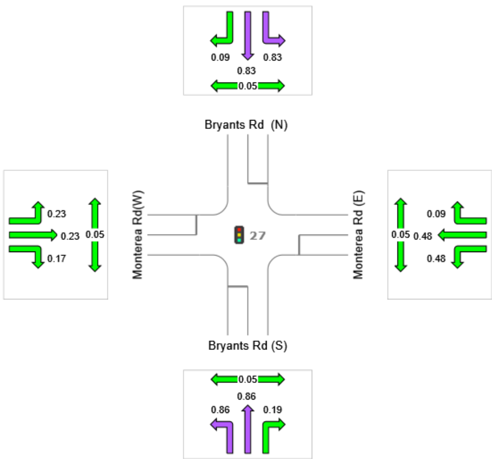
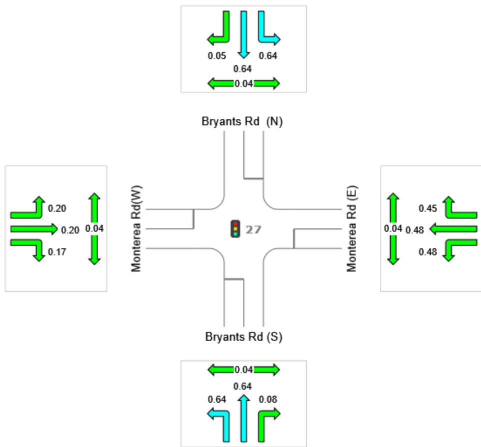
Movement Performance - Vehicles

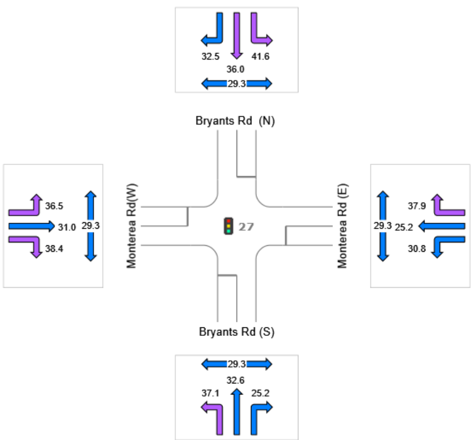
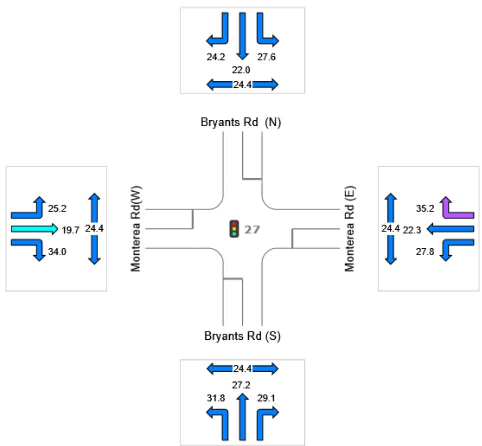
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Bryants Rd (S)												
10	L2	1	0.0	0.025	5.5	LOS A	0.0	0.0	0.00	0.01	0.00	58.1
2	T1	46	2.3	0.025	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	59.7
12	R2	23	0.0	0.019	5.9	LOS A	0.1	0.6	0.43	0.58	0.43	48.3
Approach		71	1.5	0.025	2.0	NA	0.1	0.6	0.14	0.20	0.14	55.4
East: Monterea Rd (E)												
1	L2	145	0.0	0.203	7.4	LOS A	0.8	5.4	0.47	0.71	0.47	48.3
2	T1	1	0.0	0.203	9.7	LOS A	0.8	5.4	0.47	0.71	0.47	52.0
6	R2	17	0.0	0.203	14.1	LOS B	0.8	5.4	0.47	0.71	0.47	51.5
Approach		163	0.0	0.203	8.1	LOS A	0.8	5.4	0.47	0.71	0.47	48.6
North: Bryants Rd (N)												
7	L2	33	0.0	0.203	5.6	LOS A	0.0	0.0	0.00	0.05	0.00	57.9
8	T1	358	1.2	0.203	0.0	LOS A	0.0	0.0	0.00	0.05	0.00	59.5
9	R2	47	0.0	0.027	5.6	LOS A	0.1	0.9	0.13	0.56	0.13	52.8
Approach		438	1.0	0.203	1.0	NA	0.1	0.9	0.01	0.10	0.01	58.6
West: Monterea Rd(W)												
10	L2	95	0.0	0.091	5.7	LOS A	0.3	2.4	0.12	0.55	0.12	53.2
8	T1	7	0.0	0.091	9.6	LOS A	0.3	2.4	0.12	0.55	0.12	53.5
9	R2	1	0.0	0.091	14.0	LOS B	0.3	2.4	0.12	0.55	0.12	49.4
Approach		103	0.0	0.091	6.1	LOS A	0.3	2.4	0.12	0.55	0.12	53.2
All Vehicles		775	0.7	0.203	3.3	NA	0.8	5.4	0.14	0.30	0.14	55.1

Intersection R1027-2041

SITE LAYOUT – R1027– 2041



DEGREE OF SATURATION AM	DEGREE OF SATURATION PM
	

DELAY CONTROL (seconds) AM	DELAY CONTROL (seconds) PM
	

Intersection R1027 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 27 [2041 AM - FINAL]

R1027
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bryants Rd (S)													
Lane 1	431	0.7	502 [1]	0.857	100	32.9	LOS C	16.2	114.1	Full	500	0.0	0.0
Lane 2	100	0.0	531	0.188	100	25.2	LOS C	2.6	18.3	Short	30	0.0	NA
Approach	531	0.6		0.857		31.5	LOS C	16.2	114.1				
East: Monterea Rd (E)													
Lane 1	209	2.5	440	0.477	100	29.9	LOS C	6.3	45.2	Full	500	0.0	0.0
Lane 2	17	0.0	186	0.091	100	37.9	LOS D	0.5	3.8	Short	30	0.0	NA
Approach	226	2.3		0.477		30.5	LOS C	6.3	45.2				
North: Bryants Rd (N)													
Lane 1	278	1.1	334 [1]	0.832	100	37.1	LOS D	10.6	74.7	Full	500	0.0	0.0
Lane 2	27	0.0	318	0.086	100	32.5	LOS C	0.8	5.7	Short	30	0.0	NA
Approach	305	1.0		0.832		36.7	LOS D	10.6	74.7				
West: Monterea Rd(W)													
Lane 1	56	0.0	240	0.233	100	33.7	LOS C	1.8	12.6	Full	500	0.0	0.0
Lane 2	32	0.0	186	0.170	100	38.4	LOS D	1.0	7.3	Short	30	0.0	NA
Approach	87	0.0		0.233		35.4	LOS D	1.8	12.6				
Intersection	1149	1.0		0.857		33.0	LOS C	16.2	114.1				

Intersection R1027 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 27 [2041 PM - FINAL]

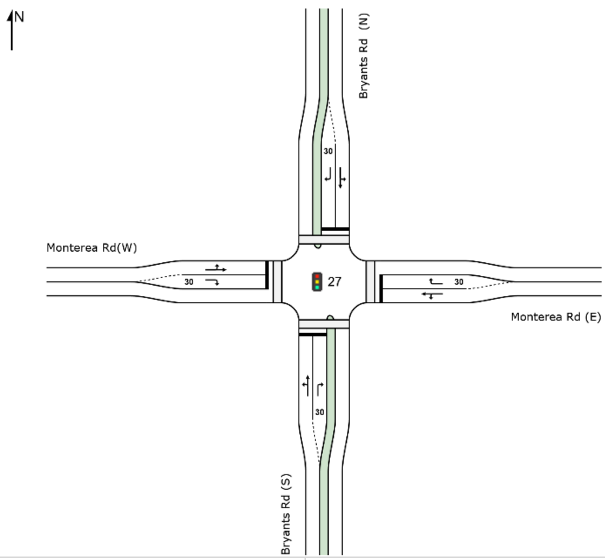
R1027
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

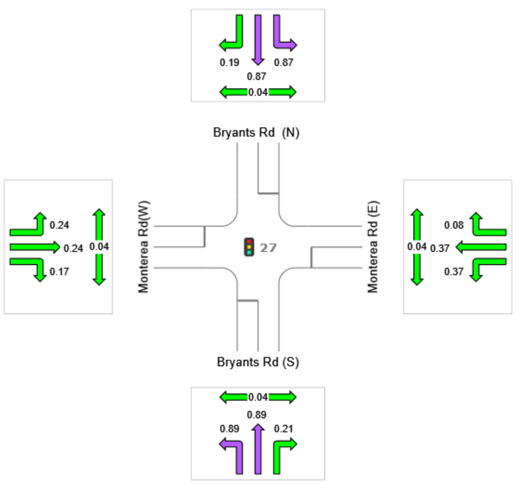
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Bryants Rd (S)													
Lane 1	194	0.0	302	0.642	100	28.0	LOS C	5.7	40.0	Full	500	0.0	0.0
Lane 2	21	0.0	279	0.076	100	29.1	LOS C	0.6	3.9	Short	30	0.0	NA
Approach	215	0.0		0.642		28.1	LOS C	5.7	40.0				
East: Monterea Rd (E)													
Lane 1	204	0.0	426	0.480	100	26.9	LOS C	5.4	37.6	Full	500	0.0	0.0
Lane 2	84	0.0	186	0.453	100	35.2	LOS D	2.5	17.6	Short	30	0.0	NA
Approach	288	0.0		0.480		29.4	LOS C	5.4	37.6				
North: Bryants Rd (N)													
Lane 1	309	1.4	484 [1]	0.639	100	22.5	LOS C	8.4	59.4	Full	500	0.0	0.0
Lane 2	23	0.0	464	0.050	100	24.2	LOS C	0.5	3.7	Short	30	0.0	NA
Approach	333	1.3		0.639		22.6	LOS C	8.4	59.4				
West: Monterea Rd(W)													
Lane 1	91	0.0	451	0.201	100	24.3	LOS C	2.2	15.1	Full	500	0.0	0.0
Lane 2	32	0.0	186	0.170	100	34.0	LOS C	0.9	6.3	Short	30	0.0	NA
Approach	122	0.0		0.201		26.8	LOS C	2.2	15.1				
Intersection	958	0.4		0.642		26.4	LOS C	8.4	59.4				

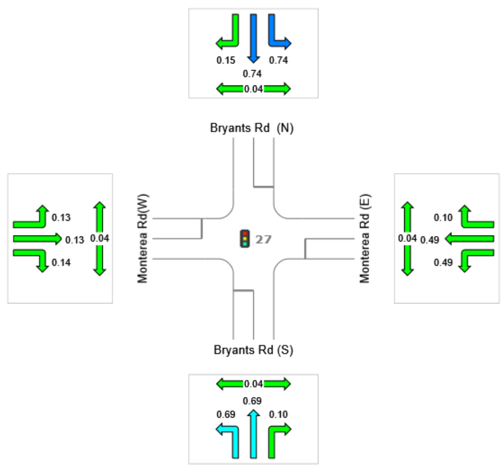
Intersection R1027-2066

SITE LAYOUT – R1027– 2066

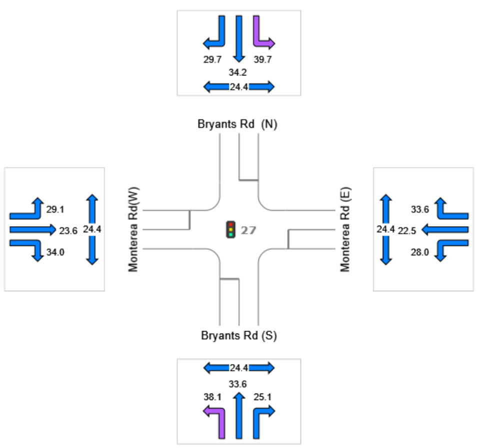


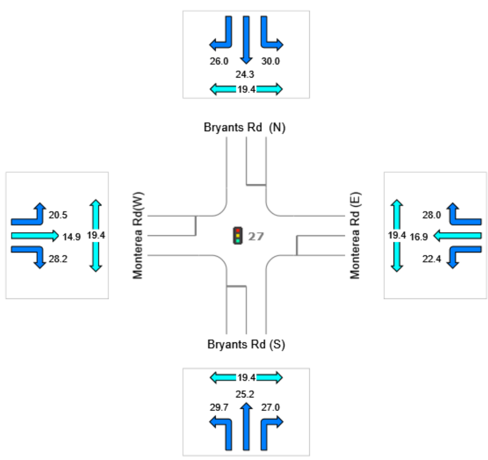
DEGREE OF SATURATION AM	DEGREE OF SATURATION PM





DELAY CONTROL (seconds) AM	DELAY CONTROL (seconds) PM





Intersection R1027 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 27 [2066 AM - FINAL same as 2041]

R1027
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bryants Rd (S)													
Lane 1	374	2.0	422 [1]	0.885	100	34.0	LOS C	13.2	93.8	Full	500	0.0	0.0
Lane 2	91	0.0	433	0.209	100	25.1	LOS C	2.2	15.4	Short	30	0.0	NA
Approach	464	1.6		0.885		32.2	LOS C	13.2	93.8				
East: Monterea Rd (E)													
Lane 1	140	0.8	378	0.371	100	26.8	LOS C	3.6	25.7	Full	500	0.0	0.0
Lane 2	14	7.7	176	0.078	100	33.6	LOS C	0.4	2.9	Short	30	0.0	NA
Approach	154	1.4		0.371		27.4	LOS C	3.6	25.7				
North: Bryants Rd (N)													
Lane 1	288	0.7	332 [1]	0.869	100	35.5	LOS D	10.0	70.5	Full	500	0.0	0.0
Lane 2	59	0.0	310	0.190	100	29.7	LOS C	1.6	10.9	Short	30	0.0	NA
Approach	347	0.6		0.869		34.5	LOS C	10.0	70.5				
West: Monterea Rd(W)													
Lane 1	80	0.0	327	0.245	100	27.5	LOS C	2.1	14.7	Full	500	0.0	0.0
Lane 2	32	0.0	186	0.170	100	34.0	LOS C	0.9	6.3	Short	30	0.0	NA
Approach	112	0.0		0.245		29.3	LOS C	2.1	14.7				
Intersection	1077	1.1		0.885		32.0	LOS C	13.2	93.8				

Intersection R1027 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 27 [2066 PM - FINAL same as 2041]

R1027
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

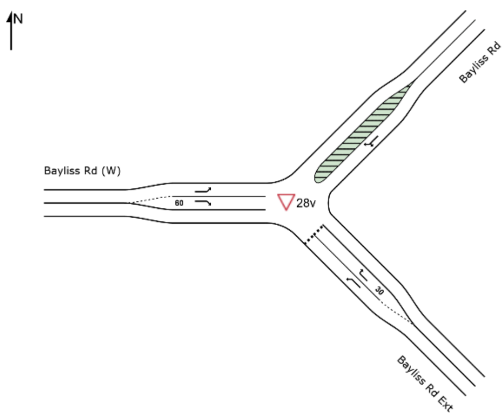
Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Bryants Rd (S)													
Lane 1	171	1.9	245	0.695	100	26.0	LOS C	4.5	31.8	Full	500	0.0	0.0
Lane 2	23	0.0	223	0.104	100	27.0	LOS C	0.5	3.8	Short	30	0.0	NA
Approach	194	1.6		0.695		26.1	LOS C	4.5	31.8				
East: Monterea Rd (E)													
Lane 1	246	0.0	504	0.488	100	21.7	LOS C	5.2	36.6	Full	500	0.0	0.0
Lane 2	22	0.0	223	0.099	100	28.0	LOS C	0.5	3.6	Short	30	0.0	NA
Approach	268	0.0		0.488		22.2	LOS C	5.2	36.6				
North: Bryants Rd (N)													
Lane 1	233	1.4	315	0.738	100	24.9	LOS C	6.1	43.2	Full	500	0.0	0.0
Lane 2	43	0.0	297	0.145	100	26.0	LOS C	1.0	6.7	Short	30	0.0	NA
Approach	276	1.1		0.738		25.0	LOS C	6.1	43.2				
West: Monterea Rd(W)													
Lane 1	66	0.0	497	0.134	100	19.6	LOS B	1.2	8.7	Full	500	0.0	0.0
Lane 2	32	0.0	223	0.142	100	28.2	LOS C	0.7	5.2	Short	30	0.0	NA
Approach	98	0.0		0.142		22.4	LOS C	1.2	8.7				
Intersection	836	0.8		0.738		24.1	LOS C	6.1	43.2				

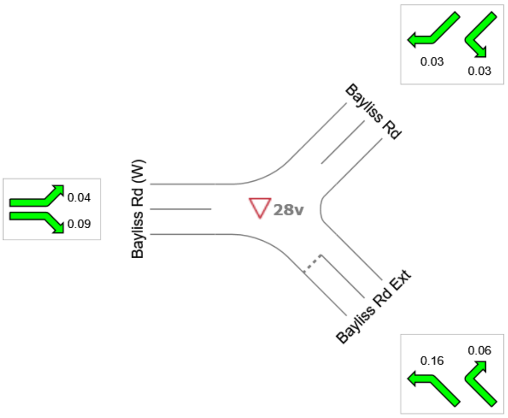
18 Intersection R1028

2031

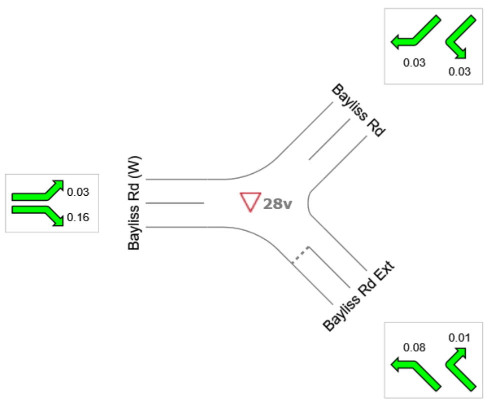
SITE LAYOUT – R1028 – 2031



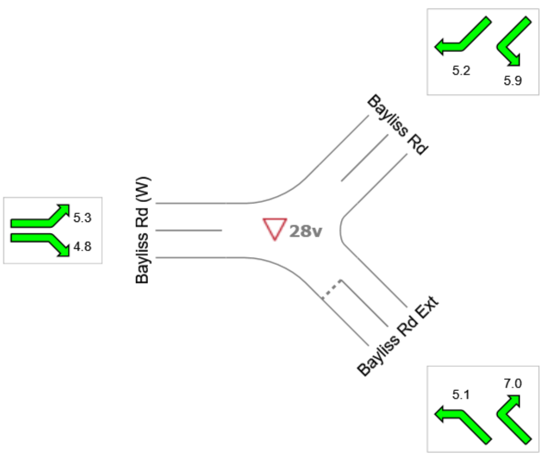
DEGREE OF SATURATION AM



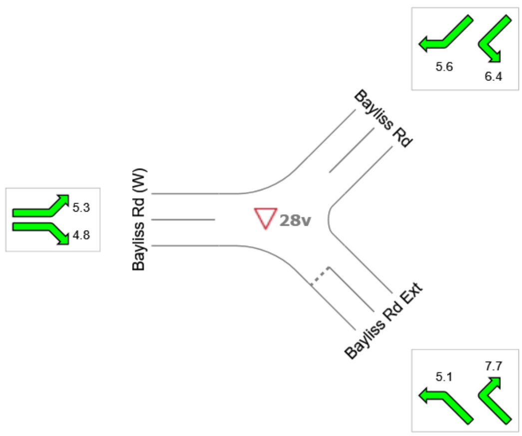
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1028 – 2031 Cont.

MOVEMENT SUMMARY 2031 AM

Site: 28v [2031 AM - FINAL]

R1028
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Bayliss Rd Ext												
21a	L1	258	0.0	0.161	5.1	LOS A	0.7	5.1	0.10	0.54	0.10	53.4
23	R2	56	0.0	0.063	7.0	LOS A	0.2	1.7	0.38	0.63	0.38	52.0
Approach		314	0.0	0.161	5.4	LOS A	0.7	5.1	0.15	0.56	0.15	53.2
NorthEast: Bayliss Rd												
24	L2	19	0.0	0.029	5.9	LOS A	0.1	0.9	0.24	0.49	0.24	53.3
26a	R1	29	0.0	0.029	5.2	LOS A	0.1	0.9	0.24	0.49	0.24	53.1
Approach		48	0.0	0.029	5.5	NA	0.1	0.9	0.24	0.49	0.24	53.1
West: Bayliss Rd (W)												
10a	L1	72	0.0	0.038	5.3	LOS A	0.0	0.0	0.00	0.59	0.00	53.3
12a	R1	155	0.0	0.087	4.8	LOS A	0.4	2.9	0.08	0.53	0.08	53.8
Approach		226	0.0	0.087	5.0	NA	0.4	2.9	0.05	0.55	0.05	53.6
All Vehicles		588	0.0	0.161	5.2	NA	0.7	5.1	0.12	0.55	0.12	53.3

MOVEMENT SUMMARY 2031 PM

Site: 28v [2031 PM - FINAL]

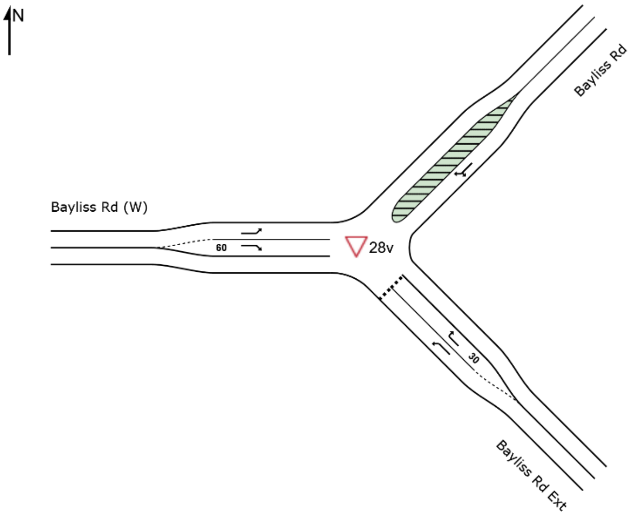
R1028
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

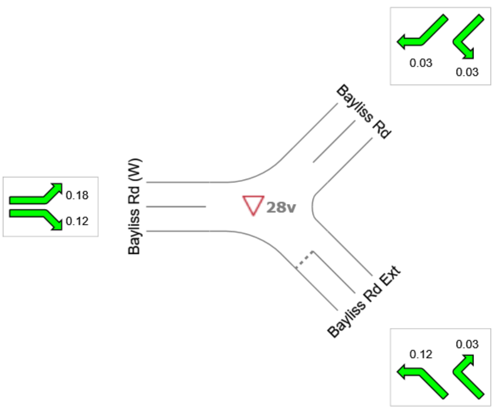
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Bayliss Rd Ext												
21a	L1	133	0.0	0.083	5.1	LOS A	0.3	2.4	0.10	0.54	0.10	53.4
23	R2	4	0.0	0.006	7.7	LOS A	0.0	0.1	0.45	0.61	0.45	51.4
Approach		137	0.0	0.083	5.1	LOS A	0.3	2.4	0.11	0.54	0.11	53.4
NorthEast: Bayliss Rd												
24	L2	14	0.0	0.029	6.4	LOS A	0.1	0.9	0.36	0.50	0.36	53.0
26a	R1	29	0.0	0.029	5.6	LOS A	0.1	0.9	0.36	0.50	0.36	52.8
Approach		43	0.0	0.029	5.9	NA	0.1	0.9	0.36	0.50	0.36	52.8
West: Bayliss Rd (W)												
10a	L1	66	0.0	0.035	5.3	LOS A	0.0	0.0	0.00	0.59	0.00	53.3
12a	R1	291	0.0	0.163	4.8	LOS A	0.8	5.9	0.07	0.53	0.07	53.8
Approach		357	0.0	0.163	4.9	NA	0.8	5.9	0.06	0.55	0.06	53.7
All Vehicles		537	0.0	0.163	5.0	NA	0.8	5.9	0.09	0.54	0.09	53.6

Intersection R1028-2041

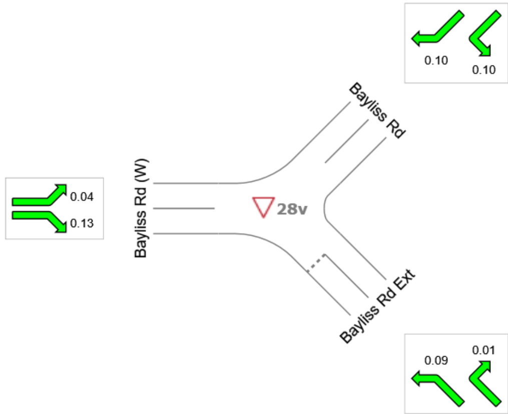
SITE LAYOUT – R1028 – 2041



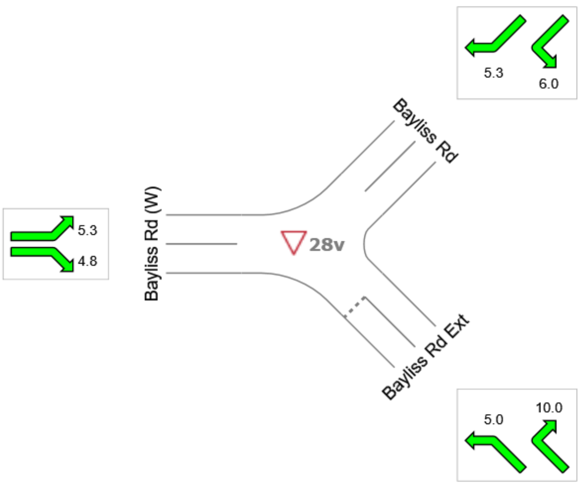
DEGREE OF SATURATION AM



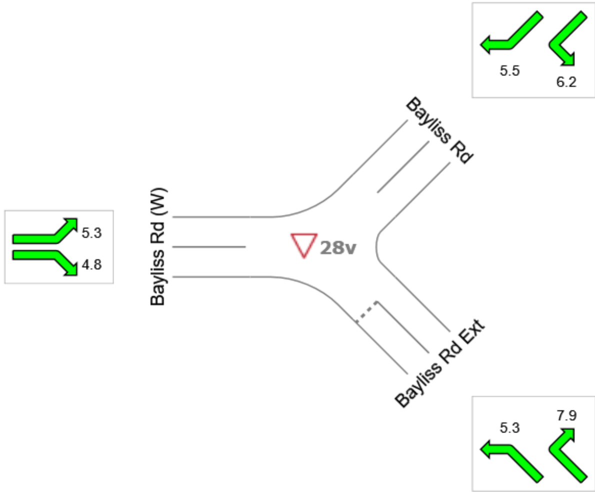
DEGREE OF SATURATION PM



<u>DELAY CONTROL (seconds) AM</u>



<u>DELAY CONTROL (seconds) PM</u>



Intersection R1028 – 2041 Cont.

MOVEMENT SUMMARY 2041 AM

Site: 28v [2041 AM - FINAL same as 2031]

R1028
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Bayliss Rd Ext												
21a	L1	198	0.0	0.123	5.0	LOS A	0.5	3.8	0.09	0.54	0.09	53.5
23	R2	16	6.7	0.029	10.0	LOS A	0.1	0.8	0.55	0.73	0.55	49.6
Approach		214	0.5	0.123	5.4	LOS A	0.5	3.8	0.12	0.56	0.12	53.2
NorthEast: Bayliss Rd												
24	L2	26	0.0	0.030	6.0	LOS A	0.1	0.9	0.26	0.48	0.26	53.1
26a	R1	24	0.0	0.030	5.3	LOS A	0.1	0.9	0.26	0.48	0.26	52.9
Approach		51	0.0	0.030	5.7	NA	0.1	0.9	0.26	0.48	0.26	53.0
West: Bayliss Rd (W)												
10a	L1	341	0.9	0.180	5.3	LOS A	0.0	0.0	0.00	0.59	0.00	53.2
12a	R1	207	0.0	0.118	4.8	LOS A	0.6	4.1	0.10	0.53	0.10	53.8
Approach		548	0.6	0.180	5.1	NA	0.6	4.1	0.04	0.57	0.04	53.4
All Vehicles		813	0.5	0.180	5.2	NA	0.6	4.1	0.07	0.56	0.07	53.3

MOVEMENT SUMMARY 2041 PM

Site: 28v [2041 PM - FINAL same as 2031]

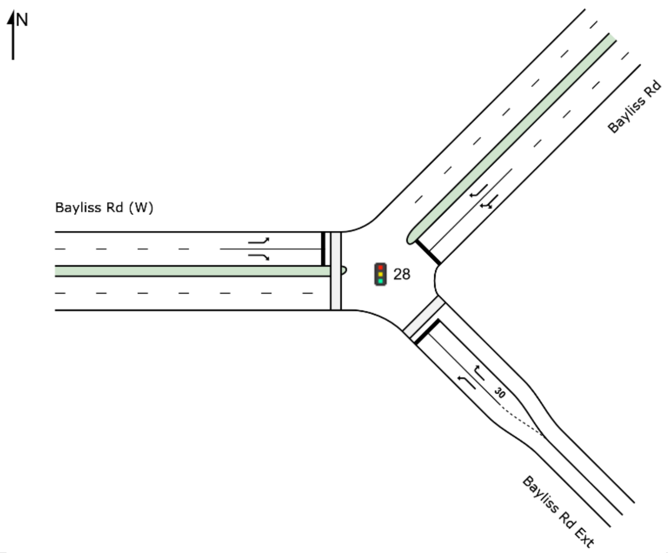
R1028
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

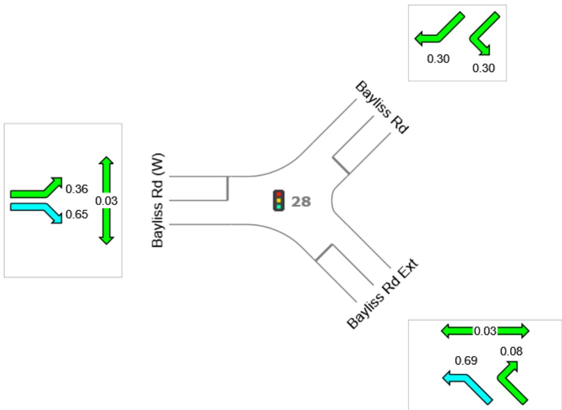
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Bayliss Rd Ext												
21a	L1	139	0.0	0.094	5.3	LOS A	0.4	2.7	0.21	0.54	0.21	53.1
23	R2	6	0.0	0.009	7.9	LOS A	0.0	0.2	0.46	0.62	0.46	51.3
Approach		145	0.0	0.094	5.4	LOS A	0.4	2.7	0.22	0.55	0.22	53.0
NorthEast: Bayliss Rd												
24	L2	37	0.0	0.097	6.2	LOS A	0.5	3.3	0.33	0.52	0.33	53.1
26a	R1	115	0.0	0.097	5.5	LOS A	0.5	3.3	0.33	0.52	0.33	52.9
Approach		152	0.0	0.097	5.7	NA	0.5	3.3	0.33	0.52	0.33	53.0
West: Bayliss Rd (W)												
10a	L1	69	0.0	0.037	5.3	LOS A	0.0	0.0	0.00	0.59	0.00	53.3
12a	R1	221	0.0	0.127	4.8	LOS A	0.6	4.4	0.12	0.53	0.12	53.7
Approach		291	0.0	0.127	5.0	NA	0.6	4.4	0.09	0.54	0.09	53.6
All Vehicles		587	0.0	0.127	5.3	NA	0.6	4.4	0.19	0.54	0.19	53.3

Intersection R1028-2066

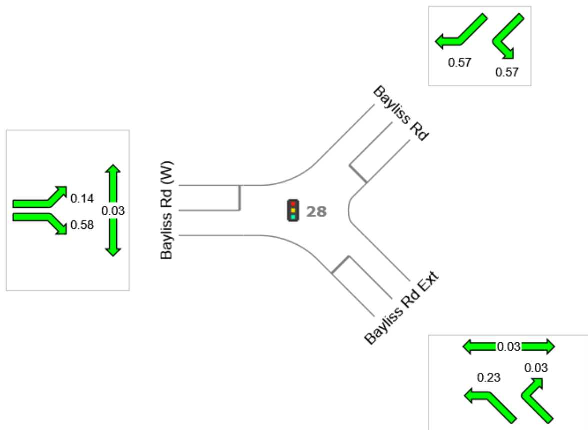
SITE LAYOUT – R1028 – 2066



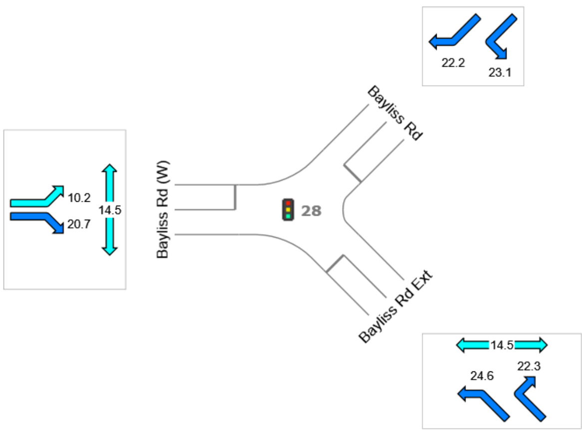
DEGREE OF SATURATION AM



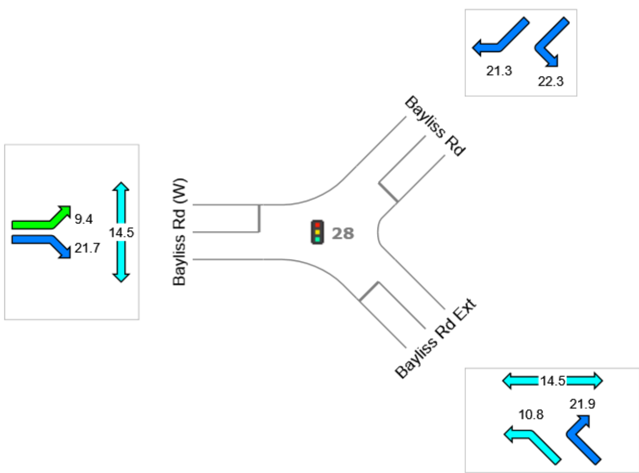
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1028 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 28 [2066 AM - FINAL]

R1028
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Bayliss Rd Ext													
Lane 1	197	0.5	286	0.689	100	24.6	LOS C	4.1	29.1	Full	500	0.0	0.0
Lane 2	23	0.0	279	0.083	100	22.3	LOS C	0.4	2.9	Short	30	0.0	NA
Approach	220	0.5		0.689		24.4	LOS C	4.1	29.1				
NorthEast: Bayliss Rd													
Lane 1	84	1.5	278	0.303	100	22.8	LOS C	1.6	11.2	Full	500	0.0	0.0
Lane 2	86	1.0	285	0.303	100	22.2	LOS C	1.6	11.5	Full	500	0.0	0.0
Approach	171	1.2		0.303		22.5	LOS C	1.6	11.5				
West: Bayliss Rd (W)													
Lane 1	376	1.4	1041	0.361	100	10.2	LOS B	4.2	29.8	Full	500	0.0	0.0
Lane 2	307	0.7	476	0.646	100	20.7	LOS C	5.9	41.3	Full	500	0.0	0.0
Approach	683	1.1		0.646		14.9	LOS B	5.9	41.3				
Intersection	1074	1.0		0.689		18.0	LOS B	5.9	41.3				

LANE SUMMARY 2066 PM

Site: 28 [2066 PM - FINAL]

R1028
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Optimum Cycle Time - Minimum Delay)

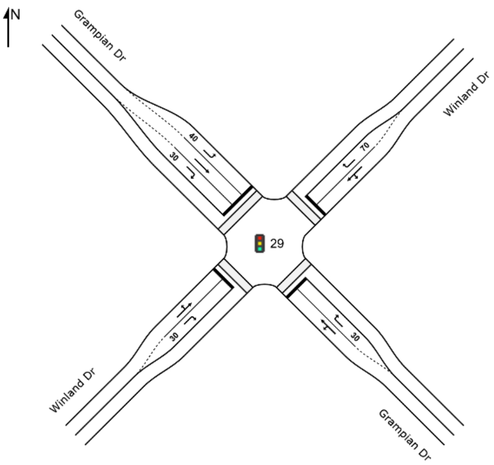
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Bayliss Rd Ext													
Lane 1	216	0.0	956	0.226	100	10.8	LOS B	2.4	17.0	Full	500	0.0	0.0
Lane 2	8	0.0	279	0.030	100	21.9	LOS C	0.1	1.0	Short	30	0.0	NA
Approach	224	0.0		0.226		11.2	LOS B	2.4	17.0				
NorthEast: Bayliss Rd													
Lane 1	216	0.0	380	0.567	100	21.5	LOS C	4.1	28.6	Full	500	0.0	0.0
Lane 2	217	0.0	382	0.567	100	21.4	LOS C	4.1	28.9	Full	500	0.0	0.0
Approach	433	0.0		0.567		21.4	LOS C	4.1	28.9				
West: Bayliss Rd (W)													
Lane 1	145	0.0	1051	0.138	100	9.4	LOS A	1.4	9.8	Full	500	0.0	0.0
Lane 2	220	0.5	381	0.577	100	21.7	LOS C	4.2	29.6	Full	500	0.0	0.0
Approach	365	0.3		0.577		16.8	LOS B	4.2	29.6				
Intersection	1022	0.1		0.577		17.5	LOS B	4.2	29.6				

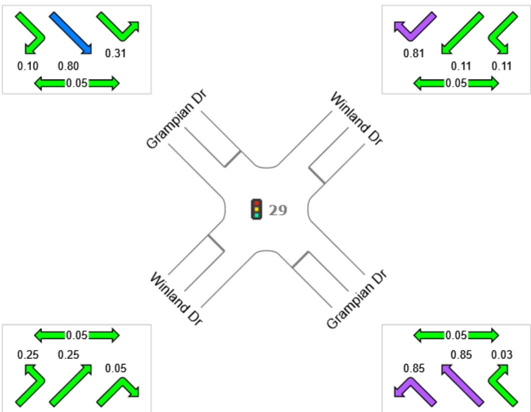
19 Intersection R1029

2031

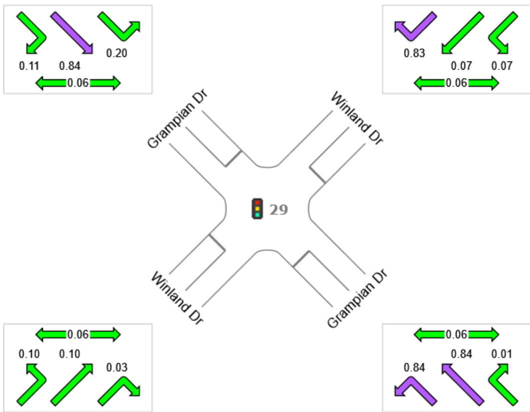
SITE LAYOUT – R1029 – 2031



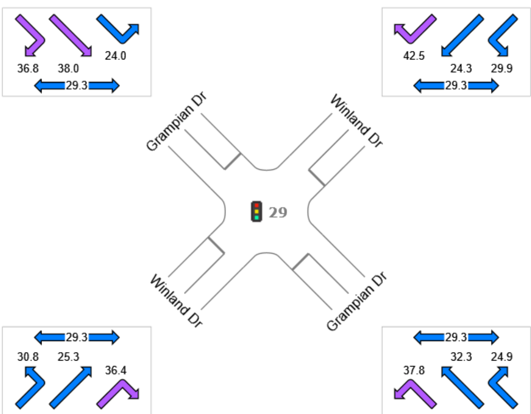
DEGREE OF SATURATION AM



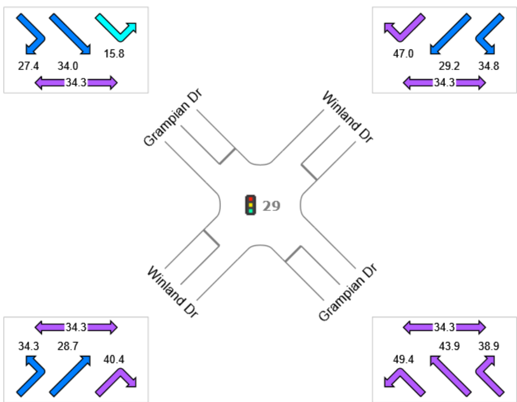
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1029 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 29 [2031 AM - FINAL]

R1029
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Grampian Dr													
Lane 1	464	0.9	545 [1]	0.851	100	32.3	LOS C	17.6	124.2	Full	500	0.0	0.0
Lane 2	15	0.0	531	0.028	100	24.9	LOS C	0.4	2.5	Short	30	0.0	NA
Approach	479	0.9		0.851		32.1	LOS C	17.6	124.2				
NorthEast: Winland Dr													
Lane 1	44	0.0	396	0.112	100	28.3	LOS C	1.2	8.7	Full	500	0.0	0.0
Lane 2	215	0.0	265	0.809	100	42.5	LOS D	8.1	56.8	Short	70	0.0	NA
Approach	259	0.0		0.809		40.1	LOS D	8.1	56.8				
NorthWest: Grampian Dr													
Lane 1	197	0.0	637	0.309	100	24.0	LOS C	5.0	35.1	Short	40	0.0	NA
Lane 2	173	4.9	216	0.799	100	38.0	LOS D	6.5	47.7	Full	500	0.0	0.0
Lane 3	21	0.0	212	0.099	100	36.8	LOS D	0.7	4.7	Short	30	0.0	NA
Approach	391	2.2		0.799		30.9	LOS C	6.5	47.7				
SouthWest: Winland Dr													
Lane 1	98	0.0	398	0.246	100	29.8	LOS C	2.9	20.0	Full	500	0.0	0.0
Lane 2	11	0.0	212	0.050	100	36.4	LOS D	0.3	2.3	Short	30	0.0	NA
Approach	108	0.0		0.246		30.5	LOS C	2.9	20.0				
Intersection	1237	1.0		0.851		33.2	LOS C	17.6	124.2				

Intersection R1029 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 29 [2031 PM - FINAL]

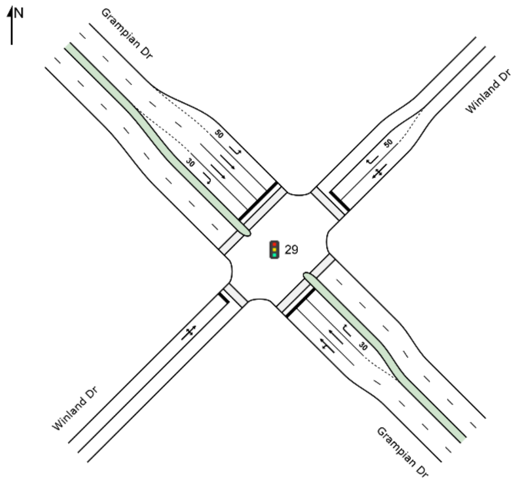
R1029
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

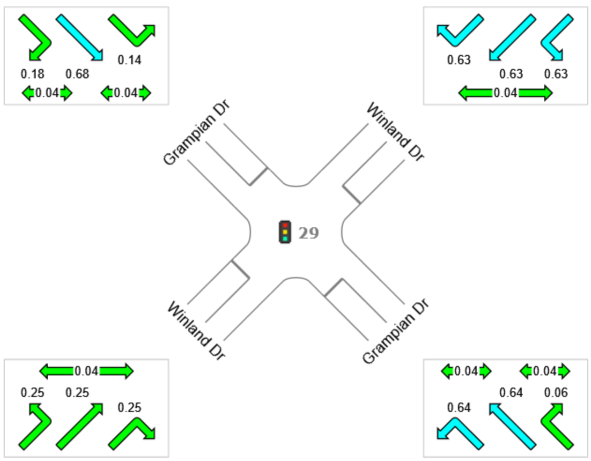
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Grampian Dr													
Lane 1	208	0.0	247 [1]	0.844	100	44.4	LOS D	9.2	64.3	Full	500	0.0	0.0
Lane 2	2	0.0	232	0.009	100	38.9	LOS D	0.1	0.5	Short	30	0.0	NA
Approach	211	0.0		0.844		44.3	LOS D	9.2	64.3				
NorthEast: Winland Dr													
Lane 1	22	0.0	339	0.065	100	31.4	LOS C	0.7	5.0	Full	500	0.0	0.0
Lane 2	248	0.8	300	0.828	100	47.0	LOS D	10.7	75.4	Short	70	0.0	NA
Approach	271	0.8		0.828		45.7	LOS D	10.7	75.4				
NorthWest: Grampian Dr													
Lane 1	195	1.1	991	0.197	100	15.8	LOS B	3.9	27.6	Short	40	0.0	NA
Lane 2	411	0.5	489 [1]	0.839	100	34.0	LOS C	16.5	116.3	Full	500	0.0	0.0
Lane 3	60	1.8	550	0.109	100	27.4	LOS C	1.7	12.1	Short	30	0.0	NA
Approach	665	0.8		0.839		28.0	LOS C	16.5	116.3				
SouthWest: Winland Dr													
Lane 1	36	2.9	351	0.102	100	32.9	LOS C	1.2	8.3	Full	500	0.0	0.0
Lane 2	5	0.0	209	0.025	100	40.4	LOS D	0.2	1.3	Short	30	0.0	NA
Approach	41	2.6		0.102		33.9	LOS C	1.2	8.3				
Intersection	1187	0.7		0.844		35.2	LOS D	16.5	116.3				

Intersection R1029-2041

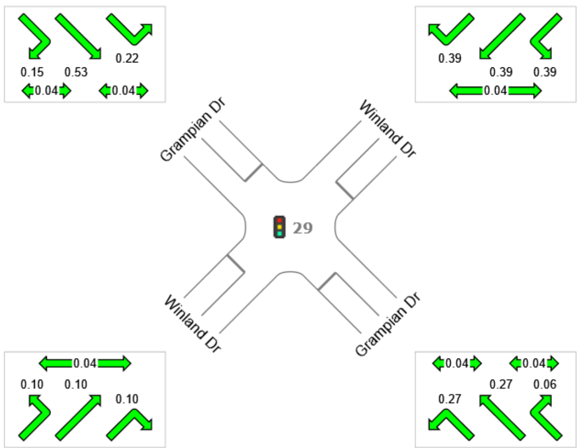
SITE LAYOUT – R1029 – 2041



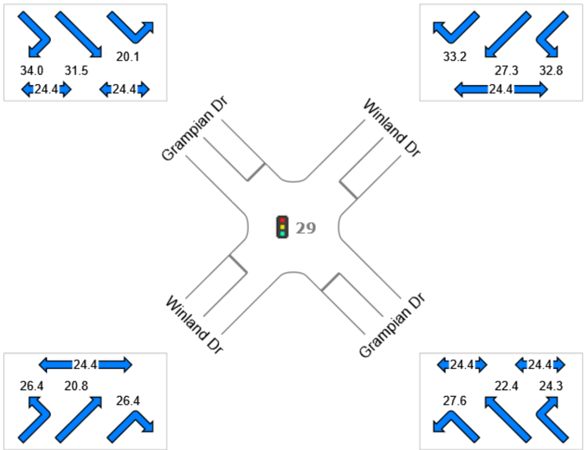
DEGREE OF SATURATION AM



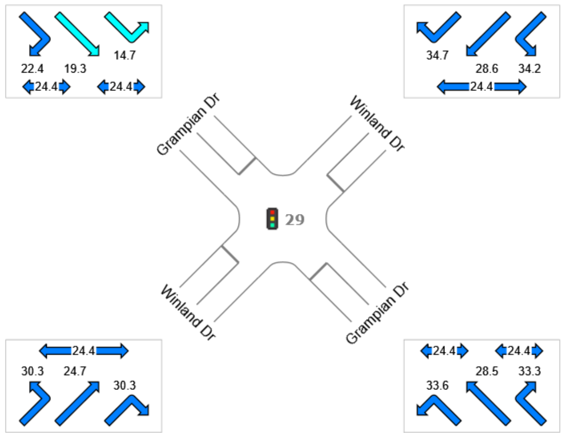
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1029 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 29 [2041 AM - FINAL]

R1029
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Grampian Dr													
Lane 1	316	0.2	491	0.642	100	22.6	LOS C	8.6	60.1	Full	500	0.0	0.0
Lane 2	311	0.2	484 [1]	0.642	100	22.7	LOS C	8.5	59.7	Full	500	0.0	0.0
Lane 3	26	0.0	464	0.057	100	24.3	LOS C	0.6	4.2	Short	30	0.0	NA
Approach	653	0.2		0.642		22.7	LOS C	8.6	60.1				
NorthEast: Winland Dr													
Lane 1	175	1.2	278	0.629	100	32.8	LOS C	5.2	36.5	Full	500	0.0	0.0
Lane 2	174	1.2	276	0.629	100	33.5	LOS C	5.2	36.5	Short	50	0.0	NA
Approach	348	1.2		0.629		33.2	LOS C	5.2	36.5				
NorthWest: Grampian Dr													
Lane 1	87	1.2	644	0.136	100	20.1	LOS C	1.8	12.5	Short	50	0.0	NA
Lane 2	129	3.7	190	0.680	100	31.5	LOS C	4.1	29.4	Full	500	0.0	0.0
Lane 3	129	3.7	190	0.680	100	31.5	LOS C	4.1	29.4	Full	500	0.0	0.0
Lane 4	33	0.0	186	0.176	100	34.0	LOS C	0.9	6.6	Short	30	0.0	NA
Approach	379	2.8		0.680		29.1	LOS C	4.1	29.4				
SouthWest: Winland Dr													
Lane 1	104	1.0	425	0.245	100	25.9	LOS C	2.6	18.1	Full	500	0.0	0.0
Approach	104	1.0		0.245		25.9	LOS C	2.6	18.1				
Intersection	1484	1.1		0.680		27.0	LOS C	8.6	60.1				

Intersection R1029 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 29 [2041 PM - FINAL]

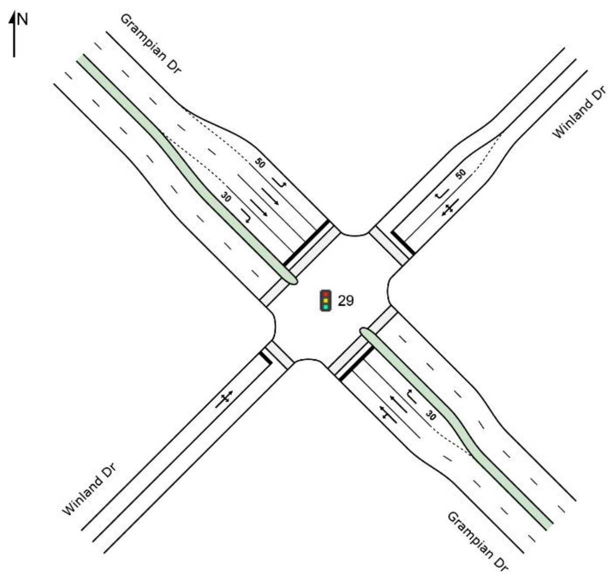
R1029
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

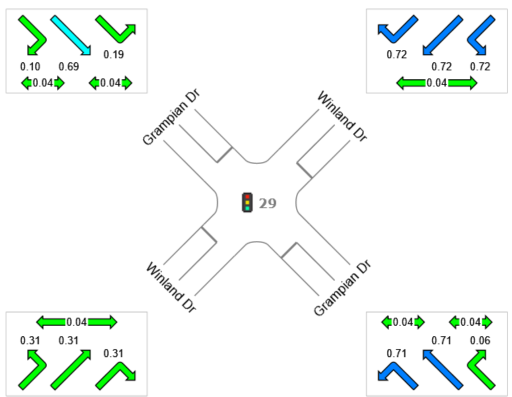
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Grampian Dr													
Lane 1	52	4.9	191	0.274	100	28.2	LOS C	1.5	11.0	Full	500	0.0	0.0
Lane 2	52	5.2	189	0.274	100	28.9	LOS C	1.5	11.0	Full	500	0.0	0.0
Lane 3	11	0.0	186	0.057	100	33.3	LOS C	0.3	2.1	Short	30	0.0	NA
Approach	115	4.6		0.274		29.0	LOS C	1.5	11.0				
NorthEast: Winland Dr													
Lane 1	74	2.0	188	0.394	100	33.8	LOS C	2.2	15.5	Full	500	0.0	0.0
Lane 2	72	2.3	183	0.394	100	35.1	LOS D	2.1	15.3	Short	50	0.0	NA
Approach	146	2.2		0.394		34.5	LOS C	2.2	15.5				
NorthWest: Grampian Dr													
Lane 1	205	0.5	925	0.222	100	14.7	LOS B	3.4	23.9	Short	50	0.0	NA
Lane 2	310	0.2	584	0.530	100	19.3	LOS B	7.8	54.4	Full	500	0.0	0.0
Lane 3	309	0.2	584 [1]	0.530	100	19.3	LOS B	7.7	54.3	Full	500	0.0	0.0
Lane 4	83	0.0	557	0.149	100	22.4	LOS C	1.8	12.7	Short	30	0.0	NA
Approach	907	0.2		0.530		18.6	LOS B	7.8	54.4				
SouthWest: Winland Dr													
Lane 1	28	0.0	276	0.103	100	28.6	LOS C	0.7	5.2	Full	500	0.0	0.0
Approach	28	0.0		0.103		28.6	LOS C	0.7	5.2				
Intersection	1197	0.9		0.530		21.7	LOS C	7.8	54.4				

Intersection R1029-2066

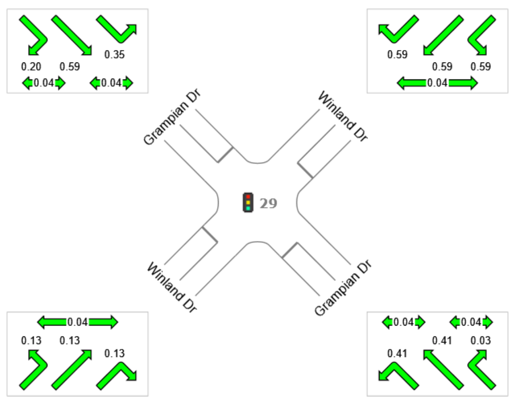
SITE LAYOUT – R1029 – 2066



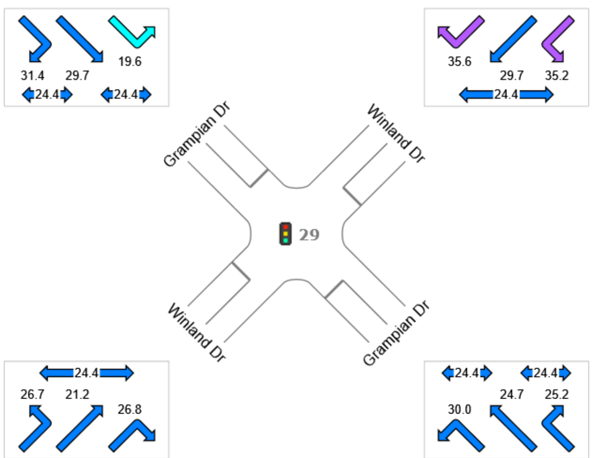
DEGREE OF SATURATION AM



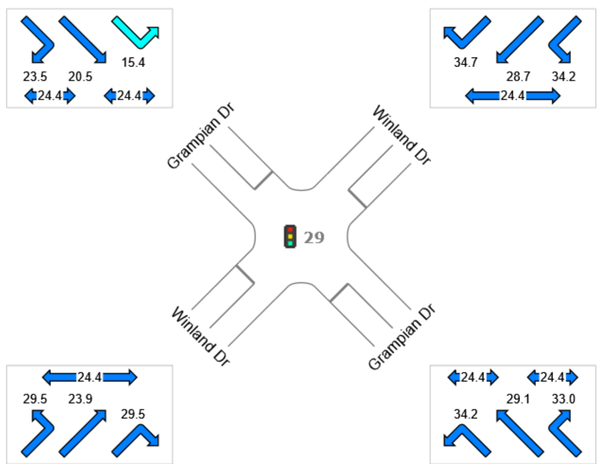
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1029 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 29 [2066 AM - FINAL same as 2041]

R1029
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Grampian Dr													
Lane 1	323	0.5	454	0.713	100	24.5	LOS C	9.4	66.0	Full	500	0.0	0.0
Lane 2	320	0.5	449 [1]	0.713	100	25.0	LOS C	9.3	65.4	Full	500	0.0	0.0
Lane 3	26	0.0	433	0.061	100	25.2	LOS C	0.6	4.3	Short	30	0.0	NA
Approach	669	0.5		0.713		24.7	LOS C	9.4	66.0				
NorthEast: Winland Dr													
Lane 1	180	0.9	251	0.716	100	35.2	LOS D	5.6	39.5	Full	500	0.0	0.0
Lane 2	176	0.9	246	0.716	100	35.8	LOS D	5.5	38.9	Short	50	0.0	NA
Approach	356	0.9		0.716		35.5	LOS D	5.6	39.5				
NorthWest: Grampian Dr													
Lane 1	126	0.8	677	0.187	100	19.6	LOS B	2.5	18.0	Short	50	0.0	NA
Lane 2	177	2.7	256	0.692	100	29.7	LOS C	5.4	39.0	Full	500	0.0	0.0
Lane 3	177	2.7	256	0.692	100	29.7	LOS C	5.4	39.0	Full	500	0.0	0.0
Lane 4	24	4.3	240	0.101	100	31.4	LOS C	0.7	4.7	Short	30	0.0	NA
Approach	504	2.3		0.692		27.3	LOS C	5.4	39.0				
SouthWest: Winland Dr													
Lane 1	126	0.0	414	0.305	100	26.0	LOS C	3.2	22.2	Full	500	0.0	0.0
Approach	126	0.0		0.305		26.0	LOS C	3.2	22.2				
Intersection	1656	1.1		0.716		27.9	LOS C	9.4	66.0				

Intersection R1029 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 29 [2066 PM - FINAL same as 2041]

R1029
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

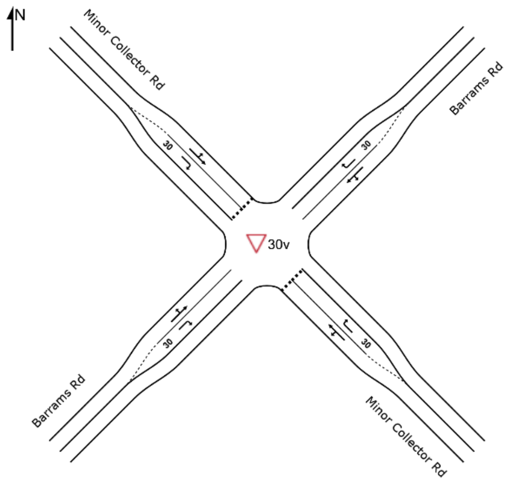
Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Grampian Dr													
Lane 1	78	6.0	189	0.414	100	28.8	LOS C	2.3	17.0	Full	500	0.0	0.0
Lane 2	78	6.2	187	0.414	100	29.5	LOS C	2.3	17.0	Full	500	0.0	0.0
Lane 3	5	0.0	186	0.028	100	33.0	LOS C	0.1	1.0	Short	30	0.0	NA
Approach	161	5.9		0.414		29.3	LOS C	2.3	17.0				
NorthEast: Winland Dr													
Lane 1	129	0.8	220	0.585	100	34.1	LOS C	3.9	27.2	Full	500	0.0	0.0
Lane 2	126	0.9	215	0.585	100	35.0	LOS D	3.8	26.8	Short	50	0.0	NA
Approach	255	0.8		0.585		34.6	LOS C	3.9	27.2				
NorthWest: Grampian Dr													
Lane 1	327	0.3	926	0.353	100	15.4	LOS B	5.9	41.2	Short	50	0.0	NA
Lane 2	324	0.5	551	0.588	100	20.5	LOS C	8.4	59.1	Full	500	0.0	0.0
Lane 3	317	0.5	539 [1]	0.588	100	20.4	LOS C	8.2	57.6	Full	500	0.0	0.0
Lane 4	106	0.0	526	0.202	100	23.5	LOS C	2.4	16.9	Short	30	0.0	NA
Approach	1075	0.4		0.588		19.2	LOS B	8.4	59.1				
SouthWest: Winland Dr													
Lane 1	38	0.0	294	0.129	100	27.8	LOS C	1.0	6.9	Full	500	0.0	0.0
Approach	38	0.0		0.129		27.8	LOS C	1.0	6.9				
Intersection	1528	1.0		0.588		23.1	LOS C	8.4	59.1				

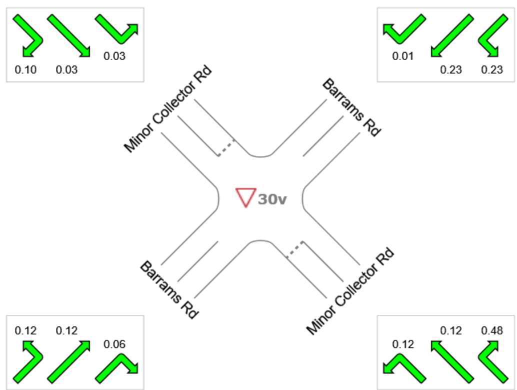
20 Intersection R1030

2031

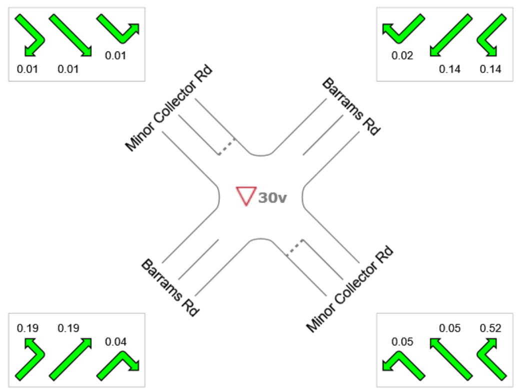
SITE LAYOUT – R1030– 2031



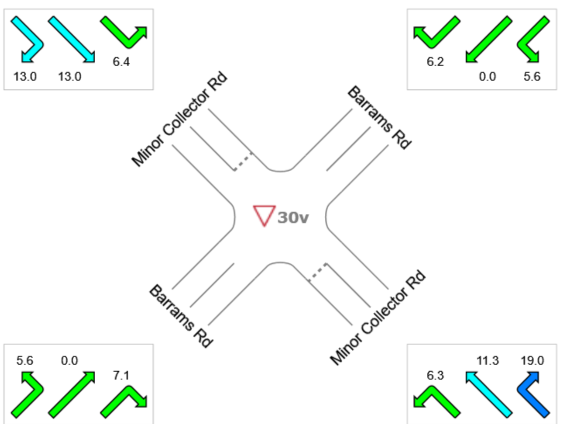
DEGREE OF SATURATION AM



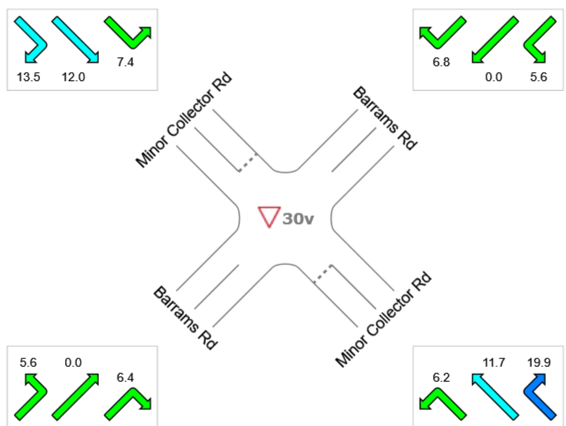
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1030 – 2031 Cont.

MOVEMENT SUMMARY 2031 AM

Site: 30v [2031 AM - FINAL same as 2026]

R1030
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Minor Collector Rd												
21	L2	123	0.0	0.117	6.3	LOS A	0.4	3.1	0.30	0.59	0.30	52.7
22	T1	3	0.0	0.117	11.3	LOS B	0.4	3.1	0.30	0.59	0.30	53.0
23	R2	166	4.4	0.476	19.0	LOS C	2.5	18.3	0.77	1.01	1.14	44.5
Approach		293	2.5	0.476	13.6	LOS B	2.5	18.3	0.56	0.83	0.77	47.7
NorthEast: Barrams Rd												
24	L2	254	1.2	0.233	5.6	LOS A	0.0	0.0	0.00	0.34	0.00	55.5
25	T1	186	0.0	0.233	0.0	LOS A	0.0	0.0	0.00	0.34	0.00	57.0
26	R2	8	0.0	0.006	6.2	LOS A	0.0	0.2	0.32	0.54	0.32	52.4
Approach		448	0.7	0.233	3.3	NA	0.0	0.2	0.01	0.34	0.01	56.0
NorthWest: Minor Collector Rd												
27	L2	18	0.0	0.034	6.4	LOS A	0.1	0.8	0.40	0.61	0.40	51.7
28	T1	6	0.0	0.034	13.0	LOS B	0.1	0.8	0.40	0.61	0.40	51.9
29	R2	40	0.0	0.104	13.0	LOS B	0.4	2.6	0.63	0.85	0.63	48.1
Approach		64	0.0	0.104	11.2	LOS B	0.4	2.6	0.54	0.76	0.54	49.4
SouthWest: Barrams Rd												
30	L2	6	0.0	0.122	5.6	LOS A	0.0	0.0	0.00	0.02	0.00	58.2
31	T1	229	0.5	0.122	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.8
32	R2	65	0.0	0.056	7.1	LOS A	0.2	1.7	0.47	0.65	0.47	52.0
Approach		301	0.3	0.122	1.7	NA	0.2	1.7	0.10	0.15	0.10	57.9
All Vehicles		1106	1.0	0.476	6.0	NA	2.5	18.3	0.21	0.44	0.27	53.6

Intersection R1030 – 2031 Cont.

MOVEMENT SUMMARY 2031 PM

Site: 30v [2031 PM - FINAL same as 2026]

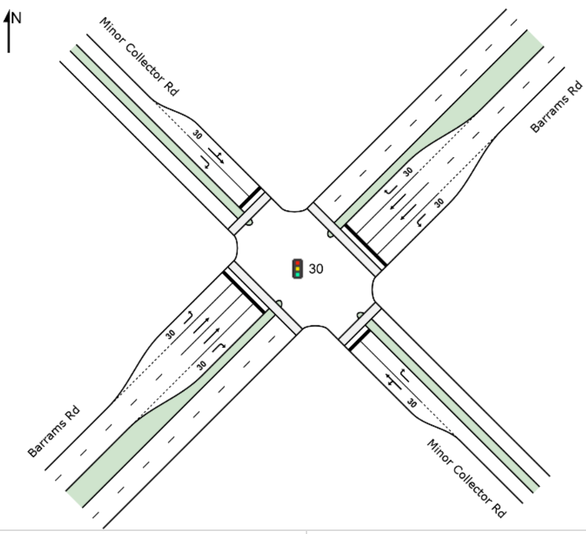
R1030
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

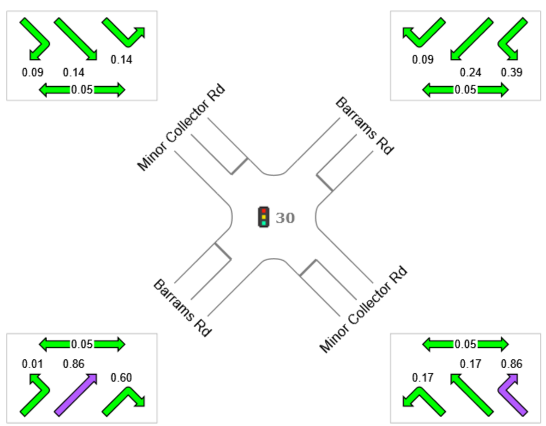
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Minor Collector Rd												
21	L2	43	0.0	0.048	6.2	LOS A	0.2	1.2	0.28	0.57	0.28	52.8
22	T1	4	0.0	0.048	11.7	LOS B	0.2	1.2	0.28	0.57	0.28	53.1
23	R2	181	0.0	0.519	19.9	LOS C	2.9	20.0	0.79	1.04	1.23	44.1
Approach		228	0.0	0.519	17.1	LOS C	2.9	20.0	0.68	0.94	1.03	45.7
NorthEast: Barrams Rd												
24	L2	107	1.0	0.143	5.6	LOS A	0.0	0.0	0.00	0.24	0.00	56.3
25	T1	162	1.3	0.143	0.0	LOS A	0.0	0.0	0.00	0.24	0.00	57.9
26	R2	23	0.0	0.018	6.8	LOS A	0.1	0.5	0.42	0.59	0.42	52.2
Approach		293	1.1	0.143	2.6	NA	0.1	0.5	0.03	0.26	0.03	56.8
NorthWest: Minor Collector Rd												
27	L2	8	12.5	0.013	7.4	LOS A	0.0	0.3	0.43	0.61	0.43	51.4
28	T1	1	0.0	0.013	12.0	LOS B	0.0	0.3	0.43	0.61	0.43	52.2
29	R2	4	0.0	0.012	13.5	LOS B	0.0	0.3	0.64	0.75	0.64	47.8
Approach		14	7.7	0.013	9.6	LOS A	0.0	0.3	0.50	0.65	0.50	50.3
SouthWest: Barrams Rd												
30	L2	22	0.0	0.194	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	58.0
31	T1	353	0.6	0.194	0.0	LOS A	0.0	0.0	0.00	0.04	0.00	59.6
32	R2	59	0.0	0.042	6.4	LOS A	0.2	1.3	0.36	0.58	0.36	52.3
Approach		434	0.5	0.194	1.2	NA	0.2	1.3	0.05	0.11	0.05	58.4
All Vehicles		968	0.7	0.519	5.5	NA	2.9	20.0	0.20	0.36	0.28	54.3

Intersection R1030-2041

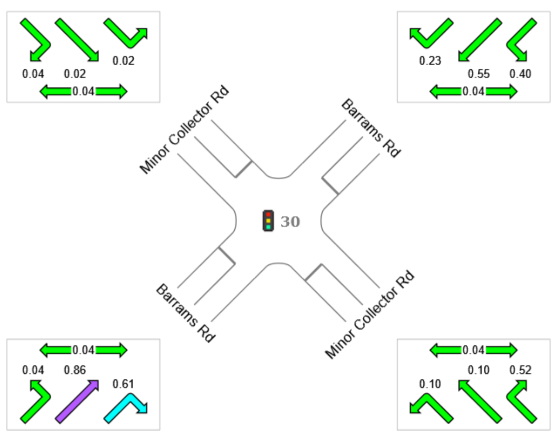
SITE LAYOUT – R1030– 2041



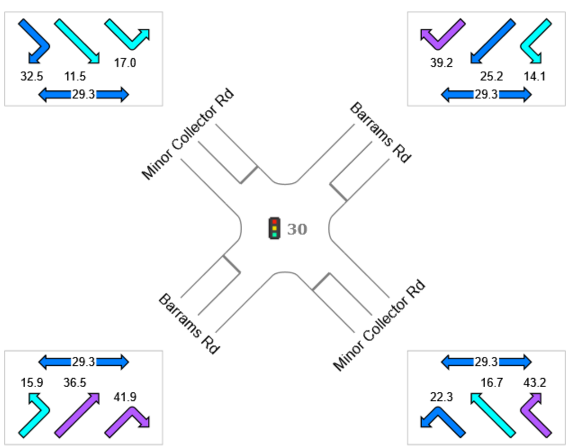
DEGREE OF SATURATION AM



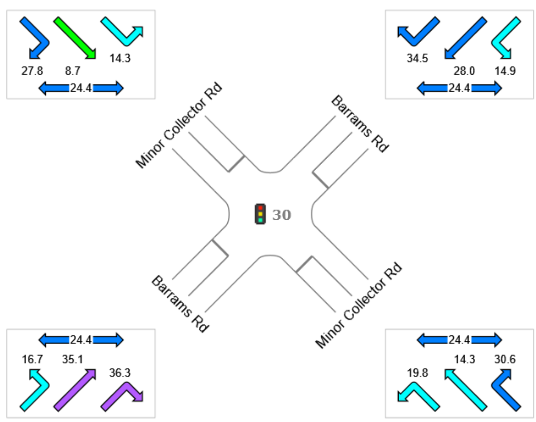
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



LANE SUMMARY 2041 AM

Site: 30 [2041 AM - FINAL]

R1030
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Minor Collector Rd													
Lane 1	112	0.0	653	0.171	100	22.2	LOS C	2.6	18.4	Short	30	0.0	NA
Lane 2	271	0.8	316 [1]	0.857	100	43.2	LOS D	10.5	74.0	Full	500	0.0	0.0
Approach	382	0.6		0.857		37.0	LOS D	10.5	74.0				
NorthEast: Barrams Rd													
Lane 1	286	1.5	735	0.389	100	14.1	LOS B	4.1	29.3	Short	30	0.0	NA
Lane 2	99	2.1	412	0.241	100	25.2	LOS C	2.9	20.6	Full	500	0.0	0.0
Lane 3	99	2.1	412	0.241	100	25.2	LOS C	2.9	20.6	Full	500	0.0	0.0
Lane 4	15	0.0	159	0.093	100	39.2	LOS D	0.5	3.4	Short	30	0.0	NA
Approach	500	1.7		0.389		19.3	LOS B	4.1	29.3				
NorthWest: Minor Collector Rd													
Lane 1	63	0.0	466	0.135	100	16.5	LOS B	0.9	6.6	Short	30	0.0	NA
Lane 2	27	0.0	318	0.086	100	32.5	LOS C	0.8	5.7	Full	500	0.0	0.0
Approach	91	0.0		0.135		21.3	LOS C	0.9	6.6				
SouthWest: Barrams Rd													
Lane 1	6	0.0	876	0.007	100	15.9	LOS B	0.1	0.8	Short	30	0.0	NA
Lane 2	355	0.9	413 [1]	0.861	100	36.6	LOS D	13.9	97.8	Full	500	0.0	0.0
Lane 3	317	0.9	369 [1]	0.861	100	36.4	LOS D	12.2	86.1	Full	500	0.0	0.0
Lane 4	95	0.0	159	0.595	100	41.9	LOS D	3.4	23.9	Short	30	0.0	NA
Approach	774	0.8		0.861		37.0	LOS D	13.9	97.8				
Intersection	1746	1.0		0.861		31.1	LOS C	13.9	97.8				

LANE SUMMARY 2041 PM

Site: 30 [2041 PM - FINAL]

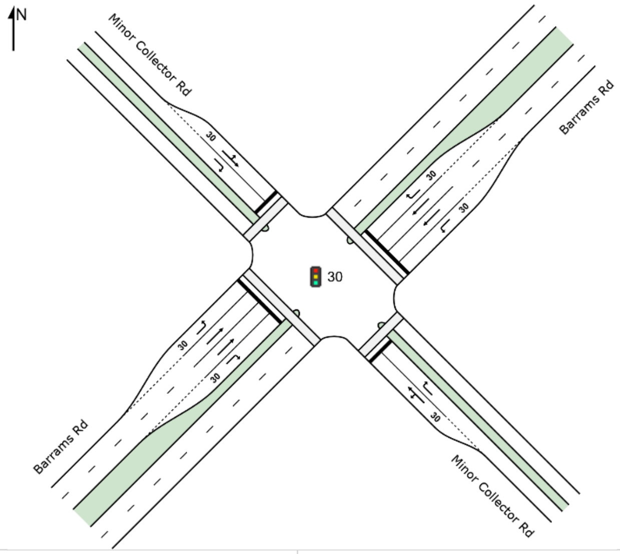
R1030
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site User-Given Cycle Time)

Lane Use and Performance

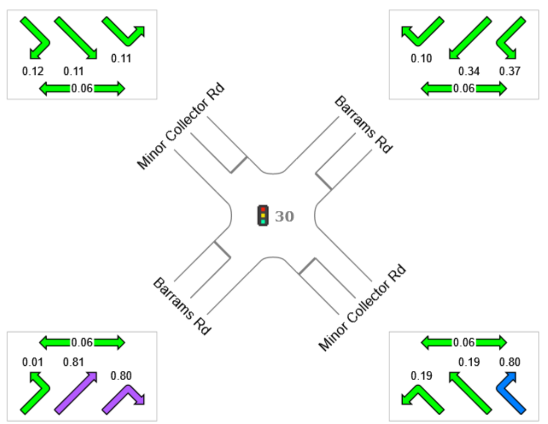
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Minor Collector Rd													
Lane 1	64	0.0	635	0.101	100	19.5	LOS B	1.3	9.0	Short	30	0.0	NA
Lane 2	175	1.2	338	0.518	100	30.6	LOS C	4.9	34.4	Full	500	0.0	0.0
Approach	239	0.9		0.518		27.6	LOS C	4.9	34.4				
NorthEast: Barrams Rd													
Lane 1	234	0.9	584	0.400	100	14.9	LOS B	3.2	22.8	Short	30	0.0	NA
Lane 2	144	0.0	260	0.555	100	28.0	LOS C	4.2	29.6	Full	500	0.0	0.0
Lane 3	144	0.0	260	0.555	100	28.0	LOS C	4.2	29.6	Full	500	0.0	0.0
Lane 4	41	7.7	176	0.233	100	34.5	LOS C	1.2	8.9	Short	30	0.0	NA
Approach	563	0.9		0.555		23.1	LOS C	4.2	29.6				
NorthWest: Minor Collector Rd													
Lane 1	12	0.0	517	0.022	100	13.8	LOS B	0.1	0.9	Short	30	0.0	NA
Lane 2	14	0.0	340	0.040	100	27.8	LOS C	0.3	2.4	Full	500	0.0	0.0
Approach	25	0.0		0.040		21.4	LOS C	0.3	2.4				
SouthWest: Barrams Rd													
Lane 1	27	0.0	774	0.035	100	16.7	LOS B	0.5	3.3	Short	30	0.0	NA
Lane 2	224	0.2	260	0.862	100	35.1	LOS D	7.7	54.0	Full	500	0.0	0.0
Lane 3	224	0.2	260	0.862	100	35.1	LOS D	7.7	54.0	Full	500	0.0	0.0
Lane 4	113	0.9	184	0.611	100	36.3	LOS D	3.5	24.6	Short	30	0.0	NA
Approach	587	0.4		0.862		34.5	LOS C	7.7	54.0				
Intersection	1415	0.7		0.862		28.5	LOS C	7.7	54.0				

Intersection R1030-2066

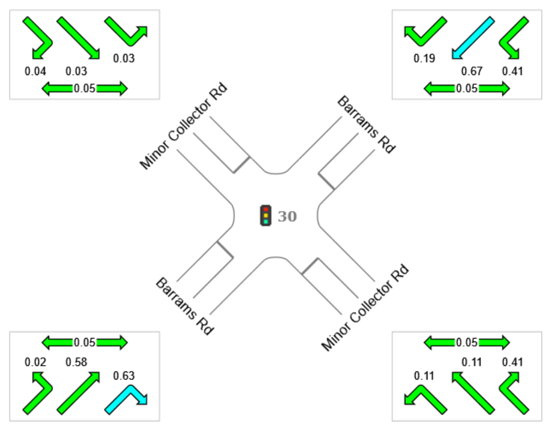
SITE LAYOUT – R1030– 2066



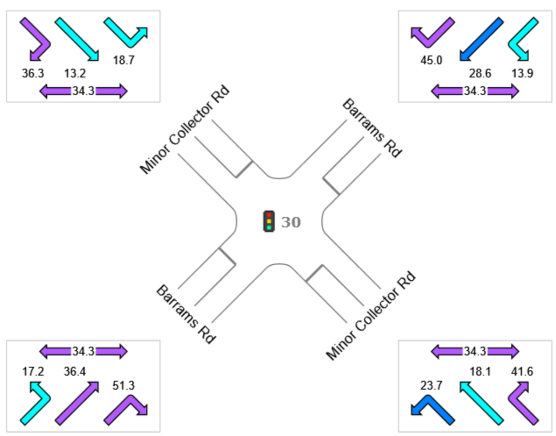
DEGREE OF SATURATION AM



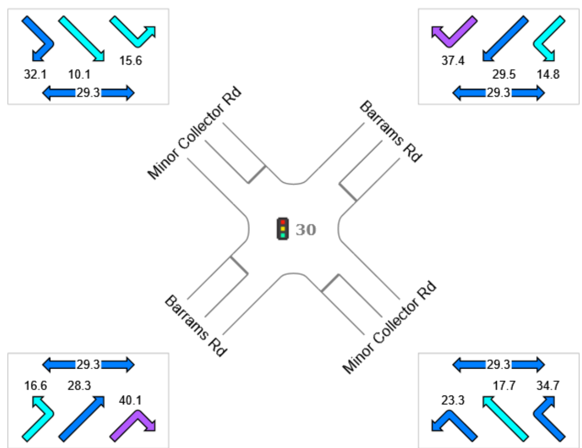
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1030 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 30 [2066 AM - FINAL same as 2041]

R1030
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Minor Collector Rd													
Lane 1	127	0.8	684	0.186	100	23.6	LOS C	3.3	23.6	Short	30	0.0	NA
Lane 2	285	3.0	357 [1]	0.799	100	41.6	LOS D	11.5	82.5	Full	500	0.0	0.0
Approach	413	2.3		0.799		36.0	LOS D	11.5	82.5				
NorthEast: Barrams Rd													
Lane 1	304	2.1	824	0.369	100	13.9	LOS B	4.8	34.0	Short	30	0.0	NA
Lane 2	149	0.4	438	0.340	100	28.6	LOS C	5.0	35.0	Full	500	0.0	0.0
Lane 3	149	0.4	438	0.340	100	28.6	LOS C	5.0	35.0	Full	500	0.0	0.0
Lane 4	13	8.3	131	0.096	100	45.0	LOS D	0.5	3.7	Short	30	0.0	NA
Approach	615	1.4		0.369		21.7	LOS C	5.0	35.0				
NorthWest: Minor Collector Rd													
Lane 1	48	0.0	446	0.109	100	18.0	LOS B	0.8	5.6	Short	30	0.0	NA
Lane 2	38	2.8	319	0.119	100	36.3	LOS D	1.3	9.1	Full	500	0.0	0.0
Approach	86	1.2		0.119		26.0	LOS C	1.3	9.1				
SouthWest: Barrams Rd													
Lane 1	5	0.0	882	0.006	100	17.2	LOS B	0.1	0.7	Short	30	0.0	NA
Lane 2	350	1.0	433 [1]	0.809	100	36.6	LOS D	14.4	101.9	Full	500	0.0	0.0
Lane 3	297	1.0	367 [1]	0.809	100	36.1	LOS D	12.0	84.4	Full	500	0.0	0.0
Lane 4	109	2.9	136	0.802	100	51.3	LOS D	4.8	34.4	Short	30	0.0	NA
Approach	762	1.2		0.809		38.4	LOS D	14.4	101.9				
Intersection	1876	1.5		0.809		31.8	LOS C	14.4	101.9				

Intersection R1030 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 30 [2066 PM - FINAL same as 2041]

R1030
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

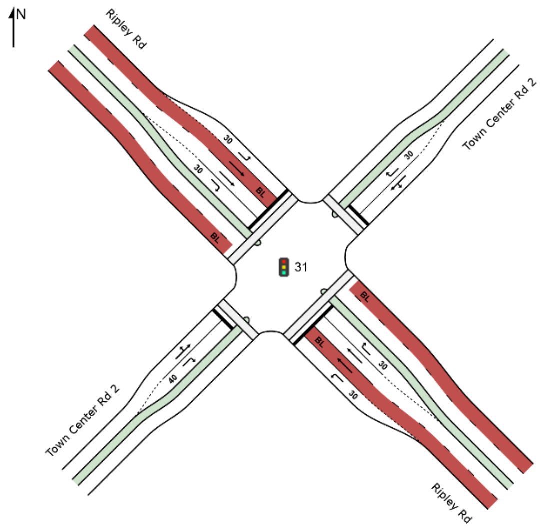
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Minor Collector Rd													
Lane 1	66	0.0	606	0.110	100	22.9	LOS C	1.6	11.1	Short	30	0.0	NA
Lane 2	131	1.6	315	0.415	100	34.7	LOS C	4.2	29.5	Full	500	0.0	0.0
Approach	197	1.1		0.415		30.7	LOS C	4.2	29.5				
NorthEast: Barrams Rd													
Lane 1	278	1.5	682	0.407	100	14.8	LOS B	4.0	28.4	Short	30	0.0	NA
Lane 2	249	0.0	371 [1]	0.672	100	29.5	LOS C	8.3	58.0	Full	500	0.0	0.0
Lane 3	257	0.0	382 [1]	0.672	100	29.6	LOS C	8.6	60.0	Full	500	0.0	0.0
Lane 4	40	0.0	212	0.188	100	37.4	LOS D	1.3	9.1	Short	30	0.0	NA
Approach	824	0.5		0.672		24.9	LOS C	8.6	60.0				
NorthWest: Minor Collector Rd													
Lane 1	15	0.0	514	0.029	100	15.2	LOS B	0.2	1.4	Short	30	0.0	NA
Lane 2	12	0.0	318	0.036	100	32.1	LOS C	0.3	2.4	Full	500	0.0	0.0
Approach	26	0.0		0.036		22.6	LOS C	0.3	2.4				
SouthWest: Barrams Rd													
Lane 1	16	0.0	849	0.019	100	16.6	LOS B	0.3	2.0	Short	30	0.0	NA
Lane 2	224	1.2	387	0.578	100	28.3	LOS C	7.2	50.7	Full	500	0.0	0.0
Lane 3	224	1.2	387	0.578	100	28.3	LOS C	7.2	50.7	Full	500	0.0	0.0
Lane 4	131	2.4	209	0.626	100	40.1	LOS D	4.6	33.0	Short	30	0.0	NA
Approach	594	1.4		0.626		30.6	LOS C	7.2	50.7				
Intersection	1641	0.9		0.672		27.6	LOS C	8.6	60.0				

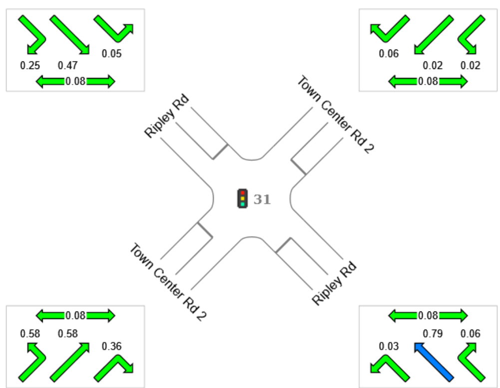
21 Intersection R1031

2031

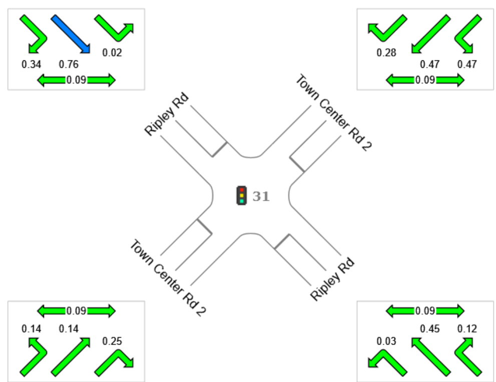
SITE LAYOUT – R1031 – 2031



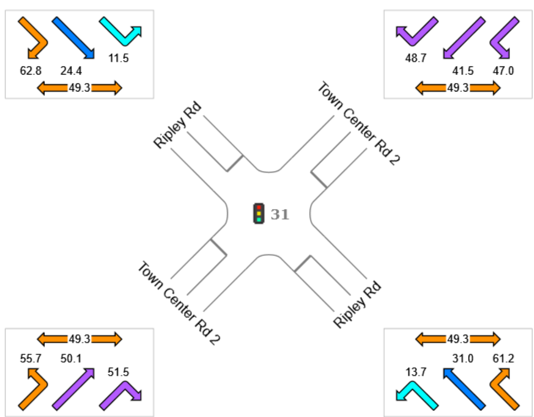
DEGREE OF SATURATION AM



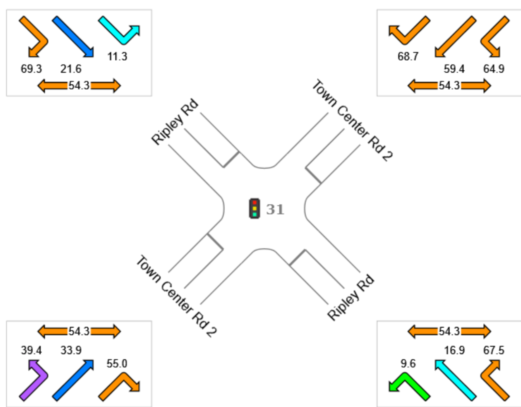
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1031 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 31 [2031 AM - FINAL]

R1031
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Rd													
Lane 1	37	0.0	1165	0.032	100	13.7	LOS B	0.7	5.1	Short	30	0.0	NA
Lane 2 (BL)	2	100.0	494	0.004	100	19.7	LOS B	0.1	0.8	Full	500	0.0	0.0
Lane 3	640	0.0	809 [1]	0.792	100	31.1	LOS C	30.4	212.9	Full	500	0.0	0.0
Lane 4	6	0.0	101	0.062	100	61.2	LOS E	0.3	2.4	Short	30	0.0	NA
Approach	685	0.3		0.792		30.4	LOS C	30.4	212.9				
NorthEast: Town Center Rd 2													
Lane 1	7	0.0	310	0.024	100	43.1	LOS D	0.3	2.3	Full	500	0.0	0.0
Lane 2	18	0.0	287	0.062	100	48.7	LOS D	0.8	5.8	Short	30	0.0	NA
Approach	25	0.0		0.062		47.0	LOS D	0.8	5.8				
NorthWest: Ripley Rd													
Lane 1	48	13.0	973	0.050	100	11.5	LOS B	0.7	5.4	Short	30	0.0	NA
Lane 2 (BL)	4	100.0	494	0.009	100	19.8	LOS B	0.1	1.7	Full	500	0.0	0.0
Lane 3	343	8.9	727 [1]	0.472	100	24.5	LOS C	13.1	98.6	Full	500	0.0	0.0
Lane 4	25	0.0	101	0.249	100	62.8	LOS E	1.4	9.7	Short	30	0.0	NA
Approach	421	9.8		0.472		25.2	LOS C	13.1	98.6				
SouthWest: Town Center Rd 2													
Lane 1	180	1.2	309	0.583	100	51.8	LOS D	8.4	59.3	Full	500	0.0	0.0
Lane 2	104	0.0	287	0.363	100	51.5	LOS D	5.1	35.9	Short	40	0.0	NA
Approach	284	0.7		0.583		51.7	LOS D	8.4	59.3				
Intersection	1416	3.2		0.792		33.4	LOS C	30.4	212.9				

Intersection R1031 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 31 [2031 PM - FINAL]

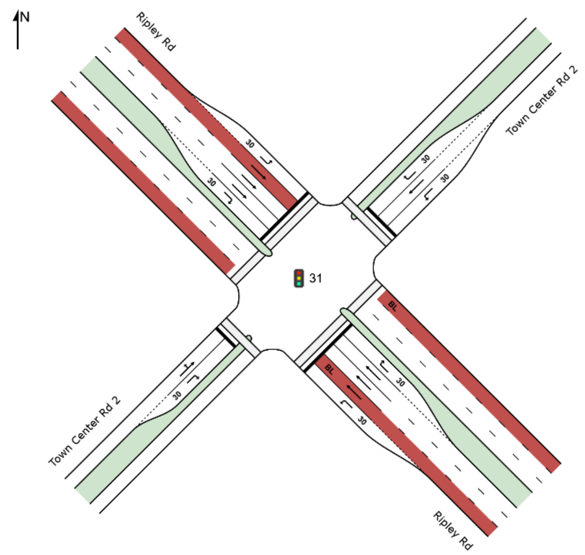
R1031
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

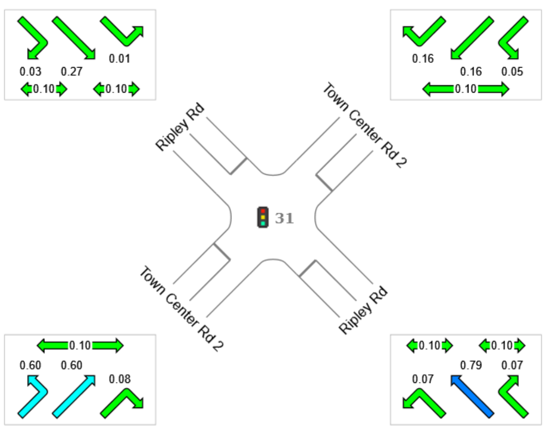
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Rd													
Lane 1	37	5.7	1338	0.028	100	9.6	LOS A	0.5	3.9	Short	30	0.0	NA
Lane 2 (BL)	4	100.0	650	0.006	100	12.8	LOS B	0.1	1.4	Full	500	0.0	0.0
Lane 3	474	0.0	1049 [1]	0.452	100	17.0	LOS B	16.2	113.4	Full	500	0.0	0.0
Lane 4	12	0.0	93	0.125	100	67.5	LOS E	0.7	4.8	Short	30	0.0	NA
Approach	526	1.2		0.452		17.5	LOS B	16.2	113.4				
NorthEast: Town Center Rd 2													
Lane 1	69	0.0	147	0.474	100	63.0	LOS E	4.1	28.6	Full	500	0.0	0.0
Lane 2	26	0.0	93	0.283	100	68.7	LOS E	1.6	11.1	Short	30	0.0	NA
Approach	96	0.0		0.474		64.5	LOS E	4.1	28.6				
NorthWest: Ripley Rd													
Lane 1	21	20.0	975	0.022	100	11.3	LOS B	0.3	2.5	Short	30	0.0	NA
Lane 2 (BL)	4	100.0	650	0.006	100	12.8	LOS B	0.1	1.4	Full	500	0.0	0.0
Lane 3	776	2.8	1015 [1]	0.764	100	21.7	LOS C	33.9	243.1	Full	500	0.0	0.0
Lane 4	31	6.9	89	0.345	100	69.3	LOS E	1.9	13.7	Short	30	0.0	NA
Approach	832	3.9		0.764		23.1	LOS C	33.9	243.1				
SouthWest: Town Center Rd 2													
Lane 1	47	0.0	329	0.144	100	37.6	LOS D	2.1	14.7	Full	500	0.0	0.0
Lane 2	69	3.0	273	0.255	100	55.0	LOS E	3.7	26.3	Short	40	0.0	NA
Approach	117	1.8		0.255		47.9	LOS D	3.7	26.3				
Intersection	1571	2.6		0.764		25.6	LOS C	33.9	243.1				

Intersection R1031-2041

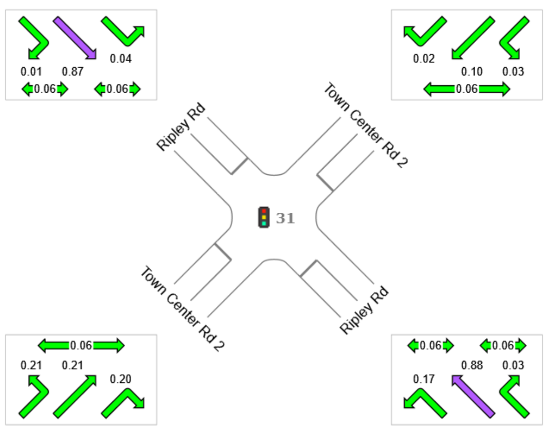
SITE LAYOUT – R1031 – 2041



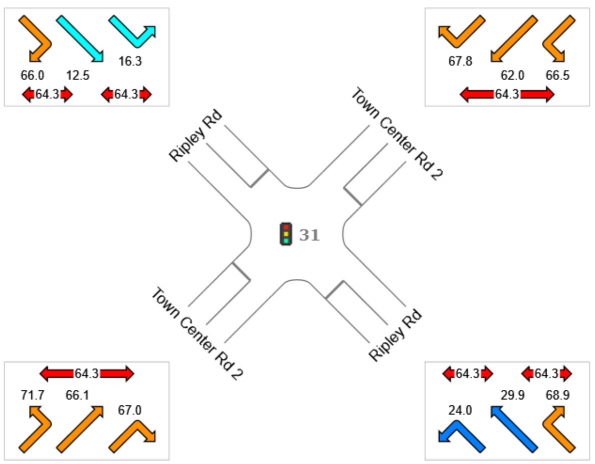
DEGREE OF SATURATION AM



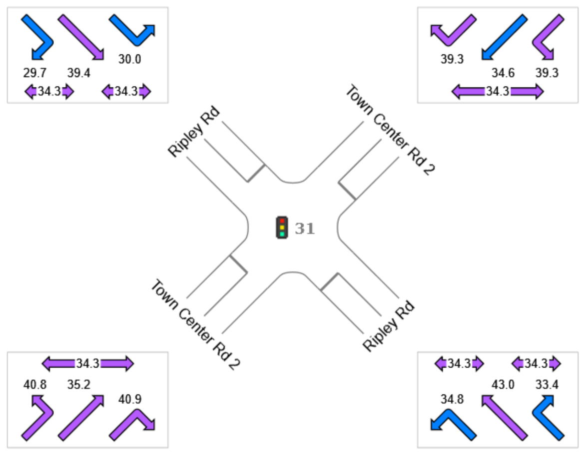
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1031– 2041 Cont.

LANE SUMMARY 2041 AM

Site: 31 [2041 AM - FINAL]

R1031
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Rd													
Lane 1	62	1.7	931	0.067	100	24.0	LOS C	2.1	15.0	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	599	0.021	100	18.1	LOS B	0.4	5.5	Full	500	0.0	0.0
Lane 3	772	2.5	973	0.793	100	30.1	LOS C	42.8	305.7	Full	500	0.0	0.0
Lane 4	761	2.5	960[1]	0.793	100	29.8	LOS C	41.8	298.7	Full	500	0.0	0.0
Lane 5	12	0.0	172	0.067	100	68.9	LOS E	0.7	5.1	Short	30	0.0	NA
Approach	1619	3.2		0.793		29.9	LOS C	42.8	305.7				
NorthEast: Town Center Rd 2													
Lane 1	11	0.0	199	0.053	100	66.5	LOS E	0.7	4.6	Short	30	0.0	NA
Lane 2	33	0.0	209	0.156	100	62.0	LOS E	2.1	14.4	Full	500	0.0	0.0
Lane 3	32	0.0	199	0.159	100	67.8	LOS E	2.0	14.0	Short	30	0.0	NA
Approach	75	0.0		0.159		65.1	LOS E	2.1	14.4				
NorthWest: Ripley Rd													
Lane 1	5	0.0	889	0.006	100	16.3	LOS B	0.1	0.8	Short	30	0.0	NA
Lane 2	12	100.0	566	0.020	100	11.0	LOS B	0.3	3.4	Full	500	0.0	0.0
Lane 3	240	5.0	904	0.266	100	12.5	LOS B	6.1	44.5	Full	500	0.0	0.0
Lane 4	240	5.0	904	0.266	100	12.5	LOS B	6.1	44.5	Full	500	0.0	0.0
Lane 5	5	0.0	199	0.026	100	66.0	LOS E	0.3	2.3	Short	30	0.0	NA
Approach	502	7.1		0.266		13.1	LOS B	6.1	44.5				
SouthWest: Town Center Rd 2													
Lane 1	119	5.3	198[1]	0.602	100	67.4	LOS E	8.0	58.4	Full	500	0.0	0.0
Lane 2	17	0.0	199	0.085	100	67.0	LOS E	1.0	7.3	Short	30	0.0	NA
Approach	136	4.7		0.602		67.4	LOS E	8.0	58.4				
Intersection	2332	4.0		0.793		29.6	LOS C	42.8	305.7				

Intersection R1031– 2041 Cont.

LANE SUMMARY 2041 PM

Site: 31 [2041 PM - FINAL]

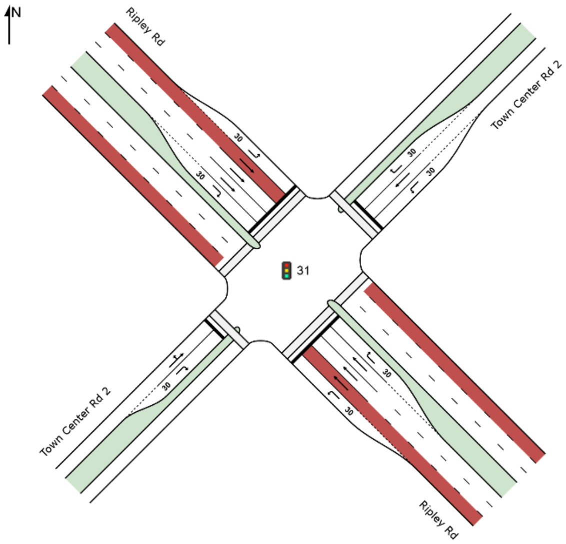
R1031
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

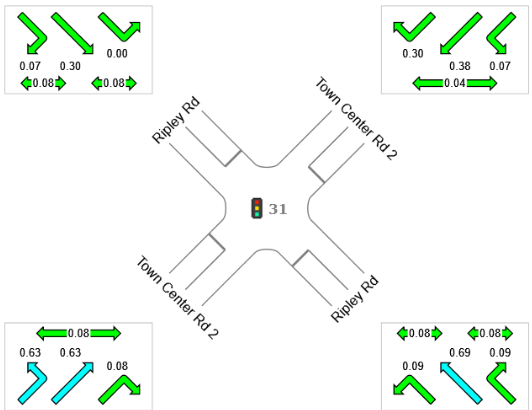
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Rd													
Lane 1	63	3.3	363	0.174	100	34.8	LOS C	2.1	15.0	Short	30	0.0	NA
Lane 2	13	100.0	236	0.053	100	28.7	LOS C	0.4	5.3	Full	500	0.0	0.0
Lane 3	337	2.7	383	0.880	100	43.3	LOS D	15.2	109.0	Full	500	0.0	0.0
Lane 4	333	2.7	379 [1]	0.880	100	43.3	LOS D	15.0	107.6	Full	500	0.0	0.0
Lane 5	9	0.0	371	0.026	100	33.4	LOS C	0.3	2.1	Short	30	0.0	NA
Approach	756	4.3		0.880		42.2	LOS D	15.2	109.0				
NorthEast: Town Center Rd 2													
Lane 1	6	0.0	232	0.027	100	39.3	LOS D	0.2	1.5	Short	30	0.0	NA
Lane 2	24	8.7	231	0.105	100	34.6	LOS C	0.9	6.5	Full	500	0.0	0.0
Lane 3	5	0.0	232	0.023	100	39.3	LOS D	0.2	1.3	Short	30	0.0	NA
Approach	36	5.9		0.105		36.1	LOS D	0.9	6.5				
NorthWest: Ripley Rd													
Lane 1	18	0.0	464	0.039	100	30.0	LOS C	0.5	3.7	Short	30	0.0	NA
Lane 2	14	100.0	295	0.046	100	25.0	LOS C	0.4	5.4	Full	500	0.0	0.0
Lane 3	418	1.8	482	0.867	100	39.6	LOS D	18.4	130.7	Full	500	0.0	0.0
Lane 4	416	1.8	479 [1]	0.867	100	39.6	LOS D	18.3	129.9	Full	500	0.0	0.0
Lane 5	4	0.0	464	0.009	100	29.7	LOS C	0.1	0.9	Short	30	0.0	NA
Approach	869	3.3		0.867		39.1	LOS D	18.4	130.7				
SouthWest: Town Center Rd 2													
Lane 1	52	0.0	242	0.213	100	35.9	LOS D	1.9	13.2	Full	500	0.0	0.0
Lane 2	47	0.0	232	0.204	100	40.9	LOS D	1.7	12.1	Short	30	0.0	NA
Approach	99	0.0		0.213		38.3	LOS D	1.9	13.2				
Intersection	1760	3.6		0.880		40.3	LOS D	18.4	130.7				

Intersection R1031-2066

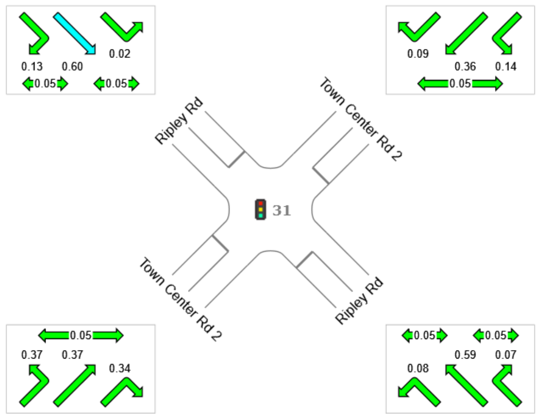
SITE LAYOUT – R1031 – 2066



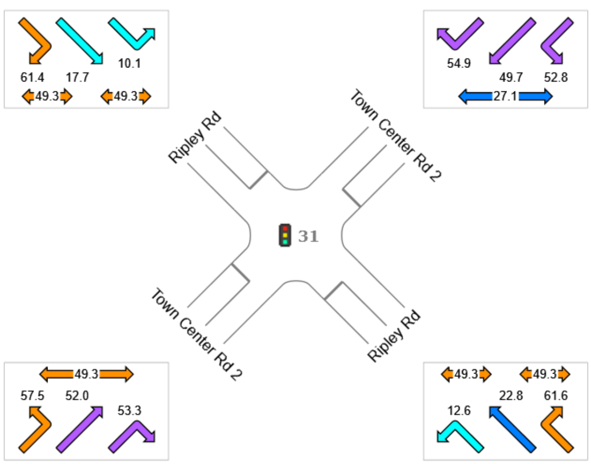
DEGREE OF SATURATION AM



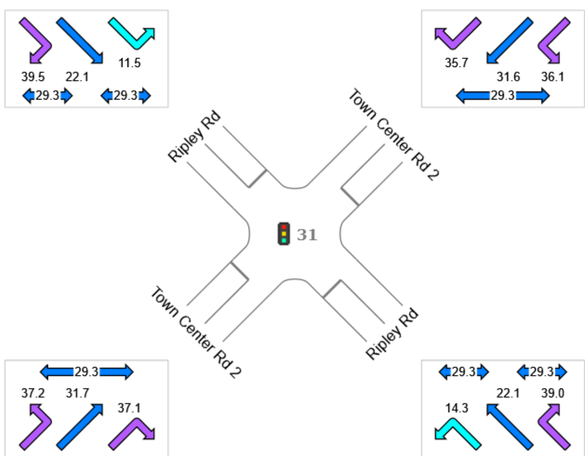
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1031– 2066 Cont.

LANE SUMMARY 2066 AM

Site: 31 [2066 AM - FINAL same as 2041]

R1031
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Rd													
Lane 1	101	7.3	1172	0.086	100	12.6	LOS B	1.9	14.0	Short	30	0.0	NA
Lane 2	12	100.0	580	0.020	100	15.3	LOS B	0.3	4.1	Full	500	0.0	0.0
Lane 3	645	3.3	937	0.688	100	23.0	LOS C	26.4	190.0	Full	500	0.0	0.0
Lane 4	637	3.3	925 [1]	0.688	100	22.8	LOS C	25.9	186.3	Full	500	0.0	0.0
Lane 5	9	0.0	101	0.094	100	61.6	LOS E	0.5	3.6	Short	30	0.0	NA
Approach	1404	4.3		0.688		22.4	LOS C	26.4	190.0				
NorthEast: Town Center Rd 2													
Lane 1	15	0.0	219	0.067	100	52.8	LOS D	0.7	5.0	Short	30	0.0	NA
Lane 2	87	0.0	230	0.379	100	49.7	LOS D	4.5	31.3	Full	500	0.0	0.0
Lane 3	66	0.0	219	0.302	100	54.9	LOS D	3.4	23.5	Short	30	0.0	NA
Approach	168	0.0		0.379		52.0	LOS D	4.5	31.3				
NorthWest: Ripley Rd													
Lane 1	1	0.0	1131	0.001	100	10.1	LOS B	0.0	0.1	Short	30	0.0	NA
Lane 2	13	100.0	580	0.022	100	15.3	LOS B	0.3	4.5	Full	500	0.0	0.0
Lane 3	278	6.7	917	0.303	100	17.8	LOS B	8.8	65.2	Full	500	0.0	0.0
Lane 4	272	6.7	896 [1]	0.303	100	17.7	LOS B	8.6	63.4	Full	500	0.0	0.0
Lane 5	7	0.0	101	0.073	100	61.4	LOS E	0.4	2.8	Short	30	0.0	NA
Approach	571	8.7		0.303		18.2	LOS B	8.8	65.2				
SouthWest: Town Center Rd 2													
Lane 1	143	0.0	226	0.633	100	54.1	LOS D	7.6	53.5	Full	500	0.0	0.0
Lane 2	17	12.5	202	0.084	100	53.3	LOS D	0.8	6.4	Short	30	0.0	NA
Approach	160	1.3		0.633		54.0	LOS D	7.6	53.5				
Intersection	2303	4.9		0.688		25.7	LOS C	26.4	190.0				

Intersection R1031– 2066 Cont.

LANE SUMMARY 2066 PM

Site: 31 [2066 PM - FINAL same as 2041]

R1031
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

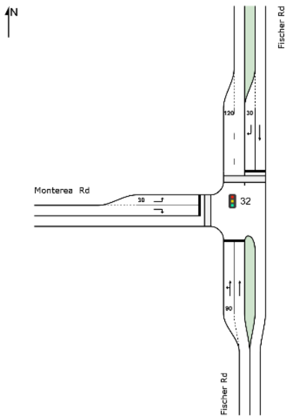
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Rd													
Lane 1	75	5.6	944	0.079	100	14.3	LOS B	1.2	9.1	Short	30	0.0	NA
Lane 2	13	100.0	371	0.034	100	18.2	LOS B	0.3	4.0	Full	500	0.0	0.0
Lane 3	354	3.2	601	0.589	100	22.2	LOS C	10.4	74.7	Full	500	0.0	0.0
Lane 4	347	3.2	589 [1]	0.589	100	22.1	LOS C	10.1	72.9	Full	500	0.0	0.0
Lane 5	11	0.0	159	0.066	100	39.0	LOS D	0.3	2.4	Short	30	0.0	NA
Approach	799	4.9		0.589		21.6	LOS C	10.4	74.7				
NorthEast: Town Center Rd 2													
Lane 1	32	6.7	228	0.139	100	36.1	LOS D	1.0	7.4	Short	30	0.0	NA
Lane 2	91	0.0	251	0.361	100	31.6	LOS C	3.0	20.8	Full	500	0.0	0.0
Lane 3	21	0.0	239	0.088	100	35.7	LOS D	0.7	4.6	Short	30	0.0	NA
Approach	143	1.5		0.361		33.2	LOS C	3.0	20.8				
NorthWest: Ripley Rd													
Lane 1	13	0.0	822	0.015	100	11.5	LOS B	0.1	0.9	Short	30	0.0	NA
Lane 2	13	100.0	371	0.034	100	18.2	LOS B	0.3	4.0	Full	500	0.0	0.0
Lane 3	363	2.5	603	0.602	100	22.3	LOS C	10.7	76.6	Full	500	0.0	0.0
Lane 4	349	2.5	580 [1]	0.602	100	22.1	LOS C	10.2	73.0	Full	500	0.0	0.0
Lane 5	21	0.0	159	0.132	100	39.5	LOS D	0.7	5.0	Short	30	0.0	NA
Approach	759	4.0		0.602		22.4	LOS C	10.7	76.6				
SouthWest: Town Center Rd 2													
Lane 1	92	0.0	247	0.370	100	33.2	LOS C	3.0	21.1	Full	500	0.0	0.0
Lane 2	80	0.0	239	0.335	100	37.1	LOS D	2.6	18.4	Short	30	0.0	NA
Approach	172	0.0		0.370		35.0	LOS D	3.0	21.1				
Intersection	1873	3.8		0.602		24.0	LOS C	10.7	76.6				

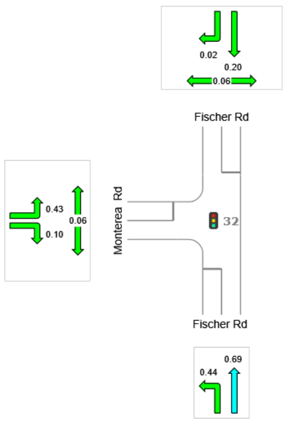
22 Intersection R1032

2031

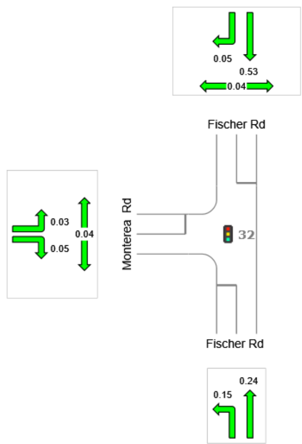
SITE LAYOUT – R1032 – 2031



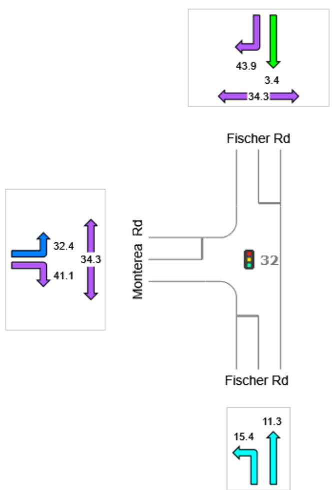
DEGREE OF SATURATION AM



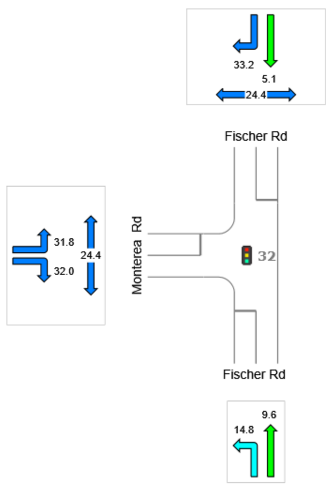
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1032 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 32 [2031 AM - FINAL same as 2026]

R1032
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Fischer Rd													
Lane 1	505	0.4	1142	0.442	64 [6]	9.9	LOS A	10.9	76.6	Short	90	0.0	NA
Lane 2	790	0.4	1143	0.692	100	12.3	LOS B	21.4	150.1	Full	500	0.0	0.0
Approach	1296	0.4		0.692		11.4	LOS B	21.4	150.1				
North: Fischer Rd													
Lane 1	284	1.9	1421	0.200	100	3.4	LOS A	3.4	23.9	Full	500	0.0	0.0
Lane 2	3	0.0	139	0.023	100	43.9	LOS D	0.1	0.8	Short	30	0.0	NA
Approach	287	1.8		0.200		3.9	LOS A	3.4	23.9				
West: Monterea Rd													
Lane 1	208	0.0	488	0.428	100	32.4	LOS C	6.9	48.2	Short	30	0.0	NA
Lane 2	20	0.0	209	0.096	100	41.1	LOS D	0.7	5.1	Full	500	0.0	0.0
Approach	228	0.0		0.428		33.2	LOS C	6.9	48.2				
Intersection	1812	0.6		0.692		12.9	LOS B	21.4	150.1				

LANE SUMMARY 2031 PM

Site: 32 [2031 PM - FINAL same as 2026]

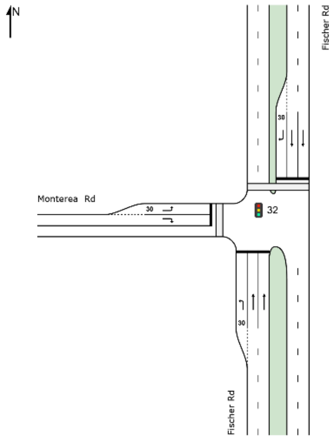
R1032
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

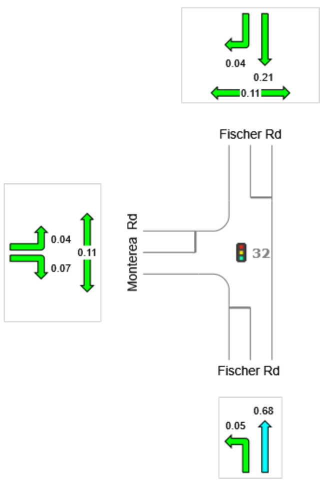
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Fischer Rd													
Lane 1	142	0.3	938	0.151	64 [6]	9.6	LOS A	2.3	16.3	Short	90	0.0	NA
Lane 2	222	0.3	941	0.236	100	9.8	LOS A	3.8	26.8	Full	500	0.0	0.0
Approach	364	0.3		0.236		9.7	LOS A	3.8	26.8				
North: Fischer Rd													
Lane 1	702	0.3	1315 [1]	0.534	100	5.1	LOS A	10.2	71.5	Full	500	0.0	0.0
Lane 2	9	0.0	186	0.051	100	33.2	LOS C	0.3	1.9	Short	30	0.0	NA
Approach	712	0.3		0.534		5.4	LOS A	10.2	71.5				
West: Monterea Rd													
Lane 1	6	0.0	217	0.029	100	31.8	LOS C	0.2	1.2	Short	30	0.0	NA
Lane 2	11	0.0	217	0.049	100	32.0	LOS C	0.3	2.0	Full	500	0.0	0.0
Approach	17	0.0		0.049		31.9	LOS C	0.3	2.0				
Intersection	1093	0.3		0.534		7.3	LOS A	10.2	71.5				

Intersection R1032-2041

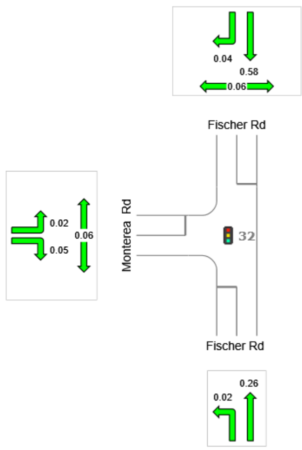
SITE LAYOUT – R1032 – 2041



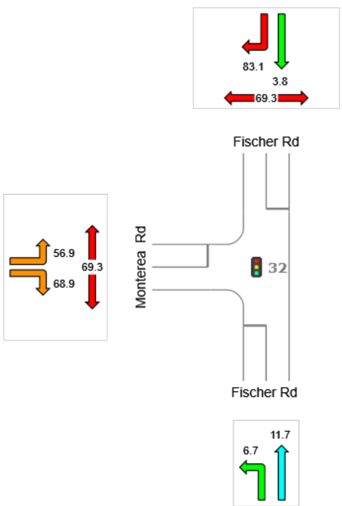
DEGREE OF SATURATION AM



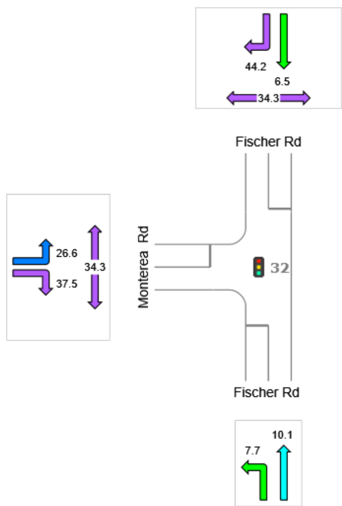
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1032 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 32 [2041 AM - FINAL]

R1032
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Fischer Rd													
Lane 1	83	0.0	1634	0.051	100	6.7	LOS A	0.7	5.1	Short	30	0.0	NA
Lane 2	875	1.3	1292 [1]	0.678	100	11.3	LOS B	31.9	226.0	Full	500	0.0	0.0
Lane 3	943	1.3	1392	0.678	100	12.0	LOS B	36.8	260.3	Full	500	0.0	0.0
Approach	1902	1.2		0.678		11.5	LOS B	36.8	260.3				
North: Fischer Rd													
Lane 1	326	1.3	1547	0.211	100	3.8	LOS A	5.6	39.3	Full	500	0.0	0.0
Lane 2	326	1.3	1547	0.211	100	3.8	LOS A	5.6	39.3	Full	500	0.0	0.0
Lane 3	3	0.0	74	0.043	100	83.1	LOS F	0.2	1.6	Short	30	0.0	NA
Approach	655	1.3		0.211		4.1	LOS A	5.6	39.3				
West: Monterea Rd													
Lane 1	14	0.0	371	0.037	100	56.9	LOS E	0.8	5.6	Short	30	0.0	NA
Lane 2	16	0.0	223	0.071	100	68.9	LOS E	1.0	7.2	Full	500	0.0	0.0
Approach	29	0.0		0.071		63.3	LOS E	1.0	7.2				
Intersection	2586	1.2		0.678		10.2	LOS B	36.8	260.3				

Intersection R1032 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 32 [2041 PM - FINAL]

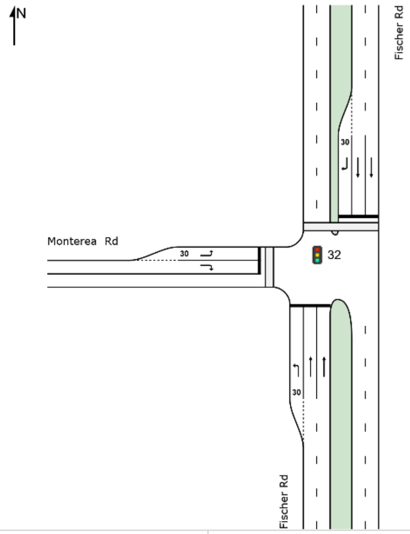
R1032
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

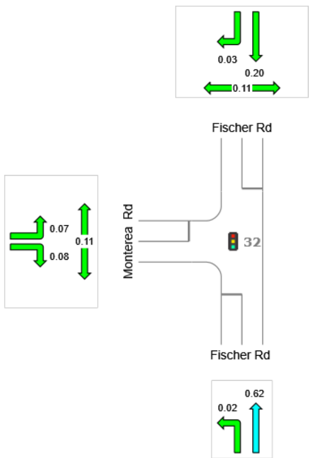
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Fischer Rd													
Lane 1	31	0.0	1439	0.021	100	7.7	LOS A	0.3	1.9	Short	30	0.0	NA
Lane 2	281	1.3	1063	0.264	100	10.1	LOS B	5.7	40.6	Full	500	0.0	0.0
Lane 3	281	1.3	1063	0.264	100	10.1	LOS B	5.7	40.6	Full	500	0.0	0.0
Approach	593	1.2		0.264		10.0	LOS A	5.7	40.6				
North: Fischer Rd													
Lane 1	793	0.4	1361	0.582	100	6.5	LOS A	15.5	109.1	Full	500	0.0	0.0
Lane 2	788	0.4	1353 [1]	0.582	100	6.5	LOS A	15.4	108.0	Full	500	0.0	0.0
Lane 3	5	0.0	139	0.038	100	44.2	LOS D	0.2	1.4	Short	30	0.0	NA
Approach	1586	0.4		0.582		6.6	LOS A	15.5	109.1				
West: Monterea Rd													
Lane 1	9	0.0	557	0.017	100	26.6	LOS C	0.3	1.8	Short	30	0.0	NA
Lane 2	13	0.0	279	0.045	100	37.5	LOS D	0.4	3.0	Full	500	0.0	0.0
Approach	22	0.0		0.045		32.8	LOS C	0.4	3.0				
Intersection	2201	0.6		0.582		7.8	LOS A	15.5	109.1				

Intersection R1032-2066

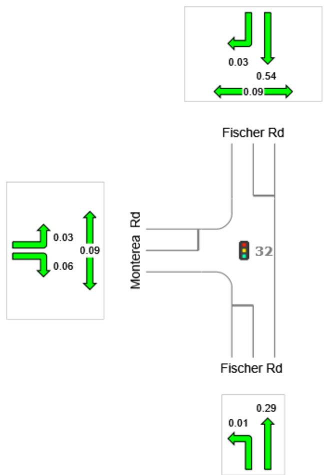
SITE LAYOUT – R1032 – 2066



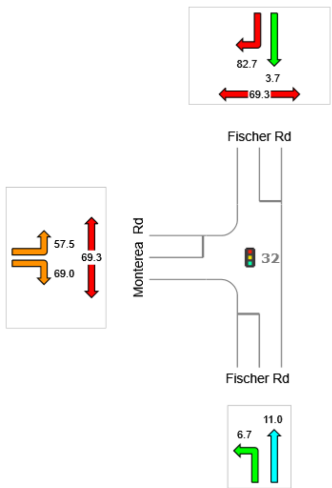
DEGREE OF SATURATION AM



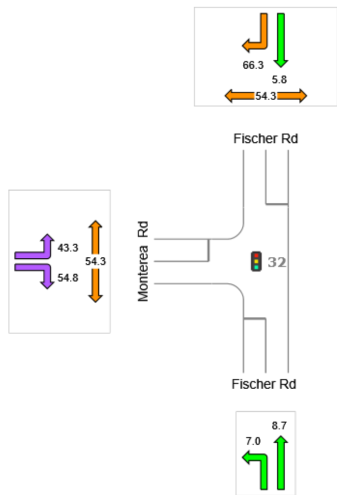
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1032– 2066 Cont.

LANE SUMMARY 2066 AM

Site: 32 [2066 AM - FINAL same as 2041]

R1032
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Fischer Rd													
Lane 1	39	0.0	1634	0.024	100	6.7	LOS A	0.3	2.3	Short	30	0.0	NA
Lane 2	837	1.3	1343 [1]	0.623	100	10.9	LOS B	29.4	208.4	Full	500	0.0	0.0
Lane 3	867	1.3	1392	0.623	100	11.2	LOS B	31.4	222.3	Full	500	0.0	0.0
Approach	1743	1.3		0.623		10.9	LOS B	31.4	222.3				
North: Fischer Rd													
Lane 1	315	2.2	1538	0.205	100	3.7	LOS A	5.3	38.1	Full	500	0.0	0.0
Lane 2	315	2.2	1538	0.205	100	3.7	LOS A	5.3	38.1	Full	500	0.0	0.0
Lane 3	2	0.0	74	0.028	100	82.7	LOS F	0.2	1.1	Short	30	0.0	NA
Approach	633	2.2		0.205		4.0	LOS A	5.3	38.1				
West: Monterea Rd													
Lane 1	26	0.0	371	0.071	100	57.5	LOS E	1.5	10.8	Short	30	0.0	NA
Lane 2	18	0.0	223	0.080	100	69.0	LOS E	1.2	8.2	Full	500	0.0	0.0
Approach	44	0.0		0.080		62.1	LOS E	1.5	10.8				
Intersection	2420	1.5		0.623		10.1	LOS B	31.4	222.3				

Intersection R1032– 2066 Cont.

LANE SUMMARY 2066 PM

Site: 32 [2066 PM - FINAL same as 2041]

R1032
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)

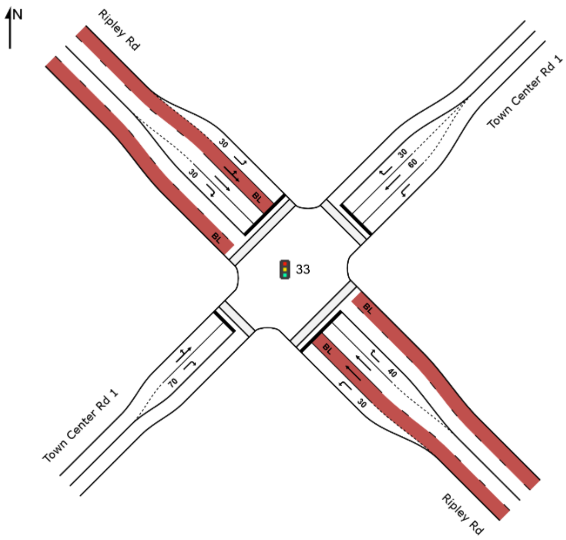
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Fischer Rd													
Lane 1	21	0.0	1579	0.013	100	7.0	LOS A	0.2	1.3	Short	30	0.0	NA
Lane 2	367	1.3	1277 [1]	0.288	100	8.7	LOS A	8.6	61.2	Full	500	0.0	0.0
Lane 3	371	1.3	1289	0.288	100	8.7	LOS A	8.7	61.9	Full	500	0.0	0.0
Approach	759	1.2		0.288		8.6	LOS A	8.7	61.9				
North: Fischer Rd													
Lane 1	798	0.5	1490	0.536	100	5.8	LOS A	18.1	127.2	Full	500	0.0	0.0
Lane 2	795	0.5	1484 [1]	0.536	100	5.8	LOS A	18.0	126.4	Full	500	0.0	0.0
Lane 3	3	0.0	93	0.034	100	66.3	LOS E	0.2	1.3	Short	30	0.0	NA
Approach	1597	0.5		0.536		5.9	LOS A	18.1	127.2				
West: Monterea Rd													
Lane 1	12	0.0	433	0.027	100	43.3	LOS D	0.5	3.6	Short	30	0.0	NA
Lane 2	14	0.0	248	0.055	100	54.8	LOS D	0.7	4.9	Full	500	0.0	0.0
Approach	25	0.0		0.055		49.5	LOS D	0.7	4.9				
Intersection	2381	0.8		0.536		7.3	LOS A	18.1	127.2				

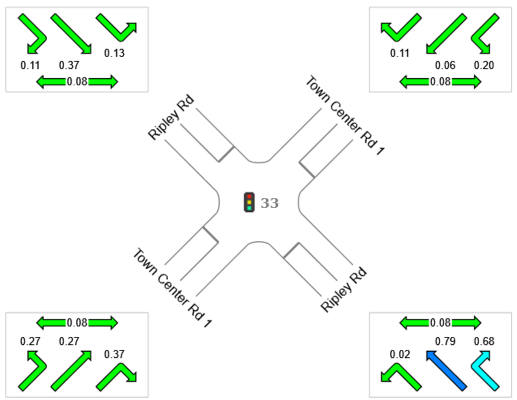
23 Intersection R1033

2031

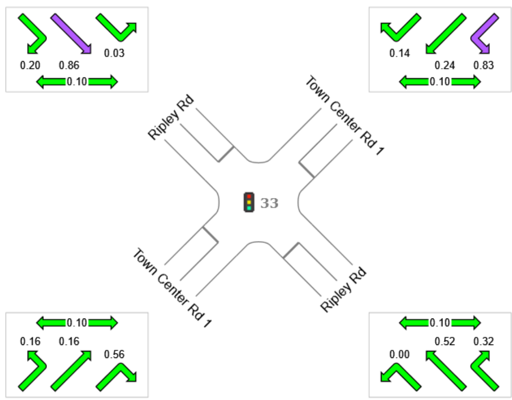
SITE LAYOUT – R1033 – 2031



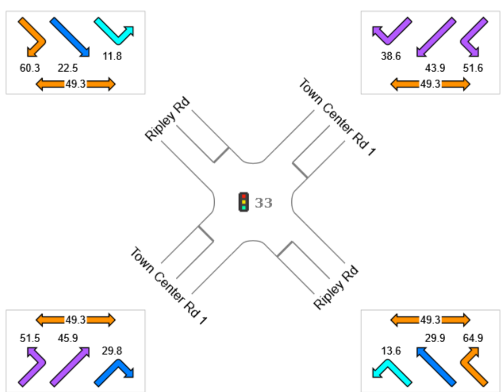
DEGREE OF SATURATION AM



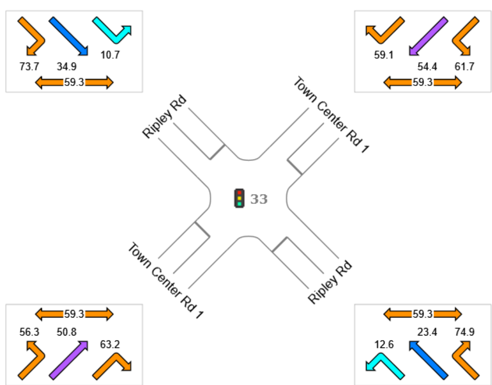
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1033 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 33 [2031 AM - FINAL]

R1033
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Rd													
Lane 1	19	0.0	1165	0.016	100	13.6	LOS B	0.4	2.6	Short	30	0.0	NA
Lane 2 (BL)	2	100.0	505	0.004	100	19.1	LOS B	0.1	0.8	Full	500	0.0	0.0
Lane 3	599	0.0	754 [1]	0.795	100	29.9	LOS C	27.5	192.7	Full	500	0.0	0.0
Lane 4	77	5.5	114	0.676	100	64.9	LOS E	4.4	32.2	Short	40	0.0	NA
Approach	697	0.9		0.795		33.3	LOS C	27.5	192.7				
NorthEast: Town Center Rd 1													
Lane 1	44	28.6	224	0.197	100	51.6	LOS D	2.1	18.7	Full	500	0.0	0.0
Lane 2	17	0.0	284	0.059	100	43.9	LOS D	0.8	5.5	Short	60	0.0	NA
Lane 3	56	0.0	490	0.114	100	38.6	LOS D	2.3	15.9	Short	30	0.0	NA
Approach	117	10.8		0.197		44.3	LOS D	2.3	18.7				
NorthWest: Ripley Rd													
Lane 1	27	0.0	1064	0.026	20 [6]	11.2	LOS B	0.4	2.6	Short	30	0.0	NA
Lane 2 (BL)	131	3.2	1025	0.128	100	11.5	LOS B	2.0	14.2	Full	500	0.0	0.0
Lane 3	277	11.8	746 [1]	0.371	100	22.7	LOS C	10.0	76.8	Full	500	0.0	0.0
Lane 4	13	0.0	118	0.107	100	60.3	LOS E	0.7	4.7	Short	30	0.0	NA
Approach	447	8.2		0.371		19.8	LOS B	10.0	76.8				
SouthWest: Town Center Rd 1													
Lane 1	75	0.0	279	0.268	100	48.0	LOS D	3.6	25.5	Full	500	0.0	0.0
Lane 2	144	0.7	386	0.373	100	29.8	LOS C	4.9	34.3	Short	70	0.0	NA
Approach	219	0.5		0.373		36.0	LOS D	4.9	34.3				
Intersection	1480	3.8		0.795		30.5	LOS C	27.5	192.7				

Intersection R1033 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 33 [2031 PM - FINAL]

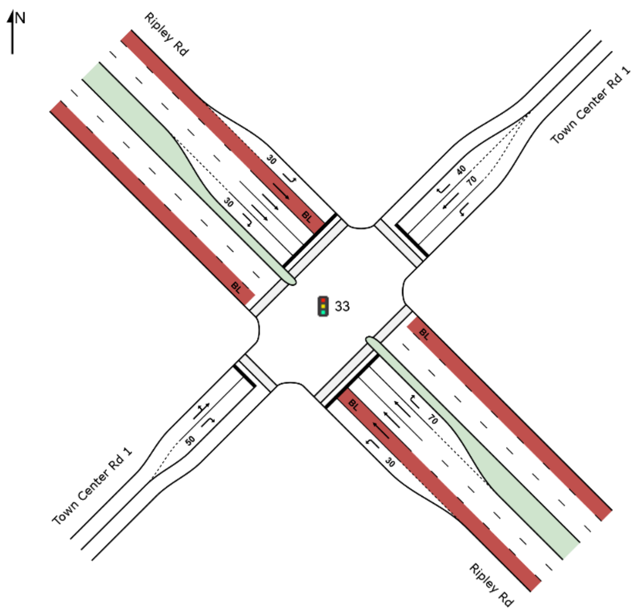
R1033
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 130 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

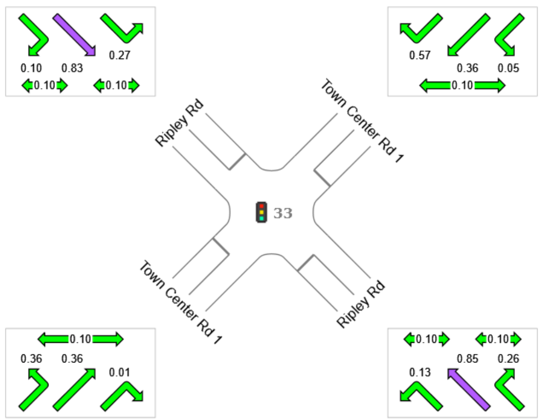
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Rd													
Lane 1	5	0.0	1257	0.004	100	12.6	LOS B	0.1	0.7	Short	30	0.0	NA
Lane 2 (BL)	4	100.0	582	0.007	100	17.6	LOS B	0.1	1.7	Full	500	0.0	0.0
Lane 3	474	0.4	911 [1]	0.520	100	23.5	LOS C	19.8	139.4	Full	500	0.0	0.0
Lane 4	26	8.0	81	0.325	100	74.9	LOS E	1.7	13.0	Short	40	0.0	NA
Approach	509	1.7		0.520		26.0	LOS C	19.8	139.4				
NorthEast: Town Center Rd 1													
Lane 1	333	0.0	403 [1]	0.825	100	61.7	LOS E	21.3	149.4	Full	500	0.0	0.0
Lane 2	64	0.0	270	0.238	100	54.4	LOS D	3.7	25.7	Short	60	0.0	NA
Lane 3	35	0.0	257	0.135	100	59.1	LOS E	2.0	13.7	Short	30	0.0	NA
Approach	432	0.0		0.825		60.4	LOS E	21.3	149.4				
NorthWest: Ripley Rd													
Lane 1	38	5.6	1127	0.034	100	10.7	LOS B	0.6	4.0	Short	30	0.0	NA
Lane 2 (BL)	4	100.0	582	0.007	100	17.6	LOS B	0.1	1.7	Full	500	0.0	0.0
Lane 3	797	2.6	926 [1]	0.860	100	35.0	LOS C	46.4	332.3	Full	500	0.0	0.0
Lane 4	17	0.0	86	0.196	100	73.7	LOS E	1.1	7.6	Short	30	0.0	NA
Approach	856	3.2		0.860		34.6	LOS C	46.4	332.3				
SouthWest: Town Center Rd 1													
Lane 1	45	0.0	278	0.163	100	52.4	LOS D	2.3	15.8	Full	500	0.0	0.0
Lane 2	143	0.0	257	0.557	100	63.2	LOS E	8.7	60.7	Short	70	0.0	NA
Approach	188	0.0		0.557		60.6	LOS E	8.7	60.7				
Intersection	1985	1.8		0.860		40.4	LOS D	46.4	332.3				

Intersection R1033-2041

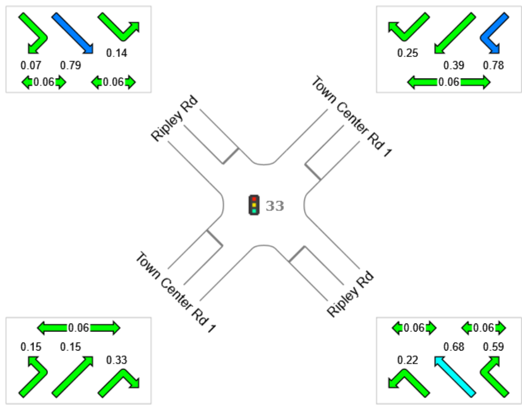
SITE LAYOUT – R1033 – 2041



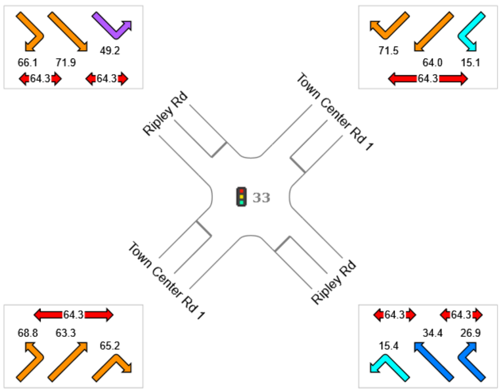
DEGREE OF SATURATION AM



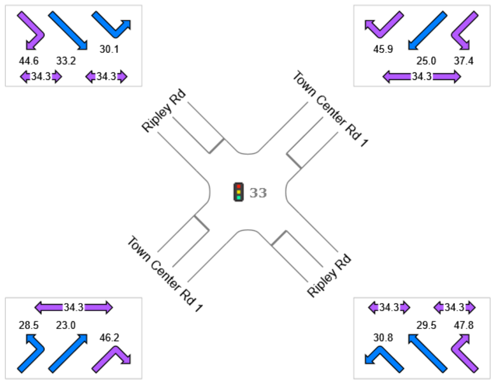
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1033 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 33 [2041 AM - FINAL]

R1033
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Rd													
Lane 1	162	0.0	1207	0.134	100	15.4	LOS B	4.1	28.9	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	591	0.021	100	18.6	LOS B	0.4	5.5	Full	500	0.0	0.0
Lane 3	820	2.4	960	0.854	100	35.0	LOS C	50.1	357.6	Full	500	0.0	0.0
Lane 4	677	2.4	792 [1]	0.854	100	34.0	LOS C	38.2	272.8	Full	500	0.0	0.0
Lane 5	238	2.7	911	0.261	100	26.9	LOS C	9.2	65.6	Short	70	0.0	NA
Approach	1909	2.9		0.854		31.8	LOS C	50.1	357.6				
NorthEast: Town Center Rd 1													
Lane 1	57	20.4	1054	0.054	100	15.1	LOS B	1.4	11.2	Full	500	0.0	0.0
Lane 2	74	2.9	205	0.359	100	64.0	LOS E	4.8	34.3	Short	70	0.0	NA
Lane 3	113	0.9	198	0.570	100	71.5	LOS E	7.5	53.2	Short	40	0.0	NA
Approach	243	6.1		0.570		56.0	LOS E	7.5	53.2				
NorthWest: Ripley Rd													
Lane 1	129	0.8	488	0.265	100	49.2	LOS D	7.0	49.1	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	135	0.094	100	61.7	LOS E	0.8	10.4	Full	500	0.0	0.0
Lane 3	177	6.4	214	0.828	100	72.4	LOS E	12.9	95.1	Full	500	0.0	0.0
Lane 4	169	6.4	204 [1]	0.828	100	72.2	LOS E	12.2	90.4	Full	500	0.0	0.0
Lane 5	22	0.0	212	0.104	100	66.1	LOS E	1.4	9.6	Short	30	0.0	NA
Approach	511	7.0		0.828		65.9	LOS E	12.9	95.1				
SouthWest: Town Center Rd 1													
Lane 1	74	7.1	202	0.365	100	63.9	LOS E	4.8	35.4	Full	500	0.0	0.0
Lane 2	1	0.0	199	0.005	100	65.2	LOS E	0.1	0.4	Short	50	0.0	NA
Approach	75	7.0		0.365		63.9	LOS E	4.8	35.4				
Intersection	2738	4.0		0.854		41.2	LOS D	50.1	357.6				

Intersection R1033 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 33 [2041 PM - FINAL]

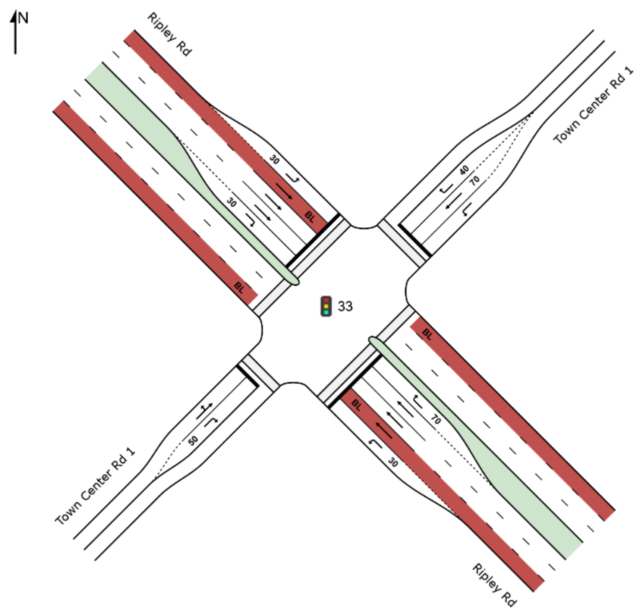
R1033
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

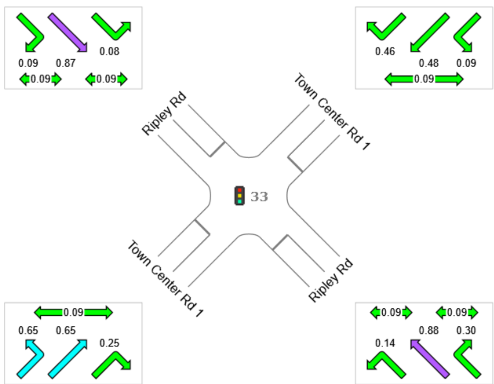
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Rd													
Lane 1	108	0.0	488	0.222	100	30.8	LOS C	3.4	23.5	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	310	0.041	100	24.1	LOS C	0.4	4.9	Full	500	0.0	0.0
Lane 3	343	2.8	503	0.682	100	29.6	LOS C	12.5	89.3	Full	500	0.0	0.0
Lane 4	343	2.8	503	0.682	100	29.6	LOS C	12.5	89.3	Full	500	0.0	0.0
Lane 5	81	2.6	137	0.593	100	47.8	LOS D	3.3	24.0	Short	70	0.0	NA
Approach	888	3.8		0.682		31.4	LOS C	12.5	89.3				
NorthEast: Town Center Rd 1													
Lane 1	412	1.8	527	0.781	100	37.4	LOS D	16.1	114.5	Full	500	0.0	0.0
Lane 2	220	0.0	561	0.392	100	25.0	LOS C	7.0	48.9	Short	70	0.0	NA
Lane 3	35	3.0	136	0.255	100	45.9	LOS D	1.4	9.9	Short	40	0.0	NA
Approach	666	1.3		0.781		33.7	LOS C	16.1	114.5				
NorthWest: Ripley Rd													
Lane 1	71	0.0	488	0.145	100	30.1	LOS C	2.1	14.9	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	310	0.041	100	24.1	LOS C	0.4	4.9	Full	500	0.0	0.0
Lane 3	398	1.9	506	0.788	100	33.4	LOS C	15.8	112.5	Full	500	0.0	0.0
Lane 4	392	1.9	498 [1]	0.788	100	33.3	LOS C	15.5	110.5	Full	500	0.0	0.0
Lane 5	9	0.0	139	0.068	100	44.6	LOS D	0.4	2.5	Short	30	0.0	NA
Approach	883	3.1		0.788		33.1	LOS C	15.8	112.5				
SouthWest: Town Center Rd 1													
Lane 1	83	0.0	554	0.150	100	24.4	LOS C	2.4	17.0	Full	500	0.0	0.0
Lane 2	46	0.0	139	0.333	100	46.2	LOS D	1.8	12.9	Short	50	0.0	NA
Approach	129	0.0		0.333		32.2	LOS C	2.4	17.0				
Intersection	2567	2.7		0.788		32.6	LOS C	16.1	114.5				

Intersection R1033-2066

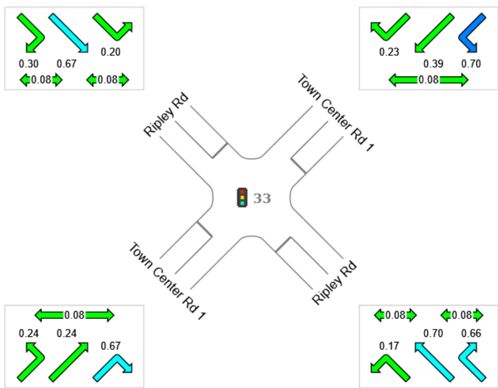
SITE LAYOUT – R1033 – 2066



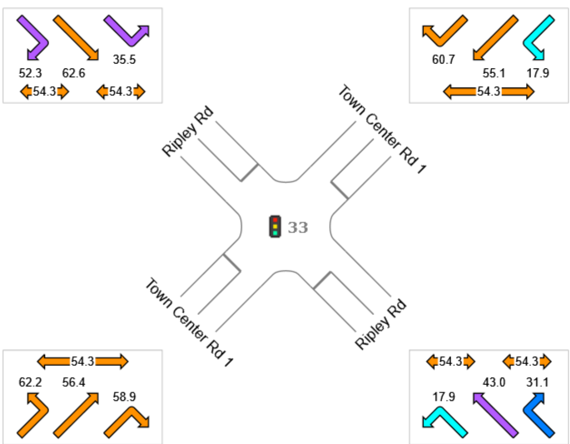
DEGREE OF SATURATION AM



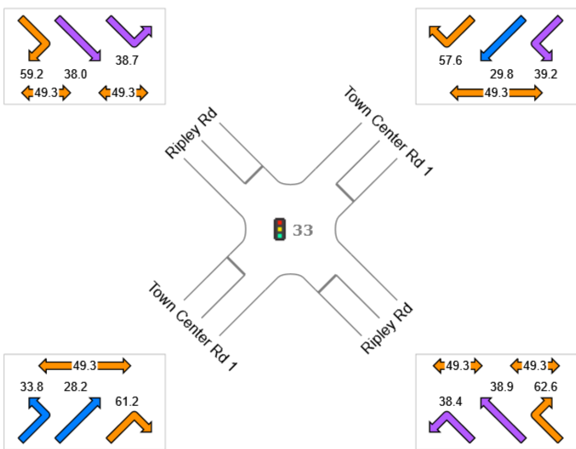
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1033– 2066 Cont.

LANE SUMMARY 2066 AM

Site: 33 [2066 AM FINAL same as 2041]

R1033
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Rd													
Lane 1	148	0.0	1068	0.139	100	17.9	LOS B	3.9	27.5	Short	30	0.0	NA
Lane 2 (BL)	12	100.0	483	0.024	100	22.5	LOS C	0.4	5.2	Full	500	0.0	0.0
Lane 3	685	3.3	779	0.879	100	43.5	LOS D	41.4	298.1	Full	500	0.0	0.0
Lane 4	580	3.3	659 [1]	0.879	100	42.7	LOS D	33.3	239.6	Full	500	0.0	0.0
Lane 5	217	5.8	728	0.298	100	31.1	LOS C	8.5	62.2	Short	70	0.0	NA
Approach	1642	4.0		0.879		39.2	LOS D	41.4	298.1				
NorthEast: Town Center Rd 1													
Lane 1	87	21.7	925	0.094	100	17.9	LOS B	2.3	18.7	Full	500	0.0	0.0
Lane 2	105	6.0	219	0.481	100	55.1	LOS E	6.0	43.8	Short	70	0.0	NA
Lane 3	99	2.1	213	0.464	100	60.7	LOS E	5.6	39.8	Short	40	0.0	NA
Approach	292	9.4		0.481		45.8	LOS D	6.0	43.8				
NorthWest: Ripley Rd													
Lane 1	47	6.7	576	0.082	100	35.5	LOS D	1.9	14.1	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	187	0.068	100	47.3	LOS D	0.6	8.4	Full	500	0.0	0.0
Lane 3	258	6.9	295	0.873	100	63.0	LOS E	16.7	123.8	Full	500	0.0	0.0
Lane 4	245	6.9	281 [1]	0.873	100	62.9	LOS E	15.8	116.9	Full	500	0.0	0.0
Lane 5	26	0.0	294	0.089	100	52.3	LOS D	1.3	9.3	Short	30	0.0	NA
Approach	589	8.6		0.873		59.9	LOS E	16.7	123.8				
SouthWest: Town Center Rd 1													
Lane 1	142	8.9	217	0.655	100	57.0	LOS E	8.3	62.5	Full	500	0.0	0.0
Lane 2	55	0.0	217	0.253	100	58.9	LOS E	3.0	21.0	Short	50	0.0	NA
Approach	197	6.4		0.655		57.6	LOS E	8.3	62.5				
Intersection	2720	5.8		0.879		45.7	LOS D	41.4	298.1				

Intersection R1033– 2066 Cont.

LANE SUMMARY 2066 PM

Site: 33 [2066 PM - FINAL same as 2041]

R1033
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site User-Given Cycle Time)

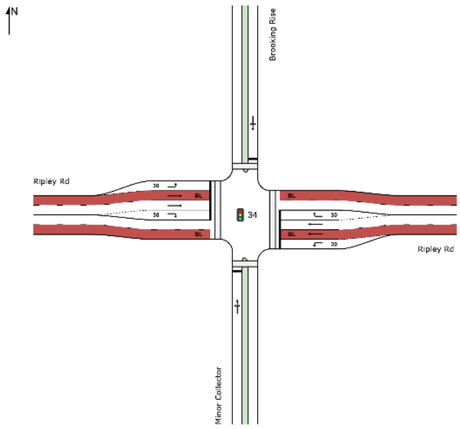
Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Rd													
Lane 1	86	1.2	502	0.172	100	38.4	LOS D	3.5	25.0	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	322	0.039	100	31.8	LOS C	0.5	6.5	Full	500	0.0	0.0
Lane 3	363	3.7	519	0.699	100	39.1	LOS D	17.7	127.5	Full	500	0.0	0.0
Lane 4	357	3.7	511	0.699	100	38.9	LOS D	17.3	125.1	Full	500	0.0	0.0
Lane 5	96	7.7	144	0.665	100	62.6	LOS E	5.4	40.1	Short	70	0.0	NA
Approach	915	5.2		0.699		41.3	LOS D	17.7	127.5				
NorthEast: Town Center Rd 1													
Lane 1	411	1.8	584 [1]	0.703	100	39.2	LOS D	18.9	134.3	Full	500	0.0	0.0
Lane 2	252	0.0	643 [1]	0.391	100	29.8	LOS C	10.3	71.8	Short	70	0.0	NA
Lane 3	39	0.0	169	0.231	100	57.6	LOS E	2.0	14.1	Short	40	0.0	NA
Approach	701	1.1		0.703		36.9	LOS D	18.9	134.3				
NorthWest: Ripley Rd													
Lane 1	102	0.0	506	0.202	100	38.7	LOS D	4.2	29.5	Short	30	0.0	NA
Lane 2 (BL)	14	100.0	322	0.042	100	31.8	LOS C	0.5	7.1	Full	500	0.0	0.0
Lane 3	347	3.2	521	0.666	100	38.6	LOS D	16.7	119.9	Full	500	0.0	0.0
Lane 4	313	3.2	470 [1]	0.666	100	37.7	LOS D	14.7	105.8	Full	500	0.0	0.0
Lane 5	46	0.0	152	0.305	100	59.2	LOS E	2.5	17.2	Short	30	0.0	NA
Approach	822	4.2		0.666		39.3	LOS D	16.7	119.9				
SouthWest: Town Center Rd 1													
Lane 1	154	2.7	638	0.241	100	29.3	LOS C	5.9	42.4	Full	500	0.0	0.0
Lane 2	113	0.0	169	0.667	100	61.2	LOS E	6.2	43.7	Short	50	0.0	NA
Approach	266	1.6		0.667		42.8	LOS D	6.2	43.7				
Intersection	2704	3.5		0.703		39.7	LOS D	18.9	134.3				

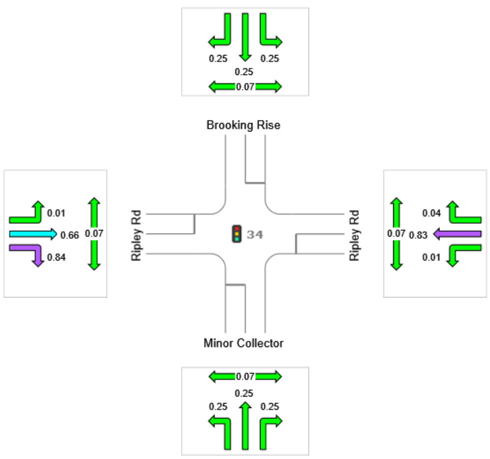
24 Intersection R1034

2031

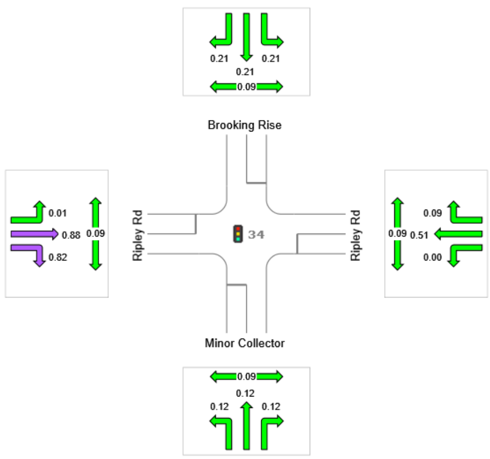
SITE LAYOUT – R1034 – 2031



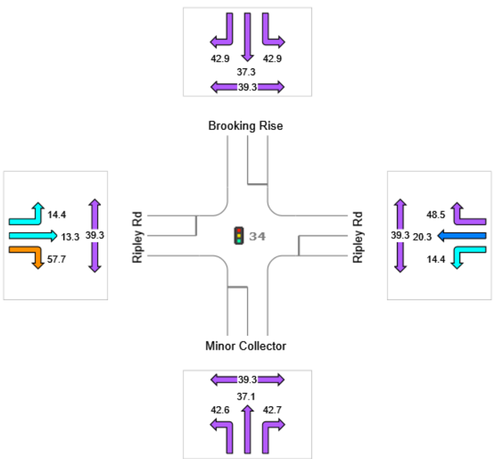
DEGREE OF SATURATION AM



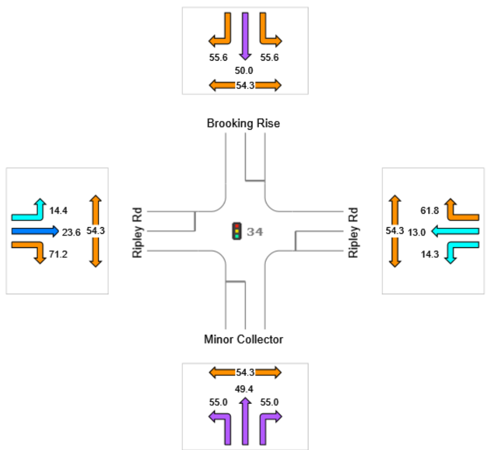
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1034– 2031 Cont.

LANE SUMMARY 2031 AM

Site: 34 [2031 AM - FINAL]

R1034
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 90 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Minor Collector													
Lane 1	66	0.0	269	0.247	100	42.5	LOS D	2.6	18.5	Full	500	0.0	0.0
Approach	66	0.0		0.247		42.5	LOS D	2.6	18.5				
East: Ripley Rd													
Lane 1	9	0.0	1052	0.009	100	14.4	LOS B	0.2	1.2	Short	30	0.0	NA
Lane 2 (BL)	2	100.0	670	0.003	100	8.9	LOS A	0.0	0.5	Full	500	0.0	0.0
Lane 3	908	0.8	1093 [1]	0.832	100	20.3	LOS C	34.9	246.3	Full	500	0.0	0.0
Lane 4	6	0.0	144	0.044	100	48.5	LOS D	0.3	1.9	Short	30	0.0	NA
Approach	926	1.0		0.832		20.4	LOS C	34.9	246.3				
North: Brooking Rise													
Lane 1	61	0.0	242	0.253	100	41.1	LOS D	2.4	17.1	Full	500	0.0	0.0
Approach	61	0.0		0.253		41.1	LOS D	2.4	17.1				
West: Ripley Rd													
Lane 1	8	0.0	1052	0.008	100	14.4	LOS B	0.2	1.1	Short	30	0.0	NA
Lane 2 (BL)	3	100.0	670	0.005	100	8.9	LOS A	0.1	0.8	Full	500	0.0	0.0
Lane 3	600	6.1	910 [1]	0.660	100	13.3	LOS B	16.7	122.9	Full	500	0.0	0.0
Lane 4	121	0.9	144	0.843	100	57.7	LOS E	6.0	42.4	Short	30	0.0	NA
Approach	733	5.6		0.843		20.6	LOS C	16.7	122.9				
Intersection	1786	2.8		0.843		22.0	LOS C	34.9	246.3				

Intersection R1034– 2031 Cont.

LANE SUMMARY 2031 PM

Site: 34 [2031 PM - FINAL]

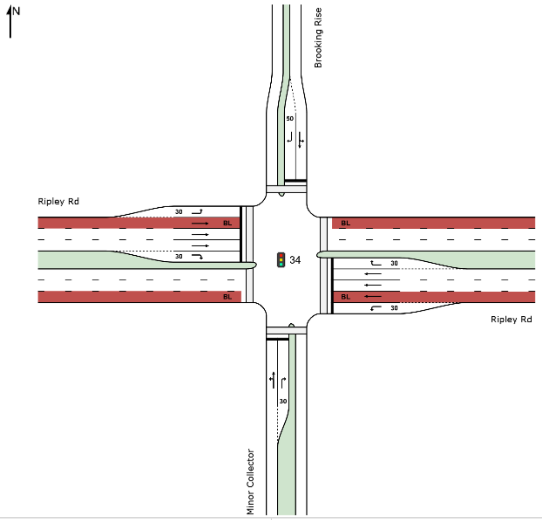
R1034
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

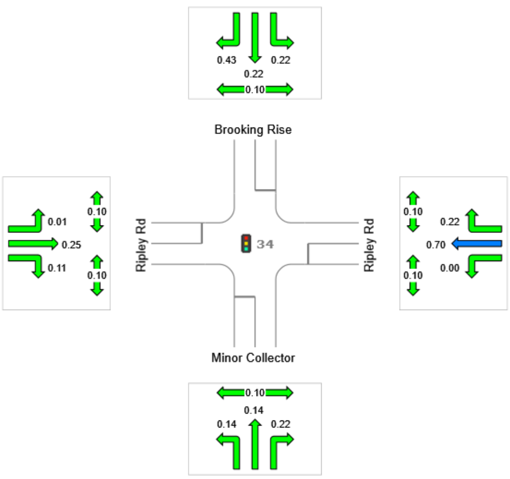
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Minor Collector													
Lane 1	27	0.0	221	0.124	100	54.8	LOS D	1.4	10.0	Full	500	0.0	0.0
Approach	27	0.0		0.124		54.8	LOS D	1.4	10.0				
East: Ripley Rd													
Lane 1	3	0.0	1161	0.003	100	14.3	LOS B	0.1	0.5	Short	30	0.0	NA
Lane 2 (BL)	4	100.0	739	0.006	100	8.9	LOS A	0.1	1.2	Full	500	0.0	0.0
Lane 3	612	0.0	1194 [1]	0.512	100	13.0	LOS B	19.2	134.3	Full	500	0.0	0.0
Lane 4	14	0.0	155	0.088	100	61.8	LOS E	0.8	5.3	Short	30	0.0	NA
Approach	633	0.7		0.512		14.0	LOS B	19.2	134.3				
North: Brooking Rise													
Lane 1	52	0.0	245	0.210	100	51.9	LOS D	2.7	19.1	Full	500	0.0	0.0
Approach	52	0.0		0.210		51.9	LOS D	2.7	19.1				
West: Ripley Rd													
Lane 1	11	0.0	1161	0.009	100	14.4	LOS B	0.2	1.6	Short	30	0.0	NA
Lane 2 (BL)	4	100.0	739	0.006	100	8.9	LOS A	0.1	1.2	Full	500	0.0	0.0
Lane 3	934	2.6	1066 [1]	0.876	100	23.7	LOS C	44.2	316.3	Full	500	0.0	0.0
Lane 4	127	0.0	155	0.823	100	71.2	LOS E	8.1	56.8	Short	30	0.0	NA
Approach	1076	2.6		0.876		29.2	LOS C	44.2	316.3				
Intersection	1787	1.8		0.876		24.9	LOS C	44.2	316.3				

Intersection R1034-2041

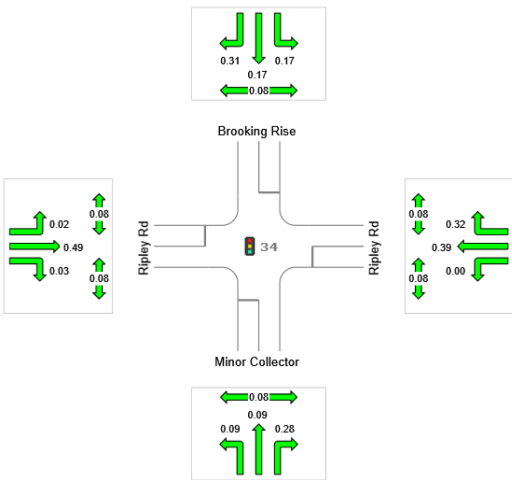
SITE LAYOUT – R1034 – 2041



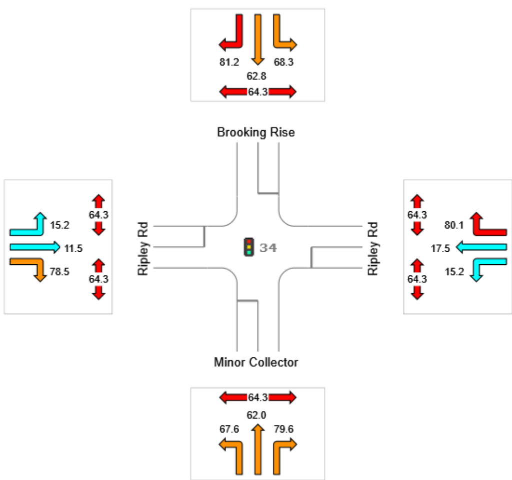
DEGREE OF SATURATION AM



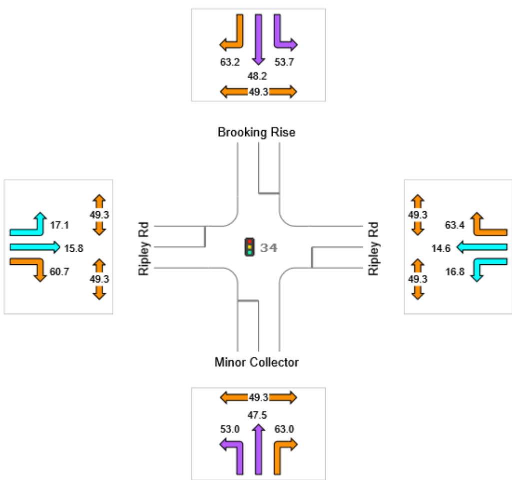
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1034 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 34 [2041 AM - FINAL]

R1034
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Minor Collector													
Lane 1	28	0.0	200	0.142	100	66.9	LOS E	1.8	12.5	Full	500	0.0	0.0
Lane 2	18	0.0	80	0.225	100	79.6	LOS E	1.3	8.8	Short	30	0.0	NA
Approach	46	0.0		0.225		71.8	LOS E	1.8	12.5				
East: Ripley Rd													
Lane 1	5	0.0	1181	0.004	100	15.2	LOS B	0.1	0.9	Short	30	0.0	NA
Lane 2 (BL)	12	100.0	751	0.015	100	9.8	LOS A	0.3	3.7	Full	500	0.0	0.0
Lane 3	855	2.9	1217	0.702	100	17.7	LOS B	37.6	269.9	Full	500	0.0	0.0
Lane 4	839	2.9	1194 [1]	0.702	100	17.4	LOS B	36.4	260.7	Full	500	0.0	0.0
Lane 5	16	13.3	73	0.217	100	80.1	LOS F	1.1	8.7	Short	30	0.0	NA
Approach	1726	3.6		0.702		18.1	LOS B	37.6	269.9				
North: Brooking Rise													
Lane 1	44	0.0	201	0.220	100	67.1	LOS E	2.8	19.7	Full	500	0.0	0.0
Lane 2	33	6.5	76	0.429	100	81.2	LOS F	2.3	17.2	Short	50	0.0	NA
Approach	77	2.7		0.429		73.1	LOS E	2.8	19.7				
West: Ripley Rd													
Lane 1	15	0.0	1181	0.012	100	15.2	LOS B	0.4	2.5	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	751	0.017	100	9.8	LOS A	0.3	4.0	Full	500	0.0	0.0
Lane 3	297	4.3	1206	0.246	100	11.5	LOS B	8.5	62.0	Full	500	0.0	0.0
Lane 4	289	4.3	1174 [1]	0.246	100	11.5	LOS B	8.3	60.0	Full	500	0.0	0.0
Lane 5	8	0.0	80	0.106	100	78.5	LOS E	0.6	4.1	Short	30	0.0	NA
Approach	622	6.1		0.246		12.5	LOS B	8.5	62.0				
Intersection	2472	4.1		0.702		19.4	LOS B	37.6	269.9				

Intersection R1034 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 34 [2041 PM - FINAL]

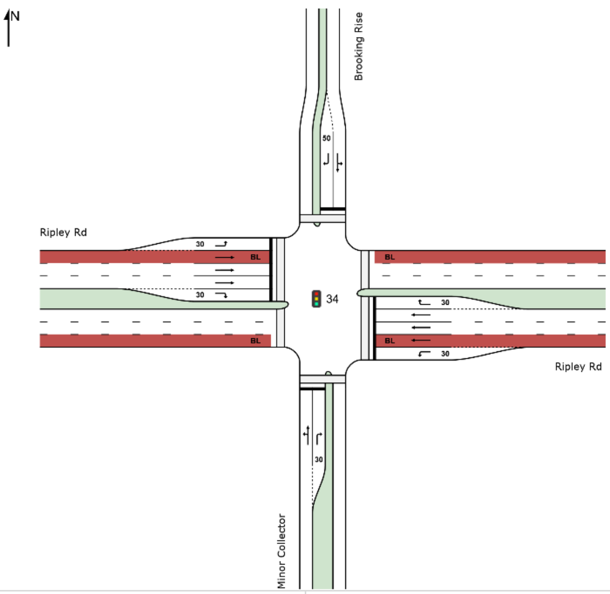
R1034
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

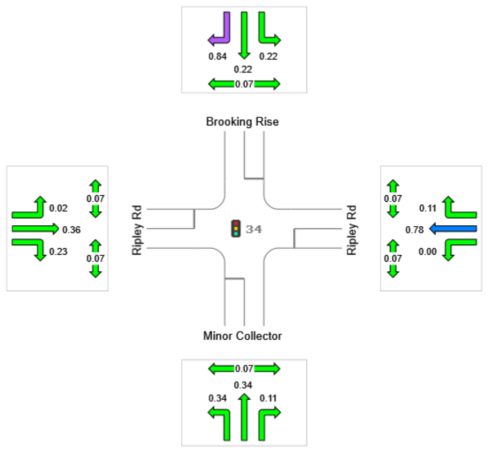
	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Minor Collector													
Lane 1	20	0.0	221	0.090	100	52.1	LOS D	1.0	6.8	Full	500	0.0	0.0
Lane 2	28	0.0	101	0.281	100	63.0	LOS E	1.6	11.0	Short	30	0.0	NA
Approach	48	0.0		0.281		58.5	LOS E	1.6	11.0				
East: Ripley Rd													
Lane 1	1	0.0	1030	0.001	100	16.8	LOS B	0.0	0.2	Short	30	0.0	NA
Lane 2 (BL)	12	100.0	655	0.018	100	11.6	LOS B	0.3	3.6	Full	500	0.0	0.0
Lane 3	414	2.8	1062	0.390	100	14.8	LOS B	12.4	89.2	Full	500	0.0	0.0
Lane 4	386	2.8	989[1]	0.390	100	14.5	LOS B	11.4	81.5	Full	500	0.0	0.0
Lane 5	31	6.9	97	0.316	100	63.4	LOS E	1.7	12.5	Short	30	0.0	NA
Approach	843	4.2		0.390		16.4	LOS B	12.4	89.2				
North: Brooking Rise													
Lane 1	38	0.0	221	0.171	100	52.8	LOS D	1.9	13.1	Full	500	0.0	0.0
Lane 2	32	0.0	101	0.312	100	63.2	LOS E	1.7	12.2	Short	50	0.0	NA
Approach	69	0.0		0.312		57.5	LOS E	1.9	13.1				
West: Ripley Rd													
Lane 1	25	0.0	1030	0.025	100	17.1	LOS B	0.6	4.2	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	655	0.019	100	11.7	LOS B	0.3	3.9	Full	500	0.0	0.0
Lane 3	525	1.0	1074	0.489	100	15.9	LOS B	17.0	119.9	Full	500	0.0	0.0
Lane 4	522	1.0	1068[1]	0.489	100	15.9	LOS B	16.9	119.0	Full	500	0.0	0.0
Lane 5	3	0.0	101	0.031	100	60.7	LOS E	0.2	1.2	Short	30	0.0	NA
Approach	1088	2.1		0.489		16.0	LOS B	17.0	119.9				
Intersection	2049	2.9		0.489		18.6	LOS B	17.0	119.9				

Intersection R1034-2066

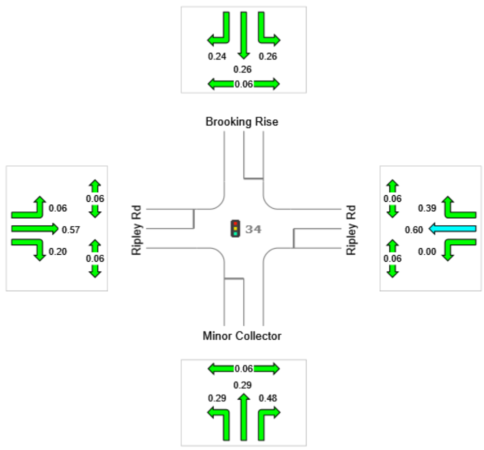
SITE LAYOUT – R1034 – 2066



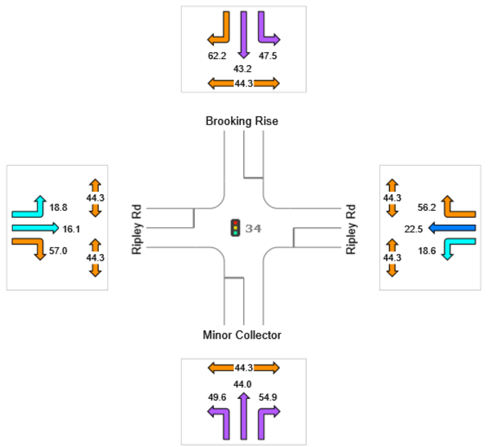
DEGREE OF SATURATION AM



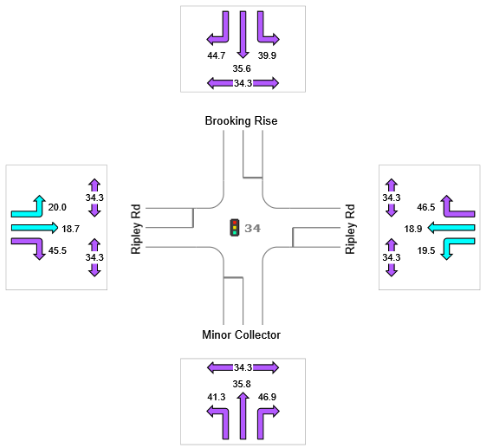
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1034 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 34 [2066 AM - FINAL same as 2041]

R1034
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Minor Collector													
Lane 1	81	0.0	242	0.336	100	49.5	LOS D	3.7	26.0	Full	500	0.0	0.0
Lane 2	15	0.0	130	0.113	100	54.9	LOS D	0.7	5.0	Short	30	0.0	NA
Approach	96	0.0		0.336		50.3	LOS D	3.7	26.0				
East: Ripley Rd													
Lane 1	4	0.0	929	0.005	100	18.6	LOS B	0.1	0.7	Short	30	0.0	NA
Lane 2 (BL)	12	100.0	591	0.020	100	13.4	LOS B	0.3	3.7	Full	500	0.0	0.0
Lane 3	751	2.9	957	0.784	100	22.6	LOS C	30.4	218.1	Full	500	0.0	0.0
Lane 4	740	2.9	943 [1]	0.784	100	22.5	LOS C	29.7	213.4	Full	500	0.0	0.0
Lane 5	13	0.0	111	0.113	100	56.2	LOS E	0.6	4.3	Short	30	0.0	NA
Approach	1519	3.6		0.784		22.8	LOS C	30.4	218.1				
North: Brooking Rise													
Lane 1	54	3.9	240	0.223	100	45.4	LOS D	2.4	17.5	Full	60	0.0	0.0
Lane 2	109	0.0	130	0.842	100	62.2	LOS E	6.0	42.0	Short	50	0.0	NA
Approach	163	1.3		0.842		56.7	LOS E	6.0	42.0				
West: Ripley Rd													
Lane 1	17	0.0	929	0.018	100	18.8	LOS B	0.4	2.8	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	591	0.021	100	13.4	LOS B	0.3	4.0	Full	500	0.0	0.0
Lane 3	337	6.3	937	0.360	100	16.3	LOS B	9.9	73.4	Full	500	0.0	0.0
Lane 4	316	6.3	878 [1]	0.360	100	16.0	LOS B	9.2	67.8	Full	500	0.0	0.0
Lane 5	25	0.0	111	0.227	100	57.0	LOS E	1.3	8.8	Short	30	0.0	NA
Approach	708	7.6		0.360		17.6	LOS B	9.9	73.4				
Intersection	2486	4.4		0.842		24.6	LOS C	30.4	218.1				

Intersection R1034 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 34 [2066 PM - FINAL same as 2041]

R1034
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

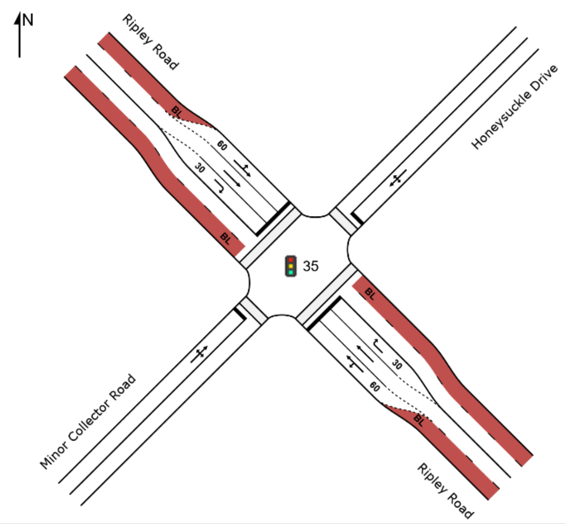
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Minor Collector													
Lane 1	68	0.0	235	0.292	100	40.1	LOS D	2.5	17.8	Full	500	0.0	0.0
Lane 2	67	0.0	139	0.484	100	46.9	LOS D	2.7	19.1	Short	30	0.0	NA
Approach	136	0.0		0.484		43.5	LOS D	2.7	19.1				
East: Ripley Rd													
Lane 1	3	0.0	789	0.004	100	19.5	LOS B	0.1	0.5	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	502	0.025	100	14.4	LOS B	0.3	3.7	Full	500	0.0	0.0
Lane 3	492	2.3	816	0.602	100	19.2	LOS B	14.9	106.5	Full	500	0.0	0.0
Lane 4	449	2.3	746 [1]	0.602	100	18.7	LOS B	13.2	94.5	Full	500	0.0	0.0
Lane 5	55	0.0	139	0.393	100	46.5	LOS D	2.2	15.4	Short	30	0.0	NA
Approach	1012	3.4		0.602		20.4	LOS C	14.9	106.5				
North: Brooking Rise													
Lane 1	60	0.0	233	0.258	100	39.6	LOS D	2.2	15.5	Full	60	0.0	0.0
Lane 2	32	6.7	133	0.237	100	44.7	LOS D	1.2	9.2	Short	50	0.0	NA
Approach	92	2.3		0.258		41.4	LOS D	2.2	15.5				
West: Ripley Rd													
Lane 1	45	0.0	789	0.057	100	20.0	LOS B	1.0	7.2	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	502	0.025	100	14.4	LOS B	0.3	3.7	Full	500	0.0	0.0
Lane 3	469	1.7	820	0.572	100	18.9	LOS B	14.0	99.2	Full	500	0.0	0.0
Lane 4	447	1.7	782 [1]	0.572	100	18.6	LOS B	13.1	93.2	Full	500	0.0	0.0
Lane 5	27	0.0	139	0.196	100	45.5	LOS D	1.1	7.5	Short	30	0.0	NA
Approach	1001	2.8		0.572		19.5	LOS B	14.0	99.2				
Intersection	2240	2.9		0.602		22.2	LOS C	14.9	106.5				

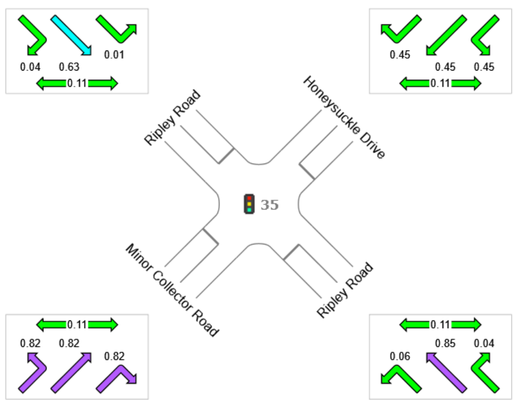
25 Intersection R1035

2031

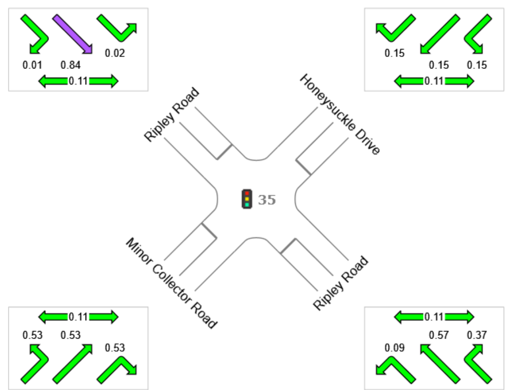
SITE LAYOUT – R1035 – 2031



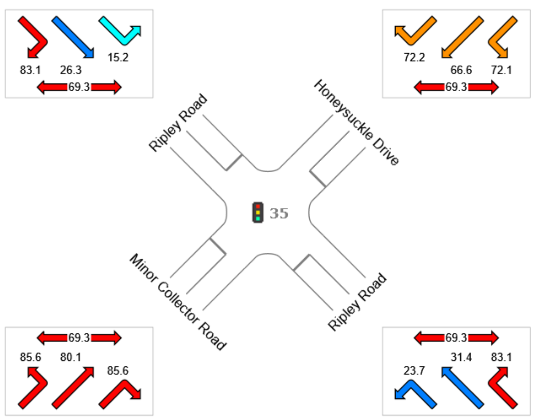
DEGREE OF SATURATION AM



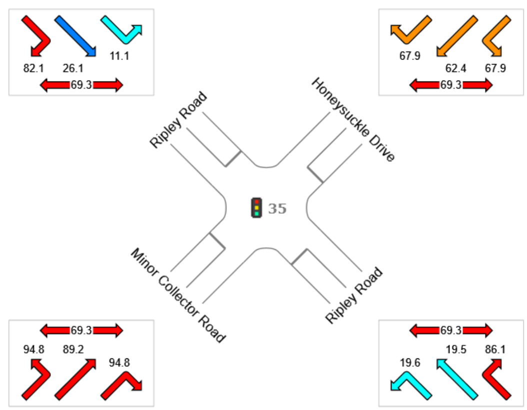
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1035 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 35 [2031 AM - FINAL]

R1035
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total	HV						Veh	Dist				
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Road													
Lane 1(..-BL)	62	3.4	960	0.065	100	23.3	LOS C	2.2	15.5	Two Seg [10]	500	0.0	0.0
Lane 2	817	0.9	966 [1]	0.846	100	31.4	LOS C	48.6	342.7	Full	500	0.0	0.0
Lane 3	3	0.0	74	0.043	100	83.1	LOS F	0.2	1.6	Short	30	0.0	NA
Approach	882	1.1		0.846		31.1	LOS C	48.6	342.7				
NorthEast: Honeysuckle Drive													
Lane 1	102	0.0	226	0.451	100	70.8	LOS E	7.1	49.4	Full	500	0.0	0.0
Approach	102	0.0		0.451		70.8	LOS E	7.1	49.4				
NorthWest: Ripley Road													
Lane 1(..-BL)	8	37.5	845	0.010	100	12.2	LOS B	0.2	1.8	Two Seg [10]	500	0.0	0.0
Lane 2	613	6.2	978 [1]	0.626	100	26.4	LOS C	30.9	227.9	Full	500	0.0	0.0
Lane 3	3	0.0	74	0.043	100	83.1	LOS F	0.2	1.6	Short	30	0.0	NA
Approach	624	6.6		0.626		26.4	LOS C	30.9	227.9				
SouthWest: Minor Collector Road													
Lane 1	263	1.2	320	0.822	100	85.4	LOS F	19.0	134.2	Full	500	0.0	0.0
Approach	263	1.2		0.822		85.4	LOS F	19.0	134.2				
Intersection	1872	2.9		0.846		39.3	LOS D	48.6	342.7				

Intersection R1035 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 35 [2031 PM - FINAL]

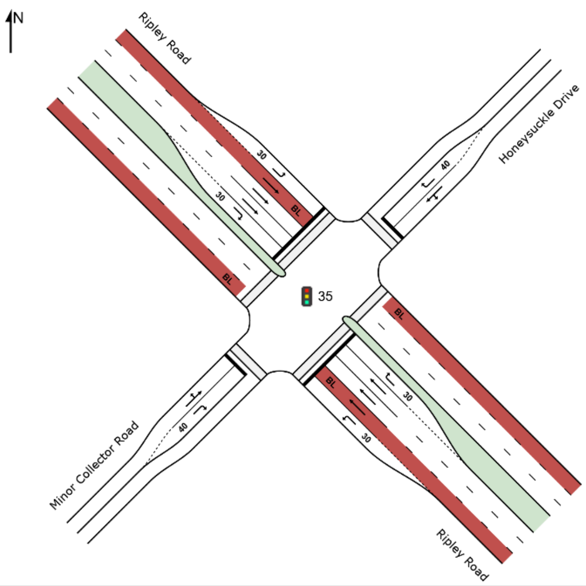
R1035
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

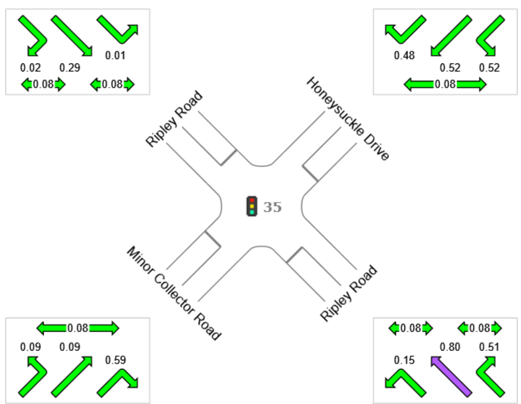
	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Road													
Lane 1(..-BL)	98	4.3	1063	0.092	100	19.2	LOS B	3.0	21.9	Two Seg [10]	500	0.0	0.0
Lane 2	606	0.0	1060 [1]	0.572	100	19.6	LOS B	26.0	182.0	Full	500	0.0	0.0
Lane 3	27	0.0	74	0.368	100	86.1	LOS F	2.1	14.6	Short	30	0.0	NA
Approach	732	0.6		0.572		22.0	LOS C	26.0	182.0				
NorthEast: Honeysuckle Drive													
Lane 1	36	0.0	241	0.148	100	66.8	LOS E	2.3	16.3	Full	500	0.0	0.0
Approach	36	0.0		0.148		66.8	LOS E	2.3	16.3				
NorthWest: Ripley Road													
Lane 1(..-BL)	23	13.6	1121	0.021	100	9.7	LOS A	0.4	3.0	Two Seg [10]	500	0.0	0.0
Lane 2	929	2.6	1102 [1]	0.843	100	26.2	LOS C	53.5	382.5	Full	500	0.0	0.0
Lane 3	1	0.0	74	0.014	100	82.1	LOS F	0.1	0.5	Short	30	0.0	NA
Approach	954	2.9		0.843		25.9	LOS C	53.5	382.5				
SouthWest: Minor Collector Road													
Lane 1	105	3.0	200	0.526	100	94.0	LOS F	8.3	59.8	Full	500	0.0	0.0
Approach	105	3.0		0.526		94.0	LOS F	8.3	59.8				
Intersection	1826	1.9		0.843		29.1	LOS C	53.5	382.5				

Intersection R1035-2041

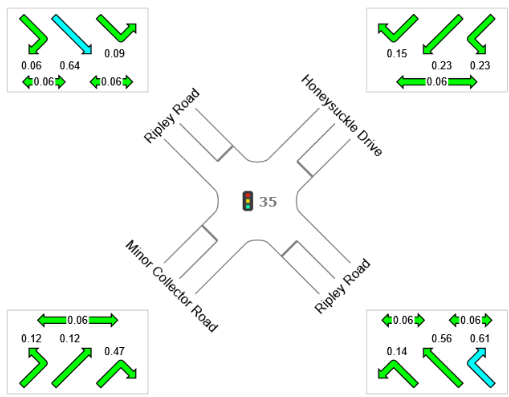
SITE LAYOUT – R1035 – 2041



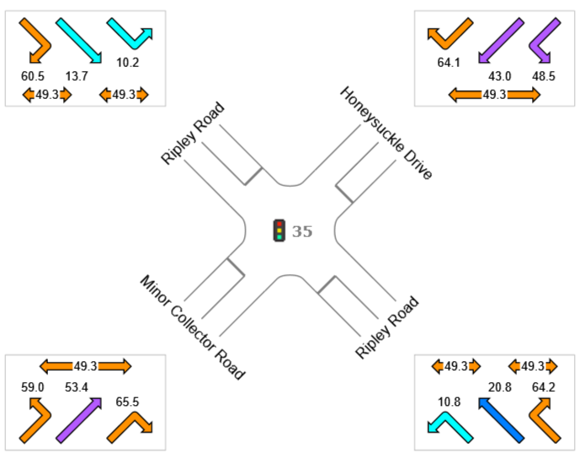
DEGREE OF SATURATION AM



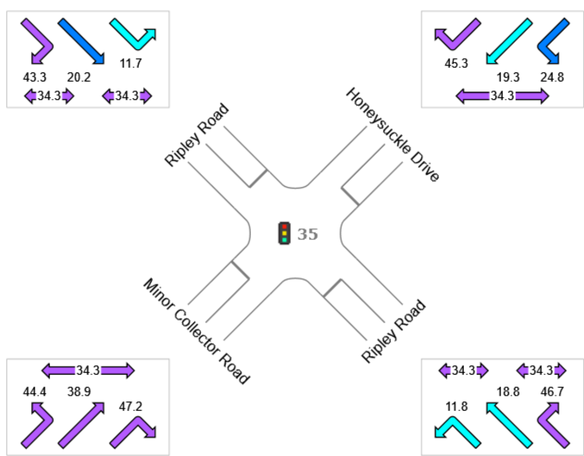
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1035 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 35 [2041 AM - FINAL]

R1035
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Road													
Lane 1	158	6.0	1085	0.146	100	10.8	LOS B	2.1	15.3	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	655	0.019	100	11.7	LOS B	0.3	3.9	Full	500	0.0	0.0
Lane 3	853	3.0	1061	0.804	100	21.1	LOS C	36.5	262.0	Full	500	0.0	0.0
Lane 4	807	3.0	1004 [1]	0.804	100	20.7	LOS C	33.5	240.4	Full	500	0.0	0.0
Lane 5	52	0.0	101	0.509	100	64.2	LOS E	2.9	20.3	Short	30	0.0	NA
Approach	1882	3.8		0.804		21.2	LOS C	36.5	262.0				
NorthEast: Honeysuckle Drive													
Lane 1	145	0.7	277	0.524	100	46.9	LOS D	6.3	44.4	Full	500	0.0	0.0
Lane 2	47	2.2	100	0.475	100	64.1	LOS E	2.7	19.0	Short	40	0.0	NA
Approach	193	1.1		0.524		51.1	LOS D	6.3	44.4				
NorthWest: Ripley Road													
Lane 1	11	0.0	1131	0.009	100	10.2	LOS B	0.1	0.9	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	655	0.019	100	11.7	LOS B	0.3	3.9	Full	500	0.0	0.0
Lane 3	309	3.8	1056	0.293	100	13.8	LOS B	8.7	62.6	Full	500	0.0	0.0
Lane 4	307	3.8	1049 [1]	0.293	100	13.8	LOS B	8.6	62.2	Full	500	0.0	0.0
Lane 5	2	0.0	101	0.021	100	60.5	LOS E	0.1	0.8	Short	30	0.0	NA
Approach	641	5.6		0.293		13.8	LOS B	8.7	62.6				
SouthWest: Minor Collector Road													
Lane 1	21	0.0	235	0.090	100	54.3	LOS D	1.2	8.1	Full	500	0.0	0.0
Lane 2	55	13.5	92	0.592	100	65.5	LOS E	3.1	24.5	Short	40	0.0	NA
Approach	76	9.7		0.592		62.4	LOS E	3.1	24.5				
Intersection	2792	4.2		0.804		22.7	LOS C	36.5	262.0				

LANE SUMMARY 2041 PM

Site: 35 [2041 PM - FINAL]

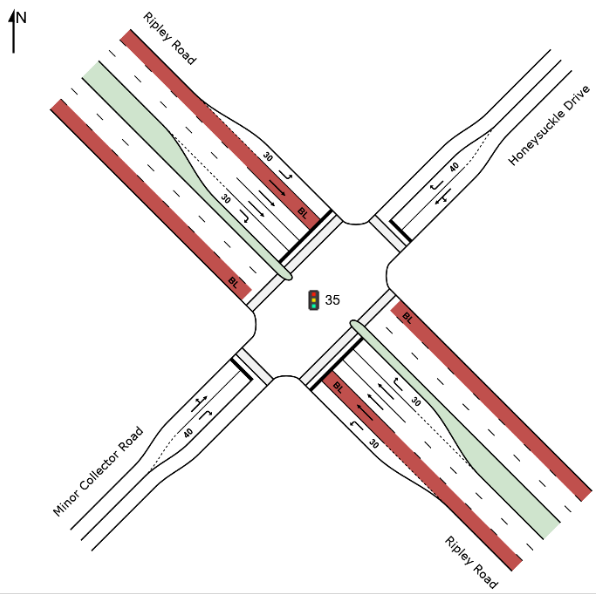
R1035
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

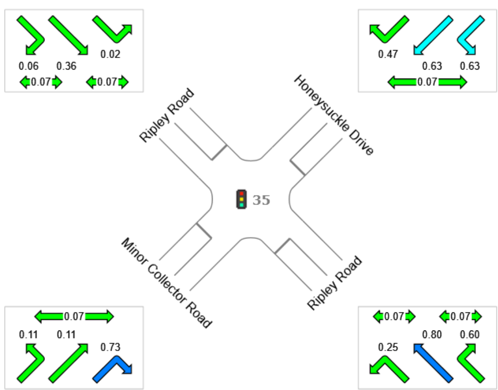
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Road													
Lane 1	26	0.8	900	0.029	20[6]	11.4	LOS B	0.3	1.9	Short	30	0.0	NA
Lane 2 (BL)	122	10.2	852	0.143	100	11.0	LOS B	1.4	10.7	Full	500	0.0	0.0
Lane 3	443	2.8	790	0.561	100	19.4	LOS B	13.3	95.3	Full	500	0.0	0.0
Lane 4	370	2.8	660[1]	0.561	100	18.5	LOS B	10.6	75.7	Full	500	0.0	0.0
Lane 5	99	0.0	163	0.609	100	46.7	LOS D	4.0	28.3	Short	30	0.0	NA
Approach	1059	3.4		0.609		20.5	LOS C	13.3	95.3				
NorthEast: Honeysuckle Drive													
Lane 1	73	0.0	319	0.228	100	23.2	LOS C	1.9	13.2	Full	500	0.0	0.0
Lane 2	21	0.0	139	0.151	100	45.3	LOS D	0.8	5.7	Short	40	0.0	NA
Approach	94	0.0		0.228		28.2	LOS C	1.9	13.2				
NorthWest: Ripley Road													
Lane 1	83	0.0	905	0.092	100	11.7	LOS B	0.9	6.5	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	488	0.026	100	15.0	LOS B	0.3	3.8	Full	500	0.0	0.0
Lane 3	509	1.0	799	0.637	100	20.3	LOS C	15.9	112.5	Full	500	0.0	0.0
Lane 4	501	1.0	786[1]	0.637	100	20.2	LOS C	15.6	110.0	Full	500	0.0	0.0
Lane 5	11	0.0	163	0.065	100	43.3	LOS D	0.4	2.8	Short	30	0.0	NA
Approach	1116	2.1		0.637		19.7	LOS B	15.9	112.5				
SouthWest: Minor Collector Road													
Lane 1	28	0.0	246	0.115	100	39.3	LOS D	1.0	7.1	Full	500	0.0	0.0
Lane 2	61	10.3	130	0.471	100	47.2	LOS D	2.5	18.9	Short	40	0.0	NA
Approach	89	7.1		0.471		44.7	LOS D	2.5	18.9				
Intersection	2358	2.8		0.637		21.4	LOS C	15.9	112.5				

Intersection R1035-2066

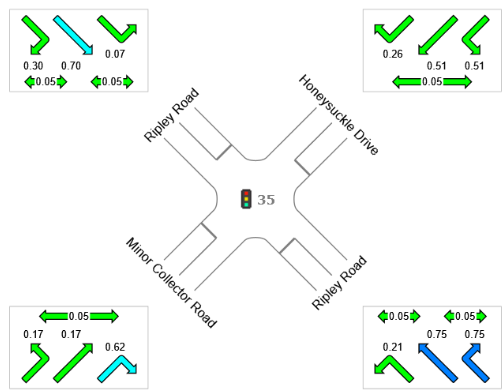
SITE LAYOUT – R1035 – 2066



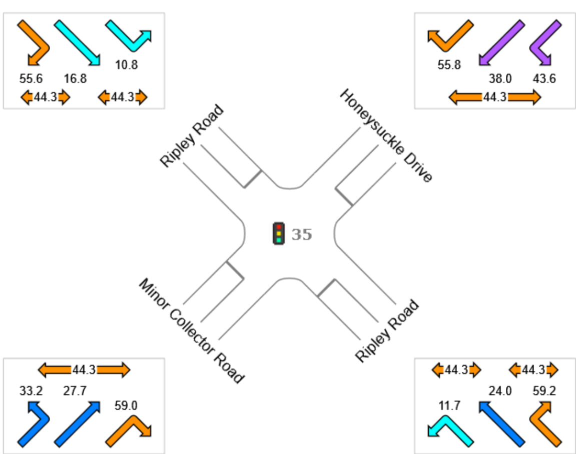
DEGREE OF SATURATION AM



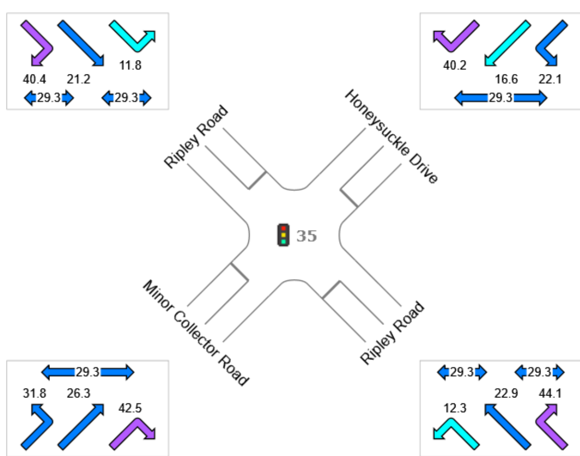
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



LANE SUMMARY 2066 AM

Site: 35 [2066 AM - FINAL same as 2041]

R1035
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Road													
Lane 1	260	2.4	1041	0.250	100	11.7	LOS B	3.7	26.2	Short	30	0.0	NA
Lane 2 (BL)	11	100.0	579	0.018	100	13.9	LOS B	0.3	3.4	Full	500	0.0	0.0
Lane 3	747	3.1	937	0.798	100	24.3	LOS C	31.3	225.1	Full	500	0.0	0.0
Lane 4	691	3.1	866 [1]	0.798	100	23.8	LOS C	28.0	201.2	Full	500	0.0	0.0
Lane 5	66	0.0	111	0.595	100	59.2	LOS E	3.4	24.0	Short	30	0.0	NA
Approach	1775	3.4		0.798		23.5	LOS C	31.3	225.1				
NorthEast: Honeysuckle Drive													
Lane 1	194	1.1	307	0.630	100	42.0	LOS D	7.1	50.3	Full	500	0.0	0.0
Lane 2	69	0.0	149	0.468	100	55.8	LOS E	3.4	24.1	Short	40	0.0	NA
Approach	263	0.8		0.630		45.7	LOS D	7.1	50.3				
NorthWest: Ripley Road													
Lane 1	17	6.3	1013	0.017	100	10.8	LOS B	0.2	1.5	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	579	0.022	100	14.0	LOS B	0.3	4.1	Full	500	0.0	0.0
Lane 3	334	6.2	918	0.363	100	16.9	LOS B	10.0	73.8	Full	500	0.0	0.0
Lane 4	328	6.2	904 [1]	0.363	100	16.8	LOS B	9.8	72.4	Full	500	0.0	0.0
Lane 5	6	0.0	111	0.057	100	55.6	LOS E	0.3	2.1	Short	30	0.0	NA
Approach	698	7.8		0.363		17.0	LOS B	10.0	73.8				
SouthWest: Minor Collector Road													
Lane 1	31	0.0	279	0.110	100	30.4	LOS C	1.1	7.8	Full	500	0.0	0.0
Lane 2	105	4.0	144	0.729	100	59.0	LOS E	5.5	39.8	Short	40	0.0	NA
Approach	136	3.1		0.729		52.6	LOS D	5.5	39.8				
Intersection	2872	4.3		0.798		25.3	LOS C	31.3	225.1				

Intersection R1035 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 35 [2066 PM - FINAL same as 2041]

R1035
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

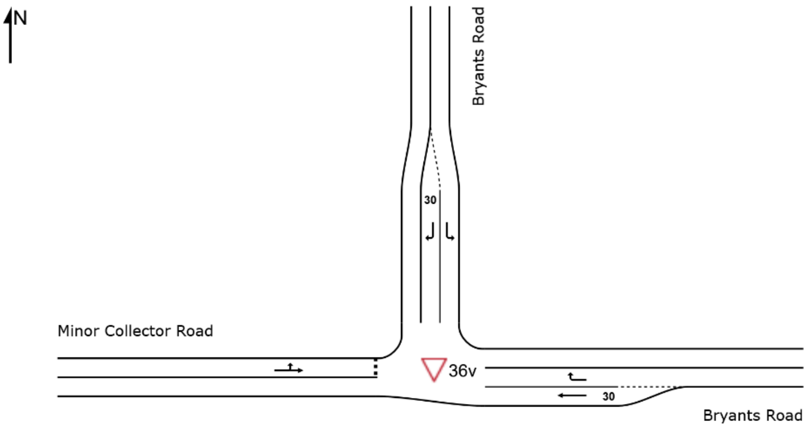
Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Road													
Lane 1	167	1.3	815	0.205	100	12.3	LOS B	1.9	13.5	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	422	0.030	100	15.9	LOS B	0.3	3.7	Full	500	0.0	0.0
Lane 3	513	2.3	686	0.748	100	23.2	LOS C	16.4	117.0	Full	500	0.0	0.0
Lane 4	435	2.3	582 [1]	0.748	100	22.6	LOS C	13.4	95.5	Full	500	0.0	0.0
Lane 5	118	1.8	157	0.750	100	44.1	LOS D	4.4	31.6	Short	30	0.0	NA
Approach	1246	3.1		0.750		23.5	LOS C	16.4	117.0				
NorthEast: Honeysuckle Drive													
Lane 1	185	0.6	360	0.514	100	21.1	LOS C	4.2	29.7	Full	500	0.0	0.0
Lane 2	41	0.0	159	0.258	100	40.2	LOS D	1.4	9.8	Short	40	0.0	NA
Approach	226	0.5		0.514		24.6	LOS C	4.2	29.7				
NorthWest: Ripley Road													
Lane 1	55	0.0	822	0.067	100	11.8	LOS B	0.6	4.1	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	422	0.030	100	15.9	LOS B	0.3	3.7	Full	500	0.0	0.0
Lane 3	480	1.6	689	0.696	100	21.5	LOS C	14.4	102.5	Full	500	0.0	0.0
Lane 4	447	1.6	642 [1]	0.696	100	21.2	LOS C	13.2	93.7	Full	500	0.0	0.0
Lane 5	48	0.0	159	0.304	100	40.4	LOS D	1.7	11.7	Short	30	0.0	NA
Approach	1042	2.6		0.696		21.6	LOS C	14.4	102.5				
SouthWest: Minor Collector Road													
Lane 1	44	0.0	262	0.169	100	27.5	LOS C	1.2	8.3	Full	500	0.0	0.0
Lane 2	94	7.9	151	0.622	100	42.5	LOS D	3.4	25.5	Short	40	0.0	NA
Approach	138	5.3		0.622		37.7	LOS D	3.4	25.5				
Intersection	2653	2.8		0.750		23.6	LOS C	16.4	117.0				

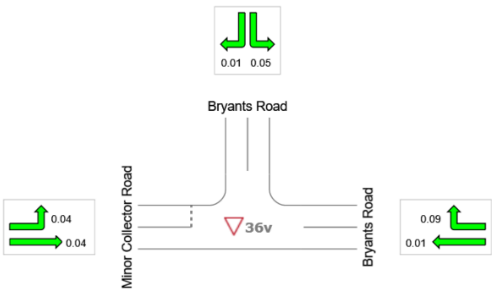
26 Intersection R1036

2031

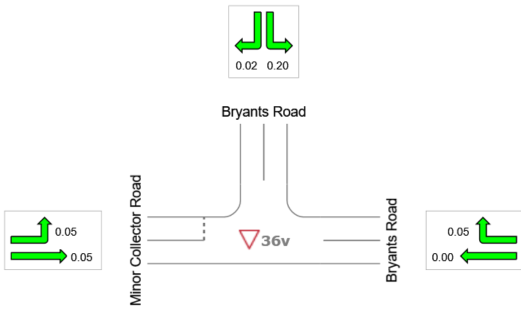
SITE LAYOUT – R1036 – 2031



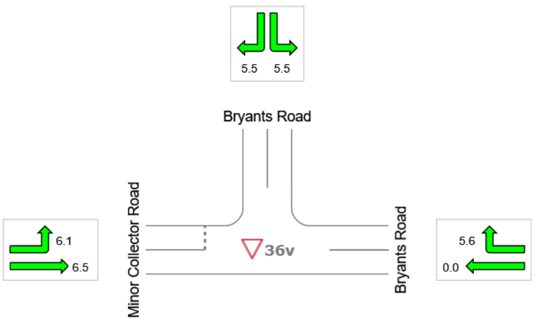
DEGREE OF SATURATION AM



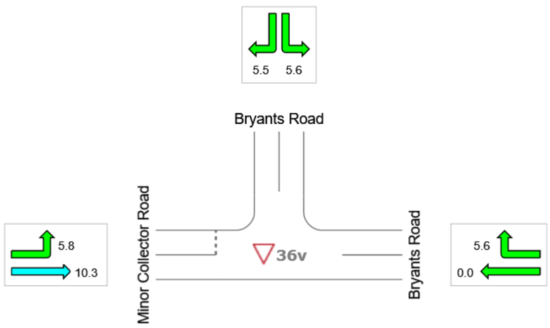
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1036 – 2031 Cont.

MOVEMENT SUMMARY 2031 AM

Site: 36v [2031 AM - FINAL]

R1036
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Bryants Road												
5	T1	18	0.0	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
6	R2	159	0.0	0.090	5.6	LOS A	0.4	3.0	0.09	0.55	0.09	53.1
Approach		177	0.0	0.090	5.0	NA	0.4	3.0	0.08	0.50	0.08	53.7
North: Bryants Road												
7	L2	86	0.0	0.047	5.5	LOS A	0.0	0.0	0.00	0.58	0.00	53.6
9	R2	24	4.3	0.014	5.5	LOS A	0.1	0.5	0.07	0.57	0.07	52.7
Approach		111	1.0	0.047	5.5	NA	0.1	0.5	0.02	0.57	0.02	53.4
West: Minor Collector Road												
10	L2	31	0.0	0.040	6.1	LOS A	0.1	1.0	0.29	0.56	0.29	52.9
11	T1	11	0.0	0.040	6.5	LOS A	0.1	1.0	0.29	0.56	0.29	53.3
Approach		41	0.0	0.040	6.2	LOS A	0.1	1.0	0.29	0.56	0.29	53.0
All Vehicles		328	0.3	0.090	5.3	NA	0.4	3.0	0.09	0.53	0.09	53.5

MOVEMENT SUMMARY 2031 PM

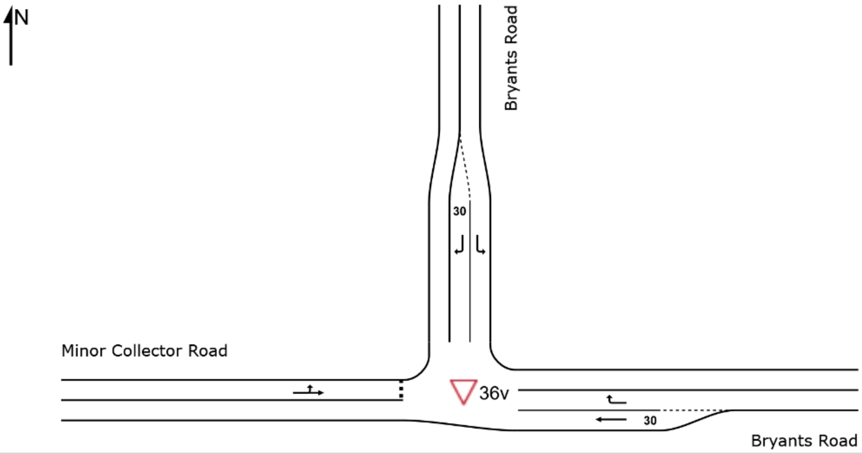
Site: 36v [2031 PM - FINAL]

R1036
Site Category: (None)
Giveway / Yield (Two-Way)

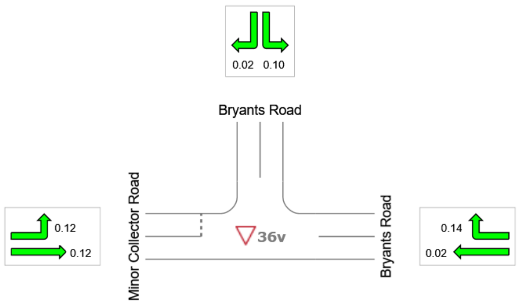
Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Bryants Road												
5	T1	8	0.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
6	R2	85	0.0	0.049	5.6	LOS A	0.2	1.6	0.11	0.55	0.11	53.1
Approach		94	0.0	0.049	5.1	NA	0.2	1.6	0.10	0.50	0.10	53.6
North: Bryants Road												
7	L2	377	0.6	0.204	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.6
9	R2	34	0.0	0.019	5.5	LOS A	0.1	0.6	0.05	0.58	0.05	53.0
Approach		411	0.5	0.204	5.6	NA	0.1	0.6	0.00	0.58	0.00	53.5
West: Minor Collector Road												
10	L2	29	0.0	0.048	5.8	LOS A	0.2	1.3	0.22	0.55	0.22	52.4
11	T1	12	18.2	0.048	10.3	LOS B	0.2	1.3	0.22	0.55	0.22	52.1
Approach		41	5.1	0.048	7.1	LOS A	0.2	1.3	0.22	0.55	0.22	52.3
All Vehicles		545	0.8	0.204	5.6	NA	0.2	1.6	0.04	0.56	0.04	53.5

Intersection R1036-2041

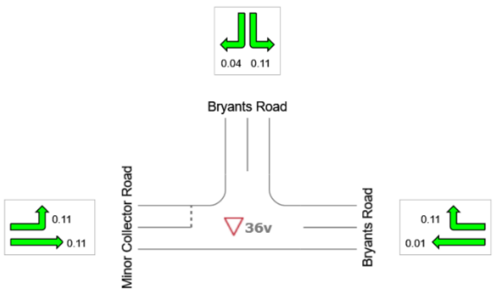
SITE LAYOUT – R1036 – 2041



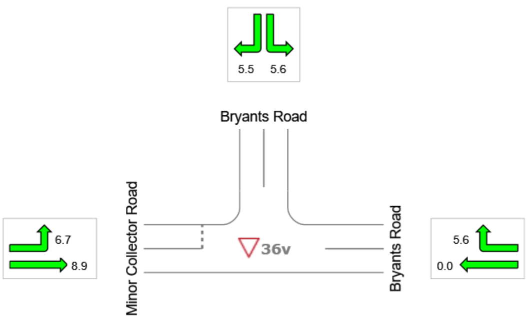
DEGREE OF SATURATION AM



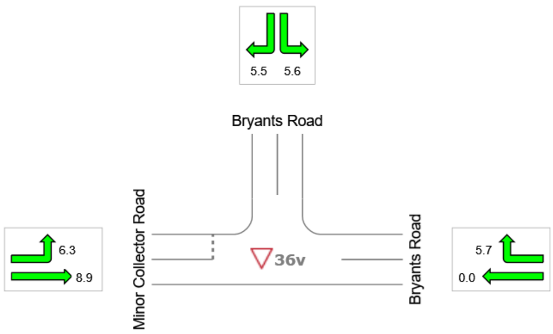
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1036 – 2041 Cont.

MOVEMENT SUMMARY 2041 AM

Site: 36v [2041 AM - FINAL same as 2031]

R1036
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
East: Bryants Road												
5	T1	34	6.3	0.018	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
6	R2	244	0.0	0.139	5.6	LOS A	0.7	4.9	0.10	0.55	0.10	53.1
Approach		278	0.8	0.139	4.9	NA	0.7	4.9	0.09	0.49	0.09	53.8
North: Bryants Road												
7	L2	180	0.0	0.097	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.6
9	R2	28	0.0	0.016	5.5	LOS A	0.1	0.5	0.11	0.56	0.11	52.8
Approach		208	0.0	0.097	5.5	NA	0.1	0.5	0.01	0.57	0.01	53.5
West: Minor Collector Road												
10	L2	80	2.6	0.120	6.7	LOS A	0.5	3.3	0.39	0.63	0.39	52.3
11	T1	25	0.0	0.120	8.9	LOS A	0.5	3.3	0.39	0.63	0.39	52.7
Approach		105	2.0	0.120	7.2	LOS A	0.5	3.3	0.39	0.63	0.39	52.4
All Vehicles		592	0.7	0.139	5.5	NA	0.7	4.9	0.12	0.54	0.12	53.5

MOVEMENT SUMMARY 2041 PM

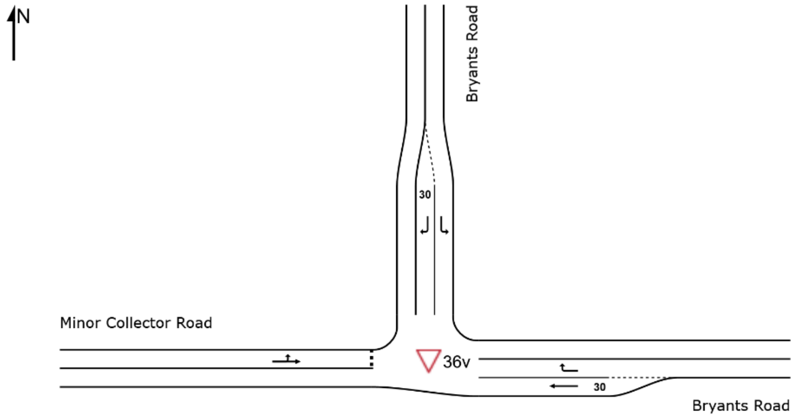
Site: 36v [2041 PM - FINAL same as 2031]

R1036
Site Category: (None)
Giveway / Yield (Two-Way)

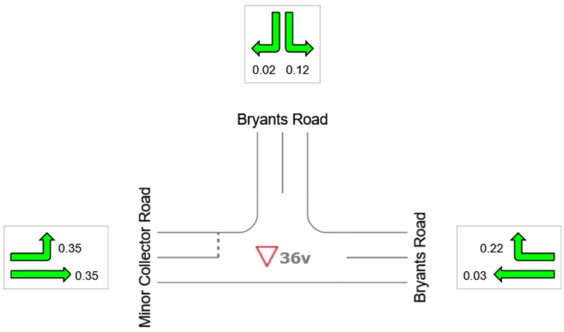
Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
East: Bryants Road												
5	T1	20	0.0	0.010	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
6	R2	180	0.0	0.107	5.7	LOS A	0.5	3.6	0.18	0.55	0.18	52.9
Approach		200	0.0	0.107	5.2	NA	0.5	3.6	0.16	0.49	0.16	53.5
North: Bryants Road												
7	L2	205	0.5	0.111	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.6
9	R2	76	1.4	0.043	5.5	LOS A	0.2	1.4	0.08	0.57	0.08	52.9
Approach		281	0.7	0.111	5.5	NA	0.2	1.4	0.02	0.57	0.02	53.4
West: Minor Collector Road												
10	L2	58	0.0	0.106	6.3	LOS A	0.4	2.9	0.36	0.61	0.36	52.3
11	T1	32	3.3	0.106	8.9	LOS A	0.4	2.9	0.36	0.61	0.36	52.5
Approach		89	1.2	0.106	7.2	LOS A	0.4	2.9	0.36	0.61	0.36	52.4
All Vehicles		571	0.6	0.111	5.7	NA	0.5	3.6	0.12	0.55	0.12	53.3

Intersection R1036-2066

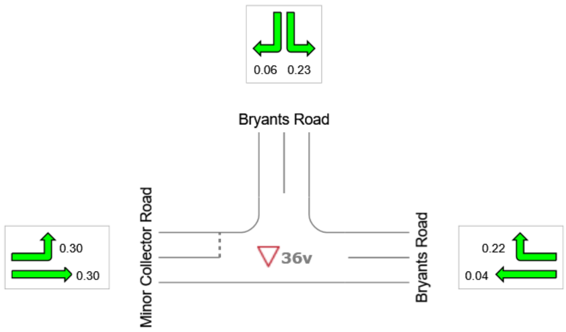
SITE LAYOUT – R1036 – 2066



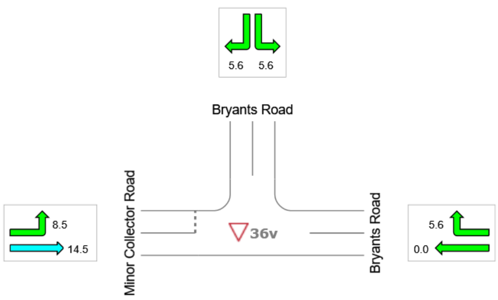
DEGREE OF SATURATION AM



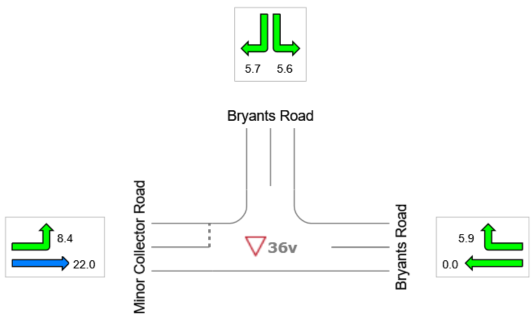
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



MOVEMENT SUMMARY 2066 AM

Site: 36v [2066AM - FINAL same as 2031]

R1036
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Bryants Road												
5	T1	63	5.0	0.033	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
6	R2	387	0.3	0.223	5.6	LOS A	1.2	8.5	0.13	0.55	0.13	53.0
Approach		451	0.9	0.223	4.9	NA	1.2	8.5	0.12	0.47	0.12	53.9
North: Bryants Road												
7	L2	226	1.9	0.124	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.5
9	R2	38	0.0	0.022	5.6	LOS A	0.1	0.7	0.15	0.56	0.15	52.7
Approach		264	1.6	0.124	5.6	NA	0.1	0.7	0.02	0.57	0.02	53.4
West: Minor Collector Road												
10	L2	154	0.7	0.355	8.5	LOS A	1.8	12.5	0.59	0.84	0.73	50.0
11	T1	75	0.0	0.355	14.5	LOS B	1.8	12.5	0.59	0.84	0.73	50.3
Approach		228	0.5	0.355	10.5	LOS B	1.8	12.5	0.59	0.84	0.73	50.1
All Vehicles		943	1.0	0.355	6.4	NA	1.8	12.5	0.21	0.59	0.24	52.8

MOVEMENT SUMMARY 2066 PM

Site: 36v [2066PM - FINAL same as 2031]

R1036
Site Category: (None)
Giveway / Yield (Two-Way)

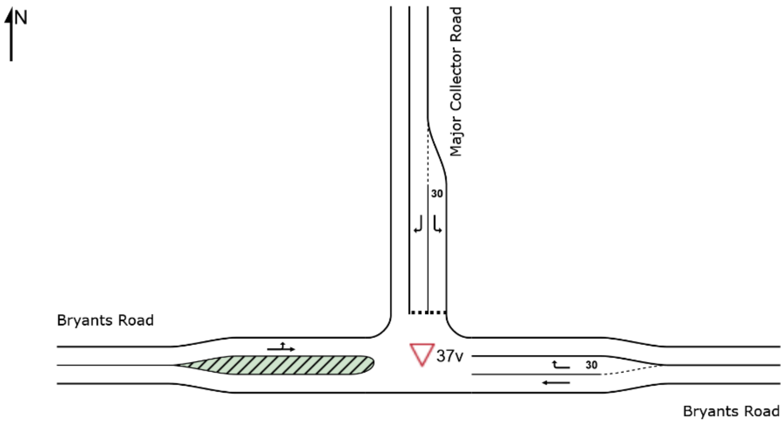
Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Bryants Road												
5	T1	75	1.4	0.039	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
6	R2	355	0.0	0.216	5.9	LOS A	1.1	8.0	0.25	0.56	0.25	52.7
Approach		429	0.2	0.216	4.9	NA	1.1	8.0	0.20	0.46	0.20	53.8
North: Bryants Road												
7	L2	424	0.0	0.230	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.6
9	R2	108	0.0	0.064	5.7	LOS A	0.3	2.1	0.17	0.56	0.17	52.7
Approach		533	0.0	0.230	5.6	NA	0.3	2.1	0.04	0.57	0.04	53.4
West: Minor Collector Road												
10	L2	55	0.0	0.299	8.4	LOS A	1.3	9.2	0.66	0.84	0.78	46.9
11	T1	58	10.9	0.299	22.0	LOS C	1.3	9.2	0.66	0.84	0.78	46.8
Approach		113	5.6	0.299	15.4	LOS C	1.3	9.2	0.66	0.84	0.78	46.8
All Vehicles		1075	0.7	0.299	6.3	NA	1.3	9.2	0.17	0.56	0.18	52.8

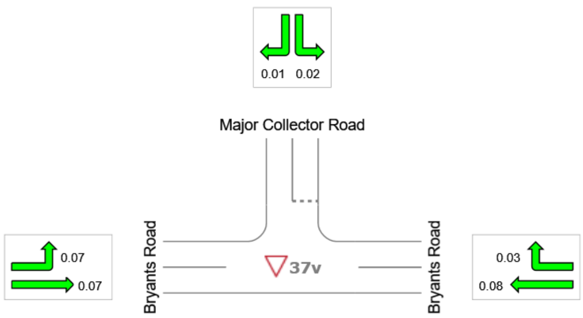
27 Intersection R1037

2031

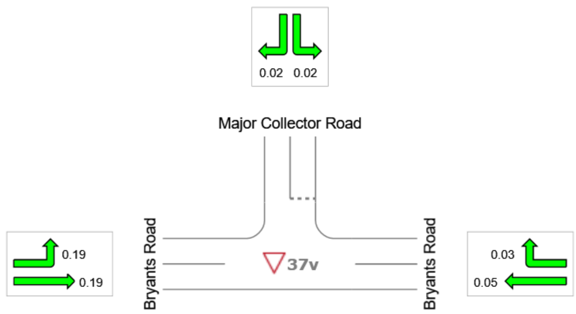
SITE LAYOUT – R1037 – 2031



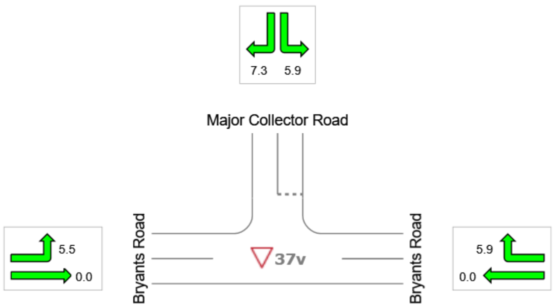
DEGREE OF SATURATION AM



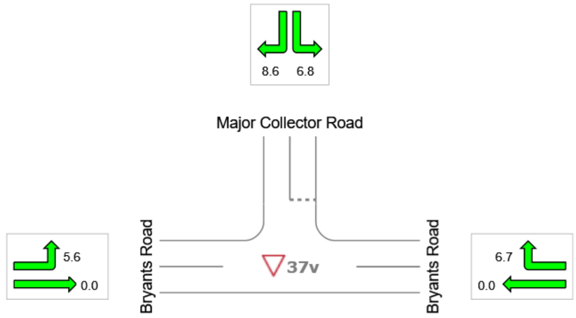
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1037 – 2031 Cont.

MOVEMENT SUMMARY 2031 AM

Site: 37v [2031 AM - FINAL same as 2026]

R1037
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Bryants Road												
5	T1	154	0.0	0.080	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
6	R2	51	0.0	0.032	5.9	LOS A	0.1	1.0	0.24	0.55	0.24	52.7
Approach		204	0.0	0.080	1.5	NA	0.1	1.0	0.06	0.14	0.06	58.0
North: Major Collector Road												
7	L2	36	0.0	0.024	5.9	LOS A	0.1	0.7	0.20	0.54	0.20	53.0
9	R2	8	0.0	0.010	7.3	LOS A	0.0	0.3	0.41	0.60	0.41	51.8
Approach		44	0.0	0.024	6.1	LOS A	0.1	0.7	0.24	0.55	0.24	52.7
West: Bryants Road												
10	L2	20	0.0	0.071	5.5	LOS A	0.0	0.0	0.00	0.09	0.00	57.6
11	T1	117	0.0	0.071	0.0	LOS A	0.0	0.0	0.00	0.09	0.00	59.2
Approach		137	0.0	0.071	0.8	NA	0.0	0.0	0.00	0.09	0.00	59.0
All Vehicles		385	0.0	0.080	1.8	NA	0.1	1.0	0.06	0.17	0.06	57.7

MOVEMENT SUMMARY 2031 PM

Site: 37v [2031 PM - FINAL same as 2026]

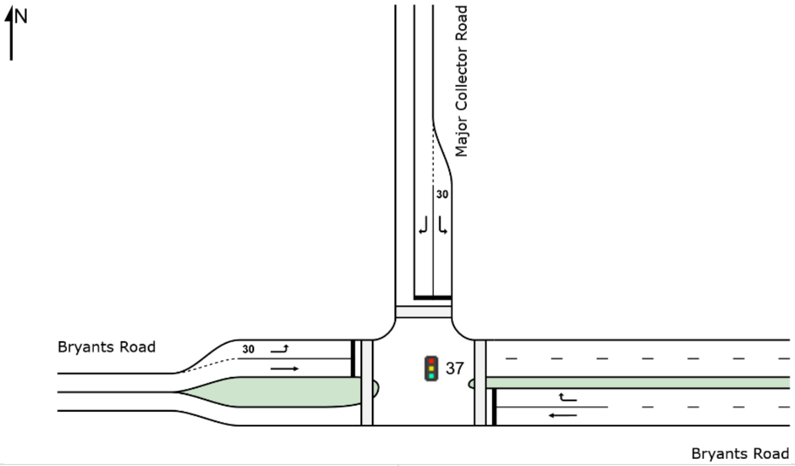
R1037
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

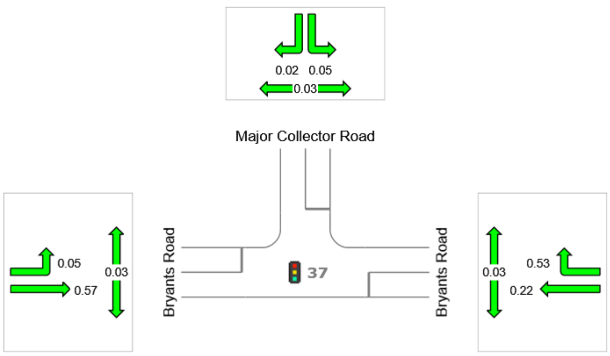
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Bryants Road												
5	T1	89	0.0	0.046	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
6	R2	41	0.0	0.032	6.7	LOS A	0.1	1.0	0.42	0.60	0.42	52.2
Approach		131	0.0	0.046	2.1	NA	0.1	1.0	0.13	0.19	0.13	57.3
North: Major Collector Road												
7	L2	25	4.2	0.022	6.8	LOS A	0.1	0.6	0.39	0.59	0.39	52.2
9	R2	14	0.0	0.021	8.6	LOS A	0.1	0.5	0.50	0.68	0.50	50.8
Approach		39	2.7	0.022	7.4	LOS A	0.1	0.6	0.43	0.62	0.43	51.7
West: Bryants Road												
10	L2	12	0.0	0.186	5.6	LOS A	0.0	0.0	0.00	0.02	0.00	58.2
11	T1	349	0.6	0.186	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.8
Approach		361	0.6	0.186	0.2	NA	0.0	0.0	0.00	0.02	0.00	59.7
All Vehicles		531	0.6	0.186	1.2	NA	0.1	1.0	0.06	0.11	0.06	58.5

Intersection R1037-2041

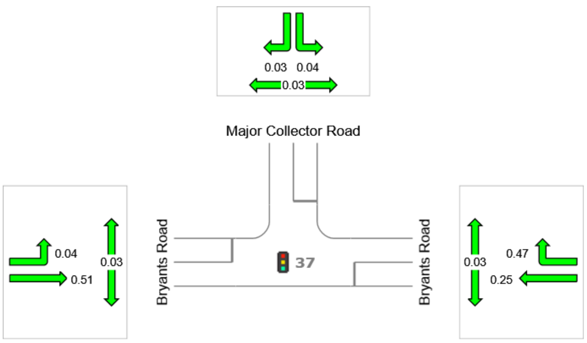
SITE LAYOUT – R1037 – 2041



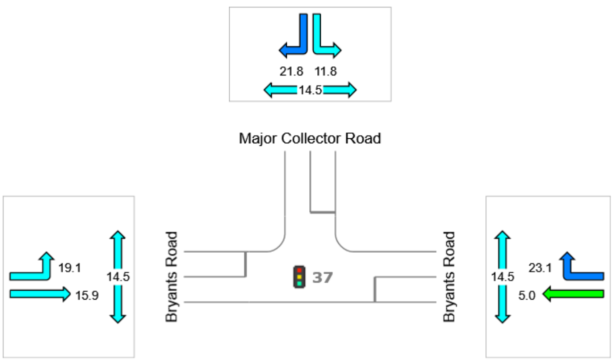
DEGREE OF SATURATION AM



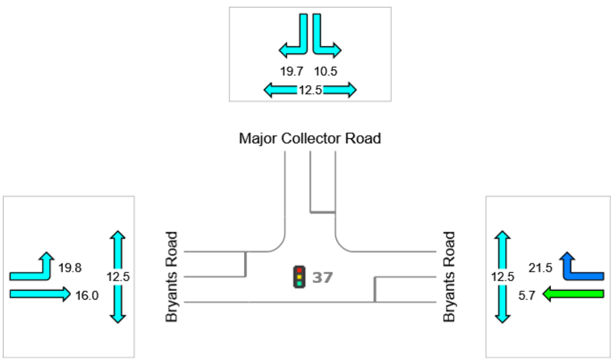
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1037 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 37 [2041 AM - FINAL]

R1037
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Bryants Road													
Lane 1	232	1.8	1060	0.218	100	5.0	LOS A	2.4	16.7	Full	500	0.0	0.0
Lane 2	172	1.2	322	0.533	100	23.1	LOS C	3.3	23.4	Full	500	0.0	0.0
Approach	403	1.6		0.533		12.7	LOS B	3.3	23.4				
North: Major Collector Road													
Lane 1	46	4.5	854	0.054	100	11.8	LOS B	0.5	3.6	Short	30	0.0	NA
Lane 2	4	0.0	279	0.015	100	21.8	LOS C	0.1	0.5	Full	500	0.0	0.0
Approach	51	4.2		0.054		12.6	LOS B	0.5	3.6				
West: Bryants Road													
Lane 1	22	0.0	418	0.053	100	19.1	LOS B	0.4	2.5	Short	30	0.0	NA
Lane 2	247	0.9	436	0.567	100	15.9	LOS B	4.6	32.4	Full	500	0.0	0.0
Approach	269	0.8		0.567		16.2	LOS B	4.6	32.4				
Intersection	723	1.5		0.567		14.0	LOS B	4.6	32.4				

LANE SUMMARY 2041 PM

Site: 37 [2041 PM - FINAL]

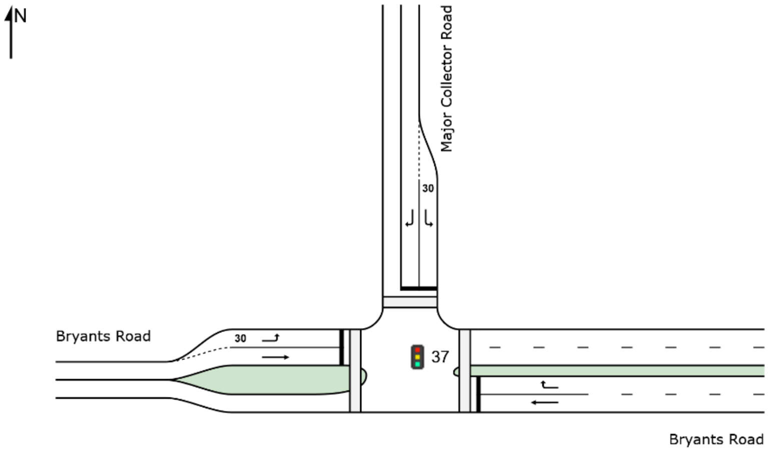
R1037
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 36 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

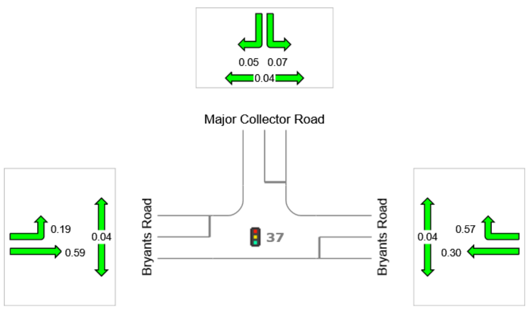
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Bryants Road													
Lane 1	242	0.0	975	0.248	100	5.7	LOS A	2.5	17.4	Full	500	0.0	0.0
Lane 2	144	0.0	310	0.466	100	21.5	LOS C	2.5	17.5	Full	500	0.0	0.0
Approach	386	0.0		0.466		11.6	LOS B	2.5	17.5				
North: Major Collector Road													
Lane 1	39	0.0	929	0.042	100	10.5	LOS B	0.4	2.5	Short	30	0.0	NA
Lane 2	8	0.0	310	0.027	100	19.7	LOS B	0.1	0.9	Full	500	0.0	0.0
Approach	47	0.0		0.042		12.2	LOS B	0.4	2.5				
West: Bryants Road													
Lane 1	12	0.0	310	0.037	100	19.8	LOS B	0.2	1.3	Short	30	0.0	NA
Lane 2	165	0.6	324	0.511	100	16.0	LOS B	2.9	20.3	Full	500	0.0	0.0
Approach	177	0.6		0.511		16.3	LOS B	2.9	20.3				
Intersection	611	0.2		0.511		13.0	LOS B	2.9	20.3				

Intersection R1037-2066

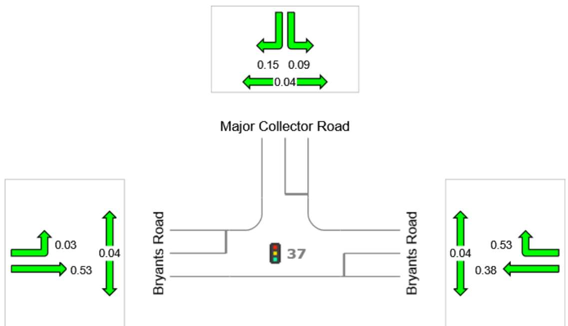
SITE LAYOUT – R1037 – 2066



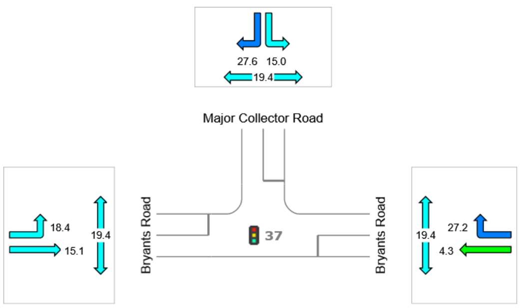
DEGREE OF SATURATION AM



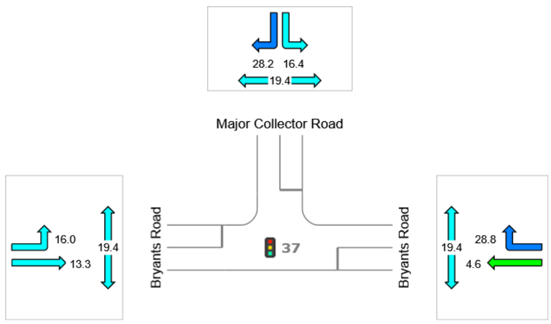
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1037 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 37 [2066 AM - FINAL same as 2041]

R1037
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Bryants Road													
Lane 1	362	2.6	1227	0.295	100	4.3	LOS A	3.9	28.2	Full	500	0.0	0.0
Lane 2	189	1.1	332	0.571	100	27.2	LOS C	4.5	32.0	Full	500	0.0	0.0
Approach	552	2.1		0.571		12.2	LOS B	4.5	32.0				
North: Major Collector Road													
Lane 1	56	1.9	770	0.072	100	15.0	LOS B	0.8	5.8	Short	30	0.0	NA
Lane 2	11	0.0	223	0.047	100	27.6	LOS C	0.2	1.7	Full	500	0.0	0.0
Approach	66	1.6		0.072		17.0	LOS B	0.8	5.8				
West: Bryants Road													
Lane 1	117	0.0	631	0.185	100	18.4	LOS B	2.1	14.4	Short	30	0.0	NA
Lane 2	382	1.1	652 [1]	0.586	100	15.1	LOS B	7.9	56.0	Full	500	0.0	0.0
Approach	499	0.8		0.586		15.9	LOS B	7.9	56.0				
Intersection	1117	1.5		0.586		14.1	LOS B	7.9	56.0				

LANE SUMMARY 2066 PM

Site: 37 [2066 PM - FINAL same as 2041]

R1037
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

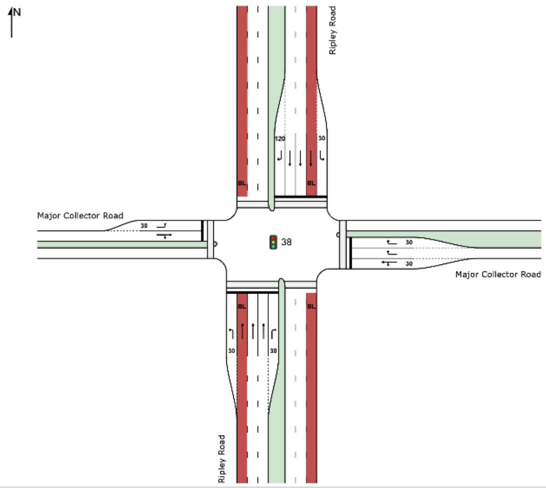
Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Bryants Road													
Lane 1	468	0.4	1244	0.376	100	4.6	LOS A	5.5	38.3	Full	500	0.0	0.0
Lane 2	138	0.0	260	0.530	100	28.8	LOS C	3.4	23.7	Full	500	0.0	0.0
Approach	606	0.3		0.530		10.1	LOS B	5.5	38.3				
North: Major Collector Road													
Lane 1	65	0.0	706	0.092	100	16.4	LOS B	1.0	7.3	Short	30	0.0	NA
Lane 2	34	0.0	223	0.151	100	28.2	LOS C	0.8	5.5	Full	500	0.0	0.0
Approach	99	0.0		0.151		20.4	LOS C	1.0	7.3				
West: Bryants Road													
Lane 1	20	0.0	706	0.028	100	16.0	LOS B	0.3	2.2	Short	30	0.0	NA
Lane 2	391	2.2	731 [1]	0.534	100	13.3	LOS B	7.6	54.4	Full	500	0.0	0.0
Approach	411	2.1		0.534		13.5	LOS B	7.6	54.4				
Intersection	1116	0.9		0.534		12.3	LOS B	7.6	54.4				

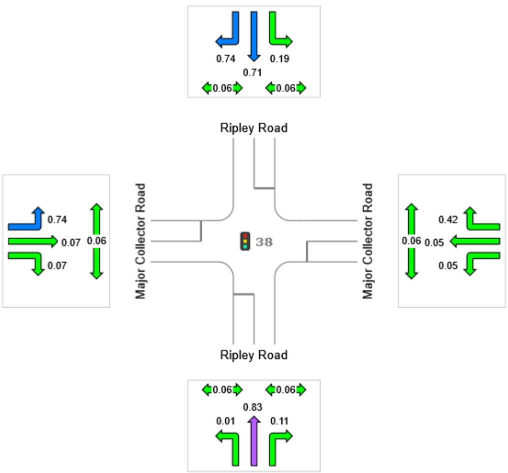
28 Intersection R1038

2031

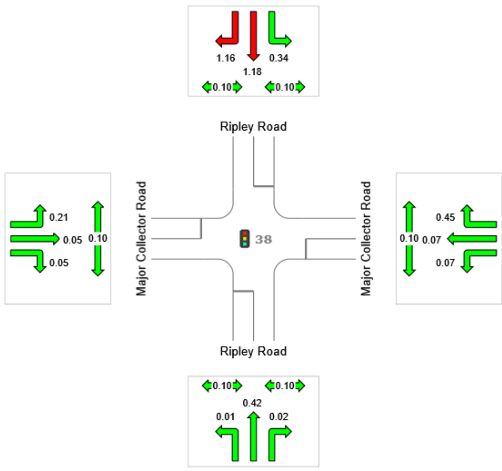
SITE LAYOUT – R1038 – 2031



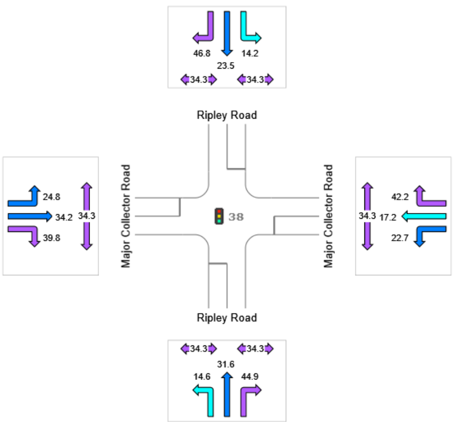
DEGREE OF SATURATION AM



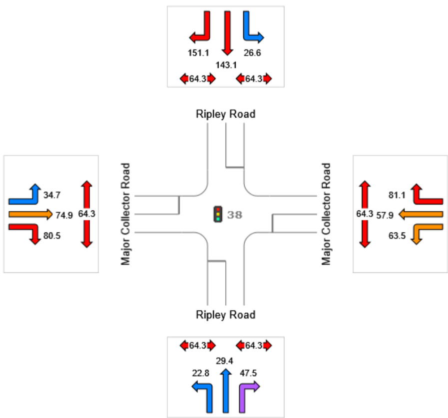
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1038 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 38 [2031 AM - FINAL]

R1038
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road													
Lane 1	8	0.0	998	0.008	100	14.6	LOS B	0.1	1.0	Short	30	0.0	NA
Lane 2 (BL)	2	100.0	399	0.005	100	18.8	LOS B	0.1	0.7	Full	500	0.0	0.0
Lane 3	539	1.7	651	0.828	100	31.6	LOS C	21.8	154.7	Full	500	0.0	0.0
Lane 4	528	1.7	638 [1]	0.828	100	31.5	LOS C	21.2	150.8	Full	500	0.0	0.0
Lane 5	15	0.0	139	0.106	100	44.9	LOS D	0.6	4.0	Short	30	0.0	NA
Approach	1093	1.8		0.828		31.6	LOS C	21.8	154.7				
East: Major Collector Road													
Lane 1	18	0.0	326	0.055	100	21.4	LOS C	0.4	2.8	Short	30	0.0	NA
Lane 2	97	0.5	231	0.419	100	42.2	LOS D	3.7	25.8	Full	500	0.0	0.0
Lane 3	97	0.5	231	0.419	100	42.2	LOS D	3.7	25.8	Short	30	0.0	NA
Approach	212	0.5		0.419		40.4	LOS D	3.7	25.8				
North: Ripley Road													
Lane 1	201	1.0	1060	0.190	100	14.2	LOS B	3.7	26.2	Short	30	0.0	NA
Lane 2 (BL)	4	100.0	443	0.010	100	16.8	LOS B	0.1	1.3	Full	500	0.0	0.0
Lane 3	500	6.1	703	0.711	100	23.6	LOS C	17.0	125.2	Full	500	0.0	0.0
Lane 4	500	6.1	703	0.711	100	23.6	LOS C	17.0	125.2	Full	500	0.0	0.0
Lane 5	154	0.7	208	0.739	100	46.8	LOS D	6.4	45.0	Short	120	0.0	NA
Approach	1359	5.0		0.739		24.8	LOS C	17.0	125.2				
West: Major Collector Road													
Lane 1	323	0.7	439	0.736	100	24.8	LOS C	8.5	59.7	Short	30	0.0	NA
Lane 2	17	0.0	243	0.069	100	34.6	LOS C	0.6	4.2	Full	500	0.0	0.0
Approach	340	0.6		0.736		25.3	LOS C	8.5	59.7				
Intersection	3003	3.0		0.828		28.4	LOS C	21.8	154.7				

Intersection R1038 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 38 [2031 PM - FINAL]

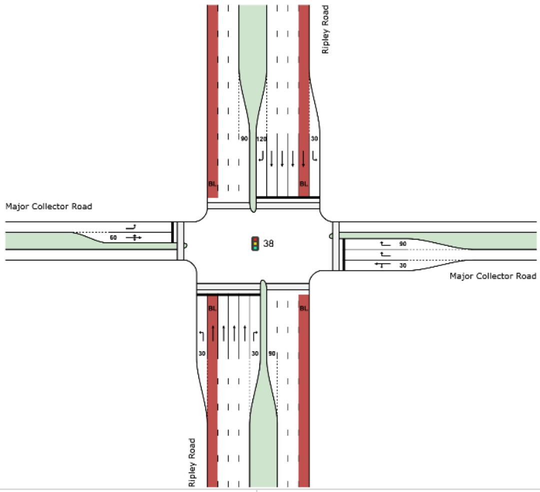
R1038
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

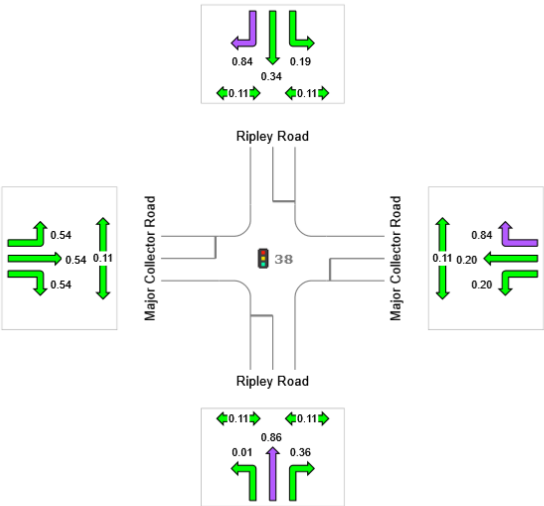
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road													
Lane 1	12	0.0	955	0.012	100	22.8	LOS C	0.4	2.6	Short	30	0.0	NA
Lane 2 (BL)	4	100.0	506	0.008	100	24.1	LOS C	0.2	2.1	Full	500	0.0	0.0
Lane 3	346	1.1	830	0.417	100	29.5	LOS C	16.2	114.3	Full	500	0.0	0.0
Lane 4	339	1.1	814 [1]	0.417	100	29.4	LOS C	15.8	111.6	Full	500	0.0	0.0
Lane 5	12	0.0	464	0.025	100	47.5	LOS D	0.6	4.1	Short	30	0.0	NA
Approach	713	1.6		0.417		29.6	LOS C	16.2	114.3				
East: Major Collector Road													
Lane 1	16	0.0	241	0.065	100	61.3	LOS E	1.0	6.7	Short	30	0.0	NA
Lane 2	35	1.5	79	0.448	100	81.1	LOS F	2.5	17.9	Full	500	0.0	0.0
Lane 3	35	1.5	79	0.448	100	81.1	LOS F	2.5	17.9	Short	30	0.0	NA
Approach	86	1.2		0.448		77.4	LOS E	2.5	17.9				
North: Ripley Road													
Lane 1	321	0.7	943 [1]	0.341	100	26.6	LOS C	12.6	89.0	Short	30	0.0	NA
Lane 2 (BL)	4	100.0	506	0.008	100	24.1	LOS C	0.2	2.1	Full	500	0.0	0.0
Lane 3	971	2.0	825	1.177	100	142.0	LOS F	110.1	783.8	Full	500	0.0	46.2
Lane 4	782	2.0	665 [1]	1.177	100	145.1	LOS F	89.6	638.0	Full	500	0.0	27.2
Lane 5	519	1.2	446 [1]	1.163	100	151.1	LOS F	57.1	403.7	Short	120	0.0	NA
Approach	2598	1.8		1.177		130.3	LOS F	110.1	783.8				
West: Major Collector Road													
Lane 1	158	0.7	739	0.214	100	34.7	LOS C	7.0	49.0	Short	30	0.0	NA
Lane 2	4	0.0	79	0.053	100	76.3	LOS E	0.3	2.3	Full	500	0.0	0.0
Approach	162	0.6		0.214		35.8	LOS D	7.0	49.0				
Intersection	3559	1.7		1.177		104.6	LOS F	110.1	783.8				

Intersection R1038-2041

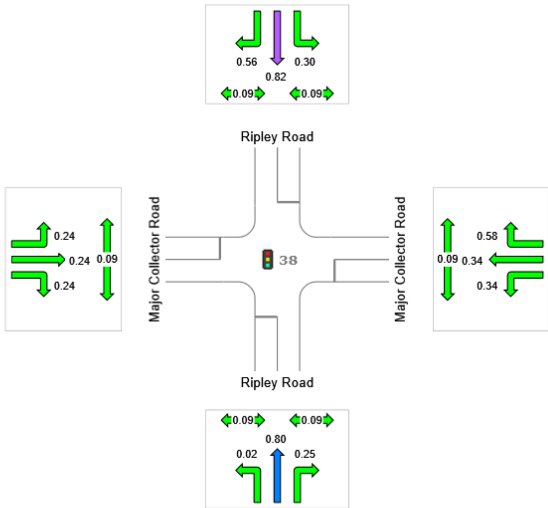
SITE LAYOUT – R1038 – 2041



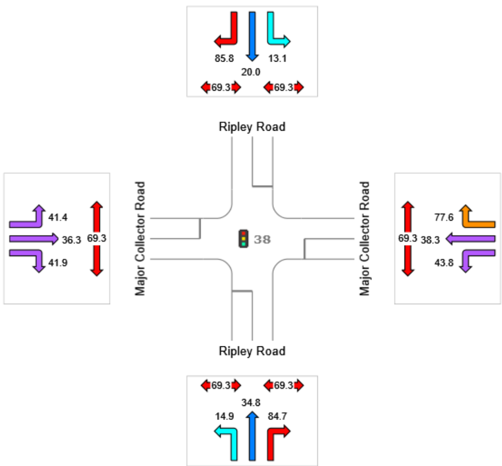
DEGREE OF SATURATION AM



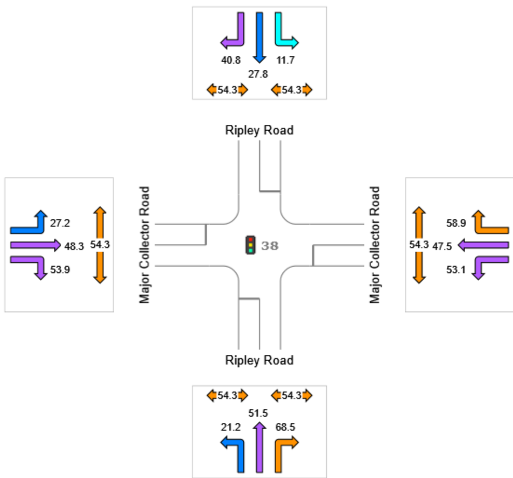
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1038 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 38 [2041 AM - FINAL]

R1038
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road													
Lane 1	15	0.0	1213	0.012	100	14.9	LOS B	0.4	2.5	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	583	0.022	100	20.5	LOS C	0.5	6.0	Full	500	0.0	0.0
Lane 3	812	2.1	949	0.855	100	37.2	LOS D	52.6	375.1	Full	500	0.0	0.0
Lane 4	812	2.1	949	0.855	100	37.2	LOS D	52.6	375.1	Full	500	0.0	0.0
Lane 5	383	2.1	882 [1]	0.434	51 [6]	25.3	LOS C	17.3	123.6	Full	500	0.0	0.0
Lane 6	32	0.0	87	0.364	100	84.7	LOS F	2.4	16.6	Short	30	0.0	NA
Approach	2065	2.7		0.855		35.5	LOS D	52.6	375.1				
East: Major Collector Road													
Lane 1	60	0.0	295	0.204	100	42.2	LOS D	2.9	20.5	Short	30	0.0	NA
Lane 2	167	6.4	197 [1]	0.844	100	81.6	LOS F	12.8	94.7	Full	500	0.0	0.0
Lane 3	111	6.4	237	0.470	56 [6]	71.6	LOS E	7.7	56.6	Short	90	0.0	NA
Approach	338	5.3		0.844		71.3	LOS E	12.8	94.7				
North: Ripley Road													
Lane 1	238	10.2	1235	0.193	100	13.1	LOS B	5.6	42.8	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	638	0.020	100	16.8	LOS B	0.4	5.4	Full	500	0.0	0.0
Lane 3	355	2.7	1035	0.343	100	20.5	LOS C	14.3	102.7	Full	500	0.0	0.0
Lane 4	355	2.7	1035	0.343	100	20.5	LOS C	14.3	102.7	Full	500	0.0	0.0
Lane 5	180	2.7	1035	0.174	51 [6]	18.4	LOS B	6.5	46.7	Full	500	0.0	0.0
Lane 6	142	3.0	170	0.837	100	85.8	LOS F	11.2	80.2	Short	120	0.0	NA
Approach	1283	5.1		0.837		26.0	LOS C	14.3	102.7				
West: Major Collector Road													
Lane 1	212	1.1	393	0.539	100	41.0	LOS D	10.4	73.8	Full	500	0.0	0.0
Lane 2	192	1.0	357	0.539	100	41.6	LOS D	9.6	67.8	Short	60	0.0	NA
Approach	404	1.0		0.539		41.3	LOS D	10.4	73.8				
Intersection	4091	3.5		0.855		36.0	LOS D	52.6	375.1				

Intersection R1038 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 38 [2041 PM - FINAL]

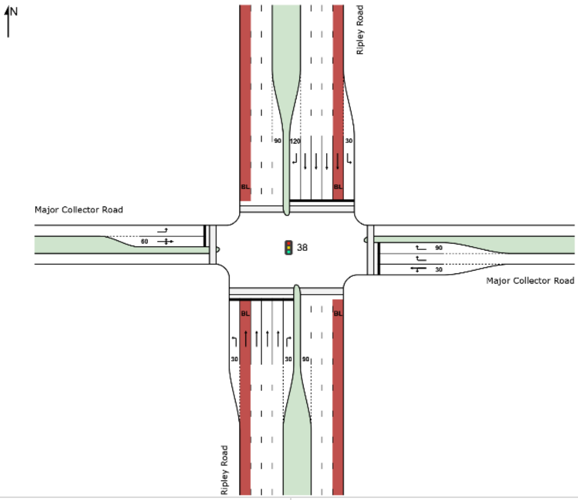
R1038
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

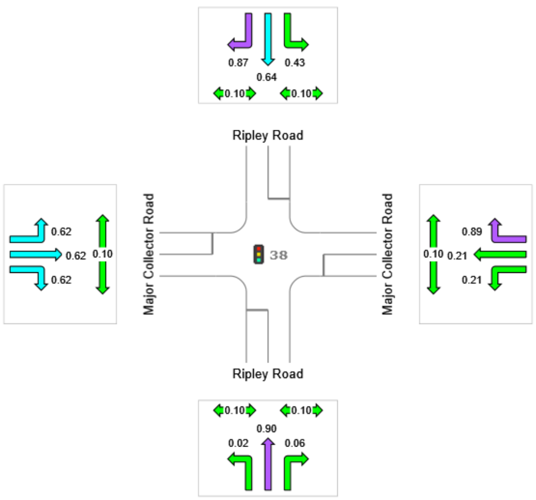
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road													
Lane 1	9	0.0	619	0.015	100	21.2	LOS C	0.2	1.7	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	236	0.053	100	42.3	LOS D	0.6	7.9	Full	500	0.0	0.0
Lane 3	306	1.9	385	0.796	100	53.3	LOS D	18.2	129.4	Full	500	0.0	0.0
Lane 4	306	1.9	385	0.796	100	53.3	LOS D	18.2	129.4	Full	500	0.0	0.0
Lane 5	151	1.9	375 [1]	0.403	51 [6]	45.3	LOS D	7.8	55.3	Full	500	0.0	0.0
Lane 6	23	0.0	93	0.249	100	68.5	LOS E	1.4	9.7	Short	30	0.0	NA
Approach	809	3.4		0.796		51.7	LOS D	18.2	129.4				
East: Major Collector Road													
Lane 1	107	1.0	313	0.343	100	51.4	LOS D	5.6	39.6	Short	30	0.0	NA
Lane 2	136	3.4	236 [1]	0.576	100	59.7	LOS E	7.7	55.5	Full	500	0.0	0.0
Lane 3	78	3.4	242	0.321	56 [6]	57.6	LOS E	4.2	30.3	Short	90	0.0	NA
Approach	321	2.6		0.576		56.4	LOS E	7.7	55.5				
North: Ripley Road													
Lane 1	332	2.9	1122	0.295	100	11.7	LOS B	5.5	39.2	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	571	0.022	100	17.1	LOS B	0.4	4.9	Full	500	0.0	0.0
Lane 3	767	0.8	938	0.818	100	29.5	LOS C	38.9	274.1	Full	500	0.0	0.0
Lane 4	767	0.8	938	0.818	100	29.5	LOS C	38.9	274.1	Full	500	0.0	0.0
Lane 5	389	0.8	938	0.415	51 [6]	21.3	LOS C	14.5	102.2	Full	500	0.0	0.0
Lane 6	344	0.9	615	0.560	100	40.8	LOS D	16.5	116.4	Short	120	0.0	NA
Approach	2612	1.5		0.818		27.5	LOS C	38.9	274.1				
West: Major Collector Road													
Lane 1	231	0.4	957	0.242	100	22.5	LOS C	7.3	51.6	Full	500	0.0	0.0
Lane 2	71	0.2	294	0.242	100	51.8	LOS D	3.7	25.9	Short	60	0.0	NA
Approach	302	0.3		0.242		29.4	LOS C	7.3	51.6				
Intersection	4044	1.9		0.818		34.7	LOS C	38.9	274.1				

Intersection R1038-2066

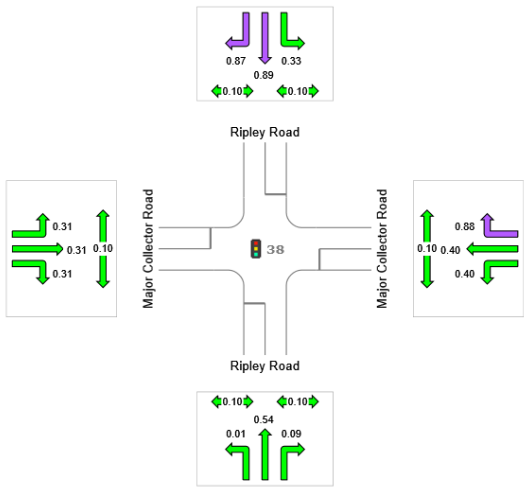
SITE LAYOUT – R1038 – 2066



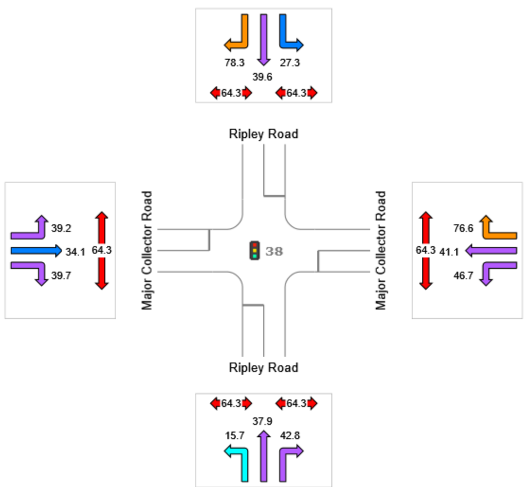
DEGREE OF SATURATION AM



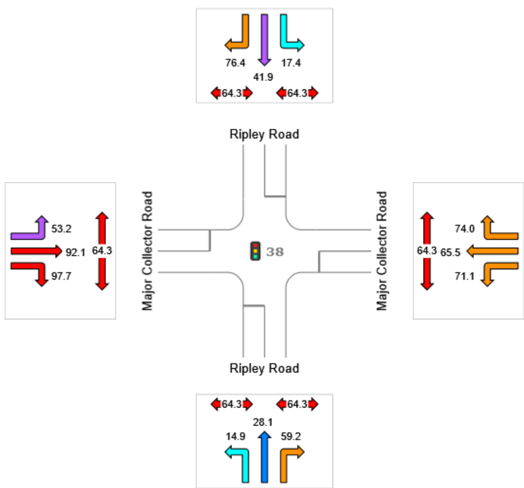
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1038 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 38 [2066 AM - FINAL same as 2041]

R1038
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Phase Times)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road													
Lane 1	28	0.0	1167	0.024	100	15.7	LOS B	0.7	4.9	Short	30	0.0	NA
Lane 2 (BL)	12	100.0	599	0.019	100	18.1	LOS B	0.4	5.0	Full	500	0.0	0.0
Lane 3	885	1.0	983	0.900	100	41.6	LOS D	59.9	422.9	Full	500	0.0	0.0
Lane 4	885	1.0	983	0.900	100	41.6	LOS D	59.9	422.9	Full	500	0.0	0.0
Lane 5	426	1.0	933 [1]	0.456	51 [6]	23.0	LOS C	18.0	127.1	Full	500	0.0	0.0
Lane 6	33	9.7	521	0.063	100	42.8	LOS D	1.6	11.9	Short	30	0.0	NA
Approach	2267	1.6		0.900		37.7	LOS D	59.9	422.9				
East: Major Collector Road													
Lane 1	61	0.0	288	0.212	100	44.7	LOS D	3.1	21.7	Short	30	0.0	NA
Lane 2	177	2.9	198 [1]	0.891	100	82.1	LOS F	13.3	95.2	Full	500	0.0	0.0
Lane 3	116	2.9	234	0.496	56 [6]	68.1	LOS E	7.5	54.1	Short	90	0.0	NA
Approach	354	2.4		0.891		71.1	LOS E	13.3	95.2				
North: Ripley Road													
Lane 1	399	3.2	921 [1]	0.433	100	27.3	LOS C	16.4	118.0	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	414	0.031	100	31.8	LOS C	0.6	7.3	Full	500	0.0	0.0
Lane 3	427	4.5	663	0.644	100	40.8	LOS D	24.3	176.6	Full	500	0.0	0.0
Lane 4	427	4.5	663	0.644	100	40.8	LOS D	24.3	176.6	Full	500	0.0	0.0
Lane 5	216	4.5	663	0.326	51 [6]	35.5	LOS D	10.7	78.0	Full	500	0.0	0.0
Lane 6	228	0.9	264	0.867	100	78.3	LOS E	16.9	119.5	Short	120	0.0	NA
Approach	1711	4.4		0.867		41.9	LOS D	24.3	176.6				
West: Major Collector Road													
Lane 1	254	1.4	407	0.625	100	38.8	LOS D	11.8	83.6	Full	500	0.0	0.0
Lane 2	217	1.3	348	0.625	100	39.3	LOS D	10.0	70.9	Short	60	0.0	NA
Approach	472	1.3		0.625		39.0	LOS D	11.8	83.6				
Intersection	4803	2.6		0.900		41.8	LOS D	59.9	422.9				

Intersection R1038 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 38 [2066 PM - FINAL same as 2041]

R1038
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Phase Times)

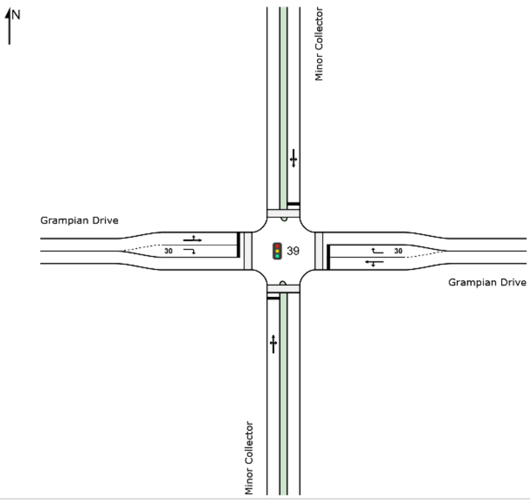
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road													
Lane 1	15	0.0	1194	0.012	100	14.9	LOS B	0.3	2.4	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	540	0.023	100	22.0	LOS C	0.5	6.0	Full	500	0.0	0.0
Lane 3	474	1.9	881	0.538	100	29.0	LOS C	23.0	163.3	Full	500	0.0	0.0
Lane 4	474	1.9	881	0.538	100	29.0	LOS C	23.0	163.3	Full	500	0.0	0.0
Lane 5	230	1.9	841 [1]	0.273	51 [6]	24.7	LOS C	9.5	67.4	Full	500	0.0	0.0
Lane 6	25	8.3	288	0.088	100	59.2	LOS E	1.5	11.0	Short	30	0.0	NA
Approach	1231	3.0		0.538		28.6	LOS C	23.0	163.3				
East: Major Collector Road													
Lane 1	72	1.5	180	0.398	100	67.8	LOS E	4.7	33.5	Short	30	0.0	NA
Lane 2	196	2.3	223 [1]	0.877	100	79.1	LOS E	14.5	103.2	Full	500	0.0	0.0
Lane 3	127	2.3	261	0.488	56 [6]	66.2	LOS E	8.2	58.3	Short	90	0.0	NA
Approach	395	2.1		0.877		72.9	LOS E	14.5	103.2				
North: Ripley Road													
Lane 1	382	1.7	1156 [1]	0.330	100	17.4	LOS B	11.5	81.6	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	540	0.023	100	22.0	LOS C	0.5	6.0	Full	500	0.0	0.0
Lane 3	792	1.1	885	0.895	100	45.7	LOS D	54.5	384.6	Full	500	0.0	0.0
Lane 4	792	1.1	885	0.895	100	45.7	LOS D	54.5	384.6	Full	500	0.0	0.0
Lane 5	401	1.1	885	0.453	51 [6]	27.5	LOS C	18.5	130.4	Full	500	0.0	0.0
Lane 6	263	0.8	303	0.867	100	76.4	LOS E	19.4	136.9	Short	120	0.0	NA
Approach	2643	1.6		0.895		41.8	LOS D	54.5	384.6				
West: Major Collector Road													
Lane 1	169	1.1	540	0.313	100	46.7	LOS D	8.9	63.1	Full	500	0.0	0.0
Lane 2	46	0.6	145	0.313	100	95.7	LOS F	4.0	27.8	Short	60	0.0	NA
Approach	215	1.0		0.313		57.1	LOS E	8.9	63.1				
Intersection	4483	2.0		0.895		41.6	LOS D	54.5	384.6				

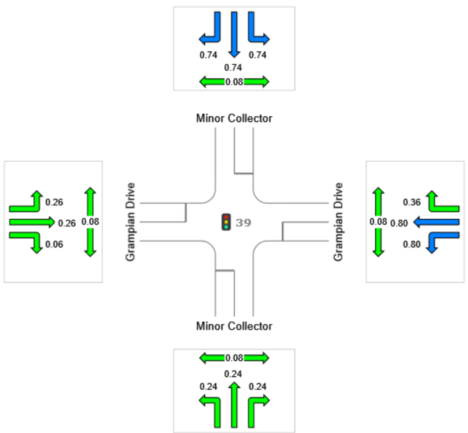
29 Intersection R1039

2031

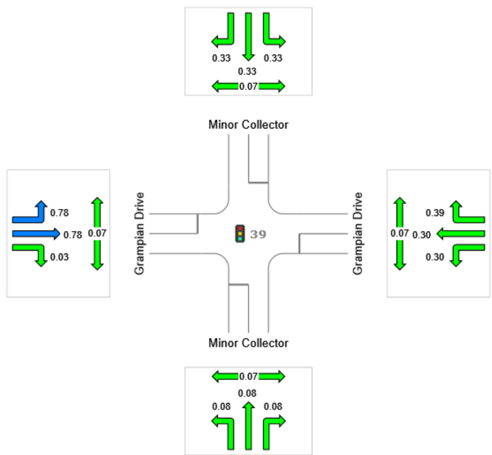
SITE LAYOUT – R1039 – 2031



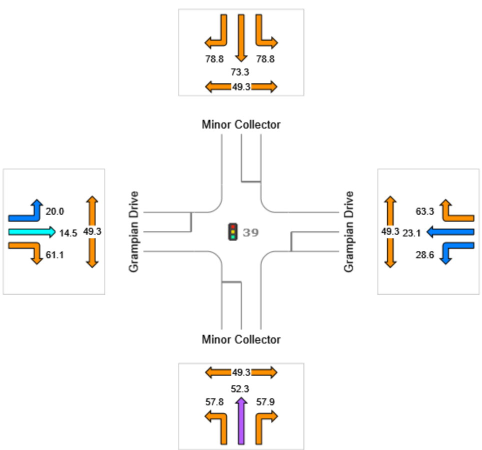
DEGREE OF SATURATION AM



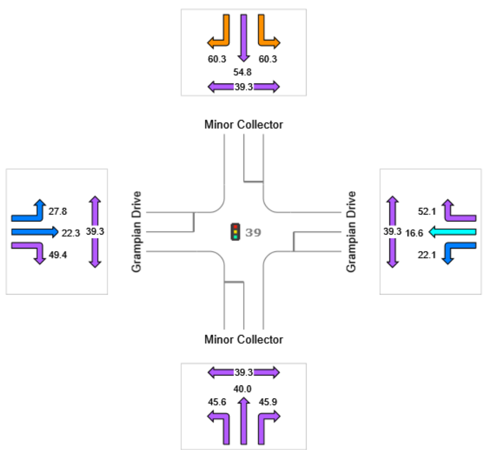
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1039 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 39 [2031 AM - FINAL]

R1039
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Minor Collector													
Lane 1	38	2.8	157	0.242	100	54.3	LOS D	2.0	14.2	Full	500	0.0	0.0
Approach	38	2.8		0.242		54.3	LOS D	2.0	14.2				
East: Grampian Drive													
Lane 1	798	0.8	999 [1]	0.799	100	23.1	LOS C	33.6	236.9	Full	500	0.0	0.0
Lane 2	37	0.0	101	0.364	100	63.3	LOS E	2.0	14.3	Short	30	0.0	NA
Approach	835	0.8		0.799		24.9	LOS C	33.6	236.9				
North: Minor Collector													
Lane 1	151	0.0	205	0.736	100	78.0	LOS E	9.5	66.8	Full	500	0.0	0.0
Approach	151	0.0		0.736		78.0	LOS E	9.5	66.8				
West: Grampian Drive													
Lane 1	265	0.8	1026	0.259	100	16.1	LOS B	7.5	52.9	Full	500	0.0	0.0
Lane 2	6	0.0	101	0.062	100	61.1	LOS E	0.3	2.4	Short	30	0.0	NA
Approach	272	0.8		0.259		17.2	LOS B	7.5	52.9				
Intersection	1295	0.7		0.799		30.3	LOS C	33.6	236.9				

Intersection R1039 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 39 [2031 PM - FINAL]

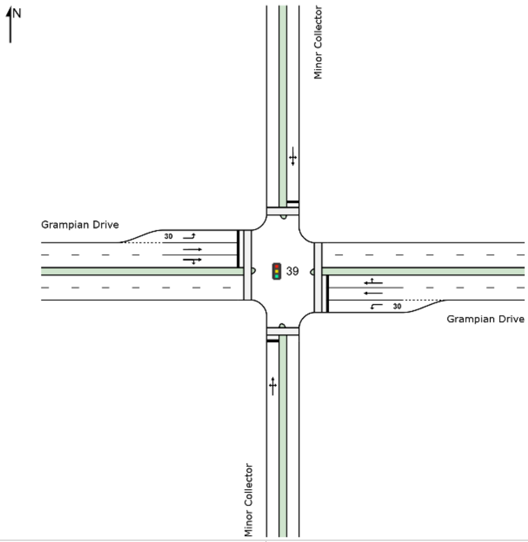
R1039
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 90 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

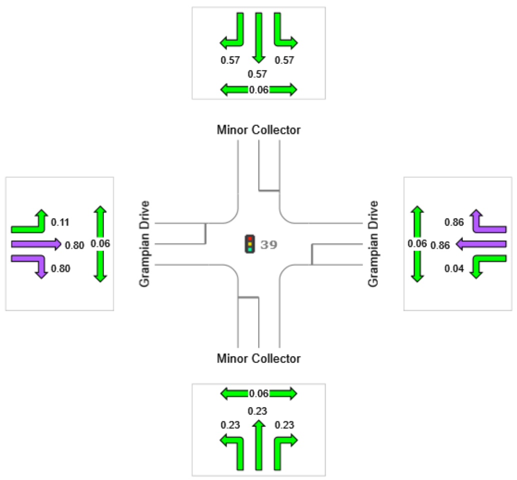
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Minor Collector													
Lane 1	15	7.1	186	0.079	100	41.7	LOS D	0.6	4.5	Full	500	0.0	0.0
Approach	15	7.1		0.079		41.7	LOS D	0.6	4.5				
East: Grampian Drive													
Lane 1	274	1.5	922	0.297	100	16.9	LOS B	7.1	50.6	Full	500	0.0	0.0
Lane 2	48	0.0	124	0.391	100	52.1	LOS D	2.2	15.3	Short	30	0.0	NA
Approach	322	1.3		0.391		22.2	LOS C	7.1	50.6				
North: Minor Collector													
Lane 1	57	0.0	170	0.334	100	57.9	LOS E	2.6	18.4	Full	500	0.0	0.0
Approach	57	0.0		0.334		57.9	LOS E	2.6	18.4				
West: Grampian Drive													
Lane 1	719	0.7	917 [1]	0.784	100	23.1	LOS C	27.0	190.2	Full	500	0.0	0.0
Lane 2	3	0.0	124	0.026	100	49.4	LOS D	0.1	0.9	Short	30	0.0	NA
Approach	722	0.7		0.784		23.3	LOS C	27.0	190.2				
Intersection	1116	0.9		0.784		25.0	LOS C	27.0	190.2				

Intersection R1039-2041

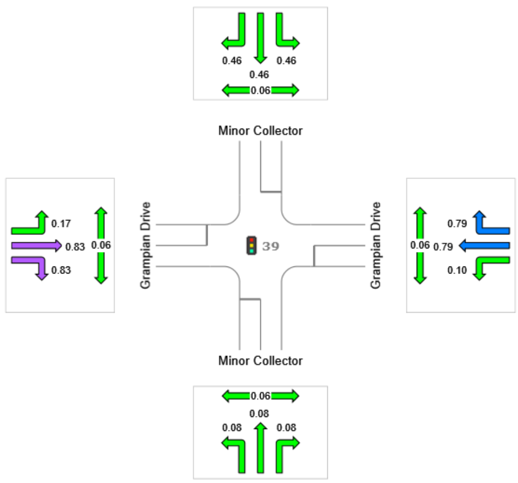
SITE LAYOUT – R1039 – 2041



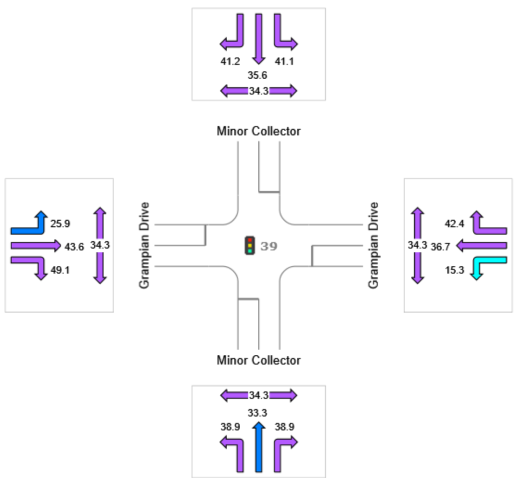
DEGREE OF SATURATION AM



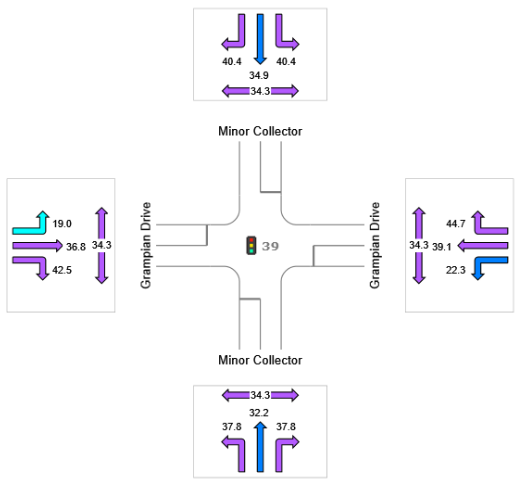
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1039 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 39 [2041AM - FINAL]

R1039
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Minor Collector													
Lane 1	64	0.0	281	0.229	100	38.0	LOS D	2.3	16.0	Full	500	0.0	0.0
Approach	64	0.0		0.229		38.0	LOS D	2.3	16.0				
East: Grampian Drive													
Lane 1	40	0.0	975	0.041	100	15.3	LOS B	0.7	5.2	Short	30	0.0	NA
Lane 2	479	0.6	555 [1]	0.864	100	36.6	LOS D	20.5	144.5	Full	500	0.0	0.0
Lane 3	497	0.9	576	0.864	100	38.0	LOS D	21.6	152.2	Full	500	0.0	0.0
Approach	1017	0.7		0.864		36.4	LOS D	21.6	152.2				
North: Minor Collector													
Lane 1	158	1.3	276	0.572	100	41.1	LOS D	6.0	42.5	Full	500	0.0	0.0
Approach	158	1.3		0.572		41.1	LOS D	6.0	42.5				
West: Grampian Drive													
Lane 1	66	0.0	604	0.110	100	25.9	LOS C	1.8	12.7	Short	30	0.0	NA
Lane 2	156	0.3	195	0.801	100	43.6	LOS D	6.7	47.0	Full	500	0.0	0.0
Lane 3	156	0.3	195	0.801	100	43.7	LOS D	6.7	47.0	Full	500	0.0	0.0
Approach	378	0.3		0.801		40.5	LOS D	6.7	47.0				
Intersection	1617	0.7		0.864		37.9	LOS D	21.6	152.2				

Intersection R1039 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 39 [2041PM - FINAL]

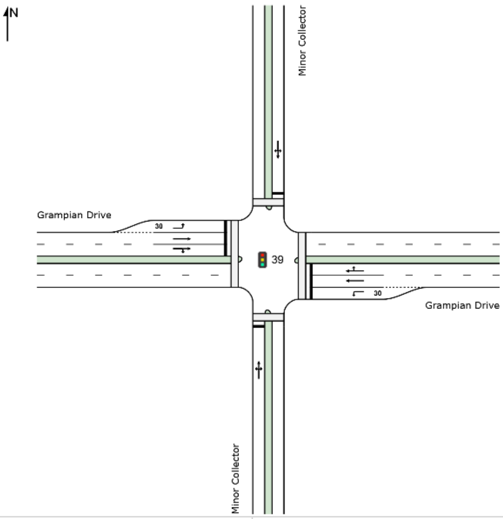
R1039
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

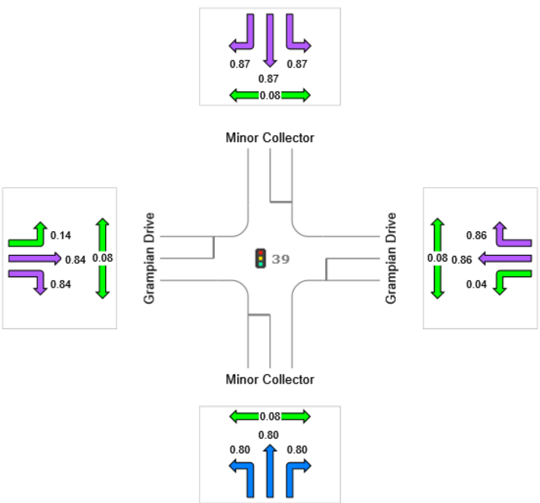
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Minor Collector													
Lane 1	21	0.0	279	0.075	100	37.5	LOS D	0.7	5.1	Full	500	0.0	0.0
Approach	21	0.0		0.075		37.5	LOS D	0.7	5.1				
East: Grampian Drive													
Lane 1	75	0.0	720	0.104	100	22.3	LOS C	1.9	13.0	Short	30	0.0	NA
Lane 2	234	0.3	298 [1]	0.785	100	39.0	LOS D	9.6	67.5	Full	500	0.0	0.0
Lane 3	244	0.2	311	0.785	100	41.3	LOS D	10.1	70.9	Full	500	0.0	0.0
Approach	553	0.2		0.785		37.7	LOS D	10.1	70.9				
North: Minor Collector													
Lane 1	129	0.0	279	0.464	100	40.1	LOS D	4.8	33.7	Full	500	0.0	0.0
Approach	129	0.0		0.464		40.1	LOS D	4.8	33.7				
West: Grampian Drive													
Lane 1	147	0.0	859	0.172	100	19.0	LOS B	3.3	23.4	Short	30	0.0	NA
Lane 2	321	0.1	388 [1]	0.827	100	36.5	LOS D	13.1	91.7	Full	500	0.0	0.0
Lane 3	383	0.1	463	0.827	100	37.0	LOS D	16.0	112.2	Full	500	0.0	0.0
Approach	851	0.1		0.827		33.7	LOS C	16.0	112.2				
Intersection	1554	0.1		0.827		35.7	LOS D	16.0	112.2				

Intersection R1039-2066

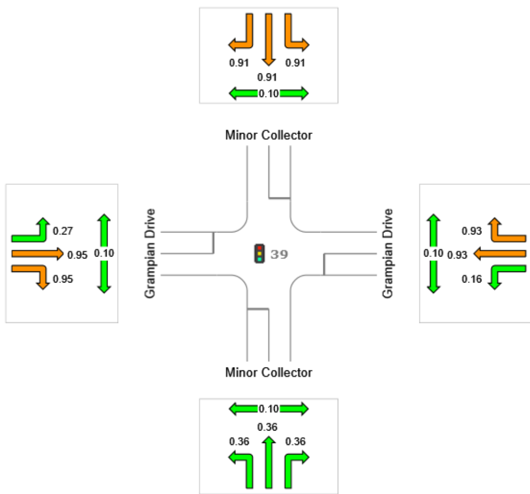
SITE LAYOUT – R1039 – 2066



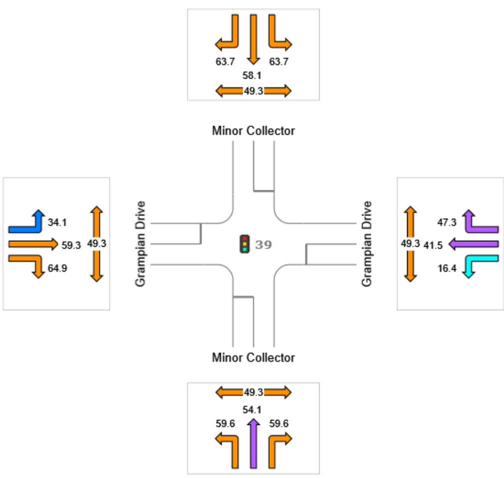
DEGREE OF SATURATION AM



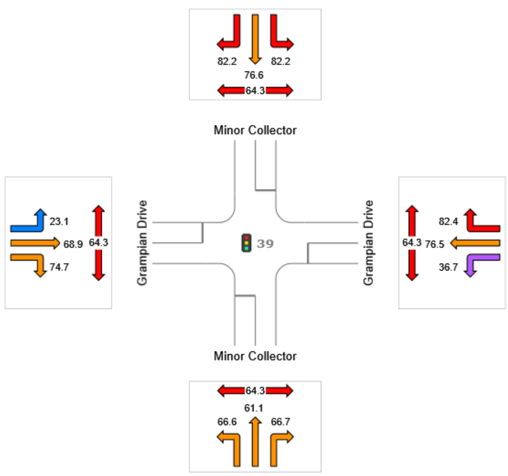
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1039 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 39 [2066 AM - FINAL same as 2041]

R1039
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Minor Collector													
Lane 1	217	0.0	272	0.796	100	58.6	LOS E	12.2	85.5	Full	500	0.0	0.0
Approach	217	0.0		0.796		58.6	LOS E	12.2	85.5				
East: Grampian Drive													
Lane 1	38	5.6	1023	0.037	100	16.4	LOS B	0.9	6.3	Short	30	0.0	NA
Lane 2	593	1.1	686 [1]	0.865	100	41.3	LOS D	32.4	228.9	Full	500	0.0	0.0
Lane 3	616	1.2	712	0.865	100	43.1	LOS D	34.2	241.8	Full	500	0.0	0.0
Approach	1247	1.3		0.865		41.5	LOS D	34.2	241.8				
North: Minor Collector													
Lane 1	246	1.3	285	0.865	100	63.6	LOS E	14.6	103.6	Full	500	0.0	0.0
Approach	246	1.3		0.865		63.6	LOS E	14.6	103.6				
West: Grampian Drive													
Lane 1	81	0.0	591	0.137	100	34.1	LOS C	3.1	21.6	Short	30	0.0	NA
Lane 2	159	4.1	189 [1]	0.840	100	59.2	LOS E	9.3	67.1	Full	500	0.0	0.0
Lane 3	174	4.1	207	0.840	100	59.4	LOS E	10.2	74.0	Full	500	0.0	0.0
Approach	414	3.3		0.840		54.4	LOS D	10.2	74.0				
Intersection	2124	1.5		0.865		48.3	LOS D	34.2	241.8				

Intersection R1039 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 39 [2066 PM - FINAL same as 2041]

R1039
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

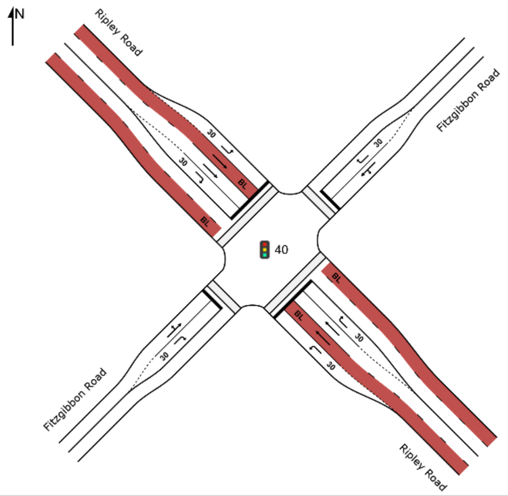
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Minor Collector													
Lane 1	86	0.0	240	0.360	100	66.0	LOS E	5.5	38.4	Full	500	0.0	0.0
Approach	86	0.0		0.360		66.0	LOS E	5.5	38.4				
East: Grampian Drive													
Lane 1	114	0.0	690	0.165	100	36.7	LOS D	5.1	35.8	Short	30	0.0	NA
Lane 2	289	0.2	310 [1]	0.932	100	76.2	LOS E	22.2	155.6	Full	500	0.0	0.0
Lane 3	358	0.1	384	0.932	100	78.3	LOS E	28.3	198.2	Full	500	0.0	0.0
Approach	761	0.1		0.932		71.3	LOS E	28.3	198.2				
North: Minor Collector													
Lane 1	265	0.4	292	0.909	100	81.8	LOS F	20.5	143.7	Full	500	0.0	0.0
Approach	265	0.4		0.909		81.8	LOS F	20.5	143.7				
West: Grampian Drive													
Lane 1	226	0.0	830 [1]	0.273	100	23.1	LOS C	7.9	55.0	Short	30	0.0	NA
Lane 2	454	0.5	477 [1]	0.951	100	68.4	LOS E	33.9	238.0	Full	500	0.0	0.0
Lane 3	634	0.5	666	0.951	100	69.2	LOS E	50.8	357.0	Full	500	0.0	0.0
Approach	1314	0.4		0.951		61.0	LOS E	50.8	357.0				
Intersection	2426	0.3		0.951		66.7	LOS E	50.8	357.0				

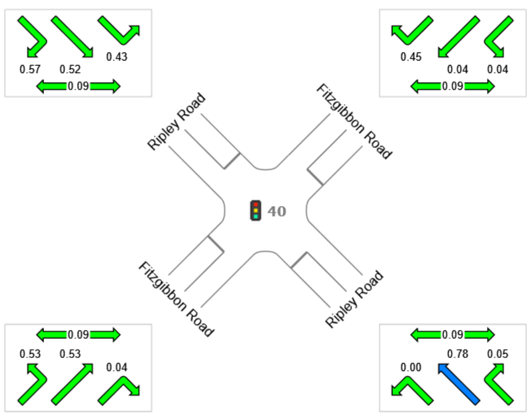
30 Intersection R1040

2031

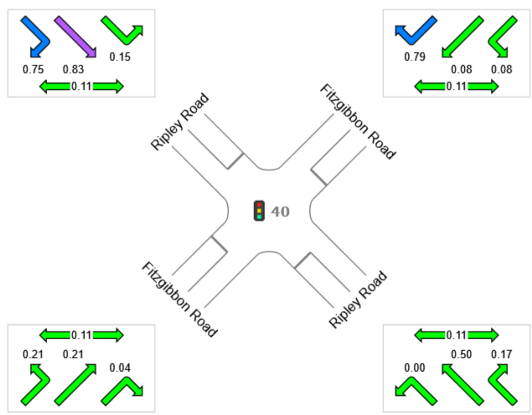
SITE LAYOUT – R1040 – 2031



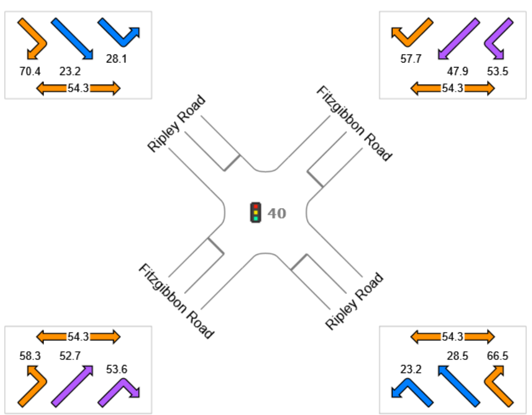
DEGREE OF SATURATION AM



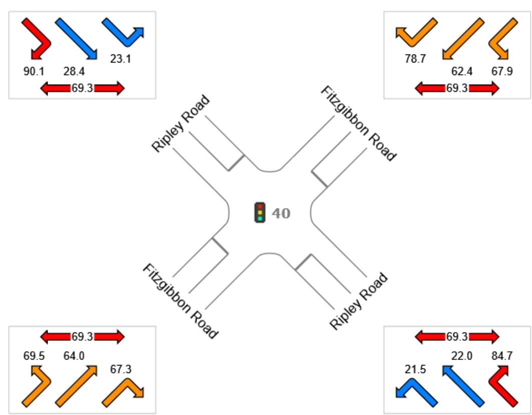
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1040 – 2031 Cont.

LANE SUMMARY 2031 AM

Site: 40 [2031 AM - FINAL]

R1040
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Road													
Lane 1	1	0.0	867	0.001	100	23.2	LOS C	0.0	0.2	Short	30	0.0	NA
Lane 2 (BL)	2	100.0	552	0.004	100	17.9	LOS B	0.1	0.8	Full	500	0.0	0.0
Lane 3	706	0.3	903 [1]	0.782	100	28.5	LOS C	34.3	240.6	Full	500	0.0	0.0
Lane 4	4	0.0	93	0.045	100	66.5	LOS E	0.2	1.7	Short	30	0.0	NA
Approach	714	0.6		0.782		28.7	LOS C	34.3	240.6				
NorthEast: Fitzgibbon Road													
Lane 1	9	0.0	269	0.035	100	51.0	LOS D	0.5	3.4	Full	500	0.0	0.0
Lane 2	114	4.6	255	0.446	100	57.7	LOS E	6.3	45.5	Short	30	0.0	NA
Approach	123	4.3		0.446		57.2	LOS E	6.3	45.5				
NorthWest: Ripley Road													
Lane 1	363	0.9	854 [1]	0.425	100	28.1	LOS C	13.9	98.4	Short	30	0.0	NA
Lane 2 (BL)	4	100.0	552	0.008	100	18.0	LOS B	0.1	1.7	Full	500	0.0	0.0
Lane 3	401	9.4	772 [1]	0.519	100	23.2	LOS C	15.8	119.9	Full	500	0.0	0.0
Lane 4	53	0.0	93	0.567	100	70.4	LOS E	3.3	22.8	Short	30	0.0	NA
Approach	821	5.5		0.567		28.4	LOS C	15.8	119.9				
SouthWest: Fitzgibbon Road													
Lane 1	142	0.0	268 [1]	0.530	100	55.8	LOS E	7.9	55.4	Full	500	0.0	0.0
Lane 2	9	0.0	263	0.036	100	53.6	LOS D	0.5	3.4	Short	30	0.0	NA
Approach	152	0.0		0.530		55.7	LOS E	7.9	55.4				
Intersection	1809	3.0		0.782		32.8	LOS C	34.3	240.6				

Intersection R1040 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 40 [2031 PM - FINAL]

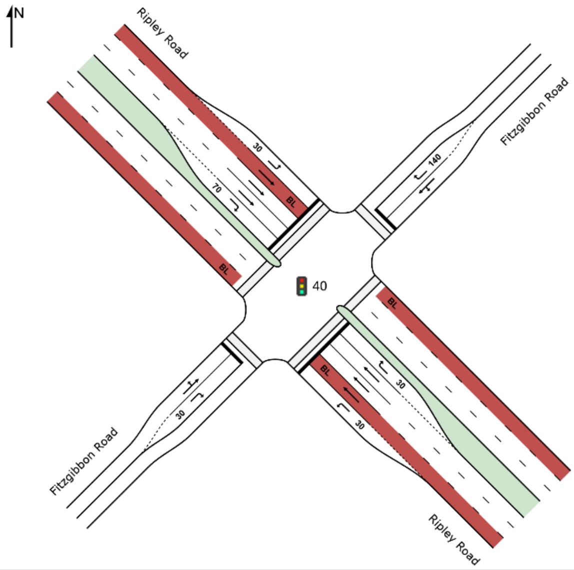
R1040
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

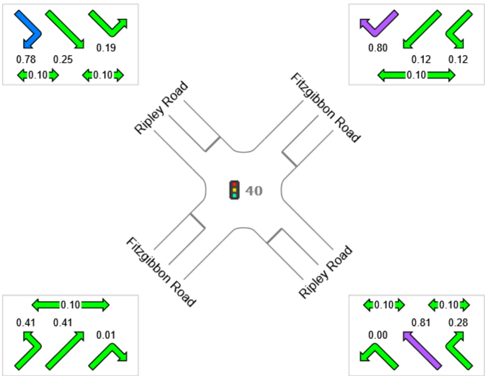
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Road													
Lane 1	2	0.0	1015	0.002	100	21.5	LOS C	0.1	0.5	Short	30	0.0	NA
Lane 2 (BL)	4	100.0	646	0.007	100	16.1	LOS B	0.1	1.8	Full	500	0.0	0.0
Lane 3	517	0.0	1042 [1]	0.496	100	22.1	LOS C	22.8	159.7	Full	500	0.0	0.0
Lane 4	13	0.0	74	0.170	100	84.7	LOS F	0.9	6.6	Short	30	0.0	NA
Approach	536	0.8		0.496		23.5	LOS C	22.8	159.7				
NorthEast: Fitzgibbon Road													
Lane 1	19	0.0	241	0.079	100	65.2	LOS E	1.2	8.6	Full	500	0.0	0.0
Lane 2	178	0.0	226 [1]	0.788	100	78.7	LOS E	13.4	93.5	Short	30	0.0	NA
Approach	197	0.0		0.788		77.4	LOS E	13.4	93.5				
NorthWest: Ripley Road													
Lane 1	148	0.0	1015	0.146	100	23.1	LOS C	5.2	36.5	Short	30	0.0	NA
Lane 2 (BL)	4	100.0	646	0.007	100	16.1	LOS B	0.1	1.8	Full	500	0.0	0.0
Lane 3	817	3.4	981 [1]	0.832	100	28.4	LOS C	46.5	334.7	Full	500	0.0	0.0
Lane 4	56	0.0	74	0.751	100	90.1	LOS F	4.4	31.0	Short	30	0.0	NA
Approach	1025	3.1		0.832		31.0	LOS C	46.5	334.7				
SouthWest: Fitzgibbon Road													
Lane 1	51	0.0	240	0.211	100	67.4	LOS E	3.4	23.5	Full	500	0.0	0.0
Lane 2	8	0.0	235	0.036	100	67.3	LOS E	0.5	3.8	Short	30	0.0	NA
Approach	59	0.0		0.211		67.4	LOS E	3.4	23.5				
Intersection	1817	2.0		0.832		35.0	LOS C	46.5	334.7				

Intersection R1040-2041

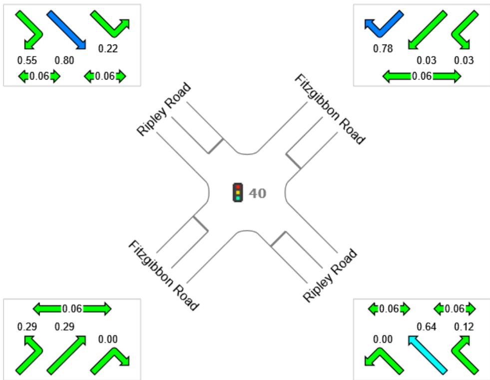
SITE LAYOUT – R1040 – 2041



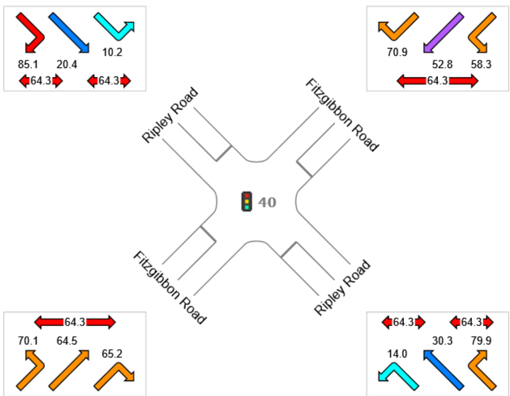
DEGREE OF SATURATION AM



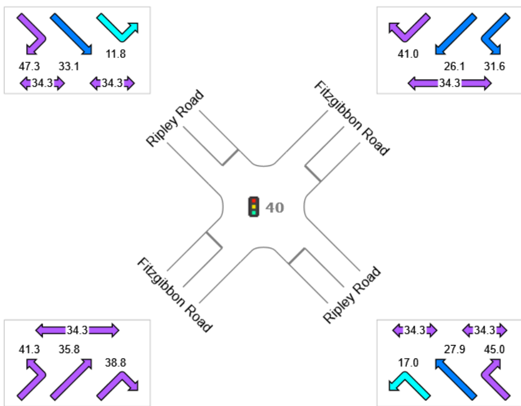
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1040 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 40 [2041 AM - FINAL]

R1040
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Road													
Lane 1	1	0.0	1220	0.001	100	14.0	LOS B	0.0	0.2	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	599	0.021	100	18.1	LOS B	0.4	5.5	Full	500	0.0	0.0
Lane 3	792	2.4	974	0.813	100	30.7	LOS C	44.7	319.1	Full	500	0.0	0.0
Lane 4	772	2.4	949 [1]	0.813	100	30.1	LOS C	42.8	305.4	Full	500	0.0	0.0
Lane 5	22	0.0	80	0.278	100	79.9	LOS E	1.6	10.9	Short	30	0.0	NA
Approach	1600	3.1		0.813		31.0	LOS C	44.7	319.1				
NorthEast: Fitzgibbon Road													
Lane 1	38	0.0	326	0.116	100	55.5	LOS E	2.2	15.3	Full	500	0.0	0.0
Lane 2	242	7.8	302	0.803	100	70.9	LOS E	17.0	126.8	Short	140	0.0	NA
Approach	280	6.8		0.803		68.8	LOS E	17.0	126.8				
NorthWest: Ripley Road													
Lane 1	240	2.2	1241	0.193	100	10.2	LOS B	3.6	25.4	Short	30	0.0	NA
Lane 2 (BL)	12	100.0	599	0.019	100	18.1	LOS B	0.4	5.0	Full	500	0.0	0.0
Lane 3	238	5.1	957	0.249	100	20.5	LOS C	9.0	65.5	Full	500	0.0	0.0
Lane 4	238	5.1	957	0.249	100	20.5	LOS C	9.0	65.5	Full	500	0.0	0.0
Lane 5	61	1.7	79	0.776	100	85.1	LOS F	4.6	32.4	Short	70	0.0	NA
Approach	788	5.3		0.776		22.3	LOS C	9.0	65.5				
SouthWest: Fitzgibbon Road													
Lane 1	81	1.3	198	0.410	100	69.8	LOS E	5.3	37.6	Full	500	0.0	0.0
Lane 2	1	0.0	199	0.005	100	65.2	LOS E	0.1	0.4	Short	30	0.0	NA
Approach	82	1.3		0.410		69.7	LOS E	5.3	37.6				
Intersection	2751	4.1		0.813		33.5	LOS C	44.7	319.1				

Intersection R1040 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 40 [2041 PM - FINAL]

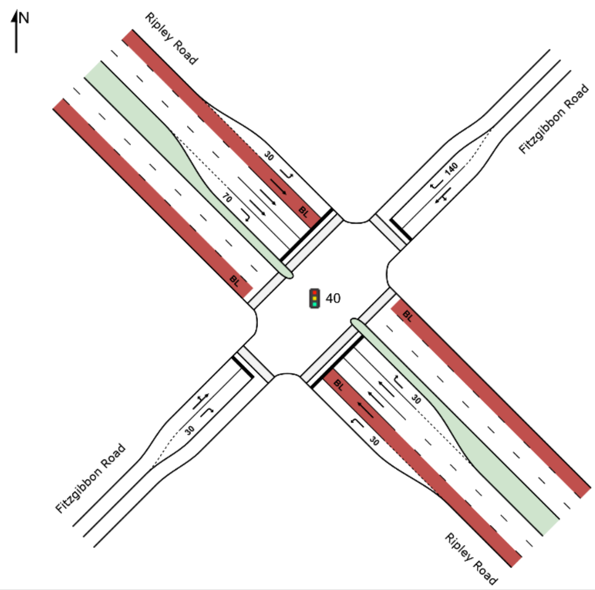
R1040
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

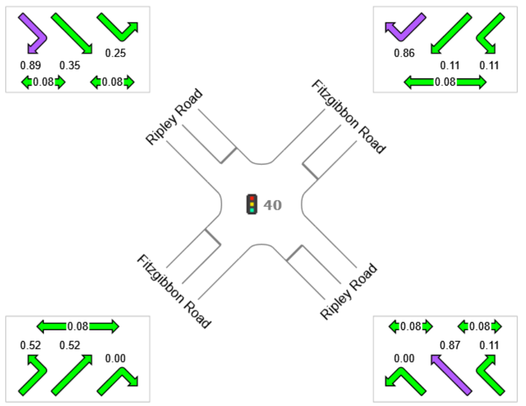
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Road													
Lane 1	1	0.0	882	0.001	100	17.0	LOS B	0.0	0.1	Short	30	0.0	NA
Lane 2 (BL)	12	100.0	325	0.036	100	23.2	LOS C	0.3	4.4	Full	500	0.0	0.0
Lane 3	338	2.8	527	0.642	100	28.0	LOS C	11.9	85.0	Full	500	0.0	0.0
Lane 4	327	2.8	509 [1]	0.642	100	27.8	LOS C	11.4	81.7	Full	500	0.0	0.0
Lane 5	17	0.0	139	0.121	100	45.0	LOS D	0.7	4.6	Short	30	0.0	NA
Approach	695	4.4		0.642		28.3	LOS C	11.9	85.0				
NorthEast: Fitzgibbon Road													
Lane 1	13	0.0	432	0.029	100	27.9	LOS C	0.4	2.7	Full	500	0.0	0.0
Lane 2	322	1.3	414	0.778	100	41.0	LOS D	13.0	91.8	Short	140	0.0	NA
Approach	335	1.3		0.778		40.5	LOS D	13.0	91.8				
NorthWest: Ripley Road													
Lane 1	200	1.1	922	0.217	100	11.8	LOS B	2.5	17.3	Short	30	0.0	NA
Lane 2 (BL)	14	100.0	325	0.042	100	23.3	LOS C	0.4	5.2	Full	500	0.0	0.0
Lane 3	424	1.7	530	0.799	100	33.2	LOS C	16.9	120.3	Full	500	0.0	0.0
Lane 4	424	1.7	530	0.799	100	33.2	LOS C	16.9	120.3	Full	500	0.0	0.0
Lane 5	77	0.0	139	0.552	100	47.3	LOS D	3.1	22.0	Short	70	0.0	NA
Approach	1138	2.7		0.799		30.3	LOS C	16.9	120.3				
SouthWest: Fitzgibbon Road													
Lane 1	67	0.0	232	0.290	100	41.2	LOS D	2.5	17.5	Full	500	0.0	0.0
Lane 2	1	0.0	232	0.005	100	38.8	LOS D	0.0	0.3	Short	30	0.0	NA
Approach	68	0.0		0.290		41.1	LOS D	2.5	17.5				
Intersection	2236	2.9		0.799		31.5	LOS C	16.9	120.3				

Intersection R1040-2066

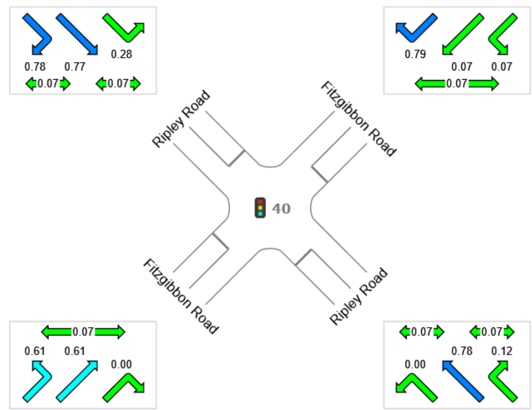
SITE LAYOUT – R1040– 2066



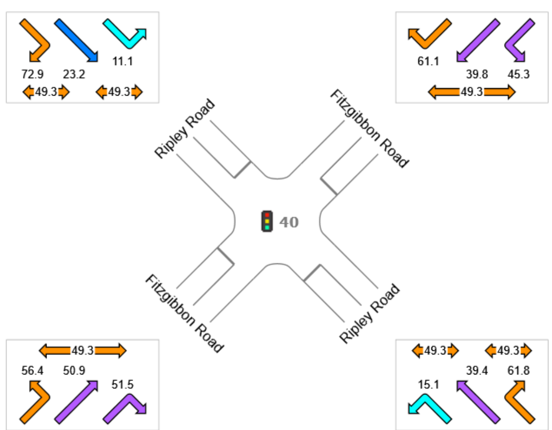
DEGREE OF SATURATION AM



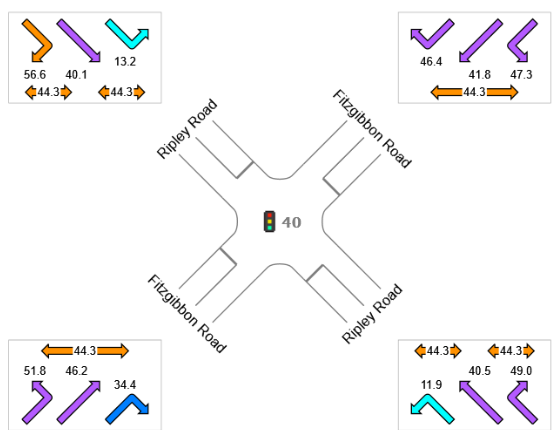
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1040 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 40 [2066 AM - FINAL same as 2041]

R1040
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Road													
Lane 1	2	0.0	1097	0.002	100	15.1	LOS B	0.0	0.3	Short	30	0.0	NA
Lane 2 (BL)	11	100.0	494	0.021	100	20.0	LOS B	0.3	4.3	Full	500	0.0	0.0
Lane 3	699	3.0	800	0.874	100	39.5	LOS D	38.7	278.2	Full	500	0.0	0.0
Lane 4	689	3.0	788 [1]	0.874	100	39.4	LOS D	38.0	272.9	Full	500	0.0	0.0
Lane 5	12	0.0	101	0.114	100	61.8	LOS E	0.6	4.4	Short	30	0.0	NA
Approach	1413	3.7		0.874		39.5	LOS D	38.7	278.2				
NorthEast: Fitzgibbon Road													
Lane 1	39	0.0	363	0.107	100	42.6	LOS D	1.7	12.1	Full	500	0.0	0.0
Lane 2	300	2.8	348	0.863	100	61.1	LOS E	17.7	126.8	Short	140	0.0	NA
Approach	339	2.5		0.863		59.0	LOS E	17.7	126.8				
NorthWest: Ripley Road													
Lane 1	276	3.4	1104	0.250	100	11.1	LOS B	3.9	28.4	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	494	0.026	100	20.0	LOS C	0.4	5.1	Full	500	0.0	0.0
Lane 3	272	7.0	780	0.349	100	23.3	LOS C	9.9	73.2	Full	500	0.0	0.0
Lane 4	272	7.0	780	0.349	100	23.3	LOS C	9.9	73.2	Full	500	0.0	0.0
Lane 5	89	1.2	100	0.891	100	72.9	LOS E	5.5	39.2	Short	70	0.0	NA
Approach	922	6.6		0.891		24.4	LOS C	9.9	73.2				
SouthWest: Fitzgibbon Road													
Lane 1	115	0.0	221	0.520	100	55.7	LOS E	6.0	42.0	Full	500	0.0	0.0
Lane 2	1	0.0	219	0.005	100	51.5	LOS D	0.0	0.3	Short	30	0.0	NA
Approach	116	0.0		0.520		55.7	LOS E	6.0	42.0				
Intersection	2789	4.4		0.891		37.5	LOS D	38.7	278.2				

Intersection R1040 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 40 [2066 PM - FINAL same as 2041]

R1040
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

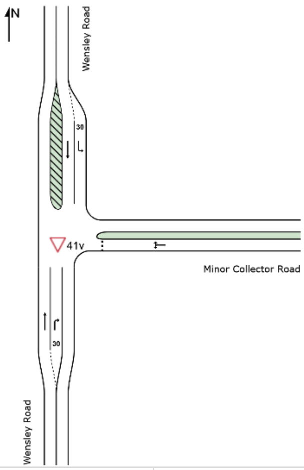
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Road													
Lane 1	1	0.0	947	0.001	100	11.9	LOS B	0.0	0.1	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	295	0.043	100	31.0	LOS C	0.5	6.1	Full	500	0.0	0.0
Lane 3	371	3.2	478	0.777	100	40.7	LOS D	17.9	129.0	Full	500	0.0	0.0
Lane 4	353	3.2	455 [1]	0.777	100	40.5	LOS D	16.9	121.7	Full	500	0.0	0.0
Lane 5	27	0.0	223	0.123	100	49.0	LOS D	1.2	8.6	Short	30	0.0	NA
Approach	765	4.7		0.777		40.7	LOS D	17.9	129.0				
NorthEast: Fitzgibbon Road													
Lane 1	17	0.0	251	0.067	100	42.8	LOS D	0.7	5.1	Full	500	0.0	0.0
Lane 2	380	0.3	482	0.789	100	46.4	LOS D	18.5	130.0	Short	140	0.0	NA
Approach	397	0.3		0.789		46.3	LOS D	18.5	130.0				
NorthWest: Ripley Road													
Lane 1	266	0.8	942	0.283	100	13.2	LOS B	3.9	27.1	Short	30	0.0	NA
Lane 2 (BL)	13	100.0	295	0.043	100	31.0	LOS C	0.5	6.1	Full	500	0.0	0.0
Lane 3	368	2.4	480	0.767	100	40.2	LOS D	17.6	125.8	Full	500	0.0	0.0
Lane 4	368	2.4	480	0.767	100	40.2	LOS D	17.6	125.8	Full	500	0.0	0.0
Lane 5	173	0.6	222	0.778	100	56.6	LOS E	8.9	62.9	Short	70	0.0	NA
Approach	1187	2.8		0.778		36.4	LOS D	17.6	125.8				
SouthWest: Fitzgibbon Road													
Lane 1	146	2.2	240	0.610	100	50.7	LOS D	7.0	50.2	Full	500	0.0	0.0
Lane 2	1	0.0	483	0.002	100	34.4	LOS C	0.0	0.3	Short	30	0.0	NA
Approach	147	2.1		0.610		50.6	LOS D	7.0	50.2				
Intersection	2497	3.0		0.789		40.2	LOS D	18.5	130.0				

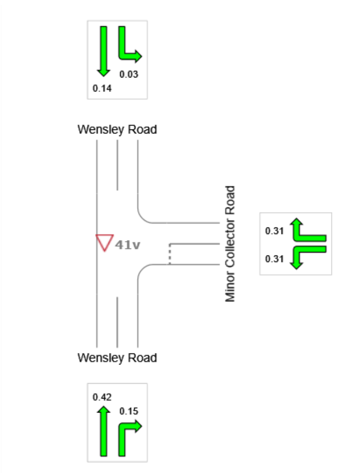
31 Intersection R1041

2031

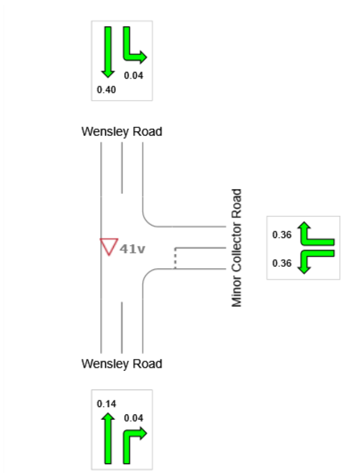
SITE LAYOUT – R1041 – 2031



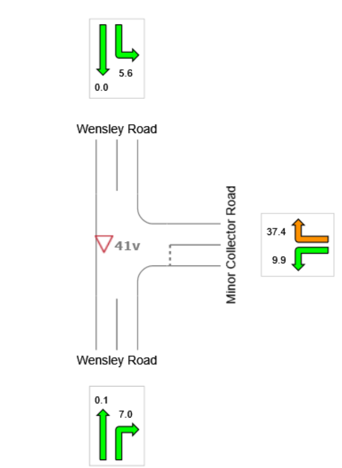
DEGREE OF SATURATION AM



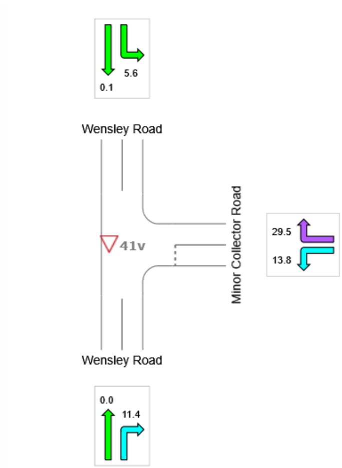
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1041 – 2031 Cont.

MOVEMENT SUMMARY 2031 AM

Site: 41v [2031 AM - FINAL same as 2026]

R1041
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Wensley Road												
2	T1	808	1.7	0.423	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	155	0.0	0.148	7.0	LOS A	0.6	4.3	0.42	0.66	0.42	52.0
Approach		963	1.4	0.423	1.2	NA	0.6	4.3	0.07	0.11	0.07	58.5
East: Minor Collector Road												
4	L2	18	0.0	0.313	9.9	LOS A	1.1	7.7	0.78	0.90	0.93	40.0
6	R2	39	0.0	0.313	37.4	LOS E	1.1	7.7	0.78	0.90	0.93	39.8
Approach		57	0.0	0.313	28.8	LOS D	1.1	7.7	0.78	0.90	0.93	39.9
North: Wensley Road												
7	L2	56	3.8	0.031	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.5
8	T1	257	5.3	0.136	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		313	5.1	0.136	1.0	NA	0.0	0.0	0.00	0.10	0.00	58.7
All Vehicles		1333	2.2	0.423	2.3	NA	1.1	7.7	0.08	0.14	0.09	57.4

MOVEMENT SUMMARY 2031 PM

Site: 41v [2031 PM - FINAL same as 2026]

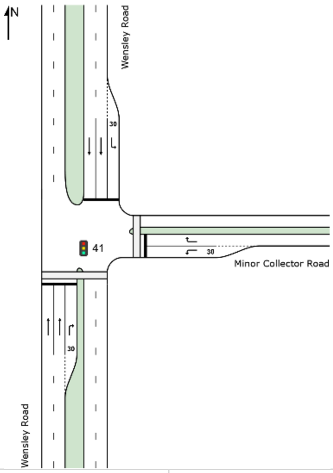
R1041
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

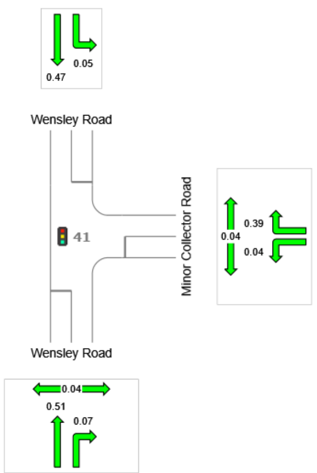
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Wensley Road												
2	T1	267	2.0	0.140	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
3	R2	19	0.0	0.038	11.4	LOS B	0.1	0.9	0.67	0.84	0.67	48.9
Approach		286	1.8	0.140	0.8	NA	0.1	0.9	0.04	0.06	0.04	59.1
East: Minor Collector Road												
4	L2	54	0.0	0.355	13.8	LOS B	1.4	9.5	0.83	0.98	1.04	43.8
6	R2	44	0.0	0.355	29.5	LOS D	1.4	9.5	0.83	0.98	1.04	43.6
Approach		98	0.0	0.355	20.9	LOS C	1.4	9.5	0.83	0.98	1.04	43.7
North: Wensley Road												
7	L2	71	3.0	0.039	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.5
8	T1	776	0.7	0.400	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		846	0.9	0.400	0.5	NA	0.0	0.0	0.00	0.05	0.00	59.3
All Vehicles		1231	1.0	0.400	2.2	NA	1.4	9.5	0.08	0.12	0.09	57.6

Intersection R1041-2041

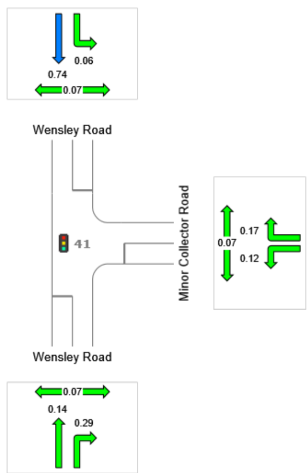
SITE LAYOUT – R1041 – 2041



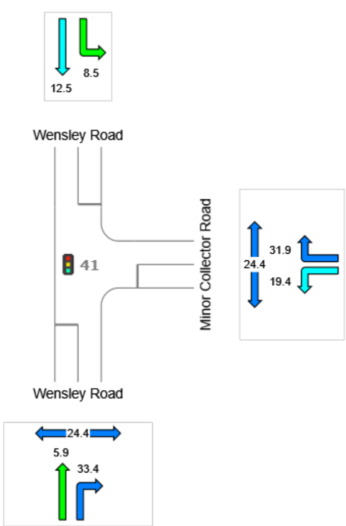
DEGREE OF SATURATION AM



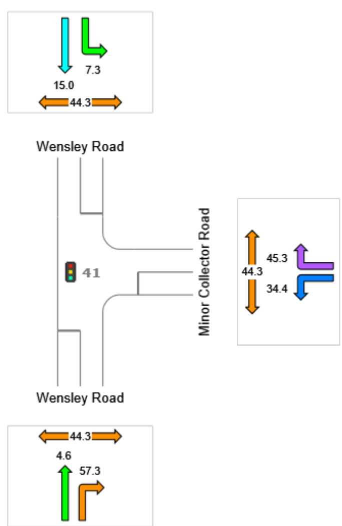
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1041 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 41 [2041 AM - FINAL]

R1041
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Wensley Road													
Lane 1	638	0.7	1261	0.506	100	5.9	LOS A	9.8	68.8	Full	500	0.0	0.0
Lane 2	628	0.7	1241 [1]	0.506	100	5.9	LOS A	9.5	67.1	Full	500	0.0	0.0
Lane 3	13	0.0	186	0.068	100	33.4	LOS C	0.4	2.5	Short	30	0.0	NA
Approach	1279	0.7		0.506		6.2	LOS A	9.8	68.8				
East: Minor Collector Road													
Lane 1	28	0.0	650	0.044	100	19.4	LOS B	0.6	3.9	Short	30	0.0	NA
Lane 2	103	6.1	267	0.386	100	31.9	LOS C	2.9	21.3	Full	500	0.0	0.0
Approach	132	4.8		0.386		29.2	LOS C	2.9	21.3				
North: Wensley Road													
Lane 1	65	1.6	1285	0.051	100	8.5	LOS A	0.6	4.2	Short	30	0.0	NA
Lane 2	399	1.4	856 [1]	0.467	100	12.5	LOS B	8.2	58.2	Full	500	0.0	0.0
Lane 3	406	1.4	869	0.467	100	12.5	LOS B	8.4	59.4	Full	500	0.0	0.0
Approach	871	1.5		0.467		12.2	LOS B	8.4	59.4				
Intersection	2281	1.2		0.506		9.8	LOS A	9.8	68.8				

Intersection R1041 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 41 [2041 PM - FINAL]

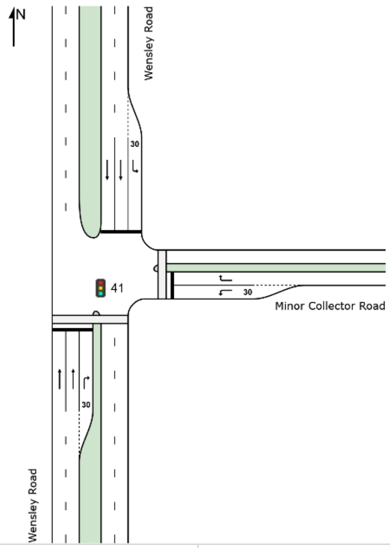
R1041
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

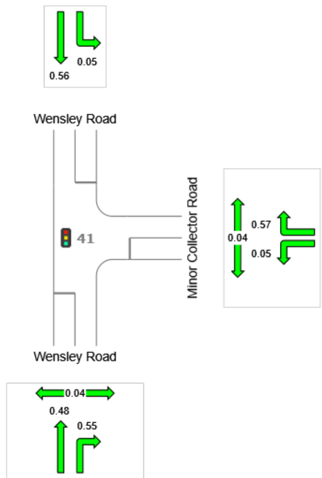
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Wensley Road													
Lane 1	199	0.3	1402	0.142	100	4.6	LOS A	3.0	20.8	Full	500	0.0	0.0
Lane 2	199	0.3	1402	0.142	100	4.6	LOS A	3.0	20.8	Full	500	0.0	0.0
Lane 3	33	0.0	111	0.293	100	57.3	LOS E	1.6	11.4	Short	30	0.0	NA
Approach	432	0.2		0.293		8.6	LOS A	3.0	20.8				
East: Minor Collector Road													
Lane 1	63	0.0	520	0.121	100	34.4	LOS C	2.3	16.1	Short	30	0.0	NA
Lane 2	51	0.0	297	0.170	100	45.3	LOS D	2.2	15.2	Full	500	0.0	0.0
Approach	114	0.0		0.170		39.3	LOS D	2.3	16.1				
North: Wensley Road													
Lane 1	83	1.3	1509	0.055	100	7.3	LOS A	0.7	5.3	Short	30	0.0	NA
Lane 2	802	0.5	1079 [1]	0.743	100	14.5	LOS B	26.3	185.2	Full	500	0.0	0.0
Lane 3	866	0.5	1166	0.743	100	15.4	LOS B	30.2	212.2	Full	500	0.0	0.0
Approach	1752	0.5		0.743		14.6	LOS B	30.2	212.2				
Intersection	2297	0.5		0.743		14.7	LOS B	30.2	212.2				

Intersection R1041-2066

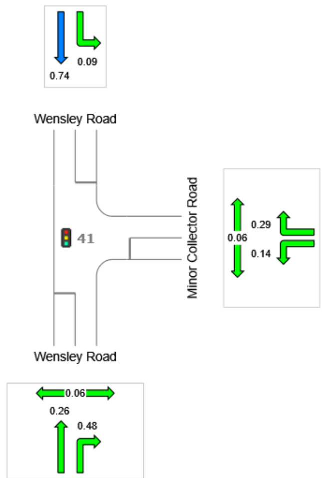
SITE LAYOUT – R1041 – 2066



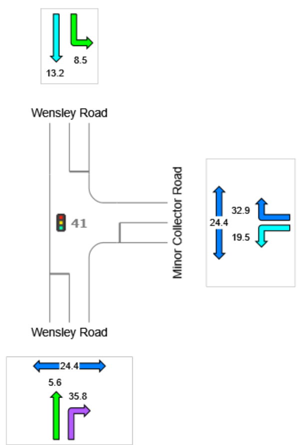
DEGREE OF SATURATION AM



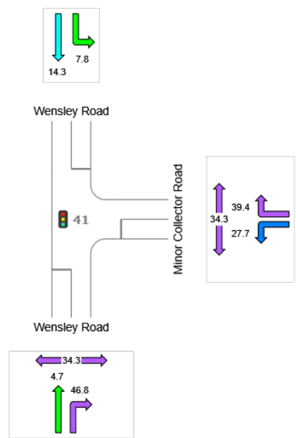
DEGREE OF SATURATION PM



<u>DELAY CONTROL (seconds) AM</u>



<u>DELAY CONTROL (seconds) PM</u>



Intersection R1041 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 41 [2066 AM - FINAL same as 2041]

R1041
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Wensley Road													
Lane 1	602	0.7	1261	0.477	100	5.7	LOS A	9.0	63.1	Full	500	0.0	0.0
Lane 2	537	0.7	1125 [1]	0.477	100	5.5	LOS A	7.6	53.6	Full	500	0.0	0.0
Lane 3	102	0.0	186	0.550	100	35.8	LOS D	3.1	21.8	Short	30	0.0	NA
Approach	1241	0.7		0.550		8.1	LOS A	9.0	63.1				
East: Minor Collector Road													
Lane 1	35	0.0	650	0.053	100	19.5	LOS B	0.7	4.7	Short	30	0.0	NA
Lane 2	157	2.7	273	0.574	100	32.9	LOS C	4.6	32.7	Full	500	0.0	0.0
Approach	192	2.2		0.574		30.5	LOS C	4.6	32.7				
North: Wensley Road													
Lane 1	58	3.6	1267	0.046	100	8.5	LOS A	0.5	3.7	Short	30	0.0	NA
Lane 2	466	2.1	835 [1]	0.558	100	13.1	LOS B	10.0	71.6	Full	500	0.0	0.0
Lane 3	483	2.1	866	0.558	100	13.2	LOS B	10.5	75.1	Full	500	0.0	0.0
Approach	1007	2.2		0.558		12.9	LOS B	10.5	75.1				
Intersection	2440	1.4		0.574		11.8	LOS B	10.5	75.1				

Intersection R1041 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 41 [2066 PM - FINAL same as 2041]

R1041
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

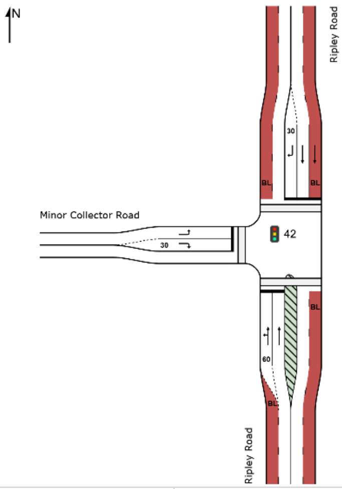
Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Wensley Road													
Lane 1	350	0.3	1362	0.257	100	4.7	LOS A	4.9	34.6	Full	500	0.0	0.0
Lane 2	350	0.3	1362	0.257	100	4.7	LOS A	4.9	34.6	Full	500	0.0	0.0
Lane 3	66	0.0	139	0.476	100	46.8	LOS D	2.7	18.8	Short	30	0.0	NA
Approach	766	0.3		0.476		8.3	LOS A	4.9	34.6				
East: Minor Collector Road													
Lane 1	78	0.0	557	0.140	100	27.7	LOS C	2.2	15.6	Short	30	0.0	NA
Lane 2	79	2.7	273	0.289	100	39.4	LOS D	2.8	20.4	Full	500	0.0	0.0
Approach	157	1.3		0.289		33.6	LOS C	2.8	20.4				
North: Wensley Road													
Lane 1	123	0.9	1431	0.086	100	7.8	LOS A	1.1	8.0	Short	30	0.0	NA
Lane 2	708	0.5	956 [1]	0.741	100	13.8	LOS B	19.6	137.8	Full	500	0.0	0.0
Lane 3	792	0.5	1069	0.741	100	14.7	LOS B	23.4	164.8	Full	500	0.0	0.0
Approach	1623	0.5		0.741		13.8	LOS B	23.4	164.8				
Intersection	2546	0.5		0.741		13.4	LOS B	23.4	164.8				

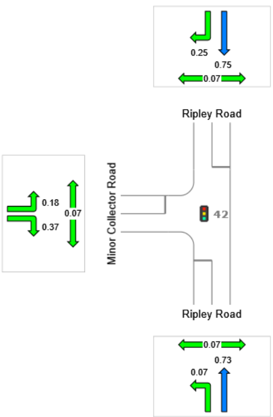
32 Intersection R1042

2031

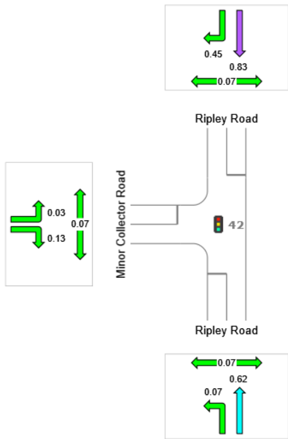
SITE LAYOUT – R1042 – 2031



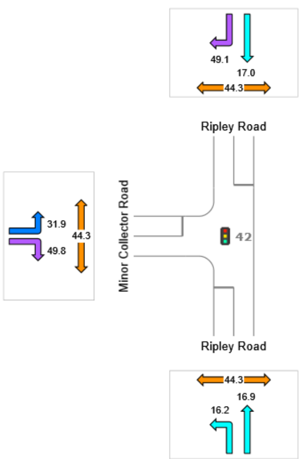
DEGREE OF SATURATION AM



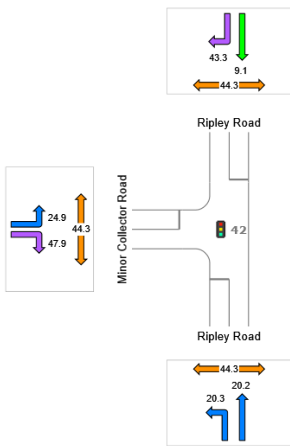
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



INTERSECTION R1042 – 2031 CONT.

LANE SUMMARY 2031 AM

Site: 42 [2031 AM - FINAL]

R1042
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road													
Lane 1(..-BL)	65	6.5	1001	0.065	100	15.6	LOS B	1.4	10.5	Two Seg [10]	500	0.0	0.0
Lane 2	745	3.1	1027 [1]	0.726	100	16.9	LOS B	26.0	186.8	Full	500	0.0	0.0
Approach	811	3.4		0.726		16.8	LOS B	26.0	186.8				
North: Ripley Road													
Lane 1 (BL)	4	100.0	662	0.006	100	10.2	LOS B	0.1	1.2	Full	500	0.0	0.0
Lane 2	733	7.0	975 [1]	0.752	100	17.0	LOS B	25.7	190.7	Full	500	0.0	0.0
Lane 3	59	5.4	233	0.253	100	49.1	LOS D	2.7	19.6	Short	30	0.0	NA
Approach	796	7.4		0.752		19.4	LOS B	25.7	190.7				
West: Minor Collector Road													
Lane 1	105	2.0	586	0.180	100	31.9	LOS C	3.7	26.3	Full	500	0.0	0.0
Lane 2	88	0.0	241	0.366	100	49.8	LOS D	4.1	28.6	Short	30	0.0	NA
Approach	194	1.1		0.366		40.1	LOS D	4.1	28.6				
Intersection	1800	4.9		0.752		20.5	LOS C	26.0	190.7				

INTERSECTION R1042 – 2031 CONT.

LANE SUMMARY 2031 PM

Site: 42 [2031 PM - FINAL]

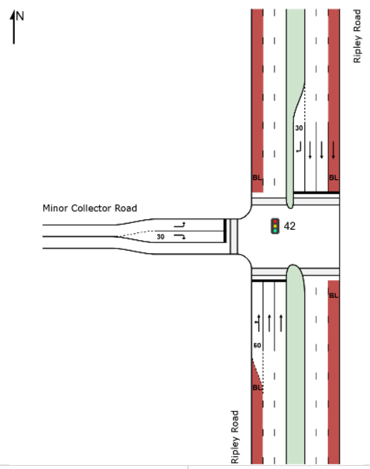
R1042
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

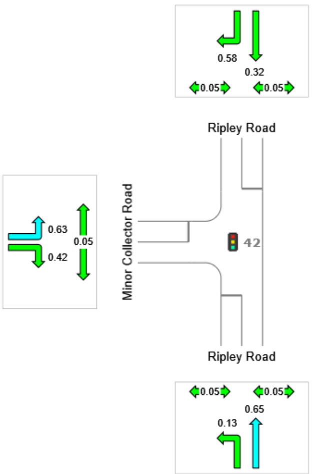
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Ripley Road													
Lane 1(..-BL)	57	9.3	847	0.067	100	19.4	LOS B	1.5	11.1	Two Seg [10]	500	0.0	0.0
Lane 2	557	0.9	904 [1]	0.616	100	20.3	LOS C	19.7	139.0	Full	500	0.0	0.0
Approach	614	1.7		0.616		20.2	LOS C	19.7	139.0				
North: Ripley Road													
Lane 1 (BL)	4	100.0	886	0.005	100	3.3	LOS A	0.1	0.7	Full	500	0.0	0.0
Lane 2	1037	3.1	1243 [1]	0.834	100	9.1	LOS A	29.0	208.1	Full	500	0.0	0.0
Lane 3	175	0.6	388	0.450	100	43.3	LOS D	7.6	53.3	Short	30	0.0	NA
Approach	1216	3.1		0.834		14.0	LOS B	29.0	208.1				
West: Minor Collector Road													
Lane 1	22	4.8	718	0.031	100	24.9	LOS C	0.6	4.7	Full	500	0.0	0.0
Lane 2	31	0.0	241	0.126	100	47.9	LOS D	1.3	9.4	Short	30	0.0	NA
Approach	53	2.0		0.126		38.2	LOS D	1.3	9.4				
Intersection	1882	2.6		0.834		16.7	LOS B	29.0	208.1				

Intersection R1042-2041

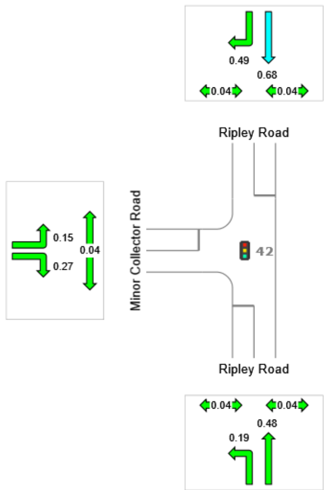
SITE LAYOUT – R1042 – 2041



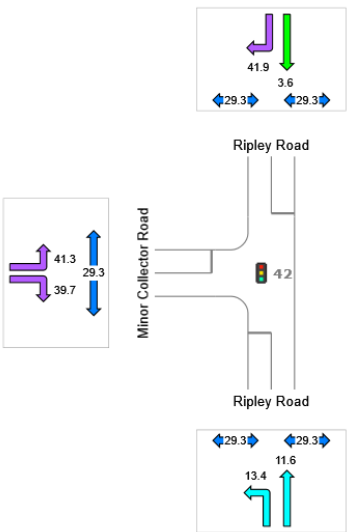
DEGREE OF SATURATION AM



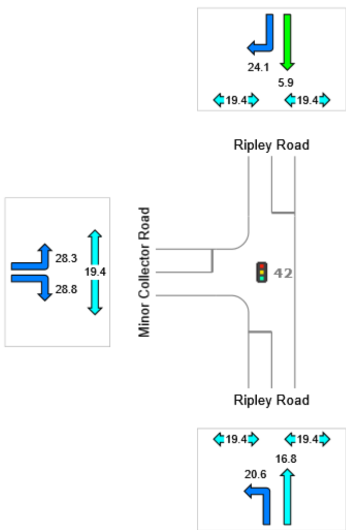
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1042 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 42 [2041 AM - FINAL]

R1042
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road													
Lane 1(..-BL)	131	9.7	980	0.133	100	12.4	LOS B	2.1	15.9	Two Seg [10]	500	0.0	0.0
Lane 2	682	3.2	1043 [1]	0.653	100	11.5	LOS B	16.1	115.6	Full	500	0.0	0.0
Lane 3	695	3.2	1064	0.653	100	11.7	LOS B	16.6	119.3	Full	500	0.0	0.0
Approach	1507	3.8		0.653		11.7	LOS B	16.6	119.3				
North: Ripley Road													
Lane 1 (BL)	13	100.0	861	0.015	100	2.8	LOS A	0.1	1.5	Full	500	0.0	0.0
Lane 2	436	4.5	1381	0.316	100	3.6	LOS A	5.2	37.8	Full	500	0.0	0.0
Lane 3	436	4.5	1381	0.316	100	3.6	LOS A	5.2	37.8	Full	500	0.0	0.0
Lane 4	89	3.5	155	0.576	100	41.9	LOS D	3.2	23.2	Short	30	0.0	NA
Approach	975	5.6		0.576		7.1	LOS A	5.2	37.8				
West: Minor Collector Road													
Lane 1	115	2.8	182	0.630	100	41.3	LOS D	4.1	29.5	Full	500	0.0	0.0
Lane 2	78	1.4	184	0.423	100	39.7	LOS D	2.7	19.0	Short	30	0.0	NA
Approach	193	2.2		0.630		40.6	LOS D	4.1	29.5				
Intersection	2675	4.3		0.653		12.1	LOS B	16.6	119.3				

Intersection R1042 – 2041 Cont.

LANE SUMMARY 2041 PM

Site: 42 [2041 PM - FINAL]

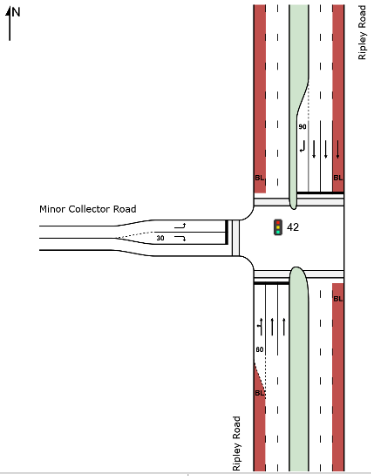
R1042
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

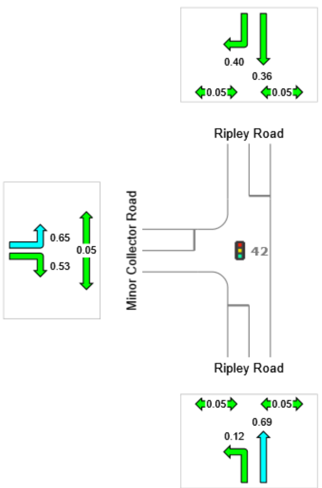
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road													
Lane 1(..-BL)	93	13.6	482	0.192	100	19.3	LOS B	1.8	13.7	Two Seg [10]	500	0.0	0.0
Lane 2	248	8.9	516	0.481	100	16.8	LOS B	5.3	39.6	Full	500	0.0	0.0
Lane 3	248	8.9	516	0.481	100	16.8	LOS B	5.3	39.6	Full	500	0.0	0.0
Approach	589	9.6		0.481		17.2	LOS B	5.3	39.6				
North: Ripley Road													
Lane 1 (BL)	13	100.0	756	0.017	100	3.5	LOS A	0.1	1.5	Full	500	0.0	0.0
Lane 2	846	1.0	1240	0.682	100	6.3	LOS A	13.3	94.1	Full	500	0.0	0.0
Lane 3	687	1.0	1007 [1]	0.682	100	5.5	LOS A	9.5	67.0	Full	500	0.0	0.0
Lane 4	218	1.0	443	0.492	100	24.1	LOS C	4.8	34.0	Short	30	0.0	NA
Approach	1763	1.7		0.682		8.2	LOS A	13.3	94.1				
West: Minor Collector Road													
Lane 1	34	3.1	218	0.155	100	28.3	LOS C	0.8	5.7	Full	500	0.0	0.0
Lane 2	60	0.0	223	0.269	100	28.8	LOS C	1.4	10.1	Short	30	0.0	NA
Approach	94	1.1		0.269		28.6	LOS C	1.4	10.1				
Intersection	2446	3.6		0.682		11.1	LOS B	13.3	94.1				

Intersection R1042-2066

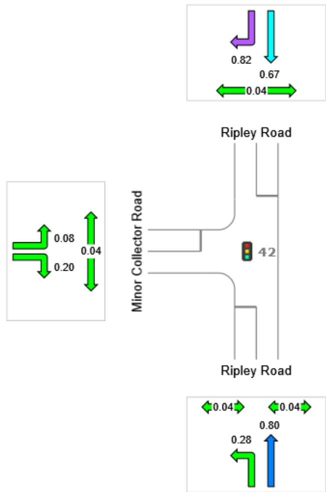
SITE LAYOUT – R1042 – 2066



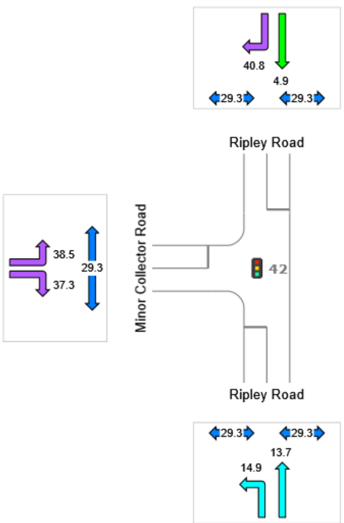
DEGREE OF SATURATION AM



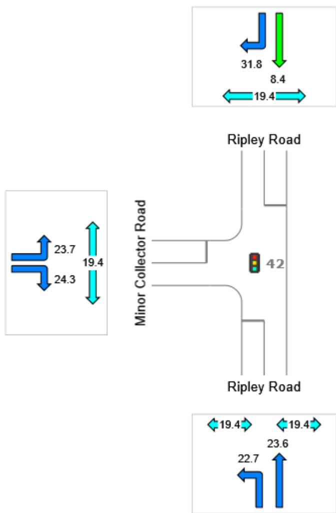
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



LANE SUMMARY 2066 AM

Site: 42 [2066 AM - FINAL same as 2041]

R1042
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Ripley Road													
Lane 1(..-BL)	111	11.4	894	0.124	100	13.9	LOS B	1.9	14.8	Two Seg [10]	500	0.0	0.0
Lane 2	664	1.8	968 [1]	0.686	100	13.6	LOS B	16.9	120.1	Full	500	0.0	0.0
Lane 3	680	1.8	991	0.686	100	13.8	LOS B	17.5	124.6	Full	500	0.0	0.0
Approach	1455	2.5		0.686		13.7	LOS B	17.5	124.6				
North: Ripley Road													
Lane 1 (BL)	13	100.0	810	0.016	100	3.7	LOS A	0.1	1.8	Full	500	0.0	0.0
Lane 2	465	5.0	1295	0.359	100	4.9	LOS A	6.6	48.0	Full	500	0.0	0.0
Lane 3	465	5.0	1295	0.359	100	4.9	LOS A	6.6	48.0	Full	500	0.0	0.0
Lane 4	63	0.0	159	0.397	100	40.8	LOS D	2.2	15.4	Short	90	0.0	NA
Approach	1005	5.9		0.397		7.1	LOS A	6.6	48.0				
West: Minor Collector Road													
Lane 1	174	0.0	265	0.655	100	38.5	LOS D	6.0	42.3	Full	500	0.0	0.0
Lane 2	137	3.8	258	0.530	100	37.3	LOS D	4.6	33.1	Short	30	0.0	NA
Approach	311	1.7		0.655		38.0	LOS D	6.0	42.3				
Intersection	2771	3.6		0.686		14.1	LOS B	17.5	124.6				

Intersection R1042 – 2066 Cont.

LANE SUMMARY 2066 PM

Site: 42 [2066 PM - FINAL same as 2041]

R1042
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

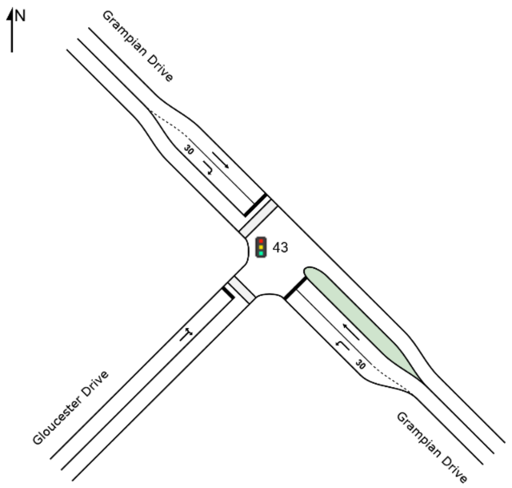
Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
South: Ripley Road													
Lane 1(..-BL)	116	12.7	415	0.279	100	21.5	LOS C	2.4	18.4	Two Seg 10	500	0.0	0.0
Lane 2	365	3.6	457	0.798	100	23.7	LOS C	9.8	70.4	Full	500	0.0	0.0
Lane 3	365	3.6	457	0.798	100	23.7	LOS C	9.8	70.4	Full	500	0.0	0.0
Approach	845	4.9		0.798		23.4	LOS C	9.8	70.4				
North: Ripley Road													
Lane 1 (BL)	14	100.0	662	0.021	100	5.3	LOS A	0.1	1.9	Full	500	0.0	0.0
Lane 2	724	1.2	1084	0.668	100	8.5	LOS A	12.6	89.1	Full	500	0.0	0.0
Lane 3	724	1.2	1084	0.668	100	8.5	LOS A	12.6	89.1	Full	500	0.0	0.0
Lane 4	302	1.4	368	0.821	100	31.8	LOS C	8.4	59.6	Short	90	0.0	NA
Approach	1763	2.0		0.821		12.4	LOS B	12.6	89.1				
West: Minor Collector Road													
Lane 1	28	0.0	371	0.077	100	23.7	LOS C	0.6	4.1	Full	500	0.0	0.0
Lane 2	73	0.0	371	0.196	100	24.3	LOS C	1.5	10.8	Short	30	0.0	NA
Approach	101	0.0		0.196		24.1	LOS C	1.5	10.8				
Intersection	2709	2.8		0.821		16.3	LOS B	12.6	89.1				

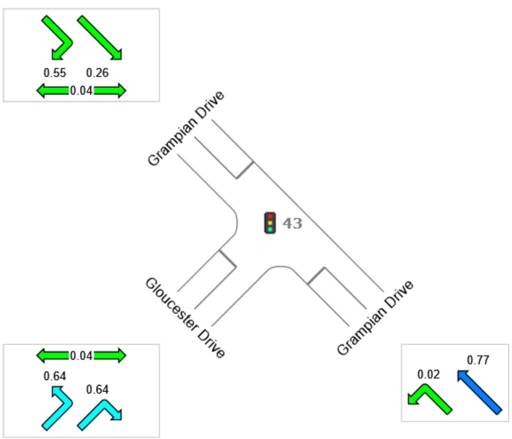
33 Intersection R1043

2031

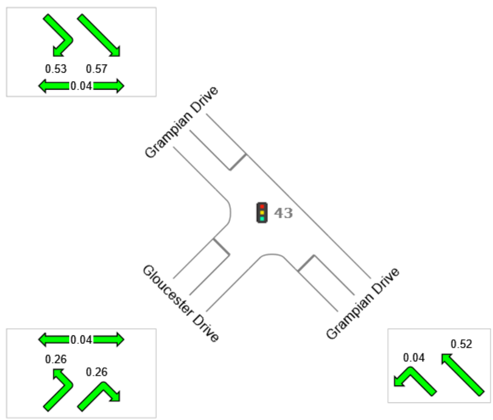
SITE LAYOUT – R1043 – 2031



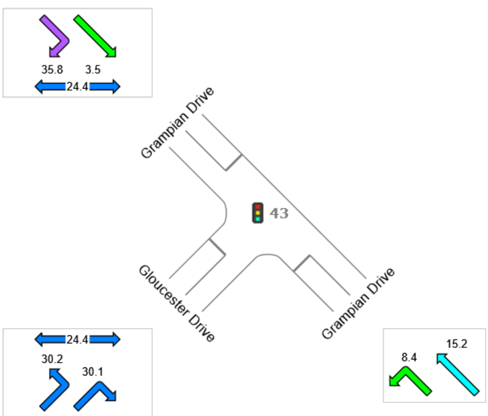
DEGREE OF SATURATION AM



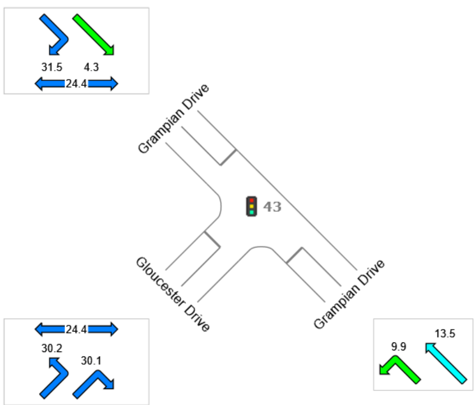
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



LANE SUMMARY 2031 AM

Site: 43 [2031 AM - FINAL]

R1043
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Grampian Drive													
Lane 1	24	0.0	1300	0.019	100	8.4	LOS A	0.2	1.5	Short	30	0.0	NA
Lane 2	735	0.6	953 [1]	0.771	100	15.2	LOS B	18.9	132.7	Full	500	0.0	0.0
Approach	759	0.6		0.771		15.0	LOS B	18.9	132.7				
NorthWest: Grampian Drive													
Lane 1	356	2.1	1347	0.264	100	3.5	LOS A	3.8	27.2	Full	500	0.0	0.0
Lane 2	100	3.2	182	0.551	100	35.8	LOS D	3.1	21.9	Short	30	0.0	NA
Approach	456	2.3		0.551		10.6	LOS B	3.8	27.2				
SouthWest: Gloucester Drive													
Lane 1	240	0.0	376	0.638	100	30.2	LOS C	6.8	47.7	Full	500	0.0	0.0
Approach	240	0.0		0.638		30.2	LOS C	6.8	47.7				
Intersection	1455	1.0		0.771		16.1	LOS B	18.9	132.7				

LANE SUMMARY 2031 PM

Site: 43 [2031 PM - FINAL]

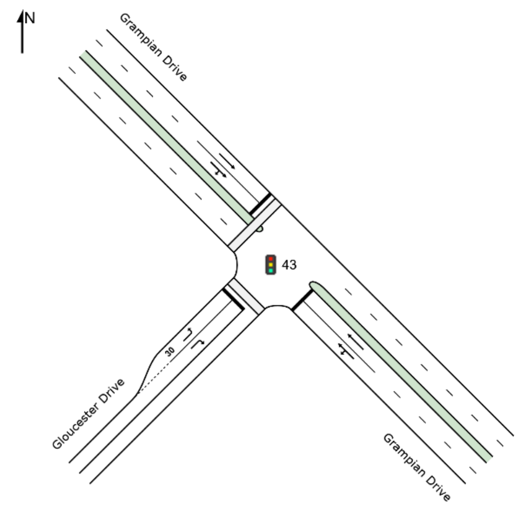
R1043
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

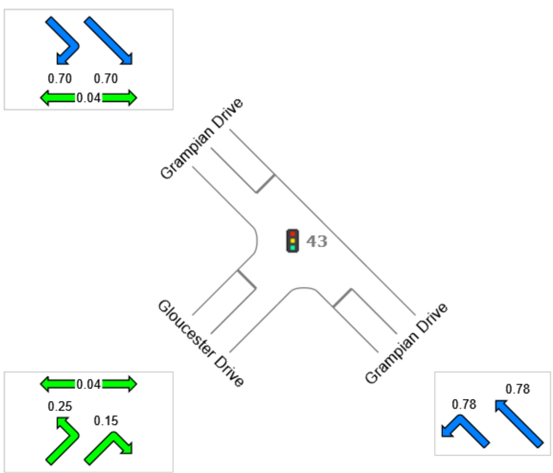
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Grampian Drive													
Lane 1	47	0.0	1176	0.040	100	9.9	LOS A	0.5	3.6	Short	30	0.0	NA
Lane 2	425	0.7	823 [1]	0.517	100	13.5	LOS B	9.2	64.6	Full	500	0.0	0.0
Approach	473	0.7		0.517		13.1	LOS B	9.2	64.6				
NorthWest: Grampian Drive													
Lane 1	636	0.8	1123 [1]	0.566	100	4.3	LOS A	8.3	58.5	Full	500	0.0	0.0
Lane 2	163	1.3	307	0.532	100	31.5	LOS C	4.6	32.7	Short	30	0.0	NA
Approach	799	0.9		0.566		9.9	LOS A	8.3	58.5				
SouthWest: Gloucester Drive													
Lane 1	78	1.4	304	0.256	100	30.1	LOS C	2.1	14.8	Full	500	0.0	0.0
Approach	78	1.4		0.256		30.1	LOS C	2.1	14.8				
Intersection	1349	0.9		0.566		12.2	LOS B	9.2	64.6				

Intersection R1043-2041

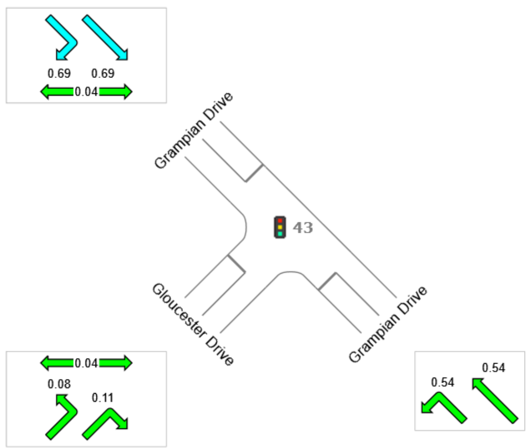
SITE LAYOUT – R1043 – 2041



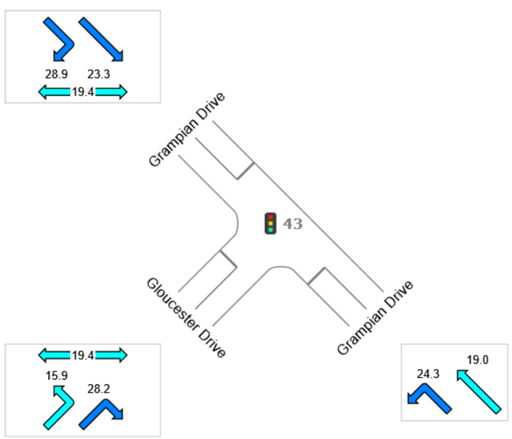
DEGREE OF SATURATION AM



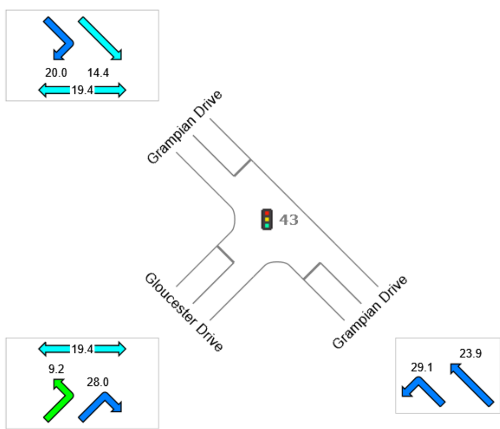
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1043 – 2041 Cont.

LANE SUMMARY 2041 AM

Site: 43 [2041 AM - FINAL]

R1043
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Grampian Drive													
Lane 1	514	0.5	662	0.776	100	19.0	LOS B	12.7	89.6	Full	500	0.0	0.0
Lane 2	513	0.5	661	0.776	100	19.3	LOS B	12.8	89.7	Full	500	0.0	0.0
Approach	1026	0.5		0.776		19.1	LOS B	12.8	89.7				
NorthWest: Grampian Drive													
Lane 1	241	3.0	344	0.701	100	23.3	LOS C	6.1	44.0	Full	500	0.0	0.0
Lane 2	237	1.8	337	0.701	100	26.5	LOS C	6.0	42.8	Full	500	0.0	0.0
Approach	478	2.4		0.701		24.9	LOS C	6.1	44.0				
SouthWest: Gloucester Drive													
Lane 1	195	0.5	777	0.251	100	15.9	LOS B	3.1	22.1	Short	30	0.0	NA
Lane 2	34	0.0	223	0.151	100	28.2	LOS C	0.8	5.5	Full	500	0.0	0.0
Approach	228	0.5		0.251		17.7	LOS B	3.1	22.1				
Intersection	1733	1.0		0.776		20.5	LOS C	12.8	89.7				

LANE SUMMARY 2041 PM

Site: 43 [2041 PM - FINAL]

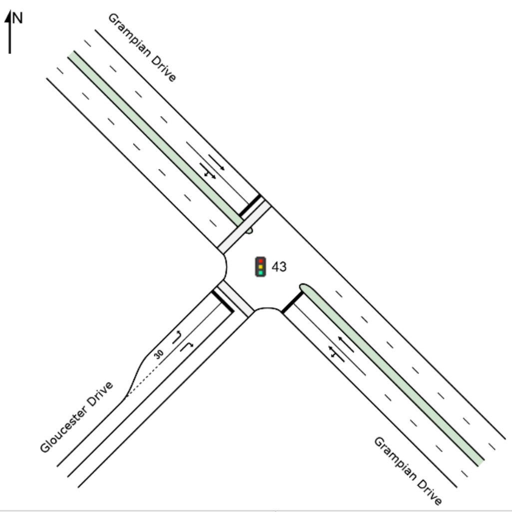
R1043
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 50 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

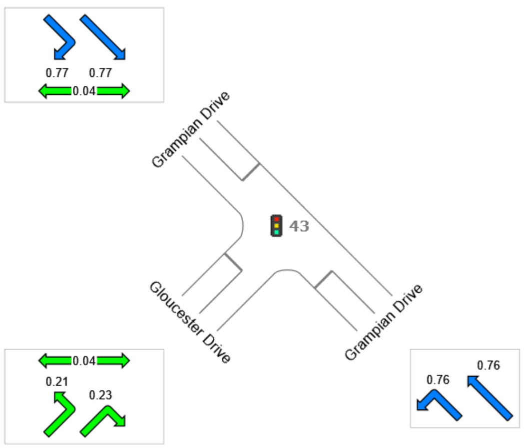
	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Grampian Drive													
Lane 1	124	2.9	231	0.537	100	23.7	LOS C	3.1	22.1	Full	500	0.0	0.0
Lane 2	123	3.0	229	0.537	100	24.3	LOS C	3.1	22.2	Full	500	0.0	0.0
Approach	247	3.0		0.537		24.0	LOS C	3.1	22.2				
NorthWest: Grampian Drive													
Lane 1	539	0.2	779	0.692	100	14.4	LOS B	11.5	80.9	Full	500	0.0	0.0
Lane 2	528	0.8	763	0.692	100	16.4	LOS B	11.3	79.8	Full	500	0.0	0.0
Approach	1066	0.5		0.692		15.4	LOS B	11.5	80.9				
SouthWest: Gloucester Drive													
Lane 1	89	1.2	1179	0.076	100	9.2	LOS A	0.8	5.8	Short	30	0.0	NA
Lane 2	24	0.0	223	0.109	100	28.0	LOS C	0.6	3.9	Full	500	0.0	0.0
Approach	114	0.9		0.109		13.2	LOS B	0.8	5.8				
Intersection	1427	1.0		0.692		16.7	LOS B	11.5	80.9				

Intersection R1043-2066

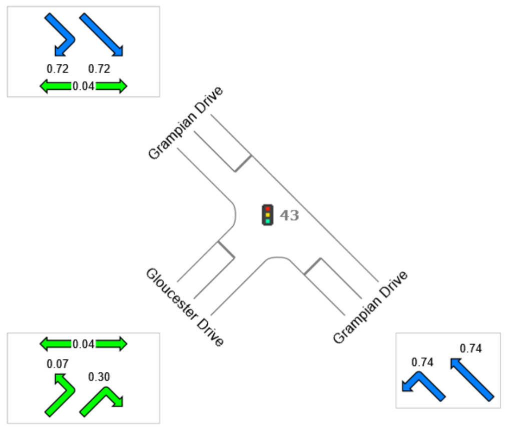
SITE LAYOUT – R1043 – 2066



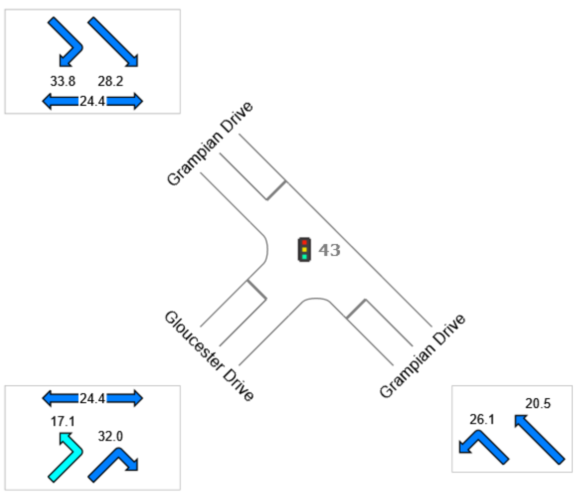
DEGREE OF SATURATION AM



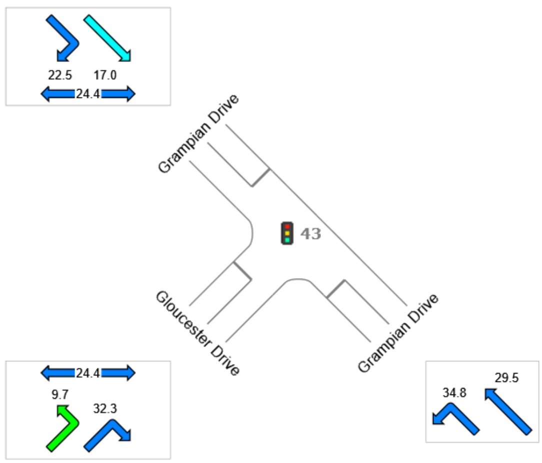
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1043 – 2066 Cont.

LANE SUMMARY 2066 AM

Site: 43 [2066 AM - FINAL same as 2041]

R1043
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Grampian Drive													
Lane 1	541	0.6	711	0.761	100	20.8	LOS C	15.2	107.2	Full	500	0.0	0.0
Lane 2	542	0.6	712	0.761	100	20.5	LOS C	15.3	107.4	Full	500	0.0	0.0
Approach	1083	0.6		0.761		20.7	LOS C	15.3	107.4				
NorthWest: Grampian Drive													
Lane 1	294	2.3	384	0.767	100	28.1	LOS C	9.1	65.2	Full	500	0.0	0.0
Lane 2	288	2.4	375	0.767	100	30.8	LOS C	8.9	63.8	Full	500	0.0	0.0
Approach	582	2.4		0.767		29.4	LOS C	9.1	65.2				
SouthWest: Gloucester Drive													
Lane 1	165	1.3	798	0.207	100	17.1	LOS B	3.0	21.5	Short	30	0.0	NA
Lane 2	56	0.0	248	0.225	100	32.0	LOS C	1.5	10.8	Full	500	0.0	0.0
Approach	221	1.0		0.225		20.8	LOS C	3.0	21.5				
Intersection	1886	1.2		0.767		23.4	LOS C	15.3	107.4				

LANE SUMMARY 2066 PM

Site: 43 [2066 PM - FINAL same as 2041]

R1043
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

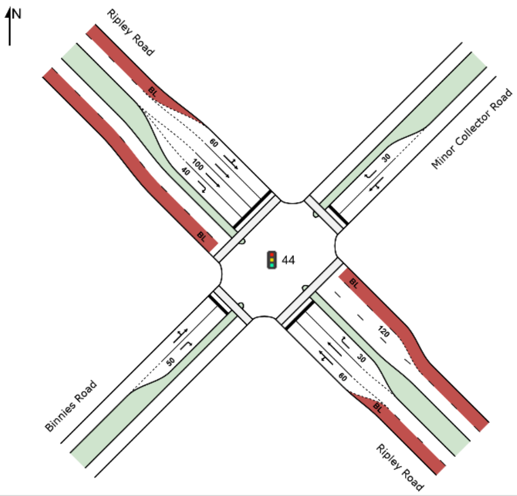
Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Grampian Drive													
Lane 1	215	2.4	290	0.739	100	29.5	LOS C	6.7	47.8	Full	500	0.0	0.0
Lane 2	213	2.5	288	0.739	100	29.7	LOS C	6.6	47.5	Full	500	0.0	0.0
Approach	427	2.5		0.739		29.6	LOS C	6.7	47.8				
NorthWest: Grampian Drive													
Lane 1	587	0.3	811	0.723	100	17.0	LOS B	15.1	106.1	Full	500	0.0	0.0
Lane 2	579	0.2	800	0.723	100	18.6	LOS B	14.9	104.8	Full	500	0.0	0.0
Approach	1165	0.3		0.723		17.7	LOS B	15.1	106.1				
SouthWest: Gloucester Drive													
Lane 1	89	1.2	1197	0.075	100	9.7	LOS A	1.0	6.7	Short	30	0.0	NA
Lane 2	75	0.0	248	0.302	100	32.3	LOS C	2.1	14.7	Full	500	0.0	0.0
Approach	164	0.6		0.302		20.0	LOS B	2.1	14.7				
Intersection	1757	0.8		0.739		20.8	LOS C	15.1	106.1				

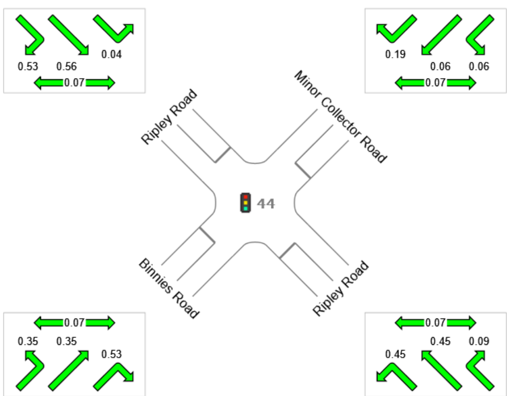
34 Intersection R1044

2031

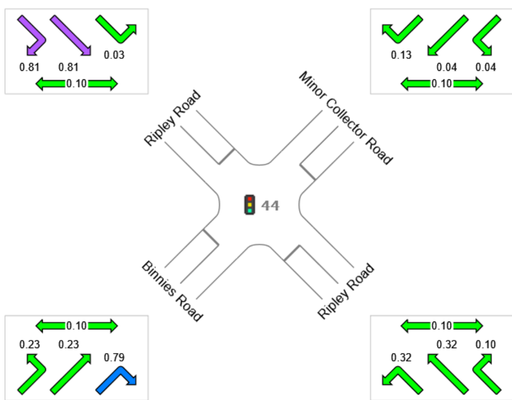
SITE LAYOUT – R1044– 2031



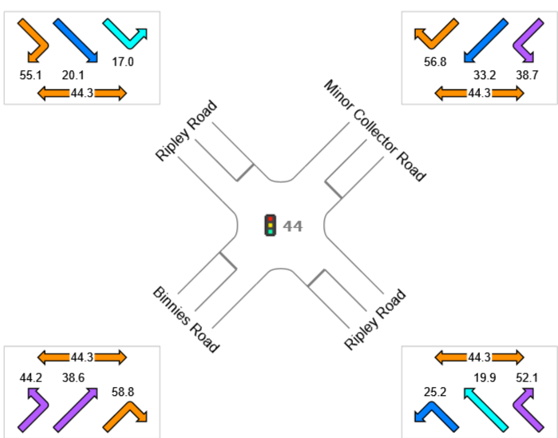
DEGREE OF SATURATION AM



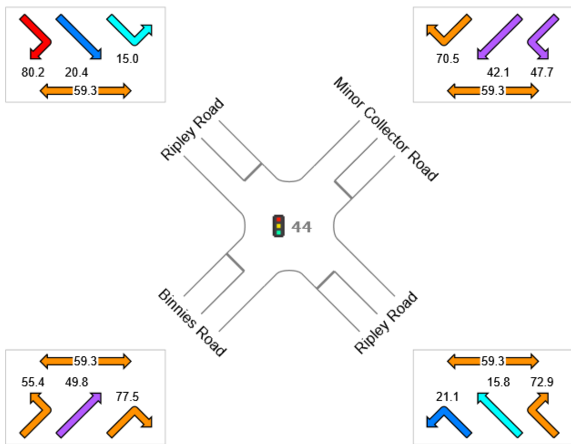
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



LANE SUMMARY 2031 AM

Site: 44 [2031 AM FINAL]

R1044
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Road													
Lane 1(..-BL)	384	3.5	859	0.447	100	20.8	LOS C	7.9	57.0	Two Seg [10]	500	0.0	0.0
Lane 2	370	3.5	828 [1]	0.447	100	20.1	LOS C	12.2	88.3	Full	500	0.0	0.0
Lane 3	16	0.0	167	0.094	100	52.1	LOS D	0.7	5.1	Short	30	0.0	NA
Approach	769	3.4		0.447		21.1	LOS C	12.2	88.3				
NorthEast: Minor Collector Road													
Lane 1	23	0.0	406	0.057	100	37.5	LOS D	0.9	6.3	Full	500	0.0	0.0
Lane 2	21	0.0	111	0.189	100	56.8	LOS E	1.0	7.3	Short	30	0.0	NA
Approach	44	0.0		0.189		46.6	LOS D	1.0	7.3				
NorthWest: Ripley Road													
Lane 1(..-BL)	42	10.0	946	0.045	100	16.0	LOS B	0.9	7.2	Two Seg [10]	500	0.0	0.0
Lane 2	303	7.0	840	0.361	64 [6]	19.3	LOS B	9.6	71.5	Full	500	0.0	0.0
Lane 3	409	7.0	724 [1]	0.564	100	20.7	LOS C	14.0	103.6	Short	100	0.0	NA
Lane 4	87	2.4	164	0.532	100	55.1	LOS E	4.3	30.8	Short	40	0.0	NA
Approach	841	6.6		0.564		23.6	LOS C	14.0	103.6				
SouthWest: Binnies Road													
Lane 1	122	0.9	347	0.352	100	41.7	LOS D	5.3	37.2	Full	500	0.0	0.0
Lane 2	58	3.6	109	0.533	100	58.8	LOS E	3.0	21.4	Short	50	0.0	NA
Approach	180	1.8		0.533		47.2	LOS D	5.3	37.2				
Intersection	1835	4.6		0.564		25.4	LOS C	14.0	103.6				

Intersection R1044 – 2031 Cont.

LANE SUMMARY 2031 PM

Site: 44 [2031 PM FINAL]

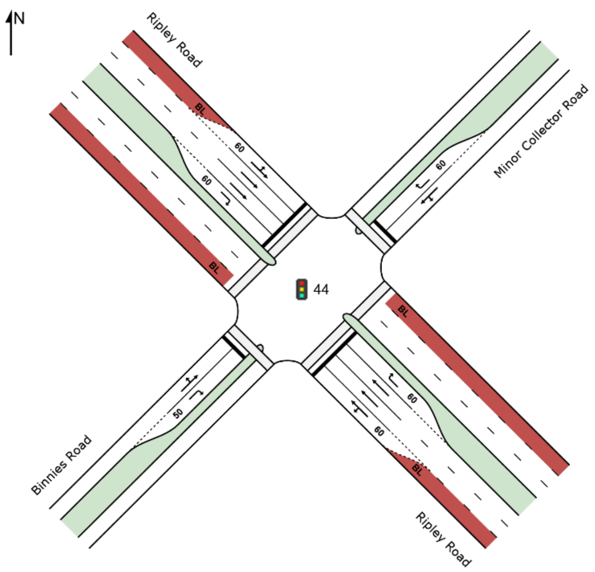
R1044
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 130 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

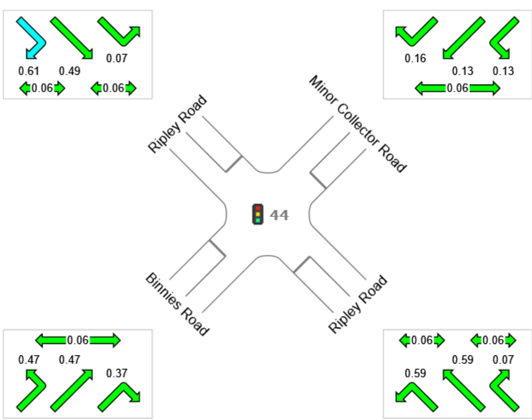
	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Road													
Lane 1(..-BL)	344	1.6	1080	0.319	100	17.1	LOS B	8.0	57.0	Two Seg [10]	500	0.0	0.0
Lane 2	340	0.5	1067 [1]	0.319	100	16.0	LOS B	11.2	78.9	Full	500	0.0	0.0
Lane 3	8	0.0	86	0.098	100	72.9	LOS E	0.5	3.8	Short	30	0.0	NA
Approach	693	1.1		0.319		17.2	LOS B	11.2	78.9				
NorthEast: Minor Collector Road													
Lane 1	16	0.0	407	0.039	100	47.3	LOS D	0.8	5.4	Full	500	0.0	0.0
Lane 2	14	7.7	108	0.126	100	70.5	LOS E	0.9	6.4	Short	30	0.0	NA
Approach	29	3.6		0.126		58.1	LOS E	0.9	6.4				
NorthWest: Ripley Road													
Lane 1(..-BL)	36	11.8	1101	0.033	100	13.8	LOS B	0.8	6.4	Two Seg [10]	500	0.0	0.0
Lane 2	546	2.6	1053 [1]	0.519	64 [6]	18.5	LOS B	20.8	149.2	Full	500	0.0	0.0
Lane 3	701	2.6	865 [1]	0.811	100	21.9	LOS C	30.9	221.4	Short	100	0.0	NA
Lane 4	68	1.5	85	0.807	100	80.2	LOS F	4.8	34.0	Short	40	0.0	NA
Approach	1352	2.8		0.811		23.3	LOS C	30.9	221.4				
SouthWest: Binnies Road													
Lane 1	72	1.5	316	0.227	100	53.3	LOS D	3.9	27.8	Full	500	0.0	0.0
Lane 2	91	0.0	114	0.792	100	77.5	LOS E	6.2	43.5	Short	80	0.0	NA
Approach	162	0.6		0.792		66.8	LOS E	6.2	43.5				
Intersection	2236	2.1		0.811		25.0	LOS C	30.9	221.4				

Intersection R1044-2041

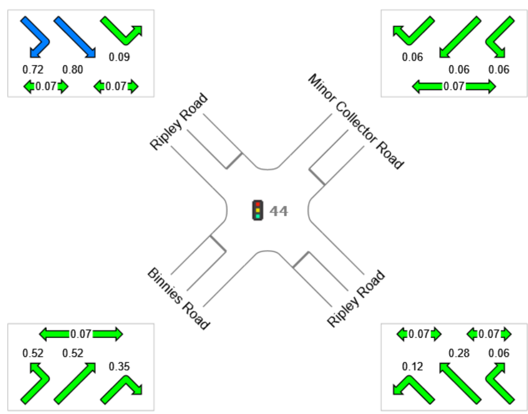
SITE LAYOUT – R1044– 2041



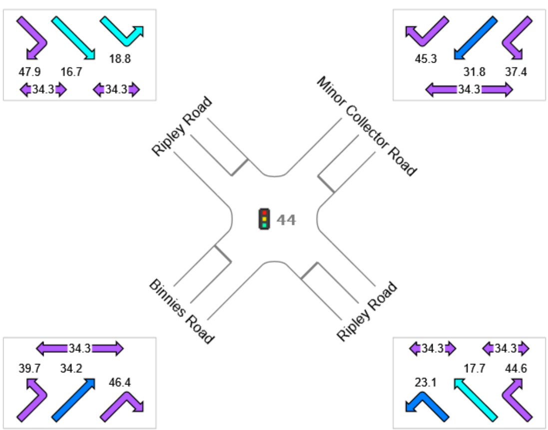
DEGREE OF SATURATION AM



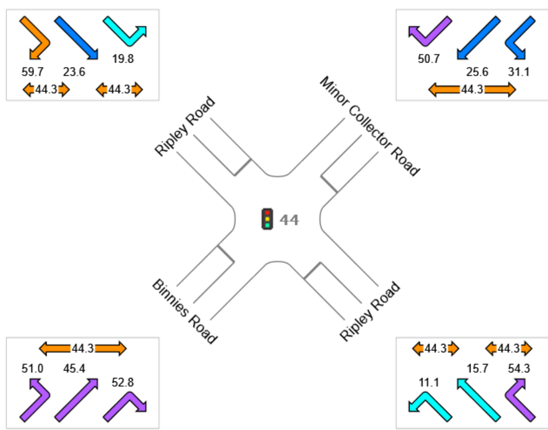
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



LANE SUMMARY 2041 AM

Site: 44 [2041 AM FINAL]

R1044
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Road													
Lane 1(..-BL)	496	4.8	837	0.592	100	19.4	LOS B	8.0	58.0	Two Seg [10]	500	0.0	0.0
Lane 2	509	3.2	860	0.592	100	17.8	LOS B	14.9	107.5	Full	500	0.0	0.0
Lane 3	504	3.2	851 [1]	0.592	100	17.7	LOS B	14.7	105.9	Full	500	0.0	0.0
Lane 4	9	0.0	139	0.068	100	44.6	LOS D	0.4	2.5	Short	60	0.0	NA
Approach	1518	3.7		0.592		18.5	LOS B	14.9	107.5				
NorthEast: Minor Collector Road													
Lane 1	37	2.9	282	0.131	100	35.8	LOS D	1.3	9.1	Full	500	0.0	0.0
Lane 2	22	0.0	139	0.159	100	45.3	LOS D	0.9	6.0	Short	60	0.0	NA
Approach	59	1.8		0.159		39.3	LOS D	1.3	9.1				
NorthWest: Ripley Road													
Lane 1(..-BL)	52	24.5	733	0.070	100	16.6	LOS B	1.1	9.5	Two Seg [10]	500	0.0	0.0
Lane 2	419	4.1	855	0.491	100	16.8	LOS B	11.6	84.0	Full	500	0.0	0.0
Lane 3	419	4.1	855	0.491	100	16.8	LOS B	11.6	84.0	Full	500	0.0	0.0
Lane 4	82	3.8	136	0.606	100	47.9	LOS D	3.4	24.6	Short	60	0.0	NA
Approach	973	5.2		0.606		19.4	LOS B	11.6	84.0				
SouthWest: Binnies Road													
Lane 1	133	1.6	279	0.475	100	38.0	LOS D	4.9	34.8	Full	500	0.0	0.0
Lane 2	51	2.1	137	0.368	100	46.4	LOS D	2.0	14.4	Short	50	0.0	NA
Approach	183	1.7		0.475		40.4	LOS D	4.9	34.8				
Intersection	2733	4.0		0.606		20.7	LOS C	14.9	107.5				

Intersection R1044– 2041 Cont.

LANE SUMMARY 2041 PM

Site: 44 [2041 PM FINAL]

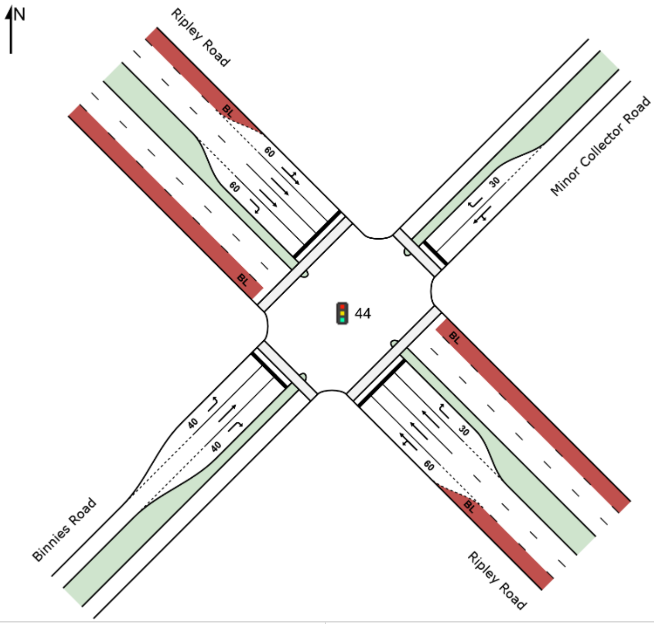
R1044
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site Optimum Cycle Time - Minimum Delay)

Lane Use and Performance

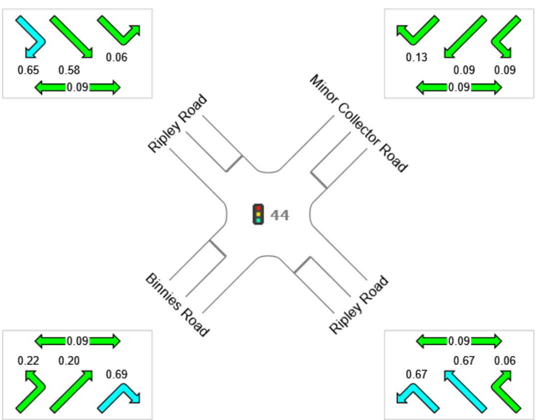
	Demand Flows Total	Demand Flows HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Road													
Lane 1(..-BL)	118	15.2	971	0.121	100	10.0	LOS B	1.5	11.6	Two Seg [10]	500	0.0	0.0
Lane 2	261	1.6	946	0.276	100	16.0	LOS B	7.4	52.6	Full	500	0.0	0.0
Lane 3	261	1.6	946	0.276	100	16.0	LOS B	7.4	52.6	Full	500	0.0	0.0
Lane 4	8	0.0	130	0.065	100	54.3	LOS D	0.4	2.8	Short	60	0.0	NA
Approach	647	4.1		0.276		15.4	LOS B	7.4	52.6				
NorthEast: Minor Collector Road													
Lane 1	16	0.0	260	0.061	100	29.6	LOS C	0.5	3.6	Full	500	0.0	0.0
Lane 2	12	0.0	186	0.062	100	50.7	LOS D	0.5	3.7	Short	60	0.0	NA
Approach	27	0.0		0.062		38.5	LOS D	0.5	3.7				
NorthWest: Ripley Road													
Lane 1(..-BL)	72	17.6	827	0.087	100	18.1	LOS B	1.8	14.6	Two Seg [10]	500	0.0	0.0
Lane 2	716	1.0	899 [1]	0.797	100	23.8	LOS C	29.2	206.4	Full	500	0.0	0.0
Lane 3	693	1.0	870 [1]	0.797	100	23.6	LOS C	27.9	197.2	Full	500	0.0	0.0
Lane 4	94	0.0	130	0.721	100	59.7	LOS E	4.9	34.4	Short	60	0.0	NA
Approach	1575	1.7		0.797		25.6	LOS C	29.2	206.4				
SouthWest: Binnies Road													
Lane 1	124	0.0	237	0.523	100	48.6	LOS D	5.9	41.2	Full	500	0.0	0.0
Lane 2	65	0.0	186	0.351	100	52.8	LOS D	3.1	21.8	Short	50	0.0	NA
Approach	189	0.0		0.523		50.1	LOS D	5.9	41.2				
Intersection	2439	2.2		0.797		25.0	LOS C	29.2	206.4				

Intersection R1044-2066

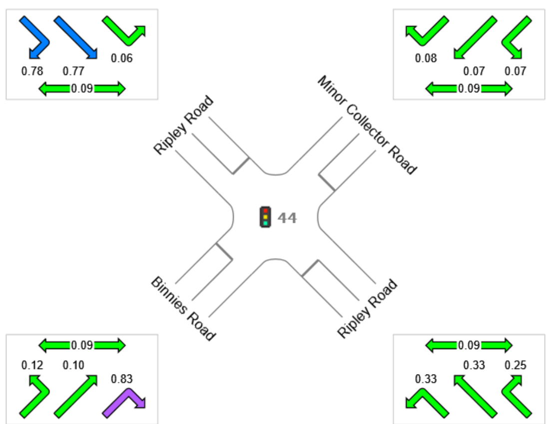
SITE LAYOUT – R1044– 2066



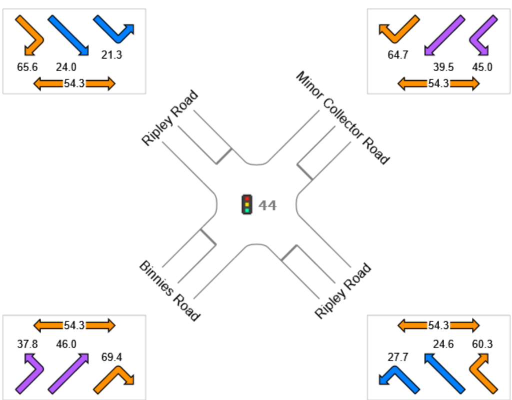
DEGREE OF SATURATION AM



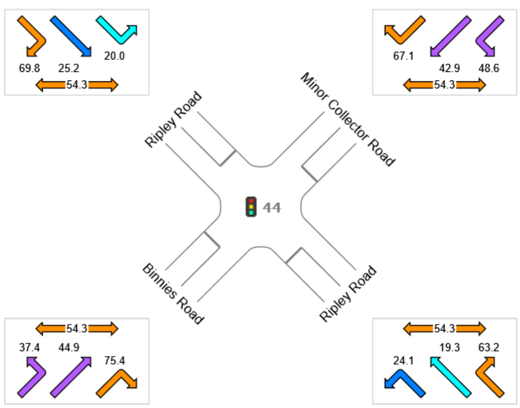
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1044– 2066 Cont.

LANE SUMMARY 2066 AM

Site: 44 [2066 AM FINAL]

R1044
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	Demand Flows HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	95% Back of Queue Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Ripley Road													
Lane 1(..-BL)	464	4.5	697 [1]	0.665	100	25.1	LOS C	8.1	58.7	Two Seg [10]	500	0.0	0.0
Lane 2	454	1.9	682 [1]	0.665	100	23.7	LOS C	18.3	130.3	Full	500	0.0	0.0
Lane 3	589	1.9	885 [1]	0.665	100	26.2	LOS C	26.2	186.4	Full	500	0.0	0.0
Lane 4	11	0.0	170	0.062	100	60.3	LOS E	0.6	4.0	Short	30	0.0	NA
Approach	1517	2.7		0.665		25.3	LOS C	26.2	186.4				
NorthEast: Minor Collector Road													
Lane 1	38	0.0	412	0.092	100	43.7	LOS D	1.8	12.3	Full	500	0.0	0.0
Lane 2	16	0.0	124	0.128	100	64.7	LOS E	0.9	6.4	Short	30	0.0	NA
Approach	54	0.0		0.128		49.9	LOS D	1.8	12.3				
NorthWest: Ripley Road													
Lane 1(..-BL)	48	26.1	830	0.058	100	19.0	LOS B	1.4	12.0	Two Seg [10]	500	0.0	0.0
Lane 2	492	5.8	846 [1]	0.581	100	24.6	LOS C	20.6	151.1	Full	500	0.0	0.0
Lane 3	434	5.8	747 [1]	0.581	100	23.6	LOS C	17.4	127.9	Full	500	0.0	0.0
Lane 4	111	1.0	169	0.654	100	65.6	LOS E	6.6	46.7	Short	60	0.0	NA
Approach	1084	6.2		0.654		28.1	LOS C	20.6	151.1				
SouthWest: Binnies Road													
Lane 1	129	0.8	585	0.221	100	37.8	LOS D	5.5	39.0	Short	40	0.0	NA
Lane 2	68	1.5	338	0.203	100	46.0	LOS D	3.5	24.5	Full	500	0.0	0.0
Lane 3	84	1.3	123	0.686	100	69.4	LOS E	5.2	36.8	Short	40	0.0	NA
Approach	282	1.1		0.686		49.2	LOS D	5.5	39.0				
Intersection	2937	3.8		0.686		29.1	LOS C	26.2	186.4				

Intersection R1044– 2066 Cont.

LANE SUMMARY 2066 PM

Site: 44 [2066 PM FINAL]

R1044
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

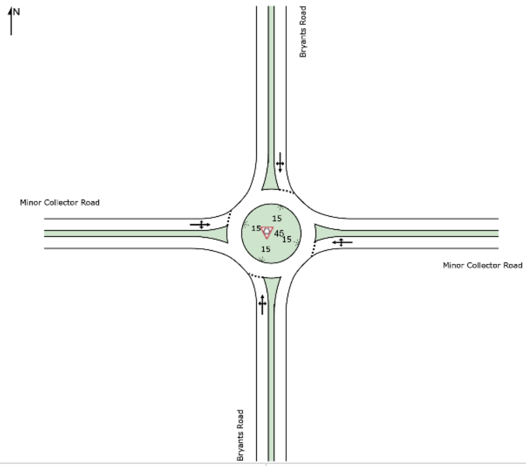
Lane Use and Performance

	Demand Flows Total	HV	Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue Veh	Dist	Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	veh/h	%	veh/h	v/c	%	sec			m		m	%	%
SouthEast: Ripley Road													
Lane 1(..-BL)	308	6.7	921	0.335	100	20.9	LOS C	7.8	57.6	Two Seg [10]	500	0.0	0.0
Lane 2	315	2.9	941	0.335	100	19.7	LOS B	11.0	79.2	Full	500	0.0	0.0
Lane 3	281	2.9	839 [1]	0.335	100	19.2	LOS B	9.6	69.1	Full	500	0.0	0.0
Lane 4	39	0.0	155	0.252	100	63.2	LOS E	2.2	15.5	Short	30	0.0	NA
Approach	943	4.0		0.335		21.7	LOS C	11.0	79.2				
NorthEast: Minor Collector Road													
Lane 1	25	8.3	340	0.074	100	45.5	LOS D	1.2	9.1	Full	500	0.0	0.0
Lane 2	7	0.0	93	0.079	100	67.1	LOS E	0.4	3.0	Short	30	0.0	NA
Approach	33	6.5		0.079		50.4	LOS D	1.2	9.1				
NorthWest: Ripley Road													
Lane 1(..-BL)	42	70.0	682	0.062	100	17.1	LOS B	1.2	12.9	Two Seg [10]	500	0.0	0.0
Lane 2	704	0.0	912 [1]	0.772	100	25.8	LOS C	32.4	226.9	Full	500	0.0	0.0
Lane 3	652	0.0	844 [1]	0.772	100	24.8	LOS C	28.8	201.5	Full	500	0.0	0.0
Lane 4	119	2.7	152	0.783	100	69.8	LOS E	7.5	53.4	Short	60	0.0	NA
Approach	1517	2.2		0.783		28.6	LOS C	32.4	226.9				
SouthWest: Binnies Road													
Lane 1	66	4.8	554	0.120	100	37.4	LOS D	2.8	20.1	Short	40	0.0	NA
Lane 2	36	0.0	341	0.105	100	44.9	LOS D	1.8	12.4	Full	500	0.0	0.0
Lane 3	75	4.2	90	0.829	100	75.4	LOS E	4.9	35.5	Short	40	0.0	NA
Approach	177	3.6		0.829		55.0	LOS D	4.9	35.5				
Intersection	2669	3.0		0.829		28.2	LOS C	32.4	226.9				

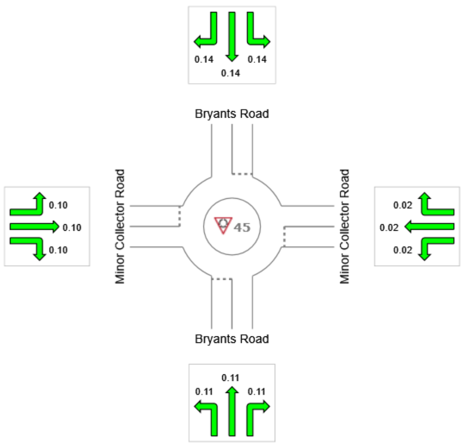
35 Intersection R1045

2031

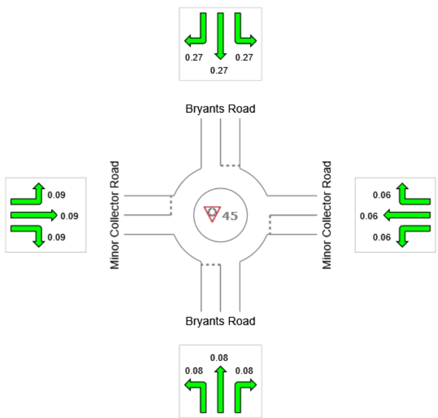
SITE LAYOUT – R1045– 2031



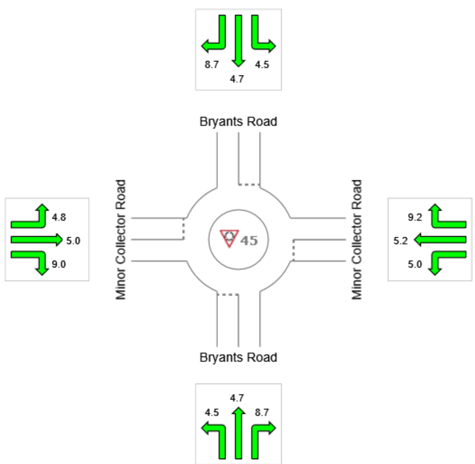
DEGREE OF SATURATION AM



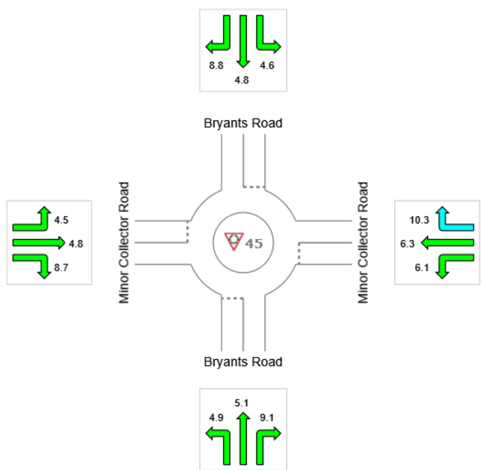
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1045 – 2031 Cont.

MOVEMENT SUMMARY 2031 AM

Site: 45 [2031 AM - FINAL same as 2026]

R1045
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Bryants Road												
1	L2	12	0.0	0.112	4.5	LOS A	0.6	4.0	0.21	0.48	0.21	53.5
2	T1	108	1.0	0.112	4.7	LOS A	0.6	4.0	0.21	0.48	0.21	54.6
3	R2	24	0.0	0.112	8.7	LOS A	0.6	4.0	0.21	0.48	0.21	54.4
Approach		144	0.7	0.112	5.3	LOS A	0.6	4.0	0.21	0.48	0.21	54.5
East: Minor Collector Road												
4	L2	13	0.0	0.020	5.0	LOS A	0.1	0.7	0.34	0.54	0.34	53.1
5	T1	4	0.0	0.020	5.2	LOS A	0.1	0.7	0.34	0.54	0.34	54.2
6	R2	5	0.0	0.020	9.2	LOS A	0.1	0.7	0.34	0.54	0.34	54.0
Approach		22	0.0	0.020	6.1	LOS A	0.1	0.7	0.34	0.54	0.34	53.5
North: Bryants Road												
7	L2	1	0.0	0.136	4.5	LOS A	0.7	5.0	0.22	0.52	0.22	53.0
8	T1	115	0.0	0.136	4.7	LOS A	0.7	5.0	0.22	0.52	0.22	54.1
9	R2	61	1.7	0.136	8.7	LOS A	0.7	5.0	0.22	0.52	0.22	53.8
Approach		177	0.6	0.136	6.1	LOS A	0.7	5.0	0.22	0.52	0.22	54.0
West: Minor Collector Road												
10	L2	77	0.0	0.104	4.8	LOS A	0.5	3.7	0.31	0.53	0.31	53.5
11	T1	27	0.0	0.104	5.0	LOS A	0.5	3.7	0.31	0.53	0.31	54.6
12	R2	18	0.0	0.104	9.0	LOS A	0.5	3.7	0.31	0.53	0.31	54.4
Approach		122	0.0	0.104	5.5	LOS A	0.5	3.7	0.31	0.53	0.31	53.8
All Vehicles		465	0.5	0.136	5.7	LOS A	0.7	5.0	0.25	0.51	0.25	54.1

Intersection R1045 – 2031 Cont.

MOVEMENT SUMMARY 2031 PM

Site: 45 [2031 PM - FINAL same as 2026]

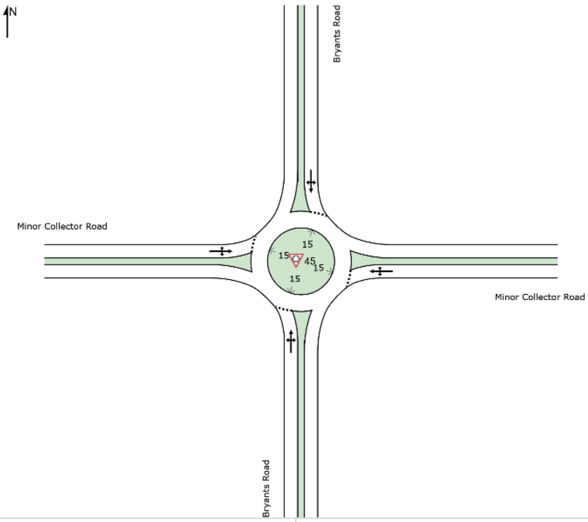
R1045
Site Category: (None)
Roundabout

Movement Performance - Vehicles

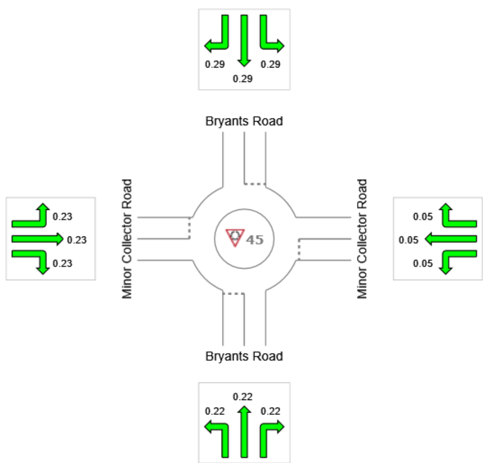
Mov ID	Turn	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
South: Bryants Road												
1	L2	17	0.0	0.079	4.9	LOS A	0.4	2.8	0.32	0.52	0.32	53.1
2	T1	56	0.0	0.079	5.1	LOS A	0.4	2.8	0.32	0.52	0.32	54.2
3	R2	19	0.0	0.079	9.1	LOS A	0.4	2.8	0.32	0.52	0.32	54.0
Approach		92	0.0	0.079	5.9	LOS A	0.4	2.8	0.32	0.52	0.32	53.9
East: Minor Collector Road												
4	L2	31	0.0	0.065	6.1	LOS A	0.3	2.3	0.50	0.61	0.50	52.7
5	T1	22	0.0	0.065	6.3	LOS A	0.3	2.3	0.50	0.61	0.50	53.8
6	R2	9	0.0	0.065	10.3	LOS B	0.3	2.3	0.50	0.61	0.50	53.5
Approach		62	0.0	0.065	6.8	LOS A	0.3	2.3	0.50	0.61	0.50	53.2
North: Bryants Road												
7	L2	1	0.0	0.273	4.6	LOS A	1.6	11.5	0.28	0.53	0.28	52.9
8	T1	238	0.9	0.273	4.8	LOS A	1.6	11.5	0.28	0.53	0.28	53.9
9	R2	120	0.0	0.273	8.8	LOS A	1.6	11.5	0.28	0.53	0.28	53.7
Approach		359	0.6	0.273	6.2	LOS A	1.6	11.5	0.28	0.53	0.28	53.8
West: Minor Collector Road												
10	L2	45	0.0	0.093	4.5	LOS A	0.5	3.3	0.24	0.51	0.24	53.4
11	T1	44	0.0	0.093	4.8	LOS A	0.5	3.3	0.24	0.51	0.24	54.5
12	R2	25	0.0	0.093	8.7	LOS A	0.5	3.3	0.24	0.51	0.24	54.3
Approach		115	0.0	0.093	5.5	LOS A	0.5	3.3	0.24	0.51	0.24	54.0
All Vehicles		627	0.3	0.273	6.1	LOS A	1.6	11.5	0.30	0.53	0.30	53.8

Intersection R1045-2041

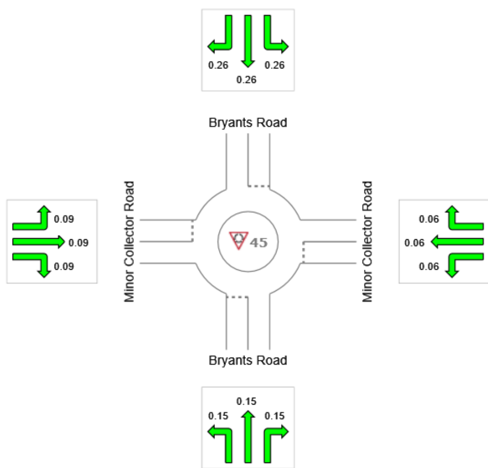
SITE LAYOUT – R1045– 2041



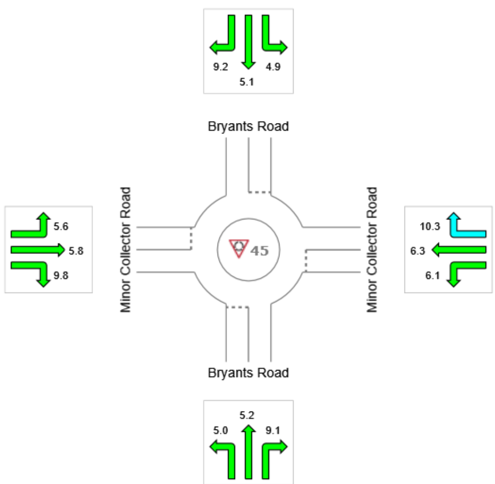
DEGREE OF SATURATION AM



DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



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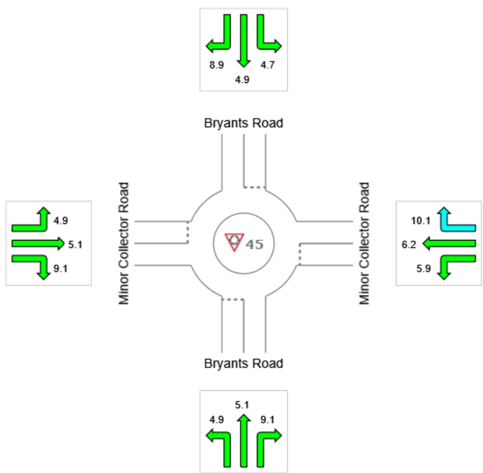


Intersection R1045 – 2041 Cont.

MOVEMENT SUMMARY 2041 AM

Site: 45 [2041 AM - FINAL same as 2026]

R1045
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
South: Bryants Road												
1	L2	21	0.0	0.215	5.0	LOS A	1.2	8.8	0.36	0.53	0.36	53.0
2	T1	191	1.1	0.215	5.2	LOS A	1.2	8.8	0.36	0.53	0.36	54.0
3	R2	43	0.0	0.215	9.1	LOS A	1.2	8.8	0.36	0.53	0.36	53.9
Approach		255	0.8	0.215	5.8	LOS A	1.2	8.8	0.36	0.53	0.36	53.9
East: Minor Collector Road												
4	L2	26	0.0	0.050	6.1	LOS A	0.3	1.8	0.51	0.62	0.51	52.5
5	T1	9	0.0	0.050	6.3	LOS A	0.3	1.8	0.51	0.62	0.51	53.5
6	R2	12	0.0	0.050	10.3	LOS B	0.3	1.8	0.51	0.62	0.51	53.3
Approach		47	0.0	0.050	7.2	LOS A	0.3	1.8	0.51	0.62	0.51	52.9
North: Bryants Road												
7	L2	1	0.0	0.292	4.9	LOS A	1.8	12.9	0.37	0.55	0.37	52.6
8	T1	233	0.0	0.292	5.1	LOS A	1.8	12.9	0.37	0.55	0.37	53.6
9	R2	123	4.3	0.292	9.2	LOS A	1.8	12.9	0.37	0.55	0.37	53.2
Approach		357	1.5	0.292	6.5	LOS A	1.8	12.9	0.37	0.55	0.37	53.5
West: Minor Collector Road												
10	L2	155	0.0	0.231	5.6	LOS A	1.3	9.4	0.47	0.61	0.47	53.0
11	T1	55	0.0	0.231	5.8	LOS A	1.3	9.4	0.47	0.61	0.47	54.0
12	R2	37	0.0	0.231	9.8	LOS A	1.3	9.4	0.47	0.61	0.47	53.8
Approach		246	0.0	0.231	6.3	LOS A	1.3	9.4	0.47	0.61	0.47	53.3
All Vehicles		905	0.8	0.292	6.3	LOS A	1.8	12.9	0.40	0.56	0.40	53.5

Intersection R1045 – 2041 Cont.

MOVEMENT SUMMARY 2041 PM

Site: 45 [2041 PM - FINAL same as 2026]

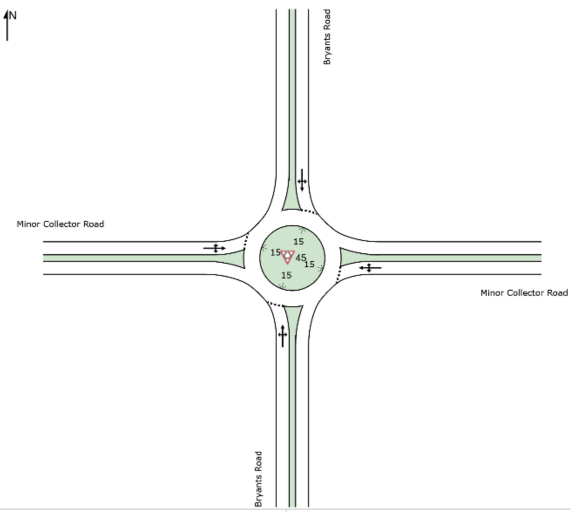
R1045
Site Category: (None)
Roundabout

Movement Performance - Vehicles

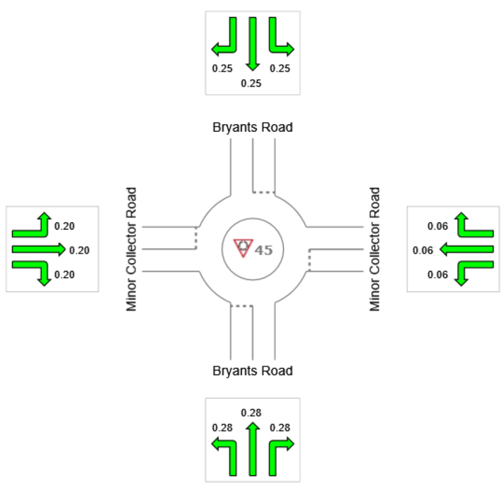
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Bryants Road												
1	L2	32	0.0	0.149	4.9	LOS A	0.8	5.6	0.33	0.53	0.33	53.1
2	T1	107	0.0	0.149	5.1	LOS A	0.8	5.6	0.33	0.53	0.33	54.1
3	R2	36	0.0	0.149	9.1	LOS A	0.8	5.6	0.33	0.53	0.33	53.9
Approach		175	0.0	0.149	5.9	LOS A	0.8	5.6	0.33	0.53	0.33	53.9
East: Minor Collector Road												
4	L2	28	0.0	0.059	5.9	LOS A	0.3	2.1	0.49	0.59	0.49	52.8
5	T1	21	0.0	0.059	6.2	LOS A	0.3	2.1	0.49	0.59	0.49	53.9
6	R2	8	0.0	0.059	10.1	LOS B	0.3	2.1	0.49	0.59	0.49	53.6
Approach		58	0.0	0.059	6.6	LOS A	0.3	2.1	0.49	0.59	0.49	53.3
North: Bryants Road												
7	L2	1	0.0	0.262	4.7	LOS A	1.6	11.0	0.30	0.53	0.30	52.8
8	T1	223	1.4	0.262	4.9	LOS A	1.6	11.0	0.30	0.53	0.30	53.8
9	R2	113	0.0	0.262	8.9	LOS A	1.6	11.0	0.30	0.53	0.30	53.6
Approach		337	0.9	0.262	6.2	LOS A	1.6	11.0	0.30	0.53	0.30	53.7
West: Minor Collector Road												
10	L2	42	0.0	0.093	4.9	LOS A	0.5	3.4	0.33	0.54	0.33	53.1
11	T1	41	0.0	0.093	5.1	LOS A	0.5	3.4	0.33	0.54	0.33	54.2
12	R2	24	0.0	0.093	9.1	LOS A	0.5	3.4	0.33	0.54	0.33	54.0
Approach		107	0.0	0.093	5.9	LOS A	0.5	3.4	0.33	0.54	0.33	53.7
All Vehicles		677	0.5	0.262	6.1	LOS A	1.6	11.0	0.33	0.54	0.33	53.7

Intersection R1045-2066

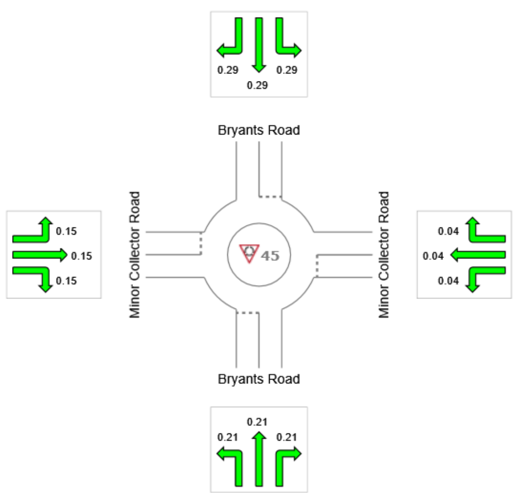
SITE LAYOUT – R1045– 2066



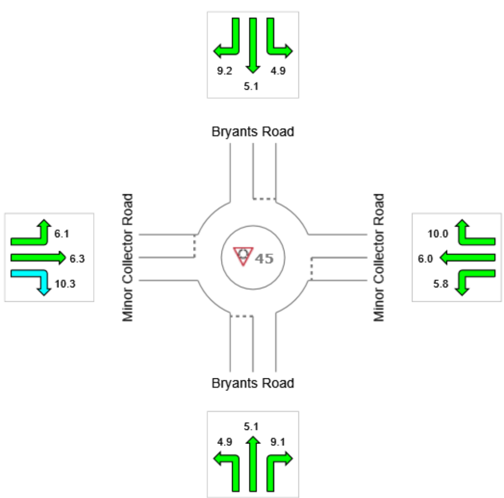
DEGREE OF SATURATION AM



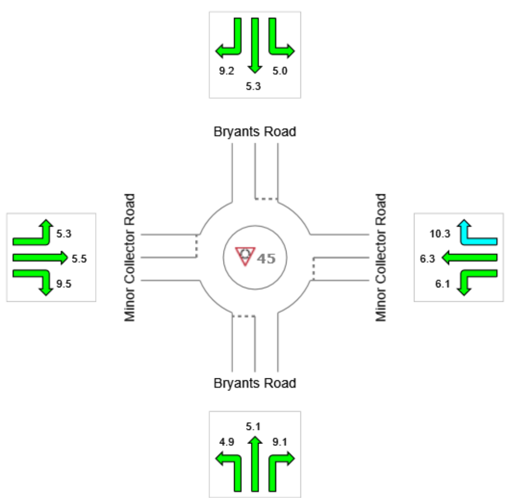
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



MOVEMENT SUMMARY 2066 AM

Site: 45 [2066 AM - FINAL same 2026]

R1045
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Bryants Road												
1	L2	28	0.0	0.283	4.9	LOS A	1.7	12.3	0.36	0.52	0.36	53.0
2	T1	261	1.2	0.283	5.1	LOS A	1.7	12.3	0.36	0.52	0.36	54.0
3	R2	59	0.0	0.283	9.1	LOS A	1.7	12.3	0.36	0.52	0.36	53.9
Approach		348	0.9	0.283	5.8	LOS A	1.7	12.3	0.36	0.52	0.36	53.9
East: Minor Collector Road												
4	L2	33	0.0	0.059	5.8	LOS A	0.3	2.1	0.47	0.60	0.47	52.7
5	T1	12	0.0	0.059	6.0	LOS A	0.3	2.1	0.47	0.60	0.47	53.7
6	R2	15	0.0	0.059	10.0	LOS A	0.3	2.1	0.47	0.60	0.47	53.5
Approach		59	0.0	0.059	6.9	LOS A	0.3	2.1	0.47	0.60	0.47	53.1
North: Bryants Road												
7	L2	1	0.0	0.249	4.9	LOS A	1.5	10.5	0.35	0.55	0.35	52.6
8	T1	197	0.0	0.249	5.1	LOS A	1.5	10.5	0.35	0.55	0.35	53.7
9	R2	104	4.0	0.249	9.2	LOS A	1.5	10.5	0.35	0.55	0.35	53.3
Approach		302	1.4	0.249	6.5	LOS A	1.5	10.5	0.35	0.55	0.35	53.5
West: Minor Collector Road												
10	L2	126	0.0	0.203	6.1	LOS A	1.2	8.1	0.53	0.64	0.53	52.7
11	T1	44	0.0	0.203	6.3	LOS A	1.2	8.1	0.53	0.64	0.53	53.8
12	R2	31	0.0	0.203	10.3	LOS B	1.2	8.1	0.53	0.64	0.53	53.6
Approach		201	0.0	0.203	6.8	LOS A	1.2	8.1	0.53	0.64	0.53	53.1
All Vehicles		911	0.8	0.283	6.3	LOS A	1.7	12.3	0.40	0.56	0.40	53.6

Intersection R1045 – 2066 Cont.

MOVEMENT SUMMARY 2066 PM

Site: 45 [2066 PM - FINAL same as 2026]

R1045
Site Category: (None)
Roundabout

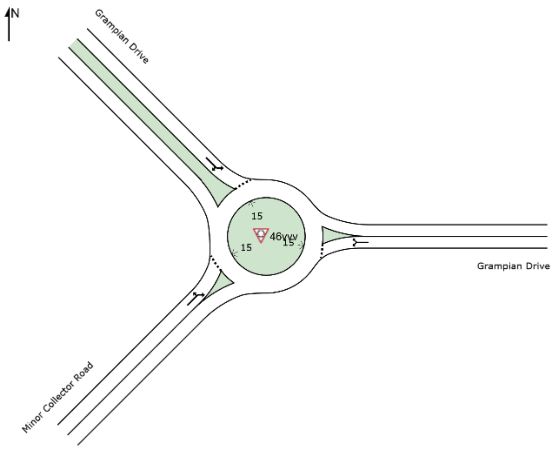
Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Bryants Road												
1	L2	46	0.0	0.215	4.9	LOS A	1.2	8.7	0.35	0.53	0.35	53.0
2	T1	159	0.0	0.215	5.1	LOS A	1.2	8.7	0.35	0.53	0.35	54.1
3	R2	53	0.0	0.215	9.1	LOS A	1.2	8.7	0.35	0.53	0.35	53.9
Approach		258	0.0	0.215	5.9	LOS A	1.2	8.7	0.35	0.53	0.35	53.8
East: Minor Collector Road												
4	L2	20	0.0	0.043	6.1	LOS A	0.2	1.6	0.51	0.59	0.51	52.7
5	T1	15	0.0	0.043	6.3	LOS A	0.2	1.6	0.51	0.59	0.51	53.8
6	R2	6	0.0	0.043	10.3	LOS B	0.2	1.6	0.51	0.59	0.51	53.5
Approach		41	0.0	0.043	6.8	LOS A	0.2	1.6	0.51	0.59	0.51	53.2
North: Bryants Road												
7	L2	1	0.0	0.293	5.0	LOS A	1.8	12.7	0.38	0.56	0.38	52.5
8	T1	234	1.4	0.293	5.3	LOS A	1.8	12.7	0.38	0.56	0.38	53.5
9	R2	118	0.0	0.293	9.2	LOS A	1.8	12.7	0.38	0.56	0.38	53.3
Approach		353	0.9	0.293	6.6	LOS A	1.8	12.7	0.38	0.56	0.38	53.4
West: Minor Collector Road												
10	L2	62	0.0	0.146	5.3	LOS A	0.8	5.5	0.41	0.58	0.41	52.8
11	T1	61	0.0	0.146	5.5	LOS A	0.8	5.5	0.41	0.58	0.41	53.9
12	R2	36	0.0	0.146	9.5	LOS A	0.8	5.5	0.41	0.58	0.41	53.7
Approach		159	0.0	0.146	6.3	LOS A	0.8	5.5	0.41	0.58	0.41	53.4
All Vehicles		811	0.4	0.293	6.3	LOS A	1.8	12.7	0.38	0.56	0.38	53.6

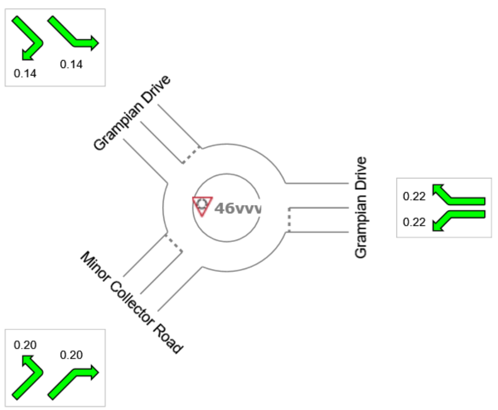
36 Intersection R1046

2031

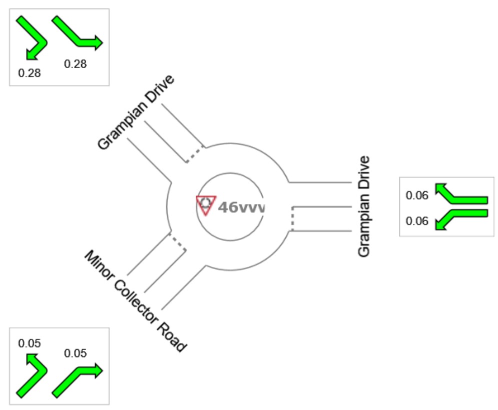
SITE LAYOUT – R1046 – 2031



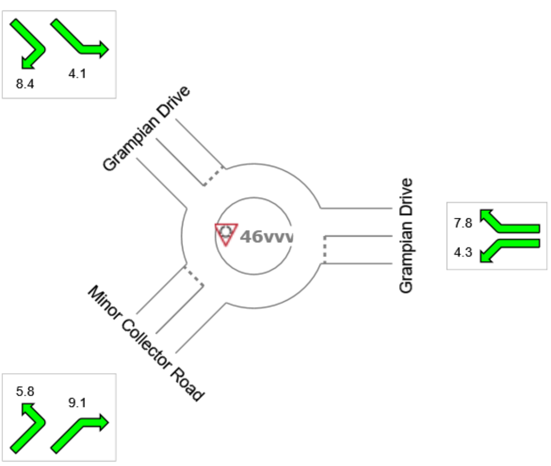
DEGREE OF SATURATION AM



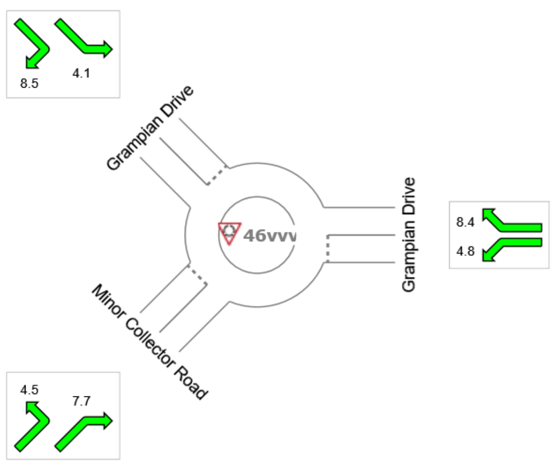
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1046 – 2031 Cont.

MOVEMENT SUMMARY 2031 AM

Site: 46vvv [2031 AM - FINAL]

R1046
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Grampian Drive												
4a	L1	8	0.0	0.221	4.3	LOS A	1.4	9.9	0.23	0.59	0.23	52.6
6a	R1	294	0.0	0.221	7.8	LOS A	1.4	9.9	0.23	0.59	0.23	52.4
Approach		302	0.0	0.221	7.7	LOS A	1.4	9.9	0.23	0.59	0.23	52.4
NorthWest: Grampian Drive												
27a	L1	157	1.3	0.144	4.1	LOS A	0.8	6.0	0.11	0.50	0.11	54.6
29	R2	58	0.0	0.144	8.4	LOS A	0.8	6.0	0.11	0.50	0.11	54.7
Approach		215	1.0	0.144	5.2	LOS A	0.8	6.0	0.11	0.50	0.11	54.6
SouthWest: Minor Collector Road												
30	L2	185	0.6	0.198	5.8	LOS A	1.1	7.7	0.48	0.62	0.48	53.3
32a	R1	19	0.0	0.198	9.1	LOS A	1.1	7.7	0.48	0.62	0.48	53.8
Approach		204	0.5	0.198	6.1	LOS A	1.1	7.7	0.48	0.62	0.48	53.3
All Vehicles		721	0.4	0.221	6.5	LOS A	1.4	9.9	0.27	0.57	0.27	53.3

MOVEMENT SUMMARY 2031 PM

Site: 46vvv [2031 PM - FINAL]

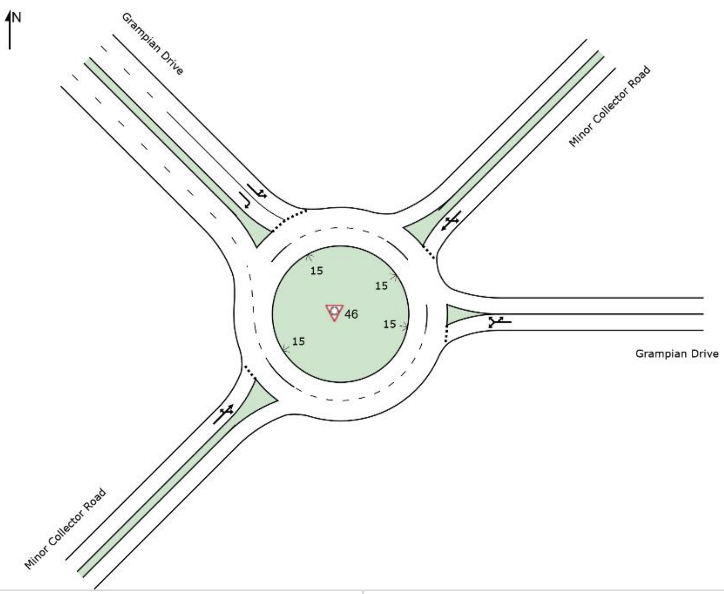
R1046
Site Category: (None)
Roundabout

Movement Performance - Vehicles

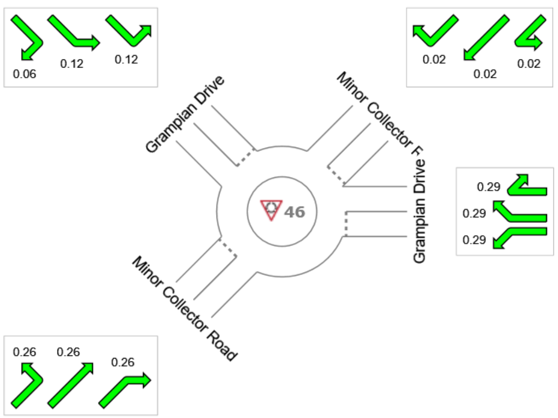
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Grampian Drive												
4a	L1	1	0.0	0.063	4.8	LOS A	0.3	2.5	0.34	0.59	0.34	52.3
6a	R1	68	6.2	0.063	8.4	LOS A	0.3	2.5	0.34	0.59	0.34	51.8
Approach		69	6.1	0.063	8.3	LOS A	0.3	2.5	0.34	0.59	0.34	51.8
NorthWest: Grampian Drive												
27a	L1	285	0.0	0.282	4.1	LOS A	1.7	12.3	0.14	0.52	0.14	54.4
29	R2	139	0.8	0.282	8.5	LOS A	1.7	12.3	0.14	0.52	0.14	54.4
Approach		424	0.2	0.282	5.5	LOS A	1.7	12.3	0.14	0.52	0.14	54.4
SouthWest: Minor Collector Road												
30	L2	29	0.0	0.047	4.5	LOS A	0.2	1.6	0.21	0.55	0.21	53.1
32a	R1	28	0.0	0.047	7.7	LOS A	0.2	1.6	0.21	0.55	0.21	53.6
Approach		58	0.0	0.047	6.1	LOS A	0.2	1.6	0.21	0.55	0.21	53.3
All Vehicles		552	1.0	0.282	5.9	LOS A	1.7	12.3	0.18	0.53	0.18	53.9

Intersection R1046-2041

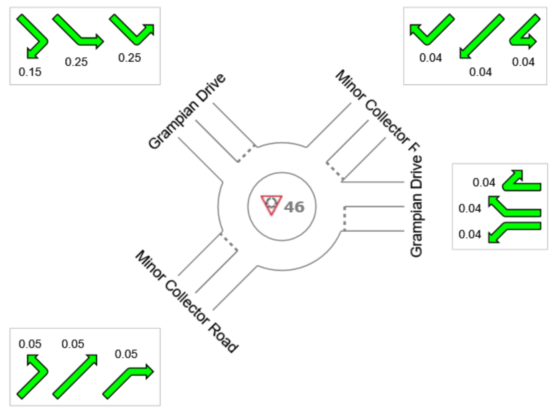
SITE LAYOUT – R1046 – 2041



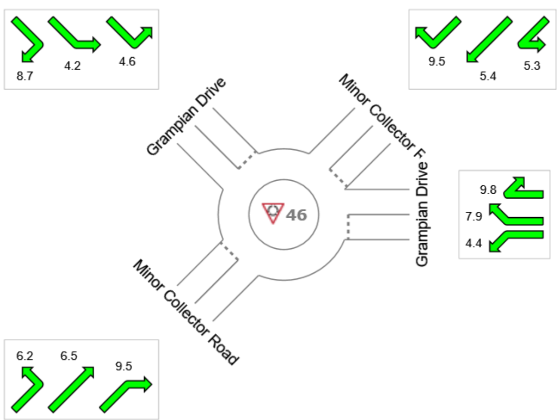
DEGREE OF SATURATION AM



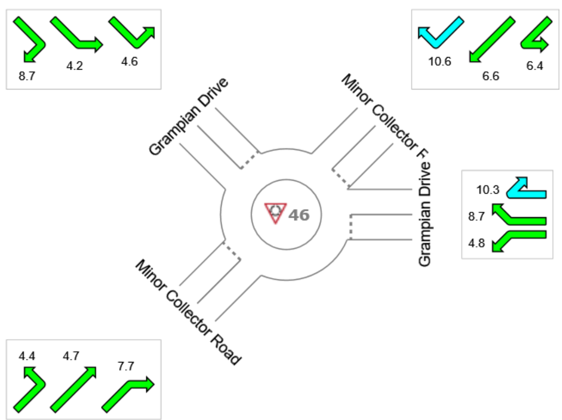
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1046– 2041 Cont.

MOVEMENT SUMMARY 2041 AM

Site: 46 [2041 AM - FINAL]

R1046
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Grampian Drive												
4a	L1	11	0.0	0.288	4.4	LOS A	1.4	10.0	0.20	0.60	0.20	52.9
6a	R1	352	0.0	0.288	7.9	LOS A	1.4	10.0	0.20	0.60	0.20	52.6
6b	R3	12	0.0	0.288	9.8	LOS A	1.4	10.0	0.20	0.60	0.20	53.4
Approach		374	0.0	0.288	7.8	LOS A	1.4	10.0	0.20	0.60	0.20	52.7
NorthEast: Minor Collector Road												
24b	L3	15	0.0	0.017	5.3	LOS A	0.1	0.4	0.33	0.55	0.33	53.4
25	T1	1	0.0	0.017	5.4	LOS A	0.1	0.4	0.33	0.55	0.33	55.1
26	R2	1	0.0	0.017	9.5	LOS A	0.1	0.4	0.33	0.55	0.33	54.9
Approach		17	0.0	0.017	5.5	LOS A	0.1	0.4	0.33	0.55	0.33	53.6
NorthWest: Grampian Drive												
27	L2	1	0.0	0.121	4.6	LOS A	0.5	4.0	0.13	0.42	0.13	54.7
27a	L1	173	4.3	0.121	4.2	LOS A	0.5	4.0	0.13	0.42	0.13	55.6
29	R2	64	1.6	0.061	8.7	LOS A	0.3	1.8	0.14	0.62	0.14	52.5
Approach		238	3.5	0.121	5.4	LOS A	0.5	4.0	0.13	0.48	0.13	54.7
SouthWest: Minor Collector Road												
30	L2	222	0.5	0.265	6.2	LOS A	1.3	9.3	0.50	0.66	0.50	53.3
31	T1	2	0.0	0.265	6.5	LOS A	1.3	9.3	0.50	0.66	0.50	54.6
32a	R1	23	0.0	0.265	9.5	LOS A	1.3	9.3	0.50	0.66	0.50	53.9
Approach		247	0.4	0.265	6.5	LOS A	1.3	9.3	0.50	0.66	0.50	53.4
All Vehicles		876	1.1	0.288	6.8	LOS A	1.4	10.0	0.27	0.58	0.27	53.4

MOVEMENT SUMMARY 2041 PM

Site: 46 [2041 PM - FINAL]

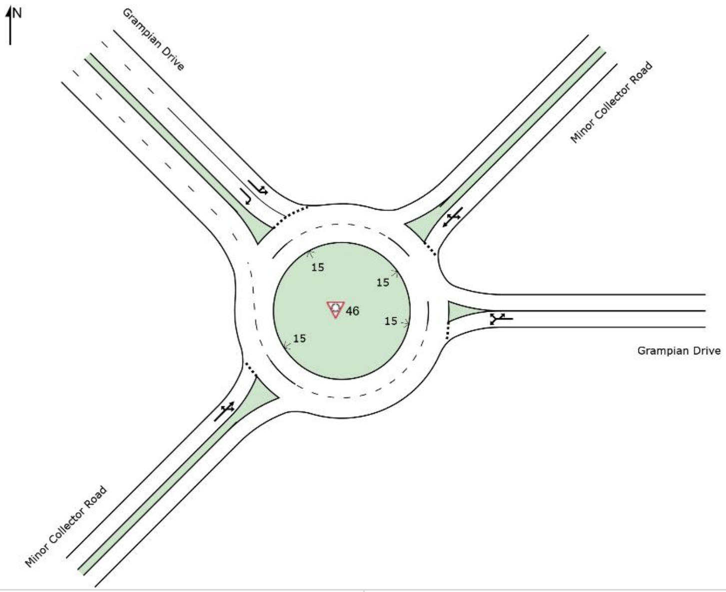
R1046
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Grampian Drive												
4a	L1	1	0.0	0.044	4.8	LOS A	0.2	1.4	0.31	0.61	0.31	52.5
6a	R1	39	18.9	0.044	8.7	LOS A	0.2	1.4	0.31	0.61	0.31	51.5
6b	R3	2	0.0	0.044	10.3	LOS B	0.2	1.4	0.31	0.61	0.31	53.1
Approach		42	17.5	0.044	8.7	LOS A	0.2	1.4	0.31	0.61	0.31	51.6
NorthEast: Minor Collector Road												
24b	L3	32	0.0	0.041	6.4	LOS A	0.2	1.1	0.47	0.65	0.47	52.8
25	T1	2	0.0	0.041	6.6	LOS A	0.2	1.1	0.47	0.65	0.47	54.5
26	R2	1	0.0	0.041	10.6	LOS B	0.2	1.1	0.47	0.65	0.47	54.3
Approach		35	0.0	0.041	6.6	LOS A	0.2	1.1	0.47	0.65	0.47	53.0
NorthWest: Grampian Drive												
27	L2	1	0.0	0.250	4.6	LOS A	1.2	8.4	0.12	0.42	0.12	54.7
27a	L1	387	0.0	0.250	4.2	LOS A	1.2	8.4	0.12	0.42	0.12	55.8
29	R2	189	0.6	0.154	8.7	LOS A	0.7	4.6	0.12	0.63	0.12	52.6
Approach		578	0.2	0.250	5.6	LOS A	1.2	8.4	0.12	0.49	0.12	54.7
SouthWest: Minor Collector Road												
30	L2	29	0.0	0.050	4.4	LOS A	0.2	1.4	0.14	0.54	0.14	53.5
31	T1	1	0.0	0.050	4.7	LOS A	0.2	1.4	0.14	0.54	0.14	54.7
32a	R1	28	0.0	0.050	7.7	LOS A	0.2	1.4	0.14	0.54	0.14	54.1
Approach		59	0.0	0.050	6.0	LOS A	0.2	1.4	0.14	0.54	0.14	53.8
All Vehicles		714	1.2	0.250	5.9	LOS A	1.2	8.4	0.15	0.51	0.15	54.3

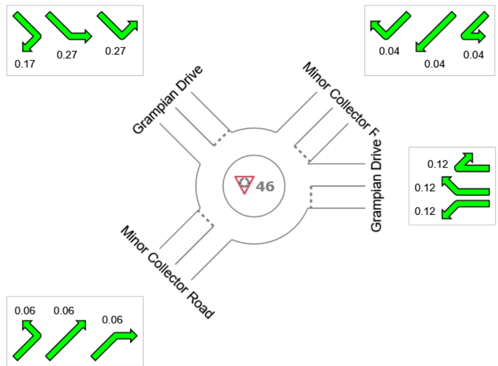
Intersection R1046-2066

SITE LAYOUT – R1046 – 2066

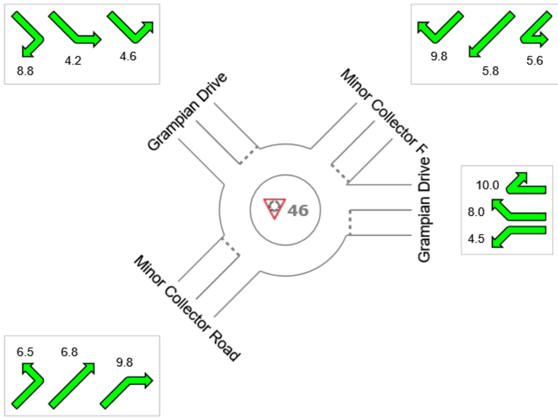


DEGREE OF SATURATION AM

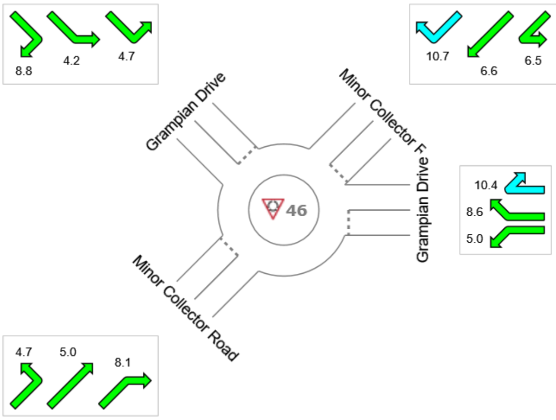
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1046 – 2066 Cont.

MOVEMENT SUMMARY 2066 AM

Site: 46 [2066 AM - FINAL]

R1046
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
East: Grampian Drive												
4a	L1	12	0.0	0.334	4.5	LOS A	1.8	12.3	0.25	0.60	0.25	52.7
6a	R1	395	0.0	0.334	8.0	LOS A	1.8	12.3	0.25	0.60	0.25	52.5
6b	R3	13	0.0	0.334	10.0	LOS A	1.8	12.3	0.25	0.60	0.25	53.3
Approach		419	0.0	0.334	8.0	LOS A	1.8	12.3	0.25	0.60	0.25	52.5
NorthEast: Minor Collector Road												
24b	L3	21	0.0	0.024	5.6	LOS A	0.1	0.6	0.38	0.58	0.38	53.3
25	T1	1	0.0	0.024	5.8	LOS A	0.1	0.6	0.38	0.58	0.38	55.0
26	R2	1	0.0	0.024	9.8	LOS A	0.1	0.6	0.38	0.58	0.38	54.8
Approach		23	0.0	0.024	5.8	LOS A	0.1	0.6	0.38	0.58	0.38	53.5
NorthWest: Grampian Drive												
27	L2	1	0.0	0.166	4.6	LOS A	0.8	5.8	0.14	0.42	0.14	54.6
27a	L1	240	4.4	0.166	4.2	LOS A	0.8	5.8	0.14	0.42	0.14	55.6
29	R2	88	1.2	0.083	8.8	LOS A	0.4	2.5	0.15	0.62	0.15	52.5
Approach		329	3.5	0.166	5.4	LOS A	0.8	5.8	0.14	0.48	0.14	54.7
SouthWest: Minor Collector Road												
30	L2	233	0.5	0.289	6.5	LOS A	1.5	10.5	0.54	0.69	0.54	53.1
31	T1	2	0.0	0.289	6.8	LOS A	1.5	10.5	0.54	0.69	0.54	54.3
32a	R1	24	0.0	0.289	9.8	LOS A	1.5	10.5	0.54	0.69	0.54	53.7
Approach		259	0.4	0.289	6.8	LOS A	1.5	10.5	0.54	0.69	0.54	53.2
All Vehicles		1031	1.2	0.334	6.8	LOS A	1.8	12.3	0.29	0.58	0.29	53.4

Intersection R1046 – 2066 Cont.

MOVEMENT SUMMARY 2066 PM

Site: 46 [2066 PM - FINAL]

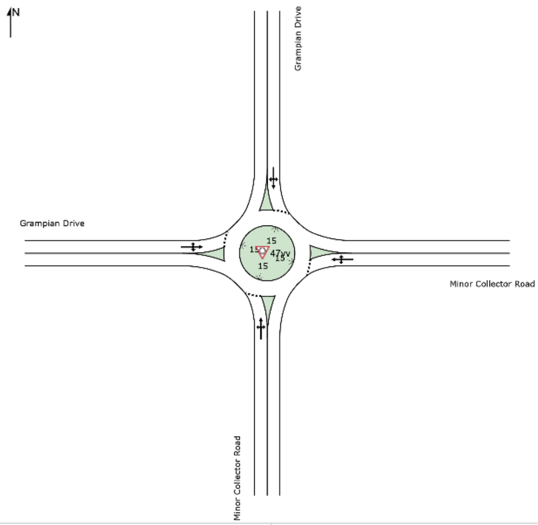
R1046
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	v/c	sec		veh	m				km/h
East: Grampian Drive												
4a	L1	1	0.0	0.118	5.0	LOS A	0.5	3.7	0.33	0.64	0.33	52.2
6a	R1	97	7.6	0.118	8.6	LOS A	0.5	3.7	0.33	0.64	0.33	51.7
6b	R3	21	0.0	0.118	10.4	LOS B	0.5	3.7	0.33	0.64	0.33	52.8
Approach		119	6.2	0.118	8.9	LOS A	0.5	3.7	0.33	0.64	0.33	51.9
NorthEast: Minor Collector Road												
24b	L3	28	0.0	0.038	6.5	LOS A	0.1	1.0	0.48	0.66	0.48	52.8
25	T1	2	0.0	0.038	6.6	LOS A	0.1	1.0	0.48	0.66	0.48	54.4
26	R2	1	0.0	0.038	10.7	LOS B	0.1	1.0	0.48	0.66	0.48	54.2
Approach		32	0.0	0.038	6.6	LOS A	0.1	1.0	0.48	0.66	0.48	52.9
NorthWest: Grampian Drive												
27	L2	1	0.0	0.271	4.7	LOS A	1.4	9.5	0.17	0.43	0.17	54.5
27a	L1	401	0.0	0.271	4.2	LOS A	1.4	9.5	0.17	0.43	0.17	55.5
29	R2	196	0.5	0.167	8.8	LOS A	0.7	5.1	0.17	0.62	0.17	52.4
Approach		598	0.2	0.271	5.7	LOS A	1.4	9.5	0.17	0.49	0.17	54.5
SouthWest: Minor Collector Road												
30	L2	35	0.0	0.063	4.7	LOS A	0.3	1.8	0.25	0.56	0.25	53.2
31	T1	1	0.0	0.063	5.0	LOS A	0.3	1.8	0.25	0.56	0.25	54.4
32a	R1	34	0.0	0.063	8.1	LOS A	0.3	1.8	0.25	0.56	0.25	53.7
Approach		69	0.0	0.063	6.3	LOS A	0.3	1.8	0.25	0.56	0.25	53.5
All Vehicles		818	1.0	0.271	6.3	LOS A	1.4	9.5	0.21	0.53	0.21	53.9

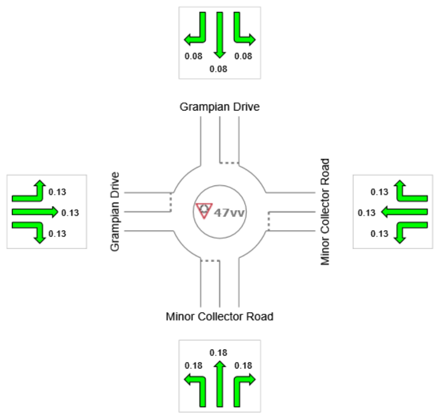
37 Intersection R1047

2031

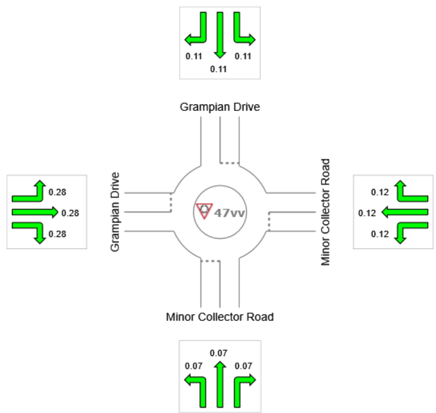
SITE LAYOUT – R1047 – 2031



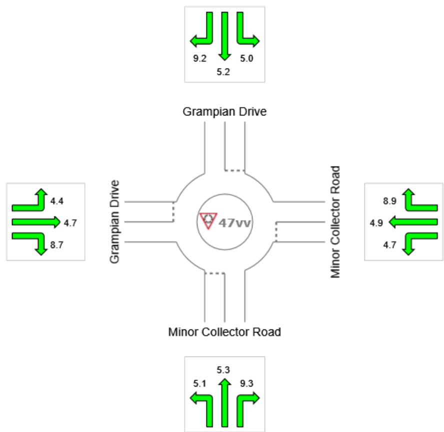
DEGREE OF SATURATION AM



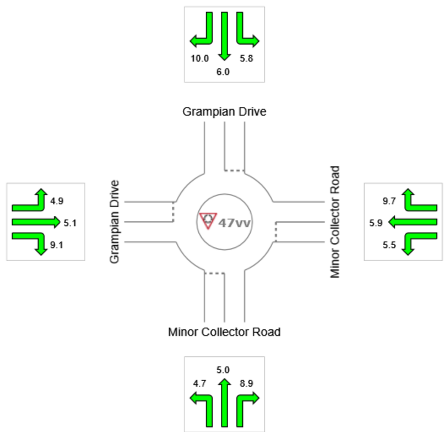
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



MOVEMENT SUMMARY 2031 AM

Site: 47vv [2031 AM - FINAL]

R1047
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Minor Collector Road												
1	L2	180	0.0	0.182	5.1	LOS A	1.0	7.0	0.37	0.54	0.37	53.7
2	T1	27	0.0	0.182	5.3	LOS A	1.0	7.0	0.37	0.54	0.37	54.9
3	R2	2	0.0	0.182	9.3	LOS A	1.0	7.0	0.37	0.54	0.37	54.6
Approach		209	0.0	0.182	5.1	LOS A	1.0	7.0	0.37	0.54	0.37	53.9
East: Minor Collector Road												
4	L2	1	0.0	0.128	4.7	LOS A	0.7	4.6	0.28	0.51	0.28	53.1
5	T1	119	0.0	0.128	4.9	LOS A	0.7	4.6	0.28	0.51	0.28	54.2
6	R2	36	0.0	0.128	8.9	LOS A	0.7	4.6	0.28	0.51	0.28	54.0
Approach		156	0.0	0.128	5.8	LOS A	0.7	4.6	0.28	0.51	0.28	54.1
North: Grampian Drive												
7	L2	61	0.0	0.075	5.0	LOS A	0.4	2.6	0.33	0.54	0.33	53.4
8	T1	13	0.0	0.075	5.2	LOS A	0.4	2.6	0.33	0.54	0.33	54.5
9	R2	13	0.0	0.075	9.2	LOS A	0.4	2.6	0.33	0.54	0.33	54.3
Approach		86	0.0	0.075	5.6	LOS A	0.4	2.6	0.33	0.54	0.33	53.7
West: Grampian Drive												
10	L2	1	0.0	0.128	4.4	LOS A	0.7	4.7	0.21	0.55	0.21	52.7
11	T1	82	1.3	0.128	4.7	LOS A	0.7	4.7	0.21	0.55	0.21	53.7
12	R2	83	2.5	0.128	8.7	LOS A	0.7	4.7	0.21	0.55	0.21	53.4
Approach		166	1.9	0.128	6.7	LOS A	0.7	4.7	0.21	0.55	0.21	53.5
All Vehicles		618	0.5	0.182	5.8	LOS A	1.0	7.0	0.30	0.54	0.30	53.8

Intersection R1047 – 2031 Cont.

MOVEMENT SUMMARY 2031 PM

Site: 47vv [2031 PM - FINAL]

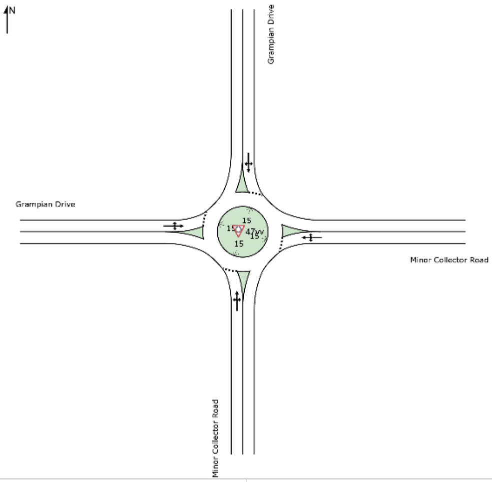
R1047
Site Category: (None)
Roundabout

Movement Performance - Vehicles

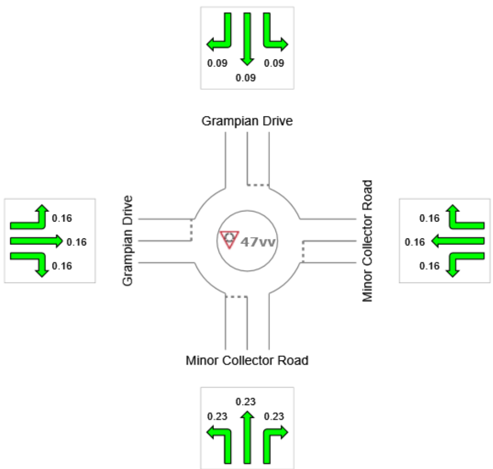
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Minor Collector Road												
1	L2	38	0.0	0.074	4.7	LOS A	0.4	2.7	0.30	0.49	0.30	53.7
2	T1	45	2.3	0.074	5.0	LOS A	0.4	2.7	0.30	0.49	0.30	54.7
3	R2	3	0.0	0.074	8.9	LOS A	0.4	2.7	0.30	0.49	0.30	54.6
Approach		86	1.2	0.074	5.0	LOS A	0.4	2.7	0.30	0.49	0.30	54.3
East: Minor Collector Road												
4	L2	1	0.0	0.115	5.5	LOS A	0.6	4.3	0.43	0.64	0.43	51.5
5	T1	37	8.6	0.115	5.9	LOS A	0.6	4.3	0.43	0.64	0.43	52.2
6	R2	82	0.0	0.115	9.7	LOS A	0.6	4.3	0.43	0.64	0.43	52.3
Approach		120	2.6	0.115	8.5	LOS A	0.6	4.3	0.43	0.64	0.43	52.3
North: Grampian Drive												
7	L2	59	0.0	0.105	5.8	LOS A	0.6	3.9	0.48	0.59	0.48	53.1
8	T1	42	0.0	0.105	6.0	LOS A	0.6	3.9	0.48	0.59	0.48	54.2
9	R2	5	0.0	0.105	10.0	LOS A	0.6	3.9	0.48	0.59	0.48	54.0
Approach		106	0.0	0.105	6.1	LOS A	0.6	3.9	0.48	0.59	0.48	53.6
West: Grampian Drive												
10	L2	36	0.0	0.279	4.9	LOS A	1.7	11.9	0.35	0.59	0.35	52.0
11	T1	100	0.0	0.279	5.1	LOS A	1.7	11.9	0.35	0.59	0.35	53.0
12	R2	209	0.0	0.279	9.1	LOS A	1.7	11.9	0.35	0.59	0.35	52.8
Approach		345	0.0	0.279	7.5	LOS A	1.7	11.9	0.35	0.59	0.35	52.8
All Vehicles		658	0.6	0.279	7.1	LOS A	1.7	11.9	0.38	0.59	0.38	53.0

Intersection R1047-2041

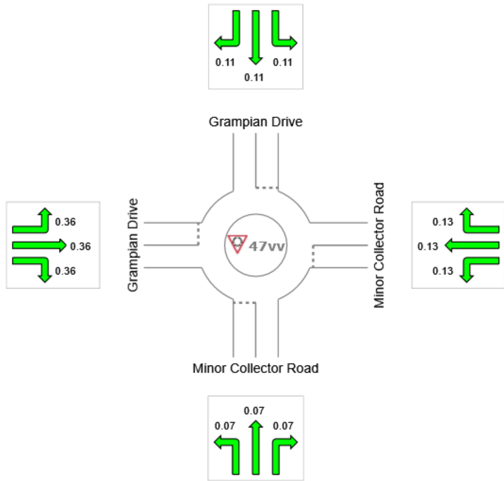
SITE LAYOUT – R1047 – 2041



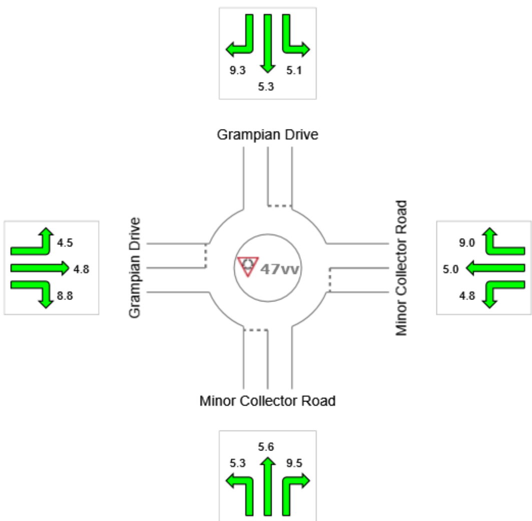
DEGREE OF SATURATION AM



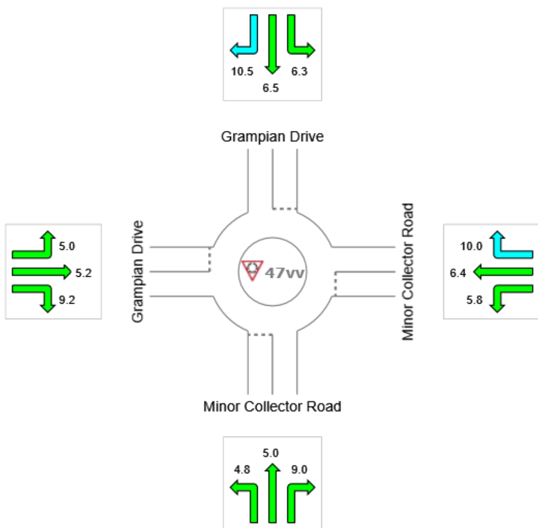
DEGREE OF SATURATION PM



DELAY CONTROL (seconds) AM



DELAY CONTROL (seconds) PM



Intersection R1047 – 2041 Cont.

MOVEMENT SUMMARY 2041 AM

Site: 47vv [2041 AM - FINAL]

R1047
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Minor Collector Road												
1	L2	218	0.0	0.228	5.3	LOS A	1.3	9.2	0.42	0.57	0.42	53.6
2	T1	33	3.2	0.228	5.6	LOS A	1.3	9.2	0.42	0.57	0.42	54.6
3	R2	3	0.0	0.228	9.5	LOS A	1.3	9.2	0.42	0.57	0.42	54.5
Approach		254	0.4	0.228	5.4	LOS A	1.3	9.2	0.42	0.57	0.42	53.7
East: Minor Collector Road												
4	L2	1	0.0	0.157	4.8	LOS A	0.8	5.8	0.31	0.52	0.31	53.0
5	T1	144	0.0	0.157	5.0	LOS A	0.8	5.8	0.31	0.52	0.31	54.1
6	R2	43	0.0	0.157	9.0	LOS A	0.8	5.8	0.31	0.52	0.31	53.9
Approach		188	0.0	0.157	5.9	LOS A	0.8	5.8	0.31	0.52	0.31	54.0
North: Grampian Drive												
7	L2	74	0.0	0.093	5.1	LOS A	0.5	3.3	0.37	0.56	0.37	53.3
8	T1	16	0.0	0.093	5.3	LOS A	0.5	3.3	0.37	0.56	0.37	54.4
9	R2	15	0.0	0.093	9.3	LOS A	0.5	3.3	0.37	0.56	0.37	54.2
Approach		104	0.0	0.093	5.7	LOS A	0.5	3.3	0.37	0.56	0.37	53.6
West: Grampian Drive												
10	L2	22	0.0	0.165	4.5	LOS A	0.9	6.4	0.24	0.55	0.24	52.7
11	T1	93	1.1	0.165	4.8	LOS A	0.9	6.4	0.24	0.55	0.24	53.8
12	R2	96	6.6	0.165	8.8	LOS A	0.9	6.4	0.24	0.55	0.24	53.3
Approach		211	3.5	0.165	6.6	LOS A	0.9	6.4	0.24	0.55	0.24	53.4
All Vehicles		757	1.1	0.228	5.9	LOS A	1.3	9.2	0.34	0.55	0.34	53.7

Intersection R1047 – 2041 Cont.

MOVEMENT SUMMARY 2041 PM

Site: 47vv [2041 PM - FINAL]

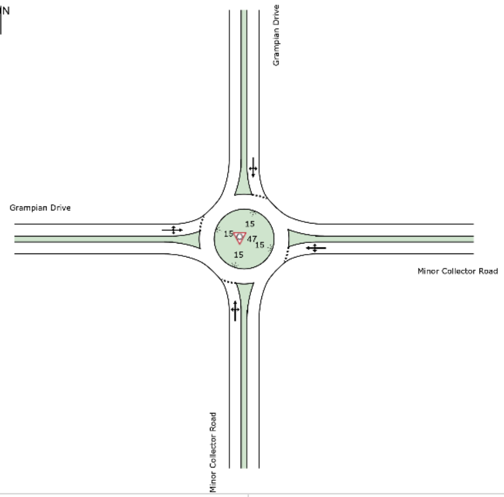
R1047
Site Category: (None)
Roundabout

Movement Performance - Vehicles

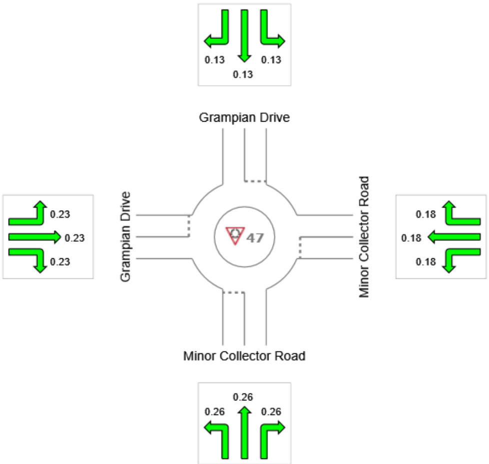
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Minor Collector Road												
1	L2	38	0.0	0.074	4.8	LOS A	0.4	2.8	0.31	0.49	0.31	53.6
2	T1	45	2.3	0.074	5.0	LOS A	0.4	2.8	0.31	0.49	0.31	54.7
3	R2	3	0.0	0.074	9.0	LOS A	0.4	2.8	0.31	0.49	0.31	54.5
Approach		86	1.2	0.074	5.0	LOS A	0.4	2.8	0.31	0.49	0.31	54.2
East: Minor Collector Road												
4	L2	1	0.0	0.127	5.8	LOS A	0.7	4.9	0.49	0.66	0.49	51.3
5	T1	40	13.2	0.127	6.4	LOS A	0.7	4.9	0.49	0.66	0.49	51.9
6	R2	82	0.0	0.127	10.0	LOS B	0.7	4.9	0.49	0.66	0.49	52.1
Approach		123	4.3	0.127	8.8	LOS A	0.7	4.9	0.49	0.66	0.49	52.0
North: Grampian Drive												
7	L2	59	0.0	0.114	6.3	LOS A	0.6	4.4	0.55	0.63	0.55	52.8
8	T1	42	0.0	0.114	6.5	LOS A	0.6	4.4	0.55	0.63	0.55	53.9
9	R2	5	0.0	0.114	10.5	LOS B	0.6	4.4	0.55	0.63	0.55	53.7
Approach		106	0.0	0.114	6.6	LOS A	0.6	4.4	0.55	0.63	0.55	53.3
West: Grampian Drive												
10	L2	46	0.0	0.359	5.0	LOS A	2.4	17.1	0.38	0.60	0.38	51.9
11	T1	129	0.8	0.359	5.2	LOS A	2.4	17.1	0.38	0.60	0.38	52.9
12	R2	271	2.3	0.359	9.2	LOS A	2.4	17.1	0.38	0.60	0.38	52.6
Approach		446	1.7	0.359	7.6	LOS A	2.4	17.1	0.38	0.60	0.38	52.6
All Vehicles		762	1.8	0.359	7.4	LOS A	2.4	17.1	0.42	0.60	0.42	52.8

Intersection R1047-2066

SITE LAYOUT – R1047 – 2066



DEGREE OF SATURATION AM



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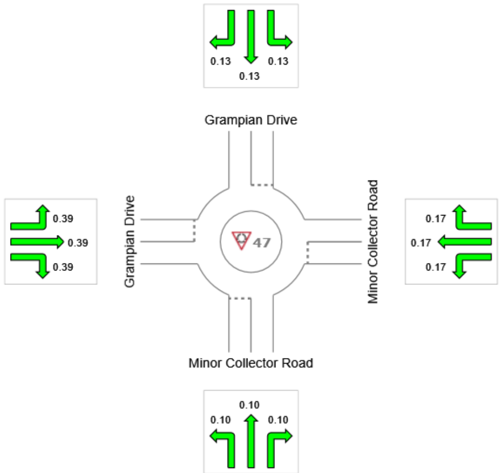
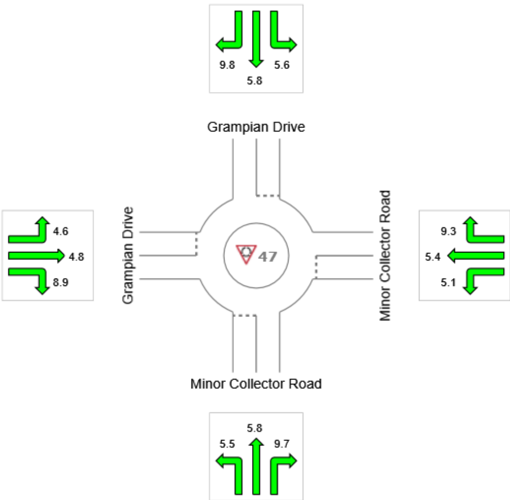


DELAY CONTROL (seconds) AM



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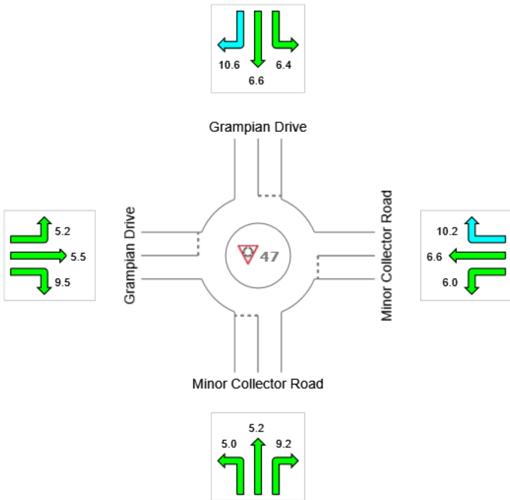

Intersection R1047 – 2066 Cont.

MOVEMENT SUMMARY 2066 AM

Site: 47 [2066 AM - FINAL]

R1047
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Minor Collector Road												
1	L2	246	0.0	0.262	5.5	LOS A	1.6	11.1	0.46	0.59	0.46	53.4
2	T1	37	2.9	0.262	5.8	LOS A	1.6	11.1	0.46	0.59	0.46	54.5
3	R2	3	0.0	0.262	9.7	LOS A	1.6	11.1	0.46	0.59	0.46	54.3
Approach		286	0.4	0.262	5.6	LOS A	1.6	11.1	0.46	0.59	0.46	53.6
East: Minor Collector Road												
4	L2	1	0.0	0.183	5.1	LOS A	1.0	7.1	0.38	0.55	0.38	52.7
5	T1	157	3.4	0.183	5.4	LOS A	1.0	7.1	0.38	0.55	0.38	53.7
6	R2	47	0.0	0.183	9.3	LOS A	1.0	7.1	0.38	0.55	0.38	53.6
Approach		205	2.6	0.183	6.3	LOS A	1.0	7.1	0.38	0.55	0.38	53.7
North: Grampian Drive												
7	L2	97	0.0	0.130	5.6	LOS A	0.7	4.8	0.44	0.59	0.44	53.1
8	T1	21	0.0	0.130	5.8	LOS A	0.7	4.8	0.44	0.59	0.44	54.2
9	R2	19	0.0	0.130	9.8	LOS A	0.7	4.8	0.44	0.59	0.44	54.0
Approach		137	0.0	0.130	6.2	LOS A	0.7	4.8	0.44	0.59	0.44	53.4
West: Grampian Drive												
10	L2	32	0.0	0.229	4.6	LOS A	1.3	9.5	0.27	0.55	0.27	52.7
11	T1	129	0.8	0.229	4.8	LOS A	1.3	9.5	0.27	0.55	0.27	53.7
12	R2	134	6.3	0.229	8.9	LOS A	1.3	9.5	0.27	0.55	0.27	53.2
Approach		295	3.2	0.229	6.6	LOS A	1.3	9.5	0.27	0.55	0.27	53.4
All Vehicles		923	1.7	0.262	6.2	LOS A	1.6	11.1	0.38	0.57	0.38	53.5

MOVEMENT SUMMARY 2066 PM

Site: 47 [2066 PM - FINAL]

R1047
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Minor Collector Road												
1	L2	46	0.0	0.095	5.0	LOS A	0.5	3.6	0.37	0.52	0.37	53.4
2	T1	56	1.9	0.095	5.2	LOS A	0.5	3.6	0.37	0.52	0.37	54.5
3	R2	4	0.0	0.095	9.2	LOS A	0.5	3.6	0.37	0.52	0.37	54.3
Approach		106	1.0	0.095	5.3	LOS A	0.5	3.6	0.37	0.52	0.37	54.0
East: Minor Collector Road												
4	L2	1	0.0	0.171	6.0	LOS A	0.9	6.9	0.52	0.68	0.52	51.1
5	T1	54	13.7	0.171	6.6	LOS A	0.9	6.9	0.52	0.68	0.52	51.8
6	R2	108	0.0	0.171	10.2	LOS B	0.9	6.9	0.52	0.68	0.52	51.9
Approach		163	4.5	0.171	9.0	LOS A	0.9	6.9	0.52	0.68	0.52	51.9
North: Grampian Drive												
7	L2	67	0.0	0.134	6.4	LOS A	0.8	5.3	0.57	0.64	0.57	52.7
8	T1	48	0.0	0.134	6.6	LOS A	0.8	5.3	0.57	0.64	0.57	53.8
9	R2	6	0.0	0.134	10.6	LOS B	0.8	5.3	0.57	0.64	0.57	53.6
Approach		122	0.0	0.134	6.7	LOS A	0.8	5.3	0.57	0.64	0.57	53.2
West: Grampian Drive												
10	L2	47	0.0	0.387	5.2	LOS A	2.7	18.9	0.45	0.62	0.45	51.7
11	T1	133	0.8	0.387	5.5	LOS A	2.7	18.9	0.45	0.62	0.45	52.7
12	R2	277	3.0	0.387	9.5	LOS A	2.7	18.9	0.45	0.62	0.45	52.4
Approach		457	2.1	0.387	7.9	LOS A	2.7	18.9	0.45	0.62	0.45	52.4
All Vehicles		848	2.1	0.387	7.6	LOS A	2.7	18.9	0.47	0.62	0.47	52.6

Appendix E Demographic analysis

SGS Economics & Planning

DEMOGRAPHIC ANALYSIS FOR THREE PRIORITY DEVELOPMENT AREAS

FINAL REPORT
FEBRUARY 2020

Prepared for
Economic Development Queensland - DSDMIP

Independent insight.

SGS Economics and Planning Pty Ltd
ACN 007 437 729
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Offices in Canberra, Hobart, Melbourne, Sydney

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LIST OF FIGURES

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GLOSSARY

CBD	Central Business District
CHaPs	Community Hubs and Partnerships
DoE	Department Education
DSDMIP	Queensland Department of State Development, Infrastructure and Planning
EDQ	Economic Development Queensland
ICC	Ipswich City Council
ICOP	Infrastructure Charging and Offsets Plan
PDA	Priority Development Area
QGSO	Queensland Government Statisticians Office
SA2	Statistical Area 2
SEQ	South East Queensland
ShapingSEQ	ShapingSEQ Regional Plan
TMR	Department of Transport and Main Roads

Version Control

Report Version	Date Provided	File Name
Final Report v3	05/02/2020	*20190482 Demographic Analysis – Final Report 200205.docx*
Final Report v2	15/01/2020	*20190482 Demographic Analysis – Final Report 200115.docx*
Final Report v1	20/12/2019	*20190482 Demographic Analysis – Final Report 201219.docx*
Draft Report	10/12/2019	*20190482 PDA Demographic Analysis – Final Report 101219.docx*

EXECUTIVE SUMMARY

This report provides land use projections for the Greater Flagstone, Yarrabilba and Ripley Valley Priority Development Areas (PDA).

The land use projections have been produced by a method that combines a 'top down' approach with a 'bottom up' approach ensuring that all relevant information is used to produce a robust set of projections.

The key 'top down' data input is the South East Queensland population projections produced by SGS. The 'bottom up' input data, includes Census data, building approvals data, information from developers, transport model land use data as well as State Government and Council population projections.

Each of these datasets has its own strengths and weakness. For example, SGS has applied an annual reduction to the dwelling's yields provided by developers (informed by the SGS South East Queensland population projection model). Effectively, the developers appear slightly optimistic about the number of dwellings they could sell each year. This small reduction means that the SGS expects the various PDAs will be fully built out around 5 years later than previously expected.

Key statistics (rounded to the nearest thousand) for each PDA are:

- Greater Flagstone (2066)
    - Dwellings – 54,000
    - Population – 145,000
    - Employment – 34,000
- Yarrabilba (2066)
    - Dwellings – 19,000
    - Population – 53,000
    - Employment – 13,000
- Ripley Valley (2066)
    - Dwellings – 50,000
    - Population – 135,000
    - Employment – 14,000

1. INTRODUCTION

1.1 Project scope

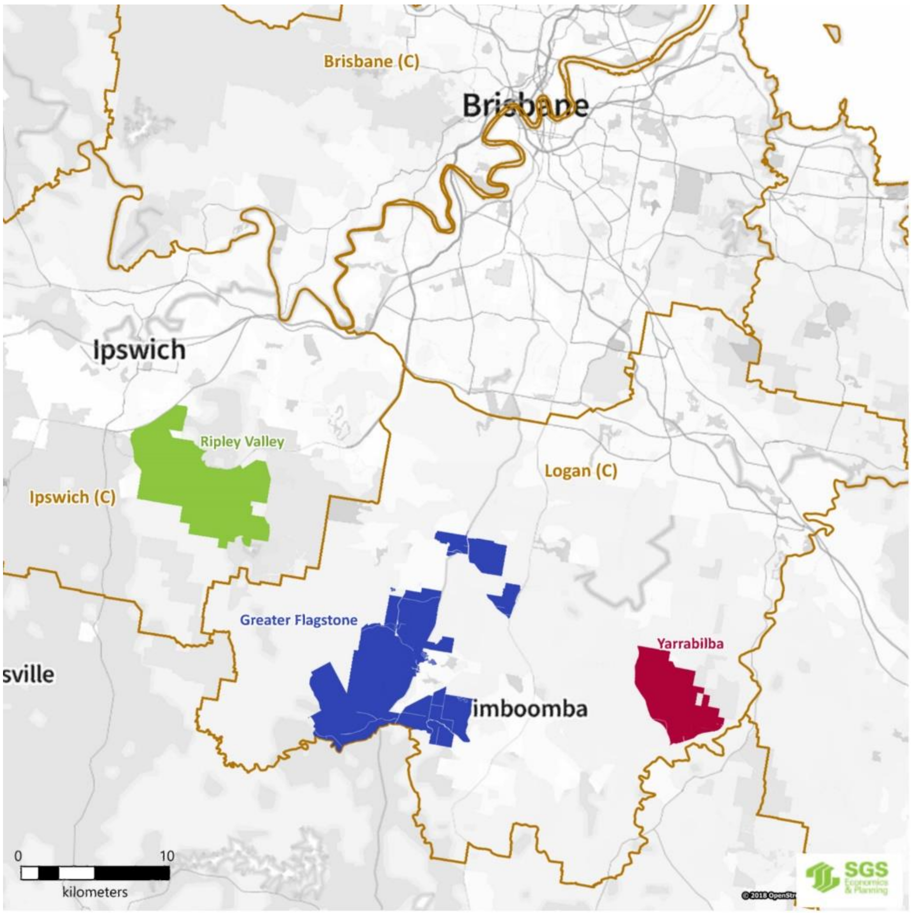
This report provides updated demographic forecasts of dwellings, population and employment for the Greater Flagstone, Yarrabilba and Ripley Valley Priority Development Areas (PDA).

These forecasts are informed by existing population growth assumptions and employment projections produced by Logan City Council (Logan CC), Ipswich City Council, VLC and Jacobs transport modelling as well as Queensland Government Statisticians Office (QGSO) 2018 forecasts, the ShapingSEQ Regional Plan (ShapingSEQ) and individual feedback from developers. SGS has also conducted a review of the most recent data available for each PDA, including the recent ABS building approvals data, to inform the forecasts.

1.2 Study area

The project study area is defined as the three priority development areas (PDAs) of Greater Flagstone, Yarrabilba and Ripley Valley. These are shown on Figure 1 below.

FIGURE 1: MAP OF STUDY AREA



Source: SGS Economics and Planning

1.3 Disclaimer

This report and associated data form a confidential document that has been prepared by SGS Economics & Planning Pty Ltd (SGS). This model has been provided at the request of the Queensland Department of State Development, Infrastructure and Planning (DSDMIP) in relation to Greater Flagstone, Yarrabilba and Ripley Valley Demographic Analysis ('the Project').

The analysis contained in this model has been prepared by SGS based on SGS' own information, as well as information provided by DSDMIP.

No verification of the information provided by DSDMIP or other third parties has been carried out by SGS, and in particular, SGS has not undertaken any review of the information supplied or made available during the course of the engagement. This model does not purport to contain all the information DSDMIP may require in considering the Project.

SGS has based this report on the assumption that the information received or obtained is accurate and, where it is represented by management as such, complete. SGS makes no express or implied representation or warranty as to the accuracy, reliability or completeness of the information provided.

SGS may in its absolute discretion, but without being under any obligation to do so, update or adjust this model, or any inputs that are used within this model.

SGS will not provide any express or implied opinion (and assumes no responsibility) as to whether actual results will be consistent with, or reflect the results of, any of the outputs generated by this model.

SGS has taken all due care in the preparation of this model. However, SGS and its associated consultants are not liable to any person or entity for any damage or loss that has occurred, or may occur, in relation to that person or entity taking or not taking action in respect of the outputs generated by this model.

This model is for the sole use of DSDMIP in assisting with the decision-making process relating to the Project. All information contained in this model is strictly confidential and must not be copied, reproduced, distributed, disseminated or used, in whole or in part, for any purpose other than as detailed above without SGS' explicit written permission.

1.4 Report structure

This report is structured as follows:

- Chapter 2 Methodology – outlines the approach used to produce demographic forecasts for each PDA
- Chapter 3 Greater Flagstone – provides a comparison of existing forecasts and SGS' forecasts for this PDA
- Chapter 4 Yarrabilba – provides a comparison of existing forecasts and SGS' forecasts for this PDA
- Chapter 5 Ripley Valley – provides a comparison of existing forecasts and SGS' forecasts for this PDA
- Appendices – includes further detail on each developer area within each of the PDAs

2. METHOD OVERVIEW

This section briefly describes the method used to produce forecasts of dwellings, population and employment for each priority development area (PDA).

These dwelling, population and employment projections are the result of our method that combines a 'top down' approach with a 'bottom up' approach to ensure that all relevant information is used to produce a set of land use projections.

The key 'top down' data input is the South East Queensland (SEQ) population projections produced by SGS. These account for the total demand for future housing and where that housing is likely to take place. These are informed by State Government and Australian Bureau of Statistics (ABS) population projections and relevant data on the economic performance of SEQ.

The 'bottom up' input data includes Census data, building approvals data, information from developers in the PDAs, Council population projections and transport model land use data. Each of these datasets has its own strengths and weaknesses, which have been assessed.

These various data sources are brought together to create a coherent view of the growth in dwellings, population and employment over the next 50 years.

Some of the key aspects and assumptions of our 'top down' approach with a 'bottom up' methodology are summarised below.

2.1 Dwellings

The **ultimate dwelling yield** has been estimated as the total number of potential dwellings in each PDA at full build out. The ultimate dwelling yield is based around the expected dwelling densities and the amount of net developable land. Full build out is assumed to be 2066 for Greater Flagstone, 2056 for Yarrabilba and 2066 for Ripley Valley.

Forecast **dwelling timing** between 2019 and 2031 has been informed by the feedback provided by developers for each developer area, as shown on the map in Figure 1.

In Greater Flagstone and Yarrabilba SGS has applied a 5 per cent reduction to the total dwelling yield in each year to account for the likelihood that not all of the dwellings planned by developers are achieved in that year. This reduction was informed by SGS' SEQ population projection model which assesses potential residential growth across the whole of SEQ. Effectively, this means that developers are slightly optimistic (5 per cent) about the number of dwelling they could sell each year.

In Ripley Valley SGS has used recent dwelling approvals, developer feedback data (where available) and assumptions on the timing of development to estimate total dwellings in this PDA.

2.2 Population

The population projection is based on the applying an average person per household to the dwelling projections.

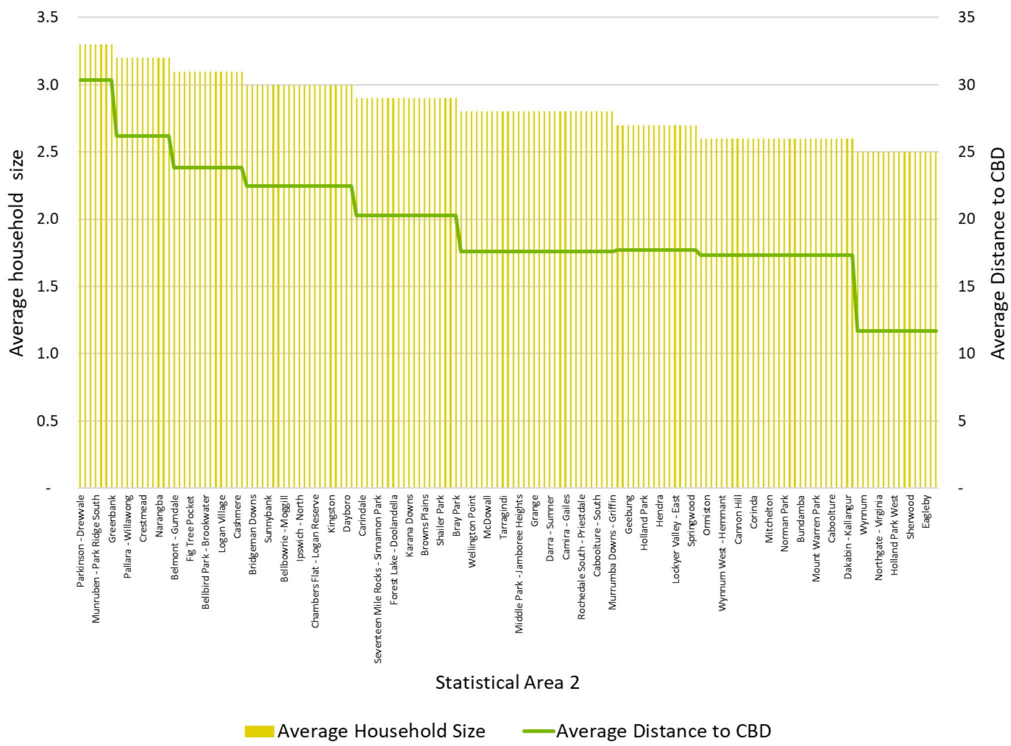
This has been informed by the **dwelling mix** based on Council forecasts of attached and detached dwellings, and the average household size expected in a greenfield area adjusted to account for variations in dwelling mix (e.g. detached houses or medium density).

Figure 2 presents the average distance to Brisbane CBD for each SA2 within each average household size grouping. The purpose of this figure is to illustrate that, in general, as distance to the CBD increases, the average household size increases[1]. Locations like Springfield, Coomera and North Lakes all have average household sizes between 3.0-3.2 persons per household.

For an area like Yarrabilba, Greater Flagstone and Ripley Valley, an average household size of around 3.0 could be expected. This will vary within the PDAs as some areas will have larger or smaller dwellings.

This analysis is supported by the average household size used by VLC and Logan City Council (Greater Flagstone and Yarrabilba) or Jacobs and Ipswich City Council (Ripley Valley). In the long term, the average person per household does decline as the first generation of children born in the PDA, move out of home and their parents remain. Although even in the later years of the analysis the PDA average person per households is still above State average of 2.6.

FIGURE 2: AVERAGE HOUSEHOLD SIZE BY THE AVERAGE DISTANCE TO THE CBD SELECTED SA2



Source: SGS Economic and Planning from ABS Census data 2016

The age profile is derived from the population projection. After a review by SGS, the QGSO projections for share of population in each age group was used to create the age breakdowns.

[1] This figure compares the average household size of the SA2 with the average distance of the SA2 from the CBD, not the actual distance. For example, the average household size of Dakabin-Kallangur SA2 is 2.6 persons per households. Typically, areas with an average household size of 2.6 persons are located 17km from the CBD, which is closer than the actual distance of the SA2 to the CBD. This illustrates that Dakabin-Kallangur SA2 has a lower household size than other SA2s of a similar distance from the CBD.

2.3 Employment

The bulk of the employment which will be located in the PDAs will be population serving. To produce a projection of future employment, a set of job to population ratios have been utilised and applied to the projected population.

Table 1 presents the assumed employment growth for population serving industries which have been used for the PDAs (which are based on the historical averages for greenfield areas). Using these numbers, the rate of employment growth is between 0.6 to 0.7 jobs per new household in Greater Flagstone and Yarrabilba, and 0.3 jobs per new household in Ripley Valley.

TABLE 1: POPULATION SERVING EMPLOYMENT ASSUMPTIONS

Industry	Jobs per 1000 new residents	
	Greater Flagstone & Yarrabilba	Ripley Valley
Construction	20	22
Retail Trade	20	20
Accommodation and Food Services	15	9
Financial and Insurance Services	5	1
Rental, Hiring and Real Estate Services	7	4
Professional, Scientific and Technical Services	25	26
Administrative and Support Services	10	9
Public Administration and Safety	15	12
Education and Training	30	22
Health Care and Social Assistance	75	34
Arts and Recreation Services	9	1
Other Services	3	5
Total Population Serving Employment	**234**	**165**

Source: SGS Economics and Planning, based on ABS Census (1996 – 2016)

3. GREATER FLAGSTONE

This chapter provides a comparison of existing forecasts produced for Greater Flagstone and SGS' forecasts for the PDA.

3.1 Dwellings

Total occupied private dwellings have been forecast for Greater Flagstone, and each of the developer areas within the PDA. The following section compares previous forecasts prepared by Logan CC and VLC, along with our own analysis of developer feedback data and recent development trends in the region.

Comparison of existing forecasts

Table 2 below highlights the variation in dwelling forecasts for the City of Logan between the State Government's ShapingSEQ, QGSO 2018 projections, Council's own figures as well as VLC's Strategic Transport Modelling for the LGA. The values for 2016 vary slightly, whereas the variation increases for projections at 2041 and 2061. Logan CC and the ShapingSEQ forecast similar dwelling numbers in 2041, with 198,000 dwellings. The 2061 forecast varies by 5,545 dwellings between Logan CC and VLC. ShapingSEQ and QGSO do not currently have forecasts specific to the PDA for 2061.

TABLE 2: LOGAN LOCAL GOVERNMENT AREA DWELLING FORECASTS

Projection Source	2016	2041	2061	Growth 2016 – 2061
ShapingSEQ	108,770	198,670	N/A	N/A
QGSO 2018 Projections	108,770	192,533	N/A	N/A
Logan City Council	111,484	198,579	292,498	181,014
VLC Forecasts	110,216	196,593	286,953	176,737

Source: ShapingSEQ, Logan City Council, VLC Transport Modelling, QGSO Forecasts 2018

Feedback was received from each developer in Greater Flagstone on their 'realistic' and 'aspirational' dwelling yields per year to 2031. These are summarized in Table 3 below (Further information available in Appendix 1). Annual dwelling yield is expected to be between 44 and 365 dwellings per year across the developer areas in Greater Flagstone.

This information has been used to inform SGS' dwelling forecasts, specifically the timing and location of dwelling growth to 2031. In some cases, data was provided on the dwelling mix (detached vs attached dwellings), and where relevant this has been used to inform the population projections in the following chapter.

This reduction was informed by SGS SEQ population projection model which assessing potential residential growth across the whole of the SEQ. Effectively, this means that developers were slightly optimistic (5 per cent[2]) about the number of dwellings they could sell each year.

[2] Although this 5 per cent varies from year to year, hence there isn't a constant 5 per cent reduction applied to all developer areas in all year.

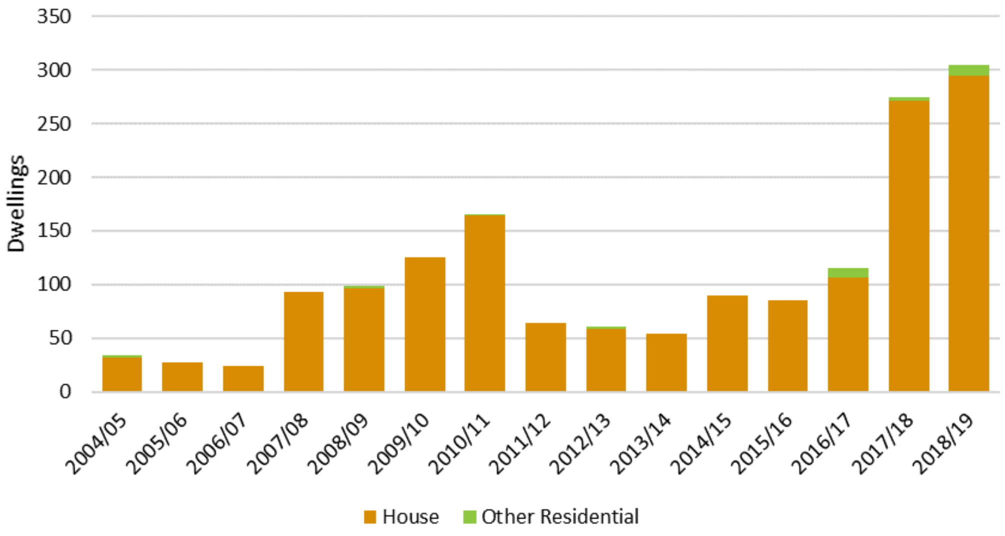
TABLE 3: GREATER FLAGSTONE DEVELOPER – EXPECTED DWELLINGS IN 2031

Developer Area	Realistic 2031 Dwellings	Realistic Dwellings per year	Aspirational 2031 Dwellings	Aspirational Dwellings per year
Celestino	875	67	1,900	146
Mirvac	2,701	265	2,961	291
Peet Flagstone City	4,751	365	6,500	500
Pioneer Fortune	1,399	108	1,749	135
Wilsons New Beith	569	44	946	73
Flinders Land Holdings	3,357	258	4,465	343
Villa Green	1,502	116	1,502	116
Total	15,154	1,223	20,023	1,604

Source: Greater Flagstone Developers 2019

The following chart shows recent building approvals for Greenbank SA2, representing Greater Flagstone. It should be noted Greater Flagstone covers approximately one quarter of the Greenbank SA2 and a small component of the Jimboomba SA2. Recent data shows that between 250 to 300 dwellings have been approved per year. Recent development in the Greater Flagstone PDA has been slow, with issues relating to infrastructure provision delaying residential development.

FIGURE 3: RECENT BUILDING APPROVALS GREATER FLAGSTONE (GREENBANK SA2)



Source: ABS Dwellings Approvals 2018/19

SGS forecasts

Table 4 shows the dwelling forecasts for the Greater Flagstone prepared by SGS, compared to those prepared by Logan CC and VLC. SGS forecasts total dwellings in Greater Flagstone PDA to reach 54,000 dwellings at ultimate development in 2066. This is broadly in line with Logan CC and VLC forecasts for 2061. By 2066 it is expected that 19 per cent of dwellings in Logan LGA will be located in Greater Flagstone.

SGS forecasts in 2041 are slightly higher than VLC and Logan CC forecasts due to the different datasets and assumptions used by SGS. As shown in Figure 4, SGS forecasts are slightly above the VLC and Logan CC forecasts up to 2046, due to the use of developer feedback data. Beyond 2046 SGS forecasts are lower than VLC and Logan CC as development is expected to occur at a slower rate, with both reaching 54,000 dwellings by 2066.

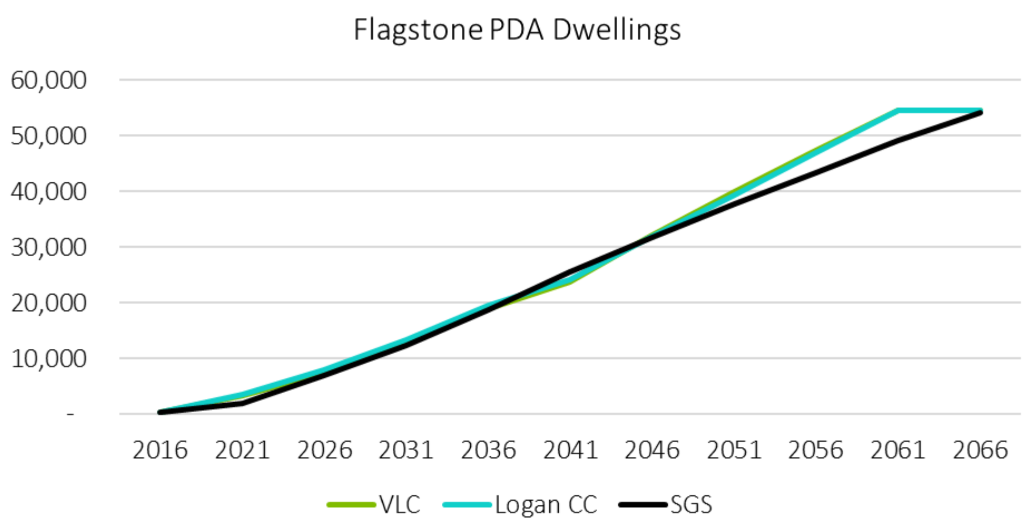
These forecasts assume that major infrastructure would have been provided and a number of sub-precincts would have been planned and activated.

TABLE 4: GREATER FLAGSTONE PDA DWELLING FORECASTS

Projection Source	2016	2041	2066	Growth 2016 – 2066
SGS	236	25,484	54,145	53,910
Logan City Council	272	24,182	54,597*	54,325*
VLC	248	23,683	54,586*	54,338*

Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling
* Note These are 2061 estimates

FIGURE 4: GREATER FLAGSTONE PDA DWELLING FORECASTS



Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling

Table 5 presents SGS' forecasts of dwellings by developer area within the Greater Flagstone PDA. Areas with the largest forecast dwellings include Peet Flagstone City, Pioneer Fortune, Wilsons New Beith, Flinders Land Holdings, Celestino and Mirvac.

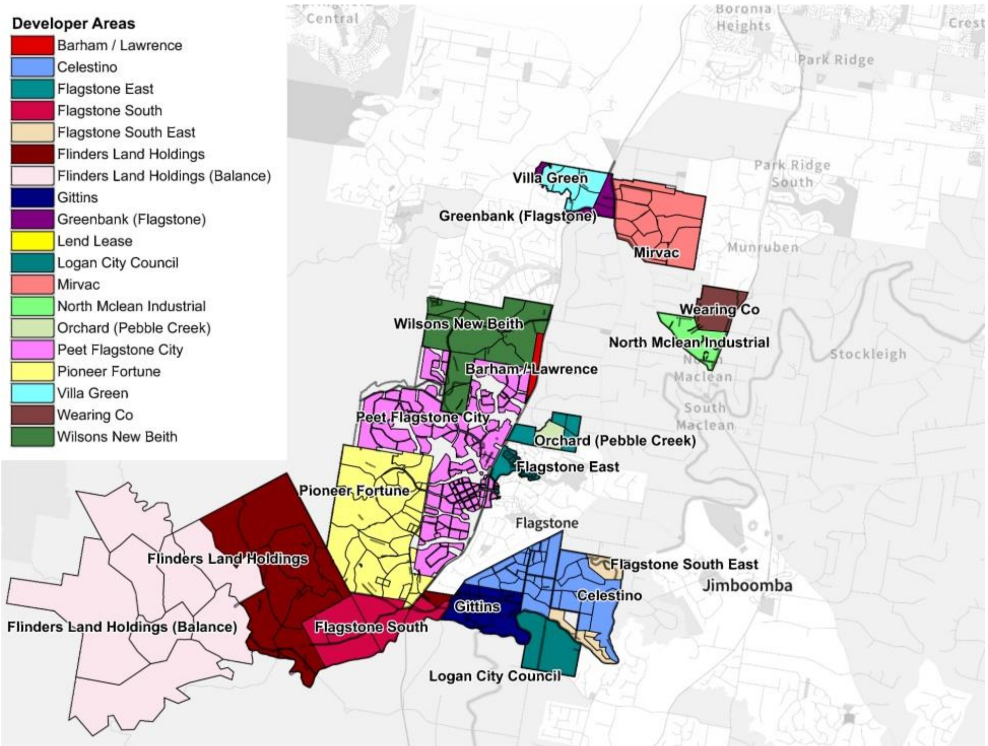
These forecasts have been informed by the developer feedback provided by each of the large developers on their realistic and aspirational dwelling yields to 2031.

TABLE 5: GREATER FLAGSTONE PDA DWELLING FORECASTS BY DEVELOPER AREA

Developer Area	2016	2041	2066	Growth 2016 – 2061
Celestino	-	2,807	6,643	6,643
Mirvac	-	3,018	3,114	3,114
Peet Flagstone City	-	6,581	14,121	14,121
Pioneer Fortune	-	2,920	7,533	7,533
Wilsons New Beith	-	3,219	7,463	7,463
Flinders Land Holdings	-	4,398	7,673	7,673
Villa Green	-	1,411	1,427	1,427
Gittins	-	-	1,861	1,861
Flagstone East	149	481	1,046	897
Flagstone South	8	8	2,377	2,369
Flagstone South East	54	64	301	247
Greenbank (Flagstone)	10	12	13	3
Logan City Council	1	1	1	0
North Mclean Industrial	12	12	13	1
Orchard (Pebble Creek)	-	552	558	558
Wearing Co	1	1	1	0
Barham / Lawrence	-	-	-	-
Total Greater Flagstone PDA	**235**	**25,485**	**54,145**	**53,910**

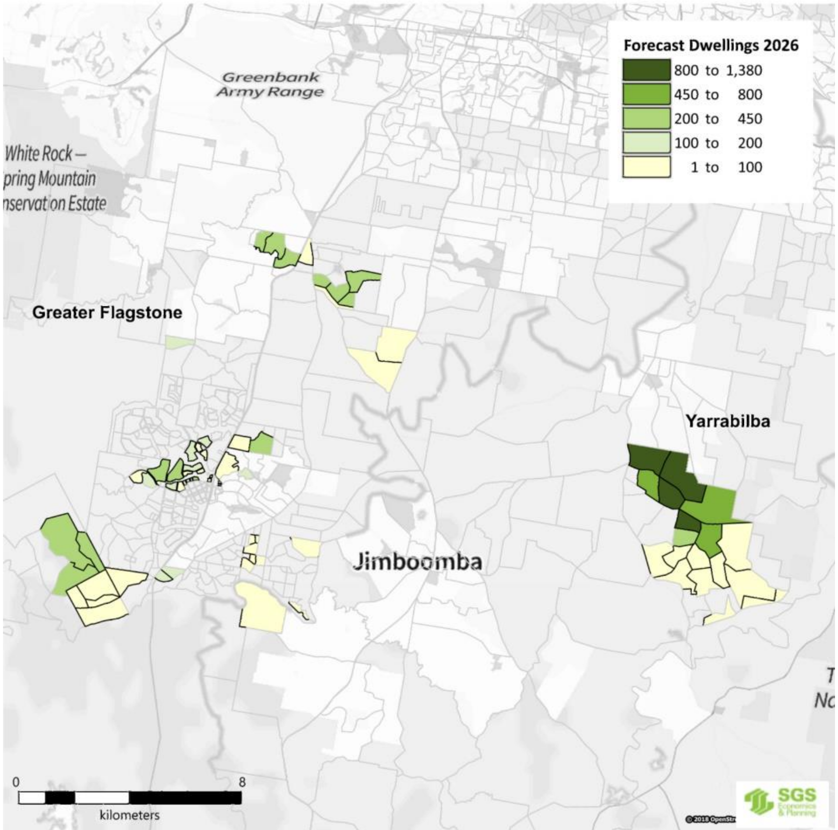
Source: SGS Economics and Planning 2019

FIGURE 5: GREATER FLAGSTONE PDA DEVELOPER AREAS



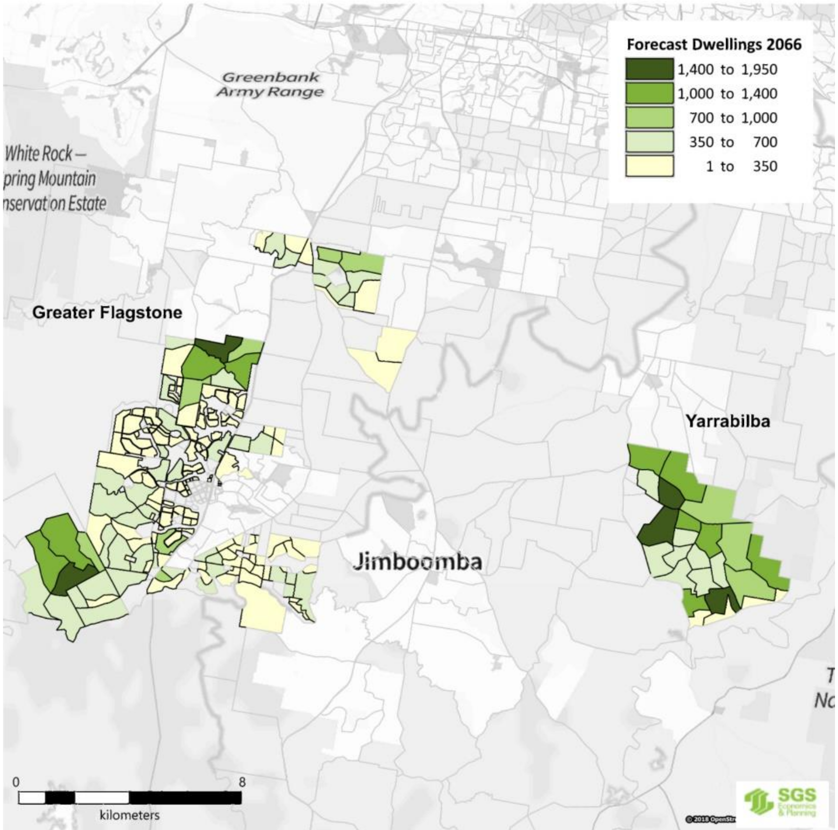
Source: DSDMIP Economic Development Queensland

FIGURE 6: GREATER FLAGSTONE PDA DWELLING FORECASTS 2026



Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling

FIGURE 7: GREATER FLAGSTONE PDA DWELLING FORECASTS 2066



Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling

3.2 Population

Comparison of existing forecasts

Table 6 below highlights the variation in population forecasts for the City of Logan between ShapingSEQ, QGSO 2018 projections, Council's own figures as well as VLC's Strategic Transport Modelling for the area. While values are similar in 2016, there is considerable variation in forecasts for 2041. Logan CC and VLC have the same values whereas QGSO and ShapingSEQ are projecting more people in the Logan LGA by 2041 (i.e. a faster rate of population growth).

TABLE 6: LOGAN LOCAL GOVERNMENT AREA POPULATION FORECASTS

Projection Source	2016	2041	2061	Growth 2016 – 2061	Average household size 2016	Average household size 2061
Shaping SEQ	313,800	586,000	NA	NA	2.9	NA
QGSO 2018 Projections	313,785	554,327	NA	NA	2.9	NA
Logan City Council	313,846	548,628	782,821	468,975	2.8	2.7
VLC Forecasts	313,846	548,628	782,821	468,975	2.8	2.7

Source: Shaping SEQ, Logan City Council, VLC Transport Modelling, QGSO Forecasts 2018

SGS Forecasts

SGS forecasts of population for Greater Flagstone PDA are shown in Table 7. An estimated 145,000 residents are forecast for the PDA in 2066, based on an average household size of 2.7 persons per household. This aligns with Logan CC and VLC's forecasts of population.

As shown in Figure 8, SGS forecasts of population are slightly above the VLC and Logan CC forecasts up to 2046, in line with our dwelling forecast. Beyond 2046 SGS forecasts are lower than VLC and Logan CC as growth is expected to occur at a slower rate.

SGS forecasts a decline in average household size, from a high of 3.3 in 2016, to 2.9 by 2031 and 2.7 in the longer term beyond 2046. This trend is seen in older growth areas that have already developed.

Average household size tends to be higher in the early development stages as families with children move in to detached dwellings. This is expected to decline in the longer term due to more apartments being built and changing age profiles, with more older people less school aged people.

Greater Flagstone household size is still expected to remain slightly above the QLD average household size of 2.6 persons per household.

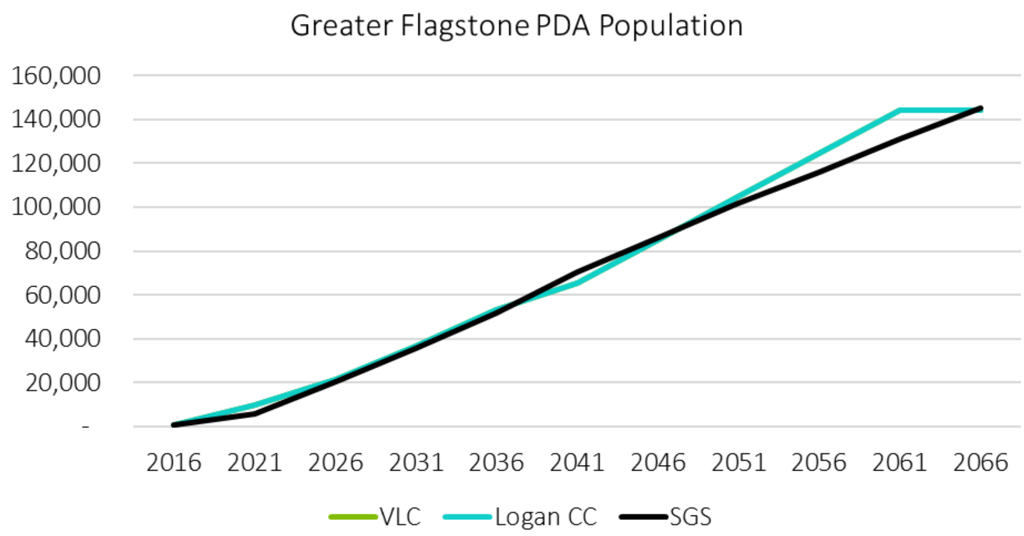
TABLE 7: GREATER FLAGSTONE PDA POPULATION FORECASTS

Projection Source	2016	2041	2066	Growth 2016 – 2066
SGS	775	70,548	144,738	143,963
Avg household size	3.3	2.8	2.7	-0.6
Logan City Council	819	65,394	144,335*	143,516*
Avg household size	3.0	2.7	2.6	-0.4
VLC	816	65,391	144,332*	143,516*
Avg household size	3.3	2.8	2.6	-0.6

Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling

* Note These are 2061 estimates

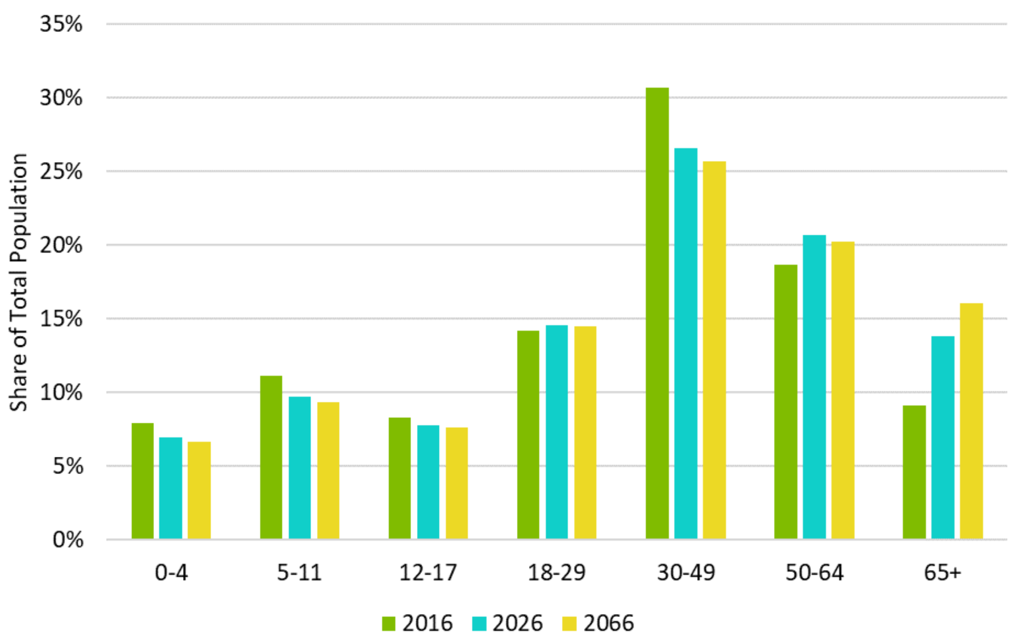
FIGURE 8: GREATER FLAGSTONE PDA POPULATION FORECASTS



Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling

Population forecasts by age group have been prepared for Greater Flagstone using the QGSO population by age forecasts for the SA2 in which it is located (Greenbank SA2). It has been assumed that as the PDA develops there will be a changing age profile of residents. The proportion of older age people (50 to 64 and 65+) is forecast to increase in 2036 and 2066 (see Figure 9). This is in line with state-wide trends of an ageing population.

FIGURE 9: GREATER FLAGSTONE PDA POPULATION BY AGE – SHARE OF AGE GROUP

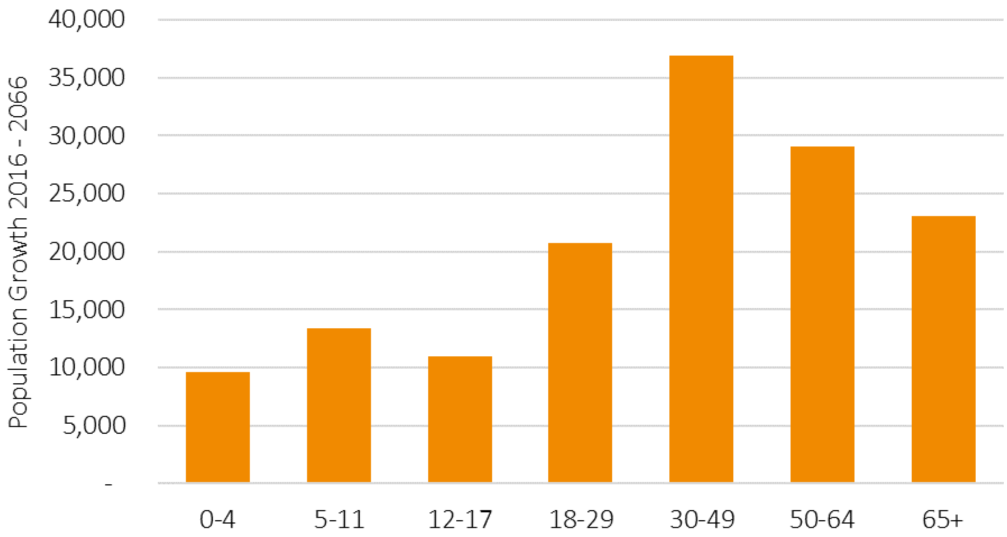


Source: SGS Economics and Planning 2019, QGSO 2018

As shown in Figure 10 below, the number of primary school aged children (5-11 years) living in Greater Flagstone is forecast to increase by 13,400 people to 2066. The number of secondary school aged children (12-17 years) is forecast to increase by 11,000 people to 2066.

The largest amount of population growth is forecast for the 30-49 and 50-64 age group.

FIGURE 10: GREATER FLAGSTONE PDA POPULATION – FORECAST GROWTH BY AGE GROUP



Source: SGS Economics and Planning 2019

There is of course a high degree of uncertainty regarding the future age breakdown of the PDA. This is particularly the case for school aged children. The size of this age group clearly has implications for future school provision. Looking at the existing shares of school aged children for SA2 across Greater Brisbane provides an indication of a possible future range for the PDA (using 2016 ABS Census data).

For children aged 5-11 years, the percentage can be as high as 13 per cent (for example the North Lakes - Mango Hill SA2 is 13.1 per cent). Other SA2 with a similar percentage of children aged 5-11 include the Redbank Plains SA2 (13.5 per cent), Narangba SA2 (13.2%) and Goodna (12.7%). On average, 9.3 per cent of the population across Greater Brisbane were aged 5 to 11 years (in 2016).

Applying this 13 per cent to the PDA projections provides an indication of a future with a very high percentage of primary school aged children. Table 8 compares the baseline forecast of primary school aged children in Greater Flagstone PDA (aged 5 to 11 years), with a high scenario forecast.

TABLE 8: PRIMARY SCHOOL AGED CHILDREN – HIGH SCENARIO, GREATER FLAGSTONE PDA

Population aged 5-11 years	2016	2026	2036	2046	2056	2066	Growth 2016-66
Baseline Forecast	86	1,966	4,829	8,052	10,805	13,536	13,450
Share of total population	11%	10%	9%	9%	9%	9%	
High scenario	86	2,437	6,729	10,357	13,899	17,412	17,326
Share of total population	11%	12%	13%	12%	12%	12%	

Source: SGS Economics and Planning based on ABS Census data 2016

For secondary school children, the current (2016) percentage of the population aged 12-17 years can be as high as 10 per cent (for example the Marsden and Crestmead SA2 are 10.1 per cent). Other SA2 with a similar percentage of children aged 12-17 years include the North Lakes – Mango Hill SA (9.3 per cent), Goodna SA2 (9.2%) and Wakerley (9.2%). On average, 7.6 per cent of the population across Greater Brisbane were aged 12 to 17 years (in 2016).

Applying this 10 per cent to the PDA projections in 2036 provides an indication of a future with a very high percentage of secondary school aged children. Table 9 compares the baseline forecast of secondary school aged children in Greater Flagstone PDA (aged 12 to 17 years), with a high scenario forecast.

TABLE 9: SECONADRY SCHOOL AGED CHILDREN – HIGH SCENARIO, GREATER FLAGSTONE PDA

Population aged 12-17 years	2016	2026	2036	2046	2056	2066	Growth 2016-66
Baseline Forecast	64	1,582	3,940	6,570	8,816	11,044	10,980
Share of total population	8%	8%	8%	8%	8%	8%	
High scenario	64	1,828	5,177	7,768	10,424	13,059	12,995
Share of total population	8%	9%	10%	9%	9%	9%	

Source: SGS Economics and Planning based on ABS Census data 2016

3.3 Employment

Total employment has been forecast for Greater Flagstone, and each of the developer areas within the PDA. SGS has compared previous forecasts prepared by Logan CC and VLC, along with our own analysis of population serving employment trends in new growth areas.

Table 10 compares total employment forecasts for the Logan Local Government Area (LGA) prepared by three sources (Shaping SEQ, Logan CC and VLC transport modelling). All three sources are broadly in line, with employment in Logan LGA forecast to reach 168,000 by 2041 and 272,000 by 2066. VLC forecasts are slightly higher than Logan in 2066 by a small amount.

TABLE 10: LOGAN LOCAL GOVERNMENT AREA EMPLOYMENT FORECASTS

Projection Source	2016	2041	2066	Growth 2016 – 2066
ShapingSEQ	101,980	168,125	N/A	N/A
Logan City Council	103,129	168,313	272,020	168,891
VLC	103,164	168,544	272,251	169,087

Source: ShapingSEQ, Logan City Council, VLC Transport Modelling

Table 9 illustrates SGS' forecasts for total employment in Greater Flagstone PDA to reach 16,900 jobs by 2041, and 34,400 jobs by 2066 (ultimate development). This represents 0.6 additional jobs per additional household in Greater Flagstone.

By 2066 it is expected that 12 per cent of jobs in Logan LGA will be located in Greater Flagstone. The majority of these jobs are expected to be population serving industries including retail, accommodation and food services, health, education and construction.

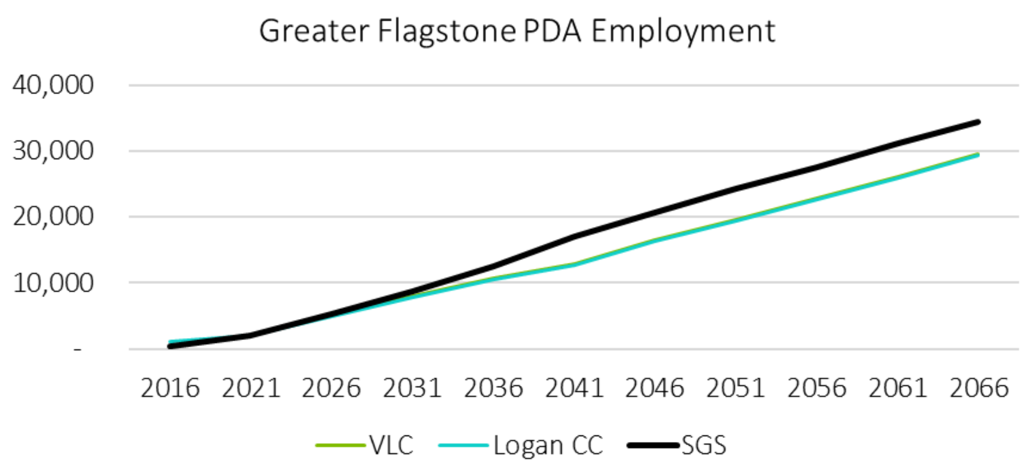
SGS forecasts are slightly higher than VLC and Logan CC forecasts due to the different method used by SGS. SGS employment forecasts are linked to the projected population growth which is also higher than VLC and Logan, as outlined in Section 3.2.

TABLE 11: GREATER FLAGSTONE PDA EMPLOYMENT FORECASTS

Projection Source	2016	2041	2066	Growth 2016 – 2061
SGS	409	16,942	34,387	33,978
Logan City Council	1,044	12,719	29,339	28,295
VLC	409	12,915	29,535	29,126

Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling

FIGURE 11: GREATER FLAGSTONE PDA EMPLOYMENT FORECASTS



Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling

Table 12 presents SGS' forecasts of total employment by developer area within the Greater Flagstone PDA. Areas with the largest forecast number of jobs include Peet Flagstone City, North Mclean Industrial, Wearing Co, Pioneer Fortune and Wilsons New Beith.

TABLE 12: GREATER FLAGSTONE PDA EMPLOYMENT FORECASTS BY DEVELOPER AREA

Developer Area	2016	2041	2066	Growth 2016 – 2066
Celestino	6	985	1,559	1,554
Mirvac	1	259	674	673
Peet Flagstone City	25	8,407	15,991	15,967
Pioneer Fortune	14	831	2,305	2,291
Wilsons New Beith	37	631	2,136	2,100
Flinders Land Holdings	14	524	1,582	1,568
Villa Green	2	79	70	68
Gittins	2	3	400	398
Flagstone East	27	56	296	269
Flagstone South	6	8	106	101
Flagstone South East	9	12	22	13
Greenbank (Flagstone)	250	1,141	1,013	763
Logan City Council	4	5	4	1
North Mclean Industrial	1	3,970	4,224	4,224
Orchard (Pebble Creek)	12	31	27	16
Wearing Co	0	0	3,976	3,976
Barham / Lawrence	0	1	1	0
Total Greater Flagstone PDA	409	16,942	34,387	33,978

Source: SGS Economics and Planning 2019

4. YARRABILBA

This chapter provides a comparison of existing forecasts produced for Yarrabilba and SGS' forecasts for this PDA.

4.1 Dwellings

Comparison of existing forecasts

As Yarrabilba and Greater Flagstone are both within the Logan LGA, comparison LGA figures for Dwellings, Population and Employment have been outlined above in the Greater Flagstone section.

Feedback was received from Lend Lease, which at the time of writing is assumed to be the only developer in Yarrabilba. Lend Lease provided their realistic and aspirational dwelling yields per year to 2031. These are summarized in Table 13 below (Further information in Appendix 1). Lend Lease expect their annual dwelling yield to be between 380 and 450 dwellings per year in Yarrabilba. This information has been used to inform SGS' dwelling forecasts, specifically the timing and location of dwelling growth to 2031.

SGS has applied a 5 per cent reduction to the total dwelling yield in each year to account for the likelihood that not all of the dwellings planned by developers are sold in that year.

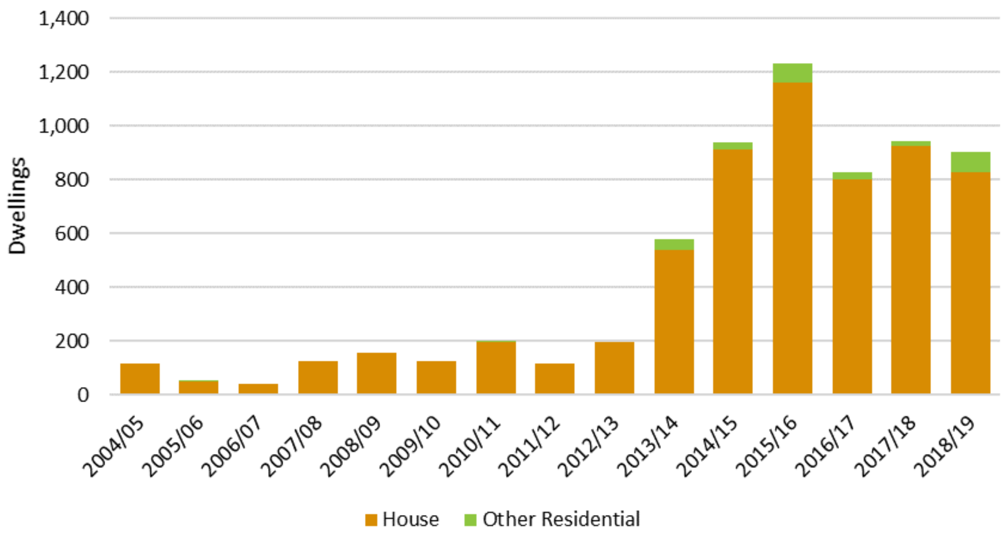
TABLE 13: DEVELOPER FEEDBACK DATA ON EXPECTED DWELLINGS IN 2031 – YARRABILBA

Developer Area	Realistic 2031 Dwellings	Realistic Dwellings per year	Aspirational 2031 Dwellings	Aspirational Dwellings per year
Lend Lease	8,175	394	8,870	452

Source: Lend Lease 2019

The following chart shows recent building approvals for Jimboomba SA2, representing Yarrabilba. It should be noted Yarrabilba covers approximately one quarter of the Jimboomba SA2. Recent data shows that between 800 to 1,000 dwellings have been approved per year in the broader SA2 area.

FIGURE 12: RECENT BUILDING APPROVALS YARRABILBA (JIMBOOMBA SA2)



Source: ABS Dwellings Approvals 2018/19

SGS forecasts

Table 14 shows the dwelling forecasts for the Yarrabilba prepared by SGS, compared to those prepared by Logan CC and VLC. SGS forecasts total dwellings in Yarrabilba PDA to reach 19,000 dwellings at ultimate development in 2066. This is broadly in line with Logan CC and VLC forecasts for 2061. By 2066 it is expected that 7 per cent of dwellings in Logan LGA will be located in Yarrabilba.

SGS forecasts in 2041 are slightly lower than VLC and Logan CC forecasts due to the different datasets and assumptions used by SGS. As shown in Figure 13, SGS forecasts are slightly below the VLC and Logan CC forecasts up to 2051, due to the use of developer feedback data. Beyond 2051 SGS forecasts are in line with VLC and Logan CC with both reaching 19,000 dwellings by 2056.

These forecasts assume that major infrastructure would have been provided and a number of sub-precincts would have been planned and activated.

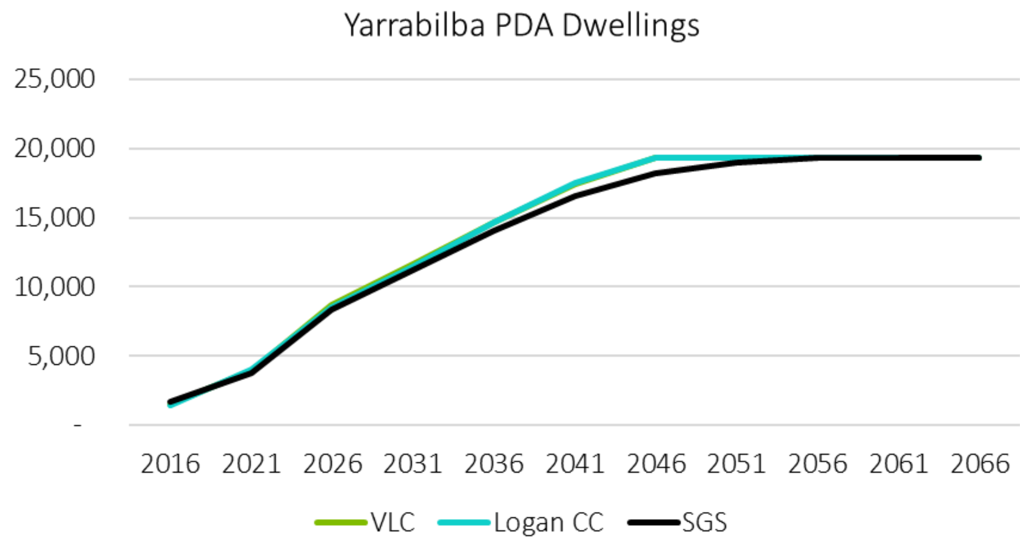
TABLE 14: YARRABILBA PDA DWELLING FORECASTS

Projection Source	2016	2041	2066	Growth 2016 – 2066
SGS	1,652	16,537	19,332	17,680
Logan City Council	1,450	17,492	19,318*	17,868*
VLC	1,525	17,407	19,332*	17,806*

Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling

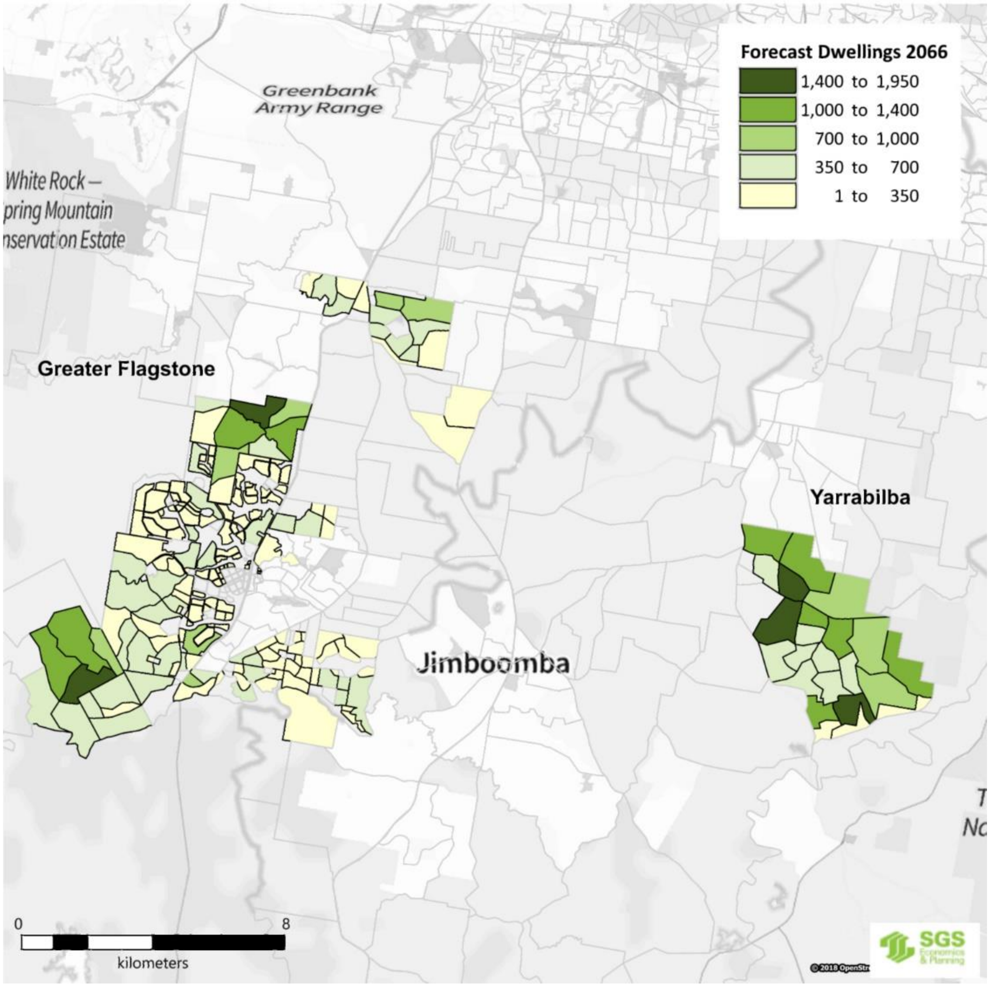
* Note: These are 2061 estimates

FIGURE 13: YARRABILBA PDA DWELLING FORECASTS



Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling

FIGURE 14: YARRABILBA PDA DWELLING FORECASTS 2066



Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling

4.2 Population

SGS Forecasts

SGS forecasts of population for Yarrabilba PDA are shown in Table 15. An estimated 52,800 residents are forecast for the PDA in 2066, based on an average household size of 2.7 persons per household. This aligns with Logan CC and VLC's forecasts of population.

As shown in Figure 15, SGS forecasts of population are slightly below the VLC and Logan CC forecasts up to 2051, in line with our dwelling forecast. Beyond 2051 SGS forecasts are in line with VLC and Logan CC as the PDA reaches full development.

SGS forecasts a decline in average household size, from 2.9 in 2016, to 2.7 from 2041 onwards. This trend is seen in older growth areas that have already developed. Average household size tends to be higher in the early development stages as families with children move in to detached dwellings. This is expected to decline in the longer term due to more apartments being built and changing age profiles, with more older people and less school aged people.

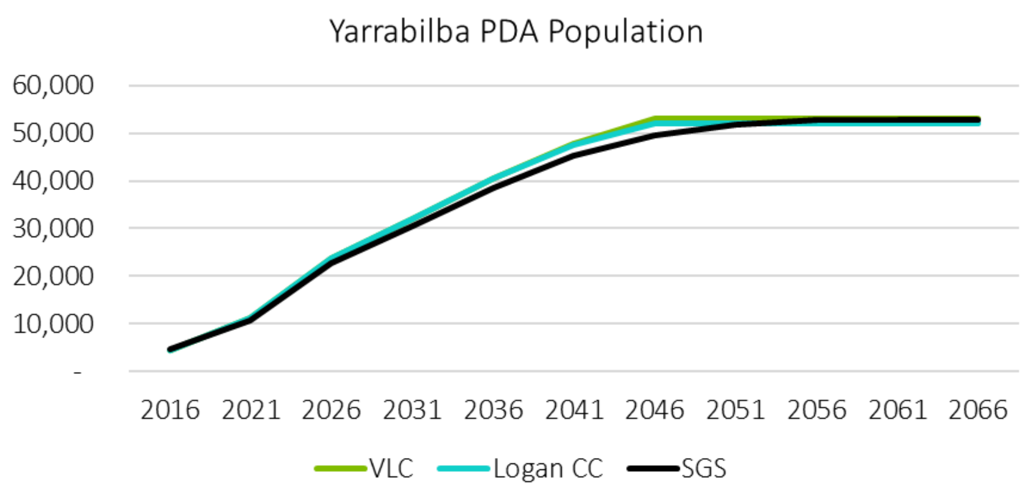
Yarrabilba's household size is still expected to remain slightly above the QLD average household size of 2.6 persons per household.

TABLE 15: YARRABILBA PDA POPULATION FORECASTS

Projection Source	2016	2041	2066	Growth 2016 – 2066
SGS	4,809	45,159	52,792	47,983
Avg household size	2.9	2.7	2.7	-0.2
Logan City Council	4,441	47,639	52,099*	47,658*
Avg household size	3.1	2.7	2.7	-0.4
VLC	4,441	47,709	53,086*	47,658*
Avg household size	3.1	2.7	2.7	-0.4

Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling
* Note These are 2061 estimates

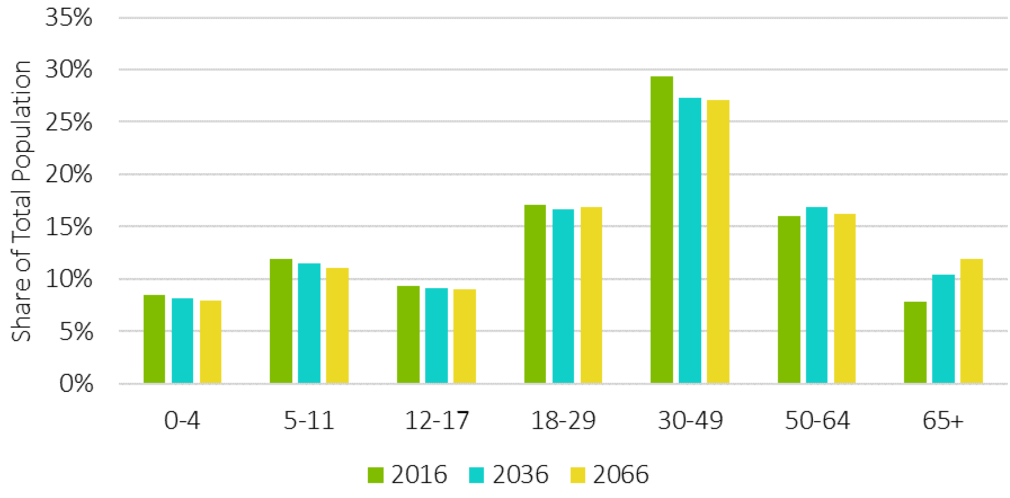
FIGURE 15: YARRABILBA PDA POPULATION FORECASTS



Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling

Population forecasts by age group have been prepared for Yarrabilba using the QGSO population by age forecasts for the SA2 in which it is located (Jimboomba SA2). It has been assumed that as the PDA develops there will be a changing age profile of residents. The proportion of older age people (50 to 64 and 65+) is forecast to increase in 2036 and 2066 (see Figure 16). This is in line with state-wide trends of an ageing population.

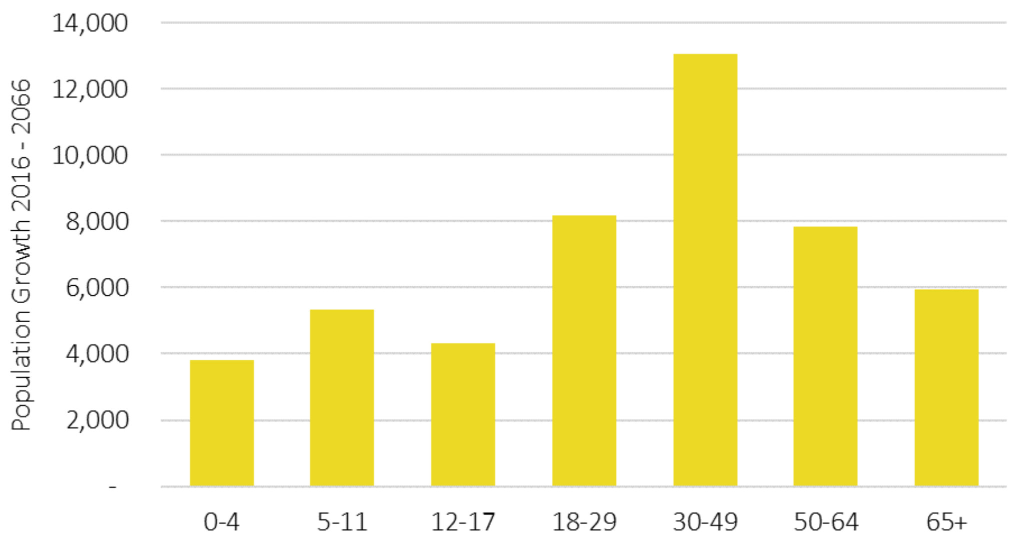
FIGURE 16: YARRABILBA PDA POPULATION BY AGE – SHARE OF AGE GROUP



Source: SGS Economics and Planning 2019, QGSO 2018

As shown in Figure 17, the number of primary school aged children (5-11 years) living in Yarrabilba is forecast to increase by 5,300 people to 2066. The number of secondary school aged children (12-17 years) is forecast to increase by 4,300 people to 2066. The largest amount of population growth is forecast for the 30-49 age group (13,000 additional residents).

FIGURE 17: YARRABILBA PDA POPULATION BY AGE – FORECAST GROWTH BY AGE GROUP



Source: SGS Economics and Planning 2019

There is of course a high degree of uncertainty regarding the future age breakdown of the PDA. This is particularly the case for school aged children. The size of this age group clearly has implications for future school provision. Looking at the existing shares of school aged children for SA2 across Greater Brisbane provides an indication of a possible future range for the PDA (using 2016 ABS Census data).

For children aged 5-11 years, the percentage can be as high as 13 per cent (for example the North Lakes - Mango Hill SA2 is 13.1 per cent). Other SA2 with a similar percentage of children aged 5-11 include the Redbank Plains SA2 (13.5 per cent), Narangba SA2 (13.2%) and Goodna (12.7%). On average, 9.3 per cent of the population across Greater Brisbane were aged 5 to 11 years (in 2016).

Applying this 13 per cent to the PDA projections provides an indication of a future with a very high percentage of primary school aged children. Table 16 compares the baseline forecast of primary school aged children in Yarrabilba PDA (aged 5 to 11 years), with a high scenario forecast.

TABLE 16: PRIMARY SCHOOL AGED CHILDREN – HIGH SCENARIO, YARRABILBA PDA

Population aged 5-11 years	2016	2026	2036	2046	2056	2066	Growth 2016-66
Baseline Forecast	571	2,314	3,758	5,483	5,833	5,833	5,262
Share of total population	12%	11%	11%	11%	11%	11%	
High scenario	571	2,422	4,421	5,955	6,335	6,335	5,764
Share of total population	12%	12%	13%	12%	12%	12%	

Source: SGS Economics and Planning based on ABS Census data 2016

For secondary school children, the current (2016) percentage of the population aged 12-17 years can be as high as 10 per cent (for example the Marsden and Crestmead SA2 are 10.1 per cent). Other SA2 with a similar percentage of children aged 12-17 years include the North Lakes – Mango Hill SA (9.3 per cent), Goodna SA2 (9.2%) and Wakerley (9.2%). On average, 7.6 per cent of the population across Greater Brisbane were aged 12 to 17 years (in 2016).

Applying this 10 per cent to the PDA projections in 2036 provides an indication of a future with a very high percentage of secondary school aged children. Table 17 compares the baseline forecast of secondary school aged children in Yarrabilba PDA (aged 12 to 17 years), with a high scenario forecast.

TABLE 17: SECONADRY SCHOOL AGED CHILDREN – HIGH SCENARIO, YARRABILBA PDA

Population aged 12-17 years	2016	2026	2036	2046	2056	2066	Growth 2016-66
Baseline Forecast	450	1,829	3,047	4,446	4,730	4,730	4,280
Share of total population	9%	9%	9%	9%	9%	9%	
High scenario	450	1,816	3,401	4,466	4,751	4,751	4,301
Share of total population	9%	9%	10%	9%	9%	9%	

Source: SGS Economics and Planning based on ABS Census data 2016

4.3 Employment

Total employment has been forecast for Yarrabilba PDA. SGS has compared previous forecasts prepared by Logan CC and VLC, along with our own analysis of population serving employment trends in new growth areas.

SGS forecasts total employment in Yarrabilba PDA to reach 11,200 jobs by 2041, and 13,000 jobs by 2066 (ultimate development). This represents 0.7 additional jobs per additional household in Yarrabilba.

By 2066 it is expected that 5 per cent of jobs in Logan LGA will be located in Yarrabilba. The majority of these jobs are expected to be population serving industries including retail, accommodation and food services, health, education and construction.

SGS forecasts are slightly lower than VLC and Logan CC forecasts due to the different method used by SGS. SGS employment forecasts are linked to the population growth which is also lower than VLC and Logan CC.

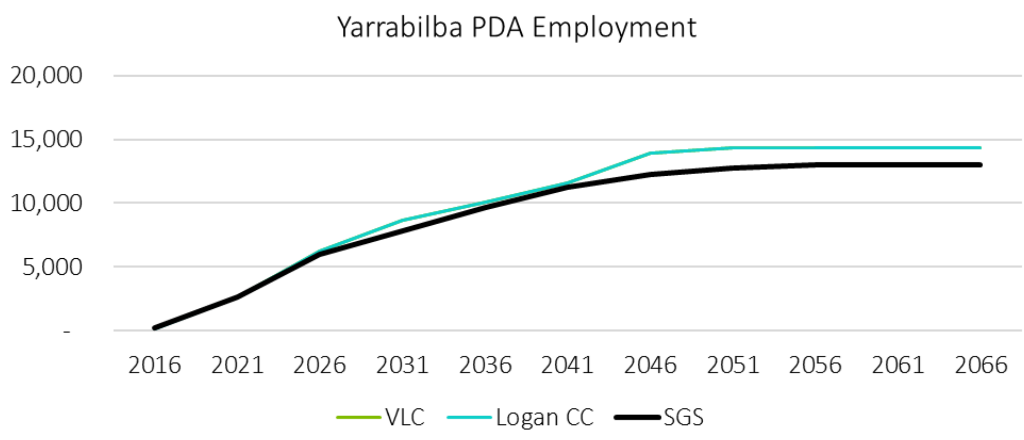
It has been assumed that the majority of Yarrabilba PDA will be developed by Lend Lease, therefore developer area breakdowns are not provided.

TABLE 18: YARRABILBA PDA EMPLOYMENT FORECASTS

Projection Source	2016	2041	2066	Growth 2016 – 2066
SGS	188	11,242	13,028	12,840
Logan City Council	99	11,560	14,373	14,275
VLC	188	11,560	14,373	14,186

Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling

FIGURE 18: YARRABILBA PDA EMPLOYMENT FORECASTS



Source: SGS Economics and Planning 2019, Logan City Council, VLC Transport Modelling

5. RIPLEY VALLEY

This chapter provides a comparison of existing forecasts produced for Ripley Valley and SGS' forecasts for this PDA.

5.1 Dwellings

Total occupied private dwellings have been forecast for Ripley Valley, and each of the developer areas within the PDA. The following section compares previous forecasts prepared by Ipswich City Council (ICC) and Jacobs, along with our own analysis of developer feedback data and recent development trends in the region.

Comparison of existing forecasts

Table 19 below highlights the variation in dwelling forecasts for the City of Ipswich between the State Government ShapingSEQ and the Queensland Government Statistician's Office's (QGSO) 2018 projections. Whilst 2016 estimates are in line, the growth forecast for the LGA varies dramatically between the two sources in 2041. The QGSO projections are based on more recently released ABS Census data and suggest a greater level of growth forecast.

TABLE 19: IPSWICH LOCAL GOVERNMENT AREA DWELLING FORECASTS

Projection Source	2016	2041	Growth 2016 – 2041
Shaping SEQ	72,092	183,792	111,700
QGSO 2018 Projections	72,090	218,102	146,012

Source: Shaping SEQ, Ipswich City Council, QGSO Projections 2018

Feedback was received from a number of developers in Ripley Valley on their realistic and aspirational dwelling yields per year to 2031. The realistic dwelling yield figures provided by developers have been revised in consultation with EDQ and are as summarised in Table 20 below. Annual dwelling yield is expected to be between 25 and 259 dwellings per year across the developer areas. This information has been used to inform SGS' dwelling forecasts, specifically the timing and location of dwelling growth to 2031.

Aspirational dwelling figures information was provided by developers in Ripley Valley to provide alternative dwelling forecasts for the developer areas. In an effort to provide a conservative estimate, these figures have not been used to inform SGS' dwelling forecasts.

TABLE 20: RIPLEY VALLEY – EXPECTED DWELLINGS IN 2031

Developer Area	Realistic 2031 Dwellings	Realistic Dwellings per year	Aspirational 2031 Dwellings	Aspirational Dwellings per year
Intrapac	1034	94	1,352	123
Okeland Communities	4419	259	4,495	295
Satterley Property Group	740	56	804	63
South Ripley Developments	262	25	642	58
Stocklands	1,270	127	1,420	129
Totals	**7,725**	**561**	**8,713**	**668**

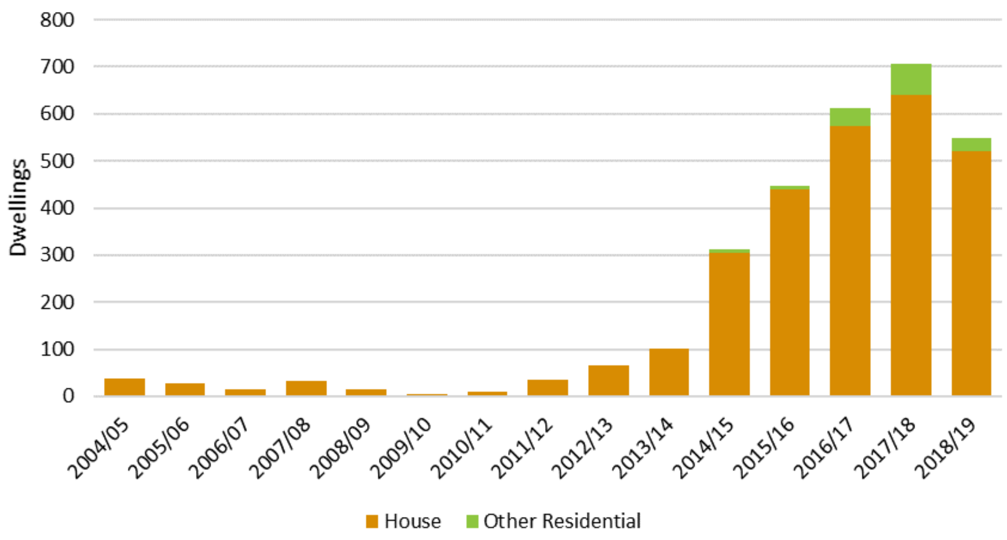
Source: SGS and developer feedback, 2019

The following chart shows recent building approvals for Ripley SA2, representing a slightly larger area than the Ripley Valley PDA. Recent data shows that between 600 to 700 dwellings have been approved per year.

Ripley Valley has an ultimate dwelling yield of about 50,000 dwellings and is located on the western edge of the Brisbane urban extent. Relative to other PDAs in SEQ it is quite well connected to employment, transport and parkland.

This data on recent building approvals has been used to estimate the total number of dwellings in Ripley Valley from 2016 to 2019.

FIGURE 19: RECENT BUILDING APPROVALS – RIPLEY VALLEY (SA2)



Source: ABS Dwellings Approvals 2018/19

Note: 2018/19 is not a full year of data

SGS forecasts

Table 21 shows the dwelling forecasts for the Ripley Valley PDA prepared by SGS, compared to those prepared by ICC and Jacobs. SGS forecasts total dwellings in Ripley Valley PDA to reach 50,000 dwellings at ultimate development in 2051. This is broadly in line with ICC and Jacobs forecasts of ultimate development, however SGS expects this ultimate dwellings estimate to be reached later than 2046.

SGS forecasts in 2046 are lower than Jacobs and ICC forecasts due to the different datasets and assumptions used by SGS. As shown in Figure 20, SGS forecasts are below the Jacobs and

ICC forecasts up to 2046, due to the use of recent dwelling approvals, new lot approvals and developer feedback data.

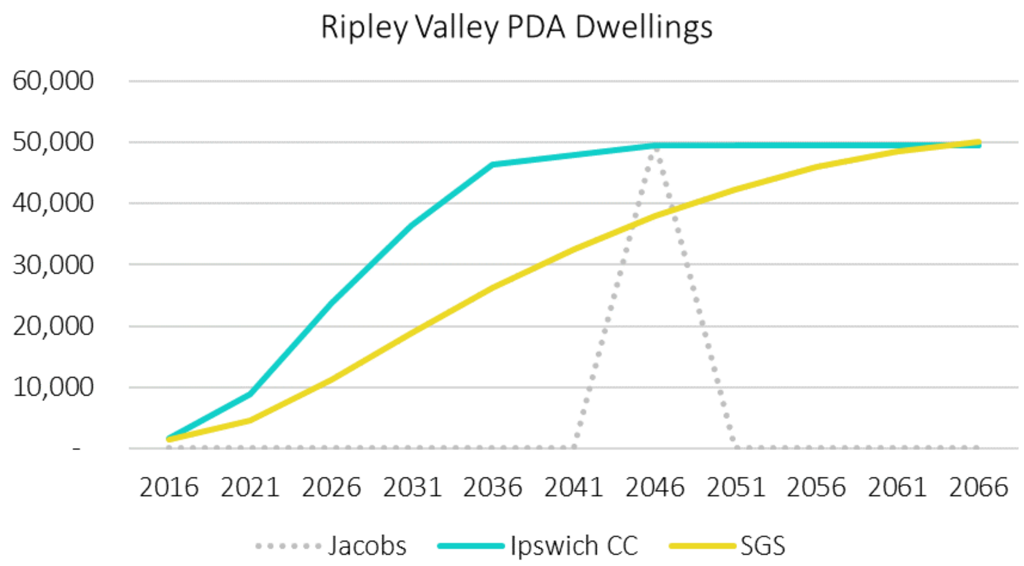
These forecasts assume that major infrastructure would have been provided and a number of sub-precincts would have been planned and activated by 2066.

TABLE 21: RIPLEY VALLEY PDA DWELLING FORECASTS

Projection Source	2016	2046	2066	Growth 2016 – 2061
SGS	1,444	37,971	50,000	48,556
Ipswich City Council	1,555	49,453	49,453	47,898
Jacobs	NA	50,004	NA	NA

Source: SGS Economics and Planning 2019, Ipswich City Council, Jacobs Transport Modelling

FIGURE 20: RIPLEY VALLEY PDA DWELLING FORECASTS



Source: SGS Economics and Planning 2019, Ipswich City Council, VLC Transport Modelling

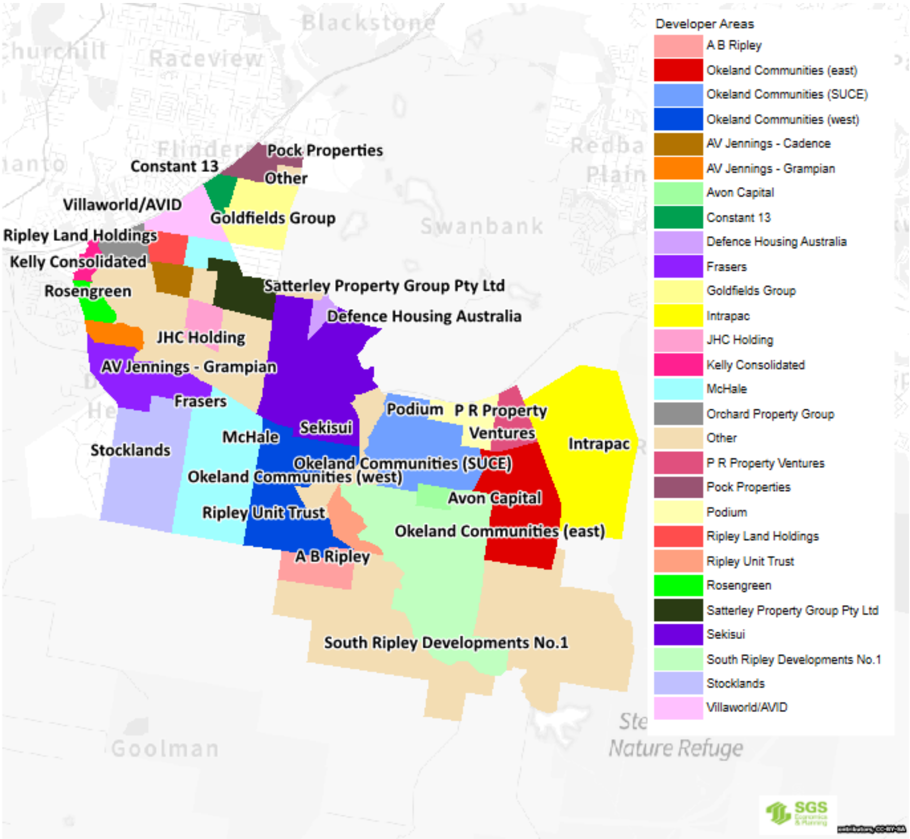
Table 22 presents SGS' forecasts of dwellings by developer area within the Ripley Valley PDA. Areas with the largest forecast dwellings include Okeland Communities, Sekisui, Intrapac, South Ripley Developments, McHale and Stocklands. These forecasts have been informed by the developer feedback provided by a number of developers on their realistic and aspirational dwelling yields to 2031, as well as information provided by EDQ on approved lots.

TABLE 22: RIPLEY VALLEY PDA DWELLING FORECASTS BY DEVELOPER AREA

Developer Area	2016	2046	2066	Growth 2016 – 2061
Intrapac	-	2,289	2,289	2,289
A B Ripley	1	190	190	189
Okeland Communities (east)	1	1,586	1,761	1,760
Okeland Communities (SUCE)	624	2,720	2,720	2,096
Okeland Communities (west)	-	1,585	1,760	1,760
AV Jennings - Cadence	-	303	303	303
AV Jennings - Grampian	1	178	178	177
Avon Capital	1	369	369	368
Pock Properties	1	137	137	136
Constant 13	-	86	86	86
Defence Housing Australia	1	370	370	369
Frasers	1	970	970	969
Goldfields Group	1	1,125	1,125	1,124
Villaworld/AVID	-	600	600	600
JHC Holding	3	316	316	313
Orchard Property Group - Kelly	1	63	63	62
McHale - Monterea	-	543	543	543
McHale - South	1	1,800	2,677	2,676
Other	55	7,442	13,860	13,805
Orchard Property Group - Daleys	-	426	426	426
Podium	1	450	450	449
Ripley Land Holdings	1	437	437	436
Ripley Unit Trust	1	294	294	293
Rosengreen	1	102	102	101
Satterley Property Group Pty Ltd	1	1,050	1,050	1,049
Sekisui	734	8,158	12,012	11,277
South Ripley Developments No.1	12	2,362	2,812	2,800
Stocklands	1	2,020	2,100	2,099
Total	**1,444**	**37,971**	**50,000**	**48,556**

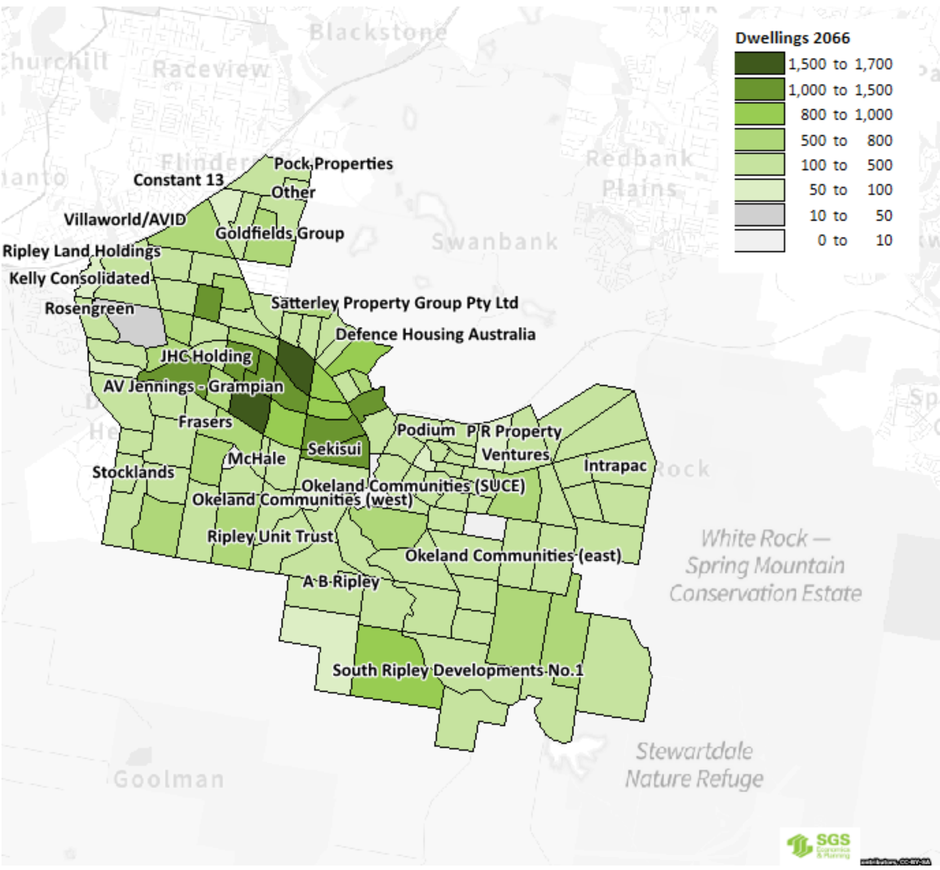
Source: SGS Economics and Planning 2019

FIGURE 21: RIPLEY VALLEY PDA DEVERLOPER AREAS



Source: DSDMIP Economic Development Queensland

FIGURE 22: RIPLEY VALLEY PDA DWELLING FORECASTS 2066



5.2 Population

Comparison of existing forecasts

Table 23 below highlights the variation in population forecasts for the City of Ipswich between the State Government ShapingSEQ and Queensland Government Statistician's Office 2018 projections. While values are similar in 2016, there is considerable variation in forecasts for 2041. QGSO are projecting more people in the Ipswich LGA by 2041 (i.e. a faster rate of population growth).

TABLE 23: IPSWICH LOCAL GOVERNMENT AREA POPULATION FORECASTS

Projection Source	2016	2041	Growth 2016 – 2041	Average household size 2016	Average household size 2041
Shaping SEQ	200,100	520,000	319,900	2.8	2.8
QGSO 2018 Projections	200,123	557,649	357,526	2.8	2.6

Source: Shaping SEQ, Ipswich City Council, Jacobs Transport Modelling, QGSO Forecasts 2018

SGS Forecasts

SGS forecasts of population for Ripley Valley PDA are shown in Table 24. An estimated 135,000 residents are forecast for the PDA in 2066, based on an average household size of 2.7 persons per household. This is slightly higher than ICC and Jacobs forecasts of population as a result of the higher average household size that has been used.

As shown in Figure 23, SGS forecasts of population are below the Jacobs and ICC forecasts up to 2046, in line with our dwelling forecast. Beyond 2046 SGS forecasts are higher than Jacobs and ICC as a result of the higher average household size. The ICC population forecast appears to be based on historical average household size for the PDA area, which reflects a rural residential population (with less people per household) rather than a greenfield development area.

SGS forecasts a decline in average household size, from a high of 2.9 in 2016, to 2.7 by 2066. This trend is seen in older growth areas that have already developed. Average household size tends to be higher in the early development stages as families with children move in to detached dwellings. This is expected to decline in the longer term due to more apartments being built and changing age profiles, with more older people less school aged people.

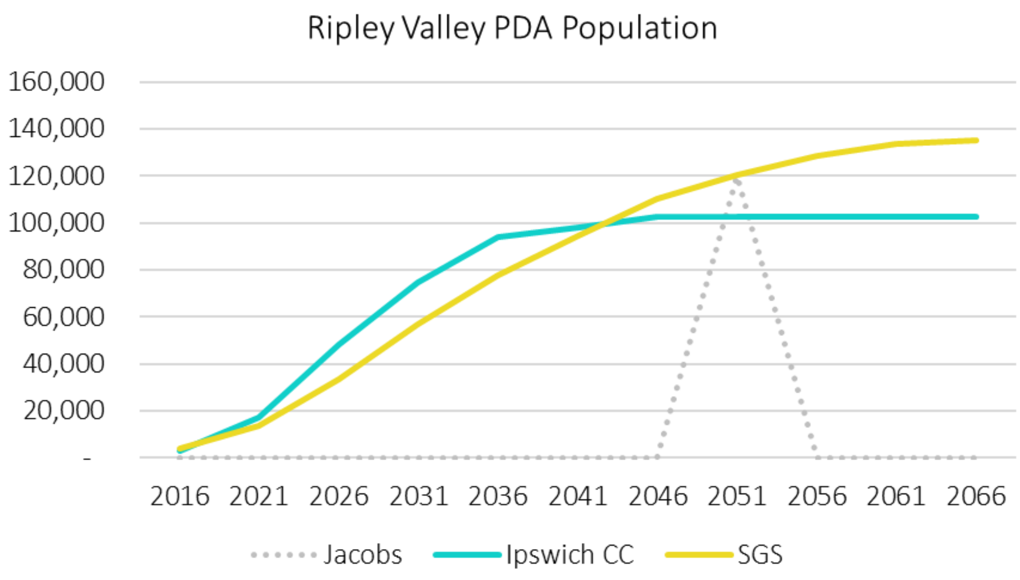
Ripley Valley household size is still expected to remain slightly above the QLD average household size of 2.6 persons per household.

TABLE 24: RIPLEY VALLEY PDA POPULATION FORECASTS

Projection Source	2016	2046	2066	Growth 2016 – 2066
SGS	4,188	110,116	135,001	130,813
Avg household size	2.9	2.9	2.7	
Ipswich City Council	2,857	102,546	102,546	99,689
Avg household size	1.8	2.1	2.1	
Jacobs	NA	120,002	NA	NA
Avg household size	NA	2.4	NA	NA

Source: SGS Economics and Planning 2019, Ipswich City Council, Jacobs Transport Modelling

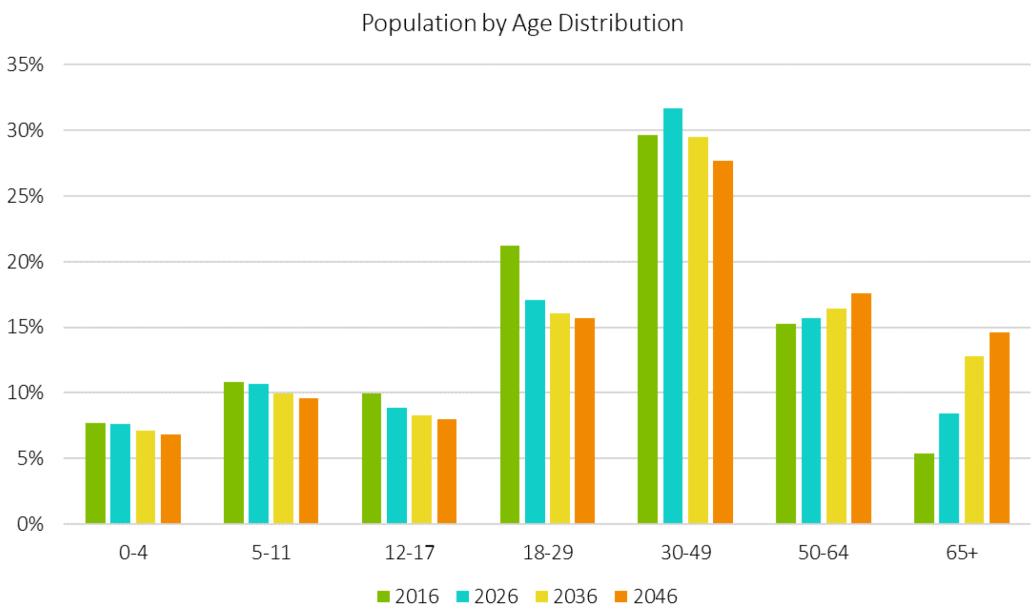
FIGURE 23: RIPLEY VALLEY PDA POPULATION FORECASTS



Source: SGS Economics and Planning 2019, Ipswich City Council, Jacobs Transport Modelling

Population forecasts by age group have been prepared for Ripley Valley using the QGSO population by age forecasts for the SA2 in which it is located (Ripley SA2). It has been assumed that as the PDA develops there will be a changing age profile of residents. The proportion of older age people (50 to 64 and 65+) is forecast to increase in 2036 and 2066 (see Figure 24). This is in line with state-wide trends of an ageing population.

FIGURE 24: RIPLEY VALLEY PDA POPULATION BY AGE – SHARE OF AGE GROUP

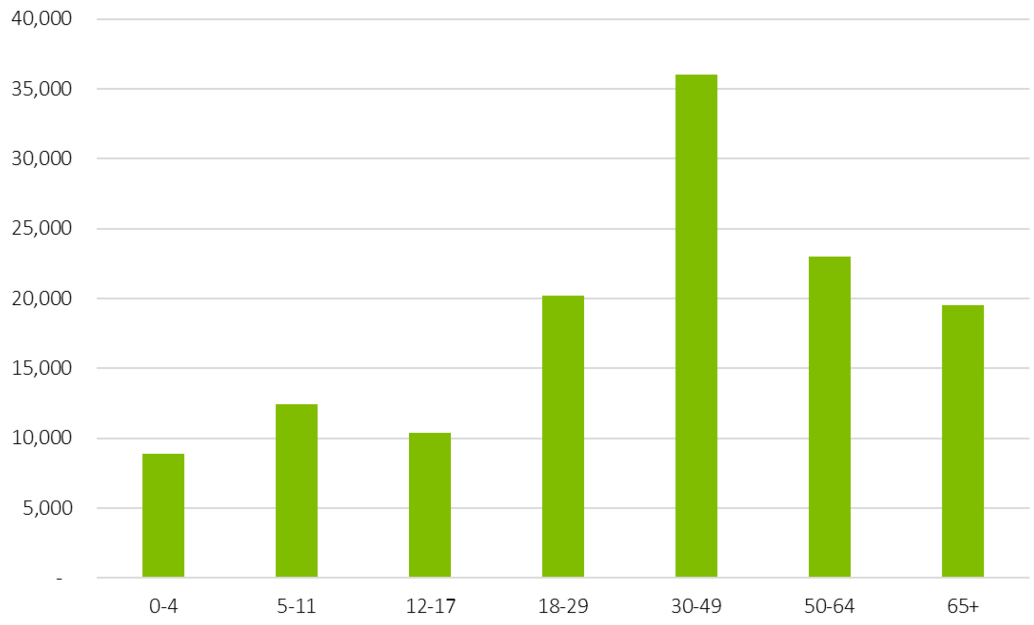


Source: SGS Economics and Planning 2019

As shown in Figure 25 below, the number of primary school aged children (5-11 years) living in Ripley Valley is forecast to increase by 12,400 people to 2066. The number of secondary school aged children (12-17 years) is forecast to increase by 10,400 people to 2066.

The largest amount of population growth is forecast for the 30-49 and 50-64 age group.

FIGURE 25: RIPLEY VALLEY PDA POPULATION BY AGE – FORECAST GROWTH BY AGE GROUP



Source: SGS Economics and Planning 2019

There is of course a high degree of uncertainty regarding the future age breakdown of the PDA. This is particularly the case for school aged children. The size of this age group clearly has implications for future school provision. Looking at the existing shares of school aged children for SA2 across Greater Brisbane provides an indication of a possible future range for the PDA (using 2016 ABS Census data).

For children aged 5-11 years, the percentage can be as high as 13 per cent (for example the North Lakes - Mango Hill SA2 is 13.1 per cent). Other SA2 with a similar percentage of children aged 5-11 include the Redbank Plains SA2 (13.5 per cent), Narangba SA2 (13.2%) and Goodna (12.7%). On average, 9.3 per cent of the population across Greater Brisbane were aged 5 to 11 years (in 2016).

Applying this 13 per cent to the PDA projections provides an indication of a future with a very high percentage of primary school aged children. Table 25 compares the baseline forecast of primary school aged children in Ripley Valley PDA (aged 5 to 11 years), with a high scenario forecast.

TABLE 25: PRIMARY SCHOOL AGED CHILDREN – HIGH SCENARIO, RIPLEY VALLEY PDA

Population aged 5-11 years	2016	2026	2036	2046	2056	2066	Growth 2016-66
Baseline Forecast	453	3,587	7,703	10,536	12,311	12,917	12,464
Share of total population	11%	11%	10%	10%	10%	10%	
High scenario	453	4,023	10,095	13,214	15,440	16,200	15,747
Share of total population	11%	12%	13%	12%	12%	12%	

Source: SGS Economics and Planning based on ABS Census data 2016

For secondary school children, the current (2016) percentage of the population aged 12-17 years can be as high as 10 per cent (for example the Marsden and Crestmead SA2 are 10.1 per cent). Other SA2 with a similar percentage of children aged 12-17 years include the North Lakes – Mango Hill SA (9.3 per cent), Goodna SA2 (9.2%) and Wakerley (9.2%). On average, 7.6 per cent of the population across Greater Brisbane were aged 12 to 17 years (in 2016).

Applying this 10 per cent to the PDA projections in 2036 provides an indication of a future with a very high percentage of secondary school aged children. Table 26 compares the baseline forecast of secondary school aged children in Ripley Valley PDA (aged 12 to 17 years), with a high scenario forecast.

TABLE 26: SECONADRY SCHOOL AGED CHILDREN – HIGH SCENARIO, RIPLEY VALLEY PDA

Population aged 12-17 years	2016	2026	2036	2046	2056	2066	Growth 2016-66
Baseline Forecast	416	2,966	6,414	8,837	10,325	10,834	10,418
Share of total population	10%	9%	8%	8%	8%	8%	
High scenario	416	3,352	7,765	9,910	11,580	12,150	11,734
Share of total population	10%	10%	10%	9%	9%	9%	

Source: SGS Economics and Planning based on ABS Census data 2016

5.3 Employment

SGS forecasts total employment in Ripley Valley PDA to reach 11,700 jobs by 2046, and 14,200 jobs by 2066 (ultimate development). This represents 0.3 additional jobs per additional household in Ripley Valley.

The majority of these jobs are expected to be population serving industries including retail, accommodation and food services, health, education and construction.

SGS forecasts are slightly higher than Jacobs and ICC forecasts due to the different method used by SGS. SGS employment forecasts are linked to the population growth which is also higher than Jacobs and Ipswich.

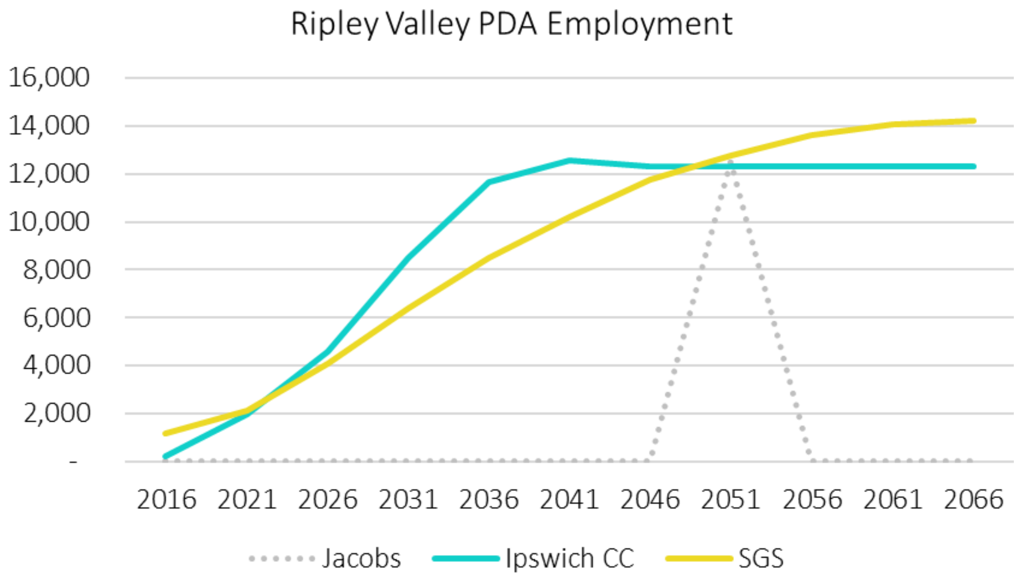
TABLE 27: RIPLEY VALLEY PDA EMPLOYMENT FORECASTS

Projection Source	2016	2046	2066	Growth 2016 – 2061
SGS	1,150	11,743	14,231	13,081
Ipswich City Council	218	12,541	NA	12,323*
Jacobs	NA	12,534	NA	NA

Source: SGS Economics and Planning 2019, Ipswich City Council, Jacobs Transport Modelling

Note: This is growth to 2046

FIGURE 26: RIPLEY VALLEY PDA EMPLOYMENT FORECASTS



Source: SGS Economics and Planning 2019, Ipswich City Council, Jacobs Transport Modelling

Table 28 presents SGS' forecasts of total employment by developer area within the Ripley Valley PDA. Areas with the largest forecast number of jobs include Sekisui and Okeland Communities (SUCE).

TABLE 28: RIPLEY VALLEY PDA EMPLOYMENT FORECASTS BY DEVELOPER AREA

Developer Area	2016	2046	2066	Growth 2016 – 2061
Intrapac	18	188	228	210
A B Ripley	-	-	-	-
Okeland Communities (east)	30	307	372	341
Okeland Communities (SUCE)	109	1,115	1,351	1,242
Okeland Communities (west)	37	381	462	425
AV Jennings - Cadence	4	46	55	51
AV Jennings - Grampian	4	46	55	51
Avon Capital	3	34	41	38
Pock Properties	5	50	60	56
Constant 13	0	0	0	0
Defence Housing Australia	1	14	17	16
Frasers	18	186	226	208
Goldfields Group	23	237	287	264
Villaworld/AVID	4	37	45	41
JHC Holding	7	67	81	74
Orchard Property Group - Kelly	5	50	60	56
McHale - Monterea	12	122	148	136
McHale - South	12	122	148	136
Other	119	1,217	1,475	1,356
Orchard Property Group - Daleys	28	290	351	323
Podium	4	45	55	50
Ripley Land Holdings	0	0	0	0
Ripley Unit Trust	-	-	-	-
Rosengreen	-	-	-	-
Satterley Property Group Pty Ltd	21	216	262	241
Sekisui	577	5,888	7,136	6,559
South Ripley Developments No.1	69	708	857	788
Stocklands	37	377	457	420
Total Ripley Valley	**1,150**	**11,743**	**14,231**	**13,081**

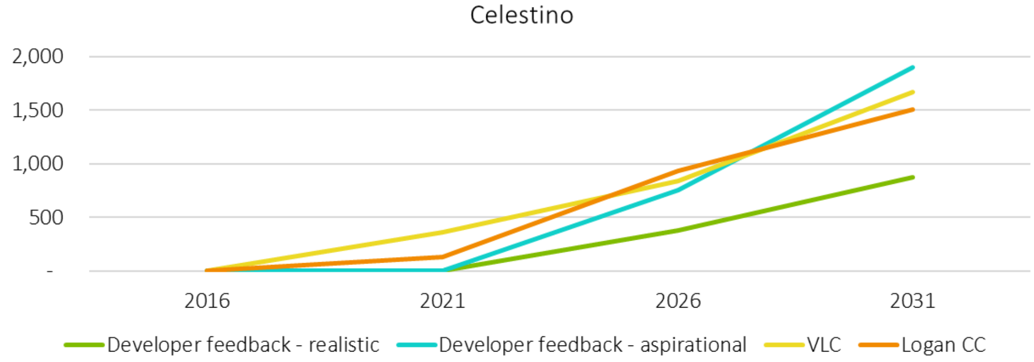
Source: SGS Economics and Planning 2019

APPENDICES

Appendix 1 – Greater Flagstone & Yarrabilba Developer Areas Comparison

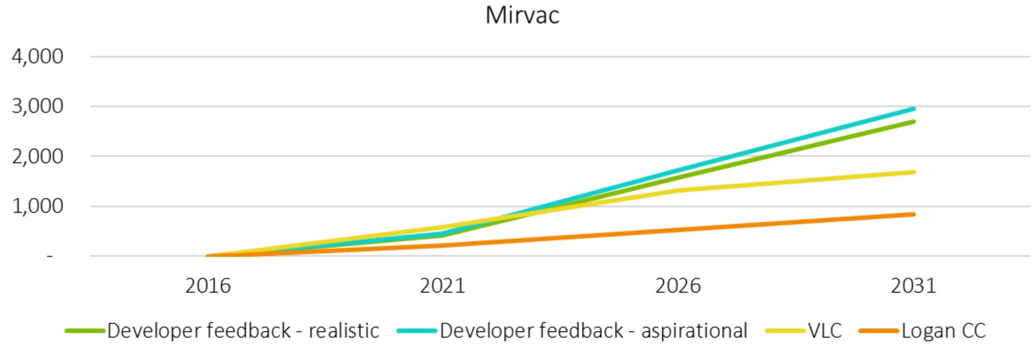
The following charts compare forecasts produced by Logan CC, VLC transport modelling and developer feedback (realistic and aspirational) for each developer area within Greater Flagstone PDA. Across all developer areas the aspirational developer feedback forecast is highest.

FIGURE 27: GREATER FLAGSTONE – CELESTINO DEVELOPER AREA FORECAST



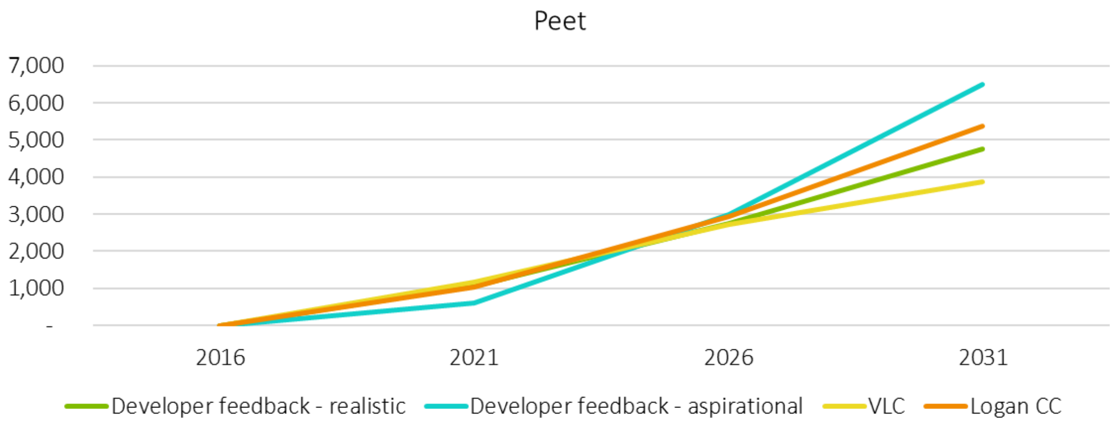
Source: Logan City Council, VLC Transport Modelling, Developer Feedback documentation

FIGURE 28: GREATER FLAGSTONE – MIRVAC DEVELOPER AREA FORECAST



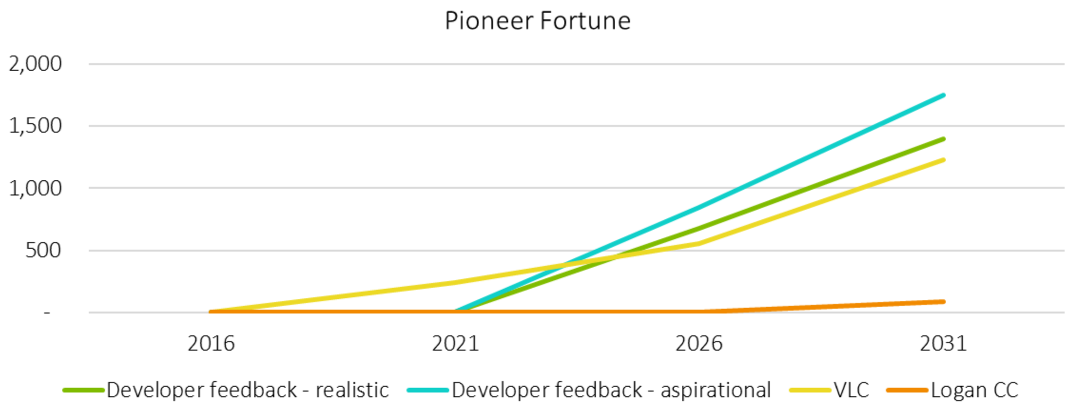
Source: Logan City Council, VLC Transport Modelling, Developer Feedback documentation

FIGURE 29: GREATER FLAGSTONE – PEET DEVELOPER AREA FORECAST



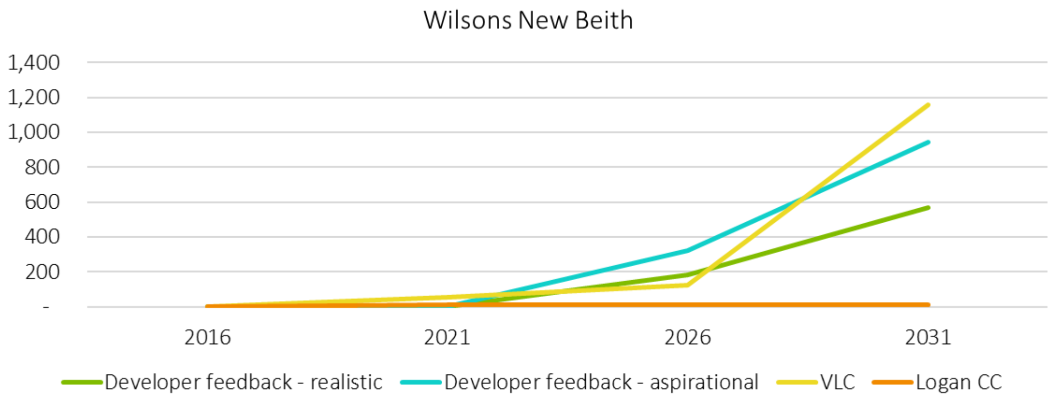
Source: Logan City Council, VLC Transport Modelling, Developer Feedback documentation

FIGURE 30: GREATER FLAGSTONE – PIONEER FORTUNE DEVELOPER AREA FORECAST



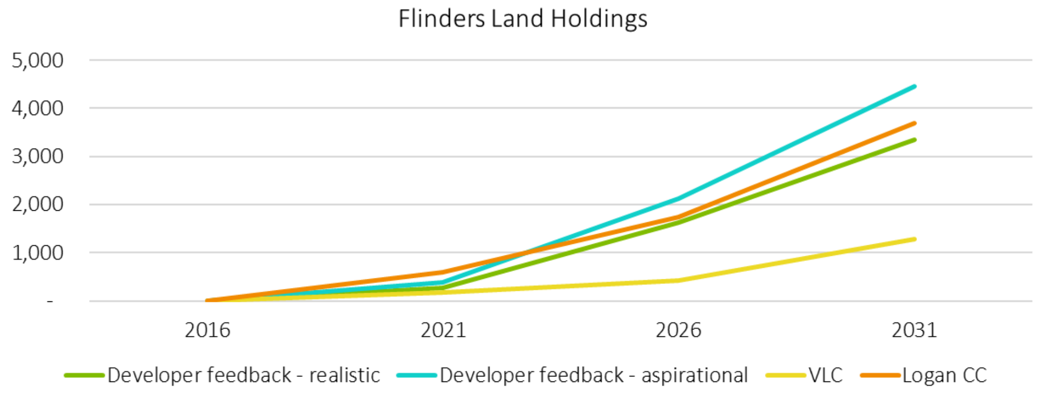
Source: Logan City Council, VLC Transport Modelling, Developer Feedback documentation

FIGURE 31: GREATER FLAGSTONE – WILSONS NEW BEITH DEVELOPER AREA FORECAST



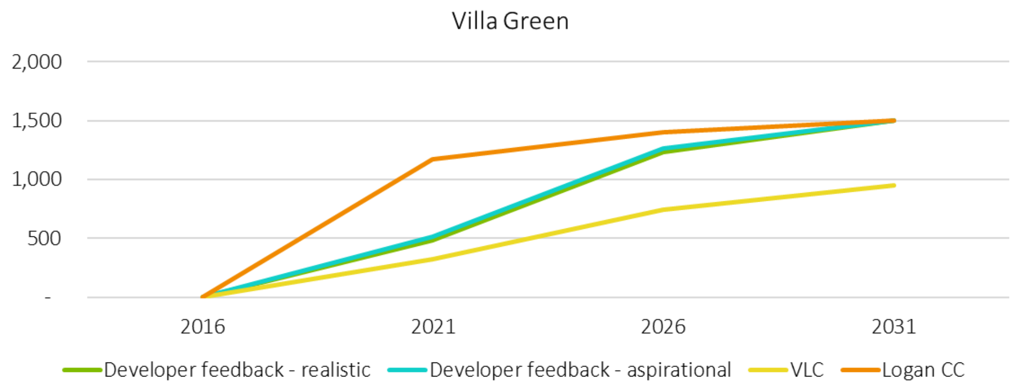
Source: Logan City Council, VLC Transport Modelling, Developer Feedback documentation

FIGURE 32: GREATER FLAGSTONE – FLINDERS LAND HOLDINGS DEVELOPER AREA FORECAST



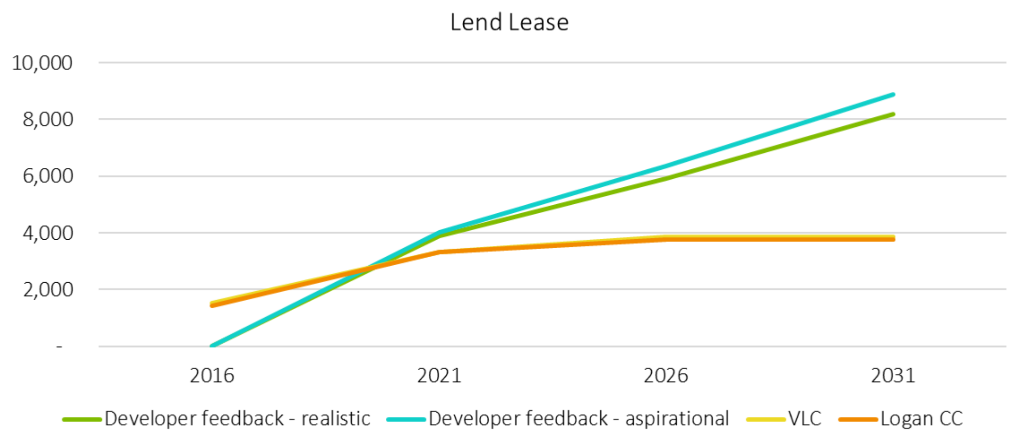
Source: Logan City Council, VLC Transport Modelling, Developer Feedback documentation

FIGURE 33: GREATER FLAGSTONE – VILLA GREEN DEVELOPER AREA FORECAST



Source: Logan City Council, VLC Transport Modelling, Developer Feedback documentation

FIGURE 34: YARRABILBA – LEND LEASE DEVELOPER AREA FORECAST

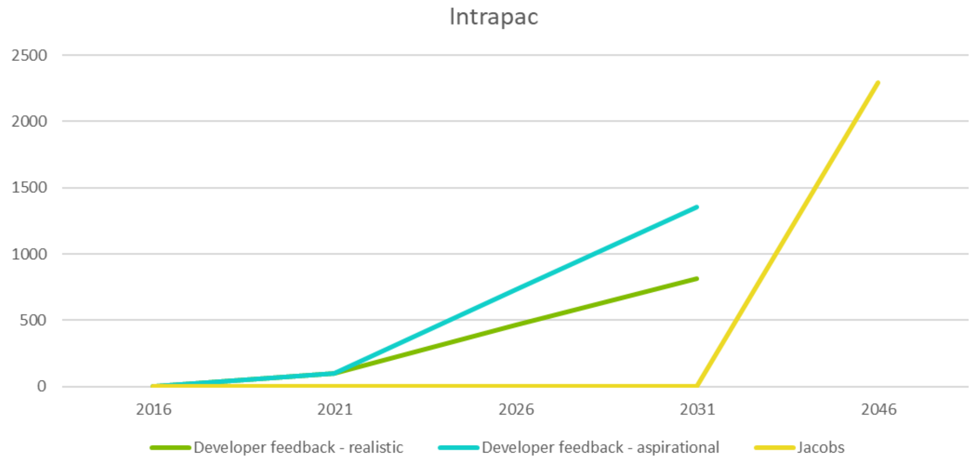


Source: Logan City Council, VLC Transport Modelling, Developer Feedback documentation

Appendix 2 – Ripley Valley Developer Areas Comparison

The following charts compare forecasts produced by Ipswich CC, Jacobs and developer feedback (realistic and aspirational), where available, within Ripley Valley PDA. Dwelling projections by Jacobs are limited to 2046, and dwelling projections by Ipswich are not available for areas owned by Intrapac and Stocklands. Across all developer areas the aspirational developer feedback forecast is highest.

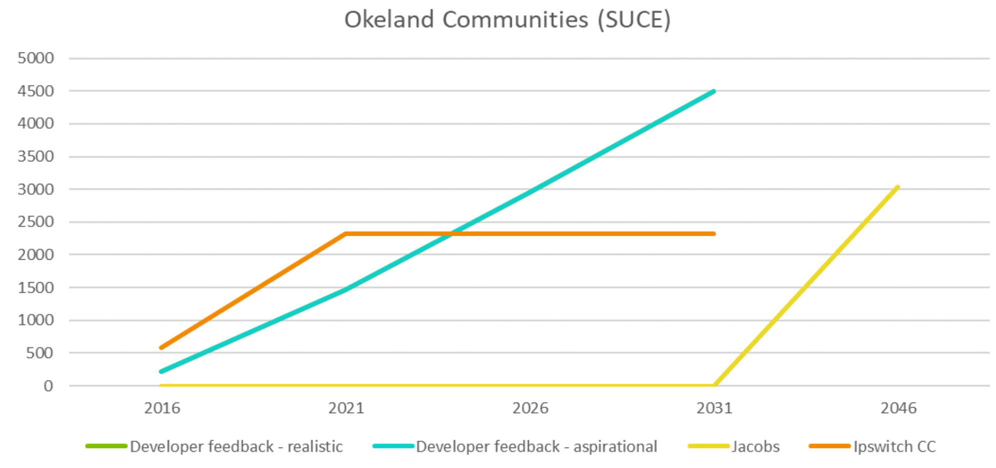
FIGURE 35: RIPLEY VALLEY – INTRAPAC DEVELOPER AREA FORECAST



Source: Jacobs and Developer Feedback documentation

Note: Ipswich City Council dwelling projections for Intrapac developer area were not available

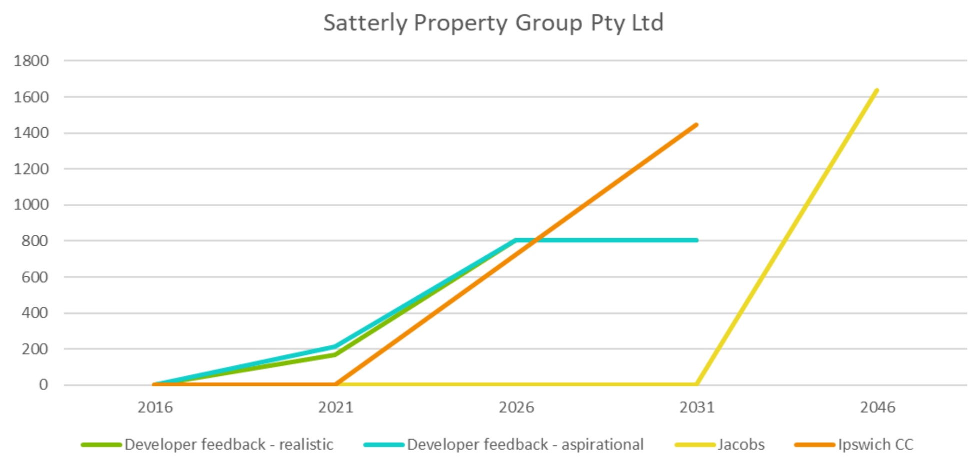
FIGURE 36: RIPLEY VALLEY – OKELAND COMMUNITIES (SUCE) DEVELOPER AREA FORECAST



Source: Ipswich City Council, Jacobs, Developer Feedback documentation

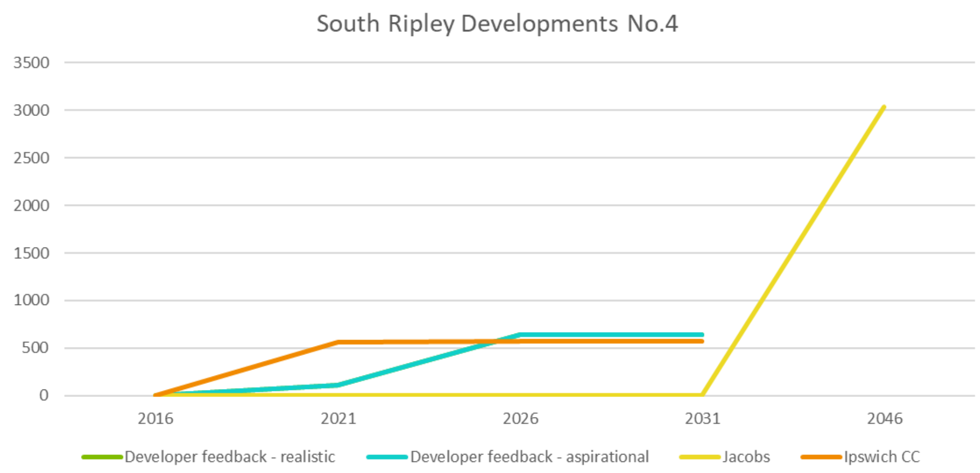
Note: there is no variation between the realistic and aspirational developer feedback dwelling projections

FIGURE 37: RIPLEY VALLEY – SATTERLY PROPERTY GROUP PTY LTD DEVELOPER AREA FORECAST



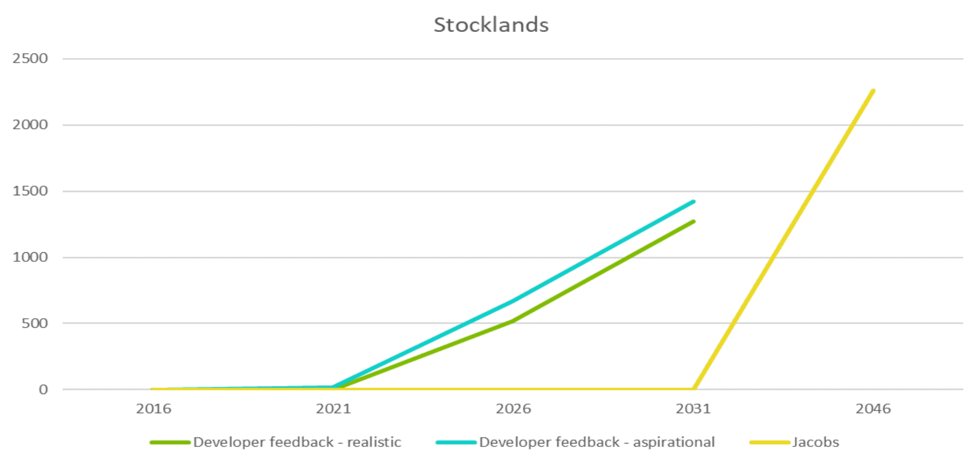
Source: Ipswich City Council, Jacobs, Developer Feedback documentation

FIGURE 38: RIPLEY VALLEY – SOUTH RIPLEY DEVELOPMENTS NO.4 DEVELOPER AREA FORECAST



Source: Ipswich City Council, Jacobs, Developer Feedback documentation
Note: there is no variation between the realistic and aspirational developer feedback dwelling projections

FIGURE 39: RIPLEY VALLEY – STOCKLANDS DEVELOPER AREA FORECAST



Source: Ipswich City Council, Jacobs, Developer Feedback documentation
Note: Ipswich City Council dwelling projections for Stocklands developer area were not available

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