APPENDIX B: TECHNICAL MEMO - SERVICING SANITARY SERVICING PLAN - DRAFT

APPENDIX B: TECHNICAL MEMO – SANITARY SERVICING PLAN

1.0 Overview

The City of Brandon (City) is establishing an Industrial Secondary Plan for the East Brandon Industrial Area. The purpose of the Plan is to describe in detail a land use framework for the development and servicing of the Brandon industrial lands.

To assist in the Industrial Secondary Plan a draft **sanitary servicing plan** has been prepared and is detailed in the memorandum.

The **sanitary servicing plan** includes:

- Review available background information, GIS mapping, reports, studies on the existing sanitary services and treatment in the industrial area.
- Consultation with the City on preferences, history, constraints and strategies related to the sanitary servicing in the area.
- Consultation with industry working group to create land use concept and servicing strategies for industrial areas.
- Review servicing methodologies (pressure sewer, gravity sewer, lift station, local storage and treatment/ pre-treatment).
- Review water re-use opportunities from the wastewater effluent.
- Develop servicing options with conceptual layouts for the growth nodes and corridors.

- Develop costing to assist in implementation planning.
- Develop implementation/ staging options for the plan timeframes (0-2, 3-10, 11+ years).
- Prepare functional servicing plans for short (0-2 year) and medium (3-10 year) term improvements.
- Consultation with the City throughout for feedback.

2.0 Background Information

For the **sanitary servicing plan** the following background information was reviewed:

2.1 GIS Mapping

Lidar and GIS data layers were obtained from the City to support the work. In addition, the City of Brandon Cobra Reference Atlas was used to review and detail existing infrastructure in the study area and surrounding areas that affect potential servicing.

2.2 Reports and Studies

The following reports and studies were reviewed:

- City of Brandon, Water Utility Master Plan – Final Report (AECOM) – October 2015.
- City of Brandon, Industrial Land Development Forecast (East Brandon Industrial Area) – Report (RW Consulting) – February 2016.
- City of Brandon Standard Construction Specifications.

- City of Brandon, Land Drainage Infrastructure Capital Improvement Plan Report (Draft) – March 2017.
- City of Winnipeg, Water Demand Estimation and Design Guidelines (http://www.winnipeg.ca/waterandwaste/dept/waterdemand.stm).
- City of Winnipeg, Wastewater Flow Estimation and Servicing Guidelines (http://www.winnipeg.ca/waterandwaste/dept/wastewaterFlow.stm).

3.0 Consultation

3.1 Consultation with the City of Brandon

Consultation with the City's Engineering Department is ongoing in terms of assisting in the development of the **sanitary servicing plan**. This includes initial review of area constraints, existing services, future capital projects and discussion servicing preferences. It is expected that additional consultation will be required to confirm flow estimates and assumptions, conceptual alignment, implementing and staging options.

3.2 Consultation with the Industry Working Group / Stakeholders

A Public and Stakeholder Brainstorming Session was held on October 5, 2017. At this event, an initial land use concept plan and sanitary servicing strategy was reviewed in groups. Stakeholders confirmed the assumption that the lack of sanitary servicing in the area was an impediment to further development.

4.0 Sanitary Level of Service

The City is in the process of developing sanitary levels of service. Until this is available, a comparable guideline (City of Winnipeg) will be used for the **sanitary plan** for initial discussion.

4.1 Wastewater Flow Estimation and Servicing Guidelines

(To be confirmed by the City's Engineering Department)

Wastewater	Average Dry Weather Flow (ADWF) L/ha/day	Peak Dry Weather Flow (PDWF) L/ha/day	Extraneous Flow Contributions L/ha/day	Peak Wet Weather Flow (PWWF) L/ha/day
	Daily average wastewater flows	ADWF x peaking factor	Ground water infiltration	PDWF + extraneous flows
Commercial	16,800	28,100	2,200	30,300
Light Industrial	22,500	37,600	2,200	70,100
Wet Industrial	33,600	44,900	2,200	47,100

4.2 Wastewater Design Guidelines: Public Right-of-Way

Wastewater sewers must be designed:

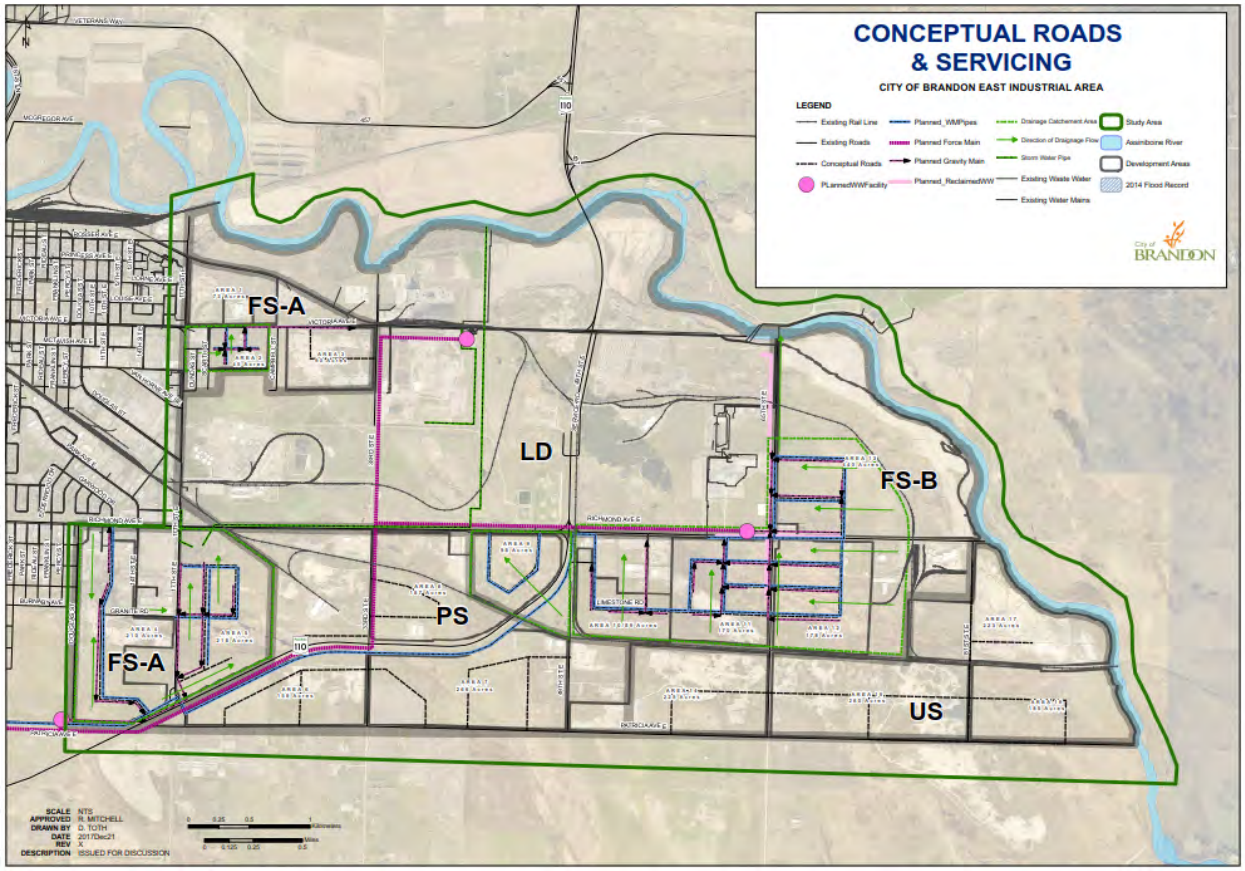
- To prevent surcharging under peak flow conditions, with a minimum full flowing velocity of 0.6 m/s, using a roughness co-efficient (n) of 0.013.
- The minimum wastewater sewer size is ø250 mm.
- Wastewater manhole spacing on common sewers cannot exceed 150 m.
- Wastewater manholes should be a minimum of 1 m off property lines.
- All newly constructed sewers must be separate sewers, even in existing combined sewer districts.
- All wastewater sewers, appurtenances, and service connections must be constructed in accordance with the latest revision of the City of Brandon Standard Construction Specifications.

4.2.1 Wastewater Servicing Guidelines: Private Services

- The minimum wastewater service size is 150 mm.
- Wastewater service connections are not permitted to connect directly into manholes.
- Land drainage service connections may not connect into the wastewater collection system.
- Sump pump discharge lines must be directed onto private property and not into the wastewater sewer system.
- Roof drain downspout discharges must be directed onto private property and not into the wastewater sewer.

5.0 Servicing Methodology

The land use concepts developed to date are based on concentrating future development in several key areas as identified in the Land Use Intensity and Servicing Levels Plan.



Within the Plan, land use designations define the level of servicing, as outlined below.

Land Use Designation	Area	Level of Servicing
Full Service Area (FS)	FS-A – Victoria Avenue Industrial Node Areas 1, 2, 3	• Intended for lighter to general industry - No hazardous uses • Anticipate mix of industrial and office/commercial/services, compatible recreation • Business park environment – higher standards for design/landscaping, in particular at gateway intersections and other areas of high visibility • Some building design standards, prohibition against manufactured structures for housing principal uses • Higher standard of site development, landscaping, fenced and paved parking in front of buildings, outside storage behind buildings and screened, etc. • Small to medium lot sizes • Commercial uses servicing workers and businesses • No need for rail spurs, although possibility for larger-lot FSA to the west • Municipal Water – no heavy water users • Municipal Sewer – standard effluent • Fire Protection • Paved roads • Surface LDS in roadway ditching in Victoria and Richmond industrial areas with limited on-site storage using parking lots and roof-tops, lots typically too small for internal catch basins and leads to street LDS • Larger FSA sites to west will require on-site storage, parking lots and ponds, with controlled release to street ditches via pipes or swales. TBD • Hydro service, user dependent, standard industrial service in Vic and Richmond industrial areas • Natural gas • Fibre-optic
	FS-A – Richmond Park Industrial Node Areas 4, 5	

Land Use Designation	Area	Level of Servicing
	FS-B – PTH #110 Industrial Node Areas 9, 10	• Intended for General to Heavy Industry – Hazardous uses accommodated • No commercial uses
	FS-B – Richmond East Industrial Node Areas 11, 12, 13	• Intended for General Industry including hazardous-potential uses • No commercial uses • Limited site landscaping and design standards • Larger lot sizes • Rail access, multi-modal potential • Municipal water • Private sewage disposal (Provincial OWMS regulations apply) • Fire Protection (standard where hydrants are available, may require private augmentation) • Paved roads • Land drainage, road ditches, on-site storage • Hydro, user dependent • Natural Gas • Fibre optic
Partially Serviced Area (PS)	PS – Partially Serviced Area Areas 6, 7, 8	
Limited Development Area (LD)	LD – Limited Development Area	• Future development not anticipated beyond current uses – status quo • No services anticipated, but owner dependent • Land retained for plant buffering • Environmental constraints (wetland area)

Land Use Designation	Area	Level of Servicing
Unserviced Area (US)	US – Unserviced Area Areas 14,15,16	• Intended for future general or heavy industrial • Large lot sizes • Rail accessible • Private water supply, trucked with cisterns • Private sewage disposal (septic tanks and fields, subject to provincial OWMS regulations) • Fire Protection – no hydrants • Roads – gravel, ditches • Land drainage – on-site management • Hydro user-dependent • Natural gas, user dependent • Telecommunications, wired

6.0 Sanitary Flow Estimation Analysis

The table below summarizes the sanitary flow assumptions for the identified areas. The flows will require review by the City's Engineering Department with respect to estimated values and levels of service.

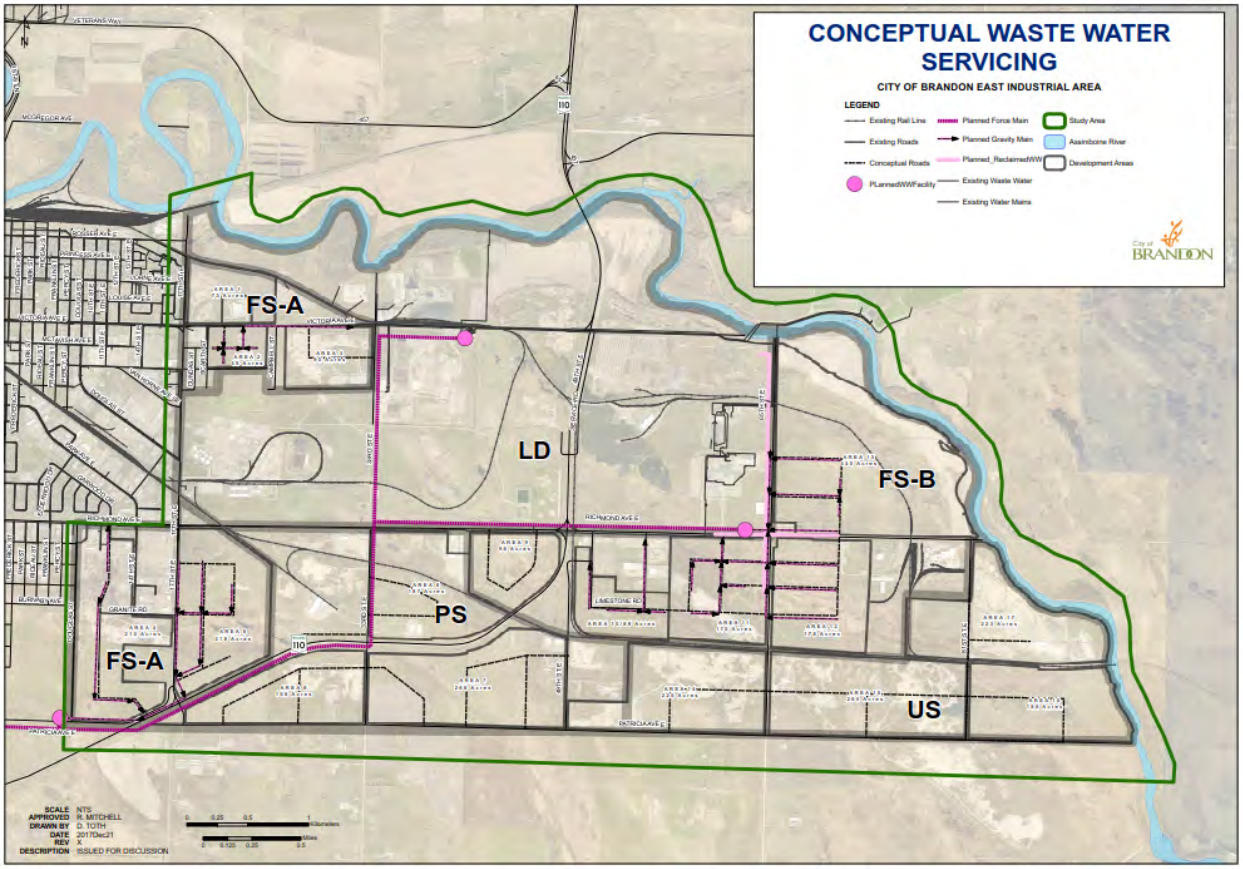
City of Brandon
East Industrial Area Development Strategy

Infrastructure Demand Summary
Sewer Service

Area	Description	Designation		Acres	Ha	ADWF	ADWF	PHD	PDWF	PDWF	PHD	Extraneous Flow	PWWF	PWWF	PWWF	RCW	Comments
						L/ha/day	L/day	L/s	L/ha/day	L/day	L/s		L/ha/day	L/day	L/s	L/s	
1	FS-A – Victoria Avenue Industrial Node	FS-A	Commercial	73	29.5	16,800	496,307	**5.74**	28,100	830,132	**9.61**	2,200	30,300	895,125	**10.36**	-	Service off existing 200 mm WW on west limit of area or north connecting into existing 1050 mm WW
2	FS-A – Victoria Avenue Industrial Node	FS-A	Commercial	45	18.2	16,800	305,943	**3.54**	28,100	511,725	**5.92**	2,200	30,300	551,789	**6.39**	-	New gravity collection piping (250 mm/ 200 mm). New Gravity line on Victoria Ave E to west of 33rd St E and tie into existing 1050 mm WW. Gravity feasibility to be confirmed.
3	FS-A – Victoria Avenue Industrial Node	FS-A	Commercial	90	36.4	16,800	611,885	**7.08**	28,100	1,023,451	**11.85**	2,200	30,300	1,103,579	**12.77**	-	Service off new gravity line on Victoria Ave E to west of 33rd St E and tie into existing 1050 mm WW. Gravity feasibility to be confirmed.
4	FS-A – Richmond Park Industrial Node	FS-A	Commercial	210	85.0	16,800	1,427,732	**16.52**	28,100	2,388,052	**27.64**	2,200	30,300	2,575,017	**29.80**	-	Area existing capacity is fully allocated. Remainder of are to be services with new gravity collection piping south to HWY 110/ 17th St E, along Patricia Ave E to Proposed Lift Station at Patricia Ave E and Douglas St.
5	FS-A – Richmond Park Industrial Node	FS-A	Commercial	245	99.1	16,800	1,665,688	**19.28**	28,100	2,786,061	**32.25**	2,200	30,300	3,004,187	**34.77**	-	Services with new gravity collection piping south to HWY 110/ 17th St E, along Patricia Ave E to Proposed Lift Station at Patricia Ave E and Douglas St.
6	PS – Partially Serviced Area	PS		158	63.9												Un-serviced - Holding tanks
7	PS – Partially Serviced Area	PS		187	75.7												Un-serviced - Holding tanks
8	PS – Partially Serviced Area	PS		266	107.6												Un-serviced - Holding tanks
9	FS-B – PTH #110 Industrial Node	FS-B	Light Industrial	98	39.7	22,500	892,333	**10.33**	37,600	1,491,187	**17.26**	2,200	39,800	1,578,437	**18.27**	-	New gravity collection piping from area to proposed new lift station on Richmond Ave E, West of 65th St. E. Lift Station FM from station to wastewater treatment facility.
10	FS-B – PTH #110 Industrial Node	FS-B	Light Industrial	89	36.0	22,500	810,384	**9.38**	37,600	1,354,241	**15.67**	2,200	39,800	1,433,479	**16.59**	-	New gravity collection piping from area to proposed new lift station on Richmond Ave E, West of 65th St. E. Lift Station FM from station to wastewater treatment facility.
11	FS-B – Richmond East Industrial Node	FS-B	Light Industrial	170	68.8	22,500	1,547,924	**17.92**	37,600	2,586,753	**29.94**	2,200	39,800	2,738,105	**31.69**	TBD	New gravity collection piping from area to proposed new lift station on Richmond Ave E, West of 65th St. E. Lift Station FM from station to wastewater treatment facility. **Reclaimed Wastewater Flow Allowance (TBD)**
12	FS-B – Richmond East Industrial Node	FS-B	Light Industrial	178	72.0	22,500	1,620,767	**18.76**	37,600	2,708,482	**31.35**	2,200	39,800	2,866,957	**33.18**	TBD	New gravity collection piping from area to proposed new lift station on Richmond Ave E, West of 65th St. E. Lift Station FM from station to wastewater treatment facility. **Reclaimed Wastewater Flow Allowance (TBD)**
13	FS-B – Richmond East Industrial Node	FS-B	Light Industrial	207	83.8	22,500	1,884,825	**21.82**	37,600	3,149,752	**36.46**	2,200	39,800	3,334,046	**38.59**	TBD	New gravity collection piping from area to proposed new lift station on Richmond Ave E, West of 65th St. E. Lift Station FM from station to wastewater treatment facility. **Reclaimed Wastewater Flow Allowance (TBD)**
14	US – Un-serviced Area	US		225	91.1												Un-serviced
15	US – Un-serviced Area	US		260	105.2												Un-serviced
16	US – Un-serviced Area	US		185	74.9												Un-serviced
17	US – Un-serviced Area	US		160	64.7												Un-serviced

7.0 Sanitary Servicing Plan Conceptual Layouts

The following figure illustrates the draft conceptual sanitary servicing layout for the Plan areas. The concept will be further reviewed by the City's Engineering Department prior to finalizing.



8.0 Development Costing

Development costing to assist in implementation planning will be completed later in the study after the Plan and plan assumptions have been reviewed by the City.

9.0 Develop Implementation / Staging Options

Develop implementation / staging options for the plan timeframes (0-2, 3-10, 11+ years) will be completed later in the study after the Plan and Plan assumptions have been reviewed by the City.

10 Functional Servicing Plans

Functional servicing plans for short (0-2 year) and medium (3-10 year) term improvements will be completed later in the study after the Plan and plan assumptions have been reviewed by the City.

APPENDIX B: TECHNICAL MEMO - SERVICING
STORM WATER SERVICING PLAN - DRAFT

APPENDIX B: TECHNICAL MEMO – STORM WATER SERVICING PLAN

1.0 Overview

The City of Brandon (City) is establishing an Industrial Secondary Plan for the East Brandon Industrial Area. The purpose of the Plan is to describe in detail a land use framework for the development and servicing of the Brandon industrial lands.

To assist in the Industrial Secondary Plan a draft **storm water servicing plan** has been prepared and is detailed in the memorandum.

The **storm water plan** includes:

- Review available background information, GIS mapping, reports, and studies on the existing storm services and treatment in the industrial area including the City of Brandon – Land Drainage Infrastructure Capital Improvement Plan.
- Consultation with the City on preferences, history, constraints and strategies related to the storm servicing plan.
- Consultation with industry working group to create land use concept and servicing strategies for industrial areas.
- Review City requirements for storm water management targets for quantity, quality, erosion, and water balance including requirements related to increased extreme events in the region due to a changing climate.

- Review environmental and other screening considerations.
- Review servicing methodologies (site based storm water management, central storm sewer management).
- Develop servicing options with conceptual layouts for the growth nodes and corridors.
- Develop costing to assist in implementation planning.
- Develop implementation / staging options for the plan timeframes (0-2, 3-10, 11+ years).
- Prepare functional servicing plans for short (0-2 year) and medium (3-10 year) term improvements.
- Consultation with the City throughout for feedback.

2.0 Background Information

For the **storm water servicing plan** the following background information was reviewed:

2.1 GIS Mapping

Lidar and GIS data layers were obtained from the City to support the work. In addition, the City of Brandon Cobra Reference Atlas was used to review and detail existing storm water infrastructure in the study area and surrounding areas that affect potential servicing.

2.2 Reports and Studies

The following reports and studies were reviewed:

- City of Brandon, Land Drainage Infrastructure Capital Improvement Plan Report (Draft) – March 2017.
- City of Brandon, Water Utility Master Plan – Final Report (AECOM) – October 2015.
- City of Brandon, Industrial Land Development Forecast (East Brandon Industrial Area) – Report (RW Consulting) – February 2016.
- City of Brandon Standard Construction Specifications.
- City of Winnipeg, Water Demand Estimation and Design Guidelines (http://www.winnipeg.ca/waterandwaste/dept/waterdemand.stm).
- City of Winnipeg, Wastewater Flow Estimation and Servicing Guidelines (http://www.winnipeg.ca/waterandwaste/dept/wastewaterFlow.stm).

3.0 Consultation

3.1 Consultation with the City of Brandon

Consultation with the City's Engineering Department is ongoing in terms of assisting in the development of the **storm water servicing plan**. This includes initial review of area constraints, existing services, future capital projects and discussion servicing preferences. It is expected that additional consultation will be required to confirm assumptions, conceptual alignment, implementing and staging options.

3.2 Consultation with the Industry Working Group / Stakeholders

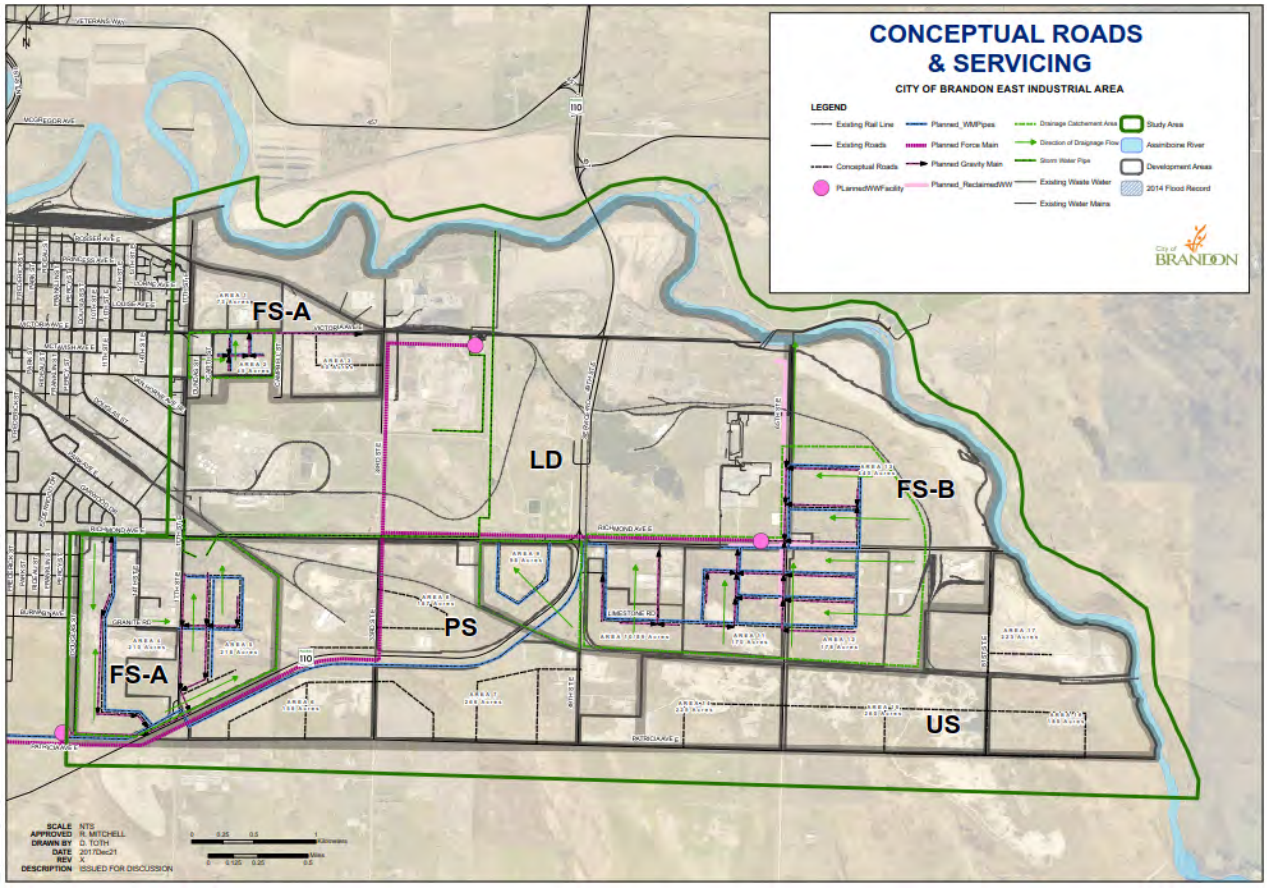
A Public and Stakeholder Brainstorming Session was held on October 5, 2017.

4.0 Storm Water Level of Service

- Enclosed Conduit or Piped Systems:
    - Hydraulic capacity equal to or greater than a City of Brandon 5-year design storm.
- Open Channel Systems: Local Ditches/Channels - 25-year design storm contained within channel.
    - Regional Waterways - 100-year design storm contained within channel.
- Design storm shall consider future climate change.
- Post-development site runoff must not exceed pre-development runoff.
- Inflow and Outflow:
    - Arrange for disposal of all storm water in, from and through the development, which may be cut off from its natural drainage course.
- Consider naturalized storm water retention basins.

5.0 Servicing Methodology

The land use concepts developed to date are based on concentrating future development in several key areas as identified in the Land Use Intensity and Servicing Levels Plan.



Within the Plan, land use designations define the level of servicing as outlined below.

Land Use Designation	Area	Level of Servicing
Full Service Area (FS)	FS-A – Victoria Avenue Industrial Node Areas 1, 2, 3	• Intended for lighter to general industry - no hazardous uses • Anticipate mix of industrial and office/commercial/services, compatible recreation • Business park environment – higher standards for design/landscaping, in particular at gateway intersections and other areas of high visibility • Some building design standards, prohibition against manufactured structures for housing principal uses • Higher standard of site development, landscaping, fenced and paved parking in front of buildings, outside storage behind buildings and screened, etc. • Small to medium lot sizes • Commercial uses servicing workers and businesses • No need for rail spurs, although possibility for larger-lot FSA to the west • Municipal Water – no heavy water users • Municipal Sewer – standard effluent • Fire Protection • Paved roads • Surface LDS in roadway ditching in Victoria and Richmond industrial areas with limited on-site storage using parking lots and roof-tops, lots typically too small for internal catch basins and leads to street LDS. • Larger FSA sites to west will require on-site storage, parking lots and ponds, with controlled release to street ditches via pipes or swales. TBD • Hydro service, user dependent, standard industrial service in Vic and Richmond industrial areas • Natural gas • Fibre-optic
	FS-A – Richmond Park Industrial Node Areas 4, 5	

Land Use Designation	Area	Level of Servicing
	FS-B – PTH #110 Industrial Node Areas 9, 10	• Intended for General to Heavy Industry – Hazardous uses accommodated • No commercial uses
	FS-B – Richmond East Industrial Node Areas 11, 12, 13	• Intended for General Industry including hazardous-potential uses • No commercial uses • Limited site landscaping and design standards • Larger lot sizes • Rail access, multi-modal potential • Municipal water • Private sewage disposal (Provincial OWMS regulations apply) • Fire Protection (standard where hydrant's available, may require private augmentation) • Paved roads • Land drainage, road ditches, on-site storage • Hydro, user dependent • Natural Gas • Fibre optic
Partially Serviced Area (PS)	PS – Partially Serviced Area Areas 6, 7, 8	

Land Use Designation	Area	Level of Servicing
Limited Development Area (LD)	LD – Limited Development Area	• Future development not anticipated beyond current uses – status quo • No services anticipated, but owner dependent • Land retained for plant buffering • Environmental constraints (wetland area)
Unserviced Area (US)	US – Unserviced Area Areas 14, 15, 16	• Intended for future general or heavy industrial • Large lot sizes • Rail accessible • Private water supply, trucked with cisterns • Private sewage disposal (septic tanks and fields, subject to provincial OWMS regulations) • Fire Protection – no hydrants • Roads – gravel, ditches • Land drainage – on-site management • Hydro user-dependent • Natural gas, user dependent • Telecommunications, wired

6.0 Storm Water Flow Estimation Analysis

The table below summarizes the storm water flow assumptions for the identifies areas. The flows will require review by the City's Engineering Department with respect to estimated values and levels of service.

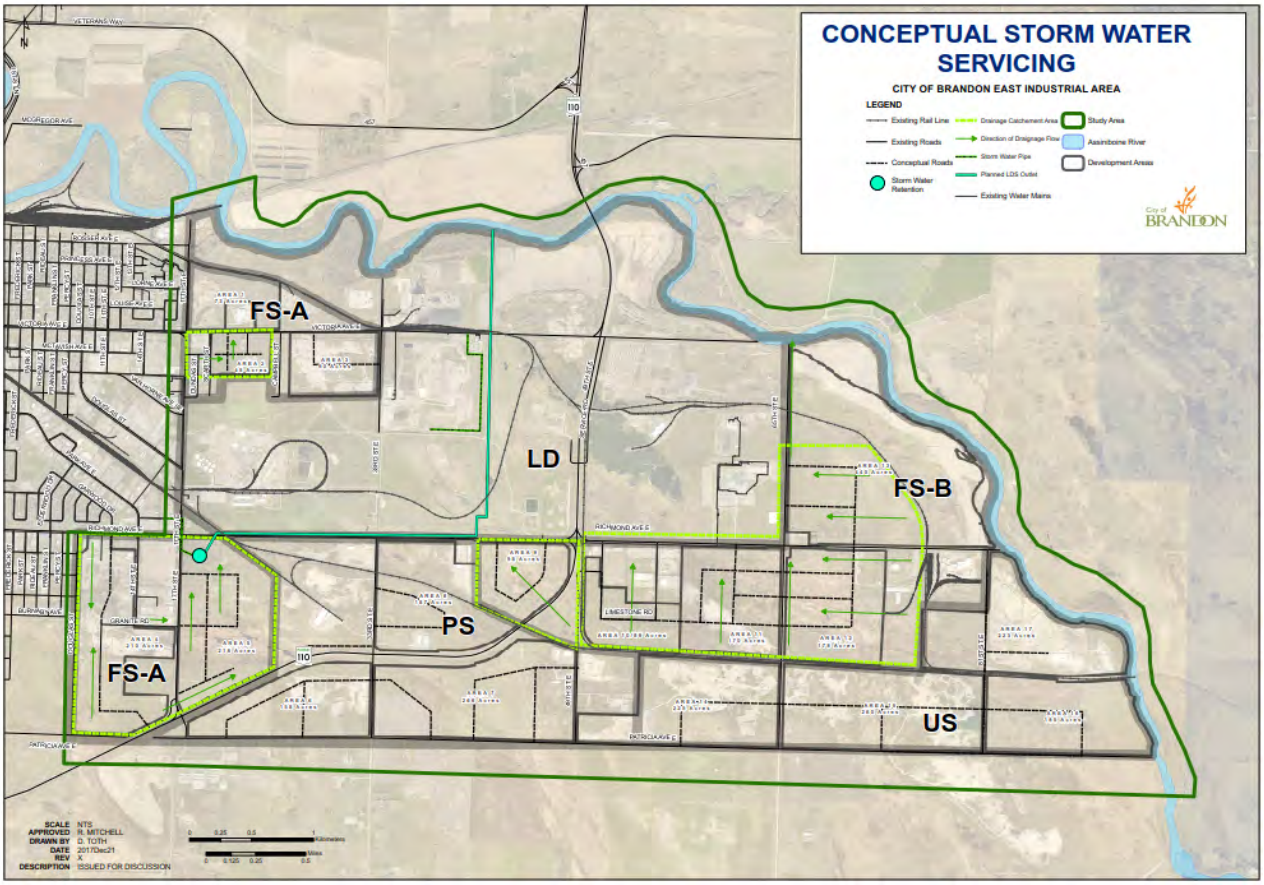
City of Brandon
East Industrial Area Development Strategy

Infrastructure Demand Summary
Stormwater Service

Area	Description	Designation		Acres	Ha		Comments
1	FS-A – Victoria Avenue Industrial Node	FS-A	Commercial	73	29.5	**Enclosed Conduit or Piped Systems:** Hydraulic capacity equal to or greater than a City of Brandon 10 year design storm. **Open Channel Systems:** Local Ditches/Channels - 25 year design storm contained within channel. Regional Waterways - 100 year design storm contained within channel. **Design storm shall consider future climate change.** **Inflow and Outflow** Arrange for disposal of all storm water in, from and through the development, which may be cut off from its natural drainage course.	Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.
2	FS-A – Victoria Avenue Industrial Node	FS-A	Commercial	45	18.2		Central storm sewer management. Drainage likely to be retained in ditching and discharged to Victoria Ave. E drain. Drainage study and permitting will be required.
3	FS-A – Victoria Avenue Industrial Node	FS-A	Commercial	90	36.4		Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.
4	FS-A – Richmond Park Industrial Node	FS-A	Commercial	210	85.0		Central storm sewer management. Drainage likely to be retained in retention pond Area 5, south east of 17th St. E and Richmond Ave. E. Pond will discharge to planned LDS outlet.
5	FS-A – Richmond Park Industrial Node	FS-A	Commercial	245	99.1		Central storm sewer management. Drainage likely to be retained in retention pond Area 5, south east of 17th St. E and Richmond Ave. E. Pond will discharge to planned LDS outlet.
6	PS – Partially Serviced Area	PS		158	63.9		Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.
7	PS – Partially Serviced Area	PS		187	75.7		Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.
8	PS – Partially Serviced Area	PS		266	107.6		Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.
9	FS-B – PTH #110 Industrial Node	FS-B	Light Industrial	98	39.7		Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.
10	FS-B – PTH #110 Industrial Node	FS-B	Light Industrial	89	36.0		Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.
11	FS-B – Richmond East Industrial Node	FS-B	Light Industrial	170	68.8		Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.
12	FS-B – Richmond East Industrial Node	FS-B	Light Industrial	178	72.0		Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.
13	FS-B – Richmond East Industrial Node	FS-B	Light Industrial	207	83.8		Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.
14	US – Un-serviced Area	US		225	91.1		Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.
15	US – Un-serviced Area	US		260	105.2		Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.
16	US – Un-serviced Area	US		185	74.9		Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.
17	US – Un-serviced Area	US		160	64.7		Site based stormwater management. Post-development site runoff must not exceed pre-development runoff.

7.0 Storm Water Servicing Plan Conceptual Layouts

The following figure illustrates the draft conceptual storm water servicing layout for the Plan areas. The concept will be further reviewed by the City's Engineering Department prior to finalizing.



8.0 Development Costing

Development costing to assist in implementation planning will be completed later in the study after the Plan and plan assumptions have been reviewed by the City

9.0 Develop Implementation / Staging Options

Develop implementation / staging options for the plan timeframes (0-2, 3-10, 11+ years) will be completed later in the study after the Plan and Plan assumptions have been reviewed by the City.

10 Functional Servicing Plans

Functional servicing plans for short (0-2 year) and medium (3-10 year) term improvements will be completed later in the study after the Plan and plan assumptions have been reviewed by the City.

APPENDIX B: TECHNICAL MEMO - SERVICING WATER SERVICING PLAN - DRAFT

APPENDIX B: TECHNICAL MEMO – WATER SERVICING PLAN

1.0 Overview

The City of Brandon (City) is establishing an Industrial Secondary Plan for the East Brandon Industrial Area. The purpose of the Plan is to describe in detail a land use framework for the development and servicing of the Brandon industrial lands.

To assist in the Industrial Secondary Plan a draft **water servicing plan** has been prepared and is detailed in the memorandum.

The **water servicing plan** includes:

- Review of available background information, GIS mapping, reports, studies on the existing water, groundwater and fire protection services in the industrial area including the City of Brandon – Water Utility Mater Plan.
- Consultation with the City on preferences, history, constraints and strategies related to the water servicing plan.
- Consultation with an industry working group to create land use concept and servicing strategies for industrial areas.
- Review of requirements, standards for water supply and fire protection.
- Review of servicing methodology, uses and strategies (water supply, local storage, fire storage, groundwater).

  - Confirmation of pressures (domestic and fire) with water modeling software.
- Review of non-potable water re-use options / opportunities.
- Development of servicing options with conceptual layouts for the growth nodes and corridors.
- Development costing to assist in implementation planning.
- Develop implementation / staging options for the plan timeframes (0-2, 3-10, 11+ years).
- Prepare of functional servicing plans for short (0-2 year) and medium (3-10 year) term improvements.
- Consultation with the City throughout for feedback.

2.0 Background Information

For the **water servicing plan** the following background information was reviewed:

2.1 GIS Mapping

Lidar and GIS data layers were obtained from the City to support the work. In addition, the City of Brandon Cobra Reference Atlas was used to review and detail existing water infrastructure in the study area and surrounding areas that affect potential servicing.

2.2 Reports and Studies

The following reports and studies were reviewed:

- City of Brandon, Water Utility Master Plan – Final Report (AECOM) – October 2015.
- City of Brandon, Industrial Land Development Forecast (East Brandon Industrial Area) – Report (RW Consulting) – February 2016.
- City of Brandon Standard Construction Specifications.
- City of Brandon, Land Drainage Infrastructure Capital Improvement Plan Report (Draft) – March 2017.
- City of Winnipeg, Water Demand Estimation and Design Guidelines (http://www.winnipeg.ca/waterandwaste/dept/waterdemand.stm).
- City of Winnipeg, Wastewater Flow Estimation and Servicing Guidelines (http://www.winnipeg.ca/waterandwaste/dept/wastewaterFlow.stm).

3.0 Consultation

3.1 Consultation with the City of Brandon

Consultation with the City's Engineering Department is ongoing in terms of assisting in the development of the **water servicing plan**. This includes initial review of area constraints, existing services, future capital projects and discussion servicing preferences. It is expected that additional consultation will be required to confirm demand estimates, fire protections assumptions, conceptual alignment, system water network modelling and implementing and staging options.

3.2 Consultation with the Industry Working Group / Stakeholders

A Public and Stakeholder Brainstorming Session was held on October 5, 2017. At this event, an initial land use concept plan and water servicing strategy was reviewed in groups. Stakeholders confirmed the assumption that the lack of water servicing and fire protection to existing undeveloped industrial lands in the area was a major impediment to further development. It was also noted that the cost to provide water service as single landowner was prohibitive.

In regard to non-potable water re-use, several local businesses were favorable to the opportunity of using this water source. It was also noted that some type of incentive would be required to further consider the option.

4.0 Water Supply and Fire Protection Level of Service

The City is in the process of developing water supply and fire protection levels of service. Until this is available, a comparable guideline (City of Winnipeg) will be used for the **water servicing plan** for initial discussion.

4.1 Water Demand Estimation and Design Guidelines

(To be confirmed by the City's Engineering Department)

Water Demand	Average Day Water Demand (ADD) L/ha/day	Maximum Day Water Demand (MDD) L/ha/day	Peak Hour Water Demand (PHD) L/ha/day
	ADD	1.6 x ADD	2.5 x ADD
Commercial	16,800	26,880	42,000
Light Industrial	22,500	36,000	56,250
Wet Industrial	33,600	57,000	84,000

4.2 Water Design Guidelines:

4.2.1 Fire flow analysis: (to be confirmed by the City)

- Fire flow targets should follow guidelines set by the Fire Underwriters Survey, found within Part II of the "Water Supply for Fire Protection" document.
    - Available fire flow must be stated at 140 kPa (20 psi) residual during Maximum Day Demand.
    - An allowance for hydrant losses must be included in the hydraulic modeling of fire flows.

- The following fire flow targets are suggested in the absence of building construction details based on the Fire Underwriters Survey 'Water Supply for Fire Protection':
  - Street Side Commercial: 250 L/s (TBC).
  - Industrial: 383 L/s (TBC).

4.2.2 Peak Hour Demand Pressure Analysis

- Minimum water main pressure during peak hour demand = 207 kPa (30 psi)
- Minimum feeder main pressure during peak hour demand = 310 kPa (45 psi)

4.2.3 Water Layout Standards: Public Right-of-Way

- Water mains must be designed with 2.5 m ground cover minimum with minimum diameter of 150 mm.
- Maximum hydrant linear spacing to be 90 m with 75 m radius of protection.
- Hydrants must be placed at high points in the water main profile.
- No more than 2 hydrants are to be installed between main line valves.
- Hydrants and valves are to be placed on projected property line where possible.
- Suggested maximum spacing between main line valves is 150 m.
- Minimum 2 valves at every water main tee, 3 valves at every water main cross.
- All bays and cul-de-sacs must be isolated.
- Maximum 20 services between valves.
- Maximum 20 customers are to be supplied from a single feed.

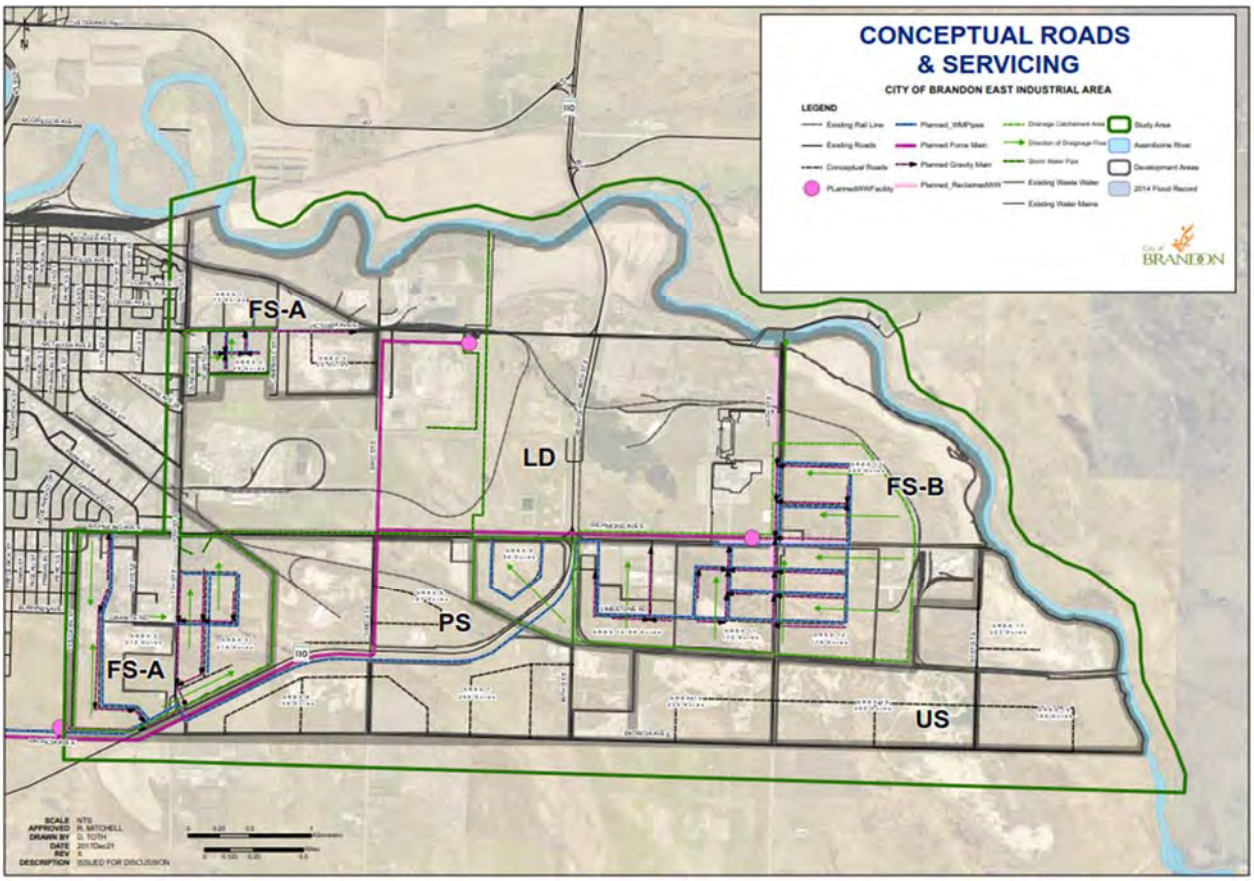
- Final layout is subject to review for flushing and maintenance procedures.
- Dead end water mains must have a hydrant installed at the end.
- All water mains, appurtenances, and service connections must be constructed in accordance with the latest revision of the City of Brandon Standard Construction Specifications.
- All waterworks shall be designed and constructed in accordance the Provincial Office of Drinking Water requirements, including on minimum separation distances from wastewater piping.

4.2.4 Water Servicing Guidelines: Private Services

- Minimum water fire service size is to be 150 mm.
- Service valves for fire services, or combined fire-domestic services are to be placed 1 m from the City water main.

5.0 Servicing Methodology

The land use concepts developed to date are based on concentrating future development in several key areas as identified in the Land Use Intensity and Servicing Levels Plan.



Within the Plan, land use designations define the level of servicing, as outlined below.

Land Use Designation	Area	Level of Servicing
Full Service Area (FS)	FS-A – Victoria Avenue Industrial Node Areas 1, 2, 3	• Intended for lighter to general industry - No hazardous uses • Anticipate mix of industrial and office/commercial/services, compatible recreation • Business park environment – higher standards for design/landscaping, in particular at gateway intersections and other areas of high visibility • Some building design standards, prohibition against manufactured structures for housing principal uses. • Higher standard of site development, landscaping, fenced and paved parking in front of buildings, outside storage behind buildings and screened, etc. • Small to medium lot sizes • Commercial uses servicing workers and businesses • No need for rail spurs, although possibility for larger-lot FSA to the west • Municipal Water – no heavy water users • Municipal Sewer – standard effluent • Fire Protection • Paved roads • Surface LDS in roadway ditching in Victoria and Richmond industrial areas with limited on-site storage using parking lots and roof-tops, lots typically too small for internal catch basins and leads to street LDS • Larger FSA sites to west will require on-site storage, parking lots and ponds, with controlled release to street ditches via pipes or swales. TBD • Hydro service, user dependent, standard industrial service in Vic and Richmond industrial areas • Natural gas • Fibre-optic
	FS-A – Richmond Park Industrial Node Areas 4, 5	

Land Use Designation	Area	Level of Servicing
	FS-B – PTH #110 Industrial Node Areas 9, 10	• Intended for General to Heavy Industry – Hazardous uses accommodated • No commercial uses
	FS-B – Richmond East Industrial Node Areas 11, 12, 13	• Intended for General Industry including hazardous-potential uses • No commercial uses • Limited site landscaping and design standards • Larger lot sizes • Rail access, multi-modal potential • Municipal water • Private sewage disposal (Provincial OWMS regulations apply) • Fire Protection (standard where hydrant's available, may require private augmentation) • Paved roads • Land drainage, road ditches, on-site storage • Hydro, user dependent • Natural Gas • Fibre optic
Partially Serviced Area (PS)	PS – Partially Serviced Area Areas 6, 7, 8	

Land Use Designation	Area	Level of Servicing
Limited Development Area (LD)	LD – Limited Development Area	• Future development not anticipated beyond current uses – status quo • No services anticipated, but owner dependent • Land retained for plant buffering • Environmental constraints (wetland area)
Unserviced Area (US)	US – Unserviced Area Areas 14, 15, 16	• Intended for future general or heavy industrial • Large lot sizes • Rail accessible • Private water supply, trucked with cisterns • Private sewage disposal (septic tanks and fields, subject to provincial OWMS regulations.) • Fire Protection – no hydrants • Roads – gravel, ditches • Land drainage – on-site management • Hydro user-dependent • Natural gas, user dependent • Telecommunications, wired

6.0 Water Flow Estimation Analysis

The table below summarizes the water demand assumptions for the identified areas. The estimated flows will be used for hydraulic modelling (i.e. confirmation of pressures (domestic and fire) with water modeling software), after the City's Engineering Department has reviewed the estimated values and levels of service.

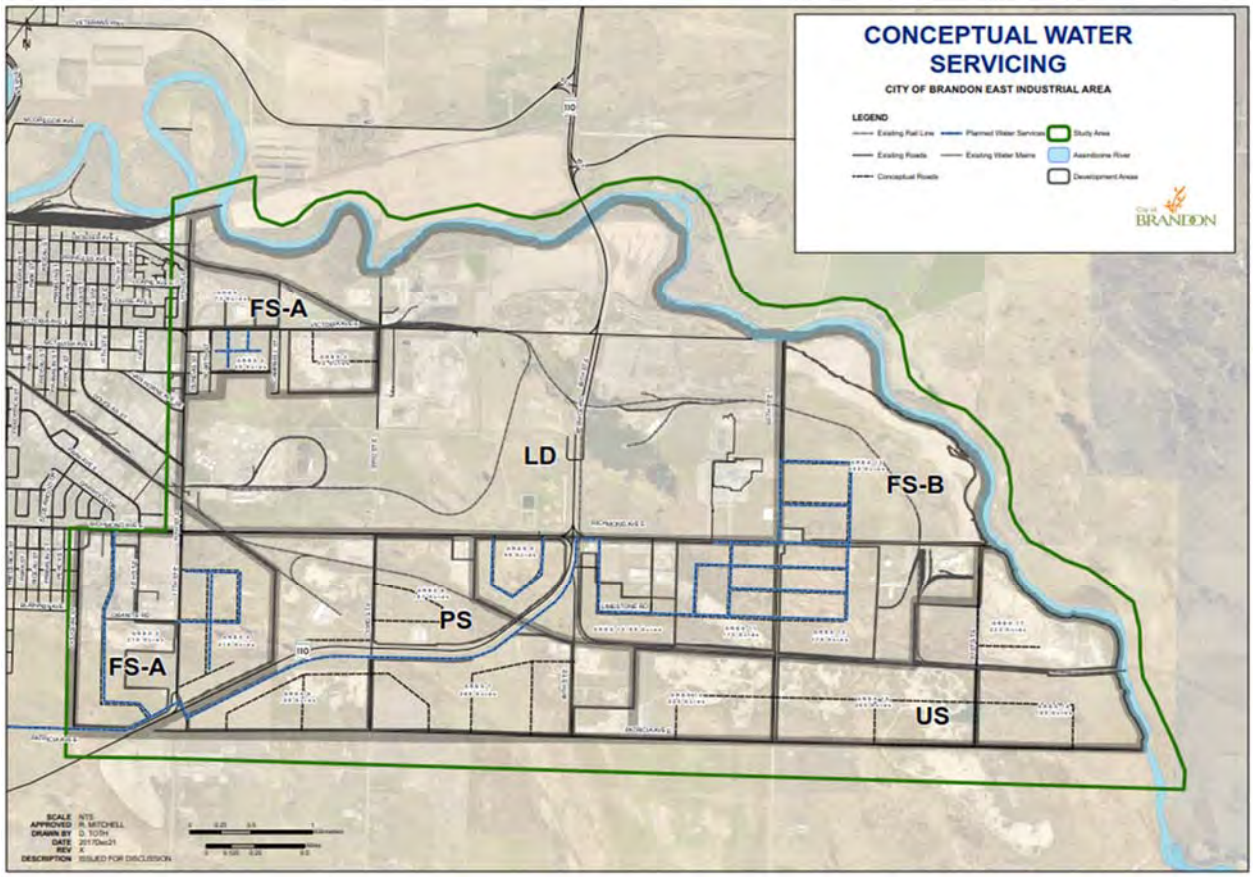
City of Brandon
East Industrial Area Development Strategy

Infrastructure Demand Summary
Water Service

Area	Description	Designation		Acres	Ha	ADD	ADD	ADD	PHD	PHD	PHD	Min Pressure	Fire Flow	Min Fire Pressure	Comments
						L/ha/day	L/day	L/s	L/ha/day	L/day	L/s	kPa	L/s	kPa	
1	FS-A – Victoria Avenue Industrial Node	FS-A	Commercial	73	29.5	16,800	496,307	5.74	42,000	1,240,767	14.36	310	250	140	Service area off of existing 300 mm WM on Victoria Ave. E
2	FS-A – Victoria Avenue Industrial Node	FS-A	Commercial	45	18.2	16,800	305,943	3.54	42,000	764,857	8.85	310	250	140	Service area off of existing 300 mm WM on Scarth St. and Victoria Ave. E.
3	FS-A – Victoria Avenue Industrial Node	FS-A	Commercial	90	36.4	16,800	611,885	7.08	42,000	1,529,713	17.71	310	250	140	Service area off of existing 300 mm WM on Victoria Ave. E
4	FS-A – Richmond Park Industrial Node	FS-A	Commercial	210	85.0	16,800	1,427,732	16.52	42,000	3,569,331	41.31	310	250	140	Service off of existing 300 mm WM on 14th St E and Richmond Ave E
5	FS-A – Richmond Park Industrial Node	FS-A	Commercial	245	99.1	16,800	1,665,688	19.28	42,000	4,164,219	48.20	310	250	140	Service off of Area $ piping and extent to Patricia Ave. Future extension of water west along Patricia Ave E at 9th St.
6	PS – Partially Serviced Area	PS		158	63.9	16,800	1,074,199	12.43	42,000	2,685,496	31.08	310	TBC	140	Un-serviced - Water Available in Vicinity
7	PS – Partially Serviced Area	PS		187	75.7	16,800	1,271,362	14.71	42,000	3,178,404	36.79	310	TBC	140	Un-serviced - Water Available in Vicinity
8	PS – Partially Serviced Area	PS		266	107.6	16,800	1,808,461	20.93	42,000	4,521,152	52.33	310	TBC	140	Un-serviced - Water Available in Vicinity
9	FS-B – PTH #110 Industrial Node	FS-B	Light Industrial	98	39.7	22,500	892,333	10.33	56,250	2,230,832	25.82	310	383	140	Service off existing 300 mm WM along Richmond Ave E. Service only after second 300 mm line is extended from
10	FS-B – PTH #110 Industrial Node	FS-B	Light Industrial	89	36.0	22,500	810,384	9.38	56,250	2,025,959	23.45	310	383	140	Service from 300 mm extension at HWY 110 /17th St to HWY 110 / Richmond Ave E. Additional 300 mm extension from HWY 110 / 17th to Patricia Ave E and 9th St. May be required to satisfy flows into area.
11	FS-B – Richmond East Industrial Node	FS-B	Light Industrial	170	68.8	22,500	1,547,924	17.92	56,250	3,869,810	44.79	310	383	140	Service from 300 mm extension at HWY 110 /17th St to HWY 110 / Richmond Ave E. Additional 300 mm extension from HWY 110 / 17th to Patricia Ave E and 9th St. May be required to satisfy flows into area.
12	FS-B – Richmond East Industrial Node	FS-B	Light Industrial	178	72.0	22,500	1,620,767	18.76	56,250	4,051,919	46.90	310	383	140	Service from 300 mm extension at HWY 110 /17th St to HWY 110 / Richmond Ave E. Additional 300 mm extension from HWY 110 / 17thy to Patricia Ave E and 9th St. May be required to satisfy flows into area.
13	FS-B – Richmond East Industrial Node	FS-B	Light Industrial	207	83.8	22,500	1,884,825	21.82	56,250	4,712,063	54.54	310	383	140	Service from 300 mm extension at HWY 110 /17th St to HWY 110 / Richmond Ave E. Additional 300 mm extension from HWY 110 / 17th to Patricia Ave E and 9th St. May be required to satisfy flows into area.
14	US – Un-serviced Area	US		225	91.1										Un-serviced
15	US – Un-serviced Area	US		260	105.2										Un-serviced
16	US – Un-serviced Area	US		185	74.9										Un-serviced
17	US – Un-serviced Area	US		160	64.7										Un-serviced

7.0 Water Servicing Plan Conceptual Layouts

The following figure illustrates the draft conceptual servicing layout for water servicing to the Plan areas. The concept will be further reviewed by the City's Engineering Department prior to finalizing.



8.0 Development Costing

Development costing to assist with implementation planning will be completed later in the study after the Plan and plan assumptions have been reviewed by the City.

9.0 Develop Implementation / Staging Options

Develop implementation / staging options for the Plan timeframes (0-2, 3-10, 11+ years) will be completed later in the study after the Plan and plan assumptions have been reviewed by the City.

10 Functional Servicing Plans

Functional servicing plans for short (0-2 year) and medium (3-10 year) term improvements will be completed later in the study after the Plan and plan assumptions have been reviewed by the City.

East Brandon Industrial Area Secondary Plan Traffic Impact Assessment

DRAFT MEMORANDUM

Project Number: 046-001

Project Title: East Brandon Traffic Impact Assessment

Proponent Name: MORR Transportation Consulting Ltd.

Address: 202-1465 Buffalo Place, Winnipeg, MB R3T 1L8

APPENDIX C: TRANSPORTATION

The contents of this report are copyrighted and may not be reproduced in any form without the written consent of MORR Transportation Consulting Ltd.

APPENDIX C: TRANSPORTATION

Draft MEMORANDUM

East Brandon Industrial Area Secondary Plan Traffic Impact Assessment

Submitted by

MORR Transportation Consulting Ltd.

Winnipeg, Manitoba

December, 2017

APPENDIX C: TRANSPORTATION

TABLE OF CONTENTS

1 INTRODUCTION 7

1.1 BACKGROUND 7
1.2 EAST BRANDON INDUSTRIAL AREA 10
1.3 STUDY AREA AND ANALYSIS SCOPE 10

2 EXISTING CONDITIONS 12

2.1 EXISTING ROAD NETWORK 12
2.2 EXISTING BACKGROUND TRAFFIC VOLUMES 16

3 EAST BRANDON INDUSTRIAL AREA 18

3.1 TRIP GENERATION 18
3.2 DEVELOPMENT FLOOR AREA REQUIREMENT 19
3.3 TRIP GENERATION RESULTS 22
3.4 TRIP DISTRIBUTION AND ASSIGNMENT 25

4 FUTURE CONDITIONS 30

4.1 FUTURE BACKGROUND TRAFFIC VOLUMES 30
4.2 FUTURE TRAFFIC VOLUMES 30

5 TRAFFIC ANALYSIS 38

5.1 VICTORIA AVENUE EAST AND 17TH STREET EAST 42
5.2 VICTORIA AVENUE EAST AND 33RD STREET EAST 46
5.3 VICTORIA AVENUE EAST AND PTH 110 50
5.4 RICHMOND AVENUE EAST AND 17TH STREET EAST 54
5.5 RICHMOND AVENUE EAST AND PTH 110 57
5.6 RICHMOND AVENUE EAST AND LIMESTONE ROAD EAST 63
5.7 PTH 110 AND 17TH STREET EAST 68
5.8 PTH 110 AMD 33RD STREET EAST 72

6 TRANSPORTATION SYSTEM MODIFICATIONS 76

7 Other Considerations 88

7.1 TRANSIT ACTIVITY 88
7.2 ACTIVE TRANSPORTATION FACILITIES 92
7.3 RAIL LINES 94
7.4 RECOMMENDED CORRIDOR CONSIDERATIONS 96

7.5 SPEED LIMIT RECOMMENDATIONS 101
7.6 ENVIRONMENTAL IMPACTS 102

8 CONCLUSIONS AND RECOMMENDATIONS 104

Appendix A: East Brandon Industrial Area Land Use Concepts

Appendix B: Level of Service Definitions

Appendix C: Synchro Analysis Reports

Appendix D: Synchro Analysis Reports – Recommended Modifications

LIST OF TABLES

Table 1 – Traffic Count Dates 16
Table 2 – ITE Trip Generation Manual Trip Generation Rates 18
Table 3 – Study Area Characteristics 19
Table 4 – Projected Land Use, High-Growth Scenario (Hectares) 20
Table 5 – Projected Floor Area, High-Growth Scenario (1000 ft^2) 20
Table 6 – Projected Floor Areas for Study Area (1000 sq-ft) 21
Table 7 – Trips Generated by Developments Served by Limestone Road East and Limestone Road West 22
Table 8 – 2019 Estimated Total Number of Trips Generated by the Proposed Development 23
Table 9 – 2027 Estimated Total Number of Trips Generated by the Proposed Development 24
Table 10 – 2037 Estimated Total Number of Trips Generated by the Proposed Development 25
Table 11 – Historical Population Annual Growth Rate 30
Table 12 – Historical Traffic Annual Growth Rate 30
Table 13 – Intersection Operations (Victoria Ave E and 17th St E) 42
Table 14 – Traffic Signal Warrant (Victoria Ave E and 17th St E) 43
Table 15 – Recommended treatments for design year horizons (Victoria Ave E and 17th St E) 44
Table 16 – Intersection Operations with Recommended Modifications (Victoria Ave E and 17th St E) 44
Table 17 – Intersection Operations (Victoria Ave E and 33rd St E) 46
Table 18 – Intersection Treatment Warrants (Victoria Ave E and 33rd St E) 47
Table 19 – Traffic Signal Warrant (Victoria Ave E and 33rd St E) 48
Table 20 – Recommended treatments for design year horizons (Victoria Ave E and 33rd St E) 48
Table 21 – Intersection Operations with Recommended Modifications (Victoria Ave E and 33rd St E) 49
Table 22 – Intersection Operations (Victoria Ave E and PTH 110) 50
Table 23 - Intersection Treatment Warrants (Victoria Ave E and PTH 110) 51
Table 24 - Traffic Signal Warrant (Victoria Ave E and PTH 110) 52

Table 25 – Recommended treatments for design year horizons (Victoria Ave E and PTH 110) 52
Table 26 – Intersection Operations (Victoria Ave E and PTH 110) 53
Table 27 – Intersection Operations (17th St E and Richmond Ave E) 54
Table 28 – Recommended treatments for design year horizons (17th St E and Richmond Ave E) 55
Table 29 – Intersection Operations (17th Street East and Richmond Avenue) 55
Table 30 – Intersection Operations (Richmond Ave E and PTH 110) 57
Table 31 - Intersection Treatment Warrants (Richmond Ave E and PTH 110) 59
Table 32 - Traffic Signal Warrant (Richmond Ave E and PTH 110) 59
Table 33 – Recommended treatments for design year horizons (Richmond Ave E and PTH 110) 59
Table 34 – Intersection Operations (Richmond Ave E and PTH 110) 60
Table 35 – Signalized Intersection Operations (Richmond Ave E and PTH 110) 60
Table 36 – Intersection Operations (Richmond Ave E and Limestone Rd E) 64
Table 37 - Intersection Treatment Warrants (Richmond Ave E and Limestone Rd E) 65
Table 38 – Traffic Signal Warrant (Richmond Ave E and Limestone Rd E) 65
Table 39 – Recommended treatments for design year horizons (Richmond Ave E and Limestone Rd E) 66
Table 40 – Intersection Operations (Richmond Ave E and Limestone Rd E) 66
Table 41 – Signalized Intersection Operations (Richmond Ave E and Limestone Rd E) 66
Table 42 – Intersection Operations (PTH 110 and 17th St E) 68
Table 43 - Intersection Treatment Warrants (PTH 110 and 17th St E) 69
Table 44 – Traffic Signal Warrant (PTH 110 and 17th St E) 69
Table 45 – Recommended treatments for design year horizons (PTH 110 and 17th St E) .. 70
Table 46 – Intersection Operations (PTH 110 and 17th St E) 70
Table 47 – Intersection Operations (PTH 110 and 33rd St E) 72
Table 48 - Intersection Treatment Warrant (PTH 110 and 33rd St E) 73
Table 49 - Traffic Signal Warrant (PTH 110 and 33rd St E) 74
Table 50 – Recommended treatments for design year horizons (PTH 110 and 33rd St E) . 74
Table 51 – Intersection Operations (PTH 110 and 33rd St E) 75
Table 52 – Proposed modifications and percent of total traffic represented by development traffic 77
Table 53 – Peak Hour Volumes to Development Areas 88

Table 54 – Projected study area AADT values 97
Table 55 – Assumptions for environmental calculations 103
Table 56 – Assumptions for environmental calculations 103

LIST OF FIGURES

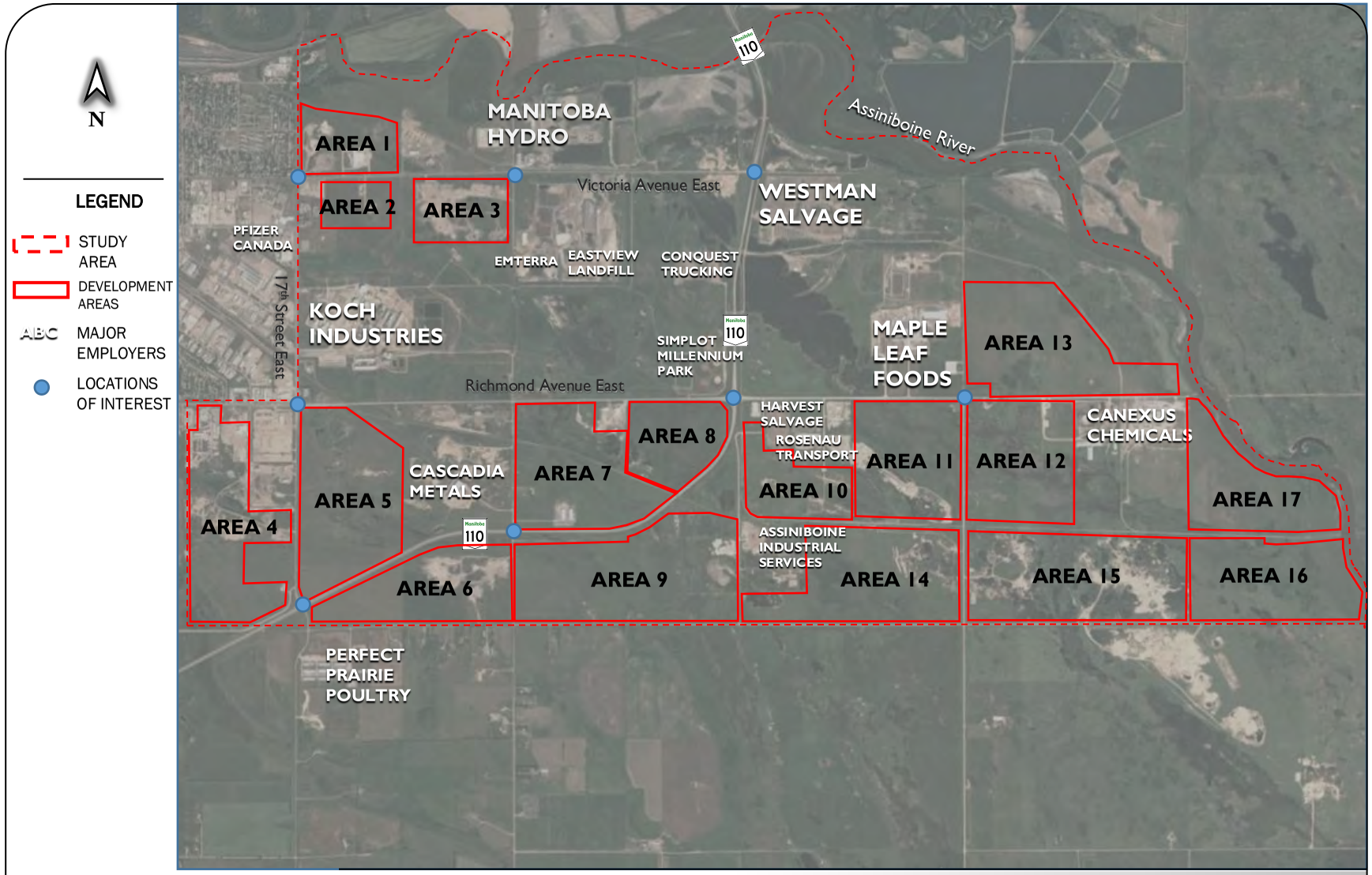
Figure 1 – Study Site 8
Figure 2 – Rights of Way 9
Figure 3 – 2017 Existing Transportation Network 14
Figure 4 – Designated Truck and Dangerous Goods Routes 15
Figure 5 – 2017 Background Traffic Volumes 17
Figure 6 – Trip Distribution Diagram for Area 3 27
Figure 7 – Total 2037 Development Generated Traffic Volumes 29
Figure 8 – 2019 Background Traffic Volumes 32
Figure 9 – 2019 Total Traffic Volumes 33
Figure 10 – 2027 Background Traffic Volumes 34
Figure 11 – 2027 Total Traffic Volumes 35
Figure 12 – 2037 Background Traffic Volumes 36
Figure 13 – 2037 Total Traffic Volumes 37
Figure 14 – Illustration of Intersection Treatments, Shown for Eastbound Traffic Flow 40
Figure 15 - Recommended Intersection Enhancements for Victoria Ave A at 17th St E 80
Figure 16 - Recommended Intersection Enhancements for Victoria Ave E at 33rd St E 81
Figure 17 - Recommended Intersection Enhancements for Victoria Ave E at PTH 110 82
Figure 18 - Recommended Intersection Enhancements for Richmond Ave E and 17th St E 83
Figure 19 - Recommended Intersection Enhancements for Richmond Ave E and PTH 110 84
Figure 20 - Recommended Intersection Enhancements for Richmond Ave E and Limestone Rd E 85
Figure 21 - Recommended Intersection Enhancements for PTH 110 and 17th St E 86
Figure 22 - Recommended Intersection Enhancements for PTH 110 at 33rd St E 87
Figure 23 – Transit Facilities 91
Figure 24 – Active Transportation Facilities 93
Figure 25 – Railway Facilities 95

Figure 26 – Typical undivided rural collector street cross-section 98
Figure 27 – Typical divided urban arterial street cross-section 99
Figure 28 – Typical undivided arterial street cross-section. 100

1 INTRODUCTION

1.1 BACKGROUND

MORR Transportation Consulting Ltd., has prepared this Traffic Impact Assessment (TIA) as part of the East Brandon Area Industrial Secondary Plan on behalf of the City of Brandon (City). The study area, referred to as the East Brandon Industrial Area (EBIA) is located to the east of the City of Brandon, and extends east of Provincial Trunk Highway (PTH) 110, which serves as an east by-pass to the City. Figure 1 illustrates the EBIA study region. Figure 2 illustrates the property ownership and rights-of-way within the study area. This report details the anticipated traffic impacts from the development on the surrounding intersections.



MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

Figure 1
STUDY AREA

MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

Figure 2
STUDY AREA ROADWAY RIGHT OF WAY

1.2 EAST BRANDON INDUSTRIAL AREA

The East Brandon Industrial Area (EBIA) is an approximately 6,600 acre area bordered by the east side of the City of Brandon, the Assiniboine River, and Patricia Avenue East. The location of the EBIA is illustrated in Figure 1 and Appendix A.

Some of the best attributes of the area include the presence of PTH 110 (the East Brandon by-pass), CP and CN rail lines, proximity to water and wastewater treatment plants, and relatively few conflicts with residential development. This area currently hosts a wealth of existing industrial facilities, including Manitoba Hydro, Koch Industries, Westman Salvage, Maple Leaf Foods, and Canexus Chemicals. As a result, the transportation network accommodates a high percentage of heavy vehicles, reaching as high as 20% in some areas, based on intersection traffic count data.

According to the 2016 City of Brandon Industrial Land Development Forecast, the estimated area required for industrial expansion over the next 30 years is approximately 190 to 240 acres. The proposed development plan is divided into 17 land use areas, as illustrated in Figure 1. The following arterial roadways provide internal access within the study area:

- PTH 110, extending from PTH 1, east of Brandon to PTH 10, south of Brandon.
- Victoria Avenue East, running approximately east-west connecting Brandon's East End neighborhood to PTH 110.
- Richmond Avenue East, running approximately east-west connecting Brandon's Green Acres neighborhood to PTH 110 and the areas east of PTH 110.
- 17th Street East, running approximately north-south connecting Brandon's East End neighborhood to PTH 110; and
- 33rd Street East, running approximately north-south connecting Richmond Avenue East to PTH 110, and providing access to Victoria Avenue East.

1.3 STUDY AREA AND ANALYSIS SCOPE

The study area, scope, and approach for this study were developed in consultation with the City of Brandon staff and are in accordance with the **2010 Manitoba Infrastructure and Transportation General Guidelines for the Preparation of Traffic Impact Studies,** and the **2007 Brandon Traffic Impact Study Policy**.

APPENDIX C: TRANSPORTATION

This study assesses weekday AM and PM peak hour conditions for the existing conditions (2017), horizon one (2019), horizon two (2027), and horizon three (2037). The following describes the specific modelling scenarios:

- 2017 – Existing traffic volumes modelled on the existing road network;
- 2019 – Future background traffic volumes modelled on the existing road network;
- 2019 – Future background traffic and total development traffic modelled on the future road network;
- 2027 – Future background traffic volumes modelled on the existing road network;
- 2027 – Future background traffic and total development traffic modelled on the future road network;
- 2037 – Future background traffic volumes modelled on the existing road network; and
- 2037 – Future background traffic and total development traffic modelled on the future road network.

The following eight intersections form part of the study area:

- Victoria Avenue East and 17th Street East;
- Victoria Avenue East and 33rd Street East;
- Victoria Avenue East and PTH 110;
- Richmond Avenue East and 17th Street East;
- Richmond Avenue East and PTH 110;
- Richmond Avenue East and Limestone Road East;
- PTH 110 and 17th Street East; and
- PTH 110 and 33rd Street East.

The study assesses the operation of the intersections using the methodology outlined in the **Highway Capacity Manual**, facilitated through the use of Synchro (version 9) software. Based on the future operations, this study recommends modifications to the transportation infrastructure to consider.

2 EXISTING CONDITIONS

2.1 EXISTING ROAD NETWORK

The following provides a description of the existing (2017) road network within the study area.

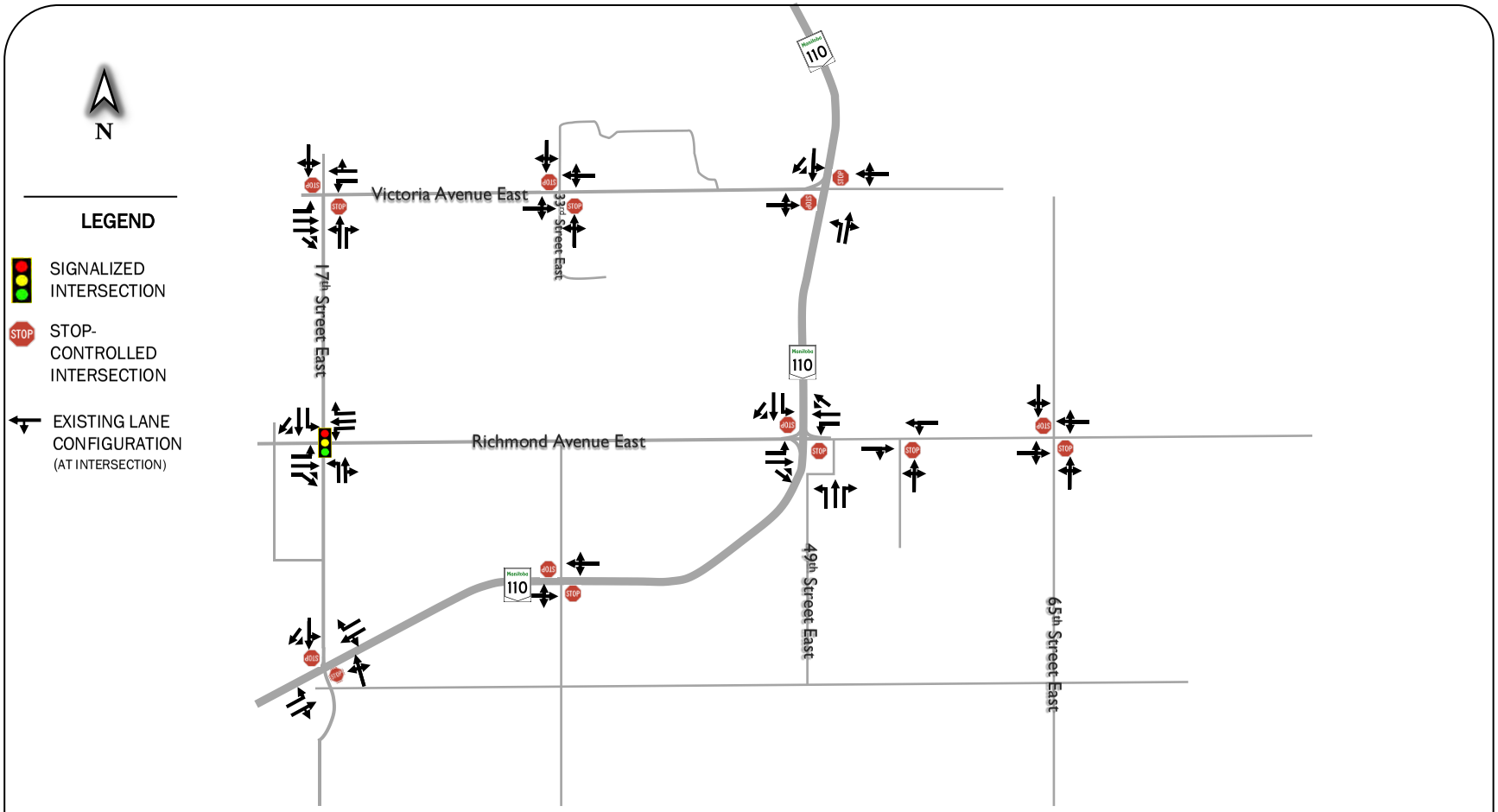
- **Victoria Avenue East** is an east-west arterial with a two-lane rural cross-section. The 2017 annual average daily traffic is approximately 5,300 (based on 2017 traffic count). The speed limit is 60 km/h. The roadway connects the eastern region of Brandon to PTH 110. Parking is not permitted on either side of the roadway and there is a sidewalk on the north side from 17th Street East to 33rd Street East. It is a Class A1 route, meaning it allows a weight limit of 56,500 kg.
- **Richmond Avenue East** is an east-west arterial with a two-lane rural cross-section. The 2017 annual average daily traffic is approximately 5,500 (based on 2012 traffic count). The speed limit is 90 km/h. The roadway connects the eastern region of Brandon to PTH 110, and industrial areas east of Brandon. Parking is not permitted on either side of the roadway. It is an RTAC route, meaning it allows a weight limit of 63,500 kg. It is also a dangerous goods route and a longer combination vehicle (LCV) route.
- **17th Street East** is a north-south arterial roadway with a two-lane urban cross-section, with the exception of its north end near Victoria Avenue East, where it is a four-lane urban cross-section. The 2017 annual average daily traffic is approximately 5,400 (based on 2012 traffic count). Parking is not permitted on either side of the roadway and there is a path on the east side of the roadway, between Victoria Avenue East and Richmond Avenue East. It is a Class A1 route, meaning it allows a weight limit of 56,500 kg. It is also a dangerous goods route, with the exception of the far north part.
- **33rd Street** is a local roadway with a two-lane rural cross-section. The 2017 annual average daily traffic is approximately 800 (based on 2017 traffic count). Skyline Avenue provides connectivity for local residents to Dawson Road.
- **PTH 110** is an expressway with a two-lane rural cross-section. It serves as a bypass for vehicles travelling from PTH 1 east of Brandon to PTH 10 south of Brandon, and consists of east-west and north-south sections. The 2017 annual average daily traffic within the study area is approximately 4,480 (based on 2014 traffic count). It is an

RTAC route, meaning it allows a weight limit of 63,500 kg. It is also a dangerous goods route and an LCV route, north of Richmond Avenue East. Manitoba Infrastructure has long-term plans to twin this roadway, although this initiative is highly-dependent on future traffic volumes[1].

Figure 3 illustrates the existing lane configurations and traffic control for the roadways and intersections included in the study.

Figure 4 illustrates the existing truck and dangerous goods routes within the study area.

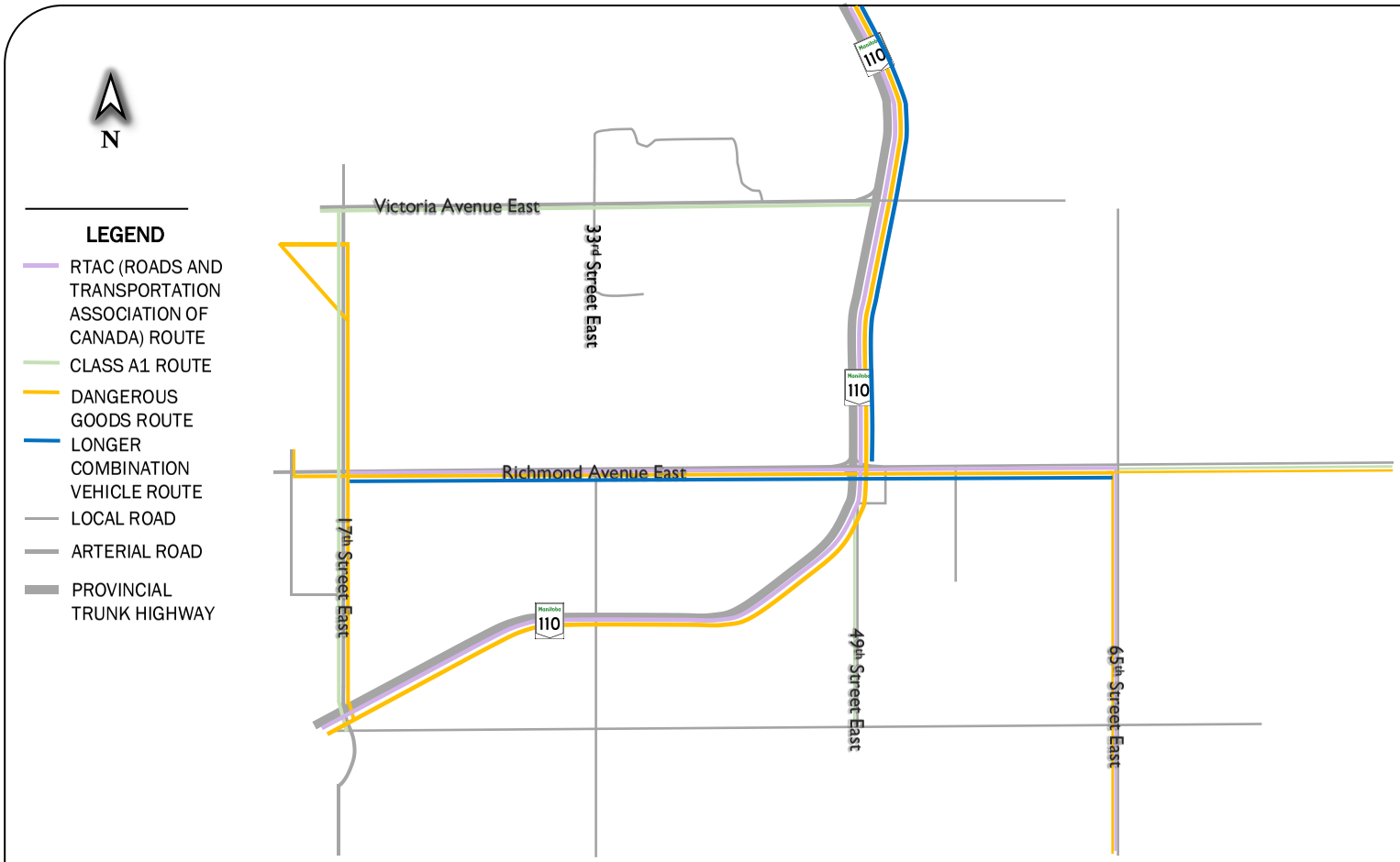
[1] Manitoba Department of Highways and Transportation (1997). Functional Design Study Brandon Eastern Access – PTH 110 (Southern Section) Technical Report.



MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

Figure 3
EXISTING TRANSPORTATION NETWORK



Taken from City of Brandon Truck Routes and Designated Dangerous Goods Routes: http://www.brandon.ca/images/pdf/truckRoutes/TruckRouteMap.pdf

MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

Figure 4

DESIGNATED TRUCK AND DANGEROUS GOODS ROUTES

2.2 EXISTING BACKGROUND TRAFFIC VOLUMES

Intersection traffic volumes were obtained from Manitoba Infrastructure where recent data were available. At the remaining intersections, turning movement counts were conducted by MORR. Details of the count dates are outlined in Table 1.

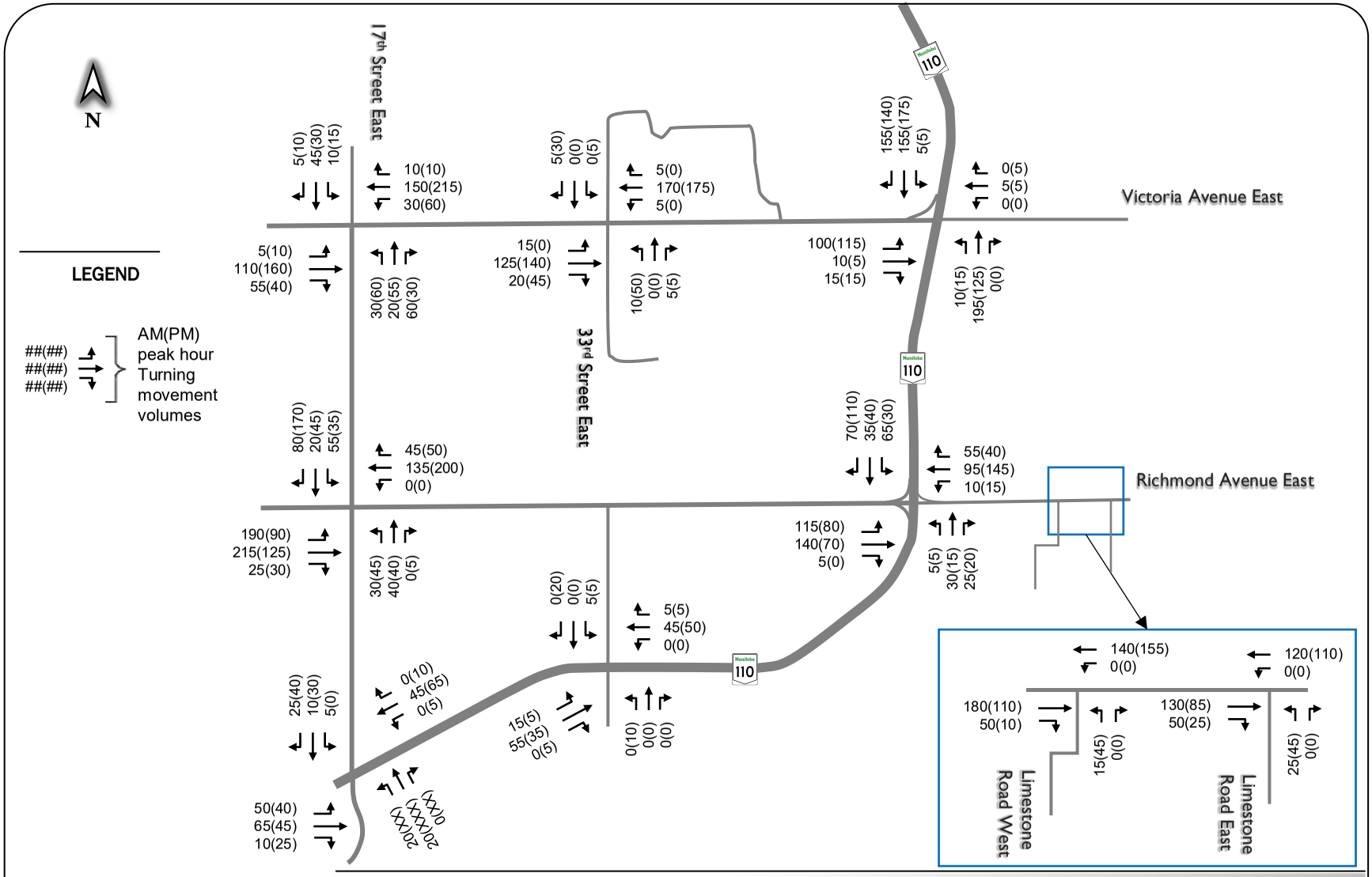
Table 1 – Traffic Count Dates

Intersection	Count Date	Count Source
Victoria Avenue East and 17th Street East	October 25 & 26, 2017	Conducted by MORR
Victoria Avenue East and 33rd Street East	October 24 & 25, 2017	Conducted by MORR
Victoria Avenue East and PTH 110	September 8 & 9, 2014	Manitoba Infrastructure
Richmond Avenue East and 17th Street East	July 18 & 20, 2012	Manitoba Infrastructure
Richmond Avenue East and PTH 110	July 5 & 11, 2013	Manitoba Infrastructure
PTH 110 and 17th Street East	October 10-12, 2017	Manitoba Infrastructure
PTH 110 and 33rd Street East	October 10-12, 2017	Manitoba Infrastructure

Since these counts were conducted on numerous dates, the counts were rounded to the nearest five vehicles and balanced between intersections (where appropriate) to account for the difference in the year of count. Counts were not always balanced between intersections because there are several minor local streets (e.g., Van Horne Avenue East, Hastings Street) that are not included in the study. The imbalance of 17th Street East and Victoria Avenue East with 17th Street East and Richmond Avenue East was especially present due to traffic generated by Douglas Street (collector), and Koch Fertilizer Canada.

Even when traffic volume from these streets is not significant, it will account for some minor fluctuations in the traffic volume arriving at the study area intersections. In particular, the traffic counts at the Richmond Avenue East and PTH 110 intersection were adjusted upward to the nearest 5 vehicles, based on the higher count volumes provided at both the Victoria Avenue East and 33rd Street East intersections (these counts are also more recent). The raw traffic count sheet for the Richmond Avenue East and PTH 110 intersection is included as a supplementary Excel file to this report.

Based on this analysis and consultation with City of Brandon staff, a conservative growth rate of 4.0% was applied to the historical counts conducted on PTH 110 (a growth rate of 2.0% was applied to the historical counts not conducted on PTH 110) to account for general increases in traffic to growth outside the study area (this process is discussed further in Section 4.1). The 2017 AM and PM balanced peak hour volumes used as the baseline (background traffic) throughout the analysis are presented in Figure 5.



MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

Figure 5
2017 BACKGROUND TRAFFIC VOLUMES

3 EAST BRANDON INDUSTRIAL AREA

3.1 TRIP GENERATION

Trips for the development were calculated based on standard equations from the Institute of Transportation Engineers (ITE) publication, **Trip Generation** (7th Edition), which is an internationally-recognized and approved source of vehicular trip rates for various facilities and land uses. The Trip Generation manual is intended for use in estimating the number of trips (with either the origin or destination inside the study site) that might be generated to / from a specific land use. Trips are defined as single or one-direction movement with either the origin or the destination inside a study site. For trip generation purposes, the total trips are a summation of all trips entering and all trips exiting a site. The following land uses from the manual were used:

- **General Light Industrial (ITE Code 110)** – This includes facilities which typically employ fewer than 500 persons, and have emphasis on activities other than manufacturing. This code was assigned to development areas which were not otherwise defined as manufacturing or warehousing.
- **Manufacturing (ITE Code 140)** – This includes facilities which convert raw materials or parts into finished products.
- **Warehousing (ITE Code 150)** – This mainly includes facilities used to store materials.

Table 2 illustrates the trip generation rates and directional distribution of entering / exiting trips for these land uses.

Table 2 – ITE Trip Generation Manual Trip Generation Rates

	Units	AM trips			PM trips			Daily Trips
		Trip Rate	% in	% out	Trip Rate	% in	% out	Trip Rate
General Light Industrial	1,000 ft^2	0.92	88%	12%	0.98	12%	88%	6.97
Manufacturing	1,000 ft^2	0.73	77%	23%	0.74	67%	33%	3.82
Warehousing	1,000 ft^2	0.45	82%	18%	0.47	25%	75%	4.96

Note: The term "units" refers to the size of development, in terms of the floor-area in units of 1,000 square feet.

3.2 DEVELOPMENT FLOOR AREA REQUIREMENT

3.2.1 Overview of Development Areas

The East Brandon Industrial Area is divided into 17 development areas in the land use concept plan, as shown in Figure 1. Based on the intended land uses outlined in the land use concept plan, characteristics of each area can be determined as follows (see Table 3):

Table 3 – Study Area Characteristics

Area	Parcel Size	Land Use Type	Other Characteristics
1, 2, 3	Approximately 75, 45, and 90-acre parcels located near the intersection of 17th Street East and Victoria Avenue East	Industrial park	Small-scale businesses and contractors Small lot sizes
4, 5	Approximately 210 and 245-acre parcels located near intersection of 65th Street East and Richmond Avenue East	Industrial park	Larger lot sizes Low-impact industrial businesses
8, 10, 11, 12	Approximately 100, 90, 170, and 180-acre parcels of land located near intersection of 65th Street East and Richmond Avenue East	General to heavy industrial	Heavy industry and trucking companies Medium lot sizes
13	Approximately 210-acre parcel located east of Maple leaf plant	Large-scale, heavy industry	Food processing and agri-business sectors Large lot sizes
6, 7, 9	Approximately 190, 160, and 265-acre parcels located in the south-central region of the study area	General to heavy industrial use	Significant aggregate potential Not located near growth node
14, 15, 16, 17	Approximately 225, 260, 185, and 160-acre parcels located in the southeast region of the study area	General to heavy industrial	Not located near growth node

3.2.2 Required Floor Areas

The required floor areas for the study horizons were developed based on projections in the 2016 City of Brandon Industrial Land Development Forecast. There are five land uses requiring development area in the East Brandon Industrial Area:

1. Resources: This is a non-manufacturing designation which is best represented by ITE code 110 – General Light Industrial
2. Utilities: This land use is not represented well by specific ITE codes, and has therefore been assigned ITE code 110 – General Light Industrial
3. Construction: This is a broad type of land use, and has therefore been assigned ITE code 110 – General Light Industrial

4. Manufacturing: This land use is well-represented by ITE code 140 – Manufacturing
5. Transportation and Warehousing: This land use is well-represented by ITE code 150 – Warehousing

Two growth scenarios were identified in the 2016 City of Brandon Industrial Land Development Forecast; base case, and high-growth. To be conservative, required floor-areas were taken from the high-growth scenario, as shown in Table 4.

Table 4 – Projected Land Use, High-Growth Scenario (Hectares)

Land Use	2020	2025	2030	2035	2040	2045	Floor Space to Land Ratio
Resources	0	0	1	1	1	1	0.2
Utilities	0	0	1	1	1	2	0.15
Construction	15	31	31	34	34	34	0.1
Manufacturing	6	21	29	32	32	32	0.2
Transportation & Warehousing	10	17	25	27	27	27	0.15
Total	31	69	87	95	95	96	-

Converting to units of 1000 square feet, and multiplying the areas by the respective floor space to land ratio yields the following industry floor area requirements (see Table 5).

Table 5 – Projected Floor Area, High-Growth Scenario (1000 ft^2)

Land Use	2020	2025	2030	2035	2040	2045
Resources	0	0	22	22	22	22
Utilities	0	0	16	16	16	32
Construction	161	334	334	366	366	366
Manufacturing	129	452	624	689	689	689
Transportation & Warehousing	161	274	404	436	436	436
Total	452	1060	1399	1528	1528	1545

Finally, interpolating for the desired study horizons and adding a 20% buffer, as discussed with the City of Brandon yields the following floor areas projected to be developed throughout the study area (see Table 6).

Table 6 – Projected Floor Areas for Study Area (1000 sq-ft)

Land Use	2019	2027	2037
Resources	0.0	10.3	25.8
Utilities	0.0	7.8	19.4
Construction	193.8	400.4	439.2
Manufacturing	155.0	625.2	826.7
Transportation & Warehousing	193.8	391.4	523.1
Total	543	1435	1834

3.2.3 Generation Among Study Zones

The following rules were applied when assigning these floor areas shown in Table 6 to the 17 study areas to estimate projected developments:

1. ITE code 110 – General Light Industrial applies to all study areas, as these are general land use types which can be applied to most areas.
2. ITE code 140 – Manufacturing applies primarily to land areas with full or partial servicing.
3. ITE code 150 – Warehousing applies primarily to land areas around the Richmond Avenue and PTH 110 growth node, as well as un-serviced areas.
4. Development square-footage is assigned based on relative area size, as seen in the land use concepts
5. Areas not near development nodes, such as areas 6 and 9, begin development sometime between 2019 and 2027, since they are not expected to grow as quickly as areas near growth nodes.
6. Un-serviced areas begin development sometime between 2027 and 2037, as conditions here are challenging and these areas are not expected to develop as quickly as the others.

Results of development assignment are shown in Table 8 through Table 10. AM and PM trips generated for each area are shown for the 2019, 2027, and 2037 development horizons in Table 8 through Table 10.

3.2.4 Volumes at Limestone Road

Although no traffic count was taken at Limestone Road West or Limestone Road East, an estimate of base traffic conditions was developed using the method of trip generation (discussed in Section 3.1). Existing developments served by Limestone Road West and Limestone Road East were identified, and their footprints were computed. Depending on land use, they were assigned one of three trip generation lane use codes, as shown in Table 2.

Trips generated by developments served by Limestone Road West and Limestone Road East are summarized in Table 7.

Table 7 – Trips Generated by Developments Served by Limestone Road East and Limestone Road West

Access Point to Development	Footprint (1000 ft^2)	Land Use Code	AM trips			PM trips		
			in	out	total	in	out	total
Limestone Road West	65	110	53	7	60	8	56	64
Limestone Road East	8	110	6	1	7	1	7	8
	18	140	45	14	59	21	38	59
	81	150	7	1	8	2	6	8

3.3 TRIP GENERATION RESULTS

Table 8 through Table 10 show the number of trips generated from the East Brandon Industrial Secondary Plan development as estimated by the ITE Trip Generation Manual. The quantity of units are developed based on floor area requirements as discussed in Table 6. These quantities represent an anticipated upper limit of unit development.

Table 8 – 2019 Estimated Total Number of Trips Generated by the Proposed Development

Land Area	Quantity (1000 ft^2 units)			AM trips			PM trips		
	Code 110	Code 140	Code 150	in	out	total	in	out	total
Area 1 (ITE code 110, 140)	9	10	-	13	3	16	4	12	16
Area 2 (ITE code 110, 140)	6	7	-	9	2	11	3	9	12
Area 3 (ITE code 110, 140)	11	13	-	16	3	19	5	15	20
Area 4 (ITE code 110, 140)	25	29	-	37	8	45	11	36	47
Area 5 (ITE code 110, 140)	30	35	-	43	9	52	13	42	55
Area 6 (ITE code 110, 150)	0	-	0	0	0	0	0	0	0
Area 7 (ITE code 110)	22	-	-	18	2	20	3	19	22
Area 8 (ITE code 110)	13	-	-	10	1	11	1	11	12
Area 9 (ITE code 110, 150)	0	-	0	0	0	0	0	0	0
Area 10 (ITE code 110, 140, 150)	11	12	27	26	5	31	8	25	33
Area 11 (ITE code 110, 140, 150)	21	24	51	49	10	59	15	47	62
Area 12 (ITE code 110, 140, 150)	22	25	54	51	11	62	15	49	64
Area 13 (ITE code 110, 150)	25	-	62	43	8	51	10	43	53
Area 14 (ITE code 110, 150)	0	-	0	0	0	0	0	0	0
Area 15 (ITE code 110, 150)	0	-	0	0	0	0	0	0	0
Area 16 (ITE code 110, 150)	0	-	0	0	0	0	0	0	0
Area 17 (ITE code 110, 150)	0	-	0	0	0	0	0	0	0
Total 2019				315	63	378	87	309	396

Table 9 – 2027 Estimated Total Number of Trips Generated by the Proposed Development

Land Area	Quantity (1000 ft^2 units)			AM trips			PM trips		
	Code 110	Code 140	Code 150	in	out	total	in	out	total
Area 1 (ITE code 110, 140)	18	41	-	37	9	46	13	35	48
Area 2 (ITE code 110, 140)	12	29	-	27	6	33	9	25	34
Area 3 (ITE code 110, 140)	22	51	-	46	11	57	16	43	59
Area 4 (ITE code 110, 140)	52	118	-	108	26	134	38	100	138
Area 5 (ITE code 110, 140)	60	138	-	127	30	157	44	117	161
Area 6 (ITE code 110, 150)	10	-	18	15	3	18	3	15	18
Area 7 (ITE code 110)	44	-	-	36	5	41	5	38	43
Area 8 (ITE code 110)	26	-	-	21	3	24	3	22	25
Area 9 (ITE code 110, 150)	17	-	31	25	4	29	6	25	31
Area 10 (ITE code 110, 140, 150)	22	50	47	64	15	79	22	59	81
Area 11 (ITE code 110, 140, 150)	42	96	91	121	28	149	41	114	155
Area 12 (ITE code 110, 140, 150)	44	101	95	127	29	156	43	119	162
Area 13 (ITE code 110, 150)	51	-	110	82	14	96	19	83	102
Area 14 (ITE code 110, 150)	0	-	0	0	0	0	0	0	0
Area 15 (ITE code 110, 150)	0	-	0	0	0	0	0	0	0
Area 16 (ITE code 110, 150)	0	-	0	0	0	0	0	0	0
Area 17 (ITE code 110, 150)	0	-	0	0	0	0	0	0	0
Total 2019				835	183	1018	262	795	1057

Table 10 – 2037 Estimated Total Number of Trips Generated by the Proposed Development

Land Area	Quantity (1000 ft^2 units)			AM trips			PM trips		
	Code 110	Code 140	Code 150	in	out	total	in	out	total
Area 1 (ITE code 110, 140)	19	55	-	46	11	57	17	42	59
Area 2 (ITE code 110, 140)	13	39	-	33	8	41	12	30	42
Area 3 (ITE code 110, 140)	23	67	-	57	14	71	21	52	73
Area 4 (ITE code 110, 140)	56	156	-	134	32	166	48	123	171
Area 5 (ITE code 110, 140)	66	183	-	156	38	194	56	143	199
Area 6 (ITE code 110, 150)	14	-	29	22	4	26	5	22	27
Area 7 (ITE code 110)	48	-	-	39	5	44	6	42	48
Area 8 (ITE code 110)	28	-	-	23	3	26	3	24	27
Area 9 (ITE code 110, 150)	23	-	49	37	7	44	8	37	45
Area 10 (ITE code 110, 140, 150)	24	67	54	77	18	95	27	71	98
Area 11 (ITE code 110, 140, 150)	46	127	102	146	35	181	51	136	187
Area 12 (ITE code 110, 140, 150)	48	133	107	153	36	189	54	142	196
Area 13 (ITE code 110, 150)	56	-	124	91	16	107	21	92	113
Area 14 (ITE code 110, 150)	5	-	16	10	2	12	2	10	12
Area 15 (ITE code 110, 150)	6	-	18	12	2	14	3	12	15
Area 16 (ITE code 110, 150)	4	-	13	8	2	10	2	8	10
Area 17 (ITE code 110, 150)	4	-	11	7	1	8	2	7	9
Total 2019				1050	235	1285	339	994	1333

In addition, considering the daily trip generation rates shown in Table 2, the daily trips generated by developments are as follows:

- 2019: 1452 entering trips, 1452 exiting trips
- 2027: 3623 entering trips, 3623 exiting trips
- 2037: 4564 entering trips, 4564 exiting trips

3.4 TRIP DISTRIBUTION AND ASSIGNMENT

The trip distribution methodology used the existing 2017 traffic conditions as a predictor for where future development trips will go. The first step to this methodology is to determine where trips entering/exiting the study area originate. Several sources of trips were defined, as follows:

- From Brandon, via Victoria Avenue East
- From Brandon, via the north end of 17th Street East
- From PTH 1, via the north part of PTH 110
- From Brandon, via Richmond Avenue East
- From south of Brandon (or the south part of Brandon), via the southwest part of PTH 110
- From south of Brandon, via the south end of 17th Street East

Once entry/exit points to the study area were defined, specific candidate routes were selected for each study area. Finally, the trips generated were split among the candidate routes for an area based on the existing 2017 traffic distribution.

For example, Area 3 (see Figure 6) can be associated with several main candidate routes:

- Trips from Brandon along Victoria Avenue East will enter the study area at the intersection of Victoria Avenue East and 17th Street East from the west (source 1)
- Trips from Brandon along 17th Street East will enter the study area at the intersection of Victoria Avenue East and 17th Street East from the north (source 2)
- Trips directly from PTH 1 will enter the study area through PTH 110 and travel west on Victoria Avenue East (source 3)
- Trips from the south or from Richmond Avenue East will make their way north on 17th Street East before turning right on Victoria Avenue East (source 4)

Trips are distributed among the four sources (see Figure 6) based on existing 2017 link volumes relative to one-another.

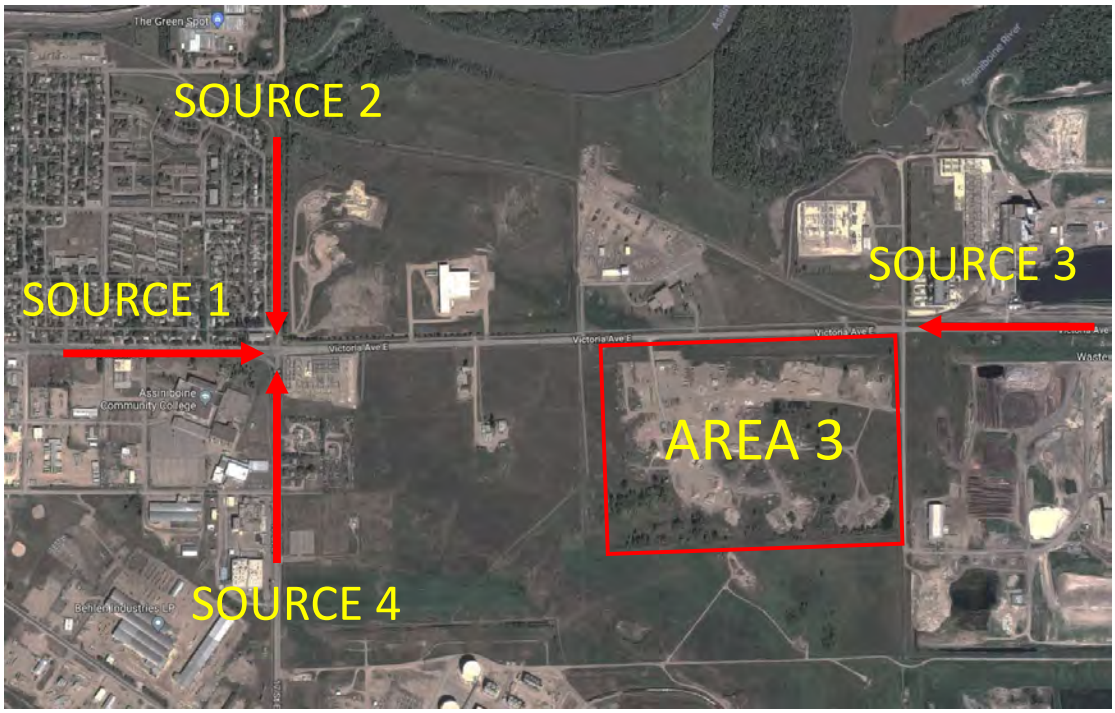


Figure 6 – Trip Distribution Diagram for Area 3

For Area 3, trip distribution and assignment results are as follows.

AM Period:

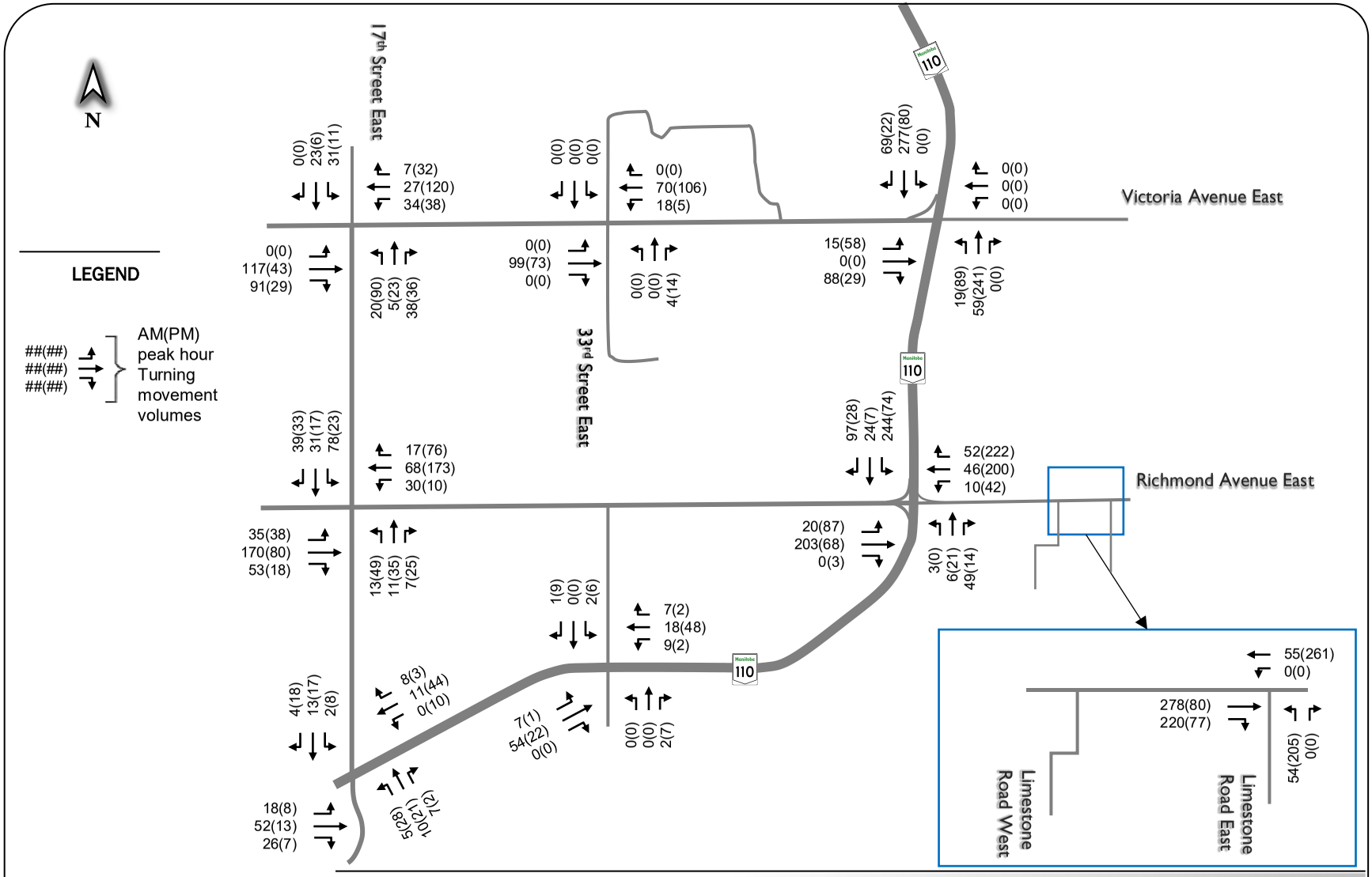
- 10% of trips from north end of 17th Street East
- 31% of trips from the east on Victoria Avenue East
- 3% of trips from the southwest on PTH 110
- 1% of trips from the south on 17th Street East
- 36% of trips from the west on Victoria Avenue East
- 21% of trips from the west on Richmond Avenue East

PM Period:

- 11% of trips from north end of 17th Street East
- 27% of trips from the east on Victoria Avenue East
- 3% of trips from the southwest on PTH 110
- 1% of trips from the south on 17th Street East

- 40% of trips from the west on Victoria Avenue East
- 18% of trips from the west on Richmond Avenue East

Figure 7 illustrates the total development volumes from the East Brandon Industrial Area by the year 2037 (final study horizon).



Brandon East Industrial Area Secondary Plan

Figure 7
2037 DEVELOPMENT TRAFFIC VOLUMES

4 FUTURE CONDITIONS

4.1 FUTURE BACKGROUND TRAFFIC VOLUMES

Future background traffic comprises two components:

- Traffic increases related to additional through traffic growth on the roadway network; and
- Traffic increases related to other proposed developments in the immediate area.

Population data from Statistics Canada and traffic data from Manitoba Infrastructure were collected to establish an expected annual traffic growth rate. Table 11 shows the historical population and growth rate for the City of Brandon. Table 12 shows the historical annual average daily traffic on study area roadways where annual traffic data is available.

Table 11 – Historical Population Annual Growth Rate

Data Source	Data Location	Years	% Annual Growth
Statistics Canada	City of Brandon Population Data	2011 - 2016	1.2
Statistics Canada	Brandon CMA Population Data	2011 - 2016	1.1

Source: Statistics Canada

Table 12 – Historical Traffic Annual Growth Rate

Data Source	Data Location	Years	% Annual Growth
MHTIS (Station 2469)	Victoria Avenue East, east of Hydro Plant	2008 - 2016	1.8
MHTIS (Station 85)	PTH 110, 0.5 km south of PR 457	2011 - 2016	4.8
MHTIS (Station 2569)	PTH 110, 0.6 km north of Richmond Avenue East	2013 - 2016	3.8

Source: Manitoba Highway Traffic Information System

Based on this analysis and consultation with City of Brandon staff, a conservative growth rate of 4.0% was applied to PTH 110, to account for general increases in traffic due to growth outside the study area. A conservative growth rate of 2.0% was applied to all other roadways within the study area, also to account for general increases in traffic due to growth outside the study area.

4.2 FUTURE TRAFFIC VOLUMES

Figure 8 presents the projected 2019 background traffic volumes in the study area, based on applying the two and four percent annual growth factor.

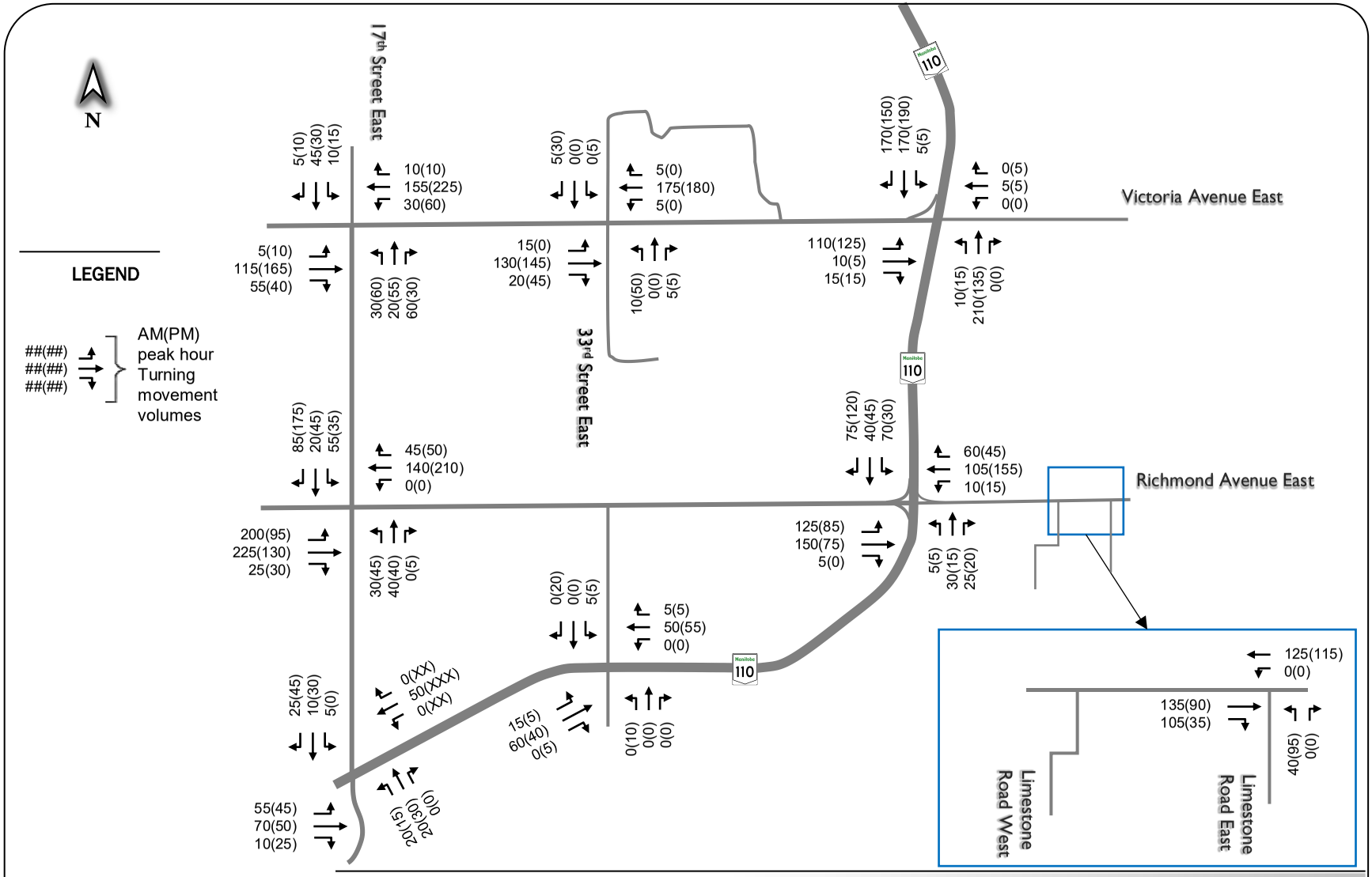
Figure 9 illustrates the total future traffic volumes on the roadway network at the 2019 horizon, calculated by adding the projected EBIA development traffic to the background traffic.

Figure 10 presents the projected 2027 background traffic volumes in the study area, based on applying the two and four percent annual growth factor.

Figure 11 illustrates the total future traffic volumes on the roadway network at the 2027 horizon, calculated by adding the projected EBIA development traffic to the background traffic.

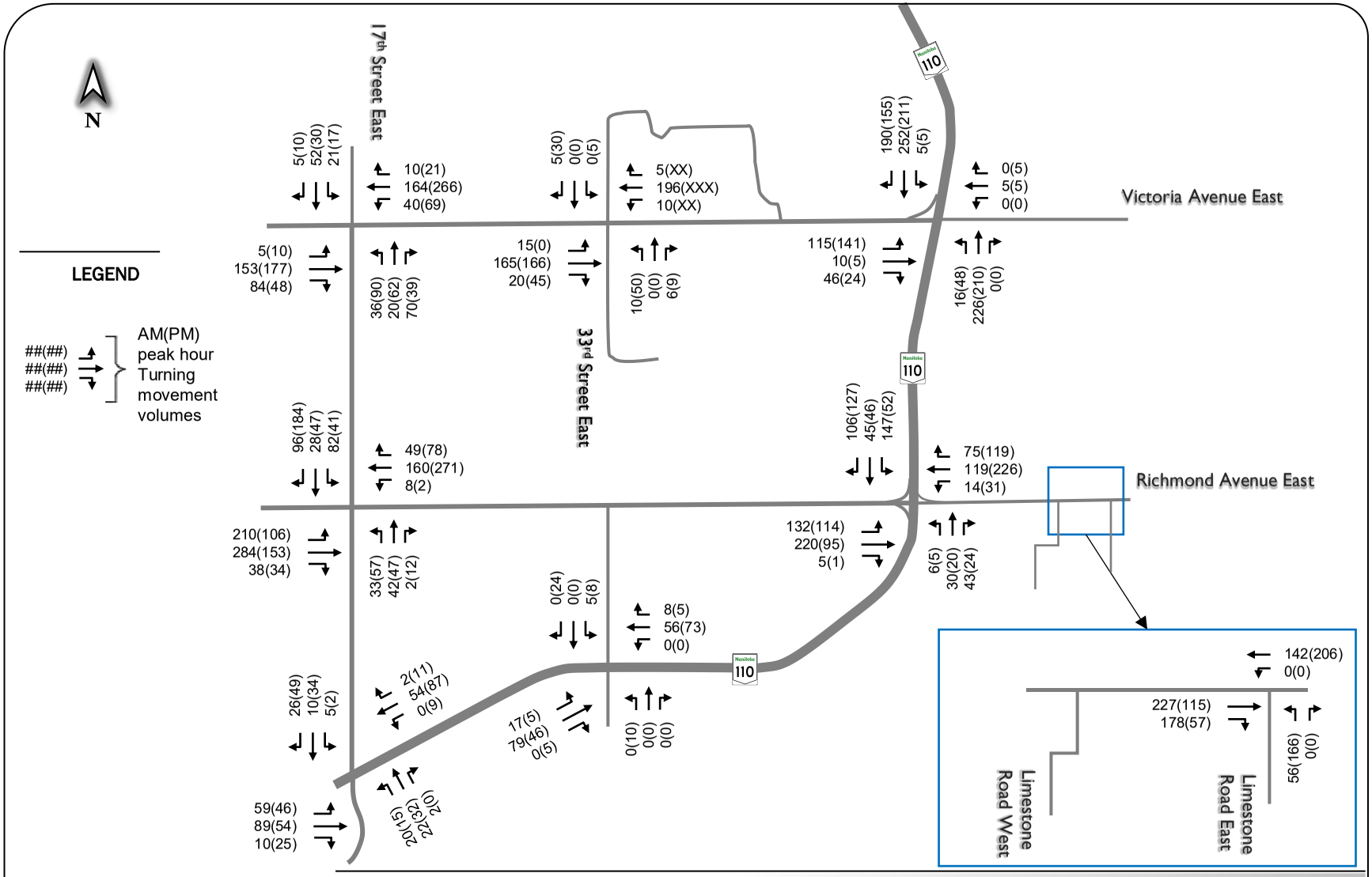
Figure 12 presents the projected 2037 background traffic volumes in the study area, based on applying the two and four percent annual growth factor.

Figure 13 illustrates the total future traffic volumes on the roadway network at the 2037 horizon, calculated by adding the projected EBIA development traffic to the background traffic.



Brandon East Industrial Area Secondary Plan

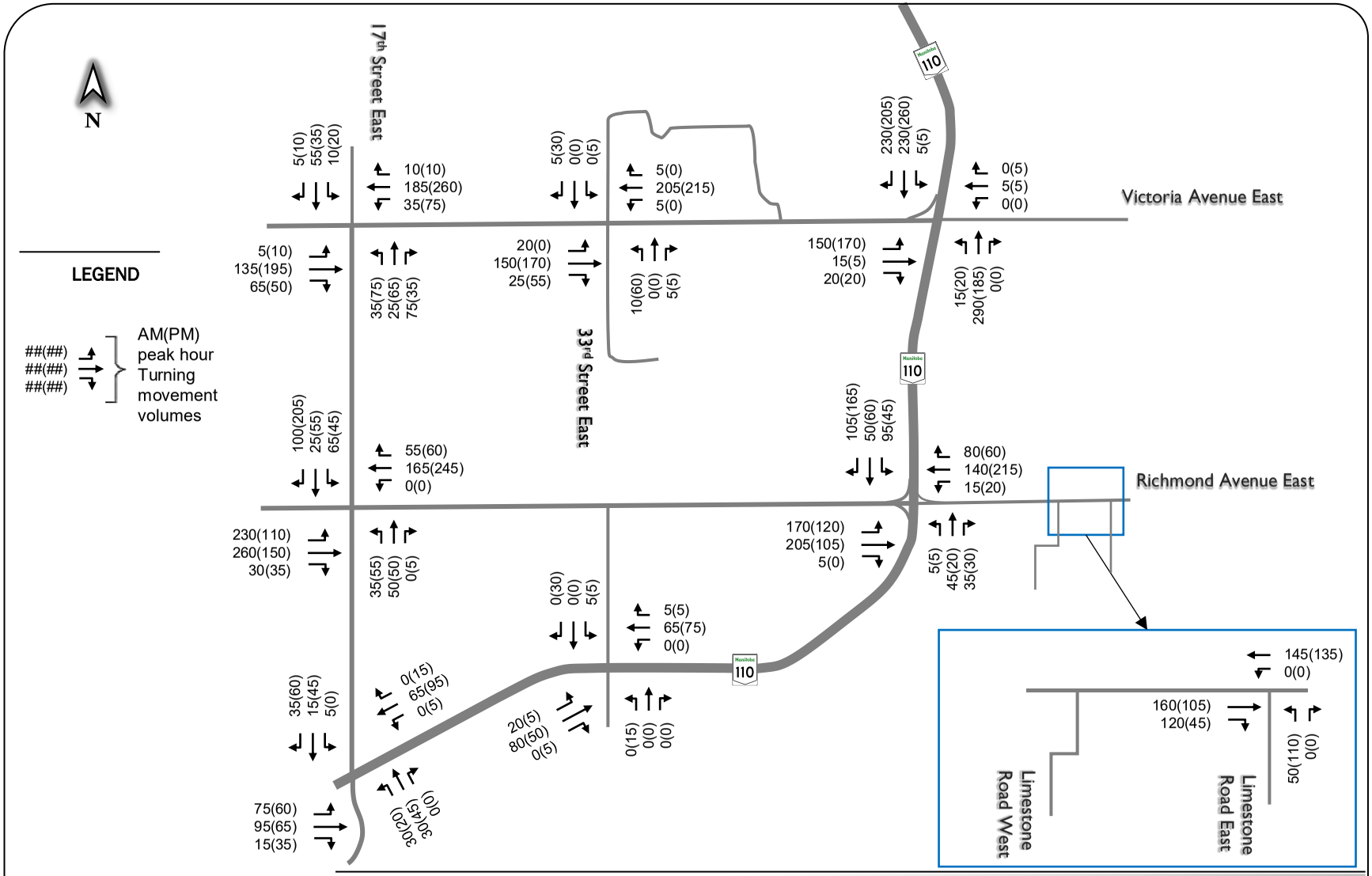
Figure 8
2019 BACKGROUND TRAFFIC VOLUMES



Brandon East Industrial Area Secondary Plan

Figure 9
2019 TOTAL TRAFFIC VOLUMES

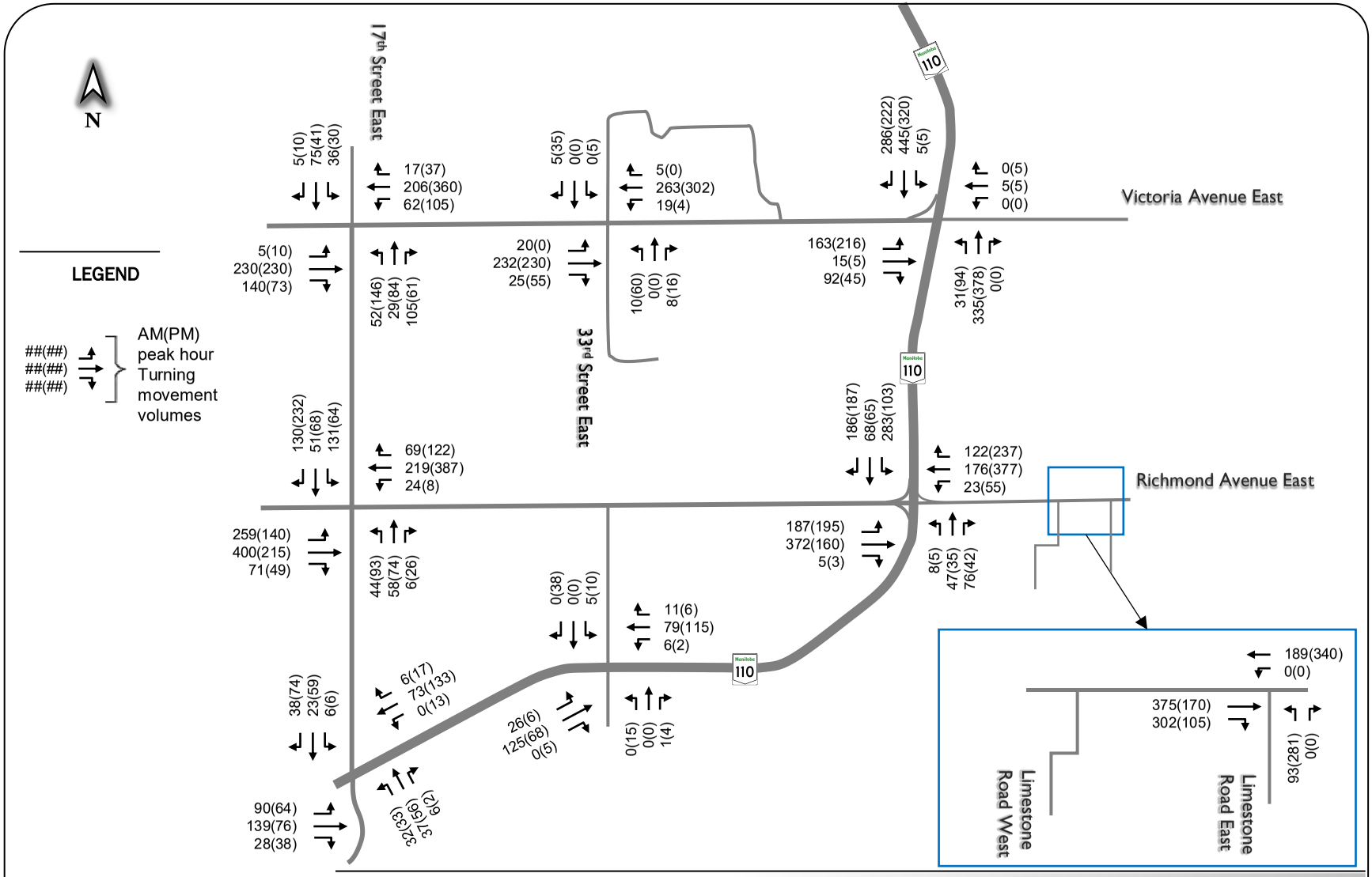
MORR TRANSPORTATION CONSULTING



MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

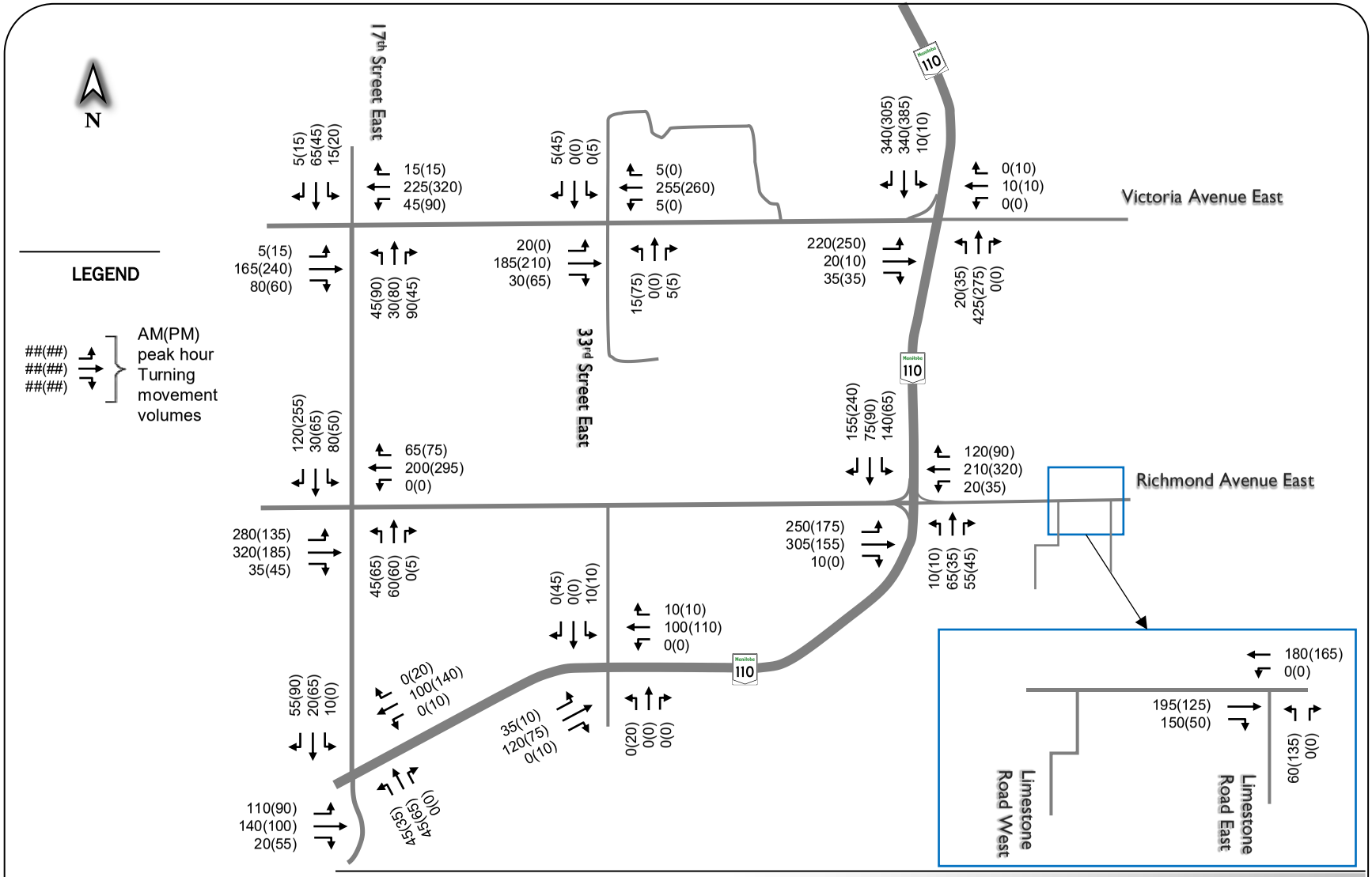
Figure 10
2027 BACKGROUND TRAFFIC VOLUMES



MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

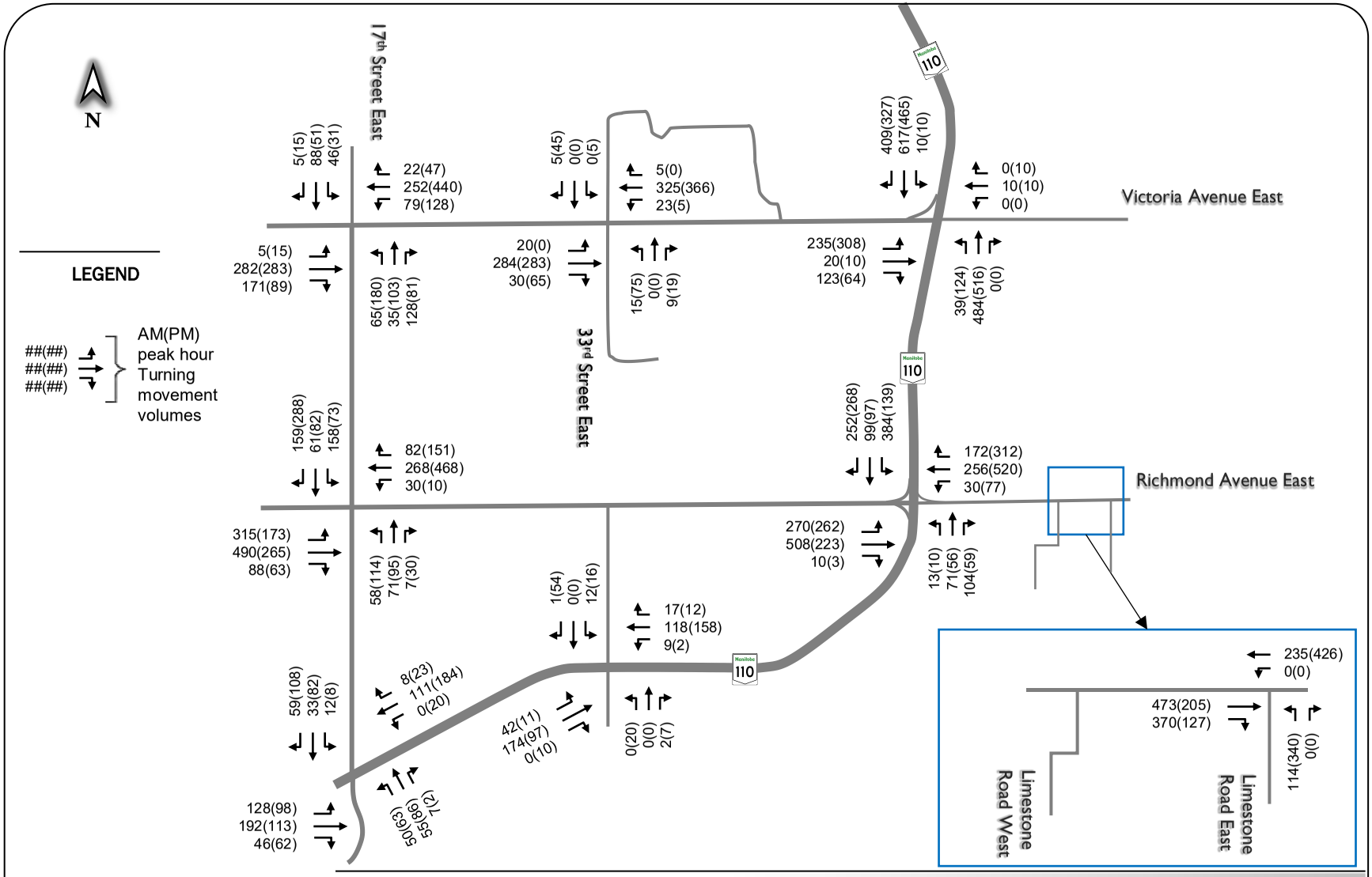
Figure 11
2027 TOTAL TRAFFIC VOLUMES



MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

Figure 12
2037 BACKGROUND TRAFFIC VOLUMES



MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

Figure 13
2037 TOTAL TRAFFIC VOLUMES

5 TRAFFIC ANALYSIS

This section presents the initial intersection traffic operations and traffic analysis of the study area intersections for the traffic scenarios (background traffic and total traffic), and across all horizon years (2019, 2027, and 2037). Intersection traffic operations are presented for the current intersection configurations to illustrate how traffic growth in the horizon years may affect the level-of-service. The traffic analysis comprises the following four distinct steps: (1) application of intersection treatment warrants; (2) application of traffic signal warrants, (3) application of roundabout evaluation methodologies, and (4) analysis of intersection traffic operations based on the intersection treatments and warranted traffic signals.

Traffic Operations at Intersections

Traffic operations at the Study Site intersections during the AM and PM peak hours were analyzed based on the methodology outlined in the U.S. Transportation Research Board's **Highway Capacity Manual** (HCM), using the Synchro (version 9) software package. For the signalized intersection analyses, the HCM level of service (LOS)[2], intersection capacity utilization (ICU)[3], average vehicular delay, and volume-to-capacity (v/c) ratio were noted and tabulated in this section. In addition, the LOS, delay, and v/c ratio for any critical movements[4] were identified. For the unsignalized intersections, the LOS, delay, and v/c ratios were identified for the stop-controlled movements. The LOS for every individual movement is provided in the Synchro reports within Appendix C.

---

[2] Highway Capacity Manual Level of Service is a measure qualifying the amount of delay experienced by motorists, expressed either for specific turning movements or for the intersection as a whole. A more detailed explanation of HCM LOS is provided in Appendix B.

[3] Intersection capacity utilization indicates how an intersection is functioning and how much extra capacity is available to handle traffic fluctuations and incidents. A more detailed explanation of ICU is provided in Appendix B.

[4] Critical movements are defined as:

- any through movement, or shared through/turning lane, with a v/c greater than 0.85; and
- any exclusive turning lane with a v/c greater than 0.90.

The analysis of existing conditions reflects the existing lane configurations and traffic control at the intersections as of 2017. The existing geometric and traffic control configurations were carried forward into the future conditions analyses unless otherwise noted. Information on signal timings was obtained from the Traffic Signal Coordination Study in the City of Brandon[5]. The coordination study recommends a signal cycle time of 100 seconds for major Brandon intersections. In the Synchro software, a custom cycle length may be specified by the user, or the optimal cycle length as defined by the software can be used. For modelling purposes, one of two cycle lengths were used, based on which produced the best LOS results: (1) 100 seconds, and (2) the optimal cycle-length. Signal phasing splits were optimized by the Synchro software. Basic saturations flow rates were set at 1750 vehicles per hour as suggested in the **City of Brandon Traffic Impact Study Policy**.

The City of Brandon has established a preferred LOS of C during peak hours of operation, although LOS D may be accepted if there is no cost effective manner of achieving LOS C. In the case where current LOS levels do not achieve these targets, a lower level of service may be accepted; however, post development LOS should meet or exceed pre-development LOS.

Application of Intersection Treatment Warrants

The **Warrants and Standards for Intersection Treatments of Rural Two-Lane Highways Design Guide**, published by Manitoba Infrastructure (2001), was used to determine if any intersection treatments were warranted on the approaches of each study intersection. The design guide provides a step by step procedure to determine if the following treatments are warranted in the presented hierarchy:

1. Right-turn cut-offs,
2. Left- and right-turn auxiliary lanes,
3. Bypasses, and
4. Intersection widening.

The basic elements of these intersection treatments are illustrated in Figure 14 for eastbound traffic flow (modifications shown in blue).

[5] MMM Group Limited (2015). Traffic Signal Coordination Study in the City of Brandon.

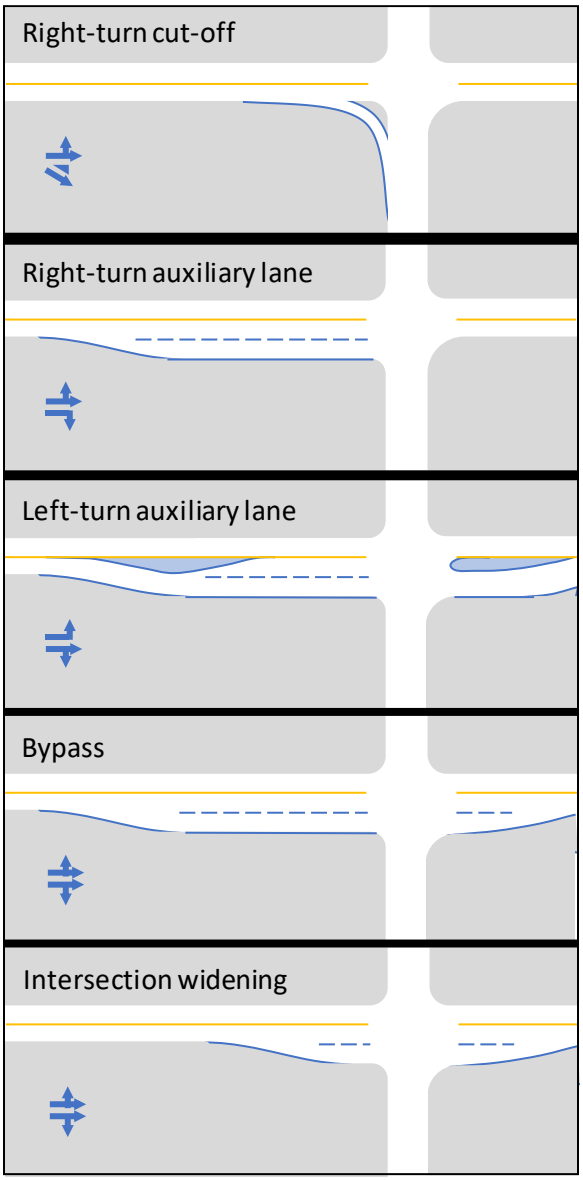


Figure 14 – Illustration of Intersection Treatments, Shown for Eastbound Traffic Flow

The Guide states "The Design Guide is strictly intended for rural applications. Both the treatments and the warrants recommended in this guide are inappropriate for an urban setting. In particular, they are not appropriate for signalized intersections" (pg. 1) and that "the warrants are generally intended to apply to roadways with a design speed between 80 and 120 km/h" (pg. 2). Therefore, the intersection treatment warrants were not applied to all study intersections.

Application of Traffic Signal Warrants

The TAC Traffic Signal Warrant Handbook (2014) was used to determine if a traffic signal would be warranted at any of the un-signalized intersections under projected traffic conditions. The handbook is used to determine the warrant score of an intersection and if the warrant score exceeds the warrant threshold then a signal is warranted at the intersection. The warrant threshold used in the TAC guide is 100, as is recommended by MIT Policy / Standard No. 400-A-2 for urban areas with populations greater than 20,000. Brandon's population was 48,000 in 2016 and the study area is within City boundaries so a 100 warrant threshold was used for this study.

Evaluation of Roundabout

Evaluation of roundabouts was based on the methodology outlined in National Cooperative Highway Research Program (NCHRP) Report 672: Roundabouts: An Informational Guide (2nd Edition, 2010), published by the Transportation Research Board. The HCM LOS, queues, delays, and v/c ratios are provided for each approach and the intersection as a whole. NCHRP Report 672 states that an approach level v/c of 0.85 is considered to be the maximum acceptable v/c ratio for design purposes.

This study assesses weekday AM and PM peak hour conditions for the existing conditions (2017), the 2019 horizon, the 2027 horizon, and the 2037 horizon. The following describes the specific modelling scenarios:

- 2017 – Existing traffic volumes modelled on the existing road network;
- 2019 – Future background traffic volumes modelled on the existing road network;
- 2019 – Future background traffic and total development traffic modelled on the future road network;
- 2027 – Future background traffic volumes modelled on the existing road network;
- 2027 – Future background traffic and total development traffic modelled on the future road network;
- 2037 – Future background traffic volumes modelled on the existing road network; and
- 2037 – Future background traffic and total development traffic modelled on the future road network.

5.1 VICTORIA AVENUE EAST AND 17TH STREET EAST

5.1.1 Existing Intersection Operations

Existing traffic operations at the intersection of Victoria Avenue and 33rd Street are summarized in Table 13.

The intersection operates at an acceptable level of service (LOS C to D) up until (and including) the 2027 background traffic horizon.

Under 2027 total traffic conditions, the northbound approach is projected to reach LOS F and experience substantial increases in delay. Similarly, under 2037 total traffic conditions, the southbound approach is also projected to reach LOS F and experience substantial increases in delay.

Table 13 – Intersection Operations (Victoria Ave E and 17th St E)

Peak Period	Scenario	Approach	HCM LOS	ICU	Delay (sec/veh)	v/c	95th Percentile Queue **(m)**
AM	2017 Existing	NB on 17th	B	---	10.8	0.11	2.9
		SB on 17th	B	---	12.3	0.12	3.1
		Overall intersection	---	0.26	---	---	---
	2019 Background	NB on 17th	B	---	10.9	0.11	3.0
		SB on 17th	B	---	12.4	0.12	3.2
		Overall intersection	---	0.26	---	---	---
	2019 Total	NB on 17th	B	---	11.6	0.14	3.9
		SB on 17th	B	---	13.8	0.17	5.0
		Overall intersection	---	0.35	---	---	---
	2027 Background	NB on 17th	B	---	11.5	0.15	4.1
		SB on 17th	B	---	13.5	0.15	4.3
		Overall intersection	---	0.35	---	---	---
	2027 Total	NB on 17th	C	---	15.0	0.30	9.9
		SB on 17th	C	---	20.1	0.35	12.2
		Overall intersection	---	0.40	---	---	---
	2037 Background	NB on 17th	B	---	13.1	0.23	6.9
		SB on 17th	C	---	15.7	0.22	6.5
		Overall intersection	---	0.39	---	---	---
	2037 Total	NB on 17th	C	---	21.5	0.49	21.5
		SB on 17th	D	---	32.1	0.54	23.8
		Overall intersection	---	0.44	---	---	---
PM	2017 Existing	NB on 17th	C	---	17.6	0.34	12.0
		SB on 17th	B	---	14.7	0.14	3.9
		Overall intersection	---	0.39	---	---	---

	2019 Background	NB on 17th SB on 17th Overall intersection	C B ---	--- --- 0.39	18.0 15.0 ---	0.35 0.14 ---	12.4 4.0 ---
	2019 Total	NB on 17th SB on 17th Overall intersection	D C ---	--- --- 0.46	25.4 17.0 ---	0.54 0.17 ---	24.5 4.9 ---
	2027 Background	NB on 17th SB on 17th Overall intersection	D C ---	--- --- 0.43	25.5 18.1 ---	0.52 0.21 ---	22.8 6.1 ---
	2027 Total	NB on 17th SB on 17th Overall intersection	F D ---	--- --- 0.57	173.5 34.0 ---	1.30 0.42 ---	131.2 15.5 ---
	2037 Background	NB on 17th SB on 17th Overall intersection	F C ---	--- --- 0.49	59.2 24.5 ---	0.84 0.32 ---	56.2 10.8 ---
	2037 Total	NB on 17th SB on 17th Overall intersection	F F ---	--- --- 0.65	> 300 112 ---	2.58 0.85 ---	> 200 41.8 ---

5.1.2 Intersection Treatment Design

The intersection treatment design warrant calculations were not conducted for this intersection, since these calculations are applicable to two-lane undivided rural highways only. This intersection is better represented by an urban area.

5.1.3 Signalization Warrants

The intersections traffic signal warrant points based on the TAC Traffic Signal Warrant Handbook (2014) are provided in Table 14. Results indicate that a traffic signal would be required at this intersection in horizon year 2037 under total traffic volume conditions. Although a traffic signal is not warranted until the 2037 horizon year, a signal is recommended earlier based on the Synchro analysis to accommodate total traffic in 2027, or 2037 background traffic.

Table 14 – Traffic Signal Warrant (Victoria Ave E and 17th St E)

Traffic Scenario	Warrant Points (W)	Signal Warranted **if W > 100**
2019 Background	28	No
2027 Background	40	No
2037 Background	57	No

2019 Total	40	No
2027 Total	84	No
2037 Total	121	Yes

5.1.4 Operations with Recommended Intersection Treatments

Recommended intersection modifications are outlined in Table 15, based on existing intersection operations, signalization warrants, and intersection design treatment warrants.

Table 15 – Recommended treatments for design year horizons (Victoria Ave E and 17th St E)

Design Year	Traffic Condition	
	Background Traffic	Total Traffic
2019	N/A	N/A
2027	N/A	Traffic signal
2037	Traffic signal	-

Intersection operations for the recommended modifications in Table 15 were tested in Synchro, and operations are summarized in Table 16.

Table 16 – Intersection Operations with Recommended Modifications (Victoria Ave E and 17th St E)

Peak Period	Scenario	Overall Intersection			Critical Movements[1]			
		HCM LOS	ICU	Delay (sec/veh)	Movement	HCM LOS	Delay (sec/veh)	v/c
AM	2027 Total	B	0.53	11.4	none	---	---	---
	2037 Background	B	0.45	11.2	none	---	---	---
	2037 Total	B	0.59	12.0	none	---	---	---
PM	2027 Total	B	0.61	14.4	none	---	---	---
	2037 Background	B	0.56	13.2	none	---	---	---
	2037 Total	C	0.69	21.4	none	---	---	---

[1] Critical movements are defined as: (1) any through movement, or shared through/turning lane, with a v/c greater than 0.85; or (2) any exclusive turning lane with a v/c greater than 0.90.

The intersection of Victoria Avenue and 17th Street East operates at an acceptable level of service (LOS B to C) for all traffic horizons. Intersection operations with a traffic signal represent a significant improvement compared to intersection operations with a two-way stop control, particularly at the 2037 horizon.

Additionally, modifying the northbound lane configuration to an exclusive left-turn in the left-hand lane and a thru/right-turn in the right-hand lane is recommended for consideration. This

configuration was assumed when analyzing the intersection with recommended modifications, as it allows for adequate servicing of the heavy northbound left-turn movement.

5.1.5 Intersection Summary

The intersection operations analysis indicates that the intersection operates at an acceptable level of service for all approaches with two-way stop control, up until (and including) the 2027 background traffic horizon, as indicated in Table 13. The signal warrant analysis reveals that signals will be warranted based on 2037 total traffic conditions, but should be considered earlier to accommodate 2027 total traffic or 2037 background traffic conditions (see Table 15). Additionally, at the time of signalization, it is recommended to modify the northbound lane configuration such that it includes and exclusive left-turn lane.

5.2 VICTORIA AVENUE EAST AND 33RD STREET EAST

5.2.1 Existing Intersection Operations

Existing traffic operations at the intersection of Victoria Avenue and 33rd Street East are summarized in Table 17. The intersection currently operates at an acceptable level of service (LOS B to C). The minor street (33rd Street) approach operates well below capacity and with minimal queueing at all horizon years.

Table 17 – Intersection Operations (Victoria Ave E and 33rd St E)

Peak Period	Scenario	Approach	HCM LOS	ICU	Delay (sec/veh)	v/c	95th Percentile Queue **(m)**
AM	2017 Existing	NB on 33rd	B	---	11.1	0.03	< 1
		Overall intersection	---	0.31	---	---	---
	2019 Background	NB on 33rd	B	---	11.2	0.03	< 1
		Overall intersection	---	0.31	---	---	---
	2019 Total	NB on 33rd	B	---	11.6	0.03	< 1
		Overall intersection	---	0.31	---	---	---
	2027 Background	NB on 33rd	B	---	11.8	0.03	< 1
		Overall intersection	---	0.36	---	---	---
	2027 Total	NB on 33rd	B	---	13.2	0.04	1.1
		Overall intersection	---	0.36	---	---	---
	2037 Background	NB on 33rd	B	---	13.2	0.05	1.1
		Overall intersection	---	0.39	---	---	---
	2037 Total	NB on 33rd	C	---	15.7	0.07	1.8
		Overall intersection	---	0.41	---	---	---
PM	2017 Existing	NB on 33rd	B	---	12.7	0.11	3.0
		Overall intersection	---	0.28	---	---	---
	2019 Background	NB on 33rd	B	---	12.8	0.11	3.1
		Overall intersection	---	0.28	---	---	---
	2019 Total	NB on 33rd	B	---	13.5	0.13	3.6
		Overall intersection	---	0.30	---	---	---
	2027 Background	NB on 33rd	B	---	14.3	0.15	4.3
		Overall intersection	---	0.31	---	---	---
	2027 Total	NB on 33rd	C	---	17.1	0.22	6.5
		Overall intersection	---	0.39	---	---	---
	2037 Background	NB on 33rd	C	---	17.4	0.23	7.0
		Overall intersection	---	0.35	---	---	---
	2037 Total	NB on 33rd	C	---	23.3	0.35	11.9
		Overall intersection	---	0.44	---	---	---

5.2.2 Intersection Treatment Design

Results from the intersection treatment design warrant calculations are presented in Table 18. These results indicate that:

Eastbound Victoria Ave E

- A bypass is warranted in 2019 based on background traffic.
- A left-turn auxiliary lane is warranted in 2027 based on total traffic or in 2037 based on background traffic.
- A right-turn cut-off is warranted in 2027 based on total traffic or in 2037 based on background traffic.

Westbound Victoria Ave E

- Intersection widening is warranted in 2019 based on background traffic.
- A left-turn auxiliary lane is warranted in 2027 based on total traffic.

Table 18 – Intersection Treatment Warrants (Victoria Ave E and 33rd St E)

		Background Traffic						Total Traffic					
		2019		2027		2037		2019		2027		2037	
Warrant	Treatment	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Eastbound Victoria Ave E													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Left-Turn Conflict Warrant	Auxiliary Lane	No	No	No	No	Yes	No	No	No	Yes	No	Yes	No
Right-Turn Conflict Warrant	Cut-Off Auxiliary Lane									Yes	Yes		
Left-Turn Bypass Warrant	Bypass	Yes	No	Yes	No			Yes	No				
Right-Turn Bypass Warrant	Bypass												
Intersection Widening Warrant	Widening												
Westbound Victoria Ave E													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	No	No	No	No	No	No	No	No
Left-Turn Conflict Warrant	Auxiliary Lane	No	No	No	No	No	No	No	No	Yes	No	Yes	No
Right-Turn Conflict Warrant	Cut-Off Auxiliary Lane					No	No			No	No	No	No
Left-Turn Bypass Warrant	Bypass	No	No	No	No	No	No	No	No				
Right-Turn Bypass Warrant	Bypass	No	No	No	No	No	No	No	No				
Intersection Widening Warrant	Widening	Yes	No	Yes	No	Yes	No	Yes	No				
Northbound 33rd St E													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	No	No	No	No	No	No	No	No

Turning Provision Warrant		No											
Southbound 33rd St E													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	No	No	No	No	No	No	No	No
Turning Provision Warrant		No											

5.2.3 Signalization Warrants

The intersection traffic signal warrant points based on the TAC Traffic Signal Warrant Handbook (2014) are provided in Table 19. Results indicate that a traffic signal would not be required at this intersection for any of the traffic scenarios.

Table 19 – Traffic Signal Warrant (Victoria Ave E and 33rd St E)

Traffic Scenario	Warrant Points (W)	Signal Warranted **if W > 100**
2019 Background	7	No
2027 Background	9	No
2037 Background	14	No
2019 Total	8	No
2027 Total	15	No
2037 Total	22	No

5.2.4 Operations with Recommended Intersection Treatments

Based on existing intersection operations, signalization warrants, and intersection treatment design warrants, recommended intersection modifications are outlined in Table 20.

Table 20 – Recommended treatments for design year horizons (Victoria Ave E and 33rd St E)

Design Year	Traffic Condition	
	Background Traffic	Total Traffic
2019	Eastbound bypass Westbound intersection widening	Eastbound bypass Westbound intersection widening
2027	-	Eastbound left-turn auxiliary lane Eastbound right-turn cut-off Westbound left-turn auxiliary lane
2037	Eastbound left-turn auxiliary lane Eastbound right-turn cut-off	-

Intersection operations for the recommended modifications in Table 20 were tested in Synchro, and operations are summarized in Table 21. With the recommended modifications,

the intersection continues to operate at an acceptable level of service. The minor street operates well below capacity with minor queuing for all horizon years.

Table 21 – Intersection Operations with Recommended Modifications (Victoria Ave E and 33rd St E)

Peak Period	Scenario	Approach	HCM LOS	ICU	Delay (sec/veh)	v/c	95th Percentile Queue **(m)**
AM	2019 Background	NB on 33rd	B	---	11.4	0.03	< 1
		Overall intersection	---	0.29	---	---	---
	2019 Total	NB on 33rd	B	---	11.9	0.03	< 1
		Overall intersection	---	0.35	---	---	---
	2027 Background	NB on 33rd	B	---	12.2	0.03	< 1
		Overall intersection	---	0.31	---	---	---
	2027 Total	NB on 33rd	B	---	13.2	0.04	1.1
		Overall intersection	---	0.33	---	---	---
	2037 Background	NB on 33rd	B	---	13.2	0.05	1.1
		Overall intersection	---	0.34	---	---	---
	2037 Total	NB on 33rd	C	---	15.6	0.07	1.8
		Overall intersection	---	0.36	---	---	---
PM	2019 Background	NB on 33rd	B	---	13.4	0.12	3.3
		Overall intersection	---	0.27	---	---	---
	2019 Total	NB on 33rd	B	---	14.2	0.14	3.9
		Overall intersection	---	0.30	---	---	---
	2027 Background	NB on 33rd	C	---	15.2	0.17	4.7
		Overall intersection	---	0.30	---	---	---
	2027 Total	NB on 33rd	C	---	17.1	0.22	6.5
		Overall intersection	---	0.35	---	---	---
	2037 Background	NB on 33rd	C	---	17.4	0.23	7.0
		Overall intersection	---	0.35	---	---	---
	2037 Total	NB on 33rd	C	---	23.3	0.35	11.9
		Overall intersection	---	0.40	---	---	---

5.2.5 Intersection Summary

The intersection operations analysis indicates that the intersection operates at an acceptable level of service for all approaches with two-way stop control. The intersection design treatment warrant analysis reveals that treatments are warranted for the 2019, 2027, and 2037 horizons, as indicated in Table 20. The signal warrant analysis reveals that signals will not be warranted at this intersection for any of the design horizons.

5.3 VICTORIA AVENUE EAST AND PTH 110

5.3.1 Existing Intersection Operations

Existing traffic operations at the intersection of Victoria Avenue and PTH 110 are summarized in Table 22. The intersection operates at an acceptable level of service (LOS B to C) up until (and including) the 2027 background traffic horizon.

Under 2027 total traffic conditions, the eastbound approach is projected to reach LOS F and experience substantial increases in delay.

Table 22 – Intersection Operations (Victoria Ave E and PTH 110)

Peak Period	Scenario	Approach	HCM LOS	ICU	Delay (sec/veh)	v/c	95th Percentile Queue **(m)**
AM	2017 Existing	EB on Victoria	B	---	13.7	0.25	7.8
		WB on Victoria	B	---	12.3	0.01	< 1
		Overall intersection	---	0.35	---	---	---
	2019 Background	EB on Victoria	B	---	14.6	0.28	9.2
		WB on Victoria	B	---	12.6	0.01	< 1
		Overall intersection	---	0.37	---	---	---
	2019 Total	EB on Victoria	C	---	17.6	0.40	15.0
		WB on Victoria	B	---	14.0	0.01	< 1
		Overall intersection	---	0.43	---	---	---
	2027 Background	EB on Victoria	C	---	22.0	0.49	21.0
		WB on Victoria	B	---	14.6	0.01	< 1
		Overall intersection	---	0.45	---	---	---
	2027 Total	EB on Victoria	F	---	95.5	1.01	85.6
		WB on Victoria	C	---	20.2	0.02	< 1
		Overall intersection	---	0.60	---	---	---
	2037 Background	EB on Victoria	F	---	145.7	1.16	107.1
		WB on Victoria	C	---	19.9	0.04	1.1
		Overall intersection	---	0.61	---	---	---
	2037 Total	EB on Victoria	F	---	> 300	2.62	> 200
		WB on Victoria	D	---	33.2	0.08	2.0
		Overall intersection	---	0.81	---	---	---
PM	2017 Existing	EB on Victoria	B	---	13.4	0.25	8.0
		WB on Victoria	B	---	10.6	0.02	< 1
		Overall intersection	---	0.36	---	---	---
	2019 Background	EB on Victoria	B	---	14.2	0.29	9.4
		WB on Victoria	B	---	10.8	0.02	< 1
		Overall intersection	---	0.37	---	---	---
	2019 Total	EB on Victoria	C	---	19.8	0.43	17.2
		WB on Victoria	B	---	12.1	0.02	< 1
		Overall intersection	---	0.51	---	---	---

	2027 Background	EB on Victoria	C	---	20.4	0.48	20.3
		WB on Victoria	B	---	11.7	0.02	< 1
		Overall intersection	---	0.44	---	---	---
	2027 Total	EB on Victoria	F	---	195.4	1.27	119.8
		WB on Victoria	C	---	16.8	0.03	< 1
		Overall intersection	---	0.73	---	---	---
	2037 Background	EB on Victoria	F	---	141.8	1.15	111.9
		WB on Victoria	B	---	14.5	0.06	1.4
		Overall intersection	---	0.63	---	---	---
	2037 Total	EB on Victoria	F	---	> 300	3.75	> 200
		WB on Victoria	D	---	26.6	0.12	3.1
		Overall intersection	---	0.97	---	---	---

5.3.2 Intersection Treatment Design

Results from the intersection treatment design warrant calculations are presented in Table 23. These results indicate that:

Eastbound Victoria Ave E

- A right-turn cut-off is warranted in 2027 based on total traffic.

Table 23 - Intersection Treatment Warrants (Victoria Ave E and PTH 110)

		Background Traffic						Total Traffic					
		2019		2027		2037		2019		2027		2037	
Warrant	Treatment	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Northbound PTH 110													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	No	No	No	No	No	No	No	No
Left-Turn Conflict Warrant	Auxiliary Lane	Currently Exists											
Right-Turn Conflict Warrant	Cut-Off	No	No	No	No	No	No	No	No	No	No	No	No
Southbound PTH 110													
Right-Turn LOS Warrant	Cut-Off	Currently Exists											
Left-Turn Conflict Warrant	Auxiliary Lane	No	No	No	No	No	No	No	No	No	No	No	No
Eastbound Victoria Ave E													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Turning Provision Warrant		No											
Westbound Victoria Ave E													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	No	No	No	No	No	No	No	No
Turning Provision Warrant		No											

5.3.3 Signalization Warrants

Results provided in Table 24, indicate that a traffic signal would be required at this intersection in 2027 based on total traffic or required in 2037 based on background traffic.

Table 24 - Traffic Signal Warrant (Victoria Ave E and PTH 110)

Traffic Scenario	Warrant Points (W)	Signal Warranted **if W > 100**
2019 Background	34	No
2027 Background	62	No
2037 Background	140	Yes
2019 Total	52	No
2027 Total	133	Yes
2037 Total	276	Yes

5.3.4 Operations with Recommended Intersection Treatments

Recommended intersection modifications are outlined in Table 25, based on existing operations, signalization warrants, and intersection treatment design warrants.

Table 25 – Recommended treatments for design year horizons (Victoria Ave E and PTH 110)

Design Year	Traffic Condition	
	Background Traffic	Total Traffic
2019	N/A	N/A
2027	N/A	Eastbound right-turn cut-off Traffic signal
2037	Traffic signal	-

Intersection operations for the recommended modifications in Table 25 were tested in Synchro, and operations are summarized in Table 26. Although no critical movements were identified, this intersection as a whole is nearing capacity under 2037 total traffic, even with a traffic signal installed. This is indicated by the 97% ICU. Manitoba Infrastructure has indicated the potential for the twinning of PTH 110 at some point in the future[6]. This concept

[6] Manitoba Department of Highways and Transportation (1997). Functional Design Study Brandon Eastern Access – PTH 110 (Southern Section) Technical Report.

warrants consideration beyond the 2037 horizon, based on background and projected development traffic at this intersection.

Additionally, under 2037 total traffic operations with a traffic signal, the 95th percentile queue is predicted to be approximately 115 m for eastbound traffic. Therefore, a storage lane is recommended preceding the eastbound right-turn cut-off, extending at least 125 m from the intersection.

Table 26 – Intersection Operations (Victoria Ave E and PTH 110)

Peak Period	Scenario	Overall Intersection			Critical Movements[1]			
		HCM LOS	ICU	Delay (sec/veh)	Movement	HCM LOS	Delay (sec/veh)	v/c
AM	2027 Total	B	0.58	15.2	none	---	---	---
	2037 Background	B	0.66	17.5	none	---	---	---
	2037 Total	C	0.76	22.7	none	---	---	---
PM	2027 Total	B	0.62	15.5	none	---	---	---
	2037 Background	B	0.66	17.9	none	---	---	---
	2037 Total	C	0.97	26.5	none	---	---	---

[1] Critical movements are defined as: (1) any through movement, or shared through/turning lane, with a v/c greater than 0.85; or (2) any exclusive turning lane with a v/c greater than 0.90.

5.3.5 Intersection Summary

The intersection operations analysis indicates that the intersection operates at an acceptable level of service for all approaches with two-way stop control, up until (and including) the 2027 background traffic horizon, as indicated in Table 22. The intersection design treatment warrant analysis reveals that treatments are warranted for the 2027, and 2037 horizons, as indicated in Table 25. A storage lane preceding the eastbound right-turn cut-off is recommended to accommodate right-turning vehicles. The signal warrant analysis reveals that signals will be warranted based on 2027 total traffic, or 2037 background traffic.

Additionally, even under signalized operations, this intersection is nearing capacity under projected 2037 total traffic. Beyond 2037, the twinning of PTH 110 should be considered.

5.4 RICHMOND AVENUE EAST AND 17TH STREET EAST

5.4.1 Existing Intersection Operations

Existing traffic operations at the intersection of Victoria Avenue and 33rd Street are summarized in Table 27. This intersection operates at an acceptable level of service (LOS C) under traffic conditions for all study years, except traffic conditions under 2037 total traffic. Under projected 2037 total traffic in the PM peak period, the intersection operates at LOS D, with the critical movement (westbound through) operating at LOS E, causing increases in delay.

Projected future developments as part of the East Brandon Industrial Secondary Plan will cause substantial increases to traffic volumes at the intersection of Richmond Avenue East with 17th Street East, and the intersection of Richmond Avenue East with PTH 110 by the year 2037, resulting in an increased collision risk and deteriorating traffic operations. Additionally, Richmond Avenue East is a designated dangerous goods route as well as a designated longer combination vehicle route from 17th Street East to 65th Street East. The twinning of Richmond Avenue East will help to reduce the collision risk of these vehicles and improve traffic operations. Therefore, the twinning of Richmond Avenue East from 17th Street East to 65th Street East is recommended for the 2037 horizon year to accommodate total traffic.

Table 27 – Intersection Operations (17th St E and Richmond Ave E)

Peak Period	Scenario	Overall Intersection			Critical Movements[1]			
		HCM LOS	ICU	Delay (sec/veh)	Movement	HCM LOS	Delay (sec/veh)	v/c
AM	2017 Existing	C	0.44	25.7	none	---	---	---
	2019 Background	C	0.45	25.9	none	---	---	---
	2019 Total	C	0.48	25.8	none	---	---	---
	2027 Background	C	0.49	25.7	none	---	---	---
	2027 Total	C	0.58	28.5	none	---	---	---
	2037 Background	C	0.55	26.6	none	---	---	---
	2037 Total	C	0.65	31.2	none	---	---	---
PM	2017 Existing	C	0.42	27.4	none	---	---	---
	2019 Background	C	0.43	27.3	none	---	---	---
	2019 Total	C	0.47	28.2	none	---	---	---
	2027 Background	C	0.47	27.9	none	---	---	---
	2027 Total	C	0.58	31.7	none	---	---	---
	2037 Background	C	0.53	29.2	none	---	---	---

	2037 Total	D	0.69	38.4	WBT	E	65.3	0.97

[1] Critical movements are defined as: (1) any through movement, or shared through/turning lane, with a v/c greater than 0.85; or (2) any exclusive turning lane with a v/c greater than 0.90.

5.4.2 Intersection Treatment Design

The **Warrants and Standards for Intersection Treatments of Rural Two-Lane Highways Design Guide** does not apply to signalized intersections. This is currently a signalized intersection.

5.4.3 Signalization Warrants

The traffic signal warrant was not applied at this intersection because a traffic signal currently exists.

5.4.4 Operations with Recommended Intersection Treatments

Based on existing intersection operations and routing designations, recommended intersection modifications are outlined in Table 28.

Table 28 – Recommended treatments for design year horizons (17th St E and Richmond Ave E)

Design Year	Traffic Condition	
	Background Traffic	Total Traffic
2019	N/A	N/A
2027	N/A	N/A
2037	N/A	Twinning of Richmond Ave E

Intersection operations for the recommended modifications in Table 28 were tested in Synchro, and operations are summarized in Table 29.

Table 29 – Intersection Operations (17th Street East and Richmond Avenue)

Peak Period	Scenario	Overall Intersection			Critical Movements[1]			
		HCM LOS	ICU	Delay (sec/veh)	Movement	HCM LOS	Delay (sec/veh)	v/c
AM	2037 Total	C	0.58	25.3	none	---	---	---
PM	2037 Total	C	0.56	30.0	none	---	---	---

[1] Critical movements are defined as: (1) any through movement, or shared through/turning lane, with a v/c greater than 0.85; or (2) any exclusive turning lane with a v/c greater than 0.90.

With the recommended twinning of Richmond Avenue in 2037, this intersection operates at an acceptable level of service (LOS C) under total traffic. No critical movements are

identified, and the intersection capacity utilization is reduced as compared to existing conditions under 2037 total traffic. In this analysis, it is assumed that the twinning of Richmond Avenue adds one through-lane to the east and westbound directions of travel, and that all other lane configurations remain the same.

5.4.5 Intersection Summary

The intersection operations analysis indicates that the intersection operates at an acceptable level of service for all study horizons, except under 2037 total traffic, as indicated in Table 27. Based on 2037 total traffic at this intersection and the intersection of Richmond Avenue East with PTH 110, as well as routing designations, it is recommended to twin Richmond Avenue East from 17th Street East to 65th Street East. Intersection operations for 2037 total traffic are acceptable with this recommended treatment.

5.5 RICHMOND AVENUE EAST AND PTH 110

5.5.1 Existing Intersection Operations

Existing traffic operations at the intersection of Richmond Avenue East and PTH 110 are summarized in Table 30. The intersection of Richmond Avenue East and PTH 110 operates at an acceptable level of service (LOS B to C) under 2017 existing traffic.

Beyond existing 2017 conditions, and considering additional traffic from the East Brandon development, the northbound and southbound approaches are projected to deteriorate quickly, particularly for left-turning vehicles. Under 2027 total traffic, the northbound and southbound left-turn movements reach LOS F and experience substantial increases in delay. In the case of the southbound left-turn movement, substantial volumes also exceed available capacity.

Projected future developments as part of the East Brandon Industrial Secondary Plan will cause substantial increases to traffic volumes at the intersection of Richmond Avenue East with 17th Street East, and the intersection of Richmond Avenue East with PTH 110 by the year 2037, resulting in an increased collision risk and deteriorating traffic operations. Additionally, Richmond Avenue East is a designated dangerous goods route as well as a designated longer combination vehicle route from 17th Street East to 65th Street East. The twinning of Richmond Avenue East will help to reduce the collision risk of these vehicles and improve traffic operations. Therefore, the twinning of Richmond Avenue East from 17th Street East to 65th Street East is recommended for the 2037 horizon year to accommodate total traffic.

Table 30 – Intersection Operations (Richmond Ave E and PTH 110)

Peak Period	Scenario	Approach	HCM LOS	ICU	Delay (sec/veh)	v/c	95th Percentile Queue **(m)**
AM	2017 Existing	NBL on PTH 110	C	---	16.6	0.02	< 1
		SBL on PTH 110	C	---	18.8	0.21	6.4
		Overall intersection	---	0.31	---	---	---
	2019 Background	NBL on PTH 110	C	---	18.0	0.02	< 1
		SBL on PTH 110	C	---	20.6	0.25	7.7
		Overall intersection	---	0.32	---	---	---
	2019 Total	NBL on PTH 110	C	---	22.4	0.03	< 1
		SBL on PTH 110	E	---	46.6	0.67	34.3
		Overall intersection	---	0.37	---	---	---

	2027 Background	NBL on PTH 110	D	---	26.8	0.03	< 1
		SBL on PTH 110	E	---	45.8	0.55	23.2
		Overall intersection	---	0.41	---	---	---
	2027 Total	NBL on PTH 110	F	---	63.3	0.13	3.3
		SBL on PTH 110	F	---	> 300	3.38	> 200
		Overall intersection	---	0.58	---	---	---
	2037 Background	NBL on PTH 110	F	---	102.7	0.23	6.2
		SBL on PTH 110	F	---	> 300	2.51	121.5
		Overall intersection	---	0.52	---	---	---
	2037 Total	NBL on PTH 110	F	---	> 300	> 5	> 200
		SBL on PTH 110	F	---	> 300	> 5	> 200
		Overall intersection	---	0.72	---	---	---
PM	2017 Existing	NBL on PTH 110	C	---	15.7	0.01	< 1
		SBL on PTH 110	B	---	14.4	0.08	2.1
		Overall intersection	---	0.32	---	---	---
	2019 Background	NBL on PTH 110	C	---	16.6	0.02	< 1
		SBL on PTH 110	B	---	14.9	0.08	2.2
		Overall intersection	---	0.32	---	---	---
	2019 Total	NBL on PTH 110	C	---	23.0	0.02	< 1
		SBL on PTH 110	C	---	22.1	0.21	6.3
		Overall intersection	---	0.40	---	---	---
	2027 Background	NBL on PTH 110	C	---	24.8	0.03	< 1
		SBL on PTH 110	C	---	21.2	0.18	5.2
		Overall intersection	---	0.39	---	---	---
	2027 Total	NBL on PTH 110	F	---	89.2	0.10	2.6
		SBL on PTH 110	F	---	258.5	1.24	63.9
		Overall intersection	---	0.56	---	---	---
	2037 Background	NBL on PTH 110	F	---	87.2	0.20	5.4
		SBL on PTH 110	F	---	63.6	0.55	21.7
		Overall intersection	---	0.49	---	---	---
	2037 Total	NBL on PTH 110	F	---	> 300	> 5	> 200
		SBL on PTH 110	F	---	> 300	> 5	> 200
		Overall intersection	---	0.71	---	---	---

5.5.2 Intersection Treatment Design

Results from the intersection treatment design warrant calculations are presented in

Table 31. These results indicate that:

Northbound PTH 110

- A right-turn cut-off is warranted in 2019 based on background traffic.

Table 31 - Intersection Treatment Warrants (Richmond Ave E and PTH 110)

Warrant	Treatment	Background Traffic						Total Traffic					
		2019		2027		2037		2019		2027		2037	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Northbound PTH 110													
Right-Turn LOS Warrant	Cut-Off	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

5.5.3 Signalization Warrants

Results provided in Table 32, indicate that a traffic signal would be required at this intersection in 2027 based on total traffic or required in 2037 based on background traffic.

Table 32 - Traffic Signal Warrant (Richmond Ave E and PTH 110)

Traffic Scenario	Warrant (W)	Points	Signal Warranted **if W > 100**
2019 Background	43		No
2027 Background	82		No
2037 Background	187		Yes
2019 Total	82		No
2027 Total	237		Yes
2037 Total	474		Yes

5.5.4 Operations with Recommended Intersection Treatments

Recommended intersection modifications are outlined in Table 33, based on existing intersection operations, signalization warrants, intersection treatment design warrants, and routing designations.

Table 33 – Recommended treatments for design year horizons (Richmond Ave E and PTH 110)

Design Year	Traffic Condition	
	Background Traffic	Total Traffic
2019	Northbound right-turn cut-off	Northbound right-turn cut-off
2027	-	Traffic signal
2037	Traffic signal	Twinning of Richmond Ave E Additional southbound left-turn lane

Intersection operations for the recommended modifications in Table 33 were tested in Synchro, and operations are summarized in Table 34 and Table 35.

Table 34 – Intersection Operations (Richmond Ave E and PTH 110)

Peak Period	Scenario	Approach	HCM LOS	ICU	**Delay** (sec/veh)	v/c	95th Percentile Queue **(m)**
AM	2019 Background	NBL on PTH 110	C	---	18.0	0.02	< 1
		SBL on PTH 110	C	---	20.2	0.24	7.5
		Overall intersection	---	0.32	---	---	---
	2019 Total	NBL on PTH 110	C	---	22.4	0.03	< 1
		SBL on PTH 110	E	---	43.1	0.65	32.3
		Overall intersection	---	0.37	---	---	---
	2027 Background	NBL on PTH 110	D	---	26.8	0.03	< 1
		SBL on PTH 110	E	---	43.4	0.54	22.2
		Overall intersection	---	0.41	---	---	---
PM	2019 Background	NBL on PTH 110	C	---	16.6	0.02	< 1
		SBL on PTH 110	B	---	14.7	0.08	2.1
		Overall intersection	---	0.32	---	---	---
	2019 Total	NBL on PTH 110	C	---	23.0	0.02	< 1
		SBL on PTH 110	C	---	21.6	0.21	6.2
		Overall intersection	---	0.40	---	---	---
	2027 Background	NBL on PTH 110	C	---	24.8	0.03	< 1
		SBL on PTH 110	C	---	20.7	0.18	5.0
		Overall intersection	---	0.39	---	---	---

Table 35 – Signalized Intersection Operations (Richmond Ave E and PTH 110)

Peak Period	Scenario	Overall Intersection			Critical Movements[1]			
		HCM LOS	ICU	**Delay** (sec/veh)	Movement	HCM LOS	**Delay** (sec/veh)	v/c
AM	2027 Total	C	0.63	33.8	none	---	---	---
	2037 Background	C	0.59	29.2	none	---	---	---
	2037 Total	C	0.56	24.4	none	---	---	---
PM	2027 Total	C	0.61	28.5	none	---	---	---
	2037 Background	C	0.54	28.1	none	---	---	---
	2037 Total	C	0.54	27.4	none	---	---	---

[1] Critical movements are defined as: (1) any through movement, or shared through/turning lane, with a v/c greater than 0.85; or (2) any exclusive turning lane with a v/c greater than 0.90.

Based on Table 34, the overall intersection operates at an acceptable level of service under 2027 background traffic and 2019 total traffic with a northbound right-turn cut-off installed.

However, the southbound left-turn movement operates at sub-optimal performance, reaching LOS E and approximately 45 seconds of delay under 2019 total traffic. Although a signal is not warranted, installation of a signal should be considered under 2027 background and 2019 total traffic conditions.

Considerations should be made to ensure that adequate right-of-way is accumulated at this intersection prior to construction of the northbound right-turn channel, as the right-of-way (shown in Figure 2) is tight in this area.

With the recommended signalization and subsequent twinning of Richmond Avenue East, as illustrated in Table 33, this intersection operates at an acceptable level of service (LOS C) with no critical movements. Intersection operations under signalization show a significant improvement in terms of LOS and delay as compared to operations with the existing two-way stop. In this analysis, it is assumed that the twinning of Richmond Avenue adds one through-lane to the east and westbound directions of travel, and that a second southbound left-turn lane is added to accommodate 2037 total traffic. Even with signalization **and** twinning, this intersection operates with the eastbound left, southbound left, and westbound through movements operating at LOS D under 2037 total traffic, primarily due to heavy southbound left-turn volumes. Therefore, the addition of a second left-turn lane is recommended.

5.5.5 Consideration of Interchange

Due to the heavy traffic volumes, as well as the presence of dangerous goods and longer combination vehicles at this intersection, construction of a grade-separated interchange should be considered beyond the 2037 horizon. A grade-separated interchange would substantially improve traffic operations under future traffic conditions, as well as improve safety by reducing the potential for collisions.

Consideration of an interchange at the intersection of PTH 110 and Richmond Avenue East is not part of the original concept of PTH 110 by Manitoba Infrastructure[7]. However, the concept plan identifies the potential for twinning PTH 110 sometime in the future. Based on the intersection operations at PTH 110 and Victoria Avenue East (see Section 5.3),

[7] Manitoba Department of Highways and Transportation (1997). Functional Design Study Brandon Eastern Access – PTH 110 (Southern Section) Technical Report.

consideration of twinning PTH 110 may be warranted sometime soon after the 2037 horizon. Considerations should be made to implement a grade-separated interchange at the intersection of PTH 110 and Richmond Avenue East when plans to twin PTH 110 are underway.

5.5.6 Consideration of Roundabout

The design of a single-lane roundabout was checked for operations using the methodology described in NCHRP Report 672. Under 2037 total traffic conditions, multiple approaches reached LOS F for the AM and PM peak periods, indicating that a larger roundabout of at least 2 lanes would be required. At the intersection of PTH 110 and Richmond Avenue East, the right-of-way is constrained by a rail line located 40 m from the intersection.

For a double-lane roundabout, considering the heavy trucks percentage in this area, NCHRP recommends a minimum inscribed diameter of 46 metres. When considering the dimensions of the travel lanes and splitter island, at least 54 metres of right-of-way would need to provided for a roundabout to be feasible. Additionally, the presence of a train at the nearby rail crossing has the potential to cause vehicles to backup in the circulating lanes (especially southbound, left-turning vehicles). For these reasons, the implementation of a roundabout is not feasible at this intersection.

5.5.7 Intersection Summary

The intersection operations analysis indicates that the LOS quickly deteriorates beyond 2017 existing traffic, particularly for the northbound and southbound left-turning movements under two-way stop control (see Table 30). The intersection design treatment warrant analysis reveals that a northbound right-turn cut-off is warranted based on 2019 background traffic. The signal warrant analysis reveals that signals will be warranted based on 2027 total traffic or 2037 background traffic conditions, but should be considered earlier to accommodate 2019 total traffic or 2027 background traffic conditions (see Table 34).

Based on 2037 total traffic at this intersection and the intersection of 17th Street East with PTH 110, as well as routing designations, it is recommended to twin Richmond Avenue East from 17th Street East to 65th Street East. It is also recommended to add a second southbound left-turn lane based on heavy southbound left-turn volumes for 2037 total traffic. Intersection operations for 2037 total traffic are acceptable with these recommended treatments.

5.6 RICHMOND AVENUE EAST AND LIMESTONE ROAD EAST

5.6.1 Existing Intersection Operations

Existing traffic operations at the intersection of Richmond Avenue East and Limestone Road East are summarized in Table 36. The intersection currently operates at an acceptable level of service (LOS B) up until (and including) the 2027 background traffic horizon. At the 2027 total traffic horizon, the northbound movement on Limestone Road East degrades to LOS D. The City of Brandon has identified a particular need to address LOS issues at Limestone Road East. Additionally, this intersection is located in the middle of a major growth node within the study area. Therefore, LOS D is not recommended at this intersection.

Under 2037 total traffic conditions, the northbound approach is projected to reach LOS F and experience substantial increases in delay.

It should be noted that the existing intersection configurations at Limestone Road East and Limestone Road West were assumed for 2017 traffic operations. However, with substantial increases in traffic on Richmond Avenue East in future horizon years, stop-controlled direct access to Richmond Avenue East should be avoided where possible to reduce collision risk.

Therefore, in future horizon years, considerations should be made to convert Limestone Road West to a right-in/right-out access, and allow egress to remaining traffic in the area through Limestone Road East. This allows for a reduction in direct stop-controlled access to Richmond Avenue West, and allows efforts to be focussed on improvements to Limestone Road East. Intersection operations beyond 2017 assumed a worst-case of all traffic entering and exiting the area using Limestone Road East.

It is recommended to convert Limestone Road West to a right-in/right-out access only once recommended signalization improvements are made to Limestone Road East, to avoid a reduction in access quality to the area at any time as compared to the present configuration.

Additionally, these analyses assume the twinning of Richmond Avenue East from 17th Street East to 65th Street East to accommodate 2037 total traffic. The reasoning for this twinning is discussed in Section 5.4.1 and Section 5.5.1 of this report.

Table 36 – Intersection Operations (Richmond Ave E and Limestone Rd E)

Peak Period	Scenario	Approach	HCM LOS	ICU	**Delay** (sec/veh)	v/c	95th Percentile Queue **(m)**
AM	2017 Existing	NB on Limestone	B	---	10.9	0.04	1.1
		Overall intersection	---	0.21	---	---	---
	2019 Background	NB on Limestone	B	---	11.4	0.07	1.8
		Overall intersection	---	0.25	---	---	---
	2019 Total	NB on Limestone	B	---	13.4	0.12	3.4
		Overall intersection	---	0.35	---	---	---
	2027 Background	NB on Limestone	B	---	12.1	0.10	2.5
		Overall intersection	---	0.27	---	---	---
	2027 Total	NB on Limestone	C	---	20.6	0.31	10.1
		Overall intersection	---	0.54	---	---	---
	2037 Background	NB on Limestone	B	---	13.4	0.13	3.6
		Overall intersection	---	0.31	---	---	---
	2037 Total	NB on Limestone	D	---	32.4	0.49	20.1
		Overall intersection	---	0.65	---	---	---
PM	2017 Existing	NB on Limestone	B	---	10.5	0.07	1.8
		Overall intersection	---	0.17	---	---	---
	2019 Background	NB on Limestone	B	---	11.1	0.15	4.2
		Overall intersection	---	0.20	---	---	---
	2019 Total	NB on Limestone	B	---	14.1	0.31	10.7
		Overall intersection	---	0.28	---	---	---
	2027 Background	NB on Limestone	B	---	11.7	0.18	5.3
		Overall intersection	---	0.22	---	---	---
	2027 Total	NB on Limestone	D	---	33.8	0.73	46.3
		Overall intersection	---	0.43	---	---	---
	2037 Background	NB on Limestone	B	---	12.9	0.24	7.6
		Overall intersection	---	0.25	---	---	---
	2037 Total	NB on Limestone	F	---	108.5	1.08	109.6
		Overall intersection	---	0.52	---	---	---

5.6.2 Intersection Treatment Design

Results from the intersection treatment design warrant calculations are presented in Table 37. These results indicate that:

Eastbound Richmond Ave E

- A right-turn cut-off is warranted in 2019 based on background traffic.

Table 37 - Intersection Treatment Warrants (Richmond Ave E and Limestone Rd E)

Warrant	Treatment	Background Traffic						Total Traffic					
		2019		2027		2037		2019		2027		2037	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Eastbound Richmond Ave E													
Right-Turn LOS Warrant	Cut-Off	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Westbound Richmond Ave E													
Left-Turn Conflict Warrant	Auxiliary Lane	No	No	No	No	No	No	No	No	No	No	No	No
Left-Turn Bypass Warrant	Bypass	No	No	No	No	No	No	No	No	No	No	No	No
Intersection Widening Warrant	Widening	No	No	No	No	No	No	No	No	No	No	No	No
Northbound Limestone Ave E													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	No	No	No	No	No	No	No	No
Turning Provision Warrant		No											

5.6.3 Signalization Warrants

A traffic signal is not warranted at this intersection for any of the traffic scenarios as shown in Table 38. However, poor traffic operations performance at this intersection under 2027 total traffic conditions onward indicate that signalization should be considered at this time.

Table 38 – Traffic Signal Warrant (Richmond Ave E and Limestone Rd E)

Traffic Scenario	Warrant (W)	Points	Signal Warranted **if W > 100**
2019 Background	10		No
2027 Background	14		No
2037 Background	21		No
2019 Total	24		No
2027 Total	64		No
2037 Total	97		No

5.6.4 Operations with Recommended Intersection Treatments

Recommended intersection modifications are outlined in Table 39, based on existing intersection operations, signalization warrants, and intersection treatment design warrants. Note that based on the traffic operations performance, signalization should be considered under 2027 total traffic conditions.

Table 39 – Recommended treatments for design year horizons (Richmond Ave E and Limestone Rd E)

Design Year	Traffic Condition	
	Background Traffic	Total Traffic
2019	Eastbound right-turn cut-off	Eastbound right-turn cut-off
2027	-	Traffic signal
2037	-	Twinning of Richmond Ave E

Intersection operations for the recommended modifications in Table 39 were tested in Synchro, and operations are summarized in Table 40 and Table 41. With the recommended intersection treatments, this intersection operates at an acceptable level of service (LOS B to C) at all horizon years. Operations with recommended intersection improvements represent a better LOS as compared to existing stop-controlled conditions. In this analysis, it is assumed that the twinning of Richmond Avenue adds one through-lane to the east and westbound directions of travel, and that all other lane configurations remain the same.

Table 40 – Intersection Operations (Richmond Ave E and Limestone Rd E)

Peak Period	Scenario	Approach	HCM LOS	ICU	**Delay** (sec/veh)	v/c	95th Percentile Queue **(m)**
AM	2019 Background	NB on Limestone Overall intersection	B ---	--- 0.25	11.4 ---	0.07 ---	1.8 ---
	2019 Total	NB on Limestone Overall intersection	B ---	--- 0.35	13.4 ---	0.12 ---	3.4 ---
	2027 Background	NB on Limestone Overall intersection	B ---	--- 0.27	12.1 ---	0.10 ---	2.5 ---
	2037 Background	NB on Limestone Overall intersection	B ---	--- 0.31	13.4 ---	0.13 ---	3.6 ---
PM	2019 Background	NB on Limestone Overall intersection	B ---	--- 0.20	11.1 ---	0.15 ---	4.2 ---
	2019 Total	NB on Limestone Overall intersection	B ---	--- 0.28	14.1 ---	0.31 ---	10.7 ---
	2027 Background	NB on Limestone Overall intersection	B ---	--- 0.22	11.7 ---	0.18 ---	5.3 ---
	2037 Background	NB on Limestone Overall intersection	B ---	--- 0.25	12.9 ---	0.24 ---	7.6 ---

Table 41 – Signalized Intersection Operations (Richmond Ave E and Limestone Rd E)

Peak Period	Scenario	Overall Intersection			Critical Movements[1]			
		HCM LOS	ICU	Delay (sec/veh)	Movement	HCM LOS	Delay (sec/veh)	v/c
AM	2027 Total	C	0.57	24.7	EB	C	13.1	0.90
	2037 Total	B	0.44	15.0	none	---	---	---
PM	2027 Total	B	0.46	18.6	none	---	---	---
	2037 Total	B	0.43	15.7	none	---	---	---

[1] Critical movements are defined as: (1) any through movement, or shared through/turning lane, with a v/c greater than 0.85; or (2) any exclusive turning lane with a v/c greater than 0.90.

5.6.5 Intersection Summary

The intersection operations analysis indicates that the intersection operates at an acceptable level of service for all approaches with two-way stop control, up until (and including) the 2037 background traffic horizon, as indicated in Table 40. The intersection design treatment warrant analysis reveals that an eastbound right-turn cut-off is warranted for the 2019 horizon, as indicated in Table 39. The signal warrant analysis reveals that signals are not warranted, but nevertheless should be considered to accommodate 2027 total traffic or 2037 total traffic.

The analysis at this intersection assume the twinning of Richmond Avenue East from 17th Street East to 65th Street East, as discussed in Sections 5.4.1 and 5.5.1 of this report. Additionally, considerations should be made to convert Limestone Road West to right-in/right-out operations, and to focus improvements on Limestone Road East, to minimize the number of stop-controlled direct accesses onto the busy Richmond Avenue East. All analyses beyond 2017 assume a worst-case of all traffic entering or exiting this region to be using Limestone Road East.

It is recommended to convert Limestone Road West to a right-in/right-out access only when recommended signalization improvements are made to Limestone Road East, to avoid a reduction in access quality to the area at any time as compared to the present configuration.

5.7 PTH 110 AND 17TH STREET EAST

5.7.1 Existing Intersection Operations

Existing traffic operations at the intersection of PTH 110 and 17th Street East are summarized in Table 42. The intersection currently operates at an acceptable level of service (LOS B to D). The minor street (17th Street E) approach operates below capacity and without excessive queueing at all horizon years.

Table 42 – Intersection Operations (PTH 110 and 17th St E)

Peak Period	Scenario	Approach	HCM LOS	ICU	Delay (sec/veh)	v/c	95th Percentile Queue **(m)**
AM	2017 Existing	NB on 17th Overall intersection	B ---	--- 0.30	11.0 ---	0.07 ---	1.7 ---
	2019 Background	NB on 17th Overall intersection	B ---	--- 0.30	11.2 ---	0.07 ---	1.8 ---
	2019 Total	NB on 17th Overall intersection	B ---	--- 0.32	11.5 ---	0.08 ---	2.1 ---
	2027 Background	NB on 17th Overall intersection	B ---	--- 0.34	12.7 ---	0.12 ---	3.4 ---
	2027 Total	NB on 17th Overall intersection	B ---	--- 0.40	14.2 ---	0.17 ---	5.0 ---
	2037 Background	NB on 17th Overall intersection	C ---	--- 0.41	16.9 ---	0.25 ---	7.6 ---
	2037 Total	NB on 17th Overall intersection	C ---	--- 0.48	22.1 ---	0.37 ---	13.2 ---
PM	2017 Existing	NB on 17th Overall intersection	B ---	--- 0.29	11.2 ---	0.08 ---	2.0 ---
	2019 Background	NB on 17th Overall intersection	B ---	--- 0.30	11.5 ---	0.08 ---	2.1 ---
	2019 Total	NB on 17th Overall intersection	B ---	--- 0.30	11.9 ---	0.09 ---	2.3 ---
	2027 Background	NB on 17th Overall intersection	B ---	--- 0.33	13.0 ---	0.14 ---	3.8 ---
	2027 Total	NB on 17th Overall intersection	C ---	--- 0.42	15.4 ---	0.22 ---	6.7 ---
	2037 Background	NB on 17th Overall intersection	C ---	--- 0.47	18.8 ---	0.30 ---	9.7 ---
	2037 Total	NB on 17th Overall intersection	D ---	--- 0.55	33.2 ---	0.57 ---	26.3 ---

5.7.2 Intersection Treatment Design

Results from the intersection treatment design warrant calculations are presented in Table 43. These results indicate that:

Eastbound PTH 110

- A right-turn cut-off is warranted in 2027 based on background traffic.

Table 43 - Intersection Treatment Warrants (PTH 110 and 17th St E)

		Background Traffic						Total Traffic					
		2019		2027		2037		2019		2027		2037	
Warrant	Treatment	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Eastbound PTH 110													
Right-Turn LOS Warrant	Cut-Off	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Left-Turn Conflict Warrant	Auxiliary Lane	Currently exists											
Right-Turn Conflict Warrant	Cut-Off	No	No	No	No			No	No				
Westbound PTH 110													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	No	No	No	No	No	No	No	No
Left-Turn Conflict Warrant	Auxiliary Lane	No	No	No	No	No	No	No	No	No	No	No	No
Northbound 17th St E													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	No	No	No	No	No	No	No	No
Turning Provision Warrant		No											

5.7.3 Signalization Warrants

A traffic signal is not warranted at this intersection for any of the traffic scenarios as shown in Table 44.

Table 44 – Traffic Signal Warrant (PTH 110 and 17th St E)

Traffic Scenario	Warrant (W)	Points	Signal Warranted **if W > 100**
2019 Background	10		No
2027 Background	19		No
2037 Background	44		No
2019 Total	12		No
2027 Total	33		No
2037 Total	72		No

5.7.4 Operations with Recommended Intersection Treatments

Based on existing intersection operations, signalization warrants, and intersection treatment design warrants, recommended intersection modifications are outlined in Table 45.

Table 45 – Recommended treatments for design year horizons (PTH 110 and 17th St E)

Design Year	Traffic Condition	
	Background Traffic	Total Traffic
2019	N/A	N/A
2027	Eastbound right-turn cut-off	Eastbound right-turn cut-off
2037	-	-

Intersection operations for the recommended modifications in Table 45 were tested in Synchro, and operations are summarized in Table 46. With the recommended modifications, the intersection continues to operate at an acceptable level of service. The minor street operates below capacity and without excessive queuing for all horizon years.

Table 46 – Intersection Operations (PTH 110 and 17th St E)

Peak Period	Scenario	Approach	HCM LOS	ICU	Delay (sec/veh)	v/c	95th Percentile Queue **(m)**
AM	2027 Background	NB on 17th	B	---	12.7	0.12	3.4
		Overall intersection	---	0.34	---	---	---
	2027 Total	NB on 17th	B	---	14.2	0.17	5.0
		Overall intersection	---	0.40	---	---	---
	2037 Background	NB on 17th	C	---	16.9	0.25	7.6
		Overall intersection	---	0.41	---	---	---
	2037 Total	NB on 17th	C	---	22.0	0.37	13.1
		Overall intersection	---	0.48	---	---	---
PM	2027 Background	NB on 17th	B	---	13.0	0.14	3.8
		Overall intersection	---	0.33	---	---	---
	2027 Total	NB on 17th	C	---	15.4	0.22	6.7
		Overall intersection	---	0.42	---	---	---
	2037 Background	NB on 17th	C	---	18.7	0.29	9.6
		Overall intersection	---	0.47	---	---	---
	2037 Total	NB on 17th	D	---	32.4	0.56	25.8
		Overall intersection	---	0.55	---	---	---

5.7.5 Intersection Summary

The intersection operations analysis indicates that the intersection operates at an acceptable level of service for all approaches with two-way stop control. The intersection design treatment warrant analysis reveals that an eastbound right-turn cut-off is warranted for 2027,

and 2037 horizons, as indicated in Table 45. The signal warrant analysis reveals that signals will not be warranted at this intersection for any of the design horizons.

5.8 PTH 110 AMD 33RD STREET EAST

5.8.1 Existing Intersection Operations

Existing traffic operations at the intersection of PTH 110 and 33rd Street East are summarized in Table 47. The intersection currently operates at a good level of service (LOS A to B). The minor street (33rd Street E) approach operates well below capacity and with minimal queueing at all horizon years.

Table 47 – Intersection Operations (PTH 110 and 33rd St E)

Peak Period	Scenario	Approach	HCM LOS	ICU	Delay (sec/veh)	v/c	95th Percentile Queue **(m)**
AM	2017 Existing	NB on 33rd	A	---	0.0	0.00	< 1
		Overall intersection	---	0.21	---	---	---
	2019 Background	NB on 33rd	A	---	0.0	0.00	< 1
		Overall intersection	---	0.21	---	---	---
	2019 Total	NB on 33rd	A	---	0.0	0.00	< 1
		Overall intersection	---	0.22	---	---	---
	2027 Background	NB on 33rd	A	---	0.0	0.00	< 1
		Overall intersection	---	0.22	---	---	---
	2027 Total	NB on 33rd	A	---	0.0	0.00	< 1
		Overall intersection	---	0.27	---	---	---
	2037 Background	NB on 33rd	A	---	0.0	0.00	< 1
		Overall intersection	---	0.26	---	---	---
	2037 Total	NB on 33rd	B	---	10.1	0.00	< 1
		Overall intersection	---	0.38	---	---	---
PM	2017 Existing	NB on 33rd	B	---	10.3	0.02	< 1
		Overall intersection	---	0.17	---	---	---
	2019 Background	NB on 33rd	B	---	10.4	0.02	< 1
		Overall intersection	---	0.17	---	---	---
	2019 Total	NB on 33rd	B	---	10.7	0.02	< 1
		Overall intersection	---	0.18	---	---	---
	2027 Background	NB on 33rd	B	---	10.9	0.03	< 1
		Overall intersection	---	0.19	---	---	---
	2027 Total	NB on 33rd	B	---	11.4	0.03	< 1
		Overall intersection	---	0.18	---	---	---
	2037 Background	NB on 33rd	B	---	12.3	0.04	1.1
		Overall intersection	---	0.24	---	---	---
	2037 Total	NB on 33rd	B	---	12.8	0.06	1.5
		Overall intersection	---	0.25	---	---	---

5.8.2 Intersection Treatment Design

Results from the intersection treatment design warrant calculations are presented in Table 48. These results indicate that:

Eastbound PTH 110

- Intersection widening is warranted in 2019 based on total traffic or 2027 based on background traffic.
- A left-turn auxiliary lane is warranted in 2037 based on total traffic.
- A bypass is warranted in 2037 based on background traffic.

Westbound PTH 110

- Intersection widening is warranted in 2027 based on total traffic.

Southbound 33rd St E

- A right-turn cut-off is warranted in 2037 based on background traffic.

Table 48 - Intersection Treatment Warrant (PTH 110 and 33rd St E)

		Background Traffic						Total Traffic					
		2019		2027		2037		2019		2027		2037	
Warrant	Treatment	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Eastbound PTH 110													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	No	No	No	No	No	No	No	No
Left-Turn Conflict Warrant	Auxiliary Lane	No	No	No	No	No	No	No	No	No	No	Yes	No
Right-Turn Conflict Warrant	Cut-Off Auxiliary Lane	No	No	No	No	No	No	No	No	No	No	No	No
Left-Turn Bypass Warrant	Bypass	No	No	No	No	Yes	No	No	No	No	No		
Right-Turn Bypass Warrant	Bypass												
Intersection Widening Warrant	Widening	No	No	Yes	No			Yes	No	Yes	No		
Westbound PTH 110													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	No	No	No	No	No	No	No	No
Left-Turn Conflict Warrant	Auxiliary Lane	No	No	No	No	No	No	No	No	No	No	No	No
Right-Turn Conflict Warrant	Cut-Off Auxiliary Lane	No	No	No	No	No	No	No	No	No	No	No	No
Left-Turn Bypass Warrant	Bypass	No	No	No	No	No	No	No	No	No	No	No	No
Right-Turn Bypass Warrant	Bypass	No	No	No	No	No	No	No	No	No	No	No	No

Intersection Warrant	Widening Widening	No	No	No	No	No	No	No	No	Yes	No	Yes	No
Northbound 33rd St E													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	No	No	No	No	No	No	No	No
Turning Provision Warrant		No											
Southbound 33rd St E													
Right-Turn LOS Warrant	Cut-Off	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Turning Provision Warrant		No											

5.8.3 Signalization Warrants

A traffic signal is not warranted at this intersection for any of the traffic scenarios as shown in Table 49.

Table 49 - Traffic Signal Warrant (PTH 110 and 33rd St E)

Traffic Scenario	Warrant Points (W)	Signal Warranted **if W > 100**
2019 Background	1	No
2027 Background	2	No
2037 Background	5	No
2019 Total	2	No
2027 Total	4	No
2037 Total	8	No

5.8.4 Operations with Recommended Intersection Treatments

recommended intersection modifications are outlined in Table 50, Based on existing intersection operations, signalization warrants, and intersection treatment design warrants.

Table 50 – Recommended treatments for design year horizons (PTH 110 and 33rd St E)

Design Year	Traffic Condition	
	Background Traffic	Total Traffic
2019	N/A	Eastbound intersection widening
2027	Eastbound intersection widening	Westbound intersection widening
2037	Eastbound bypass Southbound right-turn cut-off	Eastbound left-turn auxiliary lane Southbound right-turn cut-off

Intersection operations for the recommended modifications in Table 50 were tested in Synchro, and operations are summarized in Table 51. With the recommended modifications, the intersection continues to operate at a good level of service. The minor street operates well below capacity and with minimal queuing for all horizon years. It should be noted that due to configuration characteristics, intersection widening is not expected to have a significant impact on traffic operations. In this analysis, the primary effects of intersection widening are safety-related and therefore only recommended treatments for the design year 2037 are modelled.

Table 51 – Intersection Operations (PTH 110 and 33rd St E)

Peak Period	Scenario	Approach	HCM LOS	ICU	**Delay** (sec/veh)	v/c	95th Percentile Queue **(m)**
AM	2037 Background	NB on 33rd Overall intersection	A ---	--- 0.19	0.0 ---	0.00 ---	< 1 ---
	2037 Total	NB on 33rd Overall intersection	B ---	--- 0.34	10.1 ---	0.00 ---	< 1 ---
PM	2037 Background	NB on 33rd Overall intersection	B ---	--- 0.19	12.4 ---	0.04 ---	1.1 ---
	2037 Total	NB on 33rd Overall intersection	B ---	--- 0.23	12.1 ---	0.06 ---	1.4 ---

5.8.5 Intersection Summary

The intersection operations analysis indicates that the intersection operates at a good level of service for all approaches with two-way stop control. The intersection design treatment warrant analysis reveals that treatments are warranted for 2019, 2027, and 2037 horizons, as indicated in Table 50. The signal warrant analysis reveals that signals will not be warranted at this intersection for any of the design horizons.

6 TRANSPORTATION SYSTEM MODIFICATIONS

The analysis in **Section 5.0** indicated that all study area intersections will require some type of modification in future years. These modifications are identified and discussed in this section, and shown in Table 52.

The modifications illustrated are solely required to serve the proposed development. The **2007 City of Brandon Traffic Impact Study Policy** states that:

"The proponent will be responsible for modifications solely required to serve the proposed **development. In the case of items that may also be of value to the general travelling public, the City may consider cost-sharing. Any cost sharing will be assessed on a site-by site basis.***"* **(p. D-9).**

For study area routes of value to the general travelling public, proponents are responsible for modification costs, based on the proportion of total traffic represented by development traffic. It should be noted that at this point, the development traffic proportions in Table 52 are a rough estimate of the traffic produced by the EBIA developments as a whole, relative to total traffic at a given horizon year.

The effects of an individual development on study area traffic are dependent on actual development size and location. The method to determine the effects of an individual development on traffic conditions is as follows:

1. Determine actual peak hour trips generated, using Table 2 and the actual development size
2. Add the trips generated to intersections impacted by designated routes to the individual development
3. Calculate the percent of intersection traffic represented by trips generated

Specific sizes and locations of individual developments are not known at the time of this study.

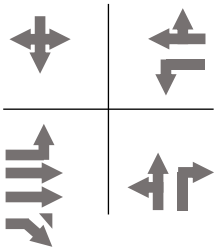
Table 52 – Proposed modifications and percent of total traffic represented by development traffic

		Recommended Modifications	Development Traffic Proportion
Victoria Ave E and 17th St E **(Figure 15)**			
Back-ground	2019		
	2027	Traffic Signal	
	2037		
Total	2019		17%
	2027	Traffic Signal	31%
	2037		31%
Victoria Ave E and 33rd St E **(Figure 16)**			
Background	2019	Eastbound bypass Westbound intersection widening	
	2027		
	2037	Eastbound right-turn cut-off Eastbound left-turn auxiliary lane	
Total	2019	Eastbound bypass Westbound intersection widening	13%
	2027	Eastbound right-turn cut-off Eastbound left-turn auxiliary lane Westbound left-turn auxiliary lane	25%
	2037		25%
Victoria Ave E and PTH 110 **(Figure 17)**			
Back-ground	2019		
	2027		
	2037	Traffic signal	
Total	2019		19%
	2027	Eastbound right-turn cut-off Traffic signal	31%
	2037		28%
Richmond Ave E and 17th St E **(Figure 18)**			
Back-ground	2019		
	2027		
	2037		
Total	2019		16%

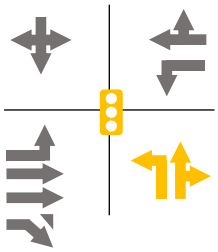
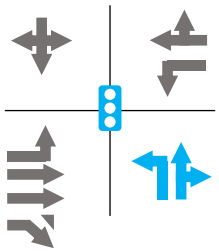
		Recommended Modifications	Development Traffic Proportion
	2027		31%
	2037	Second lane along Richmond Ave E in both directions	31%
Richmond Ave E and PTH 110 **(Figure 19)**			
Back-ground	2019	Northbound right-turn cut-off	
	2027		
	2037	Traffic signal	
Total	2019	Northbound right-turn cut-off	27%
	2027	Traffic signal	41%
	2037	Second lane along Richmond Ave E in both directions Second southbound left-turn auxiliary lane	36%
Richmond Ave E and Limestone Rd E **(Figure 20)**			
Back-ground	2019	Eastbound right-turn cut-off	
	2027		
	2037		
Total	2019	Eastbound right-turn cut-off	35%
	2027	Traffic signal	53%
	2037	Second lane along Richmond Ave E in both directions	54%
PTH 110 and 17th St E **(Figure 21)**			
Back-ground	2019		
	2027	Eastbound right-turn cut-off	
	2037		
Total	2019		11%
	2027	Eastbound right-turn cut-off	23%
	2037		22%
PTH 110 and 33rd St E **(Figure 22)**			
Back-ground	2019		
	2027	Eastbound intersection widening	
	2037	Eastbound bypass Southbound right-turn cut-off	
Total	2019	Eastbound intersection widening	18%
	2027	Westbound intersection widening	30%

Recommended Modifications		Development Traffic Proportion
2037	Eastbound left-turn auxiliary lane Southbound right-turn cut-off	26%

Existing Conditions

Dir	Roadway / Class	Speed [km/h]	Configuration
EB	Victoria Ave E *Arterial*	60	
WB	Victoria Ave E *Arterial*	60	
NB	17th St E *Arterial*	60	
SB	17th St E *Arterial*	60	

Projected Conditions

		BACKGROUND Traffic Conditions	TOTAL Traffic Conditions
2019		*No modifications warranted.*	*No modifications warranted.*
2027		*No modifications warranted.*	Traffic Signal Recommended. 
2037		Traffic Signal Recommended. 	Traffic signal warranted.

MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

Figure 15
Recommended Intersection Enhancements for Victoria Ave E at 17th St E

Existing Conditions

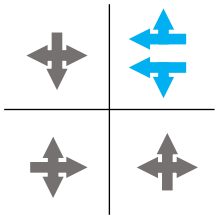
Dir	Roadway / Class	Speed [km/h]	Configuration
EB	Victoria Ave E *Arterial*	60	
WB	Victoria Ave E *Arterial*	60	
NB	33rd St E *Local*	50	
SB	33rd St E *Local*	50	

Projected Conditions

BACKGROUND Traffic Conditions

2019

Eastbound bypass.
Westbound intersection widening.

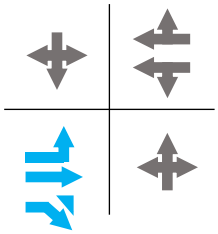


2027

No modifications warranted.

2037

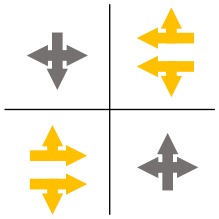
Eastbound left-turn auxiliary lane.
Eastbound right-turn cut-off.



TOTAL Traffic Conditions

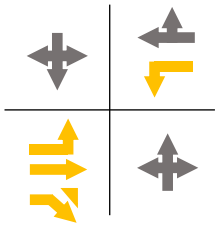
2019

Eastbound bypass.
Westbound intersection widening.



2027

Eastbound left-turn auxiliary lane.
Eastbound right-turn cut-off.
Westbound left-turn auxiliary lane.



2037

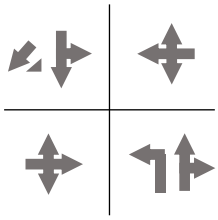
No modifications warranted.

MORR TRANSPORTATION CONSULTING

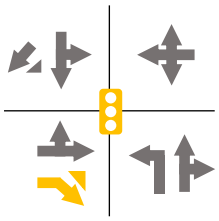
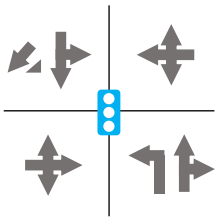
Brandon East Industrial Area Secondary Plan

Figure 16
Recommended Intersection Enhancements for Victoria Ave E at 33rd St E

Existing Conditions

Dir	Roadway / Class	Speed [km/h]	Configuration
NB	PTH 110 *Expressway*	90	
SB	PTH 110 *Expressway*	90	
EB	Victoria Ave E *Arterial*	60	
WB	Victoria Ave E *Arterial*	60	

Projected Conditions

		BACKGROUND Traffic Conditions	TOTAL Traffic Conditions
2019		*No modifications warranted.*	*No modifications warranted.*
2027		*No modifications warranted.*	Eastbound right-turn cut-off. Traffic signal warranted. 
2037		Traffic signal warranted. 	*No modifications warranted.*

MORR TRANSPORTATION CONSULTING

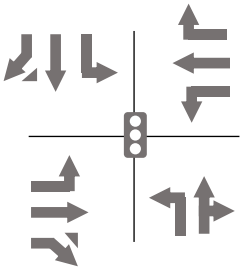
Brandon East Industrial Area Secondary Plan

Figure 17
Recommended Intersection Enhancements for Victoria Ave E at PTH 110

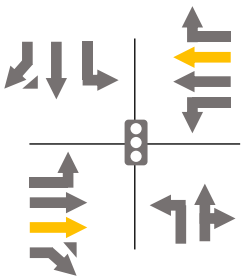
Existing Conditions

Dir	Roadway / Class	Speed [km/h]
EB	Richmond Ave E *Arterial*	60
WB	Richmond Ave E *Arterial*	60
NB	17th St E *Arterial*	60
SB	17th St E *Arterial*	60

Configuration



Projected Conditions

		BACKGROUND Traffic Conditions	TOTAL Traffic Conditions
2019		*No modifications warranted.*	*No modifications warranted.*
2027		*No modifications warranted.*	*No modifications warranted.*
2037		*No modifications warranted.*	Second lane along Richmond Ave E in both directions. 

MORR TRANSPORTATION CONSULTING

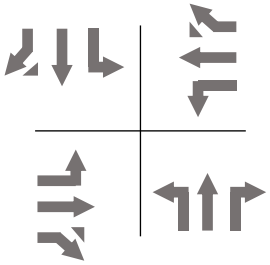
Brandon East Industrial Area Secondary Plan

Figure 18
Recommended Intersection Enhancements for Richmond Ave E at 17th St E

Existing Conditions

Dir	Roadway / Class	Speed [km/h]
EB	Richmond Ave E *Arterial*	90
WB	Richmond Ave E *Arterial*	90
NB	PTH 110 *Expressway*	90
SB	PTH 110 *Expressway*	90

Configuration

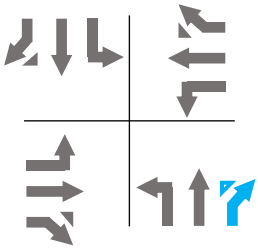


Projected Conditions

BACKGROUND Traffic Conditions

2019

Northbound right-turn cut-off.

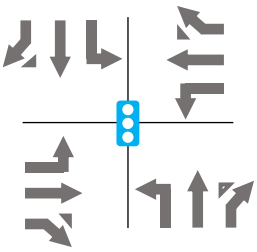


2027

No modifications warranted.

2037

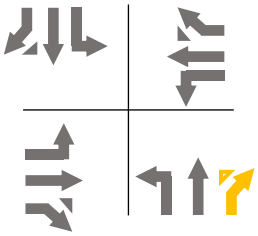
Traffic signal warranted.



TOTAL Traffic Conditions

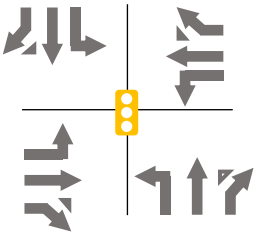
2019

Northbound right-turn cut-off.



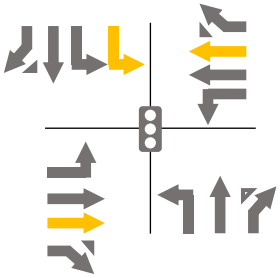
2027

Traffic signal warranted.



2037

Second lane along Richmond Ave E in both directions.
Second southbound left-turn auxiliary lane.



MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

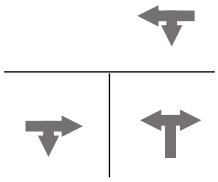
Figure 19

Recommended Intersection Enhancements for Richmond Ave E at PTH 110

Existing Conditions

Dir	Roadway / Class	Speed [km/h]
EB	Richmond Ave E *Arterial*	90
WB	Richmond Ave E *Arterial*	90
NB	Limestone Rd E *Local*	50
SB	Limestone Rd E *Local*	50

Configuration

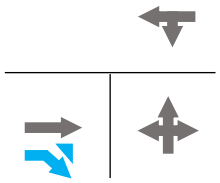


Projected Conditions

BACKGROUND Traffic Conditions

2019

Eastbound right-turn cut-off.



2027

No modifications warranted.

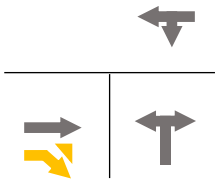
2037

No modifications warranted.

TOTAL Traffic Conditions

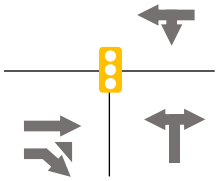
2019

Eastbound right-turn cut-off.



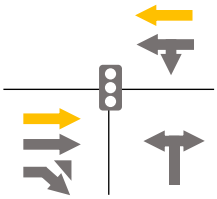
2027

Traffic signal warranted.



2037

Second lane along Richmond Ave E in both directions.



MORR TRANSPORTATION CONSULTING

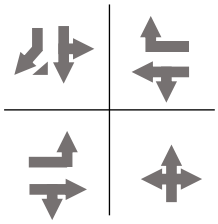
Brandon East Industrial Area Secondary Plan

Figure 20
Recommended Intersection Enhancements for Richmond Ave E at Limestone Rd E

Existing Conditions

Dir	Roadway / Class	Speed [km/h]
EB	PTH 110 *Expressway*	90
WB	PTH 110 *Expressway*	90
NB	17th St E *Arterial*	90
SB	17th St E *Arterial*	90

Configuration



Projected Conditions

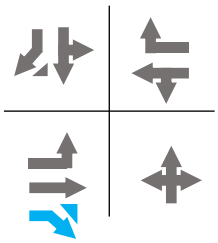
BACKGROUND Traffic Conditions

2019

No modifications warranted.

2027

Eastbound right-turn cut-off.



2037

No modifications warranted.

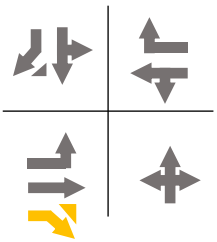
TOTAL Traffic Conditions

2019

No modifications warranted.

2027

Eastbound right-turn cut-off.



2037

No modifications warranted.

MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

Figure 21
Recommended Intersection Enhancements for PTH 110 at 17th St E

Existing Conditions

Dir	Roadway / Class	Speed [km/h]	Configuration
EB	PTH 110 *Expressway*	90	
WB	PTH 110 *Expressway*	90	
NB	33rd St E *Local*	50	
SB	33rd St E *Local*	50	

Projected Conditions

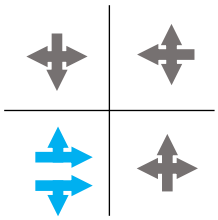
BACKGROUND Traffic Conditions

2019

No modifications warranted.

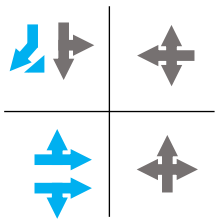
2027

Eastbound intersection widening.



2037

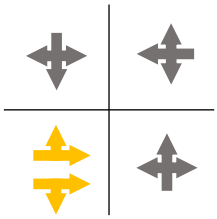
Eastbound bypass.
Southbound right-turn cut-off.



TOTAL Traffic Conditions

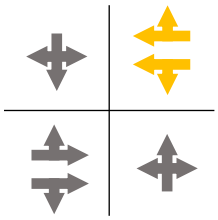
2019

Eastbound intersection widening.



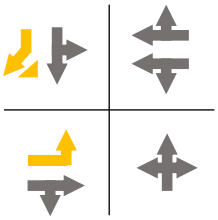
2027

Westbound intersection widening.



2037

Eastbound left-turn auxiliary lane.
Southbound right-turn cut-off.



MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

Figure 22
Recommended Intersection Enhancements for PTH 110 at 33rd St E

7 Other Considerations

7.1 TRANSIT ACTIVITY

The City of Brandon currently provides Transit services to the East Brandon Industrial Area with a few routes, primarily operating during peak hours of the day. Current routes are summarized as follows:

- Industrial/Maple Leaf route, operating in 15-minute increments from 2:00 and 4:00 PM. This route extends along Richmond Avenue from 13th Street at the east to the Maple Leaf plant to the west.
- Industrial AM special 1, operating between 5:30 and 6:00 AM. This route loops through the core of Brandon, primarily on Victoria Avenue, Rosser Avenue, Richmond Avenue, and 17th Street East, and terminates at the Maple Leaf plant.
- Industrial AM special 2, operating between 5:30 and 6:00 AM. This route loops through the core of Brandon, primarily on Park Avenue and Richmond Avenue, and terminates at the Maple Leaf plant.
- Late Night Maple Leaf route, operating between 11:45 PM and 2:15 AM. This route depends on demands of individual people riding.

Existing Transit coverage can be seen in Figure 23.

Plans for the East Brandon Industrial Area include significant developments on the south part of 17th Street East, near PTH 110, as well as the east part of Richmond Avenue East, near the existing Maple Leaf plant (see Figure 23). Table 53 illustrates the increases in AM and PM peak hour traffic using these corridors at the study horizons. Table 53 also specifies whether traffic is entering the Industrial Area (leaving Brandon), or exiting the Industrial Area (entering Brandon).

Table 53 – Peak Hour Volumes to Development Areas

Route	Horizon	AM Peak Hour		PM Peak Hour	
		Enter	Exit	Enter	Exit
17th St E, south of Richmond Ave E	2017	45	70	75	85
17th St E, south of Richmond Ave E	2019	66	75	81	104
17th St E, south of Richmond Ave E	2027	122	102	117	167
17th St E, south of Richmond Ave E	2037	149	129	145	209
Richmond Ave E, east of PTH 110	2017	140	95	70	145
Richmond Ave E, east of PTH 110	2019	220	119	95	226
Richmond Ave E, east of PTH 110	2027	372	176	160	377

Richmond Ave E, east of PTH 110	2037	508	256	223	520

Traffic volumes show an increase in peak hour demand along these two corridors. In some cases, directional traffic may increase by a factor of at least 2 or 3, primarily due to developments as part of the East Brandon Industrial Secondary Plan. Four routing recommendations follow from this analysis:

1. Increase service along the existing Richmond Avenue corridor as travel demand along this corridor increases.
2. Extend the Richmond Avenue route east of the Maple Leaf plant as new developments are implemented in that area.
3. Add service to the south part of 17th Street East corridor as travel demand along this corridor increases.
4. Add service along Victoria Avenue East between 17th Street East and 33rd Street East as new developments are implemented in the area.

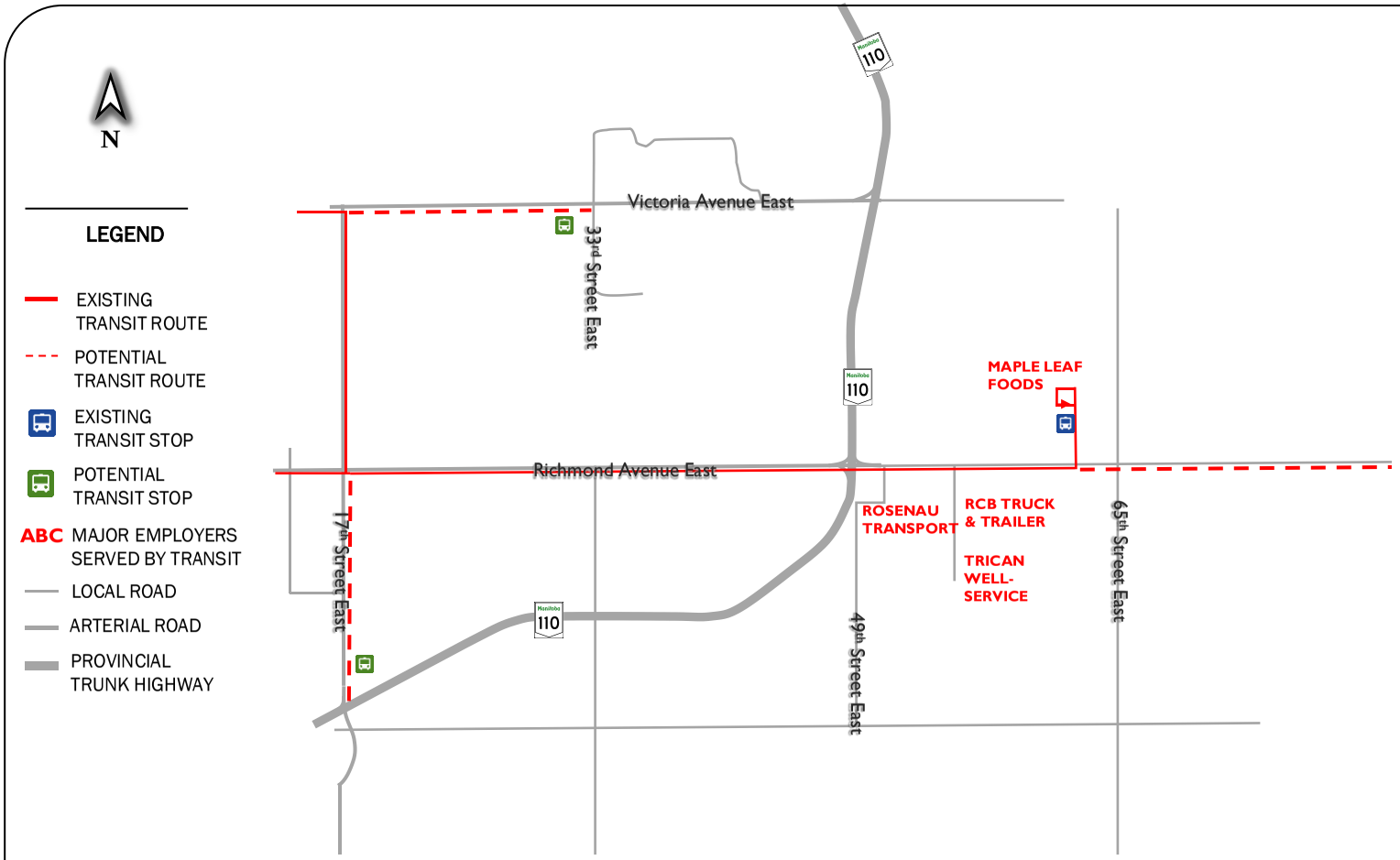
These routing recommendations will expand Transit service to more employees working in the East Brandon Industrial Area, as well as reduce the need for Transit users to walk from existing route stops to their destination. These recommendations target growth nodes, and therefore areas which are likely to be developed first. The City of Brandon's experience with early developments may serve as lessons for further Transit development to partially-serviced and un-serviced areas.

Additionally, Transit stops should be arranged along these corridors, based on the locations of new developments. These stops may represent "hubs" or "terminals" located in strategic locations to minimize the distance to new developments. Winnipeg Transit[8] specifies best practices for developing Transit routes and stops, and covers material including the following:

- Accessibility, visibility and safety
- Route connectivity
- Design and layout of bus stops, platforms, and shelters

[8] Winnipeg Transit. Designing for Sustainable Transportation and Transit in Winnipeg.

It is recommended that the City of Brandon follows a similar approach as specified in these guidelines when implementing Transit, or develops similar guidelines based on unique goals and objectives of the City of Brandon.



MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

Figure 23
TRANSIT FACILITIES

7.2 ACTIVE TRANSPORTATION FACILITIES

The East Brandon Industrial Area features pedestrian/cycling facilities, as shown in Figure 24. The existing Active Transportation (AT) network includes the following features:

- Sidewalk/path on the west side of 17th Street East, between Victoria Avenue East and Richmond Avenue East
- Sidewalk/path on the north side of Victoria Avenue East, between 17th Street East and 33rd Street East

The City of Brandon Greenspace Master Plan[9] outlines a proposed trail network to add to the existing trail network. To accommodate both walking and cycling, paths should have a width of 3.5 to 4.0 metres, as specified by the Transportation Association of Canada[10]. Proposed paths found in this document which are recommended in this study include the following (see Figure 24):

- Continuation of the existing path on the north side of Victoria Avenue East up to PTH 110
- Continuation of the existing path on the west side of 17th Street East up to PTH 110
- New path along the inside or outside of PTH 110
- New path along the north or south side of Richmond Avenue East from 17th Street East to 65th Street East
- **Optional** path extending along Patricia Avenue East, which may be implemented to serve future developments, and connects to Brandon through one of two ways:
    - Through 17th Street East
    - Through 33rd Street East via Richmond Avenue East

These routes will provide the AT connectivity required to promote walking and cycling in the East Brandon Industrial Area.

[9] City of Brandon (2015). Greenspace Master Plan.

[10] Transportation Association of Canada (1999). Geometric Design of Canadian Roads.

MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

Figure 24
ACTIVE TRANSPORTATION FACILITIES

7.3 RAIL LINES

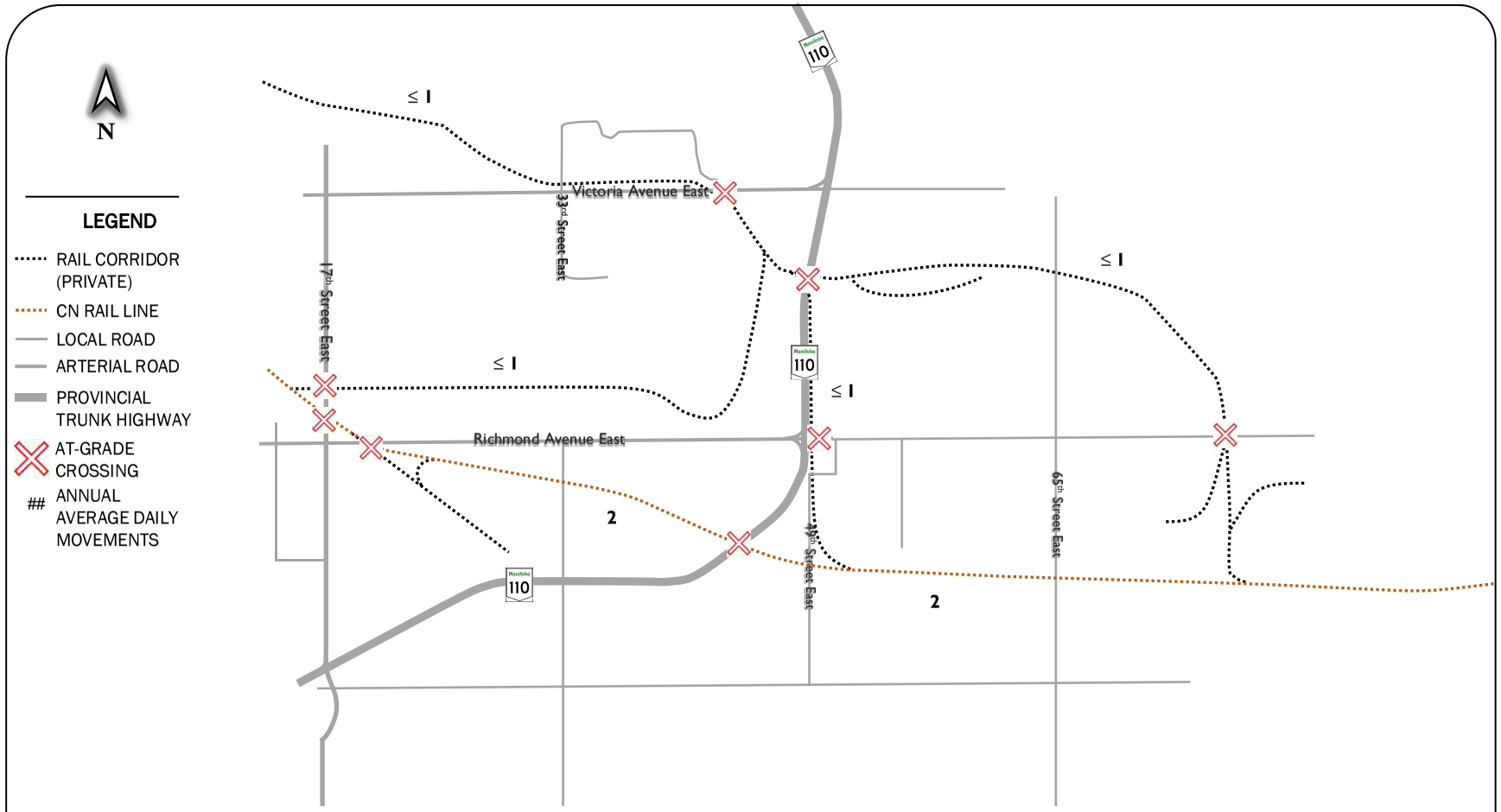
There are several rail lines located in the East Brandon Industrial Area, as follows (see Figure 25). Rail statistics are from Transport Canada's 2016 database.

- CN mainline, which extends east-west at the south end of the study area. This line crosses PTH 110, 17th Street East, and Richmond Avenue East, and serves approximately 2 rail movements per day and has a freight speed of up to 25 mph.
- Spur line between Victoria Avenue East, and Richmond Avenue East. This line serves ≤ 1 rail movement per day.
- Spur lines east of PTH 110. These lines serve ≤ 1 rail movement per day.
- Spur line north of Victoria Avenue East, connecting with the CP mainline to the north of the study area. This line serves ≤ 1 rail movement per day.

The presence of these rail lines creates a high number of railway-roadway grade crossings within the study area. Transport Canada recently released the new Grade Crossing Regulations[11] and associated Standards, which specify requirements related to (1) roadway approaches, (2) traffic control devices, (3) crossing surface, and (4) sightlines. These requirements come into effect in 2021, and the City of Brandon must check and repair any crossings which are not up to standard by this deadline. In particular, if signals are installed at the intersection of PTH 110 and Richmond Avenue East, the City of Brandon may have to upgrade the grade crossing warning system to ensure compliance with the Grade Crossing Regulations.

Additionally, efforts should be made to plan future developments such that customers who require rail access are located adjacent or along existing rail lines. This would reduce the need for additional spur lines to be built, and would limit the number of at-grade crossings.

[11] Transport Canada (2017). Grade Crossing Regulations.



MORR TRANSPORTATION CONSULTING

Brandon East Industrial Area Secondary Plan

Figure 25
RAILWAY FACILITIES

7.4 RECOMMENDED CORRIDOR CONSIDERATIONS

7.4.1 Road Classification Characteristics

The Brandon Area Road Network Development Plan[12] defines relevant basic roadway classifications as follows:

- Expressways: "Intended to handle high speed traffic around the City for the efficient movement of people and goods".
- Arterial Streets: "Intended to accommodate large volumes of traffic with a high level of safety and efficiency".
- Collector Streets: "Intended to accommodate moderate volumes of traffic travelling at moderate speeds."
- Local Streets: "Intended to provide for vehicular access to individual building lots and which accommodate low volumes of traffic travelling at low speeds".

These basic roadway classifications are accompanied by criteria relating to design speed, number of lanes, access control, intersection spacing, and right-of-way. An estimate of 2037 AADT was developed as part of this traffic impact assessment to ensure that key study area roads will be accommodating of future projected traffic operations.

The AADT estimates were developed by first calculating the 2037 daily background volumes for each roadway, using temporal characteristics from Manitoba Traffic Pattern Group (TPG) 1[13]. This TPG is reflective of routes near major urban centres such as Winnipeg and Brandon. In this traffic pattern group, the AM peak hour represents approximately 7% of daily traffic, and the PM peak hour represents approximately 9% of daily traffic.

The daily trips generated from the East Brandon Industrial Area developments for the year 2037 were also calculated, and were distributed throughout the study area traffic network using the same trip distribution method as the AM and PM peak hour trips. These 2037 daily development trips were added to the 2037 background daily traffic, producing an estimate of 2037 AADT. Table 54 shows a comparison between 2037 projected AADT, and the AADT criteria for key roadways throughout the study network. The table reveals that all current

[12] MMM Group (2007). Brandon Area Road Network Development Plan.

[13] Grande G. (2017). 2016 Traffic on Manitoba Highways.

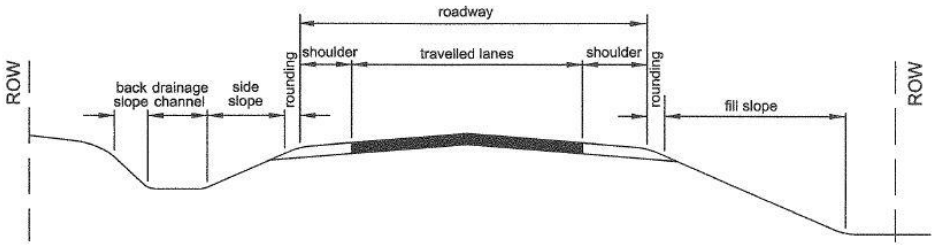
road classifications within the road study network will adequately support traffic operations throughout all study horizons.

Based on the planned land uses at the south end of the study area, it is also recommended to review the intended functionality and classification of Patricia Avenue East. From the land use map (see Appendix A), areas 4, 6, 9, 14, 15, and 16 all border Patricia Avenue East. Although these areas may not be developed as quickly as areas near development nodes, these areas will create a future demand for truck traffic along Patricia Avenue East, which is currently an unpaved, local roadway which does not allow trucks.

To accommodate future truck traffic generated by developments in these areas, it is recommended to upgrade Patricia Avenue East to a collector standard, since this roadway should provide both through traffic and land access, as well as allow the usage of trucks on this route. Upgrades should be considered between PTH 10 and the eastern limits of the study area. Figure 26 shows a typical cross-section for an undivided rural collector street. The total road width, not including drainage channels, is approximately 11.0 metres, according to the Transportation Association of Canada.

Table 54 – Projected study area AADT values

Road Link	Road Classification	AADT Criteria	Projected 2037 AADT	Result (Based on 2037 AADT)
PTH 110, between 17th Street East and Victoria Avenue East	Expressway	N/A	13,000	Classification adequate
Victoria Avenue East	Arterial	5,000 – 30,000	9,700	Classification adequate
Richmond Avenue East	Arterial	5,000 – 30,000	14,600	Classification adequate
17th Street East	Arterial	5,000 – 30,000	9,500	Classification adequate
33rd Street East, south of Victoria Avenue East	Local	< 1,500	1,300	Classification adequate
33rd Street East, between Richmond Avenue East and PTH 110	Local	< 1,500	900	Classification adequate



design speed km/h	design hour vol.	max. back slope	desirable min. side slope	shoulder rounding (m)	shoulders (m)	travelled lanes (m)	fill slopes with barrier	fill slopes no barrier
60,70	<250	3:1	3:1	0.5	2.0	3.0	2:1(rock 1.5:1)	3:1
60,70	250-450	3:1	3:1	0.5	2.0	3.3	2:1(rock 1.5:1)	3:1
60,70	>450	3:1	3:1	0.5	2.5	3.5	2:1(rock 1.5:1)	3:1
80	<250	3:1	4:1	0.5	2.0	3.3	2:1(rock 1.5:1)	4:1
80	250-450	3:1	4:1	0.5	2.5	3.5	2:1(rock 1.5:1)	4:1
80	>450	3:1	4:1	0.5	2.5	3.7	2:1(rock 1.5:1)	4:1
90	<450	3:1	4:1	0.5	2.0	3.5	2:1(rock 1.5:1)	4:1
90	>450	3:1	6:1	0.5	2.5	3.7	2:1(rock 1.5:1)	6:1
100.	<450	3:1	6:1	1.0	2.5	3.5	2:1(rock 1.5:1)	6:1
100,110	>450	3:1	6:1	1.0	3.0	3.7	2:1(rock 1.5:1)	6:1

Note: Give consideration to using flatter side slopes and back slopes to increase degree of safety provided.

Source: Transportation Association of Canada Geometric Design Guide for Urban Roads (1999).

Figure 26 – Typical undivided rural collector street cross-section

7.4.2 Loading Characteristics

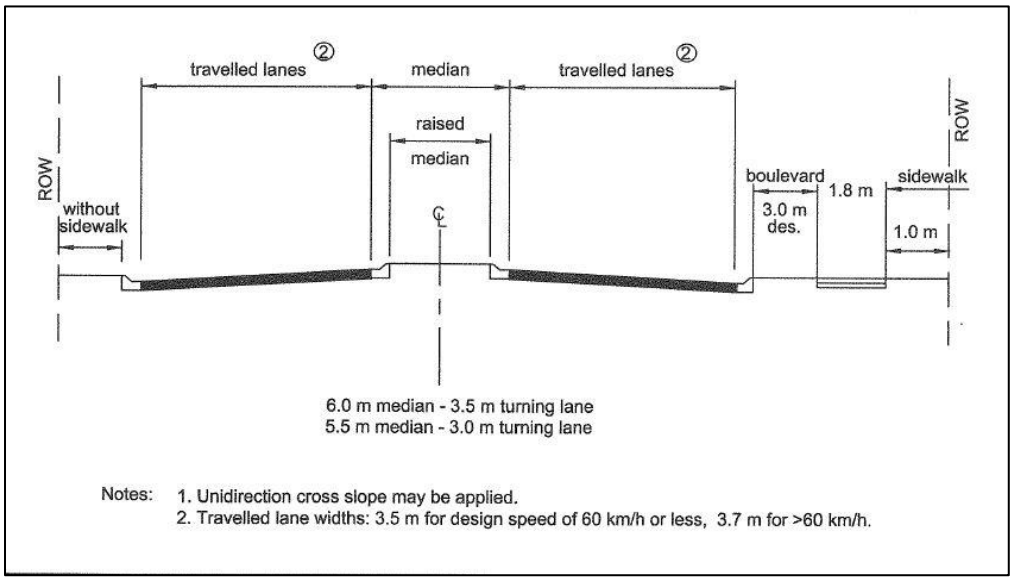
According to the land use concept plans, Partial Service areas, which include those bordering Patricia Avenue Patricia Avenue East, have significant potential for aggregate hauling. These vehicles typically take advantage of allotted roadway weight limits. The City of Brandon should provide at a minimum, Class A1 loading designation to Patricia Avenue if upgraded to a rural collector roadway. Class A1 roadways permit vehicles up to a weight limit of 56,500 kg. This loading classification should be considered between 17th Street East and 65th Street East, to accommodate development areas with the potential for aggregate hauling.

7.4.3 Rights-of-Way

Based on the operations analysis at the intersection of Richmond Avenue East and PTH 110 (see Section 5.5), the twinning of Richmond Avenue East from 17th Street East to 65th Street East is recommended to accommodate 2037 total traffic. This would produce a four-lane, arterial street. There are three conceptual options for twinning.

1. Urban cross-section, with curbs along the inside and outside edges of the roadway.

The City of Brandon Street Classification Guidelines specify a typical right-of way width of approximately 40 m for four-lane arterial roadways. The City of Winnipeg provides a similar 40 m right-of-way requirement for a major urban arterial street[14]. The inclusion of a 3.5 to 4.0 metre pathway on one side of the road, rather than sidewalks on both sides of the road (typical for an urban street design) would yield a similar right-of-way requirement. The Transportation Association of Canada provides specifications for a typical divided urban arterial roadway, as shown in Figure 27.



Source: Transportation Association of Canada Geometric Design Guide for Urban Roads (1999).

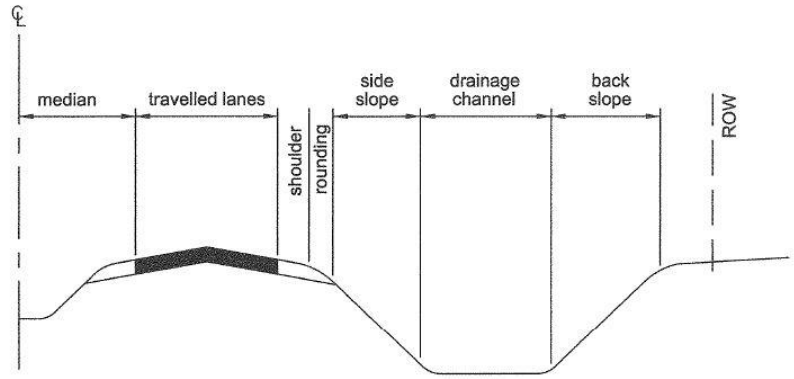
Figure 27 – Typical divided urban arterial street cross-section

Using the right-of way boundaries (see Figure 2), Richmond Avenue East has approximately 46.0 metres of right-of-way at its narrowest point. This is sufficient room to implement a divided urban arterial cross-section.

2. Rural cross-section, with ditches along inside and outside edges of the roadway.

The Transportation Association of Canada also provides specifications for a typical divided rural arterial roadway, as shown in Figure 28.

[14] City of Winnipeg (2012). Transportation Standards Manual.



speed km/h	inside shoulder 2 lanes	inside shoulder ≥3 lanes	shoulder rounding (m)	travelled lanes (m)	back slope	side slope	fill slopes with barrier	fill slopes no barrier
80,90	1.5	2.5	0.5	3.5	3:1	6:1	2:1(rock 1.5:1)	6:1
100,110,120,130	1.5	2.5	1.0	3.7	3:1	6:1	2:1(rock 1.5:1)	6:1

Source: Transportation Association of Canada Geometric Design Guide for Urban Roads (1999).

Figure 28 – Typical undivided arterial street cross-section.

Right-of-way requirements for this type of design are estimated at a high-level using the following calculations:

- Assuming a 100 km/h design speed (3.7 m travel lanes, 1.5 m shoulder, and 1.0 m shoulder rounding)
- 15.0 m outside and centre ditches (as-built on north side of Richmond Avenue East, just west of PTH 110)
- 4.0 m active transportation path with a 3.0 m buffer

This results in a 79.8 m right-of-way requirement, which exceeds the current right-of-way availability on Richmond Avenue East.

3. Rural cross-section, with raised median.

This hybrid approach may reduce costs of constructing a full urban divided arterial cross-section, while reducing right-of-way requirements. In this case, the Transportation Association of Canada specifies a 6.0 m wide raised median with curbs. This 6.0 m median would replace the following:

- Inside ditch, at 15.0 m

- Inside shoulders, at 1.5 m each
- Inside shoulder rounding, at 1.0 m each

A 6.0 m raised median could replace 20.0 m worth of shoulder and ditch modifications, resulting in a space savings of 14.0 m, bringing the required right-of-way to 66.8 m. The only right-of-way conflict points along Richmond Avenue Easy would be just east of 17th Street East near the rail line, and just west of 65th Street East.

7.4.4 Access Management and Area Circulation Roads

In general, the access management strategy should follow the City of Brandon Street Classification Guidelines. These guidelines specify:

- Access with few restrictions for local streets
- Access with some restrictions for collector streets
- Restricted access for arterial streets

In addition, direct access onto PTH 110 should be avoided.

Therefore, access should be restricted on 110, and reduced where possible on arterial streets, such as 17th Street East, Victoria Avenue East, and Richmond Avenue East. However, access may be provided onto arterial streets where there is no feasible alternative.

Area circulation roads should be constructed as local (paved or unpaved), undivided, rural roadways, with design details specified by the Transportation Association of Canada[15]. The Transportation Association of Canada specifies a width of 9.0 m for travel lanes, shoulders, and shoulder rounding, not including ditches[15].

7.5 SPEED LIMIT RECOMMENDATIONS

Speed limits can be established based on varying principles and data sources. Common analyses for establishing posted speed limits are as follows:

[15] Transportation Association of Canada (1999). Geometric Design Guide for Canadian Roads.

- Review of the Transportation Association of Canada's Canadian Guidelines for Establishing Posted Speed Limits[16], which discusses speed limits as a function of roadway geometry, pedestrians/cyclists, roadside hazards, intersection density, etc.
- Speed study
- Review of collision history

When conducting analyses to establish posted speed limits, it is important to use engineering judgement when interpreting all available data and guidelines. In the case of a speed study, vehicle speed observations are collected and the speed at which 85 percent of drivers are operating below is a reasonable target for setting speed limits.

A few problematic areas can be identified within the study area which may warrant a review of posted speed limits.

- Victoria Avenue East, which has a posted speed limit of 60 km/h. This is at the minimum recommended arterial speed, according to the City of Brandon.
- Richmond Avenue East, which has a posted speed limit of 90 km/h, where speeds may be impacted by future developments.
- 17th Street East, which has a sharp transition in posted speed limit from 60 km/h, north of Richmond Avenue East to 90 km/h, south of Richmond Avenue East.

7.6 ENVIRONMENTAL IMPACTS

Calculations were carried out to estimate the environmental impact of trips generated as a result of EBIA developments, in terms of kilograms of carbon dioxide per weekday. These calculations were carried out for each of the design horizons, as per the following steps:

1. Determine typical carbon dioxide emissions per day for a typical passenger car and typical truck
2. Estimate the proportion of daily travel attributed to a round-trip to the EBIA for a typical passenger car and typical truck
3. Determine amount of carbon dioxide emitted from a round-trip to the EBIA for a typical passenger car and typical truck

[16] Transportation Association of Canada (2009). Canadian Guidelines for Establishing Posted Speed Limits.

4. Using daily trips generated by the EBIA and assuming an overall proportion of trucks of 20%, estimate the total weekday carbon dioxide emitted from trips generated by the EBIA

The assumptions and calculations are summarized in Table 55.

Table 55 – Assumptions for environmental calculations

Passenger Cars		Trucks	
Litres per kilometer	0.09	Litres per kilometer	0.41
Kilometers per year	20,000	Kilometers per year	150000
Litres per year	1,780	Litres per year	61500
Kilograms CO_2 per litre	2.30	Kilograms CO_2 per litre	2.70
Kilograms CO_2 per year	4,094	Kilograms CO_2 per year	166050
Kilograms CO_2 per day	11.22	Kilograms CO_2 per day	454.93
Typical round-trip length (kilometers)	30	Typical hours of driving per day	8
Typical distance travelled per day (kilometers)	20,000/365 = 54.79	Typical daily hours attributed to round-trip to EBIA	1
Proportion of daily travel from round-trip to EBIA	0.55	Proportion of daily travel from round-trip to EBIA	0.13
Kilograms CO_2 per round trip	6.14	Kilograms CO_2 per round trip	56.87

Using weekday trips generated by developments in the EBIA, typical weekday carbon dioxide emissions are determined, as shown in Table 56.

Table 56 – Assumptions for environmental calculations

Design Year	Daily Passenger-Car Trips	Daily CO_2 Emissions (passenger-cars)	Daily Truck Trips	Daily CO_2 Emissions (trucks)	Daily CO_2 Emissions (total)
2019	1162	7136	290	16491	**23627**
2027	2898	17797	725	41228	**59025**
2037	3651	22421	913	51919	**74340**

8 CONCLUSIONS AND RECOMMENDATIONS

Analysis reveals the following concerning the traffic operational impacts of undertaking the East Brandon Industrial Area Developments:

- Based on the current conceptual land use plan, the anticipated limit of the development is to contain 1,834,000 square feet of floor area. Developments can be represented by manufacturing, warehousing, and general industrial land uses, and the development plan is divided into 17 distinct areas.
- At the final horizon year (2037), the development is anticipated to generate the following trips:
    - 1,285 AM peak period trips (1,050 in / 235 out)
    - 1,333 PM peak period trips (339 in / 994 out)
- The trip distribution was based on an analysis of the existing distribution of the traffic traversing the study area intersections.
- Analyses for future conditions were completed for an assumed baseline road network (see Figure 3). Some intersections are expected to be negatively impacted below an acceptable level of service (below LOS C or D) from future developments. The following summarizes the issues identified based on the expected traffic being generated by the development and the growth in background traffic and surrounding developments.
    - **17th St E and Victoria Ave E**: With additional traffic from the EBIA development, the northbound approach is projected to reach LOS F and experience substantial increases in delay. Using the methodology outlined in Section 5.1, traffic signals are warranted. With traffic signals in place, the intersection is expected to operate at an acceptable overall level of service (LOS B to C) during all peak hours, with no critical movements identified.
    - **33rd St E and Victoria Ave E**: Using the methodology outlined in Section 5.2, intersection treatments are warranted, as shown in Section 6. With these treatments, the intersection is expected to operate at an acceptable overall level of service (LOS B to C) during all peak hours.

- **PTH 110 and Victoria Ave E**: With additional traffic from the EBIA development, the eastbound approach is projected to reach LOS F and experience substantial increases in delay. Using the methodology outlined in Section 5.3, traffic signals and other intersection treatments are warranted, as shown in Section 6. With these treatments in place, the intersection is expected to operate at an acceptable overall level of service (LOS C) during all peak hours, with no critical movements identified. However, twinning of PTH 110 beyond the 2037 horizon should be considered.
- **17th St E and Richmond Ave E**: With additional traffic from the EBIA development, the westbound approach is projected to reach LOS E and experience increases in delay. Using the methodology outlined in Section 5.4, the twinning of Richmond Ave E is recommended in 2037. With this treatment in place, the intersection is expected to operate at an acceptable overall level of service (LOS C) during all peak hours, with no critical movements identified.
- **PTH 110 and Richmond Ave E**: With additional traffic from the EBIA development, the northbound and southbound approaches are projected to reach LOS F and experience substantial increases in delay. Using the methodology outlined in Section 5.5, traffic signals and other intersection treatments are warranted, as shown in Section 6. Additionally, the twinning of Richmond Ave E is recommended in 2037. Although traffic signals are warranted based on 2027 total traffic, traffic signals should be considered earlier. With these treatments and traffic signals in place, the intersection is expected to operate at an acceptable overall level of service (LOS C) during all peak hours, with no critical movements identified.
- **Richmond Ave E and Limestone Rd E**: With additional traffic from the EBIA development, the northbound approach is projected to reach LOS F and experience substantial increases in delay. Using the methodology outlined in Section 5.6, traffic signals and other intersection treatments are warranted, as shown in Section 6. Additionally, the twinning of Richmond Ave E is recommended in 2037. With these treatments in place, the intersection is expected to operate at an acceptable overall level of service (LOS B to C) during all peak hours, with no critical movements identified.

- **PTH 110 and 17th St E**: Using the methodology outlined in Section 5.7, and eastbound right-turn cut-off is warranted. With these treatments, the intersection is expected to operate at an acceptable level of service (LOS B to D) during all peak hours.
- **PTH 110 and 33rd St E**: Using the methodology outlined in Section 5.8, intersection treatments are warranted, as shown in Section 6. With these treatments, the intersection is expected to operate at a good overall level of service (LOS A to B) during all peak hours.

Based on the percent of total development traffic utilizing the study area intersections, developers are responsible for 13 to 54 percent of shared intersection improvements, depending on the intersection and study horizon. These figures represent the developments as a whole and do not consider the specific sizes and locations of developments, since these specific figures are not known at the time of the study.

Additionally, this cost sharing is solely based on the ratio of development traffic to total traffic. Actual cost sharing percentages are likely to be subject to specific sizes and locations of developments, and negotiation between the developer and the City.

Updates to this TIS may be required based on the actual timing and staging of the developments.

In addition, this study provides recommendations for the expansion of the Transit network as well as the trail network within the study area. This study also recommends corridor upgrades to Richmond Avenue East, Patricia Avenue East, as well as recommends a standard for access roads to developments. Estimates of environmental impact of future development traffic were also produced. Analysis reveals that by 2037, weekday truck and passenger-car emissions can reach approximately 70,000 kg of carbon dioxide per day.

Appendix A

East Brandon Industrial Area Land Use Concepts

BRANDON EAST INDUSTRIAL AREA DEVELOPMENT STRATEGY

LAND USE INTENSITY & SERVICING LEVELS

LEGEND

Areas Of Concern

- Methane
- Species At Risk
- Standing Water - Based on 2015 Imagery
- Existing Rail Line
- Existing Roads
- Conceptual Roads
- PLannedWWFacility
- Planned_WMPipes
- Planned Force Main
- Planned Gravity Main
- Planned_ReclaimedWW
- Existing Waste Water
- Existing Water Mains
- Study Area
- Assiniboine River
- Development Areas
- 2014 Flood Record
- Land Use

FSA - Full Service Area A & B
PSA - Partial Service Area
USA - Un-Serviced Area
LDA - Limited Development Area

Associated Engineering
EGE Engineering Ltd.
catapult community planning
MORR TRANSPORTATION CONSULTING
SBC Sison Blackburn Consulting Inc.

FSA - A
FSA - B
PSA
LDA
USA

AREA 1 73 Acres
AREA 2/52 Acres
AREA 3/90 Acres
AREA 4/209 Acres
AREA 5 244 Acres
AREA 6 157 Acres
AREA 7 284 Acres
AREA 8 265 Acres
AREA 9 89 Acres
AREA 10 170 Acres
AREA 11 178 Acres
AREA 12 206 Acres
AREA 13 224 Acres
AREA 14 259 Acres
AREA 15 184 Acres
AREA 16 160 Acres

VETERANS WAY
MCGREGOR AVE
ROSSER AVE E
PRINCESS AVE E
LORNE AVE E
LOUISE AVE E
VICTORIA AVE E
MCTAVISH AVE E
VAN HORNE AVE E
DOUGLAS ST
PARK AVE E
CARWOOD DR
ELDERWOOD DR
RICHMOND AVE E
BURNABY AVE
PATRICIA AVE E
FREDERICK ST
PARK ST
RIDEAU ST
FRANKLIN ST
PERCY ST
10TH ST E
11TH ST E
12TH ST E
13TH ST E
14TH ST E
17TH ST E
33RD ST E
49TH ST E
65TH ST E
81ST ST E
SERVICE RD
LIMESTONE RD
GRANITE RD
1ST ST N
457
110

SCALE NTS
APPROVED R. MITCHELL
DRAWN BY D. TOTH
DATE 2017Nov09
REV X
DESCRIPTION ISSUED FOR DISCUSSION

0 0.25 0.5 1 Kilometers
0 0.125 0.25 0.5 Miles

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Appendix B

Level of Service Definitions

LEVEL OF SERVICE

Level of Service (LOS) is defined as a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers.

Highway Capacity Manual Level of Service (HCM LOS)

The 2010 Highway Capacity Manual (HCM) identifies control delay as the primary service measure with LOS determined from the control delay estimate. Control delay is defined as the component of delay that results when a traffic control device causes a lane group to reduce speed or stop; it is measured against the uncontrolled condition.

Six Levels of Service are defined (briefly described below) with LOS A representing the best operating conditions, and LOS F the worst. It should be noted that there is often significant variability in the amount of delay experienced by individual drivers. The LOS criteria for stop controlled intersections are different than that used for a signalized intersection, this is primarily because of the different driver expectance at these two environments.

LOS A: This Level of Service describes the highest quality of traffic flow and is referred to as free flow. The approach appears open, turning movements are easily made and drivers have freedom of operation. Control delay is less than 10 seconds/vehicle.

LOS B: This Level of Service is referred to as a stable flow. Drivers feel somewhat restricted and occasionally may have to wait to complete the minor movement. Control delay is 10-15 seconds/vehicle for unsignalized intersections and 10-20 seconds/vehicle for signalized intersections.

LOS C: At this level, the operation is stable. Drivers feel more restricted and may have to wait, with queues developing for short periods. Control delay is 15-25 seconds/vehicle at unsignalized intersections and 20-35 seconds/vehicle at signalized intersections.

LOS D: At this level, traffic is approaching unstable flow. The motorist experiences increasing restriction and instability of flow. There are substantial delays to approaching vehicles during short peaks within the peak period, but there are enough gaps to lower demand to permit occasional clearance of developing queues and prevent excessive back-ups. Control delay is 25-35 seconds/vehicle at unsignalized intersections and 35-55 seconds/vehicle at signalized intersections.

LOS E: At this level capacity occurs. Long queues of vehicles exist and delays to vehicles may extend. Control delay is 35-50 seconds/vehicle at unsignalized intersections and 55-80 seconds/vehicle at signalized intersections.

LOS F: At this Level of Service, the intersection has failed. Capacity of the intersection has been exceeded. Control delay exceeds 50 seconds/vehicle at unsignalized intersections and exceeds 80 seconds/vehicle at signalized intersections.

The City of Brandon has established a preferred LOS of C during peak hours of operation, although LOS D may be accepted if there is no cost effective manner of achieving LOS C. In the case where current LOS levels do not achieve these targets, a lower level of service may be accepted; however, post development LOS should meet or exceed pre-development LOS.

Intersection Capacity Utilization Level of Service (ICU LOS)

Intersection capacity utilization (ICU) LOS indicates how an intersection is functioning and how much extra capacity is available to handle traffic fluctuations and incidents. The ICU LOS does not predict delay, but it can be used to predict how often an intersection will experience congestion.

Eight Levels of Service are defined (briefly described below) with LOS A representing the best operating conditions, and LOS H the worst. These letter grades are defined as follows:

LOS A: ICU less than 55% - the intersection has no congestion and can accommodate 40% more traffic on all movements.

LOS B: ICU of 55% to 64% - very little congestion and can accommodate 30% more traffic.

LOS C: ICU of 64% to 73% - very little major congestion and can accommodate 20% more traffic.

LOS D: ICU of 73% to 82% - has no congestion and can accommodate 10% more traffic on all movements.

LOS E: ICU of 82% to 91% is on the verge of congested conditions.

LOS F: ICU of 91% to 100% indicates the intersection is over capacity and likely experiences congestion periods of 15-60 consecutive minutes.

LOS G: ICU of 100% to 109% indicates the intersection is over-capacity and likely experiences congestion periods of 60-120 consecutive minutes.

LOS H: ICU greater than 109% indicates the intersection is over capacity and likely experiences congestion periods of more than 120 consecutive minutes.

Appendix C

Synchro Analysis Reports

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	190	215	25	0	135	45	30	40	0	55	20	80
Future Volume (vph)	190	215	25	0	135	45	30	40	0	55	20	80
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305		1496	1271	1341	1411		1409	1483	1261
Flt Permitted	0.50	1.00	1.00		1.00	1.00	0.74	1.00		0.67	1.00	1.00
Satd. Flow (perm)	766	1535	1305		1496	1271	1049	1411		998	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	207	234	27	0	147	49	33	43	0	60	22	87
RTOR Reduction (vph)	0	0	16	0	0	38	0	0	0	0	0	64
Lane Group Flow (vph)	207	234	11	0	147	11	33	43	0	60	22	23
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	50.0	39.0	39.0		22.0	22.0	30.5	24.0		34.5	26.0	26.0
Effective Green, g (s)	50.0	39.0	39.0		22.0	22.0	30.5	24.0		34.5	26.0	26.0
Actuated g/C Ratio	0.50	0.39	0.39		0.22	0.22	0.30	0.24		0.34	0.26	0.26
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	535	598	508		329	279	338	338		379	385	327
v/s Ratio Prot	c0.09	0.15			c0.10		0.01	0.03		c0.01	0.01	
v/s Ratio Perm	0.11		0.01			0.01	0.02			c0.04		0.02
v/c Ratio	0.39	0.39	0.02		0.45	0.04	0.10	0.13		0.16	0.06	0.07
Uniform Delay, d1	14.9	22.0	18.8		33.7	30.7	24.8	29.8		22.4	27.8	27.9
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.1	1.9	0.1		4.3	0.3	0.6	0.8		0.9	0.3	0.4
Delay (s)	17.0	23.9	18.8		38.1	30.9	25.3	30.6		23.3	28.1	28.3
Level of Service	B	C	B		D	C	C	C		C	C	C
Approach Delay (s)		20.5			36.3			28.3			26.5	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.32		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	44.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	200	225	25	0	140	45	30	40	0	55	20	85
Future Volume (vph)	200	225	25	0	140	45	30	40	0	55	20	85
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305		1496	1271	1341	1411		1409	1483	1261
Flt Permitted	0.49	1.00	1.00		1.00	1.00	0.74	1.00		0.67	1.00	1.00
Satd. Flow (perm)	753	1535	1305		1496	1271	1049	1411		998	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	217	245	27	0	152	49	33	43	0	60	22	92
RTOR Reduction (vph)	0	0	16	0	0	38	0	0	0	0	0	68
Lane Group Flow (vph)	217	245	11	0	152	11	33	43	0	60	22	24
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	50.0	39.0	39.0		22.0	22.0	30.5	24.0		34.5	26.0	26.0
Effective Green, g (s)	50.0	39.0	39.0		22.0	22.0	30.5	24.0		34.5	26.0	26.0
Actuated g/C Ratio	0.50	0.39	0.39		0.22	0.22	0.30	0.24		0.34	0.26	0.26
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	531	598	508		329	279	338	338		379	385	327
v/s Ratio Prot	c0.09	0.16			c0.10		0.01	0.03		c0.01	0.01	
v/s Ratio Perm	0.11		0.01			0.01	0.02			c0.04		0.02
v/c Ratio	0.41	0.41	0.02		0.46	0.04	0.10	0.13		0.16	0.06	0.07
Uniform Delay, d1	15.0	22.1	18.8		33.9	30.7	24.8	29.8		22.4	27.8	27.9
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.3	2.1	0.1		4.6	0.3	0.6	0.8		0.9	0.3	0.4
Delay (s)	17.3	24.2	18.8		38.5	30.9	25.3	30.6		23.3	28.1	28.3
Level of Service	B	C	B		D	C	C	C		C	C	C
Approach Delay (s)		20.9			36.6			28.3			26.6	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	45.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	230	260	30	0	165	55	35	50	0	65	25	100
Future Volume (vph)	230	260	30	0	165	55	35	50	0	65	25	100
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305		1496	1271	1341	1411		1409	1483	1261
Flt Permitted	0.47	1.00	1.00		1.00	1.00	0.74	1.00		0.64	1.00	1.00
Satd. Flow (perm)	725	1535	1305		1496	1271	1044	1411		942	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	250	283	33	0	179	60	38	54	0	71	27	109
RTOR Reduction (vph)	0	0	19	0	0	45	0	0	0	0	0	82
Lane Group Flow (vph)	250	283	14	0	179	15	38	54	0	71	27	27
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	52.0	41.0	41.0		25.0	25.0	27.5	22.0		33.5	25.0	25.0
Effective Green, g (s)	52.0	41.0	41.0		25.0	25.0	27.5	22.0		33.5	25.0	25.0
Actuated g/C Ratio	0.52	0.41	0.41		0.25	0.25	0.28	0.22		0.34	0.25	0.25
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	530	629	535		374	317	303	310		355	370	315
v/s Ratio Prot	c0.10	0.18			0.12		0.01	0.04		c0.02	0.02	
v/s Ratio Perm	c0.15		0.01			0.01	0.03			c0.05		0.02
v/c Ratio	0.47	0.45	0.03		0.48	0.05	0.13	0.17		0.20	0.07	0.09
Uniform Delay, d1	14.4	21.3	17.6		31.9	28.5	27.0	31.6		23.3	28.6	28.7
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.0	2.3	0.1		4.3	0.3	0.9	1.2		1.3	0.4	0.5
Delay (s)	17.4	23.7	17.7		36.3	28.7	27.9	32.9		24.6	29.0	29.3
Level of Service	B	C	B		D	C	C	C		C	C	C
Approach Delay (s)		20.5			34.4			30.8			27.6	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	48.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	280	320	35	0	200	65	45	60	0	80	30	120
Future Volume (vph)	280	320	35	0	200	65	45	60	0	80	30	120
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305		1496	1271	1341	1411		1409	1483	1261
Flt Permitted	0.43	1.00	1.00		1.00	1.00	0.74	1.00		0.65	1.00	1.00
Satd. Flow (perm)	653	1535	1305		1496	1271	1038	1411		963	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	304	348	38	0	217	71	49	65	0	87	33	130
RTOR Reduction (vph)	0	0	21	0	0	53	0	0	0	0	0	101
Lane Group Flow (vph)	304	348	17	0	217	18	49	65	0	87	33	29
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	55.0	44.0	44.0		26.0	26.0	25.5	20.0		29.5	22.0	22.0
Effective Green, g (s)	55.0	44.0	44.0		26.0	26.0	25.5	20.0		29.5	22.0	22.0
Actuated g/C Ratio	0.55	0.44	0.44		0.26	0.26	0.26	0.20		0.29	0.22	0.22
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	544	675	574		388	330	281	282		317	326	277
v/s Ratio Prot	c0.13	0.23			0.15		0.01	0.05		c0.02	0.02	
v/s Ratio Perm	c0.18		0.01			0.01	0.03			c0.06		0.02
v/c Ratio	0.56	0.52	0.03		0.56	0.06	0.17	0.23		0.27	0.10	0.10
Uniform Delay, d1	13.5	20.3	15.9		32.0	27.8	28.8	33.5		26.5	31.1	31.1
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	4.1	2.8	0.1		5.7	0.3	1.3	1.9		2.1	0.6	0.7
Delay (s)	17.7	23.1	16.0		37.8	28.1	30.2	35.4		28.6	31.7	31.9
Level of Service	B	C	B		D	C	C	D		C	C	C
Approach Delay (s)		20.3			35.4			33.2			30.7	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	54.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	210	284	38	8	160	49	33	42	2	82	28	96
Future Volume (vph)	210	284	38	8	160	49	33	42	2	82	28	96
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305	1421	1496	1271	1341	1402		1409	1483	1261
Flt Permitted	0.48	1.00	1.00	0.57	1.00	1.00	0.74	1.00		0.64	1.00	1.00
Satd. Flow (perm)	736	1535	1305	856	1496	1271	1041	1402		942	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	228	309	41	9	174	53	36	46	2	89	30	104
RTOR Reduction (vph)	0	0	24	0	0	40	0	2	0	0	0	79
Lane Group Flow (vph)	228	309	17	9	174	13	36	46	0	89	30	25
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	52.0	41.0	41.0	30.0	25.0	25.0	27.5	21.0		33.5	24.0	24.0
Effective Green, g (s)	52.0	41.0	41.0	30.0	25.0	25.0	27.5	21.0		33.5	24.0	24.0
Actuated g/C Ratio	0.52	0.41	0.41	0.30	0.25	0.25	0.28	0.21		0.34	0.24	0.24
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	534	629	535	285	374	317	305	294		359	355	302
v/s Ratio Prot	c0.09	c0.20		0.00	0.12		0.01	0.03		c0.02	0.02	
v/s Ratio Perm	0.13		0.01	0.01		0.01	0.02			c0.06		0.02
v/c Ratio	0.43	0.49	0.03	0.03	0.47	0.04	0.12	0.16		0.25	0.08	0.08
Uniform Delay, d1	14.1	21.8	17.6	24.7	31.8	28.4	27.0	32.3		23.7	29.5	29.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.5	2.7	0.1	0.2	4.1	0.2	0.8	1.1		1.6	0.5	0.5
Delay (s)	16.6	24.5	17.7	24.9	35.9	28.7	27.8	33.4		25.3	29.9	30.0
Level of Service	B	C	B	C	D	C	C	C		C	C	C
Approach Delay (s)		20.9			33.9			31.0			28.1	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	48.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	259	400	71	24	219	69	44	58	6	131	51	130
Future Volume (vph)	259	400	71	24	219	69	44	58	6	131	51	130
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305	1421	1496	1271	1341	1390		1409	1483	1261
Flt Permitted	0.41	1.00	1.00	0.51	1.00	1.00	0.72	1.00		0.55	1.00	1.00
Satd. Flow (perm)	635	1535	1305	763	1496	1271	1018	1390		818	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	282	435	77	26	238	75	48	63	7	142	55	141
RTOR Reduction (vph)	0	0	45	0	0	54	0	4	0	0	0	105
Lane Group Flow (vph)	282	435	32	26	238	21	48	66	0	142	55	36
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	52.0	41.0	41.0	33.0	28.0	28.0	24.1	19.0		36.0	25.4	25.4
Effective Green, g (s)	52.0	41.0	41.0	33.0	28.0	28.0	24.1	19.0		36.0	25.4	25.4
Actuated g/C Ratio	0.52	0.41	0.41	0.33	0.28	0.28	0.24	0.19		0.36	0.25	0.25
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	478	629	535	284	418	355	261	264		362	376	320
v/s Ratio Prot	c0.11	c0.28		0.00	0.16		0.01	0.05		c0.05	0.04	
v/s Ratio Perm	0.20		0.02	0.03		0.02	0.03			c0.10		0.03
v/c Ratio	0.59	0.69	0.06	0.09	0.57	0.06	0.18	0.25		0.39	0.15	0.11
Uniform Delay, d1	15.1	24.3	17.8	22.9	30.8	26.4	29.9	34.4		23.0	28.9	28.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	5.3	6.1	0.2	0.6	5.5	0.3	1.5	2.3		3.2	0.8	0.7
Delay (s)	20.4	30.4	18.0	23.5	36.4	26.7	31.4	36.7		26.1	29.7	29.3
Level of Service	C	C	B	C	D	C	C	D		C	C	C
Approach Delay (s)		25.7			33.2			34.5			28.1	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	28.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	57.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	315	490	88	30	268	82	58	71	7	158	61	159
Future Volume (vph)	315	490	88	30	268	82	58	71	7	158	61	159
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305	1421	1496	1271	1341	1391		1409	1483	1261
Flt Permitted	0.36	1.00	1.00	0.41	1.00	1.00	0.71	1.00		0.63	1.00	1.00
Satd. Flow (perm)	558	1535	1305	614	1496	1271	1008	1391		942	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	342	533	96	33	291	89	63	77	8	172	66	173
RTOR Reduction (vph)	0	0	54	0	0	62	0	4	0	0	0	137
Lane Group Flow (vph)	342	533	42	33	291	27	63	81	0	172	66	36
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	55.0	44.0	44.0	35.0	30.0	30.0	25.0	19.0		29.0	21.0	21.0
Effective Green, g (s)	55.0	44.0	44.0	35.0	30.0	30.0	25.0	19.0		29.0	21.0	21.0
Actuated g/C Ratio	0.55	0.44	0.44	0.35	0.30	0.30	0.25	0.19		0.29	0.21	0.21
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0
Lane Grp Cap (vph)	477	675	574	255	448	381	271	264		310	311	264
v/s Ratio Prot	c0.14	c0.35		0.01	0.19		0.01	0.06		c0.04	0.04	
v/s Ratio Perm	0.26		0.03	0.04		0.02	0.04			c0.12		0.03
v/c Ratio	0.72	0.79	0.07	0.13	0.65	0.07	0.23	0.31		0.55	0.21	0.14
Uniform Delay, d1	14.7	24.0	16.2	21.7	30.4	25.0	29.5	34.8		29.1	32.7	32.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	8.9	9.1	0.2	1.0	7.1	0.4	2.0	3.0		7.0	1.6	1.1
Delay (s)	23.6	33.2	16.5	22.7	37.6	25.4	31.5	37.8		36.1	34.2	33.2
Level of Service	C	C	B	C	D	C	C	D		D	C	C
Approach Delay (s)		28.2			33.7			35.1			34.6	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	31.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	65.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	90	125	30	0	200	50	45	40	5	35	45	170
Future Volume (vph)	90	125	30	0	200	50	45	40	5	35	45	170
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305		1496	1271	1341	1389		1409	1483	1261
Flt Permitted	0.43	1.00	1.00		1.00	1.00	0.70	1.00		0.73	1.00	1.00
Satd. Flow (perm)	666	1535	1305		1496	1271	982	1389		1076	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	98	136	33	0	217	54	49	43	5	38	49	185
RTOR Reduction (vph)	0	0	19	0	0	39	0	4	0	0	0	141
Lane Group Flow (vph)	98	136	14	0	217	15	49	44	0	38	49	44
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	52.0	41.0	41.0		27.0	27.0	31.5	25.0		29.5	24.0	24.0
Effective Green, g (s)	52.0	41.0	41.0		27.0	27.0	31.5	25.0		29.5	24.0	24.0
Actuated g/C Ratio	0.52	0.41	0.41		0.27	0.27	0.32	0.25		0.29	0.24	0.24
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	496	629	535		403	343	332	347		335	355	302
v/s Ratio Prot	c0.04	c0.09			c0.15		c0.01	0.03		0.01	0.03	
v/s Ratio Perm	0.07		0.01			0.01	c0.04			0.03		0.04
v/c Ratio	0.20	0.22	0.03		0.54	0.04	0.15	0.13		0.11	0.14	0.15
Uniform Delay, d1	12.9	19.1	17.6		31.2	27.0	24.4	29.1		25.5	29.9	29.9
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.9	0.8	0.1		5.1	0.2	0.9	0.8		0.7	0.8	1.0
Delay (s)	13.8	19.9	17.7		36.3	27.2	25.3	29.8		26.2	30.7	31.0
Level of Service	B	B	B		D	C	C	C		C	C	C
Approach Delay (s)		17.4			34.5			27.5			30.2	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	27.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.30		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	41.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	95	130	30	0	210	50	45	40	5	35	45	175
Future Volume (vph)	95	130	30	0	210	50	45	40	5	35	45	175
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305		1496	1271	1341	1389		1409	1483	1261
Flt Permitted	0.43	1.00	1.00		1.00	1.00	0.72	1.00		0.73	1.00	1.00
Satd. Flow (perm)	655	1535	1305		1496	1271	1015	1389		1076	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	103	141	33	0	228	54	49	43	5	38	49	190
RTOR Reduction (vph)	0	0	19	0	0	39	0	4	0	0	0	145
Lane Group Flow (vph)	103	141	14	0	228	15	49	44	0	38	49	45
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	53.0	42.0	42.0		28.0	28.0	29.7	24.0		29.3	23.8	23.8
Effective Green, g (s)	53.0	42.0	42.0		28.0	28.0	29.7	24.0		29.3	23.8	23.8
Actuated g/C Ratio	0.53	0.42	0.42		0.28	0.28	0.30	0.24		0.29	0.24	0.24
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	499	644	548		418	355	320	333		333	352	300
v/s Ratio Prot	c0.04	c0.09			c0.15		c0.01	0.03		0.01	0.03	
v/s Ratio Perm	0.07		0.01			0.01	c0.04			0.03		0.04
v/c Ratio	0.21	0.22	0.03		0.55	0.04	0.15	0.13		0.11	0.14	0.15
Uniform Delay, d1	12.5	18.5	17.0		30.6	26.2	25.6	29.8		25.7	30.0	30.1
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.9	0.8	0.1		5.0	0.2	1.0	0.8		0.7	0.8	1.1
Delay (s)	13.4	19.3	17.1		35.6	26.5	26.7	30.7		26.4	30.9	31.2
Level of Service	B	B	B		D	C	C	C		C	C	C
Approach Delay (s)		16.9			33.9			28.6			30.5	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	27.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.31		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	42.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	110	150	35	0	245	60	55	50	5	45	55	205
Future Volume (vph)	110	150	35	0	245	60	55	50	5	45	55	205
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305		1496	1271	1341	1393		1409	1483	1261
Flt Permitted	0.39	1.00	1.00		1.00	1.00	0.72	1.00		0.72	1.00	1.00
Satd. Flow (perm)	592	1535	1305		1496	1271	1013	1393		1066	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	120	163	38	0	266	65	60	54	5	49	60	223
RTOR Reduction (vph)	0	0	22	0	0	46	0	3	0	0	0	169
Lane Group Flow (vph)	120	163	16	0	266	19	60	56	0	49	60	54
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	53.0	42.0	42.0		29.0	29.0	29.5	24.0		29.5	24.0	24.0
Effective Green, g (s)	53.0	42.0	42.0		29.0	29.0	29.5	24.0		29.5	24.0	24.0
Actuated g/C Ratio	0.53	0.42	0.42		0.29	0.29	0.29	0.24		0.29	0.24	0.24
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	469	644	548		433	368	316	334		333	355	302
v/s Ratio Prot	c0.05	0.11			c0.18		c0.01	0.04		0.01	0.04	
v/s Ratio Perm	0.09		0.01			0.01	c0.05			0.04		0.04
v/c Ratio	0.26	0.25	0.03		0.61	0.05	0.19	0.17		0.15	0.17	0.18
Uniform Delay, d1	12.9	18.8	17.0		30.7	25.6	26.0	30.1		25.7	30.1	30.2
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.3	0.9	0.1		6.4	0.3	1.3	1.1		0.9	1.0	1.3
Delay (s)	14.2	19.8	17.1		37.1	25.8	27.3	31.2		26.7	31.1	31.4
Level of Service	B	B	B		D	C	C	C		C	C	C
Approach Delay (s)		17.4			34.9			29.2			30.7	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	27.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	46.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	135	185	45	0	295	75	65	60	5	50	65	255
Future Volume (vph)	135	185	45	0	295	75	65	60	5	50	65	255
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305		1496	1271	1341	1396		1409	1483	1261
Flt Permitted	0.34	1.00	1.00		1.00	1.00	0.67	1.00		0.71	1.00	1.00
Satd. Flow (perm)	517	1535	1305		1496	1271	940	1396		1055	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	147	201	49	0	321	82	71	65	5	54	71	277
RTOR Reduction (vph)	0	0	27	0	0	57	0	3	0	0	0	219
Lane Group Flow (vph)	147	201	22	0	321	25	71	67	0	54	71	58
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	55.0	44.0	44.0		31.0	31.0	28.9	22.4		26.1	21.0	21.0
Effective Green, g (s)	55.0	44.0	44.0		31.0	31.0	28.9	22.4		26.1	21.0	21.0
Actuated g/C Ratio	0.55	0.44	0.44		0.31	0.31	0.29	0.22		0.26	0.21	0.21
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	453	675	574		463	394	297	312		293	311	264
v/s Ratio Prot	c0.06	0.13			c0.21		c0.02	0.05		0.01	0.05	
v/s Ratio Perm	0.12		0.02			0.02	c0.05			0.04		0.05
v/c Ratio	0.32	0.30	0.04		0.69	0.06	0.24	0.21		0.18	0.23	0.22
Uniform Delay, d1	12.6	18.0	15.9		30.3	24.3	26.7	31.6		28.4	32.8	32.7
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.9	1.1	0.1		8.3	0.3	1.9	1.6		1.4	1.7	1.9
Delay (s)	14.5	19.2	16.1		38.6	24.6	28.6	33.2		29.8	34.5	34.6
Level of Service	B	B	B		D	C	C	C		C	C	C
Approach Delay (s)		17.1			35.8			30.9			34.0	
Approach LOS		B			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	29.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	52.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	106	153	34	2	271	78	57	47	12	41	47	184
Future Volume (vph)	106	153	34	2	271	78	57	47	12	41	47	184
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305	1421	1496	1271	1341	1368		1409	1483	1261
Flt Permitted	0.37	1.00	1.00	0.65	1.00	1.00	0.67	1.00		0.72	1.00	1.00
Satd. Flow (perm)	565	1535	1305	975	1496	1271	948	1368		1061	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	115	166	37	2	295	85	62	51	13	45	51	200
RTOR Reduction (vph)	0	0	21	0	0	59	0	9	0	0	0	158
Lane Group Flow (vph)	115	166	16	2	295	26	62	55	0	45	51	42
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	55.0	44.0	44.0	36.0	31.0	31.0	29.1	22.4		25.9	20.8	20.8
Effective Green, g (s)	55.0	44.0	44.0	36.0	31.0	31.0	29.1	22.4		25.9	20.8	20.8
Actuated g/C Ratio	0.55	0.44	0.44	0.36	0.31	0.31	0.29	0.22		0.26	0.21	0.21
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	471	675	574	373	463	394	302	306		292	308	262
v/s Ratio Prot	c0.04	0.11		0.00	c0.20		c0.01	0.04		0.01	0.03	
v/s Ratio Perm	0.09		0.01	0.00		0.02	c0.05			0.03		0.03
v/c Ratio	0.24	0.25	0.03	0.01	0.64	0.07	0.21	0.18		0.15	0.17	0.16
Uniform Delay, d1	12.0	17.6	15.9	20.5	29.7	24.3	26.4	31.4		28.4	32.5	32.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.2	0.9	0.1	0.0	6.6	0.3	1.5	1.3		1.1	1.2	1.3
Delay (s)	13.3	18.5	16.0	20.5	36.2	24.6	27.9	32.6		29.5	33.6	33.7
Level of Service	B	B	B	C	D	C	C	C		C	C	C
Approach Delay (s)		16.3			33.6			30.3			33.1	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	28.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	47.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	140	215	49	8	387	122	93	74	26	64	68	232
Future Volume (vph)	140	215	49	8	387	122	93	74	26	64	68	232
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305	1421	1496	1271	1341	1356		1409	1483	1261
Flt Permitted	0.26	1.00	1.00	0.61	1.00	1.00	0.71	1.00		0.69	1.00	1.00
Satd. Flow (perm)	393	1535	1305	917	1496	1271	1000	1356		1019	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	152	234	53	9	421	133	101	80	28	70	74	252
RTOR Reduction (vph)	0	0	28	0	0	88	0	13	0	0	0	203
Lane Group Flow (vph)	152	234	25	9	421	45	101	95	0	70	74	49
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	58.0	47.0	47.0	39.0	34.0	34.0	24.5	19.4		24.5	19.4	19.4
Effective Green, g (s)	58.0	47.0	47.0	39.0	34.0	34.0	24.5	19.4		24.5	19.4	19.4
Actuated g/C Ratio	0.58	0.47	0.47	0.39	0.34	0.34	0.24	0.19		0.24	0.19	0.19
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	419	721	613	382	508	432	262	263		269	287	244
v/s Ratio Prot	c0.07	0.15		0.00	c0.28		c0.02	0.07		0.01	0.05	
v/s Ratio Perm	0.14		0.02	0.01		0.04	c0.07			0.05		0.04
v/c Ratio	0.36	0.32	0.04	0.02	0.83	0.10	0.39	0.36		0.26	0.26	0.20
Uniform Delay, d1	12.4	16.6	14.3	18.7	30.3	22.6	30.8	34.9		30.0	34.2	33.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.4	1.2	0.1	0.1	14.4	0.5	4.2	3.8		2.3	2.2	1.8
Delay (s)	14.8	17.8	14.4	18.8	44.8	23.1	35.1	38.8		32.3	36.4	35.6
Level of Service	B	B	B	B	D	C	D	D		C	D	D
Approach Delay (s)		16.3			39.2			37.0			35.2	
Approach LOS		B			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	31.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	57.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	173	265	63	10	468	151	114	95	30	73	82	288
Future Volume (vph)	173	265	63	10	468	151	114	95	30	73	82	288
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	1535	1305	1421	1496	1271	1341	1360		1409	1483	1261
Flt Permitted	0.18	1.00	1.00	0.58	1.00	1.00	0.70	1.00		0.65	1.00	1.00
Satd. Flow (perm)	274	1535	1305	873	1496	1271	987	1360		958	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	188	288	68	11	509	164	124	103	33	79	89	313
RTOR Reduction (vph)	0	0	35	0	0	107	0	11	0	0	0	255
Lane Group Flow (vph)	188	288	33	11	509	57	124	125	0	79	89	58
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	59.0	48.0	48.0	40.0	35.0	35.0	23.5	18.4		23.5	18.4	18.4
Effective Green, g (s)	59.0	48.0	48.0	40.0	35.0	35.0	23.5	18.4		23.5	18.4	18.4
Actuated g/C Ratio	0.59	0.48	0.48	0.40	0.35	0.35	0.24	0.18		0.24	0.18	0.18
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	374	736	626	376	523	444	249	250		248	272	232
v/s Ratio Prot	c0.09	0.19		0.00	c0.34		c0.03	c0.09		0.02	0.06	
v/s Ratio Perm	0.21		0.03	0.01		0.05	0.09			0.06		0.05
v/c Ratio	0.50	0.39	0.05	0.03	0.97	0.13	0.50	0.50		0.32	0.33	0.25
Uniform Delay, d1	14.1	16.6	13.9	18.1	32.0	22.1	32.4	36.7		31.0	35.4	34.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	4.8	1.6	0.2	0.1	33.3	0.6	7.0	6.9		3.4	3.2	2.5
Delay (s)	18.8	18.2	14.0	18.3	65.3	22.7	39.3	43.6		34.4	38.6	37.4
Level of Service	B	B	B	B	E	C	D	D		C	D	D
Approach Delay (s)		17.9			54.3			41.6			37.1	
Approach LOS		B			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	38.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	68.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
2: 17th Street & Victoria Avenue

2017 Existing AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	110	55	30	150	10	30	20	60	10	45	5
Future Volume (Veh/h)	5	110	55	30	150	10	30	20	60	10	45	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	120	60	33	163	11	33	22	65	11	49	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	174			120			388	370	60	348	364	168
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	174			120			388	370	60	348	364	168
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	100			98			93	96	93	98	91	99
cM capacity (veh/h)	1364			1423			484	532	977	518	549	849

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	5	60	60	60	33	174	120	65
Volume Left	5	0	0	0	33	0	33	11
Volume Right	0	0	0	60	0	11	65	5
cSH	1364	1700	1700	1700	1423	1700	1098	559
Volume to Capacity	0.00	0.04	0.04	0.04	0.02	0.10	0.11	0.12
Queue Length 95th (m)	0.1	0.0	0.0	0.0	0.6	0.0	2.9	3.1
Control Delay (s)	7.6	0.0	0.0	0.0	7.6	0.0	10.8	12.3
Lane LOS	A				A		B	B
Approach Delay (s)	0.2				1.2		10.8	12.3
Approach LOS							B	B

Intersection Summary			
Average Delay	4.1		
Intersection Capacity Utilization	26.1%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
2: 17th Street & Victoria Avenue

2019 Background AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	115	55	30	155	10	30	20	60	10	45	5
Future Volume (Veh/h)	5	115	55	30	155	10	30	20	60	10	45	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	125	60	33	168	11	33	22	65	11	49	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	179			125			398	380	62	356	374	174
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	179			125			398	380	62	356	374	174
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	100			98			93	96	93	98	91	99
cM capacity (veh/h)	1358			1416			475	525	973	511	542	843

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	5	62	62	60	33	179	120	65
Volume Left	5	0	0	0	33	0	33	11
Volume Right	0	0	0	60	0	11	65	5
cSH	1358	1700	1700	1700	1416	1700	1080	552
Volume to Capacity	0.00	0.04	0.04	0.04	0.02	0.11	0.11	0.12
Queue Length 95th (m)	0.1	0.0	0.0	0.0	0.6	0.0	3.0	3.2
Control Delay (s)	7.7	0.0	0.0	0.0	7.6	0.0	10.9	12.4
Lane LOS	A				A		B	B
Approach Delay (s)	0.2				1.2		10.9	12.4
Approach LOS							B	B

Intersection Summary				
Average Delay	4.1			
Intersection Capacity Utilization	26.3%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	135	65	35	185	10	35	25	75	10	55	5
Future Volume (Veh/h)	5	135	65	35	185	10	35	25	75	10	55	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	147	71	38	201	11	38	27	82	11	60	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	212			147			469	445	74	420	440	206
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	212			147			469	445	74	420	440	206
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	100			97			91	94	91	98	88	99
cM capacity (veh/h)	1320			1390			411	480	957	444	496	803

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	5	74	74	71	38	212	147	76
Volume Left	5	0	0	0	38	0	38	11
Volume Right	0	0	0	71	0	11	82	5
cSH	1320	1700	1700	1700	1390	1700	994	500
Volume to Capacity	0.00	0.04	0.04	0.04	0.03	0.12	0.15	0.15
Queue Length 95th (m)	0.1	0.0	0.0	0.0	0.7	0.0	4.1	4.3
Control Delay (s)	7.7	0.0	0.0	0.0	7.7	0.0	11.5	13.5
Lane LOS	A				A		B	B
Approach Delay (s)	0.2				1.2		11.5	13.5
Approach LOS							B	B

Intersection Summary			
Average Delay	4.4		
Intersection Capacity Utilization	35.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	165	80	45	225	15	45	30	90	15	65	5
Future Volume (Veh/h)	5	165	80	45	225	15	45	30	90	15	65	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	179	87	49	245	16	49	33	98	16	71	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	261			179			572	548	90	516	540	253
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	261			179			572	548	90	516	540	253
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	100			96			85	92	90	96	84	99
cM capacity (veh/h)	1265			1351			330	415	935	362	431	750

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	5	90	90	87	49	261	180	92
Volume Left	5	0	0	0	49	0	49	16
Volume Right	0	0	0	87	0	16	98	5
cSH	1265	1700	1700	1700	1351	1700	799	427
Volume to Capacity	0.00	0.05	0.05	0.05	0.04	0.15	0.23	0.22
Queue Length 95th (m)	0.1	0.0	0.0	0.0	0.9	0.0	6.9	6.5
Control Delay (s)	7.9	0.0	0.0	0.0	7.8	0.0	13.1	15.7
Lane LOS	A				A		B	C
Approach Delay (s)	0.1				1.2		13.1	15.7
Approach LOS							B	C

Intersection Summary			
Average Delay	5.0		
Intersection Capacity Utilization	38.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	153	84	40	164	10	36	20	70	21	52	5
Future Volume (Veh/h)	5	153	84	40	164	10	36	20	70	21	52	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	166	91	43	178	11	39	22	76	23	57	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	189			166			474	451	83	412	446	184
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	189			166			474	451	83	412	446	184
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	100			97			90	95	92	95	88	99
cM capacity (veh/h)	1347			1367			408	474	944	455	490	831

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	5	83	83	91	43	189	137	85
Volume Left	5	0	0	0	43	0	39	23
Volume Right	0	0	0	91	0	11	76	5
cSH	1347	1700	1700	1700	1367	1700	970	492
Volume to Capacity	0.00	0.05	0.05	0.05	0.03	0.11	0.14	0.17
Queue Length 95th (m)	0.1	0.0	0.0	0.0	0.8	0.0	3.9	5.0
Control Delay (s)	7.7	0.0	0.0	0.0	7.7	0.0	11.6	13.8
Lane LOS	A				A		B	B
Approach Delay (s)	0.1				1.4		11.6	13.8
Approach LOS							B	B

Intersection Summary			
Average Delay	4.4		
Intersection Capacity Utilization	34.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	230	140	62	206	17	52	29	105	36	75	5
Future Volume (Veh/h)	5	230	140	62	206	17	52	29	105	36	75	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	250	152	67	224	18	57	32	114	39	82	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	242			250			664	636	125	575	627	233
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	242			250			664	636	125	575	627	233
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	100			95			79	91	87	88	78	99
cM capacity (veh/h)	1286			1270			267	362	886	314	378	772

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	5	125	125	152	67	242	203	126
Volume Left	5	0	0	0	67	0	57	39
Volume Right	0	0	0	152	0	18	114	5
cSH	1286	1700	1700	1700	1270	1700	687	362
Volume to Capacity	0.00	0.07	0.07	0.09	0.05	0.14	0.30	0.35
Queue Length 95th (m)	0.1	0.0	0.0	0.0	1.3	0.0	9.9	12.2
Control Delay (s)	7.8	0.0	0.0	0.0	8.0	0.0	15.0	20.1
Lane LOS	A				A		C	C
Approach Delay (s)	0.1				1.7		15.0	20.1
Approach LOS							C	C

Intersection Summary			
Average Delay	5.9		
Intersection Capacity Utilization	39.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
2: 17th Street & Victoria Avenue

2037 Development AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	282	171	79	252	22	65	35	128	46	88	5
Future Volume (Veh/h)	5	282	171	79	252	22	65	35	128	46	88	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	307	186	86	274	24	71	38	139	50	96	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	298			307			816	787	154	710	775	286
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	298			307			816	787	154	710	775	286
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	100			93			62	87	84	78	68	99
cM capacity (veh/h)	1225			1208			185	289	849	229	305	714

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	5	154	154	186	86	298	248	151
Volume Left	5	0	0	0	86	0	71	50
Volume Right	0	0	0	186	0	24	139	5
cSH	1225	1700	1700	1700	1208	1700	503	279
Volume to Capacity	0.00	0.09	0.09	0.11	0.07	0.18	0.49	0.54
Queue Length 95th (m)	0.1	0.0	0.0	0.0	1.8	0.0	21.5	23.8
Control Delay (s)	8.0	0.0	0.0	0.0	8.2	0.0	21.5	32.1
Lane LOS	A				A		C	D
Approach Delay (s)	0.1				1.8		21.5	32.1
Approach LOS							C	D

Intersection Summary				
Average Delay	8.5			
Intersection Capacity Utilization	44.0%	ICU Level of Service	A	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
2: 17th Street & Victoria Avenue

2017 Existing PM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	160	40	60	215	10	60	55	30	15	30	10
Future Volume (Veh/h)	10	160	40	60	215	10	60	55	30	15	30	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	174	43	65	234	11	65	60	33	16	33	11
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	245			174			588	571	87	525	566	240
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	245			174			588	571	87	525	566	240
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	99			95			81	85	96	96	92	99
cM capacity (veh/h)	1283			1357			339	395	938	358	410	765

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	11	87	87	43	65	245	158	60
Volume Left	11	0	0	0	65	0	65	16
Volume Right	0	0	0	43	0	11	33	11
cSH	1283	1700	1700	1700	1357	1700	463	430
Volume to Capacity	0.01	0.05	0.05	0.03	0.05	0.14	0.34	0.14
Queue Length 95th (m)	0.2	0.0	0.0	0.0	1.2	0.0	12.0	3.9
Control Delay (s)	7.8	0.0	0.0	0.0	7.8	0.0	17.6	14.7
Lane LOS	A				A		C	B
Approach Delay (s)	0.4				1.6		17.6	14.7
Approach LOS							C	B

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	38.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	165	40	60	225	10	60	55	30	15	30	10
Future Volume (Veh/h)	10	165	40	60	225	10	60	55	30	15	30	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	179	43	65	245	11	65	60	33	16	33	11
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	256			179			604	587	90	538	582	250
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	256			179			604	587	90	538	582	250
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	99			95			80	84	96	95	92	99
cM capacity (veh/h)	1270			1351			329	387	935	349	401	752

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	11	90	90	43	65	256	158	60
Volume Left	11	0	0	0	65	0	65	16
Volume Right	0	0	0	43	0	11	33	11
cSH	1270	1700	1700	1700	1351	1700	451	420
Volume to Capacity	0.01	0.05	0.05	0.03	0.05	0.15	0.35	0.14
Queue Length 95th (m)	0.2	0.0	0.0	0.0	1.2	0.0	12.4	4.0
Control Delay (s)	7.9	0.0	0.0	0.0	7.8	0.0	18.0	15.0
Lane LOS	A				A		C	B
Approach Delay (s)	0.4				1.6		18.0	15.0
Approach LOS							C	B

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	39.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	195	50	75	260	10	75	65	35	20	35	10
Future Volume (Veh/h)	10	195	50	75	260	10	75	65	35	20	35	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	212	54	82	283	11	82	71	38	22	38	11
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	294			212			711	692	106	635	686	288
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	294			212			711	692	106	635	686	288
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	99			94			69	79	96	92	89	98
cM capacity (veh/h)	1229			1313			265	331	912	277	344	711

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	11	106	106	54	82	294	191	71
Volume Left	11	0	0	0	82	0	82	22
Volume Right	0	0	0	54	0	11	38	11
cSH	1229	1700	1700	1700	1313	1700	369	346
Volume to Capacity	0.01	0.06	0.06	0.03	0.06	0.17	0.52	0.21
Queue Length 95th (m)	0.2	0.0	0.0	0.0	1.6	0.0	22.8	6.1
Control Delay (s)	8.0	0.0	0.0	0.0	7.9	0.0	25.5	18.1
Lane LOS	A				A		D	C
Approach Delay (s)	0.3				1.7		25.5	18.1
Approach LOS							D	C

Intersection Summary				
Average Delay	7.5			
Intersection Capacity Utilization	43.0%	ICU Level of Service	A	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
2: 17th Street & Victoria Avenue

2037 Background PM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	240	60	90	320	15	90	80	45	20	45	15
Future Volume (Veh/h)	15	240	60	90	320	15	90	80	45	20	45	15
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	261	65	98	348	16	98	87	49	22	49	16
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	364			261			878	853	130	782	845	356
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	364			261			878	853	130	782	845	356
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	99			92			47	67	94	88	82	98
cM capacity (veh/h)	1156			1258			184	260	879	187	273	643

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	16	130	130	65	98	364	234	87
Volume Left	16	0	0	0	98	0	98	22
Volume Right	0	0	0	65	0	16	49	16
cSH	1156	1700	1700	1700	1258	1700	278	270
Volume to Capacity	0.01	0.08	0.08	0.04	0.08	0.21	0.84	0.32
Queue Length 95th (m)	0.3	0.0	0.0	0.0	2.0	0.0	56.2	10.8
Control Delay (s)	8.2	0.0	0.0	0.0	8.1	0.0	59.2	24.5
Lane LOS	A				A		F	C
Approach Delay (s)	0.4				1.7		59.2	24.5
Approach LOS							F	C

Intersection Summary			
Average Delay	15.0		
Intersection Capacity Utilization	49.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	177	48	69	266	21	90	62	39	17	30	10
Future Volume (Veh/h)	10	177	48	69	266	21	90	62	39	17	30	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	192	52	75	289	23	98	67	42	18	33	11
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	312			192			680	676	96	623	664	300
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	312			192			680	676	96	623	664	300
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	99			94			66	80	95	94	91	98
cM capacity (veh/h)	1210			1336			285	340	926	287	357	699

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	11	96	96	52	75	312	207	62
Volume Left	11	0	0	0	75	0	98	18
Volume Right	0	0	0	52	0	23	42	11
cSH	1210	1700	1700	1700	1336	1700	385	363
Volume to Capacity	0.01	0.06	0.06	0.03	0.06	0.18	0.54	0.17
Queue Length 95th (m)	0.2	0.0	0.0	0.0	1.4	0.0	24.5	4.9
Control Delay (s)	8.0	0.0	0.0	0.0	7.9	0.0	25.4	17.0
Lane LOS	A				A		D	C
Approach Delay (s)	0.3				1.5		25.4	17.0
Approach LOS							D	C

Intersection Summary			
Average Delay	7.7		
Intersection Capacity Utilization	45.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	230	73	105	360	37	146	84	61	30	41	10
Future Volume (Veh/h)	10	230	73	105	360	37	146	84	61	30	41	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	250	79	114	391	40	159	91	66	33	45	11
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	431			250			924	931	125	864	911	411
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	431			250			924	931	125	864	911	411
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	99			91			6	61	93	78	82	98
cM capacity (veh/h)	1090			1270			169	231	886	149	247	593

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	11	125	125	79	114	431	316	89
Volume Left	11	0	0	0	114	0	159	33
Volume Right	0	0	0	79	0	40	66	11
cSH	1090	1700	1700	1700	1270	1700	243	211
Volume to Capacity	0.01	0.07	0.07	0.05	0.09	0.25	1.30	0.42
Queue Length 95th (m)	0.2	0.0	0.0	0.0	2.4	0.0	131.2	15.5
Control Delay (s)	8.3	0.0	0.0	0.0	8.1	0.0	173.5	34.0
Lane LOS	A				A		F	D
Approach Delay (s)	0.3				1.7		173.5	34.0
Approach LOS							F	D

Intersection Summary			
Average Delay	45.6		
Intersection Capacity Utilization	56.6%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	283	89	128	440	47	180	103	81	31	51	15
Future Volume (Veh/h)	15	283	89	128	440	47	180	103	81	31	51	15
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	308	97	139	478	51	196	112	88	34	55	16
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									38			
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	529			308			1140	1147	154	1068	1122	504
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	529			308			1140	1147	154	1068	1122	504
tC, single (s)	4.2			4.3			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	98			88			0	32	90	49	69	97
cM capacity (veh/h)	1000			1207			100	166	849	66	180	516

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	NB 1	SB 1
Volume Total	16	154	154	97	139	529	396	105
Volume Left	16	0	0	0	139	0	196	34
Volume Right	0	0	0	97	0	51	88	16
cSH	1000	1700	1700	1700	1207	1700	154	123
Volume to Capacity	0.02	0.09	0.09	0.06	0.12	0.31	2.58	0.85
Queue Length 95th (m)	0.4	0.0	0.0	0.0	3.1	0.0	276.8	41.8
Control Delay (s)	8.7	0.0	0.0	0.0	8.4	0.0	775.2	111.5
Lane LOS	A				A		F	F
Approach Delay (s)	0.3				1.7		775.2	111.5
Approach LOS							F	F

Intersection Summary			
Average Delay	201.3		
Intersection Capacity Utilization	64.9%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
3: 33rd Street & Victoria Avenue

2017 Existing AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	125	20	5	170	5	10	0	5	0	0	5
Future Volume (Veh/h)	15	125	20	5	170	5	10	0	5	0	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	136	22	5	185	5	11	0	5	0	0	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	190			158			382	379	147	382	388	188
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	190			158			382	379	147	382	388	188
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	99			100			98	100	99	100	100	99
cM capacity (veh/h)	1337			1416			537	519	857	566	539	855

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	174	195	16	5
Volume Left	16	5	11	0
Volume Right	22	5	5	5
cSH	1337	1416	608	855
Volume to Capacity	0.01	0.00	0.03	0.01
Queue Length 95th (m)	0.3	0.1	0.6	0.1
Control Delay (s)	0.8	0.2	11.1	9.2
Lane LOS	A	A	B	A
Approach Delay (s)	0.8	0.2	11.1	9.2
Approach LOS			B	A

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	30.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	130	20	5	175	5	10	0	5	0	0	5
Future Volume (Veh/h)	15	130	20	5	175	5	10	0	5	0	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	141	22	5	190	5	11	0	5	0	0	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	195			163			392	389	152	392	398	192
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	195			163			392	389	152	392	398	192
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	99			100			98	100	99	100	100	99
cM capacity (veh/h)	1331			1410			529	512	851	558	532	849

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	179	200	16	5
Volume Left	16	5	11	0
Volume Right	22	5	5	5
cSH	1331	1410	600	849
Volume to Capacity	0.01	0.00	0.03	0.01
Queue Length 95th (m)	0.3	0.1	0.7	0.1
Control Delay (s)	0.8	0.2	11.2	9.3
Lane LOS	A	A	B	A
Approach Delay (s)	0.8	0.2	11.2	9.3
Approach LOS			B	A

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	30.9%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
3: 33rd Street & Victoria Avenue

2027 Background AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	150	25	5	205	5	10	0	5	0	0	5
Future Volume (Veh/h)	20	150	25	5	205	5	10	0	5	0	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	163	27	5	223	5	11	0	5	0	0	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	228			190			461	458	176	461	470	226
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	228			190			461	458	176	461	470	226
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	98			100			98	100	99	100	100	99
cM capacity (veh/h)	1294			1378			473	465	825	500	482	814

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	212	233	16	5
Volume Left	22	5	11	0
Volume Right	27	5	5	5
cSH	1294	1378	545	814
Volume to Capacity	0.02	0.00	0.03	0.01
Queue Length 95th (m)	0.4	0.1	0.7	0.1
Control Delay (s)	0.9	0.2	11.8	9.5
Lane LOS	A	A	B	A
Approach Delay (s)	0.9	0.2	11.8	9.5
Approach LOS			B	A

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	35.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	185	30	5	255	5	15	0	5	0	0	5
Future Volume (Veh/h)	20	185	30	5	255	5	15	0	5	0	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	201	33	5	277	5	16	0	5	0	0	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	282			234			556	554	218	556	568	280
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	282			234			556	554	218	556	568	280
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	98			100			96	100	99	100	100	99
cM capacity (veh/h)	1236			1328			407	409	781	432	423	759

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	256	287	21	5
Volume Left	22	5	16	0
Volume Right	33	5	5	5
cSH	1236	1328	460	759
Volume to Capacity	0.02	0.00	0.05	0.01
Queue Length 95th (m)	0.4	0.1	1.1	0.2
Control Delay (s)	0.8	0.2	13.2	9.8
Lane LOS	A	A	B	A
Approach Delay (s)	0.8	0.2	13.2	9.8
Approach LOS			B	A

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	39.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	165	20	10	196	5	10	0	6	0	0	5
Future Volume (Veh/h)	15	165	20	10	196	5	10	0	6	0	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	179	22	11	213	5	11	0	7	0	0	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	218			201			464	462	190	466	470	216
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	218			201			464	462	190	466	470	216
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	99			99			98	100	99	100	100	99
cM capacity (veh/h)	1305			1365			470	463	810	494	481	824

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	217	229	18	5
Volume Left	16	11	11	0
Volume Right	22	5	7	5
cSH	1305	1365	562	824
Volume to Capacity	0.01	0.01	0.03	0.01
Queue Length 95th (m)	0.3	0.2	0.8	0.1
Control Delay (s)	0.7	0.4	11.6	9.4
Lane LOS	A	A	B	A
Approach Delay (s)	0.7	0.4	11.6	9.4
Approach LOS			B	A

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	31.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	232	25	19	263	5	10	0	8	0	0	5
Future Volume (Veh/h)	20	232	25	19	263	5	10	0	8	0	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	252	27	21	286	5	11	0	9	0	0	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	291			279			645	642	266	649	654	288
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	291			279			645	642	266	649	654	288
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	98			98			97	100	99	100	100	99
cM capacity (veh/h)	1226			1278			351	358	734	368	373	751

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	301	312	20	5
Volume Left	22	21	11	0
Volume Right	27	5	9	5
cSH	1226	1278	458	751
Volume to Capacity	0.02	0.02	0.04	0.01
Queue Length 95th (m)	0.4	0.4	1.1	0.2
Control Delay (s)	0.7	0.7	13.2	9.8
Lane LOS	A	A	B	A
Approach Delay (s)	0.7	0.7	13.2	9.8
Approach LOS			B	A

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	35.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	284	30	23	325	5	15	0	9	0	0	5
Future Volume (Veh/h)	20	284	30	23	325	5	15	0	9	0	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	309	33	25	353	5	16	0	10	0	0	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	358			342			780	778	326	785	792	356
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	358			342			780	778	326	785	792	356
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	98			98			94	100	99	100	100	99
cM capacity (veh/h)	1158			1211			282	297	678	297	309	688

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	364	383	26	5
Volume Left	22	25	16	0
Volume Right	33	5	10	5
cSH	1158	1211	364	688
Volume to Capacity	0.02	0.02	0.07	0.01
Queue Length 95th (m)	0.5	0.5	1.8	0.2
Control Delay (s)	0.7	0.7	15.7	10.3
Lane LOS	A	A	C	B
Approach Delay (s)	0.7	0.7	15.7	10.3
Approach LOS			C	B

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	41.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	140	45	0	175	0	50	0	5	5	0	30
Future Volume (Veh/h)	0	140	45	0	175	0	50	0	5	5	0	30
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	152	49	0	190	0	54	0	5	5	0	33
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	190			201			400	366	176	372	391	190
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	190			201			400	366	176	372	391	190
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	100			100			89	100	99	99	100	96
cM capacity (veh/h)	1337			1365			511	536	825	582	545	852

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	201	190	59	38
Volume Left	0	0	54	5
Volume Right	49	0	5	33
cSH	1337	1365	528	803
Volume to Capacity	0.00	0.00	0.11	0.05
Queue Length 95th (m)	0.0	0.0	3.0	1.2
Control Delay (s)	0.0	0.0	12.7	9.7
Lane LOS			B	A
Approach Delay (s)	0.0	0.0	12.7	9.7
Approach LOS			B	A

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	27.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	145	45	0	180	0	50	0	5	5	0	30
Future Volume (Veh/h)	0	145	45	0	180	0	50	0	5	5	0	30
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	158	49	0	196	0	54	0	5	5	0	33
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	196			207			412	378	182	384	403	196
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	196			207			412	378	182	384	403	196
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	100			100			89	100	99	99	100	96
cM capacity (veh/h)	1330			1358			501	528	818	571	536	845

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	207	196	59	38
Volume Left	0	0	54	5
Volume Right	49	0	5	33
cSH	1330	1358	519	795
Volume to Capacity	0.00	0.00	0.11	0.05
Queue Length 95th (m)	0.0	0.0	3.1	1.2
Control Delay (s)	0.0	0.0	12.8	9.8
Lane LOS			B	A
Approach Delay (s)	0.0	0.0	12.8	9.8
Approach LOS			B	A

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	27.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	170	55	0	215	0	60	0	5	5	0	35
Future Volume (Veh/h)	0	170	55	0	215	0	60	0	5	5	0	35
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	185	60	0	234	0	65	0	5	5	0	38
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	234			245			487	449	215	454	479	234
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	234			245			487	449	215	454	479	234
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	100			100			85	100	99	99	100	95
cM capacity (veh/h)	1288			1315			442	481	784	513	486	805

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	245	234	70	43
Volume Left	0	0	65	5
Volume Right	60	0	5	38
cSH	1288	1315	456	755
Volume to Capacity	0.00	0.00	0.15	0.06
Queue Length 95th (m)	0.0	0.0	4.3	1.4
Control Delay (s)	0.0	0.0	14.3	10.1
Lane LOS			B	B
Approach Delay (s)	0.0	0.0	14.3	10.1
Approach LOS			B	B

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	30.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	210	65	0	260	0	75	0	5	5	0	45
Future Volume (Veh/h)	0	210	65	0	260	0	75	0	5	5	0	45
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	228	71	0	283	0	82	0	5	5	0	49
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	283			299			596	546	264	552	582	283
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	283			299			596	546	264	552	582	283
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	100			100			78	100	99	99	100	94
cM capacity (veh/h)	1235			1256			366	422	736	442	425	756

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	299	283	87	54
Volume Left	0	0	82	5
Volume Right	71	0	5	49
cSH	1235	1256	377	709
Volume to Capacity	0.00	0.00	0.23	0.08
Queue Length 95th (m)	0.0	0.0	7.0	2.0
Control Delay (s)	0.0	0.0	17.4	10.5
Lane LOS			C	B
Approach Delay (s)	0.0	0.0	17.4	10.5
Approach LOS			C	B

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	34.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	166	45	1	217	0	50	0	9	5	0	30
Future Volume (Veh/h)	0	166	45	1	217	0	50	0	9	5	0	30
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	180	49	1	236	0	54	0	10	5	0	33
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	236			229			476	442	204	452	467	236
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	236			229			476	442	204	452	467	236
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	100			100			88	100	99	99	100	96
cM capacity (veh/h)	1286			1333			453	484	795	511	493	803

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	229	237	64	38
Volume Left	0	1	54	5
Volume Right	49	0	10	33
cSH	1286	1333	485	747
Volume to Capacity	0.00	0.00	0.13	0.05
Queue Length 95th (m)	0.0	0.0	3.6	1.3
Control Delay (s)	0.0	0.0	13.5	10.1
Lane LOS		A	B	B
Approach Delay (s)	0.0	0.0	13.5	10.1
Approach LOS			B	B

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	30.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	230	55	4	302	0	60	0	16	5	0	35
Future Volume (Veh/h)	0	230	55	4	302	0	60	0	16	5	0	35
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	250	60	4	328	0	65	0	17	5	0	38
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	328			310			654	616	280	633	646	328
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	328			310			654	616	280	633	646	328
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	100			100			81	100	98	99	100	95
cM capacity (veh/h)	1188			1245			338	383	720	382	389	713

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	310	332	82	43
Volume Left	0	4	65	5
Volume Right	60	0	17	38
cSH	1188	1245	379	648
Volume to Capacity	0.00	0.00	0.22	0.07
Queue Length 95th (m)	0.0	0.1	6.5	1.7
Control Delay (s)	0.0	0.1	17.1	10.9
Lane LOS		A	C	B
Approach Delay (s)	0.0	0.1	17.1	10.9
Approach LOS			C	B

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	38.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	283	65	5	366	0	75	0	19	5	0	45
Future Volume (Veh/h)	0	283	65	5	366	0	75	0	19	5	0	45
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	308	71	5	398	0	82	0	21	5	0	49
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	398			379			800	752	344	772	787	398
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	398			379			800	752	344	772	787	398
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	100			100			69	100	97	98	100	92
cM capacity (veh/h)	1118			1174			261	319	662	305	322	652

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	379	403	103	54
Volume Left	0	5	82	5
Volume Right	71	0	21	49
cSH	1118	1174	298	590
Volume to Capacity	0.00	0.00	0.35	0.09
Queue Length 95th (m)	0.0	0.1	11.9	2.4
Control Delay (s)	0.0	0.1	23.3	11.7
Lane LOS		A	C	B
Approach Delay (s)	0.0	0.1	23.3	11.7
Approach LOS			C	B

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	44.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	50	65	10	0	45	0	20	20	0	5	10	25
Future Volume (Veh/h)	50	65	10	0	45	0	20	20	0	5	10	25
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	54	71	11	0	49	0	22	22	0	5	11	27
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	49			82			239	234	76	244	239	49
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	49			82			239	234	76	244	239	49
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	96			100			97	97	100	99	98	97
cM capacity (veh/h)	1386			1331			659	636	976	633	604	966

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	136	49	44	43
Volume Left	54	0	22	5
Volume Right	11	0	0	27
cSH	1386	1331	647	1538
Volume to Capacity	0.04	0.00	0.07	0.03
Queue Length 95th (m)	1.0	0.0	1.7	0.7
Control Delay (s)	3.2	0.0	11.0	9.7
Lane LOS	A		B	A
Approach Delay (s)	3.2	0.0	11.0	9.7
Approach LOS			B	A

Intersection Summary			
Average Delay	4.9		
Intersection Capacity Utilization	29.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	55	70	10	0	50	0	20	20	0	5	10	25
Future Volume (Veh/h)	55	70	10	0	50	0	20	20	0	5	10	25
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	60	76	11	0	54	0	22	22	0	5	11	27
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	54			87			261	256	82	266	261	54
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	54			87			261	256	82	266	261	54
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	96			100			97	96	100	99	98	97
cM capacity (veh/h)	1380			1325			635	615	970	609	584	959

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	147	54	44	43
Volume Left	60	0	22	5
Volume Right	11	0	0	27
cSH	1380	1325	625	1528
Volume to Capacity	0.04	0.00	0.07	0.03
Queue Length 95th (m)	1.1	0.0	1.8	0.7
Control Delay (s)	3.4	0.0	11.2	9.7
Lane LOS	A		B	A
Approach Delay (s)	3.4	0.0	11.2	9.7
Approach LOS			B	A

Intersection Summary			
Average Delay	4.9		
Intersection Capacity Utilization	30.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	95	15	0	65	0	30	30	0	5	15	35
Future Volume (Veh/h)	75	95	15	0	65	0	30	30	0	5	15	35
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	82	103	16	0	71	0	33	33	0	5	16	38
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	71			119			354	346	111	362	354	71
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	71			119			354	346	111	362	354	71
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	94			100			94	94	100	99	97	96
cM capacity (veh/h)	1359			1288			532	538	934	507	508	938

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	201	71	66	59
Volume Left	82	0	33	5
Volume Right	16	0	0	38
cSH	1359	1288	535	1427
Volume to Capacity	0.06	0.00	0.12	0.04
Queue Length 95th (m)	1.5	0.0	3.4	1.0
Control Delay (s)	3.5	0.0	12.7	10.2
Lane LOS	A		B	B
Approach Delay (s)	3.5	0.0	12.7	10.2
Approach LOS			B	B

Intersection Summary			
Average Delay	5.4		
Intersection Capacity Utilization	34.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	110	140	20	0	100	0	45	45	0	10	20	55
Future Volume (Veh/h)	110	140	20	0	100	0	45	45	0	10	20	55
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	120	152	22	0	109	0	49	49	0	11	22	60
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	109			174			523	512	163	536	523	109
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	109			174			523	512	163	536	523	109
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	91			100			87	88	100	97	94	93
cM capacity (veh/h)	1314			1226			382	419	874	361	392	893

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	294	109	98	93
Volume Left	120	0	49	11
Volume Right	22	0	0	60
cSH	1314	1226	400	1076
Volume to Capacity	0.09	0.00	0.25	0.09
Queue Length 95th (m)	2.4	0.0	7.6	2.3
Control Delay (s)	3.8	0.0	16.9	11.5
Lane LOS	A		C	B
Approach Delay (s)	3.8	0.0	16.9	11.5
Approach LOS			C	B

Intersection Summary			
Average Delay	6.4		
Intersection Capacity Utilization	41.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	59	89	10	0	54	2	20	22	2	5	10	26
Future Volume (Veh/h)	59	89	10	0	54	2	20	22	2	5	10	26
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	64	97	11	0	59	2	22	24	2	5	11	28
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	61			108			296	292	102	304	296	60
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	61			108			296	292	102	304	296	60
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	95			100			96	96	100	99	98	97
cM capacity (veh/h)	1371			1300			600	585	944	569	556	952

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	172	61	48	44
Volume Left	64	0	22	5
Volume Right	11	2	2	28
cSH	1371	1300	601	1496
Volume to Capacity	0.05	0.00	0.08	0.03
Queue Length 95th (m)	1.2	0.0	2.1	0.7
Control Delay (s)	3.1	0.0	11.5	9.9
Lane LOS	A		B	A
Approach Delay (s)	3.1	0.0	11.5	9.9
Approach LOS			B	A

Intersection Summary			
Average Delay	4.7		
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	139	28	0	73	6	32	37	6	6	23	38
Future Volume (Veh/h)	90	139	28	0	73	6	32	37	6	6	23	38
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	151	30	0	79	7	35	40	7	7	25	41
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	86			181			457	448	166	472	460	82
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	86			181			457	448	166	472	460	82
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	93			100			92	91	99	98	94	96
cM capacity (veh/h)	1341			1218			439	465	871	412	435	924

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	279	86	82	73
Volume Left	98	0	35	7
Volume Right	30	7	7	41
cSH	1341	1218	472	982
Volume to Capacity	0.07	0.00	0.17	0.07
Queue Length 95th (m)	1.9	0.0	5.0	1.9
Control Delay (s)	3.2	0.0	14.2	11.2
Lane LOS	A		B	B
Approach Delay (s)	3.2	0.0	14.2	11.2
Approach LOS			B	B

Intersection Summary			
Average Delay	5.5		
Intersection Capacity Utilization	39.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	128	192	46	0	111	8	50	55	7	12	33	59
Future Volume (Veh/h)	128	192	46	0	111	8	50	55	7	12	33	59
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	139	209	50	0	121	9	54	60	8	13	36	64
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	130			259			656	642	234	676	662	126
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	130			259			656	642	234	676	662	126
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	89			100			81	83	99	95	89	93
cM capacity (veh/h)	1290			1136			292	347	798	270	319	874

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	398	130	122	113
Volume Left	139	0	54	13
Volume Right	50	9	8	64
cSH	1290	1136	331	705
Volume to Capacity	0.11	0.00	0.37	0.16
Queue Length 95th (m)	2.9	0.0	13.2	4.5
Control Delay (s)	3.5	0.0	22.1	13.6
Lane LOS	A		C	B
Approach Delay (s)	3.5	0.0	22.1	13.6
Approach LOS			C	B

Intersection Summary			
Average Delay	7.4		
Intersection Capacity Utilization	48.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	40	45	25	5	65	10	15	30	0	0	30	40
Future Volume (Veh/h)	40	45	25	5	65	10	15	30	0	0	30	40
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	43	49	27	5	71	11	16	33	0	0	33	43
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	82			76			252	240	62	252	248	76
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	82			76			252	240	62	252	248	76
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	97			100			97	95	100	100	94	95
cM capacity (veh/h)	1346			1338			619	632	994	619	599	932

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	119	87	49	76
Volume Left	43	5	16	0
Volume Right	27	11	0	43
cSH	1346	1338	628	1380
Volume to Capacity	0.03	0.00	0.08	0.06
Queue Length 95th (m)	0.8	0.1	2.0	1.4
Control Delay (s)	3.0	0.5	11.2	10.1
Lane LOS	A	A	B	B
Approach Delay (s)	3.0	0.5	11.2	10.1
Approach LOS			B	B

Intersection Summary			
Average Delay	5.2		
Intersection Capacity Utilization	29.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	45	50	25	5	70	10	15	30	0	0	30	45
Future Volume (Veh/h)	45	50	25	5	70	10	15	30	0	0	30	45
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	49	54	27	5	76	11	16	33	0	0	33	49
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	87			81			274	262	68	274	270	82
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	87			81			274	262	68	274	270	82
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	96			100			97	95	100	100	94	95
cM capacity (veh/h)	1340			1332			591	612	988	595	579	926

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	130	92	49	82
Volume Left	49	5	16	0
Volume Right	27	11	0	49
cSH	1340	1332	605	1439
Volume to Capacity	0.04	0.00	0.08	0.06
Queue Length 95th (m)	0.9	0.1	2.1	1.4
Control Delay (s)	3.1	0.4	11.5	10.1
Lane LOS	A	A	B	B
Approach Delay (s)	3.1	0.4	11.5	10.1
Approach LOS			B	B

Intersection Summary			
Average Delay	5.2		
Intersection Capacity Utilization	29.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	60	65	35	5	95	15	20	45	0	0	45	60
Future Volume (Veh/h)	60	65	35	5	95	15	20	45	0	0	45	60
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	65	71	38	5	103	16	22	49	0	0	49	65
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	119			109			366	349	90	366	360	111
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	119			109			366	349	90	366	360	111
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	95			100			95	91	100	100	90	93
cM capacity (veh/h)	1302			1299			482	540	960	496	508	891

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	174	124	71	114
Volume Left	65	5	22	0
Volume Right	38	16	0	65
cSH	1302	1299	520	1181
Volume to Capacity	0.05	0.00	0.14	0.10
Queue Length 95th (m)	1.3	0.1	3.8	2.6
Control Delay (s)	3.2	0.3	13.0	10.9
Lane LOS	A	A	B	B
Approach Delay (s)	3.2	0.3	13.0	10.9
Approach LOS			B	B

Intersection Summary			
Average Delay	5.7		
Intersection Capacity Utilization	33.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	100	55	10	140	20	35	65	0	0	65	90
Future Volume (Veh/h)	90	100	55	10	140	20	35	65	0	0	65	90
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	109	60	11	152	22	38	71	0	0	71	98
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	174			169			556	531	139	556	550	163
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	174			169			556	531	139	556	550	163
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	92			99			88	83	100	100	81	88
cM capacity (veh/h)	1240			1231			309	410	901	335	380	832

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	267	185	109	169
Volume Left	98	11	38	0
Volume Right	60	22	0	98
cSH	1240	1231	368	904
Volume to Capacity	0.08	0.01	0.30	0.19
Queue Length 95th (m)	2.1	0.2	9.7	5.5
Control Delay (s)	3.4	0.5	18.8	12.7
Lane LOS	A	A	C	B
Approach Delay (s)	3.4	0.5	18.8	12.7
Approach LOS			C	B

Intersection Summary			
Average Delay	7.2		
Intersection Capacity Utilization	47.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	46	54	25	9	87	11	15	32	0	2	34	49
Future Volume (Veh/h)	46	54	25	9	87	11	15	32	0	2	34	49
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	50	59	27	10	95	12	16	35	0	2	37	53
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	107			86			312	300	72	311	307	101
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	107			86			312	300	72	311	307	101
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	96			99			97	94	100	100	93	94
cM capacity (veh/h)	1316			1326			547	580	981	557	549	902

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	136	117	51	92
Volume Left	50	10	16	2
Volume Right	27	12	0	53
cSH	1316	1326	570	1296
Volume to Capacity	0.04	0.01	0.09	0.07
Queue Length 95th (m)	0.9	0.2	2.3	1.8
Control Delay (s)	3.1	0.7	11.9	10.4
Lane LOS	A	A	B	B
Approach Delay (s)	3.1	0.7	11.9	10.4
Approach LOS			B	B

Intersection Summary			
Average Delay	5.2		
Intersection Capacity Utilization	30.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	64	76	38	13	133	17	33	56	2	6	59	74
Future Volume (Veh/h)	64	76	38	13	133	17	33	56	2	6	59	74
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	70	83	41	14	145	18	36	61	2	7	64	80
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	163			124			458	434	104	458	446	154
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	163			124			458	434	104	458	446	154
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	94			99			91	87	100	98	86	90
cM capacity (veh/h)	1252			1282			389	476	943	411	447	842

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	194	177	99	151
Volume Left	70	14	36	7
Volume Right	41	18	2	80
cSH	1252	1282	445	943
Volume to Capacity	0.06	0.01	0.22	0.16
Queue Length 95th (m)	1.4	0.3	6.7	4.6
Control Delay (s)	3.2	0.7	15.4	12.0
Lane LOS	A	A	C	B
Approach Delay (s)	3.2	0.7	15.4	12.0
Approach LOS			C	B

Intersection Summary			
Average Delay	6.6		
Intersection Capacity Utilization	42.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	98	113	62	20	184	23	63	86	2	8	82	108
Future Volume (Veh/h)	98	113	62	20	184	23	63	86	2	8	82	108
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	107	123	67	22	200	25	68	93	2	9	89	117
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	225			190			672	640	156	676	660	212
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	225			190			672	640	156	676	660	212
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	91			98			70	73	100	96	72	85
cM capacity (veh/h)	1185			1209			225	348	881	250	320	780

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	297	247	163	215
Volume Left	107	22	68	9
Volume Right	67	25	2	117
cSH	1185	1209	285	688
Volume to Capacity	0.09	0.02	0.57	0.31
Queue Length 95th (m)	2.4	0.4	26.3	10.7
Control Delay (s)	3.5	0.9	33.2	15.5
Lane LOS	A	A	D	C
Approach Delay (s)	3.5	0.9	33.2	15.5
Approach LOS			D	C

Intersection Summary			
Average Delay	10.9		
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
14: 33rd Street & PTH 110

2017 Existing AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	55	0	0	45	5	0	0	0	5	0	0
Future Volume (Veh/h)	15	55	0	0	45	5	0	0	0	5	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	60	0	0	49	5	0	0	0	5	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	54			60			144	146	60	144	144	52
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	54			60			144	146	60	144	144	52
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	99			100			100	100	100	99	100	100
cM capacity (veh/h)	1354			1347			685	628	842	769	699	955

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	76	54	0	5
Volume Left	16	0	0	5
Volume Right	0	5	0	0
cSH	1354	1347	1700	769
Volume to Capacity	0.01	0.00	0.00	0.01
Queue Length 95th (m)	0.3	0.0	0.0	0.2
Control Delay (s)	1.7	0.0	0.0	9.7
Lane LOS	A		A	A
Approach Delay (s)	1.7	0.0	0.0	9.7
Approach LOS			A	A

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	20.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
14: 33rd Street & PTH 110

2019 Background AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	60	0	0	50	5	0	0	0	5	0	0
Future Volume (Veh/h)	15	60	0	0	50	5	0	0	0	5	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	65	0	0	54	5	0	0	0	5	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	59			65			154	156	65	154	154	56
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	59			65			154	156	65	154	154	56
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	99			100			100	100	100	99	100	100
cM capacity (veh/h)	1348			1341			674	619	836	757	690	949

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	81	59	0	5
Volume Left	16	0	0	5
Volume Right	0	5	0	0
cSH	1348	1341	1700	757
Volume to Capacity	0.01	0.00	0.00	0.01
Queue Length 95th (m)	0.3	0.0	0.0	0.2
Control Delay (s)	1.6	0.0	0.0	9.8
Lane LOS	A		A	A
Approach Delay (s)	1.6	0.0	0.0	9.8
Approach LOS			A	A

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	21.0%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
14: 33rd Street & PTH 110

2027 Background AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	80	0	0	65	5	0	0	0	5	0	0
Future Volume (Veh/h)	20	80	0	0	65	5	0	0	0	5	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	87	0	0	71	5	0	0	0	5	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	76			87			204	207	87	204	204	74
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	76			87			204	207	87	204	204	74
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	98			100			100	100	100	99	100	100
cM capacity (veh/h)	1328			1315			618	574	811	697	642	928

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	109	76	0	5
Volume Left	22	0	0	5
Volume Right	0	5	0	0
cSH	1328	1315	1700	697
Volume to Capacity	0.02	0.00	0.00	0.01
Queue Length 95th (m)	0.4	0.0	0.0	0.2
Control Delay (s)	1.7	0.0	0.0	10.2
Lane LOS	A		A	B
Approach Delay (s)	1.7	0.0	0.0	10.2
Approach LOS			A	B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	22.4%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
14: 33rd Street & PTH 110

2037 Background AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	35	120	0	0	100	10	0	0	0	10	0	0
Future Volume (Veh/h)	35	120	0	0	100	10	0	0	0	10	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	38	130	0	0	109	11	0	0	0	11	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	120			130			320	326	130	320	320	114
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	120			130			320	326	130	320	320	114
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	97			100			100	100	100	98	100	100
cM capacity (veh/h)	1277			1266			507	480	764	577	544	879

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	168	120	0	11
Volume Left	38	0	0	11
Volume Right	0	11	0	0
cSH	1277	1266	1700	577
Volume to Capacity	0.03	0.00	0.00	0.02
Queue Length 95th (m)	0.7	0.0	0.0	0.5
Control Delay (s)	2.0	0.0	0.0	11.4
Lane LOS	A		A	B
Approach Delay (s)	2.0	0.0	0.0	11.4
Approach LOS			A	B

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	25.6%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
14: 33rd Street & PTH 110

2019 Development AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	17	79	0	0	56	8	0	0	0	5	0	0
Future Volume (Veh/h)	17	79	0	0	56	8	0	0	0	5	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	18	86	0	0	61	9	0	0	0	5	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	70			86			188	192	86	188	188	66
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	70			86			188	192	86	188	188	66
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	99			100			100	100	100	99	100	100
cM capacity (veh/h)	1335			1316			637	588	812	718	659	938

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	104	70	0	5
Volume Left	18	0	0	5
Volume Right	0	9	0	0
cSH	1335	1316	1700	718
Volume to Capacity	0.01	0.00	0.00	0.01
Queue Length 95th (m)	0.3	0.0	0.0	0.2
Control Delay (s)	1.4	0.0	0.0	10.1
Lane LOS	A		A	B
Approach Delay (s)	1.4	0.0	0.0	10.1
Approach LOS			A	B

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	22.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	26	125	0	6	79	11	0	0	1	5	0	0
Future Volume (Veh/h)	26	125	0	6	79	11	0	0	1	5	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	28	136	0	7	86	12	0	0	1	5	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	98			136			298	304	136	299	298	92
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	98			136			298	304	136	299	298	92
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	98			99			100	100	100	99	100	100
cM capacity (veh/h)	1302			1259			527	496	758	597	562	906

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	164	105	1	5
Volume Left	28	7	0	5
Volume Right	0	12	1	0
cSH	1302	1259	758	597
Volume to Capacity	0.02	0.01	0.00	0.01
Queue Length 95th (m)	0.5	0.1	0.0	0.2
Control Delay (s)	1.5	0.6	9.8	11.1
Lane LOS	A	A	A	B
Approach Delay (s)	1.5	0.6	9.8	11.1
Approach LOS			A	B

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	26.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
14: 33rd Street & PTH 110

2037 Development AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	42	174	0	9	118	17	0	0	2	12	0	1
Future Volume (Veh/h)	42	174	0	9	118	17	0	0	2	12	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	46	189	0	10	128	18	0	0	2	13	0	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	146			189			439	447	189	440	438	137
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	146			189			439	447	189	440	438	137
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	96			99			100	100	100	97	100	100
cM capacity (veh/h)	1248			1200			412	398	704	472	458	854

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	235	156	2	14
Volume Left	46	10	0	13
Volume Right	0	18	2	1
cSH	1248	1200	704	487
Volume to Capacity	0.04	0.01	0.00	0.03
Queue Length 95th (m)	0.9	0.2	0.1	0.7
Control Delay (s)	1.8	0.6	10.1	12.6
Lane LOS	A	A	B	B
Approach Delay (s)	1.8	0.6	10.1	12.6
Approach LOS			B	B

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	38.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	35	5	0	50	5	10	0	0	5	0	20
Future Volume (Veh/h)	5	35	5	0	50	5	10	0	0	5	0	20
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	38	5	0	54	5	11	0	0	5	0	22
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	59			43			129	110	40	107	110	56
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	59			43			129	110	40	107	110	56
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	100			100			98	100	100	99	100	98
cM capacity (veh/h)	1348			1368			689	666	864	818	737	949

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	48	59	11	27
Volume Left	5	0	11	5
Volume Right	5	5	0	22
cSH	1348	1368	689	922
Volume to Capacity	0.00	0.00	0.02	0.03
Queue Length 95th (m)	0.1	0.0	0.4	0.7
Control Delay (s)	0.8	0.0	10.3	9.0
Lane LOS	A		B	A
Approach Delay (s)	0.8	0.0	10.3	9.0
Approach LOS			B	A

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	17.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	40	5	0	55	5	10	0	0	5	0	20
Future Volume (Veh/h)	5	40	5	0	55	5	10	0	0	5	0	20
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	43	5	0	60	5	11	0	0	5	0	22
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	65			48			140	120	46	118	120	62
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	65			48			140	120	46	118	120	62
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	100			100			98	100	100	99	100	98
cM capacity (veh/h)	1341			1362			677	656	859	805	726	941

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	53	65	11	27
Volume Left	5	0	11	5
Volume Right	5	5	0	22
cSH	1341	1362	677	913
Volume to Capacity	0.00	0.00	0.02	0.03
Queue Length 95th (m)	0.1	0.0	0.4	0.7
Control Delay (s)	0.8	0.0	10.4	9.1
Lane LOS	A		B	A
Approach Delay (s)	0.8	0.0	10.4	9.1
Approach LOS			B	A

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	17.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
14: 33rd Street & PTH 110

2027 Background PM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	50	5	0	75	5	15	0	0	5	0	30
Future Volume (Veh/h)	5	50	5	0	75	5	15	0	0	5	0	30
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	54	5	0	82	5	16	0	0	5	0	33
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	87			59			184	154	56	151	154	84
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	87			59			184	154	56	151	154	84
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	100			100			97	100	100	99	100	96
cM capacity (veh/h)	1315			1348			622	627	846	765	696	915

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	64	87	16	38
Volume Left	5	0	16	5
Volume Right	5	5	0	33
cSH	1315	1348	622	892
Volume to Capacity	0.00	0.00	0.03	0.04
Queue Length 95th (m)	0.1	0.0	0.6	1.1
Control Delay (s)	0.6	0.0	10.9	9.2
Lane LOS	A		B	A
Approach Delay (s)	0.6	0.0	10.9	9.2
Approach LOS			B	A

Intersection Summary			
Average Delay	2.8		
Intersection Capacity Utilization	18.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	75	10	0	110	10	20	0	0	10	0	45
Future Volume (Veh/h)	10	75	10	0	110	10	20	0	0	10	0	45
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	82	11	0	120	11	22	0	0	11	0	49
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	131			93			284	240	88	235	240	126
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	131			93			284	240	88	235	240	126
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	99			100			96	100	100	98	100	94
cM capacity (veh/h)	1264			1308			516	553	810	669	618	867

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	104	131	22	60
Volume Left	11	0	22	11
Volume Right	11	11	0	49
cSH	1264	1308	516	822
Volume to Capacity	0.01	0.00	0.04	0.07
Queue Length 95th (m)	0.2	0.0	1.1	1.9
Control Delay (s)	0.9	0.0	12.3	9.7
Lane LOS	A		B	A
Approach Delay (s)	0.9	0.0	12.3	9.7
Approach LOS			B	A

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	23.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	46	5	0	73	5	10	0	0	8	0	24
Future Volume (Veh/h)	5	46	5	0	73	5	10	0	0	8	0	24
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	50	5	0	79	5	11	0	0	9	0	26
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	84			55			170	146	52	144	146	82
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	84			55			170	146	52	144	146	82
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	100			100			98	100	100	99	100	97
cM capacity (veh/h)	1319			1353			642	633	850	773	702	918

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	60	84	11	35
Volume Left	5	0	11	9
Volume Right	5	5	0	26
cSH	1319	1353	642	876
Volume to Capacity	0.00	0.00	0.02	0.04
Queue Length 95th (m)	0.1	0.0	0.4	1.0
Control Delay (s)	0.7	0.0	10.7	9.3
Lane LOS	A		B	A
Approach Delay (s)	0.7	0.0	10.7	9.3
Approach LOS			B	A

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	17.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
14: 33rd Street & PTH 110

2027 Development PM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	68	5	2	115	6	15	0	4	10	0	38
Future Volume (Veh/h)	6	68	5	2	115	6	15	0	4	10	0	38
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	74	5	2	125	7	16	0	4	11	0	41
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	132			79			264	226	76	227	226	128
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	132			79			264	226	76	227	226	128
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	99			100			97	100	100	98	100	95
cM capacity (veh/h)	1263			1325			539	564	823	675	631	863

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	86	134	20	52
Volume Left	7	2	16	11
Volume Right	5	7	4	41
cSH	1263	1325	579	815
Volume to Capacity	0.01	0.00	0.03	0.06
Queue Length 95th (m)	0.1	0.0	0.9	1.6
Control Delay (s)	0.7	0.1	11.4	9.7
Lane LOS	A	A	B	A
Approach Delay (s)	0.7	0.1	11.4	9.7
Approach LOS			B	A

Intersection Summary			
Average Delay	2.8		
Intersection Capacity Utilization	18.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	97	10	2	158	12	20	0	7	16	0	54
Future Volume (Veh/h)	11	97	10	2	158	12	20	0	7	16	0	54
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	105	11	2	172	13	22	0	8	17	0	59
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	185			116			376	324	110	325	322	178
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	185			116			376	324	110	325	322	178
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	99			100			95	100	99	97	100	93
cM capacity (veh/h)	1205			1281			435	491	785	575	553	808

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	128	187	30	76
Volume Left	12	2	22	17
Volume Right	11	13	8	59
cSH	1205	1281	494	741
Volume to Capacity	0.01	0.00	0.06	0.10
Queue Length 95th (m)	0.2	0.0	1.5	2.7
Control Delay (s)	0.8	0.1	12.8	10.4
Lane LOS	A	A	B	B
Approach Delay (s)	0.8	0.1	12.8	10.4
Approach LOS			B	B

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	24.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	115	140	5	10	95	55	5	30	25	65	35	70
Future Volume (Veh/h)	115	140	5	10	95	55	5	30	25	65	35	70
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	125	152	5	11	103	60	5	33	27	71	38	76
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	103			152			546	527	152	557	527	103
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	103			152			546	527	152	557	527	103
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	91			99			98	91	97	79	90	91
cM capacity (veh/h)	1400			1285			314	374	817	332	375	874

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	125	152	5	11	103	60	5	60	71	114
Volume Left	125	0	0	11	0	0	5	0	71	0
Volume Right	0	0	5	0	0	60	0	27	0	76
cSH	1400	1700	1700	1285	1700	1700	314	680	332	1125
Volume to Capacity	0.09	0.09	0.00	0.01	0.06	0.04	0.02	0.09	0.21	0.10
Queue Length 95th (m)	2.3	0.0	0.0	0.2	0.0	0.0	0.4	2.3	6.4	2.7
Control Delay (s)	7.8	0.0	0.0	7.8	0.0	0.0	16.6	12.9	18.8	11.6
Lane LOS	A			A			C	B	C	B
Approach Delay (s)	3.5			0.5			13.1		14.3	
Approach LOS							B		B	

Intersection Summary			
Average Delay	6.5		
Intersection Capacity Utilization	30.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
15: PTH 110 & Richmond Avenue

2019 Background AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	150	5	10	105	60	5	30	25	70	40	75
Future Volume (Veh/h)	125	150	5	10	105	60	5	30	25	70	40	75
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	136	163	5	11	114	65	5	33	27	76	43	82
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	114			163			592	571	163	601	571	114
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	114			163			592	571	163	601	571	114
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	90			99			98	91	97	75	88	90
cM capacity (veh/h)	1387			1272			282	349	805	305	350	861

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	136	163	5	11	114	65	5	60	76	125
Volume Left	136	0	0	11	0	0	5	0	76	0
Volume Right	0	0	5	0	0	65	0	27	0	82
cSH	1387	1700	1700	1272	1700	1700	282	634	305	1017
Volume to Capacity	0.10	0.10	0.00	0.01	0.07	0.04	0.02	0.09	0.25	0.12
Queue Length 95th (m)	2.6	0.0	0.0	0.2	0.0	0.0	0.4	2.5	7.7	3.4
Control Delay (s)	7.9	0.0	0.0	7.9	0.0	0.0	18.0	13.4	20.6	12.1
Lane LOS	A			A			C	B	C	B
Approach Delay (s)	3.5			0.5			13.7		15.3	
Approach LOS							B		C	

Intersection Summary			
Average Delay	6.7		
Intersection Capacity Utilization	31.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	170	205	5	15	140	80	5	45	35	95	50	105
Future Volume (Veh/h)	170	205	5	15	140	80	5	45	35	95	50	105
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	185	223	5	16	152	87	5	49	38	103	54	114
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	152			223			804	777	223	820	777	152
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	152			223			804	777	223	820	777	152
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	86			99			97	80	95	45	78	86
cM capacity (veh/h)	1342			1206			170	250	743	187	250	819

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	185	223	5	16	152	87	5	87	103	168
Volume Left	185	0	0	16	0	0	5	0	103	0
Volume Right	0	0	5	0	0	87	0	38	0	114
cSH	1342	1700	1700	1206	1700	1700	170	443	187	779
Volume to Capacity	0.14	0.13	0.00	0.01	0.09	0.05	0.03	0.20	0.55	0.22
Queue Length 95th (m)	3.8	0.0	0.0	0.3	0.0	0.0	0.7	5.8	23.2	6.5
Control Delay (s)	8.1	0.0	0.0	8.0	0.0	0.0	26.8	17.3	45.8	14.3
Lane LOS	A			A			D	C	E	B
Approach Delay (s)	3.6			0.5			17.8		26.3	
Approach LOS							C		D	

Intersection Summary			
Average Delay	10.1		
Intersection Capacity Utilization	40.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	250	305	10	20	210	120	10	65	55	140	75	155
Future Volume (Veh/h)	250	305	10	20	210	120	10	65	55	140	75	155
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	272	332	11	22	228	130	11	71	60	152	82	168
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	228			332			1189	1148	332	1214	1148	228
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	228			332			1189	1148	332	1214	1148	228
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	78			98			77	47	91	0	39	77
cM capacity (veh/h)	1257			1095			47	133	642	60	134	740

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	272	332	11	22	228	130	11	131	152	250
Volume Left	272	0	0	22	0	0	11	0	152	0
Volume Right	0	0	11	0	0	130	0	60	0	168
cSH	1257	1700	1700	1095	1700	1700	47	246	60	408
Volume to Capacity	0.22	0.20	0.01	0.02	0.13	0.08	0.23	0.53	2.51	0.61
Queue Length 95th (m)	6.6	0.0	0.0	0.5	0.0	0.0	6.2	22.8	121.5	31.6
Control Delay (s)	8.7	0.0	0.0	8.4	0.0	0.0	102.7	37.2	832.9	29.6
Lane LOS	A			A			F	E	F	D
Approach Delay (s)	3.8			0.5			42.3		333.4	
Approach LOS							E		F	

Intersection Summary			
Average Delay	92.6		
Intersection Capacity Utilization	52.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	132	220	5	14	119	75	6	30	43	147	45	106
Future Volume (Veh/h)	132	220	5	14	119	75	6	30	43	147	45	106
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	143	239	5	15	129	82	7	33	47	160	49	115
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	129			239			708	684	239	724	684	129
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	129			239			708	684	239	724	684	129
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	90			99			97	89	94	33	83	86
cM capacity (veh/h)	1369			1190			214	295	727	238	296	844

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	143	239	5	15	129	82	7	80	160	164
Volume Left	143	0	0	15	0	0	7	0	160	0
Volume Right	0	0	5	0	0	82	0	47	0	115
cSH	1369	1700	1700	1190	1700	1700	214	715	238	991
Volume to Capacity	0.10	0.14	0.00	0.01	0.08	0.05	0.03	0.11	0.67	0.17
Queue Length 95th (m)	2.8	0.0	0.0	0.3	0.0	0.0	0.8	3.0	34.3	4.7
Control Delay (s)	7.9	0.0	0.0	8.1	0.0	0.0	22.4	13.8	46.6	12.8
Lane LOS	A			A			C	B	E	B
Approach Delay (s)	2.9			0.5			14.5		29.5	
Approach LOS							B		D	

Intersection Summary			
Average Delay	11.8		
Intersection Capacity Utilization	36.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	187	372	5	23	176	122	8	47	76	283	68	186
Future Volume (Veh/h)	187	372	5	23	176	122	8	47	76	283	68	186
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	203	404	5	25	191	133	9	51	83	308	74	202
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	191			404			1088	1051	404	1118	1051	191
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	191			404			1088	1051	404	1118	1051	191
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	84			98			87	69	86	0	55	74
cM capacity (veh/h)	1298			1027			71	164	583	91	165	777

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	203	404	5	25	191	133	9	134	308	276
Volume Left	203	0	0	25	0	0	9	0	308	0
Volume Right	0	0	5	0	0	133	0	83	0	202
cSH	1298	1700	1700	1027	1700	1700	71	431	91	615
Volume to Capacity	0.16	0.24	0.00	0.02	0.11	0.08	0.13	0.31	3.38	0.45
Queue Length 95th (m)	4.4	0.0	0.0	0.6	0.0	0.0	3.3	10.5	Err	18.6
Control Delay (s)	8.3	0.0	0.0	8.6	0.0	0.0	63.3	21.5	Err	19.9
Lane LOS	A			A			F	C	F	C
Approach Delay (s)	2.7			0.6			24.1		5282.9	
Approach LOS							C		F	

Intersection Summary			
Average Delay	1830.9		
Intersection Capacity Utilization	58.3%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	270	508	10	30	256	172	13	71	104	384	99	252
Future Volume (Veh/h)	270	508	10	30	256	172	13	71	104	384	99	252
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	293	552	11	33	278	187	14	77	113	417	108	274
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	278			552			1536	1482	552	1577	1482	278
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	278			552			1536	1482	552	1577	1482	278
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	76			96			0	1	76	0	0	60
cM capacity (veh/h)	1203			900			0	78	477	3	78	692

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	293	552	11	33	278	187	14	190	417	382
Volume Left	293	0	0	33	0	0	14	0	417	0
Volume Right	0	0	11	0	0	187	0	113	0	274
cSH	1203	1700	1700	900	1700	1700	0	192	3	277
Volume to Capacity	0.24	0.32	0.01	0.04	0.16	0.11	Err	0.99	127.96	1.38
Queue Length 95th (m)	7.7	0.0	0.0	0.9	0.0	0.0	Err	66.5	Err	161.9
Control Delay (s)	9.0	0.0	0.0	9.2	0.0	0.0	Err	86.7	Err	101.9
Lane LOS	A			A			F	F	F	F
Approach Delay (s)	3.1			0.6			Err		5267.2	
Approach LOS							F		F	

Intersection Summary			
Average Delay	Err		
Intersection Capacity Utilization	72.1%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	70	0	15	145	40	5	15	20	30	40	110
Future Volume (Veh/h)	80	70	0	15	145	40	5	15	20	30	40	110
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	87	76	0	16	158	43	5	16	22	33	43	120
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	158			76			462	440	76	459	440	158
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	158			76			462	440	76	459	440	158
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	93			99			99	96	98	92	90	85
cM capacity (veh/h)	1335			1373			342	431	903	414	432	812

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	87	76	0	16	158	43	5	38	33	163
Volume Left	87	0	0	16	0	0	5	0	33	0
Volume Right	0	0	0	0	0	43	0	22	0	120
cSH	1335	1700	1700	1373	1700	1700	342	1023	414	1103
Volume to Capacity	0.07	0.04	0.00	0.01	0.09	0.03	0.01	0.04	0.08	0.15
Queue Length 95th (m)	1.7	0.0	0.0	0.3	0.0	0.0	0.4	0.9	2.1	4.1
Control Delay (s)	7.9	0.0	0.0	7.7	0.0	0.0	15.7	11.0	14.4	11.3
Lane LOS	A			A			C	B	B	B
Approach Delay (s)	4.2			0.6			11.6		11.8	
Approach LOS							B		B	

Intersection Summary				
Average Delay	5.8			
Intersection Capacity Utilization	31.6%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	85	75	0	15	155	45	5	15	20	30	45	120
Future Volume (Veh/h)	85	75	0	15	155	45	5	15	20	30	45	120
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	92	82	0	16	168	49	5	16	22	33	49	130
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	168			82			490	466	82	485	466	168
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	168			82			490	466	82	485	466	168
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	93			99			98	96	98	92	88	84
cM capacity (veh/h)	1324			1366			315	414	896	396	415	802

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	92	82	0	16	168	49	5	38	33	179
Volume Left	92	0	0	16	0	0	5	0	33	0
Volume Right	0	0	0	0	0	49	0	22	0	130
cSH	1324	1700	1700	1366	1700	1700	315	983	396	1104
Volume to Capacity	0.07	0.05	0.00	0.01	0.10	0.03	0.02	0.04	0.08	0.16
Queue Length 95th (m)	1.8	0.0	0.0	0.3	0.0	0.0	0.4	1.0	2.2	4.6
Control Delay (s)	7.9	0.0	0.0	7.7	0.0	0.0	16.6	11.2	14.9	11.6
Lane LOS	A			A			C	B	B	B
Approach Delay (s)	4.2			0.5			11.8		12.1	
Approach LOS							B		B	

Intersection Summary			
Average Delay	5.9		
Intersection Capacity Utilization	32.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	120	105	0	20	215	60	5	20	30	45	60	165
Future Volume (Veh/h)	120	105	0	20	215	60	5	20	30	45	60	165
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	130	114	0	22	234	65	5	22	33	49	65	179
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	234			114			684	652	114	680	652	234
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	234			114			684	652	114	680	652	234
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	90			98			97	93	96	82	79	76
cM capacity (veh/h)	1250			1328			187	307	859	270	308	734

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	130	114	0	22	234	65	5	55	49	244
Volume Left	130	0	0	22	0	0	5	0	49	0
Volume Right	0	0	0	0	0	65	0	33	0	179
cSH	1250	1700	1700	1328	1700	1700	187	768	270	1001
Volume to Capacity	0.10	0.07	0.00	0.02	0.14	0.04	0.03	0.07	0.18	0.24
Queue Length 95th (m)	2.8	0.0	0.0	0.4	0.0	0.0	0.7	1.8	5.2	7.7
Control Delay (s)	8.2	0.0	0.0	7.8	0.0	0.0	24.8	12.7	21.2	13.7
Lane LOS	A			A			C	B	C	B
Approach Delay (s)	4.4			0.5			13.7		14.9	
Approach LOS							B		B	

Intersection Summary			
Average Delay	7.0		
Intersection Capacity Utilization	38.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	175	155	0	35	320	90	10	35	45	65	90	240
Future Volume (Veh/h)	175	155	0	35	320	90	10	35	45	65	90	240
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	190	168	0	38	348	98	11	38	49	71	98	261
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	348			168			1021	972	168	1016	972	348
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	348			168			1021	972	168	1016	972	348
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	83			97			80	79	94	45	46	59
cM capacity (veh/h)	1132			1267			54	180	799	128	181	630

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	190	168	0	38	348	98	11	87	71	359
Volume Left	190	0	0	38	0	0	11	0	71	0
Volume Right	0	0	0	0	0	98	0	49	0	261
cSH	1132	1700	1700	1267	1700	1700	54	412	128	662
Volume to Capacity	0.17	0.10	0.00	0.03	0.20	0.06	0.20	0.21	0.55	0.54
Queue Length 95th (m)	4.8	0.0	0.0	0.7	0.0	0.0	5.4	6.3	21.7	26.2
Control Delay (s)	8.8	0.0	0.0	7.9	0.0	0.0	87.2	18.7	63.6	23.3
Lane LOS	A			A			F	C	F	C
Approach Delay (s)	4.7			0.6			26.4		30.0	
Approach LOS							D		D	

Intersection Summary			
Average Delay	12.7		
Intersection Capacity Utilization	49.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	114	95	1	31	226	119	5	20	24	52	46	127
Future Volume (Veh/h)	114	95	1	31	226	119	5	20	24	52	46	127
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	124	103	1	34	246	129	5	22	26	57	50	138
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	246			103			690	665	103	689	665	246
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	246			103			690	665	103	689	665	246
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	90			97			98	93	97	79	83	81
cM capacity (veh/h)	1237			1341			205	300	871	267	301	723

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	124	103	1	34	246	129	5	48	57	188
Volume Left	124	0	0	34	0	0	5	0	57	0
Volume Right	0	0	1	0	0	129	0	26	0	138
cSH	1237	1700	1700	1341	1700	1700	205	656	267	984
Volume to Capacity	0.10	0.06	0.00	0.03	0.14	0.08	0.02	0.07	0.21	0.19
Queue Length 95th (m)	2.7	0.0	0.0	0.6	0.0	0.0	0.6	1.9	6.3	5.6
Control Delay (s)	8.2	0.0	0.0	7.8	0.0	0.0	23.0	13.2	22.1	13.3
Lane LOS	A			A			C	B	C	B
Approach Delay (s)	4.5			0.6			14.1		15.4	
Approach LOS							B		C	

Intersection Summary			
Average Delay	6.2		
Intersection Capacity Utilization	39.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	195	160	3	55	377	237	5	35	42	103	65	187
Future Volume (Veh/h)	195	160	3	55	377	237	5	35	42	103	65	187
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	212	174	3	60	410	258	5	38	46	112	71	203
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	410			174			1164	1128	174	1170	1128	410
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	410			174			1164	1128	174	1170	1128	410
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	80			95			90	72	94	0	48	65
cM capacity (veh/h)	1072			1260			48	136	793	90	137	580

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	212	174	3	60	410	258	5	84	112	274
Volume Left	212	0	0	60	0	0	5	0	112	0
Volume Right	0	0	3	0	0	258	0	46	0	203
cSH	1072	1700	1700	1260	1700	1700	48	302	90	529
Volume to Capacity	0.20	0.10	0.00	0.05	0.24	0.15	0.10	0.28	1.24	0.52
Queue Length 95th (m)	5.9	0.0	0.0	1.2	0.0	0.0	2.6	8.9	63.9	23.6
Control Delay (s)	9.2	0.0	0.0	8.0	0.0	0.0	89.2	24.0	258.5	25.4
Lane LOS	A			A			F	C	F	D
Approach Delay (s)	5.0			0.7			27.7		93.0	
Approach LOS							D		F	

Intersection Summary			
Average Delay	25.6		
Intersection Capacity Utilization	56.1%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	262	223	3	77	520	312	10	56	59	139	97	268
Future Volume (Veh/h)	262	223	3	77	520	312	10	56	59	139	97	268
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	285	242	3	84	565	339	11	61	64	151	105	291
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	565			242			1598	1545	242	1608	1545	565
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	565			242			1598	1545	242	1608	1545	565
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	70			93			0	3	91	0	0	38
cM capacity (veh/h)	936			1186			0	63	724	6	63	470

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	285	242	3	84	565	339	11	125	151	396
Volume Left	285	0	0	84	0	0	11	0	151	0
Volume Right	0	0	3	0	0	339	0	64	0	291
cSH	936	1700	1700	1186	1700	1700	0	129	6	239
Volume to Capacity	0.30	0.14	0.00	0.07	0.33	0.20	Err	0.97	25.47	1.66
Queue Length 95th (m)	10.3	0.0	0.0	1.8	0.0	0.0	Err	52.8	Err	204.0
Control Delay (s)	10.5	0.0	0.0	8.3	0.0	0.0	Err	109.5	Err	141.0
Lane LOS	B			A			F	F	F	F
Approach Delay (s)	5.7			0.7			Err		2862.3	
Approach LOS							F		F	

Intersection Summary			
Average Delay	Err		
Intersection Capacity Utilization	70.5%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	100	10	15	0	5	0	10	195	0	5	155	155
Future Volume (Veh/h)	100	10	15	0	5	0	10	195	0	5	155	155
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	109	11	16	0	5	0	11	212	0	5	168	168
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	414	412	168	434	412	212	168			212		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	414	412	168	434	412	212	168			212		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	79	98	98	100	99	100	99			100		
cM capacity (veh/h)	525	511	856	481	497	785	1297			1285		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	136	5	11	212	173	168
Volume Left	109	0	11	0	5	0
Volume Right	16	0	0	0	0	168
cSH	549	497	1297	1700	1285	1700
Volume to Capacity	0.25	0.01	0.01	0.12	0.00	0.10
Queue Length 95th (m)	7.8	0.2	0.2	0.0	0.1	0.0
Control Delay (s)	13.7	12.3	7.8	0.0	0.3	0.0
Lane LOS	B	B	A		A	
Approach Delay (s)	13.7	12.3	0.4		0.1	
Approach LOS	B	B				

Intersection Summary				
Average Delay	2.9			
Intersection Capacity Utilization	34.9%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	110	10	15	0	5	0	10	210	0	5	170	170
Future Volume (Veh/h)	110	10	15	0	5	0	10	210	0	5	170	170
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	120	11	16	0	5	0	11	228	0	5	185	185
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	448	445	185	466	445	228	185			228		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	448	445	185	466	445	228	185			228		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	76	98	98	100	99	100	99			100		
cM capacity (veh/h)	499	490	837	456	476	769	1278			1267		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	147	5	11	228	190	185
Volume Left	120	0	11	0	5	0
Volume Right	16	0	0	0	0	185
cSH	521	476	1278	1700	1267	1700
Volume to Capacity	0.28	0.01	0.01	0.13	0.00	0.11
Queue Length 95th (m)	9.2	0.3	0.2	0.0	0.1	0.0
Control Delay (s)	14.6	12.6	7.8	0.0	0.2	0.0
Lane LOS	B	B	A		A	
Approach Delay (s)	14.6	12.6	0.4		0.1	
Approach LOS	B	B				

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	36.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	150	15	20	0	5	0	15	290	0	5	230	230
Future Volume (Veh/h)	150	15	20	0	5	0	15	290	0	5	230	230
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	163	16	22	0	5	0	16	315	0	5	250	250
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	610	607	250	637	607	315	250			315		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	610	607	250	637	607	315	250			315		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	58	96	97	100	99	100	99			100		
cM capacity (veh/h)	386	393	770	340	381	685	1207			1175		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	201	5	16	315	255	250
Volume Left	163	0	16	0	5	0
Volume Right	22	0	0	0	0	250
cSH	409	381	1207	1700	1175	1700
Volume to Capacity	0.49	0.01	0.01	0.19	0.00	0.15
Queue Length 95th (m)	21.0	0.3	0.3	0.0	0.1	0.0
Control Delay (s)	22.0	14.6	8.0	0.0	0.2	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	22.0	14.6	0.4		0.1	
Approach LOS	C	B				

Intersection Summary				
Average Delay	4.5			
Intersection Capacity Utilization	45.4%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	220	20	35	0	10	0	20	425	0	10	340	340
Future Volume (Veh/h)	220	20	35	0	10	0	20	425	0	10	340	340
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	239	22	38	0	11	0	22	462	0	11	370	370
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	904	898	370	947	898	462	370			462		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	904	898	370	947	898	462	370			462		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	0	92	94	100	96	100	98			99		
cM capacity (veh/h)	236	262	658	193	253	564	1087			1034		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	299	11	22	462	381	370
Volume Left	239	0	22	0	11	0
Volume Right	38	0	0	0	0	370
cSH	259	253	1087	1700	1034	1700
Volume to Capacity	1.16	0.04	0.02	0.27	0.01	0.22
Queue Length 95th (m)	107.1	1.1	0.5	0.0	0.3	0.0
Control Delay (s)	145.7	19.9	8.4	0.0	0.4	0.0
Lane LOS	F	C	A		A	
Approach Delay (s)	145.7	19.9	0.4		0.2	
Approach LOS	F	C				

Intersection Summary			
Average Delay	28.5		
Intersection Capacity Utilization	60.5%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
11: PTH 110 & Victoria Avenue

2019 Development AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	115	10	46	0	5	0	16	226	0	5	252	190
Future Volume (Veh/h)	115	10	46	0	5	0	16	226	0	5	252	190
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	125	11	50	0	5	0	17	246	0	5	274	207
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	566	564	274	620	564	246	274			246		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	566	564	274	620	564	246	274			246		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	70	97	93	100	99	100	99			100		
cM capacity (veh/h)	413	416	746	339	403	751	1182			1248		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	186	5	17	246	279	207
Volume Left	125	0	17	0	5	0
Volume Right	50	0	0	0	0	207
cSH	469	403	1182	1700	1248	1700
Volume to Capacity	0.40	0.01	0.01	0.14	0.00	0.12
Queue Length 95th (m)	15.0	0.3	0.4	0.0	0.1	0.0
Control Delay (s)	17.6	14.0	8.1	0.0	0.2	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	17.6	14.0	0.5		0.1	
Approach LOS	C	B				

Intersection Summary				
Average Delay	3.8			
Intersection Capacity Utilization	42.6%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	163	15	92	0	5	0	31	335	0	5	445	286
Future Volume (Veh/h)	163	15	92	0	5	0	31	335	0	5	445	286
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	177	16	100	0	5	0	34	364	0	5	484	311
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	928	926	484	1034	926	364	484			364		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	928	926	484	1034	926	364	484			364		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	23	94	82	100	98	100	97			100		
cM capacity (veh/h)	229	250	567	148	241	642	983			1126		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	293	5	34	364	489	311
Volume Left	177	0	34	0	5	0
Volume Right	100	0	0	0	0	311
cSH	289	241	983	1700	1126	1700
Volume to Capacity	1.01	0.02	0.03	0.21	0.00	0.18
Queue Length 95th (m)	85.6	0.5	0.9	0.0	0.1	0.0
Control Delay (s)	95.5	20.2	8.8	0.0	0.1	0.0
Lane LOS	F	C	A		A	
Approach Delay (s)	95.5	20.2	0.8		0.1	
Approach LOS	F	C				

Intersection Summary				
Average Delay	19.0			
Intersection Capacity Utilization	59.9%	ICU Level of Service	B	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
11: PTH 110 & Victoria Avenue

2037 Development AM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	235	20	123	0	10	0	39	484	0	10	617	409
Future Volume (Veh/h)	235	20	123	0	10	0	39	484	0	10	617	409
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	255	22	134	0	11	0	42	526	0	11	671	445
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1308	1303	671	1448	1303	526	671			526		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1308	1303	671	1448	1303	526	671			526		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	0	85	70	100	92	100	95			99		
cM capacity (veh/h)	117	145	443	59	139	518	832			978		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	411	11	42	526	682	445
Volume Left	255	0	42	0	11	0
Volume Right	134	0	0	0	0	445
cSH	157	139	832	1700	978	1700
Volume to Capacity	2.62	0.08	0.05	0.31	0.01	0.26
Queue Length 95th (m)	288.6	2.0	1.3	0.0	0.3	0.0
Control Delay (s)	794.5	33.2	9.6	0.0	0.3	0.0
Lane LOS	F	D	A		A	
Approach Delay (s)	794.5	33.2	0.7		0.2	
Approach LOS	F	D				

Intersection Summary			
Average Delay	154.7		
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	115	5	15	0	5	5	15	125	0	5	175	140
Future Volume (Veh/h)	115	5	15	0	5	5	15	125	0	5	175	140
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	125	5	16	0	5	5	16	136	0	5	190	152
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	376	368	190	386	368	136	190			136		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	376	368	190	386	368	136	190			136		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	77	99	98	100	99	99	99			100		
cM capacity (veh/h)	553	540	832	520	525	867	1272			1372		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	146	10	16	136	195	152
Volume Left	125	0	16	0	5	0
Volume Right	16	5	0	0	0	152
cSH	574	654	1272	1700	1372	1700
Volume to Capacity	0.25	0.02	0.01	0.08	0.00	0.09
Queue Length 95th (m)	8.0	0.4	0.3	0.0	0.1	0.0
Control Delay (s)	13.4	10.6	7.9	0.0	0.2	0.0
Lane LOS	B	B	A		A	
Approach Delay (s)	13.4	10.6	0.8		0.1	
Approach LOS	B	B				

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	35.9%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
11: PTH 110 & Victoria Avenue

2019 Background PM.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	5	15	0	5	5	15	135	0	5	190	150
Future Volume (Veh/h)	125	5	15	0	5	5	15	135	0	5	190	150
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	136	5	16	0	5	5	16	147	0	5	207	163
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	404	396	207	414	396	147	207			147		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	404	396	207	414	396	147	207			147		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	74	99	98	100	99	99	99			100		
cM capacity (veh/h)	530	520	814	498	506	855	1254			1359		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	157	10	16	147	212	163
Volume Left	136	0	16	0	5	0
Volume Right	16	5	0	0	0	163
cSH	549	635	1254	1700	1359	1700
Volume to Capacity	0.29	0.02	0.01	0.09	0.00	0.10
Queue Length 95th (m)	9.4	0.4	0.3	0.0	0.1	0.0
Control Delay (s)	14.2	10.8	7.9	0.0	0.2	0.0
Lane LOS	B	B	A		A	
Approach Delay (s)	14.2	10.8	0.8		0.1	
Approach LOS	B	B				

Intersection Summary			
Average Delay	3.6		
Intersection Capacity Utilization	37.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	170	5	20	0	5	5	20	185	0	5	260	205
Future Volume (Veh/h)	170	5	20	0	5	5	20	185	0	5	260	205
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	185	5	22	0	5	5	22	201	0	5	283	223
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	546	538	283	562	538	201	283			201		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	546	538	283	562	538	201	283			201		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	56	99	97	100	99	99	98			100		
cM capacity (veh/h)	423	429	737	389	416	796	1173			1297		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	212	10	22	201	288	223
Volume Left	185	0	22	0	5	0
Volume Right	22	5	0	0	0	223
cSH	442	546	1173	1700	1297	1700
Volume to Capacity	0.48	0.02	0.02	0.12	0.00	0.13
Queue Length 95th (m)	20.3	0.4	0.5	0.0	0.1	0.0
Control Delay (s)	20.4	11.7	8.1	0.0	0.2	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	20.4	11.7	0.8		0.1	
Approach LOS	C	B				

Intersection Summary				
Average Delay	4.9			
Intersection Capacity Utilization	44.4%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	250	10	35	0	10	10	35	275	0	10	385	305
Future Volume (Veh/h)	250	10	35	0	10	10	35	275	0	10	385	305
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	272	11	38	0	11	11	38	299	0	11	418	332
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	832	815	418	858	815	299	418			299		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	832	815	418	858	815	299	418			299		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	0	96	94	100	96	98	96			99		
cM capacity (veh/h)	258	289	618	227	279	700	1042			1192		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	321	22	38	299	429	332
Volume Left	272	0	38	0	11	0
Volume Right	38	11	0	0	0	332
cSH	278	399	1042	1700	1192	1700
Volume to Capacity	1.15	0.06	0.04	0.18	0.01	0.20
Queue Length 95th (m)	111.9	1.4	0.9	0.0	0.2	0.0
Control Delay (s)	141.8	14.5	8.6	0.0	0.3	0.0
Lane LOS	F	B	A		A	
Approach Delay (s)	141.8	14.5	1.0		0.2	
Approach LOS	F	B				

Intersection Summary			
Average Delay	32.1		
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	141	5	24	0	5	5	48	210	0	5	211	155
Future Volume (Veh/h)	141	5	24	0	5	5	48	210	0	5	211	155
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	153	5	26	0	5	5	52	228	0	5	229	168
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	578	571	229	600	571	228	229			228		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	578	571	229	600	571	228	229			228		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	61	99	97	100	99	99	96			100		
cM capacity (veh/h)	394	401	791	359	388	769	1230			1267		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	184	10	52	228	234	168
Volume Left	153	0	52	0	5	0
Volume Right	26	5	0	0	0	168
cSH	424	516	1230	1700	1267	1700
Volume to Capacity	0.43	0.02	0.04	0.13	0.00	0.10
Queue Length 95th (m)	17.2	0.5	1.1	0.0	0.1	0.0
Control Delay (s)	19.8	12.1	8.1	0.0	0.2	0.0
Lane LOS	C	B	A		A	
Approach Delay (s)	19.8	12.1	1.5		0.1	
Approach LOS	C	B				

Intersection Summary				
Average Delay	4.8			
Intersection Capacity Utilization	51.4%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	216	5	45	0	5	5	94	378	0	5	320	222
Future Volume (Veh/h)	216	5	45	0	5	5	94	378	0	5	320	222
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	235	5	49	0	5	5	102	411	0	5	348	241
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	980	973	348	1024	973	411	348			411		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	980	973	348	1024	973	411	348			411		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	0	98	93	100	98	99	91			100		
cM capacity (veh/h)	200	221	677	167	212	604	1108			1081		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	289	10	102	411	353	241
Volume Left	235	0	102	0	5	0
Volume Right	49	5	0	0	0	241
cSH	227	314	1108	1700	1081	1700
Volume to Capacity	1.27	0.03	0.09	0.24	0.00	0.14
Queue Length 95th (m)	119.8	0.8	2.4	0.0	0.1	0.0
Control Delay (s)	195.4	16.8	8.6	0.0	0.2	0.0
Lane LOS	F	C	A		A	
Approach Delay (s)	195.4	16.8	1.7		0.1	
Approach LOS	F	C				

Intersection Summary				
Average Delay	41.0			
Intersection Capacity Utilization	73.1%	ICU Level of Service	D	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	308	10	64	0	10	10	124	516	0	10	465	327
Future Volume (Veh/h)	308	10	64	0	10	10	124	516	0	10	465	327
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	335	11	70	0	11	11	135	561	0	11	505	355
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1374	1358	505	1434	1358	561	505			561		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1374	1358	505	1434	1358	561	505			561		
tC, single (s)	7.2	6.6	6.3	7.3	6.7	6.4	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.7	4.2	3.5	2.4			2.3		
p0 queue free %	0	91	87	100	91	98	86			99		
cM capacity (veh/h)	95	122	551	73	116	494	964			948		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	416	22	135	561	516	355
Volume Left	335	0	135	0	11	0
Volume Right	70	11	0	0	0	355
cSH	111	188	964	1700	948	1700
Volume to Capacity	3.75	0.12	0.14	0.33	0.01	0.21
Queue Length 95th (m)	Err	3.1	3.9	0.0	0.3	0.0
Control Delay (s)	Err	26.6	9.3	0.0	0.3	0.0
Lane LOS	F	D	A		A	
Approach Delay (s)	Err	26.6	1.8		0.2	
Approach LOS	F	D				

Intersection Summary			
Average Delay	2075.6		
Intersection Capacity Utilization	96.7%	ICU Level of Service	F
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	130	50	0	120	25	0
Future Volume (Veh/h)	130	50	0	120	25	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	141	54	0	130	27	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			195		298	168
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			195		298	168
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		96	100
cM capacity (veh/h)			1237		642	813

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	195	130	27
Volume Left	0	0	27
Volume Right	54	0	0
cSH	1700	1237	642
Volume to Capacity	0.11	0.00	0.04
Queue Length 95th (m)	0.0	0.0	1.1
Control Delay (s)	0.0	0.0	10.9
Lane LOS			B
Approach Delay (s)	0.0	0.0	10.9
Approach LOS			B

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	20.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	135	105	0	125	40	0
Future Volume (Veh/h)	135	105	0	125	40	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	147	114	0	136	43	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			261		340	204
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			261		340	204
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		93	100
cM capacity (veh/h)			1167		606	775

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	261	136	43
Volume Left	0	0	43
Volume Right	114	0	0
cSH	1700	1167	606
Volume to Capacity	0.15	0.00	0.07
Queue Length 95th (m)	0.0	0.0	1.8
Control Delay (s)	0.0	0.0	11.4
Lane LOS			B
Approach Delay (s)	0.0	0.0	11.4
Approach LOS			B

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	24.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	160	120	0	145	50	0
Future Volume (Veh/h)	160	120	0	145	50	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	174	130	0	158	54	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			304		397	239
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			304		397	239
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		90	100
cM capacity (veh/h)			1123		561	740

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	304	158	54
Volume Left	0	0	54
Volume Right	130	0	0
cSH	1700	1123	561
Volume to Capacity	0.18	0.00	0.10
Queue Length 95th (m)	0.0	0.0	2.5
Control Delay (s)	0.0	0.0	12.1
Lane LOS			B
Approach Delay (s)	0.0	0.0	12.1
Approach LOS			B

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	27.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	195	150	0	180	60	0
Future Volume (Veh/h)	195	150	0	180	60	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	212	163	0	196	65	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			375		490	294
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			375		490	294
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		87	100
cM capacity (veh/h)			1054		494	688

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	375	196	65
Volume Left	0	0	65
Volume Right	163	0	0
cSH	1700	1054	494
Volume to Capacity	0.22	0.00	0.13
Queue Length 95th (m)	0.0	0.0	3.6
Control Delay (s)	0.0	0.0	13.4
Lane LOS			B
Approach Delay (s)	0.0	0.0	13.4
Approach LOS			B

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	31.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	227	178	0	142	56	0
Future Volume (Veh/h)	227	178	0	142	56	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	247	193	0	154	61	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			440		498	344
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			440		498	344
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		88	100
cM capacity (veh/h)			995		488	644

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	440	154	61
Volume Left	0	0	61
Volume Right	193	0	0
cSH	1700	995	488
Volume to Capacity	0.26	0.00	0.12
Queue Length 95th (m)	0.0	0.0	3.4
Control Delay (s)	0.0	0.0	13.4
Lane LOS			B
Approach Delay (s)	0.0	0.0	13.4
Approach LOS			B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	34.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	375	302	0	189	93	0
Future Volume (Veh/h)	375	302	0	189	93	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	408	328	0	205	101	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			736		777	572
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			736		777	572
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		69	100
cM capacity (veh/h)			762		331	474

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	736	205	101
Volume Left	0	0	101
Volume Right	328	0	0
cSH	1700	762	331
Volume to Capacity	0.43	0.00	0.31
Queue Length 95th (m)	0.0	0.0	10.1
Control Delay (s)	0.0	0.0	20.6
Lane LOS			C
Approach Delay (s)	0.0	0.0	20.6
Approach LOS			C

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	53.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	473	370	0	235	114	0
Future Volume (Veh/h)	473	370	0	235	114	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	514	402	0	255	124	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			916		970	715
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			916		970	715
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		51	100
cM capacity (veh/h)			647		252	390

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	916	255	124
Volume Left	0	0	124
Volume Right	402	0	0
cSH	1700	647	252
Volume to Capacity	0.54	0.00	0.49
Queue Length 95th (m)	0.0	0.0	20.1
Control Delay (s)	0.0	0.0	32.4
Lane LOS			D
Approach Delay (s)	0.0	0.0	32.4
Approach LOS			D

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	65.1%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	85	25	0	110	45	0
Future Volume (Veh/h)	85	25	0	110	45	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	92	27	0	120	49	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			119		226	106
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			119		226	106
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		93	100
cM capacity (veh/h)			1322		709	883

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	119	120	49
Volume Left	0	0	49
Volume Right	27	0	0
cSH	1700	1322	709
Volume to Capacity	0.07	0.00	0.07
Queue Length 95th (m)	0.0	0.0	1.8
Control Delay (s)	0.0	0.0	10.5
Lane LOS			B
Approach Delay (s)	0.0	0.0	10.5
Approach LOS			B

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	16.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	90	35	0	115	95	0
Future Volume (Veh/h)	90	35	0	115	95	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	38	0	125	103	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			136		242	117
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			136		242	117
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		85	100
cM capacity (veh/h)			1303		693	869

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	136	125	103
Volume Left	0	0	103
Volume Right	38	0	0
cSH	1700	1303	693
Volume to Capacity	0.08	0.00	0.15
Queue Length 95th (m)	0.0	0.0	4.2
Control Delay (s)	0.0	0.0	11.1
Lane LOS			B
Approach Delay (s)	0.0	0.0	11.1
Approach LOS			B

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	19.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	105	45	0	135	110	0
Future Volume (Veh/h)	105	45	0	135	110	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	114	49	0	147	120	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			163		286	138
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			163		286	138
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		82	100
cM capacity (veh/h)			1272		653	845

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	163	147	120
Volume Left	0	0	120
Volume Right	49	0	0
cSH	1700	1272	653
Volume to Capacity	0.10	0.00	0.18
Queue Length 95th (m)	0.0	0.0	5.3
Control Delay (s)	0.0	0.0	11.7
Lane LOS			B
Approach Delay (s)	0.0	0.0	11.7
Approach LOS			B

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	22.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	125	50	0	165	135	0
Future Volume (Veh/h)	125	50	0	165	135	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	136	54	0	179	147	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			190		342	163
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			190		342	163
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		76	100
cM capacity (veh/h)			1242		605	818

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	190	179	147
Volume Left	0	0	147
Volume Right	54	0	0
cSH	1700	1242	605
Volume to Capacity	0.11	0.00	0.24
Queue Length 95th (m)	0.0	0.0	7.6
Control Delay (s)	0.0	0.0	12.9
Lane LOS			B
Approach Delay (s)	0.0	0.0	12.9
Approach LOS			B

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	25.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	115	57	0	206	166	0
Future Volume (Veh/h)	115	57	0	206	166	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	125	62	0	224	180	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			187		380	156
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			187		380	156
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		69	100
cM capacity (veh/h)			1245		574	826

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	187	224	180
Volume Left	0	0	180
Volume Right	62	0	0
cSH	1700	1245	574
Volume to Capacity	0.11	0.00	0.31
Queue Length 95th (m)	0.0	0.0	10.7
Control Delay (s)	0.0	0.0	14.1
Lane LOS			B
Approach Delay (s)	0.0	0.0	14.1
Approach LOS			B

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	28.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	170	105	0	340	281	0
Future Volume (Veh/h)	170	105	0	340	281	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	185	114	0	370	305	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			299		612	242
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			299		612	242
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		27	100
cM capacity (veh/h)			1128		417	737

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	299	370	305
Volume Left	0	0	305
Volume Right	114	0	0
cSH	1700	1128	417
Volume to Capacity	0.18	0.00	0.73
Queue Length 95th (m)	0.0	0.0	46.3
Control Delay (s)	0.0	0.0	33.8
Lane LOS			D
Approach Delay (s)	0.0	0.0	33.8
Approach LOS			D

Intersection Summary			
Average Delay	10.6		
Intersection Capacity Utilization	43.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	205	127	0	426	340	0
Future Volume (Veh/h)	205	127	0	426	340	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	223	138	0	463	370	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			361		755	292
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			361		755	292
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		0	100
cM capacity (veh/h)			1067		341	690

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	361	463	370
Volume Left	0	0	370
Volume Right	138	0	0
cSH	1700	1067	341
Volume to Capacity	0.21	0.00	1.08
Queue Length 95th (m)	0.0	0.0	109.6
Control Delay (s)	0.0	0.0	108.5
Lane LOS			F
Approach Delay (s)	0.0	0.0	108.5
Approach LOS			F

Intersection Summary			
Average Delay	33.6		
Intersection Capacity Utilization	51.5%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix D

Synchro Analysis Reports – Recommended Modifications

HCM Unsignalized Intersection Capacity Analysis
8: 17th Street & PTH 110

2027 Background AM-MOD.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	95	15	0	65	0	30	30	0	5	15	35
Future Volume (Veh/h)	75	95	15	0	65	0	30	30	0	5	15	35
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	82	103	16	0	71	0	33	33	0	5	16	38
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	71			103			354	346	111	362	338	71
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	71			103			354	346	111	362	338	71
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	94			100			94	94	100	99	97	96
cM capacity (veh/h)	1359			1306			532	538	934	507	519	938

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	201	71	66	59
Volume Left	82	0	33	5
Volume Right	16	0	0	38
cSH	1359	1306	535	1450
Volume to Capacity	0.06	0.00	0.12	0.04
Queue Length 95th (m)	1.5	0.0	3.4	1.0
Control Delay (s)	3.5	0.0	12.7	10.2
Lane LOS	A		B	B
Approach Delay (s)	3.5	0.0	12.7	10.2
Approach LOS			B	B

Intersection Summary			
Average Delay	5.4		
Intersection Capacity Utilization	34.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	110	140	20	0	100	0	45	45	0	10	20	55
Future Volume (Veh/h)	110	140	20	0	100	0	45	45	0	10	20	55
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	120	152	22	0	109	0	49	49	0	11	22	60
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	109			152			523	512	163	536	501	109
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	109			152			523	512	163	536	501	109
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	91			100			87	88	100	97	95	93
cM capacity (veh/h)	1314			1250			383	419	874	361	404	893

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	294	109	98	93
Volume Left	120	0	49	11
Volume Right	22	0	0	60
cSH	1314	1250	400	1098
Volume to Capacity	0.09	0.00	0.25	0.08
Queue Length 95th (m)	2.4	0.0	7.6	2.2
Control Delay (s)	3.8	0.0	16.9	11.4
Lane LOS	A		C	B
Approach Delay (s)	3.8	0.0	16.9	11.4
Approach LOS			C	B

Intersection Summary			
Average Delay	6.4		
Intersection Capacity Utilization	41.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	139	28	0	73	6	32	37	6	6	23	38
Future Volume (Veh/h)	90	139	28	0	73	6	32	37	6	6	23	38
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	151	30	0	79	7	35	40	7	7	25	41
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	86			151			457	448	166	472	430	82
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	86			151			457	448	166	472	430	82
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	93			100			92	91	99	98	94	96
cM capacity (veh/h)	1341			1251			440	465	871	412	453	924

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	279	86	82	73
Volume Left	98	0	35	7
Volume Right	30	7	7	41
cSH	1341	1251	472	1014
Volume to Capacity	0.07	0.00	0.17	0.07
Queue Length 95th (m)	1.9	0.0	5.0	1.9
Control Delay (s)	3.2	0.0	14.2	11.1
Lane LOS	A		B	B
Approach Delay (s)	3.2	0.0	14.2	11.1
Approach LOS			B	B

Intersection Summary			
Average Delay	5.5		
Intersection Capacity Utilization	39.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	128	192	46	0	111	8	50	55	7	12	33	59
Future Volume (Veh/h)	128	192	46	0	111	8	50	55	7	12	33	59
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	139	209	50	0	121	9	54	60	8	13	36	64
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	130			209			656	642	234	676	612	126
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	130			209			656	642	234	676	612	126
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	89			100			82	83	99	95	89	93
cM capacity (veh/h)	1290			1188			293	347	798	270	341	874

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	398	130	122	113
Volume Left	139	0	54	13
Volume Right	50	9	8	64
cSH	1290	1188	332	743
Volume to Capacity	0.11	0.00	0.37	0.15
Queue Length 95th (m)	2.9	0.0	13.1	4.3
Control Delay (s)	3.5	0.0	22.0	13.2
Lane LOS	A		C	B
Approach Delay (s)	3.5	0.0	22.0	13.2
Approach LOS			C	B

Intersection Summary			
Average Delay	7.3		
Intersection Capacity Utilization	48.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	60	65	35	5	95	15	20	45	0	0	45	60
Future Volume (Veh/h)	60	65	35	5	95	15	20	45	0	0	45	60
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	65	71	38	5	103	16	22	49	0	0	49	65
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	119			71			366	349	90	366	322	111
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	119			71			366	349	90	366	322	111
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	95			100			95	91	100	100	91	93
cM capacity (veh/h)	1302			1344			484	540	960	496	534	891

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	174	124	71	114
Volume Left	65	5	22	0
Volume Right	38	16	0	65
cSH	1302	1344	521	1242
Volume to Capacity	0.05	0.00	0.14	0.09
Queue Length 95th (m)	1.3	0.1	3.8	2.4
Control Delay (s)	3.2	0.3	13.0	10.7
Lane LOS	A	A	B	B
Approach Delay (s)	3.2	0.3	13.0	10.7
Approach LOS			B	B

Intersection Summary			
Average Delay	5.7		
Intersection Capacity Utilization	33.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	100	55	10	140	20	35	65	0	0	65	90
Future Volume (Veh/h)	90	100	55	10	140	20	35	65	0	0	65	90
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	109	60	11	152	22	38	71	0	0	71	98
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	174			109			556	531	139	556	490	163
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	174			109			556	531	139	556	490	163
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	92			99			88	83	100	100	83	88
cM capacity (veh/h)	1240			1299			313	411	901	335	412	832

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	267	185	109	169
Volume Left	98	11	38	0
Volume Right	60	22	0	98
cSH	1240	1299	370	980
Volume to Capacity	0.08	0.01	0.29	0.17
Queue Length 95th (m)	2.1	0.2	9.6	5.0
Control Delay (s)	3.4	0.5	18.7	12.3
Lane LOS	A	A	C	B
Approach Delay (s)	3.4	0.5	18.7	12.3
Approach LOS			C	B

Intersection Summary			
Average Delay	7.0		
Intersection Capacity Utilization	47.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	64	76	38	13	133	17	33	56	2	6	59	74
Future Volume (Veh/h)	64	76	38	13	133	17	33	56	2	6	59	74
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	70	83	41	14	145	18	36	61	2	7	64	80
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	163			83			458	434	104	458	405	154
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	163			83			458	434	104	458	405	154
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	94			99			91	87	100	98	86	90
cM capacity (veh/h)	1252			1330			392	477	943	411	472	842

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	194	177	99	151
Volume Left	70	14	36	7
Volume Right	41	18	2	80
cSH	1252	1330	446	991
Volume to Capacity	0.06	0.01	0.22	0.15
Queue Length 95th (m)	1.4	0.3	6.7	4.3
Control Delay (s)	3.2	0.7	15.4	11.8
Lane LOS	A	A	C	B
Approach Delay (s)	3.2	0.7	15.4	11.8
Approach LOS			C	B

Intersection Summary			
Average Delay	6.5		
Intersection Capacity Utilization	42.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	98	113	62	20	184	23	63	86	2	8	82	108
Future Volume (Veh/h)	98	113	62	20	184	23	63	86	2	8	82	108
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	107	123	67	22	200	25	68	93	2	9	89	117
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												9
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	225			123			672	640	156	676	594	212
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	225			123			672	640	156	676	594	212
tC, single (s)	4.4			4.4			7.1	6.5	6.2	7.3	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.5			2.5			3.5	4.0	3.3	3.7	4.2	3.5
p0 queue free %	91			98			71	73	100	96	75	85
cM capacity (veh/h)	1185			1283			231	348	881	250	351	780

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	297	247	163	215
Volume Left	107	22	68	9
Volume Right	67	25	2	117
cSH	1185	1283	289	749
Volume to Capacity	0.09	0.02	0.56	0.29
Queue Length 95th (m)	2.4	0.4	25.8	9.5
Control Delay (s)	3.5	0.8	32.4	14.7
Lane LOS	A	A	D	B
Approach Delay (s)	3.5	0.8	32.4	14.7
Approach LOS			D	B

Intersection Summary			
Average Delay	10.5		
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	315	490	88	30	268	82	58	71	7	158	61	159
Future Volume (vph)	315	490	88	30	268	82	58	71	7	158	61	159
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	2917	1305	1421	2842	1271	1341	1391		1409	1483	1261
Flt Permitted	0.42	1.00	1.00	0.45	1.00	1.00	0.71	1.00		0.66	1.00	1.00
Satd. Flow (perm)	652	2917	1305	679	2842	1271	1008	1391		986	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	342	533	96	33	291	89	63	77	8	172	66	173
RTOR Reduction (vph)	0	0	60	0	0	70	0	5	0	0	0	134
Lane Group Flow (vph)	342	533	36	33	291	19	63	80	0	172	66	39
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	43.0	32.0	32.0	23.0	18.0	18.0	23.0	18.0		25.0	19.0	19.0
Effective Green, g (s)	43.0	32.0	32.0	23.0	18.0	18.0	23.0	18.0		25.0	19.0	19.0
Actuated g/C Ratio	0.51	0.38	0.38	0.27	0.21	0.21	0.27	0.21		0.29	0.22	0.22
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0
Lane Grp Cap (vph)	510	1098	491	227	601	269	292	294		319	331	281
v/s Ratio Prot	c0.15	0.18		0.01	0.10		0.01	0.06		c0.04	0.04	
v/s Ratio Perm	c0.19		0.03	0.03		0.01	0.05			c0.12		0.03
v/c Ratio	0.67	0.49	0.07	0.15	0.48	0.07	0.22	0.27		0.54	0.20	0.14
Uniform Delay, d1	13.9	20.2	17.0	23.1	29.4	26.8	23.7	28.0		24.5	26.8	26.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	6.9	1.5	0.3	1.3	2.8	0.5	1.7	2.3		6.4	1.3	1.0
Delay (s)	20.8	21.8	17.3	24.5	32.2	27.3	25.4	30.3		30.9	28.2	27.5
Level of Service	C	C	B	C	C	C	C	C		C	C	C
Approach Delay (s)		21.0			30.5			28.2			29.0	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	58.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	173	265	63	10	468	151	114	95	30	73	82	288
Future Volume (vph)	173	265	63	10	468	151	114	95	30	73	82	288
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1458	2917	1305	1421	2842	1271	1341	1360		1409	1483	1261
Flt Permitted	0.24	1.00	1.00	0.58	1.00	1.00	0.68	1.00		0.67	1.00	1.00
Satd. Flow (perm)	365	2917	1305	861	2842	1271	963	1360		994	1483	1261
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	188	288	68	11	509	164	124	103	33	79	89	313
RTOR Reduction (vph)	0	0	43	0	0	129	0	14	0	0	0	239
Lane Group Flow (vph)	188	288	25	11	509	35	124	122	0	79	89	74
Heavy Vehicles (%)	14%	14%	14%	17%	17%	17%	24%	24%	24%	18%	18%	18%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases	8		8	4		4	6			2		2
Actuated Green, G (s)	42.0	31.0	31.0	23.0	18.0	18.0	26.0	20.5		25.0	20.0	20.0
Effective Green, g (s)	42.0	31.0	31.0	23.0	18.0	18.0	26.0	20.5		25.0	20.0	20.0
Actuated g/C Ratio	0.49	0.36	0.36	0.27	0.21	0.21	0.31	0.24		0.29	0.24	0.24
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	5.5	6.0		5.5	6.0	6.0
Lane Grp Cap (vph)	411	1063	475	265	601	269	319	328		316	348	296
v/s Ratio Prot	c0.10	0.10		0.00	c0.18		c0.03	0.09		0.01	0.06	
v/s Ratio Perm	0.13		0.02	0.01		0.03	c0.09			0.06		0.06
v/c Ratio	0.46	0.27	0.05	0.04	0.85	0.13	0.39	0.37		0.25	0.26	0.25
Uniform Delay, d1	13.6	19.0	17.5	22.8	32.2	27.1	22.6	26.9		22.4	26.4	26.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.6	0.6	0.2	0.3	13.8	1.0	3.5	3.2		1.9	1.8	2.0
Delay (s)	17.2	19.7	17.7	23.1	46.0	28.1	26.1	30.1		24.3	28.2	28.4
Level of Service	B	B	B	C	D	C	C	C		C	C	C
Approach Delay (s)		18.6			41.3			28.2			27.7	
Approach LOS		B			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	30.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	165	80	45	225	15	45	30	90	15	65	5
Future Volume (vph)	5	165	80	45	225	15	45	30	90	15	65	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00		1.00	1.00			1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.89			0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00			0.99	
Satd. Flow (prot)	1554	3107	1390	1539	1605		1554	1452			1705	
Flt Permitted	0.60	1.00	1.00	0.64	1.00		0.70	1.00			0.95	
Satd. Flow (perm)	978	3107	1390	1035	1605		1141	1452			1625	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	179	87	49	245	16	49	33	98	16	71	5
RTOR Reduction (vph)	0	0	54	0	5	0	0	61	0	0	3	0
Lane Group Flow (vph)	5	179	33	49	256	0	49	70	0	0	89	0
Heavy Vehicles (%)	7%	7%	7%	8%	8%	8%	7%	7%	7%	1%	1%	1%
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)	19.0	19.0	19.0	19.0	19.0		19.0	19.0			19.0	
Effective Green, g (s)	19.0	19.0	19.0	19.0	19.0		19.0	19.0			19.0	
Actuated g/C Ratio	0.38	0.38	0.38	0.38	0.38		0.38	0.38			0.38	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)	371	1180	528	393	609		433	551			617	
v/s Ratio Prot		0.06			c0.16			0.05				
v/s Ratio Perm	0.01		0.02	0.05			0.04				c0.05	
v/c Ratio	0.01	0.15	0.06	0.12	0.42		0.11	0.13			0.14	
Uniform Delay, d1	9.7	10.2	9.8	10.1	11.4		10.0	10.1			10.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00		0.93	0.91			1.00	
Incremental Delay, d2	0.1	0.3	0.2	0.7	2.1		0.5	0.4			0.5	
Delay (s)	9.7	10.5	10.1	10.7	13.6		9.8	9.6			10.7	
Level of Service	A	B	B	B	B		A	A			B	
Approach Delay (s)		10.3			13.1			9.7			10.7	
Approach LOS		B			B			A			B	

Intersection Summary			
HCM 2000 Control Delay	11.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.28		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	44.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	230	140	62	206	17	52	29	105	36	75	5
Future Volume (vph)	5	230	140	62	206	17	52	29	105	36	75	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00		1.00	1.00			1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.88			0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)	1554	3107	1390	1539	1602		1554	1444			1697	
Flt Permitted	0.61	1.00	1.00	0.60	1.00		0.68	1.00			0.88	
Satd. Flow (perm)	995	3107	1390	967	1602		1106	1444			1517	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	250	152	67	224	18	57	32	114	39	82	5
RTOR Reduction (vph)	0	0	94	0	6	0	0	71	0	0	3	0
Lane Group Flow (vph)	5	250	58	67	236	0	57	75	0	0	123	0
Heavy Vehicles (%)	7%	7%	7%	8%	8%	8%	7%	7%	7%	1%	1%	1%
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)	19.0	19.0	19.0	19.0	19.0		19.0	19.0			19.0	
Effective Green, g (s)	19.0	19.0	19.0	19.0	19.0		19.0	19.0			19.0	
Actuated g/C Ratio	0.38	0.38	0.38	0.38	0.38		0.38	0.38			0.38	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)	378	1180	528	367	608		420	548			576	
v/s Ratio Prot		0.08			c0.15			0.05				
v/s Ratio Perm	0.01		0.04	0.07			0.05				c0.08	
v/c Ratio	0.01	0.21	0.11	0.18	0.39		0.14	0.14			0.21	
Uniform Delay, d1	9.7	10.5	10.0	10.3	11.3		10.1	10.1			10.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00		0.96	1.01			1.00	
Incremental Delay, d2	0.1	0.4	0.4	1.1	1.9		0.6	0.5			0.8	
Delay (s)	9.7	10.9	10.4	11.4	13.1		10.3	10.7			11.3	
Level of Service	A	B	B	B	B		B	B			B	
Approach Delay (s)		10.7			12.8			10.6			11.3	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	11.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.30		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	282	171	79	252	22	65	35	128	46	88	5
Future Volume (vph)	5	282	171	79	252	22	65	35	128	46	88	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00		1.00	1.00			1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.88			1.00	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)	1554	3107	1390	1539	1601		1554	1443			1697	
Flt Permitted	0.57	1.00	1.00	0.56	1.00		0.66	1.00			0.85	
Satd. Flow (perm)	938	3107	1390	915	1601		1081	1443			1475	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	307	186	86	274	24	71	38	139	50	96	5
RTOR Reduction (vph)	0	0	115	0	6	0	0	86	0	0	2	0
Lane Group Flow (vph)	5	307	71	86	292	0	71	91	0	0	149	0
Heavy Vehicles (%)	7%	7%	7%	8%	8%	8%	7%	7%	7%	1%	1%	1%
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)	19.0	19.0	19.0	19.0	19.0		19.0	19.0			19.0	
Effective Green, g (s)	19.0	19.0	19.0	19.0	19.0		19.0	19.0			19.0	
Actuated g/C Ratio	0.38	0.38	0.38	0.38	0.38		0.38	0.38			0.38	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)	356	1180	528	347	608		410	548			560	
v/s Ratio Prot		0.10			c0.18			0.06				
v/s Ratio Perm	0.01		0.05	0.09			0.07				c0.10	
v/c Ratio	0.01	0.26	0.13	0.25	0.48		0.17	0.17			0.27	
Uniform Delay, d1	9.7	10.7	10.1	10.6	11.8		10.3	10.3			10.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00		0.98	1.04			1.00	
Incremental Delay, d2	0.1	0.5	0.5	1.7	2.7		0.8	0.5			1.2	
Delay (s)	9.7	11.2	10.7	12.3	14.5		10.8	11.2			11.8	
Level of Service	A	B	B	B	B		B	B			B	
Approach Delay (s)		11.0			14.0			11.1			11.8	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	12.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	58.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	240	60	90	320	15	90	80	45	20	45	15
Future Volume (vph)	15	240	60	90	320	15	90	80	45	20	45	15
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00		1.00	1.00			1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.95			0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00			0.99	
Satd. Flow (prot)	1554	3107	1390	1539	1610		1554	1547			1669	
Flt Permitted	0.49	1.00	1.00	0.59	1.00		0.70	1.00			0.92	
Satd. Flow (perm)	803	3107	1390	957	1610		1146	1547			1547	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	16	261	65	98	348	16	98	87	49	22	49	16
RTOR Reduction (vph)	0	0	40	0	3	0	0	30	0	0	10	0
Lane Group Flow (vph)	16	261	25	98	361	0	98	106	0	0	77	0
Heavy Vehicles (%)	7%	7%	7%	8%	8%	8%	7%	7%	7%	1%	1%	1%
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)	19.0	19.0	19.0	19.0	19.0		19.0	19.0			19.0	
Effective Green, g (s)	19.0	19.0	19.0	19.0	19.0		19.0	19.0			19.0	
Actuated g/C Ratio	0.38	0.38	0.38	0.38	0.38		0.38	0.38			0.38	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)	305	1180	528	363	611		435	587			587	
v/s Ratio Prot		0.08			c0.22			0.07				
v/s Ratio Perm	0.02		0.02	0.10			c0.09				0.05	
v/c Ratio	0.05	0.22	0.05	0.27	0.59		0.23	0.18			0.13	
Uniform Delay, d1	9.8	10.5	9.8	10.7	12.4		10.5	10.3			10.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.11	1.17			1.00	
Incremental Delay, d2	0.3	0.4	0.2	1.8	4.2		1.2	0.7			0.5	
Delay (s)	10.1	10.9	10.0	12.5	16.5		12.9	12.7			10.6	
Level of Service	B	B	A	B	B		B	B			B	
Approach Delay (s)		10.7			15.7			12.8			10.6	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	13.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	230	73	105	360	37	146	84	61	30	41	10
Future Volume (vph)	10	230	73	105	360	37	146	84	61	30	41	10
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00		1.00	1.00			1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.94			0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)	1554	3107	1390	1539	1598		1554	1532			1673	
Flt Permitted	0.42	1.00	1.00	0.60	1.00		0.70	1.00			0.86	
Satd. Flow (perm)	693	3107	1390	967	1598		1144	1532			1466	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	250	79	114	391	40	159	91	66	33	45	11
RTOR Reduction (vph)	0	0	47	0	7	0	0	42	0	0	7	0
Lane Group Flow (vph)	11	250	32	114	424	0	159	115	0	0	82	0
Heavy Vehicles (%)	7%	7%	7%	8%	8%	8%	7%	7%	7%	1%	1%	1%
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)	20.0	20.0	20.0	20.0	20.0		18.0	18.0			18.0	
Effective Green, g (s)	20.0	20.0	20.0	20.0	20.0		18.0	18.0			18.0	
Actuated g/C Ratio	0.40	0.40	0.40	0.40	0.40		0.36	0.36			0.36	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)	277	1242	556	386	639		411	551			527	
v/s Ratio Prot		0.08			c0.27			0.07				
v/s Ratio Perm	0.02		0.02	0.12			c0.14				0.06	
v/c Ratio	0.04	0.20	0.06	0.30	0.66		0.39	0.21			0.16	
Uniform Delay, d1	9.1	9.8	9.2	10.2	12.2		11.9	11.1			10.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.22	1.34			1.00	
Incremental Delay, d2	0.3	0.4	0.2	1.9	5.4		2.6	0.8			0.6	
Delay (s)	9.4	10.2	9.4	12.1	17.6		17.2	15.7			11.5	
Level of Service	A	B	A	B	B		B	B			B	
Approach Delay (s)		10.0			16.5			16.4			11.5	
Approach LOS		A			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	14.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	283	89	128	440	47	180	103	81	31	51	15
Future Volume (vph)	15	283	89	128	440	47	180	103	81	31	51	15
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	1.00		1.00	1.00			1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.93			0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)	1554	3107	1390	1539	1597		1554	1528			1670	
Flt Permitted	0.47	1.00	1.00	0.42	1.00		0.63	1.00			0.85	
Satd. Flow (perm)	762	3107	1390	686	1597		1030	1528			1441	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	16	308	97	139	478	51	196	112	88	34	55	16
RTOR Reduction (vph)	0	0	57	0	5	0	0	40	0	0	9	0
Lane Group Flow (vph)	16	308	40	139	524	0	196	160	0	0	96	0
Heavy Vehicles (%)	7%	7%	7%	8%	8%	8%	7%	7%	7%	1%	1%	1%
Turn Type	Perm	NA	custom	pm+pt	NA		pm+pt	NA		Perm	NA	
Protected Phases		8		7	4		1	6			2	
Permitted Phases	8		4	4			6			2		
Actuated Green, G (s)	18.0	18.0	29.0	29.0	29.0		29.0	29.0			18.0	
Effective Green, g (s)	18.0	18.0	29.0	29.0	29.0		29.0	29.0			18.0	
Actuated g/C Ratio	0.26	0.26	0.41	0.41	0.41		0.41	0.41			0.26	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Lane Grp Cap (vph)	195	798	575	345	661		464	633			370	
v/s Ratio Prot		0.10		0.03	c0.33		c0.03	0.10				
v/s Ratio Perm	0.02		0.03	0.14			c0.14				0.07	
v/c Ratio	0.08	0.39	0.07	0.40	0.79		0.42	0.25			0.26	
Uniform Delay, d1	19.7	21.4	12.4	13.5	17.9		14.7	13.4			20.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2	0.8	1.4	0.2	3.5	9.4		2.8	1.0			1.7	
Delay (s)	20.6	22.9	12.6	17.0	27.3		17.5	14.4			22.4	
Level of Service	C	C	B	B	C		B	B			C	
Approach Delay (s)		20.4			25.2			15.9			22.4	
Approach LOS		C			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	21.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	130	20	5	175	5	10	0	5	0	0	5
Future Volume (Veh/h)	15	130	20	5	175	5	10	0	5	0	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	141	22	5	190	5	11	0	5	0	0	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	195			163			392	389	82	310	398	192
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	195			163			392	389	82	310	398	192
tC, single (s)	4.3			4.2			7.9	6.9	7.3	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	99			100			98	100	99	100	100	99
cM capacity (veh/h)	1319			1406			494	500	910	609	530	817

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	86	92	200	16	5
Volume Left	16	0	5	11	0
Volume Right	0	22	5	5	5
cSH	1319	1700	1406	576	817
Volume to Capacity	0.01	0.05	0.00	0.03	0.01
Queue Length 95th (m)	0.3	0.0	0.1	0.7	0.1
Control Delay (s)	1.5	0.0	0.2	11.4	9.4
Lane LOS	A		A	B	A
Approach Delay (s)	0.7		0.2	11.4	9.4
Approach LOS				B	A

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	29.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	150	25	5	205	5	10	0	5	0	0	5
Future Volume (Veh/h)	20	150	25	5	205	5	10	0	5	0	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	163	27	5	223	5	11	0	5	0	0	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	228			190			461	458	95	366	470	226
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	228			190			461	458	95	366	470	226
tC, single (s)	4.3			4.2			7.9	6.9	7.3	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	98			100			97	100	99	100	100	99
cM capacity (veh/h)	1281			1374			436	452	891	553	480	778

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	104	108	233	16	5
Volume Left	22	0	5	11	0
Volume Right	0	27	5	5	5
cSH	1281	1700	1374	519	778
Volume to Capacity	0.02	0.06	0.00	0.03	0.01
Queue Length 95th (m)	0.4	0.0	0.1	0.8	0.2
Control Delay (s)	1.8	0.0	0.2	12.2	9.7
Lane LOS	A		A	B	A
Approach Delay (s)	0.9		0.2	12.2	9.7
Approach LOS				B	A

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	30.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	185	30	5	255	5	15	0	5	0	0	5
Future Volume (Veh/h)	20	185	30	5	255	5	15	0	5	0	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	201	33	5	277	5	16	0	5	0	0	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	282			201			556	554	218	540	534	280
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	282			201			556	554	218	540	534	280
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	98			100			96	100	99	100	100	99
cM capacity (veh/h)	1236			1365			407	409	781	443	442	759

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	22	234	287	21	5
Volume Left	22	0	5	16	0
Volume Right	0	33	5	5	5
cSH	1236	1700	1365	460	759
Volume to Capacity	0.02	0.14	0.00	0.05	0.01
Queue Length 95th (m)	0.4	0.0	0.1	1.1	0.2
Control Delay (s)	8.0	0.0	0.2	13.2	9.8
Lane LOS	A		A	B	A
Approach Delay (s)	0.7		0.2	13.2	9.8
Approach LOS				B	A

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	33.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	15	165	20	10	196	5	10	0	6	0	0	5
Future Volume (Veh/h)	15	165	20	10	196	5	10	0	6	0	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	179	22	11	213	5	11	0	7	0	0	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	218			201			464	462	100	366	470	216
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	218			201			464	462	100	366	470	216
tC, single (s)	4.3			4.2			7.9	6.9	7.3	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	99			99			97	100	99	100	100	99
cM capacity (veh/h)	1292			1361			434	450	883	552	480	789

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	106	112	229	18	5
Volume Left	16	0	11	11	0
Volume Right	0	22	5	7	5
cSH	1292	1700	1361	541	789
Volume to Capacity	0.01	0.07	0.01	0.03	0.01
Queue Length 95th (m)	0.3	0.0	0.2	0.8	0.2
Control Delay (s)	1.3	0.0	0.4	11.9	9.6
Lane LOS	A		A	B	A
Approach Delay (s)	0.6		0.4	11.9	9.6
Approach LOS				B	A

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	34.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	232	25	19	263	5	10	0	8	0	0	5
Future Volume (Veh/h)	20	232	25	19	263	5	10	0	8	0	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	252	27	21	286	5	11	0	9	0	0	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	291			252			642	642	266	636	626	288
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	291			252			642	642	266	636	626	288
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	98			98			97	100	99	100	100	99
cM capacity (veh/h)	1226			1307			352	358	734	376	387	751

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	22	279	21	291	20	5
Volume Left	22	0	21	0	11	0
Volume Right	0	27	0	5	9	5
cSH	1226	1700	1307	1700	460	751
Volume to Capacity	0.02	0.16	0.02	0.17	0.04	0.01
Queue Length 95th (m)	0.4	0.0	0.4	0.0	1.1	0.2
Control Delay (s)	8.0	0.0	7.8	0.0	13.2	9.8
Lane LOS	A		A		B	A
Approach Delay (s)	0.6		0.5		13.2	9.8
Approach LOS					B	A

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	32.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	284	30	23	325	5	15	0	9	0	0	5
Future Volume (Veh/h)	20	284	30	23	325	5	15	0	9	0	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	309	33	25	353	5	16	0	10	0	0	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	358			309			778	778	326	768	758	356
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	358			309			778	778	326	768	758	356
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	98			98			94	100	99	100	100	99
cM capacity (veh/h)	1158			1246			283	297	678	304	323	688

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	22	342	25	358	26	5
Volume Left	22	0	25	0	16	0
Volume Right	0	33	0	5	10	5
cSH	1158	1700	1246	1700	365	688
Volume to Capacity	0.02	0.20	0.02	0.21	0.07	0.01
Queue Length 95th (m)	0.5	0.0	0.5	0.0	1.8	0.2
Control Delay (s)	8.2	0.0	7.9	0.0	15.6	10.3
Lane LOS	A		A		C	B
Approach Delay (s)	0.5		0.5		15.6	10.3
Approach LOS					C	B

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	35.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	145	45	0	180	0	50	0	5	5	0	30
Future Volume (Veh/h)	0	145	45	0	180	0	50	0	5	5	0	30
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	158	49	0	196	0	54	0	5	5	0	33
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	196			207			412	378	104	280	403	196
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	196			207			412	378	104	280	403	196
tC, single (s)	4.3			4.2			7.9	6.9	7.3	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	100			100			88	100	99	99	100	96
cM capacity (veh/h)	1318			1354			466	515	879	647	535	812

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	79	128	196	59	38
Volume Left	0	0	0	54	5
Volume Right	0	49	0	5	33
cSH	1318	1700	1354	485	786
Volume to Capacity	0.00	0.08	0.00	0.12	0.05
Queue Length 95th (m)	0.0	0.0	0.0	3.3	1.2
Control Delay (s)	0.0	0.0	0.0	13.4	9.8
Lane LOS				B	A
Approach Delay (s)	0.0		0.0	13.4	9.8
Approach LOS				B	A

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	27.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	170	55	0	215	0	60	0	5	5	0	35
Future Volume (Veh/h)	0	170	55	0	215	0	60	0	5	5	0	35
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	185	60	0	234	0	65	0	5	5	0	38
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	234			245			487	449	122	332	479	234
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	234			245			487	449	122	332	479	234
tC, single (s)	4.3			4.2			7.9	6.9	7.3	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	100			100			84	100	99	99	100	95
cM capacity (veh/h)	1274			1311			406	468	854	595	484	768

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	92	152	234	70	43
Volume Left	0	0	0	65	5
Volume Right	0	60	0	5	38
cSH	1274	1700	1311	421	743
Volume to Capacity	0.00	0.09	0.00	0.17	0.06
Queue Length 95th (m)	0.0	0.0	0.0	4.7	1.5
Control Delay (s)	0.0	0.0	0.0	15.2	10.1
Lane LOS				C	B
Approach Delay (s)	0.0		0.0	15.2	10.1
Approach LOS				C	B

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	29.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	210	65	0	260	0	75	0	5	5	0	45
Future Volume (Veh/h)	0	210	65	0	260	0	75	0	5	5	0	45
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	228	71	0	283	0	82	0	5	5	0	49
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	283			228			596	546	264	516	511	283
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	283			228			596	546	264	516	511	283
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	100			100			78	100	99	99	100	94
cM capacity (veh/h)	1235			1334			366	422	736	466	466	756

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	0	299	283	87	54
Volume Left	0	0	0	82	5
Volume Right	0	71	0	5	49
cSH	1700	1700	1334	377	715
Volume to Capacity	0.00	0.18	0.00	0.23	0.08
Queue Length 95th (m)	0.0	0.0	0.0	7.0	2.0
Control Delay (s)	0.0	0.0	0.0	17.4	10.4
Lane LOS				C	B
Approach Delay (s)	0.0		0.0	17.4	10.4
Approach LOS				C	B

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	34.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	166	45	1	217	0	50	0	9	5	0	30
Future Volume (Veh/h)	0	166	45	1	217	0	50	0	9	5	0	30
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	180	49	1	236	0	54	0	10	5	0	33
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	236			229			476	442	114	338	467	236
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	236			229			476	442	114	338	467	236
tC, single (s)	4.3			4.2			7.9	6.9	7.3	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	100			100			87	100	99	99	100	96
cM capacity (veh/h)	1272			1329			416	472	865	585	492	766

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	90	139	237	64	38
Volume Left	0	0	1	54	5
Volume Right	0	49	0	10	33
cSH	1272	1700	1329	453	736
Volume to Capacity	0.00	0.08	0.00	0.14	0.05
Queue Length 95th (m)	0.0	0.0	0.0	3.9	1.3
Control Delay (s)	0.0	0.0	0.0	14.2	10.2
Lane LOS			A	B	B
Approach Delay (s)	0.0		0.0	14.2	10.2
Approach LOS				B	B

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	30.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	230	55	4	302	0	60	0	16	5	0	35
Future Volume (Veh/h)	0	230	55	4	302	0	60	0	16	5	0	35
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	250	60	4	328	0	65	0	17	5	0	38
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	328			250			654	616	280	603	586	328
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	328			250			654	616	280	603	586	328
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	100			100			81	100	98	99	100	95
cM capacity (veh/h)	1188			1310			338	383	720	400	421	713

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	0	310	4	328	82	43
Volume Left	0	0	4	0	65	5
Volume Right	0	60	0	0	17	38
cSH	1700	1700	1310	1700	379	654
Volume to Capacity	0.00	0.18	0.00	0.19	0.22	0.07
Queue Length 95th (m)	0.0	0.0	0.1	0.0	6.5	1.7
Control Delay (s)	0.0	0.0	7.8	0.0	17.1	10.9
Lane LOS			A		C	B
Approach Delay (s)	0.0		0.1		17.1	10.9
Approach LOS					C	B

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	35.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	283	65	5	366	0	75	0	19	5	0	45
Future Volume (Veh/h)	0	283	65	5	366	0	75	0	19	5	0	45
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	308	71	5	398	0	82	0	21	5	0	49
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	398			308			800	752	344	737	716	398
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	398			308			800	752	344	737	716	398
tC, single (s)	4.2			4.1			7.3	6.7	6.4	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.7	4.2	3.5	3.5	4.0	3.3
p0 queue free %	100			100			69	100	97	98	100	92
cM capacity (veh/h)	1118			1247			262	319	662	323	354	652

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	0	379	5	398	103	54
Volume Left	0	0	5	0	82	5
Volume Right	0	71	0	0	21	49
cSH	1700	1700	1247	1700	298	595
Volume to Capacity	0.00	0.22	0.00	0.23	0.35	0.09
Queue Length 95th (m)	0.0	0.0	0.1	0.0	11.9	2.4
Control Delay (s)	0.0	0.0	7.9	0.0	23.3	11.6
Lane LOS			A		C	B
Approach Delay (s)	0.0		0.1		23.3	11.6
Approach LOS					C	B

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	40.0%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
14: 33rd Street & PTH 110

2037 Background AM-MOD.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	35	120	0	0	100	10	0	0	0	10	0	0
Future Volume (Veh/h)	35	120	0	0	100	10	0	0	0	10	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	38	130	0	0	109	11	0	0	0	11	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	120			130			320	326	65	256	320	114
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	120			130			320	326	65	256	320	114
tC, single (s)	4.8			4.8			8.9	7.9	8.3	8.0	7.0	7.4
tC, 2 stage (s)												
tF (s)	2.6			2.6			4.2	4.7	4.0	3.8	4.2	3.5
p0 queue free %	97			100			100	100	100	98	100	100
cM capacity (veh/h)	1244			1232			453	444	801	605	529	848

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	103	65	120	0	11
Volume Left	38	0	0	0	11
Volume Right	0	0	11	0	0
cSH	1244	1700	1232	1700	605
Volume to Capacity	0.03	0.04	0.00	0.00	0.02
Queue Length 95th (m)	0.8	0.0	0.0	0.0	0.4
Control Delay (s)	3.1	0.0	0.0	0.0	11.1
Lane LOS	A			A	B
Approach Delay (s)	1.9		0.0	0.0	11.1
Approach LOS				A	B

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	18.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	42	174	0	9	118	17	0	0	2	12	0	1
Future Volume (Veh/h)	42	174	0	9	118	17	0	0	2	12	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	46	189	0	10	128	18	0	0	2	13	0	1
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	146			189			438	447	189	440	438	137
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	146			189			438	447	189	440	438	137
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	96			99			100	100	100	97	100	100
cM capacity (veh/h)	1248			1200			413	398	704	472	458	854

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	46	189	156	2	14
Volume Left	46	0	10	0	13
Volume Right	0	0	18	2	1
cSH	1248	1700	1200	704	487
Volume to Capacity	0.04	0.11	0.01	0.00	0.03
Queue Length 95th (m)	0.9	0.0	0.2	0.1	0.7
Control Delay (s)	8.0	0.0	0.6	10.1	12.6
Lane LOS	A		A	B	B
Approach Delay (s)	1.6		0.6	10.1	12.6
Approach LOS				B	B

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	33.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	75	10	0	110	10	20	0	0	10	0	45
Future Volume (Veh/h)	10	75	10	0	110	10	20	0	0	10	0	45
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	82	11	0	120	11	22	0	0	11	0	49
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	131			93			235	240	46	188	240	126
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	131			93			235	240	46	188	240	126
tC, single (s)	4.8			4.8			8.9	7.9	8.3	8.0	7.0	7.4
tC, 2 stage (s)												
tF (s)	2.6			2.6			4.2	4.7	4.0	3.8	4.2	3.5
p0 queue free %	99			100			96	100	100	98	100	94
cM capacity (veh/h)	1230			1278			511	520	827	691	604	833

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	52	52	131	22	60
Volume Left	11	0	0	22	11
Volume Right	0	11	11	0	49
cSH	1230	1700	1278	511	803
Volume to Capacity	0.01	0.03	0.00	0.04	0.07
Queue Length 95th (m)	0.2	0.0	0.0	1.1	1.9
Control Delay (s)	1.7	0.0	0.0	12.4	9.8
Lane LOS	A			B	A
Approach Delay (s)	0.9		0.0	12.4	9.8
Approach LOS				B	A

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	18.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	97	10	2	158	12	20	0	7	16	0	54
Future Volume (Veh/h)	11	97	10	2	158	12	20	0	7	16	0	54
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	105	11	2	172	13	22	0	8	17	0	59
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	185			116			317	324	110	320	322	178
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	185			116			317	324	110	320	322	178
tC, single (s)	4.5			4.5			7.8	7.2	6.9	7.3	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.5			2.5			4.1	4.6	3.9	3.7	4.2	3.5
p0 queue free %	99			100			95	100	99	97	100	93
cM capacity (veh/h)	1205			1281			479	491	785	580	553	808

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	12	116	187	30	76
Volume Left	12	0	2	22	17
Volume Right	0	11	13	8	59
cSH	1205	1700	1281	535	743
Volume to Capacity	0.01	0.07	0.00	0.06	0.10
Queue Length 95th (m)	0.2	0.0	0.0	1.4	2.7
Control Delay (s)	8.0	0.0	0.1	12.1	10.4
Lane LOS	A		A	B	B
Approach Delay (s)	0.8		0.1	12.1	10.4
Approach LOS				B	B

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	22.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
15: PTH 110 & Richmond Avenue

2019 Background AM-MOD.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	125	150	5	10	105	60	5	30	25	70	40	75
Future Volume (Veh/h)	125	150	5	10	105	60	5	30	25	70	40	75
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	136	163	5	11	114	65	5	33	27	76	43	82
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	114			163			592	571	163	588	571	114
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	114			163			592	571	163	588	571	114
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	90			99			98	91	97	76	88	90
cM capacity (veh/h)	1387			1272			282	349	805	312	350	861

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	136	163	5	11	114	65	5	60	76	125
Volume Left	136	0	0	11	0	0	5	0	76	0
Volume Right	0	0	5	0	0	65	0	27	0	82
cSH	1387	1700	1700	1272	1700	1700	282	634	312	1017
Volume to Capacity	0.10	0.10	0.00	0.01	0.07	0.04	0.02	0.09	0.24	0.12
Queue Length 95th (m)	2.6	0.0	0.0	0.2	0.0	0.0	0.4	2.5	7.5	3.4
Control Delay (s)	7.9	0.0	0.0	7.9	0.0	0.0	18.0	13.4	20.2	12.1
Lane LOS	A			A			C	B	C	B
Approach Delay (s)	3.5			0.5			13.7		15.1	
Approach LOS							B		C	

Intersection Summary			
Average Delay	6.7		
Intersection Capacity Utilization	31.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	170	205	5	15	140	80	5	45	35	95	50	105
Future Volume (Veh/h)	170	205	5	15	140	80	5	45	35	95	50	105
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	185	223	5	16	152	87	5	49	38	103	54	114
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	152			223			804	777	223	802	777	152
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	152			223			804	777	223	802	777	152
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	86			99			97	80	95	46	78	86
cM capacity (veh/h)	1342			1206			170	250	743	192	250	819

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	185	223	5	16	152	87	5	87	103	168
Volume Left	185	0	0	16	0	0	5	0	103	0
Volume Right	0	0	5	0	0	87	0	38	0	114
cSH	1342	1700	1700	1206	1700	1700	170	443	192	779
Volume to Capacity	0.14	0.13	0.00	0.01	0.09	0.05	0.03	0.20	0.54	0.22
Queue Length 95th (m)	3.8	0.0	0.0	0.3	0.0	0.0	0.7	5.8	22.2	6.5
Control Delay (s)	8.1	0.0	0.0	8.0	0.0	0.0	26.8	17.3	43.4	14.3
Lane LOS	A			A			D	C	E	B
Approach Delay (s)	3.6			0.5			17.8		25.4	
Approach LOS							C		D	

Intersection Summary			
Average Delay	9.8		
Intersection Capacity Utilization	40.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	250	305	10	20	210	120	10	65	55	140	75	155
Future Volume (vph)	250	305	10	20	210	120	10	65	55	140	75	155
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1421	1496	1271	1299	1367	1162	1241	1306	1110	1250	1316	1118
Flt Permitted	0.42	1.00	1.00	0.56	1.00	1.00	0.70	1.00	1.00	0.53	1.00	1.00
Satd. Flow (perm)	626	1496	1271	766	1367	1162	919	1306	1110	701	1316	1118
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	332	11	22	228	130	11	71	60	152	82	168
RTOR Reduction (vph)	0	0	7	0	0	95	0	0	49	0	0	124
Lane Group Flow (vph)	272	332	4	22	228	35	11	71	11	152	82	44
Heavy Vehicles (%)	17%	17%	17%	28%	28%	28%	34%	34%	34%	33%	33%	33%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	51.0	40.0	40.0	32.0	27.0	27.0	23.0	18.0	18.0	37.0	26.0	26.0
Effective Green, g (s)	51.0	40.0	40.0	32.0	27.0	27.0	23.0	18.0	18.0	37.0	26.0	26.0
Actuated g/C Ratio	0.51	0.40	0.40	0.32	0.27	0.27	0.23	0.18	0.18	0.37	0.26	0.26
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	462	598	508	271	369	313	227	235	199	330	342	290
v/s Ratio Prot	c0.11	0.22		0.00	0.17		0.00	0.05		c0.06	0.06	
v/s Ratio Perm	c0.19		0.00	0.02		0.03	0.01		0.01	c0.11		0.04
v/c Ratio	0.59	0.56	0.01	0.08	0.62	0.11	0.05	0.30	0.05	0.46	0.24	0.15
Uniform Delay, d1	15.6	23.1	18.1	23.5	32.0	27.5	29.9	35.6	34.0	22.8	29.2	28.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.4	3.7	0.0	0.6	7.6	0.7	0.4	3.3	0.5	4.6	1.7	1.1
Delay (s)	21.1	26.8	18.1	24.1	39.5	28.2	30.3	38.8	34.5	27.4	30.9	29.6
Level of Service	C	C	B	C	D	C	C	D	C	C	C	C
Approach Delay (s)		24.1			34.8			36.3			29.0	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	29.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	57.1%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
15: PTH 110 & Richmond Avenue

2019 Development AM-MOD.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	132	220	5	14	119	75	6	30	43	147	45	106
Future Volume (Veh/h)	132	220	5	14	119	75	6	30	43	147	45	106
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	143	239	5	15	129	82	7	33	47	160	49	115
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	129			239			708	684	239	700	684	129
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	129			239			708	684	239	700	684	129
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	90			99			97	89	94	35	83	86
cM capacity (veh/h)	1369			1190			214	295	727	247	296	844

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	143	239	5	15	129	82	7	80	160	164
Volume Left	143	0	0	15	0	0	7	0	160	0
Volume Right	0	0	5	0	0	82	0	47	0	115
cSH	1369	1700	1700	1190	1700	1700	214	715	247	991
Volume to Capacity	0.10	0.14	0.00	0.01	0.08	0.05	0.03	0.11	0.65	0.17
Queue Length 95th (m)	2.8	0.0	0.0	0.3	0.0	0.0	0.8	3.0	32.3	4.7
Control Delay (s)	7.9	0.0	0.0	8.1	0.0	0.0	22.4	13.8	43.1	12.8
Lane LOS	A			A			C	B	E	B
Approach Delay (s)	2.9			0.5			14.5		27.7	
Approach LOS							B		D	

Intersection Summary			
Average Delay	11.2		
Intersection Capacity Utilization	36.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	187	372	5	23	176	122	8	47	76	283	68	186
Future Volume (vph)	187	372	5	23	176	122	8	47	76	283	68	186
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	4.5	6.0	6.0	4.5	6.0	6.0	4.5	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1421	1496	1271	1299	1367	1162	1241	1306	1110	1250	1316	1118
Flt Permitted	0.40	1.00	1.00	0.52	1.00	1.00	0.71	1.00	1.00	0.59	1.00	1.00
Satd. Flow (perm)	605	1496	1271	717	1367	1162	926	1306	1110	770	1316	1118
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	203	404	5	25	191	133	9	51	83	308	74	202
RTOR Reduction (vph)	0	0	3	0	0	106	0	0	67	0	0	132
Lane Group Flow (vph)	203	404	2	25	191	27	9	51	16	308	74	70
Heavy Vehicles (%)	17%	17%	17%	28%	28%	28%	34%	34%	34%	33%	33%	33%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	44.0	34.5	34.5	25.0	20.0	20.0	24.0	19.0	19.0	44.0	34.5	34.5
Effective Green, g (s)	44.0	34.5	34.5	25.0	20.0	20.0	24.0	19.0	19.0	44.0	34.5	34.5
Actuated g/C Ratio	0.44	0.34	0.34	0.25	0.20	0.20	0.24	0.19	0.19	0.44	0.34	0.34
Clearance Time (s)	6.0	6.0	6.0	4.5	6.0	6.0	4.5	6.0	6.0	4.5	6.0	6.0
Lane Grp Cap (vph)	413	516	438	208	273	232	237	248	210	437	454	385
v/s Ratio Prot	c0.09	c0.27		0.01	0.14		0.00	0.04		c0.14	0.06	
v/s Ratio Perm	0.13		0.00	0.02		0.02	0.01		0.01	c0.17		0.06
v/c Ratio	0.49	0.78	0.00	0.12	0.70	0.11	0.04	0.21	0.08	0.70	0.16	0.18
Uniform Delay, d1	18.9	29.4	21.5	28.7	37.2	32.8	29.1	34.1	33.3	21.0	22.7	22.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.1	11.3	0.0	1.2	13.9	1.0	0.3	1.9	0.7	9.2	0.8	1.0
Delay (s)	23.0	40.7	21.5	29.9	51.1	33.8	29.4	36.0	34.0	30.2	23.5	23.9
Level of Service	C	D	C	C	D	C	C	D	C	C	C	C
Approach Delay (s)		34.7			43.0			34.4			27.2	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	33.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	22.5
Intersection Capacity Utilization	62.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	270	508	10	30	256	172	13	71	104	384	99	252
Future Volume (vph)	270	508	10	30	256	172	13	71	104	384	99	252
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.5	6.0	6.0	4.5	6.0	6.0	4.5	6.0	6.0	4.5	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1421	2842	1271	1299	2598	1162	1241	1306	1110	2425	1316	1118
Flt Permitted	0.51	1.00	1.00	0.42	1.00	1.00	0.69	1.00	1.00	0.70	1.00	1.00
Satd. Flow (perm)	763	2842	1271	574	2598	1162	898	1306	1110	1795	1316	1118
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	293	552	11	33	278	187	14	77	113	417	108	274
RTOR Reduction (vph)	0	0	8	0	0	139	0	0	83	0	0	202
Lane Group Flow (vph)	293	552	3	33	278	48	14	77	30	417	108	72
Heavy Vehicles (%)	17%	17%	17%	28%	28%	28%	34%	34%	34%	33%	33%	33%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	28.0	20.5	20.5	23.0	18.0	18.0	23.4	18.4	18.4	23.6	18.5	18.5
Effective Green, g (s)	28.0	20.5	20.5	23.0	18.0	18.0	23.4	18.4	18.4	23.6	18.5	18.5
Actuated g/C Ratio	0.40	0.29	0.29	0.33	0.26	0.26	0.33	0.26	0.26	0.34	0.26	0.26
Clearance Time (s)	4.5	6.0	6.0	4.5	6.0	6.0	4.5	6.0	6.0	4.5	6.0	6.0
Lane Grp Cap (vph)	375	832	372	240	668	298	324	343	291	651	347	295
v/s Ratio Prot	c0.08	0.19		0.01	0.11		0.00	0.06		c0.05	0.08	
v/s Ratio Perm	c0.23		0.00	0.04		0.04	0.01		0.03	c0.17		0.06
v/c Ratio	0.78	0.66	0.01	0.14	0.42	0.16	0.04	0.22	0.10	0.64	0.31	0.25
Uniform Delay, d1	17.0	21.7	17.5	16.2	21.6	20.2	15.7	20.2	19.5	18.9	20.6	20.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.9	4.2	0.0	1.2	1.9	1.2	0.3	1.5	0.7	4.8	2.3	2.0
Delay (s)	31.9	25.9	17.6	17.4	23.5	21.3	15.9	21.7	20.2	23.7	23.0	22.2
Level of Service	C	C	B	B	C	C	B	C	C	C	C	C
Approach Delay (s)		27.8			22.3			20.5			23.1	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	24.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	56.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
15: PTH 110 & Richmond Avenue

2019 Background PM-MOD.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	85	75	0	15	155	45	5	15	20	30	45	120
Future Volume (Veh/h)	85	75	0	15	155	45	5	15	20	30	45	120
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	92	82	0	16	168	49	5	16	22	33	49	130
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	168			82			490	466	82	474	466	168
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	168			82			490	466	82	474	466	168
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	93			99			98	96	98	92	88	84
cM capacity (veh/h)	1324			1366			315	414	896	403	415	802

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	92	82	0	16	168	49	5	38	33	179
Volume Left	92	0	0	16	0	0	5	0	33	0
Volume Right	0	0	0	0	0	49	0	22	0	130
cSH	1324	1700	1700	1366	1700	1700	315	983	403	1104
Volume to Capacity	0.07	0.05	0.00	0.01	0.10	0.03	0.02	0.04	0.08	0.16
Queue Length 95th (m)	1.8	0.0	0.0	0.3	0.0	0.0	0.4	1.0	2.1	4.6
Control Delay (s)	7.9	0.0	0.0	7.7	0.0	0.0	16.6	11.2	14.7	11.6
Lane LOS	A			A			C	B	B	B
Approach Delay (s)	4.2			0.5			11.8		12.1	
Approach LOS							B		B	

Intersection Summary			
Average Delay	5.9		
Intersection Capacity Utilization	32.4%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
15: PTH 110 & Richmond Avenue

2027 Background PM-MOD.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	120	105	0	20	215	60	5	20	30	45	60	165
Future Volume (Veh/h)	120	105	0	20	215	60	5	20	30	45	60	165
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	130	114	0	22	234	65	5	22	33	49	65	179
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	234			114			684	652	114	663	652	234
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	234			114			684	652	114	663	652	234
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	90			98			97	93	96	82	79	76
cM capacity (veh/h)	1250			1328			187	307	859	277	308	734

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	130	114	0	22	234	65	5	55	49	244
Volume Left	130	0	0	22	0	0	5	0	49	0
Volume Right	0	0	0	0	0	65	0	33	0	179
cSH	1250	1700	1700	1328	1700	1700	187	768	277	1001
Volume to Capacity	0.10	0.07	0.00	0.02	0.14	0.04	0.03	0.07	0.18	0.24
Queue Length 95th (m)	2.8	0.0	0.0	0.4	0.0	0.0	0.7	1.8	5.0	7.7
Control Delay (s)	8.2	0.0	0.0	7.8	0.0	0.0	24.8	12.7	20.7	13.7
Lane LOS	A			A			C	B	C	B
Approach Delay (s)	4.4			0.5			13.7		14.9	
Approach LOS							B		B	

Intersection Summary			
Average Delay	7.0		
Intersection Capacity Utilization	38.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	175	155	0	35	320	90	10	35	45	65	90	240
Future Volume (vph)	175	155	0	35	320	90	10	35	45	65	90	240
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1421	1496		1299	1367	1162	1241	1306	1110	1250	1316	1118
Flt Permitted	0.38	1.00		0.65	1.00	1.00	0.69	1.00	1.00	0.67	1.00	1.00
Satd. Flow (perm)	562	1496		890	1367	1162	906	1306	1110	886	1316	1118
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	190	168	0	38	348	98	11	38	49	71	98	261
RTOR Reduction (vph)	0	0	0	0	0	62	0	0	38	0	0	196
Lane Group Flow (vph)	190	168	0	38	348	36	11	38	11	71	98	65
Heavy Vehicles (%)	17%	17%	17%	28%	28%	28%	34%	34%	34%	33%	33%	33%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	50.0	41.0		42.0	37.0	37.0	28.0	23.0	23.0	32.0	25.0	25.0
Effective Green, g (s)	50.0	41.0		42.0	37.0	37.0	28.0	23.0	23.0	32.0	25.0	25.0
Actuated g/C Ratio	0.50	0.41		0.42	0.37	0.37	0.28	0.23	0.23	0.32	0.25	0.25
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	358	613		394	505	429	270	300	255	309	329	279
v/s Ratio Prot	c0.05	0.11		0.00	c0.25		0.00	0.03		c0.02	c0.07	
v/s Ratio Perm	0.22			0.04		0.03	0.01		0.01	0.06		0.06
v/c Ratio	0.53	0.27		0.10	0.69	0.08	0.04	0.13	0.04	0.23	0.30	0.23
Uniform Delay, d1	15.5	19.6		17.3	26.6	20.5	26.2	30.5	29.9	24.5	30.4	29.9
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.5	1.1		0.5	7.5	0.4	0.3	0.9	0.3	1.7	2.3	2.0
Delay (s)	21.1	20.7		17.8	34.1	20.9	26.4	31.4	30.3	26.3	32.7	31.8
Level of Service	C	C		B	C	C	C	C	C	C	C	C
Approach Delay (s)		20.9			30.2			30.3			31.1	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	28.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	54.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
15: PTH 110 & Richmond Avenue

2019 Development PM-MOD.syn

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	114	95	1	31	226	119	5	20	24	52	46	127
Future Volume (Veh/h)	114	95	1	31	226	119	5	20	24	52	46	127
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	124	103	1	34	246	129	5	22	26	57	50	138
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)									12			20
Median type		None			None							
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	246			103			690	665	103	676	665	246
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	246			103			690	665	103	676	665	246
tC, single (s)	4.3			4.4			7.4	6.8	6.5	7.4	6.8	6.5
tC, 2 stage (s)												
tF (s)	2.4			2.5			3.8	4.3	3.6	3.8	4.3	3.6
p0 queue free %	90			97			98	93	97	79	83	81
cM capacity (veh/h)	1237			1341			205	300	871	273	301	723

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2	SB 1	SB 2
Volume Total	124	103	1	34	246	129	5	48	57	188
Volume Left	124	0	0	34	0	0	5	0	57	0
Volume Right	0	0	1	0	0	129	0	26	0	138
cSH	1237	1700	1700	1341	1700	1700	205	656	273	984
Volume to Capacity	0.10	0.06	0.00	0.03	0.14	0.08	0.02	0.07	0.21	0.19
Queue Length 95th (m)	2.7	0.0	0.0	0.6	0.0	0.0	0.6	1.9	6.2	5.6
Control Delay (s)	8.2	0.0	0.0	7.8	0.0	0.0	23.0	13.2	21.6	13.3
Lane LOS	A			A			C	B	C	B
Approach Delay (s)	4.5			0.6			14.1		15.3	
Approach LOS							B		C	

Intersection Summary			
Average Delay	6.2		
Intersection Capacity Utilization	39.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	195	160	3	55	377	237	5	35	42	103	65	187
Future Volume (vph)	195	160	3	55	377	237	5	35	42	103	65	187
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1421	1496	1271	1299	1367	1162	1241	1306	1110	1250	1316	1118
Flt Permitted	0.31	1.00	1.00	0.65	1.00	1.00	0.71	1.00	1.00	0.70	1.00	1.00
Satd. Flow (perm)	468	1496	1271	885	1367	1162	928	1306	1110	918	1316	1118
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	212	174	3	60	410	258	5	38	46	112	71	203
RTOR Reduction (vph)	0	0	2	0	0	157	0	0	37	0	0	160
Lane Group Flow (vph)	212	174	1	60	410	101	5	38	9	112	71	43
Heavy Vehicles (%)	17%	17%	17%	28%	28%	28%	34%	34%	34%	33%	33%	33%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	56.0	45.0	45.0	44.0	39.0	39.0	25.0	20.0	20.0	27.0	21.0	21.0
Effective Green, g (s)	56.0	45.0	45.0	44.0	39.0	39.0	25.0	20.0	20.0	27.0	21.0	21.0
Actuated g/C Ratio	0.56	0.45	0.45	0.44	0.39	0.39	0.25	0.20	0.20	0.27	0.21	0.21
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	366	673	571	410	533	453	247	261	222	267	276	234
v/s Ratio Prot	c0.06	0.12		0.01	c0.30		0.00	0.03		c0.03	0.05	
v/s Ratio Perm	0.26		0.00	0.06		0.09	0.00		0.01	c0.09		0.04
v/c Ratio	0.58	0.26	0.00	0.15	0.77	0.22	0.02	0.15	0.04	0.42	0.26	0.18
Uniform Delay, d1	13.6	17.1	15.1	16.4	26.6	20.4	28.2	33.0	32.3	29.4	33.0	32.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.5	0.9	0.0	0.8	10.2	1.1	0.2	1.2	0.4	4.8	2.2	1.7
Delay (s)	20.1	18.0	15.1	17.2	36.8	21.5	28.4	34.1	32.6	34.2	35.2	34.2
Level of Service	C	B	B	B	D	C	C	C	C	C	D	C
Approach Delay (s)		19.2			29.8			33.0			34.4	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	28.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	61.1%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	262	223	3	77	520	312	10	56	59	139	97	268
Future Volume (vph)	262	223	3	77	520	312	10	56	59	139	97	268
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1421	2842	1271	1299	2598	1162	1241	1306	1110	2425	1316	1118
Flt Permitted	0.24	1.00	1.00	0.60	1.00	1.00	0.69	1.00	1.00	0.72	1.00	1.00
Satd. Flow (perm)	357	2842	1271	822	2598	1162	900	1306	1110	1831	1316	1118
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	285	242	3	84	565	339	11	61	64	151	105	291
RTOR Reduction (vph)	0	0	2	0	0	251	0	0	47	0	0	213
Lane Group Flow (vph)	285	242	1	84	565	88	11	61	17	151	105	78
Heavy Vehicles (%)	17%	17%	17%	28%	28%	28%	34%	34%	34%	33%	33%	33%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	36.5	24.7	24.7	26.8	19.5	19.5	25.0	20.0	20.0	25.0	20.0	20.0
Effective Green, g (s)	36.5	24.7	24.7	26.8	19.5	19.5	25.0	20.0	20.0	25.0	20.0	20.0
Actuated g/C Ratio	0.49	0.33	0.33	0.36	0.26	0.26	0.33	0.27	0.27	0.33	0.27	0.27
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Grp Cap (vph)	351	935	418	340	675	302	322	348	296	649	350	298
v/s Ratio Prot	c0.14	0.09		0.02	0.22		0.00	0.05		c0.02	c0.08	
v/s Ratio Perm	c0.26		0.00	0.06		0.08	0.01		0.02	0.06		0.07
v/c Ratio	0.81	0.26	0.00	0.25	0.84	0.29	0.03	0.18	0.06	0.23	0.30	0.26
Uniform Delay, d1	13.8	18.4	16.9	16.6	26.2	22.2	16.8	21.2	20.5	17.8	21.9	21.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	18.2	0.7	0.0	1.7	11.8	2.4	0.2	1.1	0.4	0.8	2.2	2.1
Delay (s)	32.0	19.1	16.9	18.3	38.0	24.7	17.0	22.3	20.9	18.6	24.1	23.8
Level of Service	C	B	B	B	D	C	B	C	C	B	C	C
Approach Delay (s)		26.0			31.8			21.2			22.4	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	27.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	53.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	220	20	35	0	10	0	20	425	0	10	340	340
Future Volume (vph)	220	20	35	0	10	0	20	425	0	10	340	340
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		6.0			6.0		6.0	6.0			6.0	6.0
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	1.00
Frt		0.98			1.00		1.00	1.00			1.00	0.85
Flt Protected		0.96			1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1504			1458		1363	1434			1520	1293
Flt Permitted		0.76			1.00		0.49	1.00			0.98	1.00
Satd. Flow (perm)		1191			1458		697	1434			1497	1293
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	239	22	38	0	11	0	22	462	0	11	370	370
RTOR Reduction (vph)	0	9	0	0	0	0	0	0	0	0	0	197
Lane Group Flow (vph)	0	290	0	0	11	0	22	462	0	0	381	173
Heavy Vehicles (%)	10%	10%	10%	20%	20%	20%	22%	22%	22%	15%	15%	15%
Turn Type	Perm	NA			NA		Perm	NA		Perm	NA	Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)		20.0			20.0		28.0	28.0			28.0	28.0
Effective Green, g (s)		20.0			20.0		28.0	28.0			28.0	28.0
Actuated g/C Ratio		0.33			0.33		0.47	0.47			0.47	0.47
Clearance Time (s)		6.0			6.0		6.0	6.0			6.0	6.0
Lane Grp Cap (vph)		397			486		325	669			698	603
v/s Ratio Prot					0.01			c0.32				
v/s Ratio Perm		c0.24					0.03				0.25	0.13
v/c Ratio		0.73			0.02		0.07	0.69			0.55	0.29
Uniform Delay, d1		17.6			13.4		8.8	12.6			11.4	9.8
Progression Factor		1.00			1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		11.3			0.1		0.4	5.8			3.1	1.2
Delay (s)		28.9			13.5		9.2	18.4			14.5	11.0
Level of Service		C			B		A	B			B	B
Approach Delay (s)		28.9			13.5			17.9			12.8	
Approach LOS		C			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	163	15	92	0	5	0	31	335	0	5	445	286
Future Volume (vph)	163	15	92	0	5	0	31	335	0	5	445	286
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0			6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Frt		1.00	0.85		1.00		1.00	1.00			1.00	0.85
Flt Protected		0.96	1.00		1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1521	1352		1458		1363	1434			1521	1293
Flt Permitted		0.74	1.00		1.00		0.38	1.00			1.00	1.00
Satd. Flow (perm)		1178	1352		1458		551	1434			1516	1293
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	177	16	100	0	5	0	34	364	0	5	484	311
RTOR Reduction (vph)	0	0	67	0	0	0	0	0	0	0	0	170
Lane Group Flow (vph)	0	193	33	0	5	0	34	364	0	0	489	141
Heavy Vehicles (%)	10%	10%	10%	20%	20%	20%	22%	22%	22%	15%	15%	15%
Turn Type	Perm	NA	Perm		NA		Perm	NA		Perm	NA	Perm
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)		18.0	18.0		18.0		25.0	25.0			25.0	25.0
Effective Green, g (s)		18.0	18.0		18.0		25.0	25.0			25.0	25.0
Actuated g/C Ratio		0.33	0.33		0.33		0.45	0.45			0.45	0.45
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0			6.0	6.0
Lane Grp Cap (vph)		385	442		477		250	651			689	587
v/s Ratio Prot					0.00			0.25				
v/s Ratio Perm		c0.16	0.02				0.06				c0.32	0.11
v/c Ratio		0.50	0.07		0.01		0.14	0.56			0.71	0.24
Uniform Delay, d1		14.9	12.8		12.5		8.7	11.0			12.1	9.2
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		4.6	0.3		0.0		1.1	3.4			6.1	1.0
Delay (s)		19.5	13.1		12.5		9.9	14.4			18.2	10.2
Level of Service		B	B		B		A	B			B	B
Approach Delay (s)		17.3			12.5			14.0			15.1	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	15.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	235	20	123	0	10	0	39	484	0	10	617	409
Future Volume (vph)	235	20	123	0	10	0	39	484	0	10	617	409
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0			6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Frt		1.00	0.85		1.00		1.00	1.00			1.00	0.85
Flt Protected		0.96	1.00		1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1521	1352		1458		1363	1434			1521	1293
Flt Permitted		0.74	1.00		1.00		0.26	1.00			0.99	1.00
Satd. Flow (perm)		1170	1352		1458		375	1434			1507	1293
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	255	22	134	0	11	0	42	526	0	11	671	445
RTOR Reduction (vph)	0	0	92	0	0	0	0	0	0	0	0	191
Lane Group Flow (vph)	0	277	42	0	11	0	42	526	0	0	682	254
Heavy Vehicles (%)	10%	10%	10%	20%	20%	20%	22%	22%	22%	15%	15%	15%
Turn Type	Perm	NA	Perm		NA		Perm	NA		Perm	NA	Perm
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)		31.0	31.0		31.0		57.0	57.0			57.0	57.0
Effective Green, g (s)		31.0	31.0		31.0		57.0	57.0			57.0	57.0
Actuated g/C Ratio		0.31	0.31		0.31		0.57	0.57			0.57	0.57
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0			6.0	6.0
Lane Grp Cap (vph)		362	419		451		213	817			858	737
v/s Ratio Prot					0.01			0.37				
v/s Ratio Perm		c0.24	0.03				0.11				c0.45	0.20
v/c Ratio		0.77	0.10		0.02		0.20	0.64			0.79	0.34
Uniform Delay, d1		31.2	24.6		24.0		10.4	14.6			16.9	11.5
Progression Factor		0.85	1.14		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		14.1	0.5		0.1		2.1	3.9			7.5	1.3
Delay (s)		40.8	28.4		24.1		12.5	18.5			24.4	12.8
Level of Service		D	C		C		B	B			C	B
Approach Delay (s)		36.8			24.1			18.0			19.8	
Approach LOS		D			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	22.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	75.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	250	10	35	0	10	10	35	275	0	10	385	305
Future Volume (vph)	250	10	35	0	10	10	35	275	0	10	385	305
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		6.0			6.0		6.0	6.0			6.0	6.0
Lane Util. Factor		1.00			1.00		1.00	1.00			1.00	1.00
Frt		0.98			0.93		1.00	1.00			1.00	0.85
Flt Protected		0.96			1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1502			1360		1363	1434			1520	1293
Flt Permitted		0.74			1.00		0.42	1.00			0.99	1.00
Satd. Flow (perm)		1163			1360		604	1434			1505	1293
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	11	38	0	11	11	38	299	0	11	418	332
RTOR Reduction (vph)	0	8	0	0	7	0	0	0	0	0	0	188
Lane Group Flow (vph)	0	313	0	0	15	0	38	299	0	0	429	144
Heavy Vehicles (%)	10%	10%	10%	20%	20%	20%	22%	22%	22%	15%	15%	15%
Turn Type	Perm	NA			NA		Perm	NA		Perm	NA	Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)		22.0			22.0		26.0	26.0			26.0	26.0
Effective Green, g (s)		22.0			22.0		26.0	26.0			26.0	26.0
Actuated g/C Ratio		0.37			0.37		0.43	0.43			0.43	0.43
Clearance Time (s)		6.0			6.0		6.0	6.0			6.0	6.0
Lane Grp Cap (vph)		426			498		261	621			652	560
v/s Ratio Prot					0.01			0.21				
v/s Ratio Perm		c0.27					0.06				c0.28	0.11
v/c Ratio		0.73			0.03		0.15	0.48			0.66	0.26
Uniform Delay, d1		16.5			12.2		10.3	12.2			13.5	10.8
Progression Factor		1.00			1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		10.7			0.1		1.2	2.7			5.1	1.1
Delay (s)		27.2			12.3		11.5	14.8			18.6	11.9
Level of Service		C			B		B	B			B	B
Approach Delay (s)		27.2			12.3			14.5			15.7	
Approach LOS		C			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	216	5	45	0	5	5	94	378	0	5	320	222
Future Volume (vph)	216	5	45	0	5	5	94	378	0	5	320	222
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0			6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Frt		1.00	0.85		0.93		1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00		1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1517	1352		1360		1363	1434			1521	1293
Flt Permitted		0.72	1.00		1.00		0.51	1.00			0.99	1.00
Satd. Flow (perm)		1151	1352		1360		738	1434			1513	1293
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	235	5	49	0	5	5	102	411	0	5	348	241
RTOR Reduction (vph)	0	0	33	0	3	0	0	0	0	0	0	129
Lane Group Flow (vph)	0	240	16	0	7	0	102	411	0	0	353	112
Heavy Vehicles (%)	10%	10%	10%	20%	20%	20%	22%	22%	22%	15%	15%	15%
Turn Type	Perm	NA	Perm		NA		Perm	NA		Perm	NA	Perm
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)		20.0	20.0		20.0		28.0	28.0			28.0	28.0
Effective Green, g (s)		20.0	20.0		20.0		28.0	28.0			28.0	28.0
Actuated g/C Ratio		0.33	0.33		0.33		0.47	0.47			0.47	0.47
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0			6.0	6.0
Lane Grp Cap (vph)		383	450		453		344	669			706	603
v/s Ratio Prot					0.00			c0.29				
v/s Ratio Perm		c0.21	0.01				0.14				0.23	0.09
v/c Ratio		0.63	0.04		0.01		0.30	0.61			0.50	0.19
Uniform Delay, d1		16.9	13.5		13.4		9.9	12.0			11.1	9.3
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		7.5	0.2		0.1		2.2	4.2			2.5	0.7
Delay (s)		24.4	13.6		13.5		12.1	16.1			13.7	10.0
Level of Service		C	B		B		B	B			B	B
Approach Delay (s)		22.6			13.5			15.3			12.2	
Approach LOS		C			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	15.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	75.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	308	10	64	0	10	10	124	516	0	10	465	327
Future Volume (vph)	308	10	64	0	10	10	124	516	0	10	465	327
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		6.0	6.0		6.0		6.0	6.0			6.0	6.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Frt		1.00	0.85		0.93		1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00		1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1517	1352		1360		1363	1434			1520	1293
Flt Permitted		0.72	1.00		1.00		0.35	1.00			0.99	1.00
Satd. Flow (perm)		1140	1352		1360		496	1434			1501	1293
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	335	11	70	0	11	11	135	561	0	11	505	355
RTOR Reduction (vph)	0	0	44	0	7	0	0	0	0	0	0	174
Lane Group Flow (vph)	0	346	26	0	15	0	135	561	0	0	516	181
Heavy Vehicles (%)	10%	10%	10%	20%	20%	20%	22%	22%	22%	15%	15%	15%
Turn Type	Perm	NA	Perm		NA		Perm	NA		Perm	NA	Perm
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)		37.0	37.0		37.0		51.0	51.0			51.0	51.0
Effective Green, g (s)		37.0	37.0		37.0		51.0	51.0			51.0	51.0
Actuated g/C Ratio		0.37	0.37		0.37		0.51	0.51			0.51	0.51
Clearance Time (s)		6.0	6.0		6.0		6.0	6.0			6.0	6.0
Lane Grp Cap (vph)		421	500		503		252	731			765	659
v/s Ratio Prot					0.01			c0.39				
v/s Ratio Perm		c0.30	0.02				0.27				0.34	0.14
v/c Ratio		0.82	0.05		0.03		0.54	0.77			0.67	0.27
Uniform Delay, d1		28.5	20.2		20.1		16.5	19.7			18.3	14.0
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		16.4	0.2		0.1		7.9	7.6			4.7	1.0
Delay (s)		44.9	20.4		20.2		24.5	27.3			23.0	15.0
Level of Service		D	C		C		C	C			C	B
Approach Delay (s)		40.8			20.2			26.8			19.8	
Approach LOS		D			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	26.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	97.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	135	105	0	125	40	0
Future Volume (Veh/h)	135	105	0	125	40	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	147	114	0	136	43	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			147		340	204
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			147		340	204
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		93	100
cM capacity (veh/h)			1290		606	775

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	261	136	43
Volume Left	0	0	43
Volume Right	114	0	0
cSH	1700	1290	606
Volume to Capacity	0.15	0.00	0.07
Queue Length 95th (m)	0.0	0.0	1.8
Control Delay (s)	0.0	0.0	11.4
Lane LOS			B
Approach Delay (s)	0.0	0.0	11.4
Approach LOS			B

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	24.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	160	120	0	145	50	0
Future Volume (Veh/h)	160	120	0	145	50	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	174	130	0	158	54	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			174		397	239
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			174		397	239
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		90	100
cM capacity (veh/h)			1260		561	740

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	304	158	54
Volume Left	0	0	54
Volume Right	130	0	0
cSH	1700	1260	561
Volume to Capacity	0.18	0.00	0.10
Queue Length 95th (m)	0.0	0.0	2.5
Control Delay (s)	0.0	0.0	12.1
Lane LOS			B
Approach Delay (s)	0.0	0.0	12.1
Approach LOS			B

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	27.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	195	150	0	180	60	0
Future Volume (Veh/h)	195	150	0	180	60	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	212	163	0	196	65	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			212		490	294
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			212		490	294
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		87	100
cM capacity (veh/h)			1218		494	688

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	375	196	65
Volume Left	0	0	65
Volume Right	163	0	0
cSH	1700	1218	494
Volume to Capacity	0.22	0.00	0.13
Queue Length 95th (m)	0.0	0.0	3.6
Control Delay (s)	0.0	0.0	13.4
Lane LOS			B
Approach Delay (s)	0.0	0.0	13.4
Approach LOS			B

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	31.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	227	178	0	142	56	0
Future Volume (Veh/h)	227	178	0	142	56	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	247	193	0	154	61	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			247		498	344
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			247		498	344
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		88	100
cM capacity (veh/h)			1181		488	644

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	440	154	61
Volume Left	0	0	61
Volume Right	193	0	0
cSH	1700	1181	488
Volume to Capacity	0.26	0.00	0.12
Queue Length 95th (m)	0.0	0.0	3.4
Control Delay (s)	0.0	0.0	13.4
Lane LOS			B
Approach Delay (s)	0.0	0.0	13.4
Approach LOS			B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	34.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	375	302	0	189	93	0
Future Volume (vph)	375	302	0	189	93	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0			6.0	6.0	
Lane Util. Factor	1.00			1.00	1.00	
Frt	0.94			1.00	1.00	
Flt Protected	1.00			1.00	0.95	
Satd. Flow (prot)	1285			1367	1299	
Flt Permitted	1.00			1.00	0.95	
Satd. Flow (perm)	1285			1367	1299	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	408	328	0	205	101	0
RTOR Reduction (vph)	38	0	0	0	0	0
Lane Group Flow (vph)	698	0	0	205	101	0
Heavy Vehicles (%)	28%	28%	28%	28%	28%	28%
Turn Type	NA			NA	Prot	
Protected Phases	4			8	2	
Permitted Phases			8			
Actuated Green, G (s)	45.0			45.0	18.0	
Effective Green, g (s)	45.0			45.0	18.0	
Actuated g/C Ratio	0.60			0.60	0.24	
Clearance Time (s)	6.0			6.0	6.0	
Lane Grp Cap (vph)	771			820	311	
v/s Ratio Prot	c0.54			0.15	c0.08	
v/s Ratio Perm						
v/c Ratio	0.90			0.25	0.32	
Uniform Delay, d1	13.1			7.1	23.5	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	16.1			0.7	2.8	
Delay (s)	29.2			7.8	26.2	
Level of Service	C			A	C	
Approach Delay (s)	29.2			7.8	26.2	
Approach LOS	C			A	C	

Intersection Summary			
HCM 2000 Control Delay	24.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.1%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	473	370	0	235	114	0
Future Volume (vph)	473	370	0	235	114	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0			6.0	6.0	
Lane Util. Factor	0.95			0.95	1.00	
Frt	0.93			1.00	1.00	
Flt Protected	1.00			1.00	0.95	
Satd. Flow (prot)	2427			2598	1299	
Flt Permitted	1.00			1.00	0.95	
Satd. Flow (perm)	2427			2598	1299	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	514	402	0	255	124	0
RTOR Reduction (vph)	241	0	0	0	0	0
Lane Group Flow (vph)	675	0	0	255	124	0
Heavy Vehicles (%)	28%	28%	28%	28%	28%	28%
Turn Type	NA			NA	Prot	
Protected Phases	4			8	2	
Permitted Phases			8			
Actuated Green, G (s)	20.0			20.0	18.0	
Effective Green, g (s)	20.0			20.0	18.0	
Actuated g/C Ratio	0.40			0.40	0.36	
Clearance Time (s)	6.0			6.0	6.0	
Lane Grp Cap (vph)	970			1039	467	
v/s Ratio Prot	c0.28			0.10	c0.10	
v/s Ratio Perm						
v/c Ratio	0.70			0.25	0.27	
Uniform Delay, d1	12.5			10.0	11.3	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	4.1			0.6	1.4	
Delay (s)	16.6			10.5	12.7	
Level of Service	B			B	B	
Approach Delay (s)	16.6			10.5	12.7	
Approach LOS	B			B	B	

Intersection Summary			
HCM 2000 Control Delay	15.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	43.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	90	35	0	115	95	0
Future Volume (Veh/h)	90	35	0	115	95	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	38	0	125	103	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			98		242	117
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			98		242	117
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		85	100
cM capacity (veh/h)			1347		693	869

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	136	125	103
Volume Left	0	0	103
Volume Right	38	0	0
cSH	1700	1347	693
Volume to Capacity	0.08	0.00	0.15
Queue Length 95th (m)	0.0	0.0	4.2
Control Delay (s)	0.0	0.0	11.1
Lane LOS			B
Approach Delay (s)	0.0	0.0	11.1
Approach LOS			B

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	19.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	105	45	0	135	110	0
Future Volume (Veh/h)	105	45	0	135	110	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	114	49	0	147	120	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			114		286	138
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			114		286	138
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		82	100
cM capacity (veh/h)			1328		653	845

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	163	147	120
Volume Left	0	0	120
Volume Right	49	0	0
cSH	1700	1328	653
Volume to Capacity	0.10	0.00	0.18
Queue Length 95th (m)	0.0	0.0	5.3
Control Delay (s)	0.0	0.0	11.7
Lane LOS			B
Approach Delay (s)	0.0	0.0	11.7
Approach LOS			B

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	22.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	125	50	0	165	135	0
Future Volume (Veh/h)	125	50	0	165	135	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	136	54	0	179	147	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			136		342	163
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			136		342	163
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		76	100
cM capacity (veh/h)			1303		605	818

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	190	179	147
Volume Left	0	0	147
Volume Right	54	0	0
cSH	1700	1303	605
Volume to Capacity	0.11	0.00	0.24
Queue Length 95th (m)	0.0	0.0	7.6
Control Delay (s)	0.0	0.0	12.9
Lane LOS			B
Approach Delay (s)	0.0	0.0	12.9
Approach LOS			B

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	25.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	115	57	0	206	166	0
Future Volume (Veh/h)	115	57	0	206	166	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	125	62	0	224	180	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			125		380	156
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			125		380	156
tC, single (s)			4.4		6.7	6.5
tC, 2 stage (s)						
tF (s)			2.5		3.8	3.6
p0 queue free %			100		69	100
cM capacity (veh/h)			1315		574	826

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	187	224	180
Volume Left	0	0	180
Volume Right	62	0	0
cSH	1700	1315	574
Volume to Capacity	0.11	0.00	0.31
Queue Length 95th (m)	0.0	0.0	10.7
Control Delay (s)	0.0	0.0	14.1
Lane LOS			B
Approach Delay (s)	0.0	0.0	14.1
Approach LOS			B

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	28.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	170	105	0	340	281	0
Future Volume (vph)	170	105	0	340	281	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0			6.0	6.0	
Lane Util. Factor	1.00			1.00	1.00	
Frt	0.95			1.00	1.00	
Flt Protected	1.00			1.00	0.95	
Satd. Flow (prot)	1297			1367	1299	
Flt Permitted	1.00			1.00	0.95	
Satd. Flow (perm)	1297			1367	1299	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	185	114	0	370	305	0
RTOR Reduction (vph)	46	0	0	0	0	0
Lane Group Flow (vph)	253	0	0	370	305	0
Heavy Vehicles (%)	28%	28%	28%	28%	28%	28%
Turn Type	NA			NA	Prot	
Protected Phases	4			8	2	
Permitted Phases			8			
Actuated Green, G (s)	18.0			18.0	18.0	
Effective Green, g (s)	18.0			18.0	18.0	
Actuated g/C Ratio	0.38			0.38	0.38	
Clearance Time (s)	6.0			6.0	6.0	
Lane Grp Cap (vph)	486			512	487	
v/s Ratio Prot	0.19			c0.27	c0.23	
v/s Ratio Perm						
v/c Ratio	0.52			0.72	0.63	
Uniform Delay, d1	11.6			12.9	12.3	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	3.9			8.6	6.0	
Delay (s)	15.6			21.4	18.2	
Level of Service	B			C	B	
Approach Delay (s)	15.6			21.4	18.2	
Approach LOS	B			C	B	

Intersection Summary			
HCM 2000 Control Delay	18.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	48.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	46.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	205	127	0	426	340	0
Future Volume (vph)	205	127	0	426	340	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0			6.0	6.0	
Lane Util. Factor	0.95			0.95	1.00	
Frt	0.94			1.00	1.00	
Flt Protected	1.00			1.00	0.95	
Satd. Flow (prot)	2449			2598	1299	
Flt Permitted	1.00			1.00	0.95	
Satd. Flow (perm)	2449			2598	1299	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	223	138	0	463	370	0
RTOR Reduction (vph)	88	0	0	0	0	0
Lane Group Flow (vph)	273	0	0	463	370	0
Heavy Vehicles (%)	28%	28%	28%	28%	28%	28%
Turn Type	NA			NA	Prot	
Protected Phases	4			8	2	
Permitted Phases			8			
Actuated Green, G (s)	18.0			18.0	20.0	
Effective Green, g (s)	18.0			18.0	20.0	
Actuated g/C Ratio	0.36			0.36	0.40	
Clearance Time (s)	6.0			6.0	6.0	
Lane Grp Cap (vph)	881			935	519	
v/s Ratio Prot	0.11			c0.18	c0.28	
v/s Ratio Perm						
v/c Ratio	0.31			0.50	0.71	
Uniform Delay, d1	11.5			12.5	12.6	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	0.9			1.9	8.1	
Delay (s)	12.4			14.3	20.7	
Level of Service	B			B	C	
Approach Delay (s)	12.4			14.3	20.7	
Approach LOS	B			B	C	

Intersection Summary			
HCM 2000 Control Delay	15.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	43.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX D: TECHNICAL MEMO – ENVIRONMENTAL CONSIDERATIONS

A desktop survey of existing information was completed for the East Brandon Industrial Area (EBIA) in order to identify potential land use development constraints associated with environmental, natural resource and hazard area conditions within the project boundaries. The following sections summarize the desktop survey findings and provides recommendations for opportunistic follow-up studies where additional information would provide value. Where relevant, the environmental information pertaining to the EBIA is presented graphically in Figure D-1: Environmental Considerations, which is a duplicate of Figure 7 in the main body of the Secondary Plan.

1.0 SPECIES AT RISK

Federal and provincial legislation provides regulatory protection to species at risk (SAR) and/or listed species (endangered, threatened and species of special concern) and the presence of these species within the EBIA presents a constraint to development that can be addressed through avoidance and/or mitigation. The regulatory protection is afforded through the following legislation:

- Species at Risk Act (SARA), S.C. 2002, c. 29 and regulations administered by Environment and Climate Change Canada (ECCC); and
- The Endangered Species and Ecosystem Act (ESEA), C.C.S.M. c. E111 and regulations administered by Manitoba Sustainable Development (MSD).

In addition to the above, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) acts as an independent advisory panel to the Minister of ECCC to assess the status of wildlife species at risk of extinction. Each of the above sources (SARA, ESEA and COSEWIC) provide a schedule or list of SAR and their status in Canada.

The Manitoba Conservation Data Centre (MB CDC) was consulted in order to identify the location of known SAR within the project area. Field studies to survey the project area were not completed. The results of the database search are summarized in the table below.

Table 1: List of Species at Risk in the East Brandon Industrial Area

Scientific Name	*Cypripedium candidum*	*Lanius ludovicianus excubitorides*	*Calcarius ornatus*	*Anthus spraguei*	*Lithobates pipiens*
Common Name	Small White Lady's-slipper	Loggerhead Shrike	Chestnut-collared Longspur	Sprague's Pipit	Northern Leopard Frog
Type	Plant (orchid)	Animal (bird)	Animal (bird)	Animal (bird)	Reptile (frog)
Provincial Species Rank	S1 - very rare	S1B - very rare, breeding status	S2B - rare, breeding status	S2B - rare breeding status	S4 - widespread, abundant
ESEA Designation	Endangered	Endangered	Endangered	Threatened	
SARA Designation	Endangered	Threatened	Threatened	Threatened	Special Concern

Scientific Name	*Cypripedium candidum*	*Lanius ludovicianus excubitorides*	*Calcarius ornatus*	*Anthus spraguei*	*Lithobates pipiens*
COSEWIC Designation	Threatened	Threatened	Threatened	Threatened	Special Concern
Geographic Location	SE 8-10-18	NW 9-10-18	SE 9-10-18	NE 10-10-18 NW 11-10-18	SE 19-10-18

An explanation of the provincial ranking is provided in the tables below.

Table 2: Manitoba Species Ranking

Rank	Definition
1	Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.
2	Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.
3	Uncommon throughout its range or in the province (21 to 100 occurrences).
4	Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (> 100 occurrences).
5	Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially impossible to eradicate under present conditions.
U	Possibly in peril, but status uncertain; more information needed.

H	Historically known; may be rediscovered.
X	Believed to be extinct; historical records only, continue search.
SNR	A species not ranked. A rank has not yet assigned or the species has not been evaluated.
SNA	A conservation status rank is not applicable to the element.

Table 3: Manitoba Species Ranking Qualifiers

Code	Definition
B	Breeding status of a migratory species. Example: S1B,SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.
N	Non-breeding status of a migratory species. Example: S1B,SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.
Q	Taxonomic questions or problems involved, more information needed; appended to the global rank.
T	Rank for subspecific taxon (subspecies, variety, or population); appended to the global rank for the full species.
#	A modifier to SX or SH; the species has been reintroduced but the population is not yet established.
?	Inexact or uncertain; for numeric ranks, denotes inexactness.

As noted above, five species are known to be present in the EBIA, including one plant, three birds and one reptile. Geographic locations are provided to the quarter section, but not with greater certainty. The locations are conceptually shown in Figure D-1.

Manitoba's recommended set back distances (for birds) are provided below and are based on the level of potential disturbance (low, medium and high). Additional details are provided in the supporting information (Recommended Development Setback Distances from Birds, Manitoba Conservation Data Centre, June 24, 2015).

Table 4: Setback Distances for Birds

Species	Key Wildlife Feature	Restricted Activity Period	Recommended Setback Distance by Disturbance Category
Chestnut-collared Longspur	Nest Site	May 1 - August 15	Low - 100 m Medium - 250 m High - 650 m
Loggerhead Shrike	Nest Site	May 1 - August 15	Low - 100 m Medium - 250 m High - 500 m
Sprague's Pipit	Nest Site	May 1 - August 15	Low - 100 m Medium - 250 m High - 650 m

For birds, disturbance outside the breeding season is preferential to activity within the breeding season (territory establishment to fledged young and abandonment of nesting

territory). Minimal clearing/disturbance of suitable habitat should be employed during and even outside the breeding season. Any suitable habitat unavoidably disturbed should be reclaimed and/or rehabilitated as soon as possible. Nest sites may be difficult to observe without disturbing breeding birds; therefore, determining the main home range, territory and/or song perches through low-intensity surveys may be required to establish the approximate location of nests. Setback distances should be applied to these approximate locations.

When species are present in or near a project area, a project proponent should develop an Environmental Protection Plan (EPP) for review by MB CDC. The EPP would describe the project, timeline, location and wildlife values in the project area, including SAR. The EPP would also identify the potential impacts to wildlife values and SAR and propose impact mitigation and management measures to avoid or manage the impacts, including reclamation and/or rehabilitation.

An opportunity exists for the City of Brandon to conduct a biophysical study of the entire EBIA, or for key prioritized areas that will be developed first, if these areas are near the location of the SAR listed above. Completion of a biophysical study to pre-screen the development areas would serve to confirm the presence and location of SAR and to develop an initial EPP that would guide development, establish appropriate setback distances, and identify mitigation measures as required. Completion of this study by the City of Brandon would remove the burden for individual proponents to complete these studies on a site-specific basis when developing near an identified SAR location.

2.0 GROUNDWATER

The primary aquifer underlying the EBIA is referred to as the Brandon Channel Aquifer (BCA). The licensed industrial groundwater users in the EBIA withdraw water from the BCA. The BCA is also overlain by a shallow aquifer found within coarse grained soils. This aquifer is generally not suitable for industrial use due to limited recovery and quality. The porous nature of the soils over the BCA makes it susceptible to contamination from sources such as sewage, petroleum products, fertilizers, manure, and pesticides. The capacity of the aquifer is not fully defined; however, it is understood to be approaching its sustainable limit. Allocations for new users are not expected to be easy to obtain due to the limited capacity; therefore, groundwater is not anticipated to be a feasible industrial water source for new developments in unserviced areas.

Detailed information on the aquifer use in the EBIA is provided in the City of Brandon Water Utility Master Plan prepared by AECOM (dated October 2015), which also included a technical report titled Potential Groundwater Supply Option Review (prepared by W.L. Gibbons & Associates Inc.). Recent consultation with Mr. Steve Wiecek, P.Eng., Senior Hydrogeologist with W.L. Gibbons, confirmed that the availability of additional groundwater from the BCA at this stage is unknown and suspected to be limited at best. Mr. Wiecek indicated that a task force consisting of the City of Brandon and existing industrial users has been formed and is investigating the availability and management of BCA groundwater resource. As such, the availability of groundwater for new industrial users is uncertain and cannot be assumed to be available.

It is also noted that the City of Brandon has been investigating the installation of new groundwater supply wells to add to the potable water supply system. Potential locations for these wells have included the BCA in the EBIA area, as well as the Assiniboine Delta Aquifer (ADA) and Assiniboine River Valley Aquifer (ARVA) located directly adjacent to the EBIA and interconnected with the BCA. The City currently pumps from two wells in the ARVA to supplement the surface water supply from the Assiniboine River.

Planning activities associated with the City's potable water supply should be integrated with the EBIA planning process in order to ensure current and future industrial use in the EBIA is protected to the extent possible.

9.1.1 Groundwater Wells

The water well drillers database maintained by Manitoba Sustainable Development was consulted to obtain a listing of recorded water wells within the EBIA. More than 215 records were returned for the EBIA, with the wells listed by quarter section. A large number of records were for monitoring wells, observation wells and test wells in the area.

As noted above, it is assumed that no new large-scale water use is available from the BCA as long as the existing users continue to withdraw water and hold their existing licenses. Should a current licensed user no longer require their allocation, the currently licensed use can be purchased and transferred to a new user.

9.2.2 Disposal Wells

The geographic information system map database maintained by Manitoba Growth, Energy and Trade was consulted to identify infrastructure in the EBIA associated with deep injection well disposal and industrial water use. The database contained the following records for industrial users in the EBIA and the locations are shown in Figure D-1: Environmental Considerations.

- Salt water disposal well (License 4705) registered to Koch Fertilizer Group, with the well located at 6-18-10-18 W1M;
- Salt water disposal well (License 4704) registered to Koch Fertilizer Group, with the well located at 2-17-10-18 W1M;
- Abandoned salt water disposal well (License 4206) registered to CXY Chemicals Canada Limited Partnership, with the well located at 16-10-10-18 W1M;
- Salt water disposal well (License 4198) registered to Chemtrade Electrochem Inc., with the well located at 16-10-10-18 W1M;
- Abandoned water supply well (License 2231) registered to Canadian Occidental Petroleum Ltd., with the well located at 16-10-10-18 W1M; and
- Salt water disposal well (License 10548) registered to Canexus Corporation, with the well located at 09-10-10-18 W1M.

These records indicate that the bedrock below the BCA (isolated from the BCA) is being used by the large-scale industrial land owners in the EBIA for disposal of brine (salt water)

from industrial processes. The Petroleum Branch (under Manitoba Growth, Energy and Trade) administers the licensing of disposal wells in the bedrock formations.

3.0 HERITAGE RESOURCES

Manitoba Heritage Resources Branch (MB HRB) was consulted to identify the location of known historic resources within the EBIA, including a description of the features and requirement to complete a Heritage Resource Impact Assessment (HRIA) and/or field survey prior to development. The HRIA would require field testing to identify artifacts. The field study would include a pedestrian ground survey with subsurface testing where artifacts are located/recovered on the surface.

The potential for resources to be present was reported for all quarter sections within the EBIA with the exception of NW 17-10-18 and NE 7-10-18. A summary of the findings is provided below.

Table 4: Heritage Resource Locations in the East Brandon Industrial Area

Quarter	Section	Township	Range	Feature	Recommendation
SW	22	10	18	Assiniboine River, southern edge is treed and cultivated	HRIA Required
NW	21	10	18	Assiniboine River, cultivated and treed	HRIA required
SW	21	10	18	Assiniboine River, cultivated and treed. Southern portion has been disturbed.	HRIA required
SE	21	10	18	Assiniboine River. Treed river bank	HRIA required

Quarter	Section	Township	Range	Feature	Recommendation
SW	20	10	18	Assiniboine River, Rapids, Archaeological Site. Manitoba Hydro/Brandon Generating Station	HRIA required
SE	20	10	18	Assiniboine River, Archaeological Site. Cultivated northern portion and disturbed southern portion	HRIA required
SW	19	10	18	Assiniboine River. Previously disturbed in some areas	HRIA required
SE	19	10	18	Assiniboine River. Previously disturbed in some areas. Transmission lines.	HRIA required
NW	18	10	18	Disturbed by previous development in some areas. Cultivated	Field survey depending on type of development
NE	18	10	18	Disturbed northern half. Cultivated southern half.	Field survey in southern half depending on type of development
SW	18	10	18	Disturbed northern half. Cultivated southern half. Trail to Brandon House close to southern portion.	Field survey in southern half depending on type of development
SE	18	10	18	Disturbed in NW with wastewater lagoons and rail line. Remaining area is cultivated	Field survey depending on type of development
NW	17	10	18	Highly impacted with development. Transmission lines.	No Concerns
NE	17	10	18	Multiple waterbodies/creeks in marsh area. Rail line, cultivated, disturbed in northeast corner	Field survey depending on type of development
SW	17	10	18	Drainage, rail line and cultivated.	Field survey depending on type of development

Quarter	Section	Township	Range	Feature	Recommendation
SE	17	10	18	Rail line, wastewater lagoons and sports field. Relic water channels and active prairie pothole	Field survey depending on type of development
NW	16	10	18	Highly disturbed by previous development, rail line. Active waterbody in marsh area.	NW and SE corners may require field survey depending on type of development
NE	16	10	18	Close proximity to the Assiniboine River. Rail line. Small waterbodies in marsh area	Field survey depending on type of development
SW	16	10	18	Large waterbody/marsh area	Field survey required
SE	16	10	18	Archaeological Site. Disturbed by previous development.	Field survey required
NW	15	10	18	Assiniboine River. Cultivated field. Rail line	HRIA required
NE	15	10	18	Assiniboine River. Cultivated field.	HRIA required
SW	15	10	18	Cultivated field. Rail line.	Field survey depending on type of development
SE	15	10	18	Assiniboine River. Archaeological site. Cultivated. Rail line.	HRIA required
SW	14	10	18	Assiniboine River. Archaeological Site.	HRIA required
NE	12	10	19	Disturbed by previous development.	Field survey depending on type of development in the SW portion
SE	12	10	19	Cultivated field.	Field survey depending on type of development
NW	7	10	18	Trail to Brandon House runs through. Small waterbodies/marsh land. Rail line.	HRIA required

Quarter	Section	Township	Range	Feature	Recommendation
NE	7	10	18	Disturbed with previous development and rail line	No Concerns
SW	7	10	18	Trail to Brandon House runs through. Marsh area, cultivated?	HRIA required
SE	7	10	18	Previously disturbed by development. Marsh area in north. Cultivated in south.	Field survey depending on type of development
NW	8	10	18	Previously disturbed by development in some sections. Marsh area in north. Rail line. Cultivated in south.	Field survey depending on type of development
NE	8	10	18	Pasture land? Rail line.	Field survey depending on type of development
SW	8	10	18	Cultivated and pasture. Some disturbance from previous development.	Field survey depending on type of development
SE	8	10	18	Relic and active creek channels. Marshland. Rail line.	Field survey depending on type of development
NW	9	10	18	Previously disturbed by development in northern portion.	Field survey depending on type of development in southern portion
NE	9	10	18	Marsh area. Relic channels	Field survey depending on type of development
SW	9	10	18	Previously disturbed in NW portion. Pasture field?	Field survey depending on type of development
SE	9	10	18	Previously disturbed in NE portion. Pasture field?	Field survey depending on type of development
NW	10	10	18	Previously disturbed in portions	Field survey depending on type of development
NE	10	10	18	Archaeological site. Close proximity to Assiniboine River. Previously disturbed by development in northern portion.	Field survey depending on type of development in southern portion

Quarter	Section	Township	Range	Feature	Recommendation
SW	10	10	18	Previously disturbed by development. Rail line.	Field survey depending on type of development in eastern and SW portions
SE	10	10	18	Previously disturbed by development. Rail line.	Field survey depending on type of development in northern portion
NW	11	10	18	Archaeological site. Assiniboine River. Rail line. Disturbed by previous development.	HRIA required for development along the riverbank
NE	11	10	18	Assiniboine River. Peninsula. Pasture?	HRIA required
SW	11	10	18	Disturbed by previous development in the northern portion. Rail line.	Field survey required for the southern portion
SE	11	10	18	Assiniboine River. Creek channels. Historic Settlement across river. Rail line. Cultivated.	HRIA required

An opportunity exists for the City of Brandon to conduct the HRIA and/or field study for the entire EBIA, or for key prioritized areas that will be developed first. Completion of the HRIA/field study to pre-screen the development areas would serve to confirm the presence and location of heritage resources, recover artifacts prior to development and identify mitigation measures that would guide development. Completion of this study by the City of Brandon would remove the burden for individual proponents to complete these studies on a site-specific basis when developing property identified to have potential heritage resources (all but two quarter sections in the EBIA).

One additional historical feature was identified and consists of an old rail bridge pier located in the Assiniboine River. This feature is described by the Manitoba Historical Society (MHS) as a massive concrete pier in the centre of the Assiniboine River that was constructed by the Grand Trunk Pacific Railway in the early 20th century as part of its planned spur line from Justice to Brandon. The line was never completed and the bridge was demolished in 1024. Large abutments are also still present on the riverbanks and the right-of-way extending east is still visible in places. Photographs provided by MHS are reproduced below. The location of the site is shown in Figure D-1.

Photo 3.1: Aerial view of the Grand Trunk Pacific railway bridge pier in the centre of the Assiniboine River (source: Gordon Goldsborough, from MHS). Date of photos: April 2017.

Photo 3.2: Grand Trunk Pacific railway abutment on the south bank of the Assiniboine River (source: Gordon Goldsborough, from MHS). Date of photo: April 2017.

Photo 3.3: Grand Trunk Pacific railway bridge pier in the centre of the Assiniboine River (source Tom Mitchell from MHS). Date of photo: 2016.

The historic site may present an opportunity for development of a rest area/greenspace with appropriate signage describing the feature. Access could be considered by active transportation (river trail) or by vehicle, from Victoria Avenue East.

4.0 METHANE

The City of Brandon has mapped the location of current and former landfills in order to identify areas within the City that require monitoring and/or mitigation for methane, which can be generated by the decomposition of waste materials. The City of Brandon has also prepared a Methane Gas Site Policy (Policy Number 1004, effective date October 1, 2015). The purpose of the policy is to:

- Establish methane risk zones and develop a procedure to determine the existence of methane gas and the boundaries of current and former landfill sites which are producing or may produce methane gas;
- Formalize requirements and criteria for development within each zone; and,
- Ensure continuous monitoring of established zones is undertaken to recognize and deal with any generation or migration of methane gas.

The policy lists four zones with varying restrictions imposed on development:

- Zone 1 - the former or current landfill. No new enclosed permanent structures permitted and no new paved parking permitted;
- Zone 2 - located from 0 to 75 m from the outer perimeter of the landfill. New development requires a methane report (test probes, integrated floor probes and permanent monitoring wells) and methane migration prevention measures (impermeable barriers). Site improvements must ensure generation and migration

of methane is controlled. If the redevelopment value exceeds 50% of the existing value, the entire structure must conform; otherwise, only the improvement must conform;

- Zone 3 - located from 75 to 150 m from the outer perimeter of the landfill. New development requires open test hole, soil testing and engineering report. If methane is present, the measures for Zone 2 must be applied. If no methane is present, no permanent monitoring wells are required; however, floor probes must be installed. If the redevelopment value exceeds 50% of the existing value, the entire structure must conform; otherwise, only the improvement must conform. The developer must save harmless the City of Brandon; and,
- Zone 4 - located from 150 to 400 m from the outer perimeter of the landfill. Development is at the discretion of the developer.

In addition, Manitoba Sustainable Development (MSD) has prepared a policy with respect to construction of buildings within 400 m of an active or abandoned landfill (Construction of Buildings on or within 400 m of a Landfill, Policy Number PO-18-1926-14, effective date October 23, 2014 and revised May 11, 2016). The purpose is to establish consistent policy across the province with respect to approval of construction of a building on or within 400 m of a landfill. Existing buildings located within 400 m of a landfill will not receive a variance after the fact. The policy is specific to sites seeking approval in conjunction with a new subdivision and the policy only applies to Section 45 of the Waste Management Facilities Regulation 37/2016.

Anyone wishing to develop within 400 m of the property line of a landfill must request a variance from the Director (MSD) that includes an engineering report and risk assessment, including mitigation measures to address any methane gas present.

Three methane gas sites have been identified in the EBIA as shown in Figure D-1. These include:

1. Current Eastview Landfill operated by the City of Brandon and identified as P-11;
2. Former landfill at the northwest corner of PTH 110 and 17th Street East and identified as P-9; and
3. Former landfill at the southeast corner of Patricia Avenue and 33rd Street East and identified as P-10

The sites are shown on the map with the prescribed setback distances associated with the four zones contained within the City of Brandon policy. Development within these zones is subject to the requirements of the policy.

5.0 CONTAMINATED AND IMPACTED SITES

Manitoba Sustainable Development (MSD) maintains a database of sites associated with the administration of the Contaminated Sites Remediation Act, C.C.S.M. c. C205 (CSRA) and the Contaminated Sites Remediation Regulation 105/97, last amended MR 94/2014 (CSRR). There are currently three site classifications used:

- Contaminated site - a site designed under the CSRA (Section 7(1)) which is contaminated at a level which poses a threat to human health or safety or to the environment;
- Impacted site - a site designed under the CSRA (Section 7(2)) which is contaminated at a level that may pose a threat to human health or safety or to the environment; and,
- Listed site - a site where some type of information has been submitted to MSD and a file has been created. These can include sites where the impacts do not pose a concern, remediation has been completed, or further action is necessary.

The database listings for each of the three classifications were reviewed to identify sites within the EBIA. The results are summarized in Table 5, below, and the location for each site is illustrated in Figure D-1.

Table 5: Impacted / Listed Sites in the East Brandon Industrial Area

Name	Address	File Number	Classification
Canadian Oxy Industrial Chemicals (Former)	8080 Richmond Avenue East (NE 10-10-18)	19211	Impacted Site
Zenith Paving Ltd.	3000 Victoria Avenue East	64200	Impacted Site
Manitoba Hydro Former Hillside Substation #2684	2705 Victoria Avenue East	51754	Listed Site
Ayerst Organics	720 17th Street East	19081	Listed Site
Wesman Salvage	855 49th Street East	19140	Listed Site
Maple Leaf Pork	6355 Richmond Avenue East	19210	Listed Site
Manitoba Hydro	3305 Victoria Avenue East	1922	Listed Site

Additional contaminated or impacted sites may be present in the EBIA that are not currently identified. The presence of contaminated and/or impacted sites within the EBIA may constrain site development and some servicing (if contamination extends to areas required for underground utilities), until remediation and/or risk management of the sites is completed. Under the CSRA, owner/occupiers of sites identified as contaminated or impacted are required to prepare and implement remediation/risk management plans.

Feb. 2016

City of Brandon

Industrial Land Development Forecast (East Brandon Industrial Area)

Prepared by:
RW Consulting
2211 Cameron St,
Regina Sk S4T 2V9

(306) 961-2879
Robwoodward@sasktel.net

02/20/2016

TABLE OF CONTENTS

Executive Summary 3
Scope of Work 5
Methodology 6
Brandon's East Area Industrial Park 7
External Factors Affecting Location Decisions 9
Economic and Industrial Land Forecasting 10
- The Base Case Forecast 10
- The High Growth Forecast 14
- Determining Industrial Land Requirements 18
- Projected Industrial Land Requirements 19
- Brandon's Land Requirement Context 20

Location Identification 21
- The Mapping Process 21
- Wetland Constraints 22
- Topography Constraints 22
- Gravel / Aggregate Deposits 22
- Groundwater Stewardship 22
- Methane-Emitting Sites 23
- Manitoba Hydro – Long Term Power Supply 23

Municipal Water and Wastewater Infrastructure 24
Development Nodes 26
- Richmond Avenue Industrial Node 27
- Victoria Avenue Manufacturing Node 29
- PTH 110 & Richmond Avenue Industrial Node 31
- Property East of Maple Leaf Foods 32

Resulting Actions 34
- Ensuring Adequate Supplies of Serviced Lands 34
- "Team Brandon" Strategic Marketing 35

References 36

EXECUTIVE SUMMARY

Projected demand for industrial land in Brandon will range from a minimum of 193 to approximately 237 acres (78-96ha) between 2015 and 2045. This is based upon a 'base case' and a 'high growth' economic growth scenario for the City and the Region. All of this growth is anticipated to occur in the East Brandon Industrial Area, as it is zoned to support this type of development. The successful attraction and development of several new anchor tenants within the East Brandon Industrial Area would spur growth beyond 'base case' growth assumptions and support a 'high growth' approach to providing industrial lands.

The East Brandon Industrial Area is large, diverse and relatively unique. It has more than enough land to accommodate logical and progressive growth as identified in this report and can continue to be a growth pole for the City and south west Manitoba overall. But development may be challenging. Topographical constraints limit development locations and the dispersed nature of current industry increases infrastructure/servicing costs.

A key long term consideration will be ensuring an appropriate amount of land is serviced and ready to support continued industrial growth. Several locations are proposed for site specific analysis and development. Today the City owns relatively little developable land at these locations that could be the base for a land development process. Discussion with current landowners needs to continue to confirm their interest in participating in a development process. This discussion will confirm whether a partnership approach can be established and how the City would involve itself in a land assembly process.

Today the East Brandon Industrial Area exceeds 6,100 acres (2,469ha). The area itself is approximately 2.5 miles by 5.0 miles in size, and offers a wide range of industrial growth opportunities. To capitalize on these opportunities and to further develop the area in a logical, stepwise manner, the following locations are proposed for specific attention as nodes of industrial development within the area itself:

1. Continued expansion of the "Richmond Avenue Industrial Node", in the very southwest portion of the study region.
2. Focusing industrial growth along Victoria Ave, between 17th St E and Hastings Street.
3. Continued development of the industrial base at the corner of Richmond Avenue and PTH110, beginning in the southeast area.
4. Attraction of larger industrial users requiring larger land areas on a corporate-specific basis. Unique development agreements would prompt investment of this scale. The property directly east of the Maple Leaf Foods processing facility is proposed as the point of initial focus for this type of development. Lands to the south of Maple Leaf Foods holds longer term potential following utilization of the lands to the east.

The total land area identified in the four development nodes is more than adequate to meet the City's projected land requirements during the study period, but servicing challenges remain. City

growth can be best achieved by having the greatest possible range of industrial lands on the market, balanced by the cost, size, level of service and impacts. Differing needs by sector, combined with an anticipated desire to provide a variety of sized parcels in different areas to suit specific development interests supports identification of several development nodes. Further site-specific analysis can provide the next level of detail to define servicing requirements and create a long term growth plan specific to City interest.

SCOPE OF WORK

The City of Brandon required a market analysis and a development forecast to assist in establishing a planning framework to promote economic growth. Work included the collection and analysis of data for a market analysis that identifies key issues, trends and priorities regarding the market condition in Brandon. The result of the analysis helped establish a development forecast on the future development potential for the East Industrial Area in Brandon. The goal of the market analysis and development forecast is to provide the City a market projection on the demand and the development potential within the region. This will help guide infrastructure investment and the development framework for future activities in the Area.

Overall objectives:

- A logical plan for City investment is required to support industrial growth. It will inform the decision making process of the opportunities linked to infrastructure investment. There is a need to define the plan to attract industry rather than the converse – waiting for industry to come and ask what lands are available.

- An industrial development forecast is required that will link future economic development initiatives to the competitive strengths of the City and the anchor tenants of the Area.

- The industrial area has ample land, but much of it is un-serviced, held in corporate reserve, or unusable without significant investment effort, time, and money (marsh, former gravel sites, topographically challenging, etc.). A geographic determination of the land currently available and ready for development is needed, along with an assessment of infrastructure requirements to bring specific sites up to a 'development ready' condition.

METHODOLOGY

Cities face an ongoing challenge of matching infrastructure investment with long term community growth. In particular, a City must be ready and able to respond to industrial demands for fully serviced and provisioned land to support active development. Provision of serviced land is a key determinant of any industrial location decision process; availability can be a key competitive advantage.

This report provides a long term demand forecast for industrial land in Brandon, with particular focus on Brandon's East Industrial Area. This was achieved by bringing together information from three broad sources.

1. Forecast modelling
    a. A customized economic forecast model was created. It was developed using regional employment by industry to estimate regional output, a community hierarchy model to assess regional trade flows and leakages, and a re-balancing to ensure model cohesiveness.
    b. Industrial land requirements were drawn from the data. Businesses that would locate in the industrial area were separated from those that may locate into other areas of the City. A land area footprint linked employment projections to land requirements; footprint ratios were drawn from similar work in other Canadian cities.

2. Analysis of emerging economic, business, or policy trends that hold competitive development potential for the City.
    a. An assessment of emerging opportunities that may not now exist in Brandon was undertaken. This strategic-level assessment reviewed emerging (external) opportunities that would derive a competitive advantage from locating in Brandon. By way of example, recent federal announcements confirm a renewed interest in climate mitigation and the bio-economy; Brandon with its large agricultural resources, supply base from the Municipal landfill and potentially from current Brandon companies, is well positioned to attract industries in this sector.
    b. Work focussed on secondary research, with information provided from public resources, follow up discussions with industry associations and key informant interviews with senior official working in the targeted industry sectors.
    c. A summary discussion of potential opportunities was prepared. This included the competitive rational, potential links to existing businesses, broad benefits, key infrastructure requirements, and other. A broad assessment of land area requirements was generated. Where appropriate these potentials were fed back into the forecast model to 'shock' the output to identify City benefits.

3. Supply chain opportunity identification – discussion with current businesses.
    a. A sampling of tenants in the industrial area were contacted. A brief meeting drew out potential supply chain opportunities that would benefit the current tenant if they were attracted to Brandon. This also served to identify current challenges to investment and development within the industrial area.

A growth forecast for the City for industrial land was generated.

Findings from above were correlated with industrial land availability to ensure there is adequate, appropriately serviced land to meet the long term demand forecast. A detailed understanding of the existing industrial land with development potential was created.

1. A 'net back' process was employed to identify lands available for development. City-provided data confirmed that 1,664 (674ha) of the 6,191 (2505ha) acres hold development potential, with 1,132 (458ha) available for sale now and in the future. The region was mapped to identify currently developed properties, wetlands, challenging topography (steep, etc.), buffer areas, lands held in corporate reserve, or environmentally sensitive sites (e.g. flood plains, wetlands).

2. Specific locations for investment and development were identified.

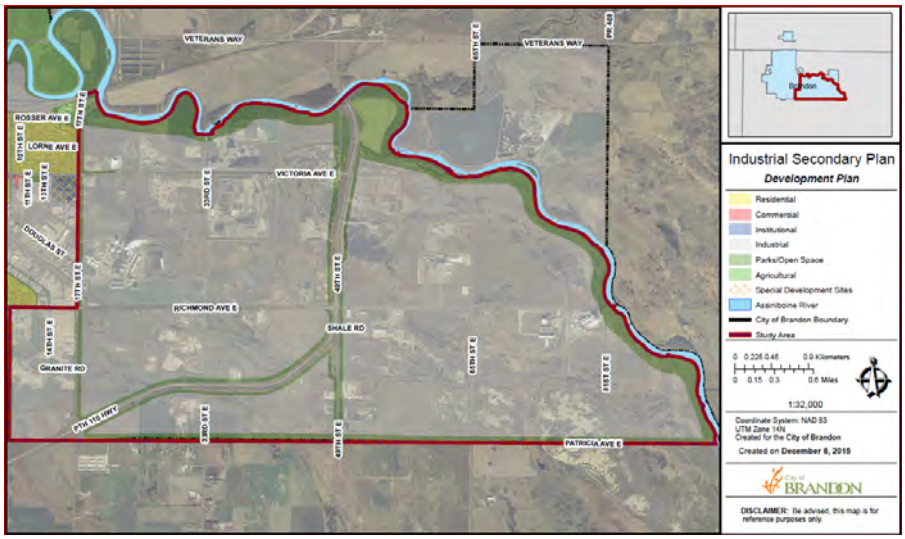
3. Current infrastructure was assessed relative to the specific locations. Gaps between existing infrastructure and developable areas were identified.

4. Areas with specific development potential were identified.

A long term projection of land required to support the growth projected through the modelling exercise then was developed and linked to the potential development sites.

BRANDON'S EAST AREA INDUSTRIAL PARK

The East Brandon Industrial Area comprises all of the lands on the 'eastern edge' edge of the City. This is a large area of approximately 6,191 acres (2,505ha), bounded to the east and north by the Assiniboine River, to the south by Patricia Avenue and to the west by 17th St E south to Richmond Ave, west to Douglas St then extending south and intersecting with Patricia Avenue. At its greatest extent it extends approximately 5.0 miles (8.1km) east/west and 2.5 (4.0km) miles north / south.



The region is home to heavy industry, oil service companies, metal processing and chemical manufacture firms, to name a few. It also houses the Brandon municipal landfill and a Manitoba

Hydro gas/coal-fired electric generating station. In addition, much of the property is underlain with significant gravel deposits, many of which have been developed.

The industrial region is diverse. Over 50 different owners hold property in the region. Eighteen different groups own more than 100 acres (40.5ha) each, with 9 owning more than 200 acres (81ha) and five own more than 400 acres (162ha). The top landowners are identified in the accompanying table. Many of the properties and land holdings are fully developed, are held in corporate reserve or are not easily developed – lowlands, wetlands or steep topography. For example, the City is a large land owner with relatively little developable area. When one accounts for the municipal landfill, wastewater treatment facilities, gravel deposits and developed sites, there is little if any City-owned land that could be developed.

Owner	Acres	Hectares
City of Brandon	887	359
Koch Fertilizer Canada	729	295
All West Gravel Ltd.	440	178
Tri-Wave Construction Ltd.	420	170
MB Hydro	400	162
Viterra Inc.	295	119
Michael Hudzik	271	110
Maple Leaf Foods Inc.	243	98
Terra International (Canada) Inc.	215	87

The region is zoned to promote long term industrial development. Lands not already designated as one of three major industrial land uses (MR; Industrial Restricted, MG; Industrial General, MH; Industrial Heavy) are largely classified as DR Development Reserve or classed as Open Space (OS) along the Assiniboine Ricer and select areas along PTH110.

Unlike many industrial areas in cities of similar size, Brandon's East Industrial Area has not been developed in a phased process. As will be described later, topographical and man-made constraints have created servicing challenges:

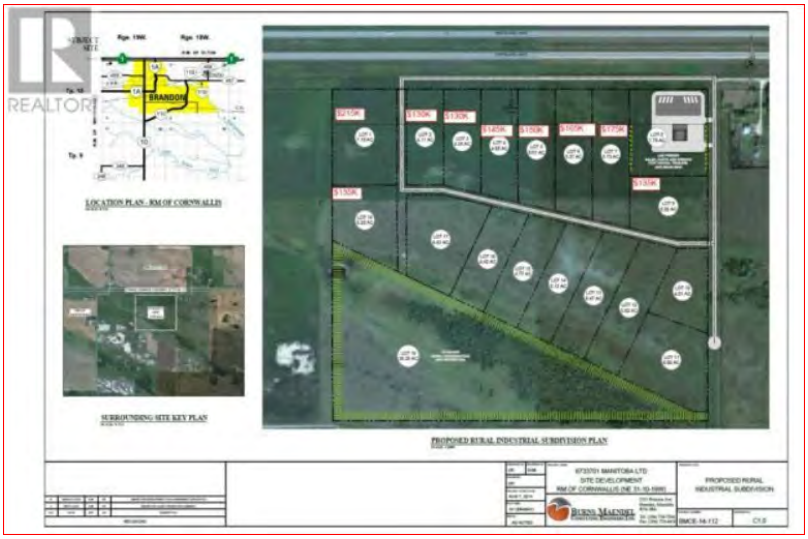
- Much of the area is underlain with gravel deposits. A series of active, unused and potential gravel pits dot the area, particularly along its southern border.
- There are significant wetlands. Two major drainages exit. Additional low and wetlands exist along the Assiniboine River.
- An area of steeper topography bisects the area, beginning at its northwest corner.
- Current industrial sites are widely dispersed. Some companies maintain significant buffer areas around their facilities. Significant areas are held corporately as development reserve.

The combined effect of this growth is dispersed development. This in turn has created infrastructure challenges, for new services must extend across areas of little or no activity. This increases the overall development cost to the City and ultimately to the end user.

EXTERNAL FACTORS AFFECTING LOCATION DECISIONS

Currently the East Brandon Industrial Area is the focus for industrial development in the Brandon region. Smaller industrial areas exist within the City, but by and large are fully developed. The City's airport property to the north is zoned MG- Industrial General, and could act as a growth pole for future transport-reliant businesses. Likewise, several businesses have been established in the rural municipality between the City and the airport. The Southview Industrial Park also exists in the RM of Cornwallis, directly south of the City limits along 17th St E, and is home to warehousing and storage facilities.

In addition, a survey of property listings (Royal LePage) indicates that a potential industrial development along Highway #1, centred on the property: NE 31-10-19WPM has been proposed.



This area is approximately 160 acres (64.7ha) in size. 18 lots have been proposed for development, with sizes ranging from ~4 acres to ~8 acres (1.6-3.2ha). A review of the mapping detail provided shows that the southwest portion of the property is not proposed for development at this time.

The proponents have approached the RM of Cornwallis with a Development Plan Amendment Application to change the current zoning from "Agricultural" to "Rural Industrial" to accommodate the planned development. The application for change currently is being considered by the Minister of Municipal Government.

In November 2014 the NE corner of the property (~8 acres/3.2ha) was granted Conditional Use for use as a rural resource industry, with intent to establish a service centre for trucks, trailers and grain bins[1]. This aligns with the business profile that is proposed for the area – namely agriculture service, truck sales/service and light manufacturing. Material provided confirm that no plans are in place to provide servicing beyond the internal road network. No water servicing is envisaged, so an alternate water provision and fire response would need to be provided.

If this project moves forward its highway proximity and relative closeness to the oil industry would create a new industrial growth pole. It would attract industrial businesses away from the East Industrial Area, particularly the transport/service industry that perceive additional benefits of a highway location. The PTH110/Richmond development node would be impacted, as it is minimally serviced and has similar lot similar lot sizes. It also would erode the City's ability to deliver services to the East Industrial Area, as development timelines would be extended.

[1] BAPD (2015), Application for an Amendment to Development Plan, NE 31-10-19WPM

2015 to 2045 year projections for Brandon were undertaken by developing a customized economic model for the City and Region. The model is based upon a regional share of the latest Manitoba provincial input-output model (2011 at project initiation). While the provincial model is rectangular in nature with 35 industries and 66 commodities and is based on the latest available Statistics Canada's Manitoba Input-Output tables, data limitations necessitated aggregation to the 25 industry level.

Two forecasts were developed. The first 'base case' was built from Manitoba input output tables, using regional employment by industry to estimate regional output, a community hierarchy model to assess regional trade flows and leakages, and re-balancing to ensure model cohesiveness. A 'high growth' projection then was developed using a series of potential major investments that could come to the East Brandon Industrial Area over the next 30 years. These major investments then were fed into the base case projection to determine the impact that these major investments would have on the economy overall, assess spinoff benefits to the City and to identify additional land requirements within the region.

Industry detail for the Brandon Economic Model is presented below. It should be noted that the Brandon Region does not contain Forestry and Logging and Fishing, Hunting and Trapping activity and the following industries are "fictive", represent margins and do not have associated employment. As such, these 5 industries are excluded from the detailed forecast process.

Crop and Animal Production
Forestry and Logging
Fishing, Hunting and Trapping
Support Activities for Agriculture and forestry
Mining and Oil and Gas Extraction
Utilities
Construction
Manufacturing
Wholesale Trade
Retail Trade
Transportation and Warehousing
Information and Cultural Industries
Finance, Insurance, Real Estate and Rental and Leasing
Professional, Scientific and Technical Services
Administrative and Support, Waste Management and Remediation Services
Educational Services
Health Care and Social Assistance
Arts, Entertainment and Recreation
Accommodation and Food Services
Other Services (Except Public Administration)
Operating, Office, Cafeteria and Laboratory Supplies
Travel, Entertainment, Advertising and Promotion
Transportation Margins
Non-Profit Institutions Serving Households
Government Sector

THE BASE CASE FORECAST

Under the Base Case Forecast, employment and GDP growth is expected to mirror the growth rate of the previous decade. It was first necessary to inflate the 2011 Brandon input-output tables to 2015 levels. This was accomplished using the Manitoba current dollar gross output 10 year average rate of change (5.05%) for gross output and gross domestic product. The latest Statistics Canada labour force survey for Brandon was employed for employment by industry for 2014. 2015 was estimated using the industry employment growth rates for Statistics Canada's South West Manitoba Economic Region. The Manitoba current dollar gross output 10 year average rate of change (5.05%) was used to project the Brandon tables to 2045 in current dollars. Statistics Canada's Manitoba

industry deflators (current dollar GDP divided by constant dollar GDP) were utilized to convert Brandon current dollar GDP to constant dollar GDP. The rate of change in each industry deflator for the latest 5 years was used to project the deflators to 2045. Employment by industry was estimated by constructing a simple production function for each industry. Constant dollar GDP by industry was regressed against employment by industry. Efficiency gains were in labour were estimated by examining the relationship between constant dollar GDP (volume) and employment. Improvements in labour productivity over the previous 10 years were assumed to continue at the same annual rate for the next 30 years. The base case forecast results are presented below:

Constant Dollar Gross Domestic Product By Industry (2007 $M) – Base Case Forecast

	2015	2020	2025	2030	2035	2040	2045
Crop and Animal Production	40	42	40	42	40	43	41
Forestry and Logging	0	0	0	0	0	0	0
Fishing, Hunting and Trapping	0	0	0	0	0	0	0
Support Activities for Agriculture and Forestry	0	0	1	1	1	1	1
Mining and Oil and Gas Extraction	152	175	201	231	265	305	350
Utilities	61	70	79	89	100	114	128
Construction	164	207	262	331	419	529	669
Manufacturing	297	331	368	410	457	509	567
Wholesale Trade	113	138	167	204	248	302	367
Retail Trade	203	244	294	354	427	514	619
Transportation and Warehousing	102	124	150	183	223	271	330
Information and Cultural Industries	120	144	174	209	252	303	364
Finance, Insurance, Real Estate and Rental and Leasing	354	430	524	637	776	944	1149
Professional, Scientific and Technical Services	57	66	77	89	104	121	141
Administrative and Support, Waste Management and Remediation Services	35	40	45	51	57	64	72
Educational Services	3	3	4	5	5	6	7
Health Care and Social Assistance	64	87	95	130	142	194	213
Arts, Entertainment and Recreation	16	18	21	23	26	30	34
Accommodation and Food Services	61	75	92	114	141	174	214
Other Services (Except Public Administration)	22	25	28	32	36	41	46
Operating, Office, Cafeteria and Laboratory Supplies	0	0	0	0	0	0	0
Travel, Entertainment, Advertising and Promotion	0	0	0	0	0	0	0
Transportation Margins	0	0	0	0	0	0	0
Non-Profit Institutions Serving Households	29	33	38	42	48	54	61
Government Sector	776	907	1060	1239	1448	1693	1979
Total	**2668**	**3159**	**3719**	**4416**	**5215**	**6210**	**7353**

Employment By Industry – Base Case Forecast

	2015	2020	2025	2030	2035	2040	2045
Crop and Animal Production	668	503	308	339	352	354	356
Forestry and Logging	0	0	0	0	0	0	0
Fishing, Hunting and Trapping	0	0	0	0	0	0	0
Support Activities for Agriculture and Forestry	14	7	6	7	7	7	7
Mining and Oil and Gas Extraction	180	166	181	199	207	208	209
Utilities	307	292	313	344	357	359	360
Construction	1910	2520	3013	3312	3441	3458	3476
Manufacturing	3010	3251	3425	3765	3912	3931	3951
Wholesale Trade	858	984	1133	1245	1293	1300	1306
Retail Trade	3795	4682	5334	5864	6092	6122	6153
Transportation and Warehousing	1057	1374	1582	1739	1807	1816	1825
Information and Cultural Industries	541	737	839	922	958	963	968
Finance, Insurance, Real Estate and Rental and Leasing	1233	1575	1813	1993	2071	2081	2091
Professional, Scientific and Technical Services	687	744	819	900	936	940	945
Administrative and Support, Waste Management and Remediation Services	692	834	889	977	1015	1020	1026
Educational Services	114	149	165	181	188	189	190
Health Care and Social Assistance	934	1284	1332	1464	1521	1528	1536
Arts, Entertainment and Recreation	390	446	477	525	545	548	550
Accommodation and Food Services	2212	2893	3375	3711	3855	3874	3894
Other Services (Except Public Administration)	585	598	640	703	731	734	738
Operating, Office, Cafeteria and Laboratory Supplies	0	0	0	0	0	0	0
Travel, Entertainment, Advertising and Promotion	0	0	0	0	0	0	0
Transportation Margins	0	0	0	0	0	0	0
Non-Profit Institutions Serving Households	716	684	731	804	835	839	843
Government Sector	9339	11555	12776	14044	14590	14663	14737
Total	**29242**	**35280**	**39151**	**43038**	**44711**	**44935**	**45160**

Land use requirements were based on a similar study conducted for the city of Edmonton. This study estimated floor area requirements per employee across 13 industries. Projected demand figures were then translated into land area requirements using site coverage ratios typical for each industry. Site coverage constitutes the percentage of a site that is covered by the built environment.

Base case land requirements by industry are presented below.

New Land Requirements per year in Hectares (vs.2015) Base Case	2020	2025	2030	2035	2040	2045
Crop and Animal Production	0	0	0	0	0	0
Forestry and Logging	0	0	0	0	0	0
Fishing, Hunting and Trapping	0	0	0	0	0	0
Support Activities for Agriculture and Forestry	0	0	0	0	0	0
Mining and Oil and Gas Extraction	0	0	0	0	0	0
Utilities	0	0	1	1	1	1
Construction	13	24	30	33	34	34
Manufacturing	5	8	14	17	18	18
Wholesale Trade	2	5	8	9	9	9
Retail Trade	17	30	41	45	46	46
Transportation and Warehousing	10	17	22	24	25	25
Information and Cultural Industries	1	1	1	1	1	1
Finance, Insurance, Real Estate and Rental and Leasing	1	2	2	3	3	3
Professional, Scientific and Technical Services	0	0	1	1	1	1
Administrative and Support, Waste Management and Remediation Services	0	1	1	1	1	1
Educational Services	0	0	1	1	1	1
Health Care and Social Assistance	3	4	5	5	5	5
Arts, Entertainment and Recreation	1	1	1	1	1	1
Accommodation and Food Services	6	11	14	15	15	15
Other Services (Except Public Administration)	0	1	1	1	1	1
Operating, Office, Cafeteria and Laboratory Supplies	0	0	0	0	0	0
Travel, Entertainment, Advertising and Promotion	0	0	0	0	0	0
Transportation Margins	0	0	0	0	0	0
Non-Profit Institutions Serving Households	0	0	1	1	1	1
Government Sector	14	22	30	34	34	35
Total	**75**	**127**	**174**	**194**	**197**	**200**

THE HIGH GROWTH FORECAST

A series of exogenous shocks (output and investment) to the Bandon economy over the next 30 years generated industry employment and output results over and above the base case results.

Construction periods were based on the mid-point year in the range and assumed a 1 year construction period. The actual manufacturing begins the next year. Construction impacts are one-time and manufacturing impacts are on-going. Model generated indirect and induced employment are included in the results. Indirect impacts measure the secondary business transactions that result from the initial expenditures. Induced impacts are third round impacts from the spending of incremental labour income in the economy after removing a portion for taxes and savings. The discrepancies between GDP and employment impacts in the high growth scenario are due to the addition of plants producing hundreds of millions in new output with only 15 to 40 new employees.

High growth forecast results are presented below:

Constant Dollar Gross Domestic Product By Industry (2007 $M) – High Growth Forecast

	2015	2020	2025	2030	2035	2040	2045
Crop and Animal Production	40	42	41	46	43	45	42
Forestry and Logging	0	0	0	0	0	0	0
Fishing, Hunting and Trapping	0	0	0	0	0	0	0
Support Activities for Agriculture and Forestry	0	0	1	1	1	1	1
Mining and Oil and Gas Extraction	152	175	204	249	281	319	363
Utilities	61	70	79	91	102	115	130
Construction	164	211	282	332	420	530	670
Manufacturing	297	331	392	615	635	664	702
Wholesale Trade	113	138	168	207	251	305	370
Retail Trade	203	244	294	354	427	514	620
Transportation and Warehousing	102	124	151	188	227	276	334
Information and Cultural Industries	120	145	174	212	254	305	366
Finance, Insurance, Real Estate and Rental and Leasing	354	430	524	639	777	946	1150
Professional, Scientific and Technical Services	57	66	78	91	105	122	142
Administrative and Support, Waste Management and Remediation Services	35	40	45	52	58	65	73
Educational Services	3	3	4	5	5	6	7
Health Care and Social Assistance	64	87	95	130	143	194	213
Arts, Entertainment and Recreation	16	18	21	23	26	30	34
Accommodation and Food Services	61	75	92	114	141	174	214
Other Services (Except Public Administration)	22	25	28	32	36	41	46
Operating, Office, Cafeteria and Laboratory Supplies	0	0	0	0	0	0	0
Travel, Entertainment, Advertising and Promotion	0	0	0	0	0	0	0

Constant Dollar Gross Domestic Product By Industry (2007 $M) – High Growth Forecast

	2015	2020	2025	2030	2035	2040	2045
Transportation Margins	0	0	0	0	0	0	0
Non-Profit Institutions Serving Households	29	33	38	43	48	55	62
Government Sector	776	907	1060	1241	1450	1695	1981
Total	**2668**	**3667**	**4751**	**6403**	**8075**	**10214**	**12949**

Employment By Industry – High Growth Forecast

	2015	2020	2025	2030	2035	2040	2045
Crop and Animal Production	668	503	324	491	504	506	508
Forestry and Logging	0	0	0	0	0	0	0
Fishing, Hunting and Trapping	0	0	0	0	0	0	0
Support Activities for Agriculture and Forestry	14	7	6	8	8	8	8
Mining and Oil and Gas Extraction	180	167	186	236	243	244	245
Utilities	307	292	315	361	374	376	378
Construction	1910	2579	3318	3327	3456	3473	3491
Manufacturing	2933	3252	4016	4440	4587	4606	4626
Wholesale Trade	858	984	1138	1280	1329	1335	1342
Retail Trade	3795	4682	5335	5868	6096	6127	6157
Transportation and Warehousing	1057	1375	1592	1815	1883	1892	1901
Information and Cultural Industries	541	738	842	941	977	981	986
Finance, Insurance, Real Estate and Rental and Leasing	1233	1575	1815	2002	2080	2090	2101
Professional, Scientific and Technical Services	687	748	839	933	968	973	977
Administrative and Support, Waste Management and Remediation Services	692	835	897	1027	1065	1070	1075
Educational Services	114	149	165	181	188	189	190
Health Care and Social Assistance	934	1284	1334	1476	1533	1540	1548
Arts, Entertainment and Recreation	390	446	477	525	545	548	550
Accommodation and Food Services	2212	2893	3375	3711	3855	3874	3894
Other Services (Except Public Administration)	585	598	640	703	731	734	738
Operating, Office, Cafeteria and Laboratory Supplies	0	0	0	0	0	0	0
Travel, Entertainment, Advertising and Promotion	0	0	0	0	0	0	0
Transportation Margins	0	0	0	0	0	0	0
Non-Profit Institutions Serving Households	716	684	734	819	850	854	859
Government Sector	9339	11556	12783	14087	14633	14706	14780
Total	**29165**	**35346**	**40132**	**44230**	**45904**	**46128**	**46353**

New land requirements are calculated using the same methodology as in the Base Case Forecast. These are presented below:

New Land Requirements per year in Hectares (vs.2015) High Growth	2020	2025	2030	2035	2040	2045
Crop and Animal Production	0	0	0	0	0	0
Forestry and Logging	0	0	0	0	0	0
Fishing, Hunting and Trapping	0	0	0	0	0	0
Support Activities for Agriculture and Forestry	0	0	0	0	0	0
Mining and Oil and Gas Extraction	0	0	1	1	1	1
Utilities	0	0	1	1	1	2
Construction	15	31	31	34	34	34
Manufacturing	6	21	29	32	32	32
Wholesale Trade	2	6	8	9	9	9
Retail Trade	17	30	41	45	46	46
Transportation and Warehousing	10	17	25	27	27	27
Information and Cultural Industries	1	1	1	1	1	1
Finance, Insurance, Real Estate and Rental and Leasing	1	2	2	3	3	3
Professional, Scientific and Technical Services	0	0	1	1	1	1
Administrative and Support, Waste Management and Remediation Services	0	1	1	1	1	1
Educational Services	0	0	1	1	1	1
Health Care and Social Assistance	3	4	5	5	6	6
Arts, Entertainment and Recreation	1	1	1	1	1	1
Accommodation and Food Services	6	11	14	15	15	15
Other Services (Except Public Administration)	0	1	1	1	1	1
Operating, Office, Cafeteria and Laboratory Supplies	0	0	0	0	0	0
Travel, Entertainment, Advertising and Promotion	0	0	0	0	0	0
Transportation Margins	0	0	0	0	0	0
Non-Profit Institutions Serving Households	0	0	1	1	1	1
Government Sector	14	22	31	34	35	35
Total	**78**	**147**	**194**	**214**	**217**	**220**

DETERMINING INDUSTRIAL LAND REQUIREMENTS

Land need forecasts were developed using assumptions concerning the percentage of employment in each sector that is likely to be housed on industrial land, and the density of employment in different sectors. Each sector was assigned an employment density based on observed densities in similar western Canadian cities. Brandon has not conducted detailed assessment of employment and density ratios in the East Brandon Industrial Area. As a result, a literature survey of similar industrial land forecasts for western Canadian Cities was conducted to build appropriate ratios for application in the Brandon case.

In 2004 Abbotsford BC confirmed that a choice of industrial lands must be available to meet a wide variety of demands[2], including different locations and sizes with various site characteristics and services. They predicted future industrial land demands based upon population and economic growth, projected job/population ratios and square footage per job ranging up to 500ft^2. They then examined floor area ratios ranging from 0.17 to 0.54 in different cities in lower mainland BC to standardize their industrial floor spade ratios, then predicted future industrial land demand.

Regina's 2007 study of Industrial Land Use Requirements [3] noted that the 1,304 acres (528ha) of industrial land supported an employment base of 6,592, or 5.05 jobs per acre (2.04/ha). In other Canadian cities, density figures for employees per hectare in industrial areas vary, but have consistently been in the range of 12 per acre, or 30 jobs per gross hectare. This differs widely by sector, with densities in areas dominated by warehousing or primary industries with much lower densities, while areas with a large concentration of offices or labour-intensive smaller businesses having higher densities.

The City of Edmonton's 2012 Demand Forecast for Industrial Lands (2012 – 2015)[4] forecast employment per industry sector then translated employment growth to land area requirements using specific rations developed for 13 industry sectors:

1. Primary Industries	2. Manufacturing	3. Construction
4. Utilities	5. Transportation & Warehousing	6. Retail/Wholesale Trade
7. Finance, Insurance, Real Estate	8. Professional, Technical	9. Accommodation & Food Service
10. Educational Services	11. Health & Welfare Services	12. Commercial Service
13. Government		

Floor area ratios then were developed and applied to the employment projections for each sector and region under review. The ratios then were translated into total land requirements using site coverage ratios typical for each industry sector.

[2] City of Abbotsford (2004) City in the Country Plan, Final Report, p26
[3] City of Regina (2007), *Industrial Growth Strategy 2007,* p 20
[4] City of Edmonton (2012) Demand Forecast for Industrial Land , 2012-2015

Given the availability of data for the East Brandon Industrial Area and Brandon overall, the economic forecast for Brandon was translated into industrial land requirements using the following multipliers:

Industry Sector	Floor Area per Employee (square meters)	Average Floor Space Ratio
1. Primary Industries	30.5	0.20
2. Manufacturing	38.2	0.20
3. Construction	21.7	0.10
4. Utilities	32.2	0.15
5. Transportation & Warehousing	48.6	0.15
6. Retail/Wholesale Trade	54.9	0.15
7. Finance, Insurance & Real Estate	8.0	0.28
8. Professional, Technical	8.0	0.25
9. Accommodation & Food Service	18.2	0.25
10. Educational Services	18.2	0.20
11. Health & Welfare Services	18.2	0.20
12. Commercial Services	18.2	0.20
13. Government Service	19.4	0.30

In other words, for every person employed in the primary industry sector (#1), total land area requirements are projected to 152.5 square metres, or 1,641.5 square feet. These multipliers were applied to Brandon's forecast model to generate an average land area requirement per sector. From this, an estimate of the proportion of industry that would locate into the East Brandon Industrial Area was modelled after the Edmonton experience, based upon the industry sector. This defined how much of the projected economic developed during the forecast period would locate into the East Brandon Industrial Area versus elsewhere.

PROJECTED INDUSTRIAL LAND REQUIREMENTS

Estimated land use requirements were separated by industry classification to identify those businesses that would be expected to locate into the East Brandon Industrial Area from those that would normally locate into other areas of the City.

Businesses that would locate into commercial rather than industrial locations were separated, and a summary of projected industrial land use requirements was developed. The accompany table identifies cumulative land industrial land requirement to 2045.

Cumulative Land Use Requirements				
	Base Case		**High Growth**	
Year	**Acres**	**Hectares**	**Acres**	**Hectares**
2020	69	28	77	31
2025	121	49	170	69
2030	166	67	215	87
2035	185	75	235	95
2040	193	78	235	95
2045	193	78	237	96

The following table provides a summary by major industry.

New Land Requirements per year in Hectares (vs.2015)	Base Case Forecast (ha)						High Growth Forecast (ha)					
	2020	2025	2030	2035	2040	2045	2020	2025	2030	2035	2040	2045
Mining and Oil and Gas Extraction	0	0	0	0	0	0	0	0	1	1	1	1
Utilities	0	0	1	1	1	1	0	0	1	1	1	2
Construction	13	24	30	33	34	34	15	31	31	34	34	34
Manufacturing	5	8	14	17	18	18	6	21	29	32	32	32
Transportation and Warehousing	10	17	22	24	25	25	10	17	25	27	27	27
Total (ha)	28	49	67	75	78	78	31	69	87	95	95	96

Note that these are forecasted minimum land requirements. For the high growth scenario additional consideration needs to be given to the actual land area requirements of the major industry that will locate into the East Brandon Industrial Area.

BRANDON'S LAND REQUIREMENT CONTEXT

The land requirement estimates are drawn from the combined analysis of Brandon's growth forecast and land usage metrics established for similar urban areas. By and large, the other urban areas have followed a stepwise, phased development process. A cohesive industrial area is the result. This is not the case for Brandon. The size of the industrial area itself has allowed for a more dispersed growth pattern. This creates several challenges:

- Servicing must extend across areas of little or no activity. This increases overall servicing costs to the City and to the end user.
- The relative abundance of land has allowed many industries to amass more property than they are using for their industrial purpose. This creates similar challenges to those noted above.

The identified land area requirements establish a minimum estimate of future land demand. Focussed development of the four growth nodes where there are minimal gaps in development will help manage infrastructure development costs and will serve to align projected and actual land use.

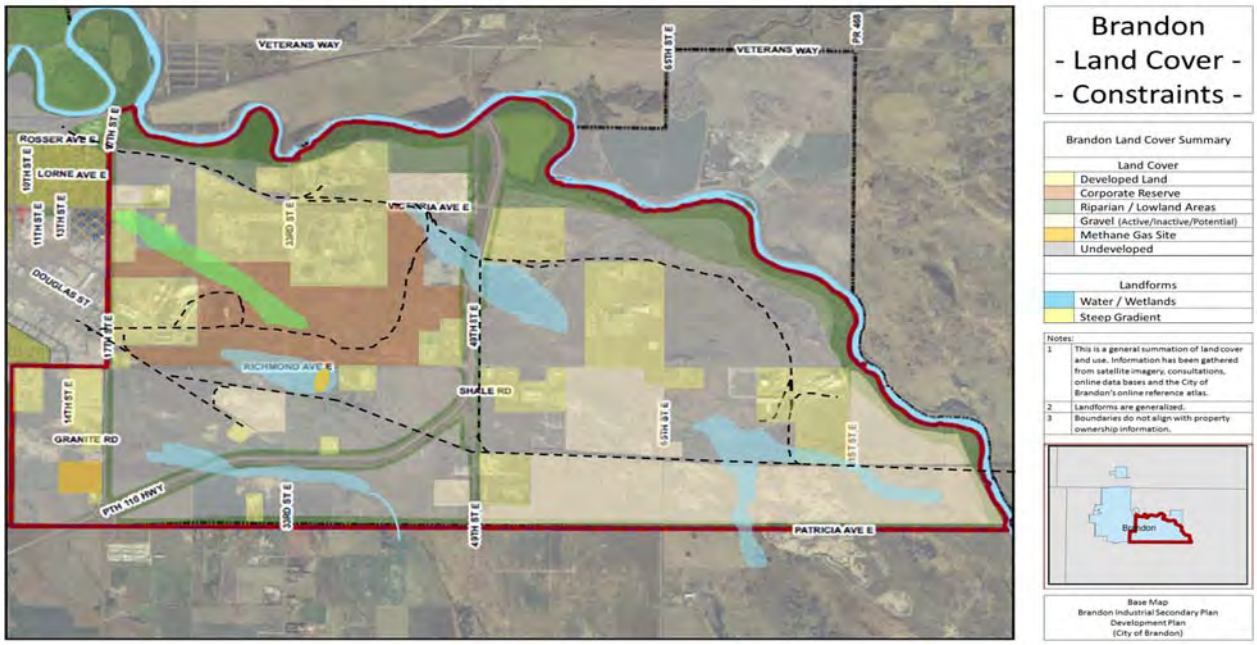
LOCATION IDENTIFICATION

The identification of sites for focussed development of industrial nodes within the East Brandon Industrial Area took place through a net back analysis process and an analysis of physical and service constraints in the area overall. When combined several areas of potential were identified. These areas then were compared to the long term industrial land projections and a land area forecast developed.

THE MAPPING PROCESS

A generalized land cover map was developed. It identified the current land cover in broad categories. As identified on the accompanying map, categories include developed, undeveloped, unsuitable for development unless strict criteria are met (methane release), and environmentally sensitive sites (riverbank). In addition, base information garnered from City sources and discussions with land owners identified properties that may look to be undeveloped but are in fact serving a corporate purpose.

A general land constraints map was developed. This identified areas with challenging topography, wetlands/lowlands and physical boundaries. When overlaid, the resulting map (below) helped define the areas that are considered to be undeveloped with minimal constraints that can be identified through land cover information.



Examination of cover and constraints defined areas of potential long term development. Once identified, detailed investigation further elaborated the constraints relative to servicing, road access and the like.

WETLAND CONSTRAINTS

Many areas within the East Brandon Industrial Area are low, often containing wetlands and areas of marsh. A band of wetland areas runs in a general diagonal direction from the southeast region to the east side of PTH110, and Victoria Avenue. A second wetland region exists along Richmond Avenue at 33rd St E, and south of that along the PTH110. These wetlands serve as seasonal catchment areas for runoff from adjacent properties.

In addition, floodplains exist along the Assiniboine River. As outlined in the *Brandon and Area Planning District Development Plan 2013*, one of the general objectives of the Growth Plan is "To protect people and property from damages that may result from flooding"[5]. Much of the land along the Assiniboine River has been zoned Development Reserve to protect sensitive riverbanks and mitigate against potential flooding.

In this study minimal attention was paid to areas adjacent to the Assiniboine River – significant growth opportunities exist in other regions.

TOPOGRAPHY CONSTRAINTS

An area of steeper topography extends from the approximate corner of Victoria Avenue and 17th St E, southward and eastward to the eastern side of the Koch industrial complex. This makes for challenging construction and servicing. In addition, any contemplated expansion of rail service must recognize this constraint, as most rail lines are built on grades of less than 1%.

GRAVEL / AGGREGATE DEPOSITS

Significant gravel / aggregate deposits exist across the industrial area. Most regions in the south and east portion of the industrial area either are being actively mined or are being held for potential future development.

Natural resource policies identified in the *Brandon and Area Planning District Development Plan* seek to preserve aggregate deposits for future extraction, encourage removal in an environmentally sound manner, and provide fur future rehabilitation of depleted sites.

Today over 850 acres (344ha) of land in the region are being held for some type of gravel or aggregate development.

GROUNDWATER STEWARDSHIP

Vulnerable groundwater areas are often defined as those areas having high potential for contamination of groundwater from sources at or near ground surface regardless of how local or extensive an aquifer may be. The degree to which aquifers are vulnerable to contamination from the surface will largely depend upon the thickness and properties of the material overlying the aquifer and the properties of the contaminant. [6]

[5] BAPD (2015) Brandon and Area Planning District Development Plan 2013, Amended January 2015, p 7
[6] Central Assiniboine and Lower Souris River Watershed – Groundwater Resource Information, p 11.

As a general "rule of thumb" aquifers that are overlain by six metres (20 feet) or more of low permeability material (such as clay or till) are considered as having low potential for contamination from surface sources. Aquifers consisting of sand and/or gravel or fractured bedrock that are exposed at or near the surface are more vulnerable to water degradation from surface activities and would be considered as having high potential for contamination.

The East Brandon Industrial Area houses significant gravel deposits. Future industrial development will need to ensure that the long term integrity of groundwater resources are maintained.

METHANE-EMITTING SITES

Three methane emission sites exist within the region. Two are mapped (see figure), and the third is the Municipal Landfill. The City of Brandon owns a site of ~30 acres (12.1ha) directly north of the Brandon Humane Society, adjacent to 17th ST E. A smaller site measuring approximately 3-5 acres (1.2 – 2ha) exists on the south side of Richmond Avenue between 33rd St E and PTH110, west of the Excel Construction building site. The property is owned by the Rural Municipality of Cornwallis.

The *Brandon & Area Planning District Development Plan, 2013* proscribes a minimum distance between new developments and sites with methane gas emission. The intent is to protect people from the potential hazards resulting from the subsoil migration of methane gas from decaying garbage at abandoned waste disposal sites. Areas within a 402 m (1,320 feet) distance of the boundaries of abandoned waste disposal sites will be considered as restricted development areas. Within these areas, development should be restricted to open space uses, such as agriculture and exterior recreational activities, and the construction of buildings will not be allowed. This separation distance may be reduced if the municipality has a program to evaluate and monitor the level of risk, which is approved by the designated Provincial Authority.[7]

MANITOBA HYDRO – LONG TERM POWER SUPPLY

The East Brandon Industrial Area is generally served with a 25 KV distribution system that offers up to 600 Amps of service. In addition, selective locations are connected to a 115 KV distribution system to support the requirements of heavy industrial users.

It is estimated that additional demand of 1 to 3 MW can be accommodated with the current infrastructure. The ability to support additional loads and demand are subject to site specific system capacity analysis.

Manitoba Hydro will provide transformation up to 2000 KVA, and the standard secondary voltages are three phase 120/208, and 347/600. Their distribution planning department advised three

[7] BAPD (2015), Brandon and Area Planning District Development Plan 2013, Amended January 2015, p 90

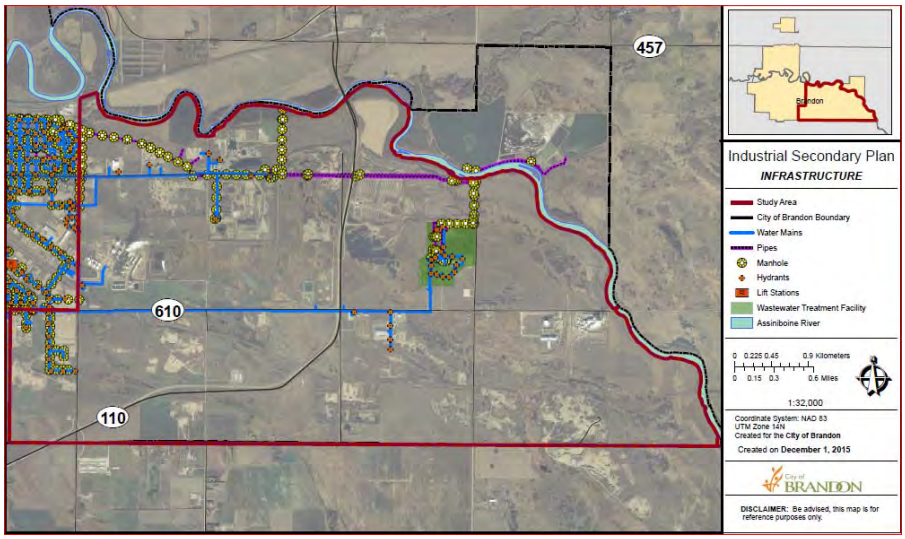
phase services in the range of 500 to 750 KVA can be served in most areas of the City, but the specifics would need to be studied on a case by case basis.

Upgrading and strengthening the power grid often can be a complex undertaking that involves more than just deploying more equipment at a sub-station, or building a new transmission line. Significant additions to or changes of the type of load (say 25 to 59 MW) can cascade upstream in the power grid and have impacts in distant locations. Manitoba Hydro representatives indicated that a customer of this size would need to be served from the transmission system, which is currently nearing capacity. Based on the 5 to 30 year time frame of this study, it is possible a load of this size could be serviced. It would require further study:

- A high level screening study called a Load Interconnection Evaluation Study (LIES) would be conducted for the specific sites under consideration.
- For sites that have an acceptable LIES outcome, a detail Load Interconnection Facility Study (LIFS) would be conducted (customer pays for the actual study, typically $50K to $100K) to determine the service extension final cost and timeline.
- The LIFS will commit Manitoba Hydro to supply infrastructure and power to a site at a price, and is valid for a limited time only.

MUNICIPAL WATER AND WASTEWATER INFRASTRUCTURE

Water and sewer service has not been developed in a stepwise, progressive manner across the Region. Service provision varies widely, and has focused on servicing along the trunk lines, as shown in the attached map. Aside from the areas in the southwest and northwest corners of the industrial area, services are limited. This is particularly so for wastewater service.



The water main along Richmond serves a group of businesses at the intersection of PTH110 and Richmond, and then extends eastward to the Maple Leaf Foods facility. This water service is not duplicated by similar sewer services (the Maple Leaf Foods plant is linked to the waste treatment facility to its north).

Some businesses that have established in the industrial area rely upon groundwater rather than municipal service for their daily needs. Discussions confirm that many businesses have their wastewater trucked to off-site disposal locations.

Overall, discussion with Brandon Municipal Engineering confirmed that servicing for both water and wastewater can be accommodated, with qualification:

- As with many developments, advance discussion will be required to confirm required water volumes and quality of the wastewater that may be returned to the municipal system. Physical capacity at the wastewater treatment facility would need to be assessed relative to potential new developments, as would the plant's capacity to handle different amounts and types of wastewater.
- Some locations have capacity limitations on their existing water/wastewater infrastructure. 'Typical' load levels may be accommodated, while industries with high demand (and resulting waste) may tax the existing infrastructure.
- Additional site specific work would be required as development proceeds to confirm linkage to the wastewater system and ensure that new connections can continue to function based upon gravity flow.
- Firefighting support (fire hydrants) would need to be provided into new developments. Adequate pressure to service new developments would need to be confirmed.
- The Richmond Avenue water main servicing the Maple Leaf Foods facility provides dedicated support to Maple Leaf. Future development cannot impact upon the City's ability to support existing businesses like Maple Leaf Foods.

The above considerations are meant to be illustrative and not exhaustive. As growth occurs, additional site specific assessments will be required to ensure that municipal service can accommodate the growth. Likewise, specific water needs and wastewater production will need to be addressed on a business by business basis.

DEVELOPMENT NODES

When the long term demand forecasts for industrial land are combined with the assessment of available lands for development within the East Brandon Industrial Area, two conclusions can be drawn:

1. There are several select areas within the area that are opportune for development of industrial nodes suitable to attract long term tenants. Location(s) for development of these nodes include:
    - Continued expansion of the "Richmond Avenue Industrial Node", in the very southwest portion of the region.
    - Focusing growth along Victoria Ave, between 17th St E and Hastings Street, as appropriate to the proximity of nearby residential development.
    - Continued development of the industrial base at the corner of Richmond Avenue and PTH110, beginning in the southeast quadrant.

2. Major industrial users that would require larger land areas can be accommodated on a select, corporate specific basis.
    - Attraction of larger industrial users requiring larger land areas on a corporate-specific basis is proposed for lands directly east of the current Maple Leaf Foods processing facility. Unique development agreements would prompt investment of this scale.
    - Lands to the south of Maple Leaf Foods holds longer term potential following utilization of the lands to the east.

RICHMOND AVENUE INDUSTRIAL NODE

Development is underway in the southeast corner of the City to serve additional industrial clients. The "Richmond Avenue" industrial area is bounded by Richmond Avenue to the north, Patricia Avenue to the south, and Douglas Street to the west. 17th St E currently marks the eastern border, but lands to the east would serve as a logical extension to the area as development progresses. To the west of 17th St E there is ~293 acres of land (118.7ha), and to the east an additional 222 acres (89.9ha).

Richmond Ave Industrial Node		
	acres	hectares
West of 17th St E.	293.4	118.7
East of 17th St E.	222.0	89.8
Total Land Area	515.4	208.6
Land Cover class		
Developed	86.3	34.9
Methane Site	29.4	11.9
Partially Developed	6.8	2.8
Under Development	86.3	34.9
Undeveloped	306.6	124.1
Total Land Area	515.4	208.6

Existing major tenants include the City of Brandon, Paul's Hauling, Crane Enterprises, Prairie Liquid Feeds and Ballingall Brothers Ltd, with sites ranging from 2.8 to 23+ acres (1.1-9.4+ha).

Currently there is a mix of developed and undeveloped properties, with a sizable amount of land now under development for industrial use. Discussions with the developer confirm a long-term interest in continued expansion of the industrial area and further developing serviced property to the south as business growth warrants.

In total, the amount of property that either is being developed or is undeveloped on the west side of 17th St E exceeds 170 acres (68.8ha). Specific to the City's assets, they own an undeveloped property south of the current Civic Services Complex and the lands which the Brandon Humane Society now occupy. Both sites hold development potential, as the parcel now housing the Humane Society could be sub-divided when needed to support additional development.

Additional opportunity for development exists on the 222 acres (89.8ha) to the east. These lands currently are zoned as DR - Development Reserve, with the intent of holding the property in an un-fragmented state for future development. A wetland exists at the north end of the property.

Several site specific considerations need to be recognized as development proceeds:

West of 17th St E:

- The current wastewater service does not have significant excess capacity. Normal day-to-day wastewater production can be accommodated, but addition of large producers of wastewater may tax the existing system.
- Directly north of the Brandon Humane Society is a retired landfill that is being monitored for methane release. This 29.4 acre (11.9ha) site has an active methane monitoring program in place to support development within the restricted emission zone.

East of 17th St E:

- Water movement across this parcel of land is to the south and east. There is a natural collection pond at the southeast corner of Richmond Ave and 17th St E that should remain.
- Richmond Avenue is a Provincial Road; provision of additional access points need to be coordinated with the Province.

The Richmond Avenue Development node holds solid long term development potential. Its proximity to existing services will allow for logical, step-wise investment by the City of Brandon. Current parcel sizes west of 17th St E are conducive to businesses that would establish in the agriculture, oilfield supply and lighter manufacturing sectors that conform to the 'MG - Industrial General' zone. Zoning in the southern undeveloped areas recognize current land use limitations and use; lands to the east of 17th St E are held as Municipal Reserve.

VICTORIA AVENUE MANUFACTURING NODE

The "Victoria Avenue Manufacturing Node" is an area along Victoria directly east of 17th St E. This area holds long term development potential given its proximity to existing services and current state of development. The area is bounded by 17th St E to the west, the rail line to the north, and Hastings Street to the east. Victoria Avenue E bisects the area, with approximately 85.7 acres (34.7ha) of land to the north and 43.6 acres (17.6ha) to the south.

Victoria Ave Manufacturing Node		
	Acres	Hectares
North of Victoria Ave	85.7	34.7
South of Victoria Ave	43.6	17.6
Total Land Area	129.3	52.3
Developed	27.8	11.3
Undeveloped	101.5	41.1
Total Land Area	129.3	52.3

Existing major tenants include Shape Foods (on the Rockstone Holdings property), a Manitoba Hydro substation at the corner of 17th St E and Victoria, and East 40 Packers.

Currently there is a mix of developed and undeveloped properties in the area, with little sign of new development. Two major landowners are present north of Victoria Ave. The City of Brandon owns a ~38.4 acre (15.5ha) parcel at the intersection of Victoria Ave and 17th St E; the Shape Foods location to the east is ~47.3 (19.1ha). The City property is an active gravel deposit that has significant gravel pits towards the north and west of the property, while the Shape Foods site is partially developed (~12 acres developed).

To the south there is a mix of developed and undeveloped properties, generally on lots ranging in size from less than 1 acre to about 2.9 acres. A major land owner is the RM of Cornwallis. They own 23+ acres (9.4+ha) of land that has been subdivided into traditional 'city block' parcels of about 2.9 acres (1.2ha). In the past some of these parcels have been sold, and now are owned by East 40 Packers, Rainbow Eavestroughing and Wheat City / ABC Towing. Several residential properties exist along 17th St E.

In total, there is approximately 100 acres of undeveloped land in the Victoria Avenue Manufacturing Node. Current zoning is predominantly MG – Industrial General (with Brandon's corner property zoned as MR – Industrial Restricted) to prompt establishment of business that would take place indoors, generate minimal truck traffic, and generate little or no noise, smoke, odour, vapour, dust or other undesirable emissions. Much of the RM of Cornwallis' land is zoned DR – Development Reserve.

Current businesses in the East Brandon Industrial Area, and in this development node would support the creation and clustering of future food processing and general manufacturing operations. Prospective businesses usually require a smaller land base, and could potentially

benefit from co-development within a shared use facility where such things as loading areas, refrigeration or common space can be jointly used.

Several site specific considerations need to be recognized as development proceeds:

North of Victoria Avenue:

- The City's gravel pit is expected to be in operation well into the foreseeable future. Several easements exist across the property that do not seem to support existing power lines or other infrastructure, and terminate north of the Assiniboine River. In combination, potential development of this property is limited.

South of Victoria Avenue:

- Several businesses south of Victoria Ave are not connected to municipal wastewater service.
- The existing subdivision design in the "Cornwallis Property" may not be sized appropriately to support future development.

The Victoria Avenue node holds long term growth potential, particularly when linked to an infrastructure development initiative that would provide logical next-stage extension of City services, and when linked to a plan to attract businesses that would complement existing industry. A coordinated development plan with local businesses like Shape Foods and West 40 Packers could help focus development into the food processing sector and create a sector nucleus for long term development.

PTH 110 & RICHMOND AVENUE INDUSTRIAL NODE

One of the more unique development regions exists at the corner of PTH110 and Richmond Avenue. The "PTH110 Industrial Node" is largely un-serviced, is subdivided into relatively large parcels suitable for large-scale industrial development, and has very good highway access. A rail transloading facility also is being contemplated for lands on its eastern edge.

PTH110 Industrial Node		
	Acres	Hectares
SE of Richmond & PTH 110 Intersection		
Developed	63.1	25.5
Undeveloped	81.3	32.9
Total Land Area	144.4	58.4
NE of Richmond & PTH 110 Intersection	108.9	44.1
SW of Richmond & PTH 110 Intersection	97.6	39.5

The focal point for development is the area in the southeast quadrant of the highway intersection. Lands on the northeast and southwest corners are undeveloped and may hold long term development potential; lands to the northwest are part of Koch's land buffer area and house retention ponds and baseball diamonds. Specific to the southeast area, there are approximately 144.4 acres (44ha); 63 (25.5ha) acres are developed and 81 acres (33ha) are undeveloped. Lands currently are zoned MH – Industrial Heavy.

Undeveloped properties are relatively large, ranging from 5-7 acres (2-3ha), with larger (20+acres) properties to the southern edge. Current tenants include metal salvage, oilfield support, trucking and transport, and asphalt/emulsions businesses. At similar land use levels, approximately ten more businesses could be established in this area before additional lands would need to be identified for development.

A property owner is examining the potential of developing a rail transloading terminal on the adjacent property to the southeast. The property would require rezoning to accommodate heavy industrial use, and establish upwards of 7,000 feet of rail track spurs. Approximately 120 rail cars could be stored on site.

This node houses businesses that typically are involved in heavier manufacturing, require larger land areas and benefit from good highway access. This includes oil service, transport and heavy haul firms. It houses companies that handle or store materials more hazardous goods, and may be a point source for emissions. The relative isolation of this node makes it conducive to continued development of businesses in the MH Industrial Heavy category.

Several site specific considerations need to be recognized as development proceeds:

- There is no wastewater service in the area. Given the distance to an existing line service provision may be cost-prohibitive; no service is anticipated for the foreseeable future. Companies need to be cognisant of this as they make location decisions.
- Municipal water is available, but concerns may arise about water quality if flow is diminished.

This development node has good road access and currently is subdivided into relatively large parcel sizes that would support establishment of larger heavy industry. Adjacent rail lines can be further developed for transhipment. The lack of wastewater servicing is a long term constraint that may not be addressed for the foreseeable future; businesses locating to this area need to less reliant on this municipal service and able to handle waste water through other means. The large land areas available for development today, combined with the lands to the north and west make this a competitive location for the establishment of heavy industry that can serve southwest Manitoba and southeast Saskatchewan.

PROPERTY EAST OF MAPLE LEAF FOODS

Directly east of the Maple Leaf Foods facility is approximately 215 acres (87ha) of undeveloped land. The land is held by four different owners; it is zoned DR – Development Reserve to recognize its long term potential for additional large-scale industrial development and to hold lands in an un-fragmented state for future development.

Area Description		
	Acres	Hectares
	~215	~87
The area is bounded to the west by 65th St E, to the south by Richmond Ave, and to the north and east by rail. All lands are relatively undeveloped. Four owners currently hold property in the area, with Viterra Inc. being the largest.		

This report documents several large-scale business opportunities that could locate into Brandon over the foreseeable future. Many of them will require large land holdings, and access to municipal services.

Today there is no development underway, but an application has been received from a company to construct a new bulk granular fertilizer storage facility on a portion of the site. The proposed facility will have a 27,500 tonne storage capacity and include a loading office and corporate office facilities. The facility will include a conveyor with a capacity to transfer 300 to 400 tonnes per hour of granular fertilizer from both truck and rail to the facility. Product blending will be able to be performed on site. As of January, 2016 FCL's application for development is under consideration, and has yet to meet corporate, municipal and provincial approvals to move forward. Total land area proposed for development is approximately 140 acres (~56.6ha), with proposed new zoning of MH – Industrial Heavy.

In light of the scale of these types of investments it is expected that much of the servicing and development requirements that would be provided by the City or the Province would be specific to the project itself. Project specific agreements stipulating the type of services needed, timing, cost sharing and other items are expected. As such, a series of constraints are not readily apparent, nor can they be anticipated in advance. As development proceeds it is expected that road traffic will increase and necessitate an evaluation of road capacity and intersection upgrading. At the corner of Richmond Avenue and 65th St E.

These lands are in close proximity to Brandon's waste treatment plant, are close to Manitoba Hydro services (power and natural gas) and benefit from good road access. Access to the municipal waste water treatment plant will be a consideration for some potential developments. Both the capacity and the quality of the wastewater may need to be assessed in advance. Depending upon the intended use, pre-treatment of the wastewater before it is sent to the Municipal facility may be required.

One local asset that could be levered to support large-scale development is the sizable volume of treated water that currently is being released from the Municipal Treatment Plant. These volumes could be used for industrial processing; proximity to the treatment facility may support industrial investment and allow the City to capitalize upon this asset.

Zoning on the properties "east of Maple Leaf Foods" should be maintained as Development Reserve to support larger-scale industrial development in keeping with the East Brandon Industrial Area, until such time that a large user (such as FCL) looks to develop. If and when these properties are developed, lands to the south of Maple Leaf Foods holds longer term potential.

RESULTING ACTIONS

During the assessment of the long term industrial land requirements several linked development questions arose. They will impact upon the long-term uptake of serviced industrial land in the East Brandon Industrial Area, and potentially beyond.

ENSURING ADEQUATE SUPPLIES OF SERVICED LANDS

The four growth nodes identified for focussed civic attention contain various amounts of private and public lands. Today the City is constrained by limited lands that they own and can be developed. While the City is a large land owner in the East Industrial Area, much of the land is being used as part of land fill operations, municipal wastewater treatment operations, gravel deposits and the like. The Richmond Avenue node has some City-owned property that can be used to prompt further growth and development. The City owns a gravel pit that would prove difficult to develop in the Victoria Avenue node, while the PTH110 node contains relatively little City owned property.

Given higher potential demand, and the volatility of that demand, it is important that the City ensure that a longer-term supply of serviced industrial lands be maintained. This may seem counterintuitive given the very large land area in the East Brandon Industrial Area, but much of the region is not well serviced or not easily available for future development. Given these factors, it would be prudent for the City to develop and maintain an inventory of serviced lands. This would give the City the flexibility to respond to the needs of potential large users, and to respond to increased interest that results from periods of strong market demand.

It is also important to ensure that there is flexibility and choice available to the market – that is, to ensure that firms searching for industrial lands have a variety of potential locations to choose from within the City. This market choice merits the coordinated development of several locations in a prudent manner that would let a firm select the best site that suits their needs. Such coordinated development supports a wider marketing effort and would add to Brandon's overall competitive strengths.

As described in the coordinated development of the three growth nodes, and the signalling that larger businesses can be served on larger development parcels, approximately 193 acres (78ha) is required in the base case scenario, and upwards of 237 acres (96ha) in the high growth scenario. The City should maintain its policy whereby a minimum of 5 years of serviced industrial land be available to prospective tenants.

This would parallel the actions of other Canadian cities. Regina's 2007 *Industrial Land Forecast* recommended that the City maintain a 5-year supply of serviced industrial land for commercial sale[8.] The City of Calgary mandates that the City retain a 30-year supply of industrial land within City limits, while the *Growth Plan for the Greater Golden Horseshoe* in Southern Ontario requires municipalities to maintain a supply of lands able to meet demand.

[8] City of Regina (2007) Industrial Land Forecast, 2007, p. 81.

There is an important role for the City in the land development process to help ensure an ongoing adequate supply of available lands and to ensure that prices remain competitive within the regional, provincial and national markets. The City should continue to ensure lands come on stream as required, and ensure the policy of providing a minimum of 5 year's supply of serviced industrial lots for sale is maintained. The City owns some land in select growth nodes that could act as a catalyst for development, but by-and-large there is little City property that could be used to initiate development. Discussion with current landowners needs to continue to confirm their interest in participating in a development process. This discussion will confirm whether a partnership approach can be established and how the City would involve itself in a land assembly process.

"TEAM BRANDON" STRATEGIC MARKETING

Much of the anticipated growth in the East Brandon Industrial Area will result from local economic growth that is captured in the 'base case' scenario outlined in this report. Proactive marketing and development can substantially increase this baseline land requirement scenario. A focussed marketing campaign can serve to both retain and support growth of existing businesses and attract significant new investment into the City.

The lands in the East Brandon Industrial Area are well positioned to attract large businesses. The competitive advantages of Brandon, both in terms of possible land availability and the wider array of Brandon's advantages like cultural amenities, educational institutions and competitive tax regime, to name a few, make for a positive investment climate.

But, other towns and cities will be actively pursuing the same large-scale opportunities. A proactive marketing campaign needs to continue to showcase the competitive advantages of the City. A strategic, concerted industry attraction process is required to attract these large, future investments. Team Brandon would establish an alliance of interested parties to succeed.

Led by the City, this coordinated effort would draw on the combined talent of private, public, not-for-profit/civic associations, and academic sector leaders to showcase the City and its competitive rational for future investment. A strategic plan process that involves all key stakeholders would clearly articulate a common goal, build clarity on roles, timelines and responsibilities and demonstrate to prospective investors the capabilities of the community.

REFERENCES

Brandon & Area Planning District (2013), *Brandon & Area Planning District Development Plan.*

Brandon & Area Planning District (2010), *BAPD District Development Plan Review*

Brandon & Area Planning District (2013), *Fringe Area Growth Strategy*

BAPD (2015), *Application for an Amendment to Development Plan*, NE 31-10-19WPM

Central Assiniboine and Lower Souris River Watershed, *Groundwater Resource Information*

City of Abbotsford (2004) *City in the Country Plan, Final Report*

City of Brandon (2015), *Continuing Consolidation By-Law No. 6642 (the Zoning By-law)*

City of Brandon (2015), *East Brandon Industrial Land Inventory Report*

City of Brandon (2014), *2014-2019 Growth Strategy*

City of Edmonton (2012) *Demand Forecast for Industrial Land, 2012 - 2015*

City of Regina (2007), *Industrial Growth Strategy 2007*

SCHEDULE E: IMPLEMENTATION RECOMMENDATIONS

The City of Brandon, in collaboration with private and public sector partners and stakeholders, will endeavor to:

1. Prepare an Implementation Strategy including an infrastructure plan, a phasing plan for capital investment, and a menu of funding mechanisms for creating an inventory of pre-serviced or readily-serviced lands in order to meet a 5-year parcel supply as recommended in the 2016 EBIA Industrial Land Development Forecast, which forecasted an overall industrial land demand to 2045 of between 78 to 96 hectares (193 to 237 acres).

2. Re-subdivide and service publicly owned lands within the Victoria Avenue Industrial Node.

3. As recommended in the 2016 EBIA Industrial Land Development Forecast, encourage Manitoba Hydro to undertake a Load Interconnection Evaluation Study (LIES) for specific sites that have the potential for accommodating industries with a high electrical demand.

4. As recommended in the 2016 EBIA Industrial Land Development Forecast, identify available capacities in the city-wide sewer and water infrastructure in relation to the potential demand from industries with a high water usage and extraordinary wastewater treatment requirements.

5. Coordinate with the Provincial Mines Branch and respective pit operators and land owners in formulating a long term strategic plan for aggregate extraction and gravel pit remediation.

6. Liaise with CN and CP and EBIA spur owners regarding potential for future spur lines and sidings and what the City and its partners can do to expedite the provision of rail service to suitable parcels in anticipation of potential demand.

7. Liaise with EBIA property owners of high-potential development lands to identify which parcels might be available for immediate purchase by prospective businesses based on a particular owner's degree-of-interest.

8. Wetland Pre-Screening: To minimize the need for individual assessments and encourage coordinated land drainage and wetland preservation within the EBIA, the City of Brandon may undertake a wetland assessment as part of more comprehensive Biophysical Study of all or some of the lands within the EBIA in order to pre-screen development site(s) to establish the nature, extent and function of the wetlands (including use by species-at-risk) and to identify the areas that can proceed with development without further, site-specific review.

9. Municipal Pre-Screening. To minimize the need for individual assessments and encourage coordinated protection for species-at-risk and their habitat within the EBIA, the City of Brandon may undertake a Biophysical Study of all or some of the lands within the EBIA in order to pre-screen development site(s) to confirm the presence and location of SAR and to develop an initial Environmental Protection Plan that would guide development, establish appropriate set-back distances, and identify mitigation measures as required. Completion of this study by the City of

DRAFT

Brandon would remove the burden for individual proponents to complete these studies on a site-specific basis when developing near an identified SAR location.

10. Update the Brandon Economic Development Strategy by integrating elements and opportunities stemming from the preparation of the EBIA Secondary Plan into an overall marketing plan promoting Brandon's readiness for receiving core and allied businesses across key industry sectors.

11. Review options for financing infrastructure improvements including common municipal mechanisms such as: utility fees, bond financing, capital reserve funds, tax increment financing (TIF), local improvements charges (LIs), trunk service area charges (TSRs), tri-level infrastructure programs, developer front-ending with paybacks, and Private-Public Partnerships (P3s).

DRAFT