FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT
PARK PLACE RESIDENTIAL
NORTH AMERICAN DEVELOPMENT GROUP
CITY OF BARRIE

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

PARK PLACE RESIDENTIAL

Prepared for: North American Development Group

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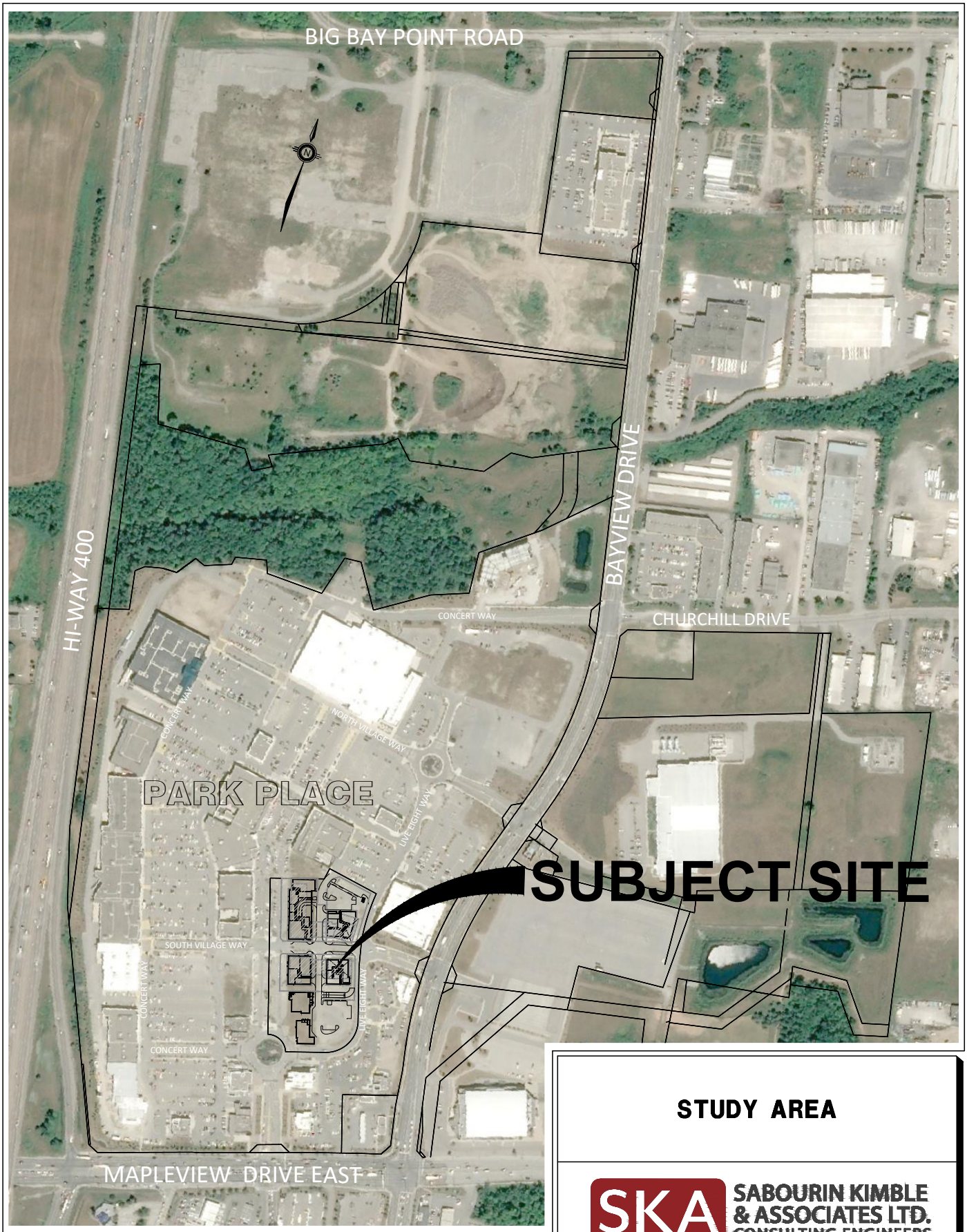
Figure SS - Site Servicing Plan……..…….(Back Pocket)

1.0 INTRODUCTION

Sabourin Kimble & Associates Ltd. has been retained by North American Development Group to carry out a functional servicing and stormwater management assessment of the Park Place Residential site located within the east half of the Park Place Village, at the north-west corner of Mapleview Drive and Bayview Drive in the City of Barrie. The following report is in accordance with the guidelines set out in the approved *Stormwater Management Analysis and Preliminary Servicing Study* (PSS) prepared by Sabourin Kimble and Associates Ltd. for the Park Place Development dated July 2003 and updated December 2007, and the approved Interim stormwater management facility design in the *Park Place Development – Phase 1 SWM Brief* prepared by Sabourin Kimble and Associates Ltd. dated August 2007 and revised February 2008. Going forward, the existing "Interim" stormwater management facility will be referred to as SWM Pond C, as it will continue to remain in place. The stormwater management strategy for this site was previously approved as a part of the PSS and Phase 1 SWM Brief, therefore this report has been prepared to confirm that the proposed revision to the subject site is still in keeping with these reports. This report also identifies how the property will be serviced and assesses whether the existing infrastructure surrounding the property is adequate to support the development.

2.0 STUDY AREA

As shown in Figure 1, the proposed Study Area is located within the east half of the Park Place Village, with Phase 1 and Phase 2 situated north and south of South Village Way respectively. The proposed site plan consists of residential buildings, ground floor retail, and underground and surface parking.



STUDY AREA

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

PROJECT NUMBER	FIGURE NO.
02:999	1

N.T.S.

3.0 MUNICIPAL SERVICES

3.1 Site Grading

The existing grading of the subject site generally falls west to east. Existing grade elevations within the Village are as high as 294.42 metres and fall to the east to as low as 291.74 metres along the limit of development.

As shown in Figure SG (back pocket), the site will be graded to accommodate the proposed site revisions and additional residential buildings. Preliminary finished floor elevations have been provided for all proposed buildings. The grading approach has been designed to satisfy current City of Barrie grading criteria, meet boundary conditions and respect drainage boundaries.

3.2 Storm Drainage

3.2.1 Existing Conditions

As shown in Figure SS (back pocket), a combination of existing 300mm to 825mm storm sewers surround and cross through the site. Overland drainage generally flows from the west to east where it is captured and conveyed in two distinct storm sewer systems. The site area north of South Village Way generally drains to the existing SWM Pond C, which is located at the north-west corner of Bayview Drive and Concert Way. The remaining site area ultimately drains to SWM Pond A, located east of Bayview Drive and south of the IBM lands.

3.2.2 Proposed Storm Servicing

Parking lots and landscape strips from Phases 1 and 2 will contribute flow to existing storm sewer systems, ensuring that existing drainage patterns are maintained. Drainage from the majority of Phase 1 will be conveyed to SWM Pond C, where it currently drains. Drainage from the remainder of the site will be conveyed to SWM Pond A, where it currently drains. As the total surface parking area will be reduced due to the proposed larger building areas, the total storm flows conveyed to the existing stormwater management ponds via existing storm sewers will also be reduced after the site revisions. As such, the existing SWM ponds and storm sewers are appropriately sized to accept major and minor system flows from the entire subject site and no upgrades to existing storm services are required. Storm sewer design sheets can be found in Appendix A.

3.3 Rooftop Drainage

3.3.1 Existing Conditions

As shown in Figure SS (back pocket), there is an existing RDC sewer system that surrounds the site, draining from north to south and ultimately to the east where it crosses Bayview Avenue and outlets to the south tributary of Lovers Creek.

3.3.2 Proposed Rooftop Servicing

As shown in Figure SS (back pocket), two connections to the existing rooftop drainage collector system located east of the subject site are proposed. These connections will convey rooftop drainage from Phases 1 and 2 in a perforated drainage system from the site and ultimately to the south tributary of Lovers Creek. The perforated storm sewer system will be designed to maintain contact with the underlying sand layer to promote active infiltration of the rooftop flows, which will be controlled to 20l/s/ha of roof. The existing 200mm to 250mm RDC sewers are appropriately sized to accommodate the rooftop drainage from the proposed site revisions and no upgrades to the existing RDC services are required. RDC sewer design sheets can be found in Appendix A.

3.4 Sanitary Drainage

3.4.1 Existing Conditions

As shown in Figure SS (back pocket), there is an existing sanitary sewer system that surrounds the site, draining from north to south and ultimately to the east where it crosses Bayview Avenue and outlets to an existing 750mm trunk sewer.

3.4.2 Proposed Sanitary Servicing

As shown in Figure SS (back pocket), two connections to the existing sanitary drainage system located east of the subject site are proposed. These connections will convey sanitary drainage from Phases 1 and 2 to the existing 200mm diameter sanitary sewers, which ultimately outlet to the existing trunk sanitary sewer located east of Bayview Drive. The existing sewers are appropriately sized to accommodate the increase in sanitary flows from the proposed site revisions and no upgrades are required to the existing sanitary services. Sanitary sewer design sheets can be found in Appendix A.

3.5 Water Supply

3.5.1 Existing Conditions

As shown in Figure SS (back pocket), a combination of existing 200mm and 250mm watermain surround and cross through the site.

3.5.2 Proposed Water System

Each Phase of the subject site will be serviced with a combination of fire and domestic watermain. These connections will be made to the existing watermain which surround the site and will extend to the building envelope. A Water System Analysis was completed by Hydratek & Associates and concluded that there is sufficient capacity to support the site revisions without further upgrades or modifications to the existing water supply network. The Water System Analysis can be found in Appendix B. Water service sizes and locations will ultimately be confirmed by the building's mechanical engineer.

4.0 STORMWATER MANAGEMENT

4.1 Stormwater Management Criteria

As the subject site falls within the original Park Place development site area, the associated stormwater management criteria for the proposed development is as specified by the Stormwater Management Analysis and Preliminary Servicing Study (PSS) for Park Place Development, 2007 prepared by Sabourin Kimble & Associates Ltd.:

- Post-development flows must be controlled to pre-development levels for all storms up to and including the 100-year storm event.
- On-site water quality controls must be provided which satisfy enhanced protection level (formerly level 1) constraints as outlined in the Ministry of Environment Stormwater Management Planning and Design Manual (March 2003).
- To maintain annual pre-development water balance under post development conditions it was determined that the runoff from building rooftops must be infiltrated as well as 5.3mm of runoff from parking lot areas.
- The Lake Simcoe Region Conservation Authority (LSRCA) requires that best efforts shall be employed such that any increase in phosphorus loading is kept to a minimum.

Excerpts from the PSS have been provided in Appendix D to reference this criteria.

4.2 Storm Drainage Plan

Under existing conditions, the majority of Phase 1 drains northerly to the existing SWM Pond C and remainder of the site drains southeasterly to the existing SWM Pond A.

After site revisions, existing drainage patterns will be maintained which convey the 100-year flows through the existing storm sewer system to SWM Pond C and SWM Pond A. The existing storm sewers and SWM Ponds have been designed to accept flow from the subject site and no upgrades are required to the existing storm services or SWM Ponds. Storm sewer design sheets can be found in Appendix A.

4.3 Water Balance

In accordance with the water balance design parameters set out in the approved PSS, rooftop runoff will be collected, controlled, and discharged to a perforated RDC sewer. A connection will be made via a perforated PVC sewer to collect the rooftop drainage from each Phase of the subject site to the existing roof drain collector system adjacent to the proposed residential development, which ultimately discharges to the south tributary of Lovers Creek. As per the approved PSS, the roof discharge will be controlled to a maximum of 20 l/s/ha of roof. For the proposed development, this corresponds total flows of 7.2 l/s and 4.6 l/s for Phases 1 and 2, respectively.

4.4 Quantity, Quality and Erosion Control

In accordance with the SWM Pond A and SWM Pond C designs set out in the approved PSS and *Park Place Development – Phase 1 SWM Brief,* February 2008, quantity, quality, and erosion control requirements for the site's runoff were accounted for in the design of the facilities. With current drainage patterns being maintained and an overall reduction in surface parking areas for the proposed site revisions, there will be an overall reduction in the storm drainage areas being conveyed to each Pond; therefore, both are adequately sized. Both ponds provide 2 year-100 year water quantity controls and MOE Enhanced Protection Level 1, while SWM Pond A and the SWM Pond C provide 84 and 24 hour extended detention of the 25mm storm event, respectively. All parking lot and grass drainage within the Park Place site plan, surrounding the subject site, is also currently conveyed to either the SWM Pond A or SWM Pond C.

4.5 Phosphorus Budget

In accordance with the LSRCA's Phosphorus budget requirements as outlined in the approved PSS, best efforts have been established to minimize phosphorus loading under post-development conditions. Phosphorus removal has been provided by 3 methods:

- Perforated RDC system collecting drainage from the rooftop
- Wet detention ponds collecting drainage from the remainder of the site
- Infiltration basin within the SWM Pond (accounts for 6.5% of the total active pond volume)

Using the MOE Phosphorus Budget Tool, the previously approved land use site plan and proposed site revision phosphorus loadings were calculated. As established in the approved PSS, best management practices (BMP) have been designed and are currently being utilized to treat runoff from the site. The total loading rate without BMP for the previously approved land use site plan was calculated based on high intensity – commercial, which yields a total phosphorus load of 4.50kg/yr. The mitigated loading rate utilizing BMP for this same site area (previously approved conditions) yields a total phosphorus load of 1.46kg/yr, a 68% annual reduction from the site. The mitigated loading rate for the proposed site revisions was also calculated based on high intensity – commercial, with a larger area proposed to drain to the RDC infiltration system, which yields a further reduced total phosphorus load of 1.38kg/yr. Therefore, the phosphorus loading rate for the proposed site revisions is lowered by an additional 0.08kg/yr, which is a further 5% annual reduction from the site from the previously approved conditions. A detailed summary of the phosphorus budget can be found in Appendix C, which indicates the further improvement to phosphorus loading.

5.0 EROSION AND SEDIMENTATION CONTROLS

Sediment fence will be placed appropriately around the site and shall be installed, where possible, prior to all construction activities within the Study Area, including underground sewer construction and building construction. As the construction will be staged due to the existing curbs and asphalt surrounding the site, the sediment control fence locations should be reviewed on an ongoing basis and relocated as necessary to ensure adequate sedimentation control. Sedimentation control measures are to be installed and operational prior to any construction activity and are to remain in place until such time as the building is constructed and the site grading complete with established sod and plantings, subject to approval by the City Engineering Department. Sediment controls must be inspected on a regular basis and after every rainfall event.

Repairs to sediment controls must be done in a timely manner to prevent sediment from entering the water and to prevent any off-site environmental impacts. The catchbasins should also be cleaned should they become laden with sediment during construction. Prior to assumption the entire storm system should be inspected and cleaned in order to ensure proper long-term function. All disturbed areas are to be reinstated to their original condition or better, as determined by the City engineering department.

6.0 CONCLUSIONS

Based on the findings of this Functional Servicing Study and Stormwater Management Analysis, the following conclusions were reached:

- The subject lands will be developed in two Phases as a mix of residential and retail uses.
- The subject site has been designed in accordance with the guidelines set out in the approved Stormwater Management Analysis and Preliminary Servicing Study (PSS) prepared by Sabourin Kimble and Associates Ltd. for the Park Place Development dated July 2003 and updated December 2007, and the approved Interim stormwater management facility (SWM Pond C) design in the Park Place Development – Phase 1 SWM Brief prepared by Sabourin Kimble and Associates Ltd. dated August 2007 and revised February 2008.
- The site will be graded for residential and retail use, satisfying current City of Barrie grading criteria, meeting boundary conditions and respecting drainage boundaries.
- The site will be serviced by two distinct existing storm sewer systems based on the existing site drainage divide. Most of Phase 1 drains to the north where storm drainage will be conveyed to the existing SWM Pond C. The remainder of the site, including Phase 2, drains to the south-east where storm drainage will be conveyed to the existing SWM Pond A. Both facilities provide 2 year-100 year water quantity controls and MOE Enhanced Protection Level 1. The existing SWM ponds and storm sewers are appropriately sized to accept major and minor system flows from the entire subject site.
- The site will be serviced by an existing roof drainage collector (RDC) system which outlets to the south tributary of Lovers Creek. Rooftop drainage will be controlled to 20 l/s/ha of roof area and will be conveyed via a perforated sewer system for infiltration. The existing RDC sewers are appropriately sized to accommodate the rooftop drainage from the proposed site revisions.
- The development will be serviced by an existing sanitary sewer system which outlets to the existing trunk sanitary sewer east of Bayview Drive. The existing sewers are appropriately sized to accommodate the increase in sanitary flows from the proposed site revisions.

- The site will be serviced by a combination of fire and domestic watermains with connections to the existing water distribution system surrounding the site. A Water System Analysis was completed by Hydratek & Associates and concluded that there is sufficient capacity to support the site revisions without further upgrades or modifications to the existing water supply network. Water service sizes and locations will be confirmed by the building's mechanical engineer.
- The total annual phosphorus load will be reduced by 5% to 1.38 kg/yr utilizing a perforated RDC system and a wet pond equipped an infiltration basin, as the proposed site revisions direct a larger area to the RDC infiltration system.
- During each phase of construction, adequate erosion and sedimentation controls must be provided in accordance with the City of Barrie and Lake Simcoe Region Conservation Authority guidelines

APPENDIX A

DESIGN SHEETS

PROJECT :	**Park Place Residential**	Old Criteria	**NOTES**
PROJECT NUMBER :	**02:999**	$I_{5YR} = \frac{1183.229}{(t + 12.036)^{0.833}}$	New Criteria $I_{5YR} = \frac{853.608}{(t + 4.699)^{0.766}}$
LOCATION:	**City of Barrie**	$I_{100YR} = \frac{2182.122}{(t + 14.443)^{0.841}}$	$I_{100YR} = \frac{1426.408}{(t + 5.273)^{0.759}}$
DATE :	**March 2022 - FSSR for ZBA**		**Designed By : MAG**

SABOURIN KIMBLE & ASSOCIATES LTD. CONSULTING ENGINEERS

5 YEAR AND 100 YEAR STORMS - PHASE 1

			AREAS OF OVERLAND FLOW							AREAS WHERE 100 YEAR STORM IS CAPTURED						STORM SEWER DESIGN									
STREET	Upstream Manhole	Downstream Manhole	A at R=0.20 (ha)	A at R=0.90 (ha)	A x R this section	Acc. AR	t (min)	I (5yr) (mm/hr)	Q (5yr) (l/s)	A at R=0.20 (ha)	A at R=0.90 (ha)	A X R this section	Acc. AR	I (100yr) (mm/hr)	Q (100yr) (l/s)	**Total Acc. AR (Design)**	**Q (Design) (l/s)**	Pipe	Pipe (mm)	Grade (%)	Capacity (l/s)	Velocity (m/s)	Length (m)	Time (min)	Total Time (min)	% Capacity
STORMWATER MANAGEMENT POND A																										
	219	213		0.00	0.000	0.000	10.00	90.00	0.00	0.08	0.11	0.12	0.115	148.40	47.41	**0.12**	**47.41**	METRIC	375	1.00	175.33	1.59	57.50	0.60	10.60	27.04%
	213	220		0.00	0.000	0.000	10.60	88.00	0.00	0.04	0.06	0.06	0.177	145.39	71.48	**0.18**	**71.48**	METRIC	375	0.50	123.98	1.12	40.00	0.59	11.20	57.66%
	220	221		0.00	0.000	0.000	11.20	86.12	0.00	0.05	0.07	0.07	0.250	142.55	98.99	**0.25**	**98.99**	IMPERIAL	450	0.50	210.32	1.28	32.00	0.42	11.61	47.07%
	221	222		0.00	0.000	0.000	11.61	84.85	0.00	0.04	0.04	0.04	0.294	140.63	114.85	**0.29**	**114.85**	IMPERIAL	450	0.50	210.32	1.28	58.00	0.75	12.37	54.61%
	222	223		0.00	0.000	0.000	12.37	82.66	0.00	0.12	0.16	0.17	0.462	137.30	176.20	**0.46**	**176.20**	IMPERIAL	525	0.50	317.25	1.42	44.50	0.52	12.89	55.54%
	223	224		0.00	0.000	0.000	12.89	81.22	0.00		0.11	0.10	0.561	135.09	210.51	**0.56**	**210.51**	IMPERIAL	525	0.50	317.25	1.42	64.00	0.75	13.64	66.36%
	224	225		0.00	0.000	0.000	13.64	79.23	0.00		0.00	0.00	0.561	132.04	205.77	**0.56**	**205.77**	IMPERIAL	525	0.50	317.25	1.42	68.00	0.80	14.44	64.86%
	225	228		0.00	0.000	0.000	14.44	77.24	0.00		0.00	0.00	0.561	128.97	200.97	**0.56**	**200.97**	IMPERIAL	525	0.50	317.25	1.42	74.00	0.87	15.31	63.35%
	203	303		0.00	0.000	0.000	10.00	90.00	0.00		0.00	0.00	0.000	148.40	0.00	**0.00**	**0.00**	METRIC	375	1.00	175.33	1.59	47.50	0.50	10.50	0.00%
	303	226		0.00	0.000	0.000	10.50	88.34	0.00		0.42	0.38	0.378	145.90	153.20	**0.38**	**153.20**	IMPERIAL	525	1.00	448.66	2.01	40.50	0.34	10.83	34.15%
	226	227		0.00	0.000	0.000	10.83	87.25	0.00		0.79	0.71	1.089	144.27	436.42	**1.09**	**436.42**	IMPERIAL	600	1.00	640.56	2.19	88.00	0.67	11.50	68.13%
	227	228		0.00	0.000	0.000	11.50	85.19	0.00		0.70	0.63	1.719	141.14	673.94	**1.72**	**673.94**	IMPERIAL	750	1.00	1161.42	2.55	70.50	0.46	11.96	58.03%
	228	231		0.00	0.000	0.000	15.31	75.19	0.00		0.26	0.23	2.514	125.79	878.45	**2.51**	**878.45**	IMPERIAL	750	2.00	1642.49	3.60	91.00	0.42	15.73	53.48%
	229	260		0.00	0.000	0.000	10.00	90.00	0.00		0.20	0.18	0.180	148.40	74.20	**0.18**	**74.20**	METRIC	375	1.00	175.33	1.59	48.00	0.50	10.50	42.32%
	261	260		0.00	0.000	0.000	10.00	90.00	0.00		0.04	0.04	0.036	148.40	14.84	**0.04**	**14.84**	METRIC	300	0.50	68.38	0.97	21.50	0.37	10.37	21.70%
	260	230		0.00	0.000	0.000	10.50	88.32	0.00		0.12	0.11	0.324	145.88	131.29	**0.32**	**131.29**	METRIC	375	1.00	175.33	1.59	22.00	0.23	10.73	74.88%
	230	231		0.00	0.000	0.000	10.73	87.57	0.00		0.14	0.13	0.450	144.75	180.94	**0.45**	**180.94**	IMPERIAL	450	0.50	210.32	1.28	15.50	0.20	10.94	86.03%
	231	216		0.00	0.000	0.000	15.73	74.24	0.00		0.07	0.06	3.027	124.31	1045.27	**3.03**	**1045.27**	IMPERIAL	750	1.50	1422.44	3.12	50.00	0.27	16.00	73.48%
	216	232		0.00	0.000	0.000	16.00	73.65	0.00		0.12	0.11	3.135	123.39	1074.57	**3.14**	**1074.57**	IMPERIAL	825	2.00	2117.79	3.84	72.00	0.31	16.31	50.74%
	232	255		0.00	0.000	0.000	16.31	72.97	0.00		0.00	0.00	3.135	122.34	1065.37	**3.14**	**1065.37**	IMPERIAL	825	2.50	2367.76	4.29	30.50	0.12	16.43	45.00%
	255	402		0.00	0.000	0.000	16.43	72.72	0.00		0.00	0.00	3.135	121.94	1061.94	**3.14**	**1061.94**	IMPERIAL	900	1.00	1888.59	2.88	32.00	0.19	16.61	56.23%
	401	402		0.00	0.000	0.000	10.00	90.00	0.00		0.28	0.25	0.252	148.40	103.88	**0.25**	**103.88**	METRIC	300	4.00	193.40	2.74	7.50	0.05	10.05	53.71%
	402	403		0.00	0.000	0.000	16.61	72.32	0.00		0.00	0.00	3.387	121.33	1141.53	**3.39**	**1141.53**	IMPERIAL	900	1.00	1888.59	2.88	11.00	0.06	16.68	60.44%
	403	129		0.00	0.000	0.000	16.68	72.19	0.00		0.00	0.00	3.387	121.12	1139.57	**3.39**	**1139.57**	IMPERIAL	900	1.00	1888.59	2.88	36.00	0.21	16.89	60.34%
	External		**External Flows from Barrieview Subdivision - Drainage Area = 12.1 Ha, Flows = 899 l/s under 100 year storm event from SWM report prepared by Skelton, Brumwell & Associates Ltd., dated March, 1989**																							
	External	100		0.00	0.000	0.000	10.00	90.00	0.00		0.01	0.01	0.009	148.40	902.71	**0.01**	**902.71**	IMPERIAL	900	2.00	2670.87	4.07	61.50	0.25	10.25	33.80%
	100	101		0.00	0.000	0.000	10.25	89.15	0.00	0.06	0.11	0.11	0.120	147.13	951.75	**0.12**	**951.75**	IMPERIAL	900	0.50	1335.43	2.03	48.50	0.40	10.65	71.27%
	101	102		0.00	0.000	0.000	10.65	87.85	0.00	0.05	0.06	0.06	0.184	145.17	976.91	**0.18**	**976.91**	IMPERIAL	975	0.50	1653.18	2.15	70.00	0.54	11.19	59.09%
	102	103		0.00	0.000	0.000	11.19	86.13	0.00	0.24	0.31	0.33	0.511	142.57	1105.08	**0.51**	**1105.08**	IMPERIAL	975	0.50	1653.18	2.15	59.00	0.46	11.65	66.85%
	103	105		0.00	0.000	0.000	11.65	84.74	0.00	0.09	0.22	0.22	0.727	140.46	1186.37	**0.73**	**1186.37**	IMPERIAL	975	2.35	3584.02	4.65	80.00	0.29	11.94	33.10%
	105	106		0.00	0.000	0.000	11.94	83.90	0.00		0.30	0.27	0.997	139.18	1288.15	**1.00**	**1288.15**	IMPERIAL	1050	0.50	2014.41	2.25	53.00	0.39	12.33	63.95%
	106	110		0.00	0.000	0.000	12.33	82.77	0.00		0.67	0.60	1.600	137.46	1513.65	**1.60**	**1513.65**	IMPERIAL	1050	0.50	2014.41	2.25	55.00	0.41	12.74	75.14%
	107	108		0.00	0.000	0.000	10.00	90.00	0.00		0.65	0.59	0.585	148.40	241.16	**0.59**	**241.16**	IMPERIAL	450	1.15	318.96	1.94	38.50	0.33	10.33	75.61%
	108	110		0.00	0.000	0.000	10.33	88.89	0.00		0.56	0.50	1.089	146.74	443.88	**1.09**	**443.88**	IMPERIAL	675	0.50	620.09	1.68	56.00	0.56	10.89	71.58%
	110	116		0.00	0.000	0.000	12.74	81.64	0.00		0.32	0.29	2.977	135.73	2025.12	**2.98**	**2025.12**	IMPERIAL	1050	0.80	2548.05	2.85	74.50	0.44	13.17	79.48%
	111	112		0.00	0.000	0.000	10.00	90.00	0.00		0.26	0.23	0.234	148.40	96.46	**0.23**	**96.46**	METRIC	300	1.00	96.70	1.37	35.00	0.43	10.43	99.75%
	112	116		0.00	0.000	0.000	10.43	88.57	0.00		0.47	0.42	0.657	146.26	266.93	**0.66**	**266.93**	IMPERIAL	525	0.50	317.25	1.42	56.00	0.66	11.08	84.14%
	114	116		0.00	0.000	0.000	10.00	90.00	0.00	0.03	0.63	0.57	0.573	148.40	236.21	**0.57**	**236.21**	IMPERIAL	450	1.00	297.43	1.81	70.00	0.64	10.64	79.42%
	116	119		0.00	0.000	0.000	13.17	80.46	0.00		0.00	0.00	4.207	133.93	2467.80	**4.21**	**2467.80**	IMPERIAL	1200	0.55	3016.40	2.58	61.00	0.39	13.57	81.81%
	113	115		0.00	0.000	0.000	10.00	90.00	0.00		0.12	0.11	0.108	148.40	44.52	**0.11**	**44.52**	METRIC	300	0.50	68.38	0.97	32.50	0.56	10.56	65.11%
	115	118		0.00	0.000	0.000	10.56	88.14	0.00		0.19	0.17	0.279	145.60	112.84	**0.28**	**112.84**	METRIC	375	0.60	135.81	1.23	26.00	0.35	10.91	83.09%
	118	171		0.00	0.000	0.000	10.91	87.01	0.00		0.00	0.00	0.279	143.90	111.52	**0.28**	**111.52**	IMPERIAL	450	0.50	210.32	1.28	17.00	0.22	11.13	53.03%
	171	119		0.00	0.000	0.000	11.13	86.32	0.00		0.12	0.11	0.387	142.85	153.57	**0.39**	**153.57**	IMPERIAL	450	0.50	210.32	1.28	30.00	0.39	11.52	73.02%
	119	121		0.00	0.000	0.000	13.57	79.43	0.00		0.00	0.00	4.594	132.34	2591.56	**4.59**	**2591.56**	IMPERIAL	1200	0.90	3858.59	3.31	26.50	0.13	13.70	67.16%
	120	121		0.00	0.000	0.000	10.00	90.00	0.00		0.39	0.35	0.351	148.40	144.69	**0.35**	**144.69**	METRIC	375	2.40	271.62	2.46	88.00	0.60	10.60	53.27%

PROJECT :	**Park Place Residential**
PROJECT NUMBER :	**02:999**
LOCATION:	**City of Barrie**
DATE :	**March 2022 - FSSR for ZBA**

Old Criteria

$I_{5YR} = \frac{1183.229}{(t + 12.036)^{0.833}}$

$I_{100YR} = \frac{2182.122}{(t + 14.443)^{0.841}}$

NOTES

New Criteria

$I_{5YR} = \frac{853.608}{(t + 4.699)^{0.766}}$

$I_{100YR} = \frac{1426.408}{(t + 5.273)^{0.759}}$

Designed By : MAG

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

5 YEAR AND 100 YEAR STORMS - PHASE 1

			AREAS OF OVERLAND FLOW							AREAS WHERE 100 YEAR STORM IS CAPTURED						STORM SEWER DESIGN									
STREET	Upstream Manhole	Downstream Manhole	A at R=0.20 (ha)	A at R=0.90 (ha)	A x R this section	Acc. AR	t (min)	I (5yr) (mm/hr)	Q (5yr) (l/s)	A at R=0.20 (ha)	A at R=0.90 (ha)	A X R this section	Acc. AR	I (100yr) (mm/hr)	Q (100yr) (l/s)	**Total Acc. AR (Design)**	**Q (Design) (l/s)**	Pipe	Pipe (mm)	Grade (%)	Capacity (l/s)	Velocity (m/s)	Length (m)	Time (min)	Total Time (min)	% Capacity
STORMWATER MANAGEMENT POND A																										
	121	127		0.00	0.000	0.000	13.70	79.08	0.00		0.28	0.25	5.197	131.81	2805.60	**5.20**	**2805.60**	IMPERIAL	1200	1.00	4067.31	3.48	55.50	0.27	13.97	68.98%
	122	127		0.00	0.000	0.000	10.00	90.00	0.00		0.33	0.30	0.297	148.40	122.43	**0.30**	**122.43**	METRIC	375	2.00	247.95	2.25	64.50	0.48	10.48	49.38%
	127	128		0.00	0.000	0.000	13.97	78.41	0.00		0.00	0.00	5.494	130.78	2898.52	**5.49**	**2898.52**	IMPERIAL	1200	1.00	4067.31	3.48	25.00	0.12	14.09	71.26%
	Ultrama EX	Ultramar STC		0.00	0.000	0.000	10.00	90.00	0.00			0.56	0.560	148.40	230.69	**0.56**	**230.69**	IMPERIAL								
	Ultramar STC	126		0.00	0.000	0.000	10.00	90.00	0.00		0.25	0.23	0.785	148.40	323.44	**0.78**	**323.44**	IMPERIAL	600	0.50	452.95	1.55	38.50	0.41	10.41	71.41%
	126	128		0.00	0.000	0.000	10.41	88.62	0.00		0.05	0.05	0.830	146.32	337.20	**0.83**	**337.20**	IMPERIAL	600	0.50	452.95	1.55	44.00	0.47	10.89	74.45%
	128	129		0.00	0.000	0.000	14.09	78.11	0.00		0.17	0.15	6.477	130.32	3247.17	**6.48**	**3247.17**	IMPERIAL	1350	1.00	5568.19	3.77	33.50	0.15	14.23	58.32%
	129	NEW MH		0.16	0.144	0.144	16.89	71.76	28.70		0.00	0.00	9.864	120.44	4202.75	**10.01**	**4231.45**	IMPERIAL	1350	0.80	4980.34	3.37	47.00	0.23	17.12	84.96%
	NEW MH	132			0.000	0.144	17.12	71.28	28.51		0.00	0.00	9.864	119.70	4182.30	**10.01**	**4210.81**	IMPERIAL	1350	2.88	9449.53	6.40	37.50	0.10	17.22	44.56%
	132	133		0.29	0.261	0.405	17.22	71.08	79.97		0.00	0.00	9.864	119.39	4173.79	**10.27**	**4253.75**	IMPERIAL	1350	1.50	6819.61	4.62	90.00	0.32	17.54	62.38%
	133	134		0.66	0.594	0.999	17.54	70.43	195.44		0.00	0.00	9.864	118.37	4145.81	**10.86**	**4341.26**	IMPERIAL	1650	0.50	6723.57	3.05	21.00	0.11	17.66	64.57%
	134	135		1.24	1.116	2.115	17.66	70.20	412.44		0.00	0.00	9.864	118.01	4136.05	**11.98**	**4548.49**	IMPERIAL	1650	0.50	6723.57	3.05	88.50	0.48	18.14	67.65%
	135	136		2.43	2.187	4.302	18.14	69.26	827.70		0.00	0.00	9.864	116.53	4095.59	**14.17**	**4923.29**	IMPERIAL	1650	0.50	6723.57	3.05	93.00	0.51	18.65	73.22%
	136	137		0.00	0.000	4.302	18.65	68.31	816.25		0.00	0.00	9.864	115.02	4054.25	**14.17**	**4870.50**	IMPERIAL	1650	0.96	9316.45	4.22	102.50	0.40	19.05	52.28%
	137	138		0.00	0.000	4.302	19.05	67.56	807.39		0.00	0.00	9.864	113.85	4022.19	**14.17**	**4829.59**	IMPERIAL	1650	0.50	6723.57	3.05	32.50	0.18	19.23	71.83%
	138	HW 1		0.00	0.000	4.302	19.23	67.24	803.57		0.00	0.00	9.864	113.35	4008.34	**14.17**	**4811.90**	IMPERIAL	1650	0.50	6723.57	3.05	119.00	0.65	19.88	71.57%
EXTERNAL 2	600	HW 2		10.76	9.684	9.684	10.00	90.00	2421.00		0.00	0.00	0.000	148.40	0.00	**9.68**	**2421.00**	IMPERIAL	1200	0.50	2876.02	2.46	19.00	0.13	10.13	84.18%
EAST LANDS	700	703		0.26	0.234	0.234	10.00	108.92	70.80		0.00	0.00	0.000	180.15	0.00	**0.23**	**70.80**	METRIC	300	0.80	86.49	1.22	39.00	0.53	10.53	81.86%
EAST LANDS	701	702		0.04	0.036	0.036	10.00	108.92	10.89		0.00	0.00	0.000	180.15	0.00	**0.04**	**10.89**	METRIC	300	0.50	68.38	0.97	31.00	0.53	10.53	15.93%
EAST LANDS	702	703		0.00	0.000	0.036	10.53	105.98	10.60		0.00	0.00	0.000	175.52	0.00	**0.04**	**10.60**	METRIC	300	0.50	68.38	0.97	48.00	0.83	11.36	15.50%
EAST LANDS	703	704		0.65	0.585	0.855	11.36	101.78	241.74		0.00	0.00	0.000	168.86	0.00	**0.86**	**241.74**	IMPERIAL	525	0.50	317.25	1.42	40.00	0.47	11.83	76.20%
EAST LANDS	704	706		0.24	0.216	1.071	11.83	99.56	296.20		0.00	0.00	0.000	165.33	0.00	**1.07**	**296.20**	IMPERIAL	525	0.50	317.25	1.42	90.00	1.06	12.89	93.36%
EAST LANDS	705	706		0.71	0.639	0.639	10.00	108.92	193.34		0.00	0.00	0.000	180.15	0.00	**0.64**	**193.34**	IMPERIAL	450	0.50	210.32	1.28	86.00	1.12	11.12	91.93%
EAST LANDS	706	707		0.18	0.162	1.872	12.89	94.95	493.72		0.00	0.00	0.000	157.98	0.00	**1.87**	**493.72**	IMPERIAL	675	0.50	620.09	1.68	63.50	0.63	13.52	79.62%
EAST LANDS	707	708		0.24	0.216	2.088	13.52	92.42	536.03		2.32	2.09	2.088	153.94	356.81	**4.18**	**892.84**	IMPERIAL	825	0.25	748.75	1.36	14.00	0.17	13.69	119.24%
EAST LANDS	708	709		0.00	0.000	2.088	13.69	91.76	532.19		0.00	0.00	2.088	152.88	350.65	**4.18**	**882.84**	IMPERIAL	825	0.25	748.75	1.36	95.50	1.17	14.86	117.91%
EAST LANDS	709	710		0.00	0.000	2.088	14.86	87.51	507.57		0.00	0.00	2.088	146.07	311.16	**4.18**	**818.73**	IMPERIAL	825	0.25	748.75	1.36	57.50	0.71	15.57	109.35%
EAST LANDS	710	711		0.00	0.000	2.088	15.57	85.16	493.96		0.00	0.00	2.088	142.29	289.28	**4.18**	**783.24**	IMPERIAL	825	0.25	748.75	1.36	77.50	0.95	16.52	104.61%
EAST LANDS	711	712		0.00	0.000	2.088	16.52	82.22	476.90		0.00	0.00	2.088	137.55	261.77	**4.18**	**738.67**	IMPERIAL	825	0.25	748.75	1.36	105.00	1.29	17.81	98.65%
EAST LANDS	712	601		0.00	0.000	2.088	17.81	78.59	455.82		0.00	0.00	2.088	131.68	227.71	**4.18**	**683.53**	IMPERIAL	825	0.25	748.75	1.36	117.00	1.44	19.25	91.29%
EAST LANDS	601	HW 2		0.00	0.000	2.088	19.25	74.95	434.71		0.00	0.00	2.088	125.78	193.49	**4.18**	**628.20**	IMPERIAL	825	0.50	1058.90	1.92	18.00	0.16	19.40	59.33%

PROJECT :	**Park Place Residential**
PROJECT NUMBER :	**02:999**
LOCATION:	**City of Barrie**
DATE :	**March 2022 - FSSR for ZBA**

Old Criteria

$I_{5YR} = \frac{1183.229}{(t + 12.036)^{0.833}}$

$I_{100YR} = \frac{2182.122}{(t + 14.443)^{0.841}}$

NOTES

New Criteria

$I_{5YR} = \frac{853.608}{(t + 4.699)^{0.766}}$

$I_{100YR} = \frac{1426.408}{(t + 5.273)^{0.759}}$

Designed By : MAG

SABOURIN KIMBLE & ASSOCIATES LTD. CONSULTING ENGINEERS

5 YEAR AND 100 YEAR STORMS - PHASE 1

			AREAS OF OVERLAND FLOW							AREAS WHERE 100 YEAR STORM IS CAPTURED						STORM SEWER DESIGN									
STREET	Upstream Manhole	Downstream Manhole	A at R=0.20 (ha)	A at R=0.90 (ha)	A x R this section	Acc. AR	t (min)	I (5yr) (mm/hr)	Q (5yr) (l/s)	A at R=0.20 (ha)	A at R=0.90 (ha)	A X R this section	Acc. AR	I (100yr) (mm/hr)	Q (100yr) (l/s)	**Total Acc. AR (Design)**	**Q (Design) (l/s)**	Pipe	Pipe (mm)	Grade (%)	Capacity (l/s)	Velocity (m/s)	Length (m)	Time (min)	Total Time (min)	% Capacity
STORMWATER MANAGEMENT POND C																									
	408	200		0.00	0.000	0.000	10.00	90.00	0.00	0.12	0.18	0.19	0.186	148.40	76.68	**0.19**	**76.68**	METRIC	375	0.50	123.98	1.12	23.50	0.35	10.35	61.85%
	200	201		0.00	0.000	0.000	10.35	88.83	0.00	0.05	0.23	0.22	0.403	146.64	164.16	**0.40**	**164.16**	IMPERIAL	450	1.00	297.43	1.81	44.50	0.41	10.76	55.19%
	201	522	0.05	0.06	0.064	0.064	10.76	87.50	15.56	0.00	0.00	0.00	0.403	144.64	161.92	**0.47**	**177.47**	IMPERIAL	450	0.50	210.32	1.28	32.50	0.42	11.18	84.38%
	522	239	0.17	0.13	0.151	0.215	11.18	86.17	51.46	0.00	0.00	0.00	0.403	142.63	159.67	**0.62**	**211.13**	IMPERIAL	450	1.60	376.23	2.29	103.00	0.75	11.93	56.12%
	239	540	0.32	0.13	0.181	0.396	11.93	83.92	92.31		0.02	0.02	0.421	139.21	162.80	**0.82**	**255.12**	IMPERIAL	450	1.00	297.43	1.81	24.00	0.22	12.15	85.77%
	540	500		0.00	0.000	0.396	12.15	83.28	91.61		0.00	0.00	0.421	138.24	161.67	**0.82**	**253.28**	IMPERIAL	450	1.00	297.43	1.81	47.50	0.44	12.59	85.15%
	500	241		0.24	0.216	0.612	12.59	82.05	139.48		0.00	0.00	0.421	136.36	159.47	**1.03**	**298.95**	IMPERIAL	450	1.80	399.05	2.43	103.50	0.71	13.30	74.91%
	205	206		0.62	0.558	0.558	10.00	90.00	139.50		0.00	0.00	0.000	148.40	0.00	**0.56**	**139.50**	IMPERIAL	600	0.50	452.95	1.55	44.50	0.48	10.48	30.80%
	206	207		0.98	0.882	1.440	10.48	88.41	353.62		0.00	0.00	0.000	146.01	0.00	**1.44**	**353.62**	IMPERIAL	600	1.50	784.52	2.69	100.50	0.62	11.10	45.07%
	207	241		1.06	0.954	2.394	11.10	86.42	574.68		0.00	0.00	0.000	143.00	0.00	**2.39**	**574.68**	IMPERIAL	600	2.00	905.89	3.10	90.50	0.49	11.59	63.44%
	241	501		0.24	0.216	3.222	13.30	80.13	717.16		0.00	0.00	0.421	133.42	156.03	**3.64**	**873.19**	IMPERIAL	750	1.50	1422.44	3.12	56.00	0.30	13.60	61.39%
	405	501		0.00	0.000	0.000	10.00	90.00	0.00		0.18	0.16	0.162	148.40	66.78	**0.16**	**66.78**	METRIC	300	3.50	180.91	2.56	24.50	0.16	10.16	36.91%
	501	502		0.00	0.000	3.222	13.60	79.35	710.18		0.06	0.05	0.637	132.22	233.96	**3.86**	**944.14**	IMPERIAL	750	1.60	1469.09	3.22	59.00	0.31	13.90	64.27%
	502	513		0.16	0.144	3.366	13.90	78.57	734.64		0.00	0.00	0.637	131.02	231.84	**4.00**	**966.48**	IMPERIAL	750	1.50	1422.44	3.12	73.50	0.39	14.29	67.95%
	529	504		0.00	0.000	0.000	10.00	90.00	0.00		0.41	0.37	0.369	148.40	152.11	**0.37**	**152.11**	IMPERIAL	450	0.50	210.32	1.28	27.50	0.36	10.36	72.33%
	530	504		0.00	0.000	0.000	10.00	90.00	0.00		0.05	0.05	0.045	148.40	18.55	**0.05**	**18.55**	METRIC	300	0.50	68.38	0.97	24.50	0.42	10.42	27.13%
	504	505		0.00	0.000	0.000	10.36	88.80	0.00		0.09	0.08	0.495	146.60	201.58	**0.50**	**201.58**	IMPERIAL	525	0.90	425.63	1.90	60.00	0.53	10.88	47.36%
	524	505			0.000	0.000	10.00	90.00	0.00		0.24	0.22	0.216	148.40	89.04	**0.22**	**89.04**	IMPERIAL	450	0.50	210.32	1.28	70.00	0.91	10.91	42.34%
	505	506			0.000	0.000	10.88	87.10	0.00		0.11	0.10	0.810	144.04	324.09	**0.81**	**324.09**	IMPERIAL	600	1.00	640.56	2.19	85.50	0.65	11.53	50.60%
	503	506			0.000	0.000	10.00	90.00	0.00		0.88	0.79	0.792	148.40	326.49	**0.79**	**326.49**	IMPERIAL	450	2.40	460.78	2.81	69.50	0.41	10.41	70.86%
	506	511			0.000	0.000	11.53	85.10	0.00		0.00	0.00	1.602	141.01	627.48	**1.60**	**627.48**	IMPERIAL	675	1.50	1074.02	2.91	71.00	0.41	11.94	58.42%
	526	511	0.00	0.00	0.000	0.000	10.00	90.00	0.00		0.75	0.68	0.675	148.40	278.26	**0.68**	**278.26**	IMPERIAL	450	2.00	420.64	2.56	64.00	0.42	10.42	66.15%
	507	508	0.00	0.00	0.000	0.000	10.00	90.00	0.00		0.81	0.73	0.729	148.40	300.52	**0.73**	**300.52**	IMPERIAL	600	0.80	572.94	1.96	71.50	0.61	10.61	52.45%
	523	508	0.00	0.00	0.000	0.000	10.00	90.00	0.00		0.04	0.04	0.036	148.40	14.84	**0.04**	**14.84**	METRIC	300	2.10	140.13	1.98	64.00	0.54	10.54	10.59%
	508	509	0.00	0.00	0.000	0.000	10.61	87.98	0.00		0.34	0.31	1.071	145.37	432.49	**1.07**	**432.49**	IMPERIAL	600	1.40	757.92	2.60	57.00	0.37	10.97	57.06%
	258	509	0.00	0.00	0.000	0.000	10.00	90.00	0.00		0.90	0.81	0.810	148.40	333.91	**0.81**	**333.91**	IMPERIAL	525	1.00	448.66	2.01	77.50	0.64	10.64	74.42%
	509	510	0.00	0.00	0.000	0.000	10.97	86.82	0.00		0.26	0.23	2.115	143.61	843.72	**2.12**	**843.72**	IMPERIAL	600	3.00	1109.48	3.80	47.00	0.21	11.18	76.05%
	262	254	0.00	0.00	0.000	0.000	10.00	90.00	0.00		0.22	0.20	0.198	148.40	81.62	**0.20**	**81.62**	METRIC	375	0.50	123.98	1.12	51.50	0.76	10.76	65.84%
	254	510	0.00	0.00	0.000	0.000	10.76	87.48	0.00		0.42	0.38	0.576	144.61	231.37	**0.58**	**231.37**	IMPERIAL	525	0.50	317.25	1.42	35.00	0.41	11.18	72.93%
	510	511			0.000	0.000	11.18	86.18	0.00		0.23	0.21	2.898	142.64	1148.25	**2.90**	**1148.25**	IMPERIAL	900	0.50	1335.43	2.03	60.00	0.49	11.67	85.98%
	511	512			0.000	0.000	11.94	83.89	0.00		0.06	0.05	5.229	139.17	2021.52	**5.23**	**2021.52**	IMPERIAL	1200	0.50	2876.02	2.46	99.00	0.67	12.61	70.29%
	527	512			0.000	0.000	10.00	90.00	0.00		0.45	0.41	0.405	148.40	166.95	**0.41**	**166.95**	METRIC	375	2.00	247.95	2.25	19.00	0.14	10.14	67.33%
	512	513			0.000	0.000	12.61	81.99	0.00		0.35	0.32	5.949	136.27	2251.89	**5.95**	**2251.89**	IMPERIAL	1200	0.50	2876.02	2.46	99.50	0.67	13.28	78.30%
	513	515	0.32	0.288	3.654	14.29	77.59	787.57		0.00	0.00	6.586	129.51	2369.42	**10.24**	**3156.99**	IMPERIAL	1350	0.50	3937.31	2.66	70.00	0.44	14.73	80.18%
	514	515	0.59	0.531	0.531	10.00	90.00	132.75		0.00	0.00	0.000	148.40	0.00	**0.53**	**132.75**	METRIC	375	1.00	175.33	1.59	11.00	0.12	10.12	75.71%
	532	533			0.000	0.000	10.00	90.00	0.00		0.02	0.02	0.018	148.40	7.42	**0.02**	**7.42**	METRIC	250	0.50	42.05	0.86	25.50	0.50	10.50	17.65%
	533	515	0.00	0.00	0.000	10.50	88.35	0.00		0.02	0.02	0.036	145.92	14.59	**0.04**	**14.59**	IMPERIAL	250	5.00	138.72	2.74	29.00	0.18	10.67	10.52%
	515	521	0.00	0.00	4.185	14.73	76.53	889.72		0.03	0.03	6.649	127.88	2361.86	**10.83**	**3251.57**	IMPERIAL	1350	0.50	3937.31	2.66	33.00	0.21	14.94	82.58%
	516	517			0.000	0.000	10.00	90.00	0.00		0.44	0.40	0.396	148.40	163.24	**0.40**	**163.24**	METRIC	375	2.00	247.95	2.25	46.00	0.34	10.34	65.84%
	517	518	0.00	0.00	0.000	0.000	10.34	88.85	0.00		0.78	0.70	1.098	146.68	447.38	**1.10**	**447.38**	IMPERIAL	525	1.20	491.48	2.20	42.50	0.32	10.66	91.03%
	518	519	0.00	0.00	0.000	0.000	10.66	87.80	0.00		0.22	0.20	1.296	145.10	522.35	**1.30**	**522.35**	IMPERIAL	525	1.50	549.49	2.46	88.00	0.60	11.26	95.06%
	519	531	0.00	0.00	0.000	0.000	11.26	85.93	0.00		0.00	0.00	1.296	142.26	512.14	**1.30**	**512.14**	IMPERIAL	525	2.00	634.50	2.84	13.50	0.08	11.34	80.72%
	531	520	0.00	0.00	0.000	0.000	11.34	85.68	0.00		0.14	0.13	1.422	141.89	560.48	**1.42**	**560.48**	IMPERIAL	525	2.50	709.39	3.17	22.00	0.12	11.45	79.01%
	528	520	0.00	0.00	0.000	0.000	10.00	90.00	0.00		0.39	0.35	0.351	148.40	144.69	**0.35**	**144.69**	IMPERIAL	450	0.50	210.32	1.28	35.00	0.46	10.46	68.80%
	520	521	0.00	0.00	0.000	0.000	11.45	85.33	0.00		0.13	0.12	1.890	141.36	742.14	**1.89**	**742.14**	IMPERIAL	675	1.00	876.94	2.37	47.00	0.33	11.78	84.63%
	521	HW3			0.000	4.185	14.94	76.05	884.04			0.00	8.539	127.12	3015.29	**12.72**	**3899.33**	IMPERIAL	1500	0.50	5214.58	2.86	39.50	0.23	15.17	74.78%

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March 2022 - FSSR for ZBA

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

ROOFTOP DRAINAGE COLLECTOR SEWER DESIGN

			TOTAL DESIGN AREA		COMMERICAL			TOTAL FLOWS	PIPE DESIGN						
Street	Upstream Manhole	Downstream Manhole	Section Area (ha)	Cummulative Area (ha)	Rooftop Section Area (ha)	Cummulative Rooftop Area (ha)	Cummulative Rooftop Flow (l/s)	Cummulative Design Flow (l/s)	Pipe	Pipe Size (mm)	Grade (%)	Capacity (l/s)	Velocity (m/s)	Length	% Capacity
RDC AREA TRIBUTARY TO EXISTING 1200 CSP															
	Plug A	200B	0.00	0.00	0.000	0.000	0.00	0.00	IMPERIAL	200	0.20	15.30	0.47	26.5	0.00%
	Plug B	200B	0.11	0.11	0.110	0.110	2.20	2.20	IMPERIAL	200	4.00	68.43	2.11	18.5	3.21%
	200B	104B	0.00	0.11	0.000	0.110	2.20	2.20	IMPERIAL	200	0.50	24.19	0.75	85.0	9.09%
	Plug A	225B	0.00	0.00	0.000	0.000	0.00	0.00	IMPERIAL	200	0.50	24.19	0.75	19.0	0.00%
	Plug B	225B	0.06	0.06	0.060	0.060	1.20	1.20	IMPERIAL	200	0.50	24.19	0.75	9.0	4.96%
	225B	104B	0.00	0.06	0.000	0.060	1.20	1.20	IMPERIAL	200	0.50	24.19	0.75	23.0	4.96%
	Plug A	104B	0.22	0.22	0.220	0.220	4.40	4.40	IMPERIAL	200	5.00	76.51	2.36	19.5	5.75%
	104B	317B	0.00	0.39	0.000	0.390	7.80	7.80	IMPERIAL	200	1.10	35.89	1.11	22.5	21.74%
	Plug A	317B	0.05	0.05	0.050	0.050	1.00	1.00	IMPERIAL	200	0.50	24.19	0.75	38.0	4.13%
	Plug B	317B	0.06	0.06	0.060	0.060	1.20	1.20	IMPERIAL	200	5.00	76.51	2.36	20.0	1.57%
	317B	105B	0.00	0.50	0.000	0.500	10.00	10.00	IMPERIAL	200	0.20	15.30	0.47	37.0	65.35%
	105B	110B	0.00	0.50	0.000	0.500	10.00	10.00	IMPERIAL	200	1.00	34.22	1.06	116.5	29.23%
	Plug A	107B	0.41	0.41	0.410	0.410	8.20	8.20	IMPERIAL	200	5.00	76.51	2.36	4.5	10.72%
	Plug B	107B	0.36	0.36	0.360	0.360	7.20	7.20	IMPERIAL	200	1.00	34.22	1.06	8.0	21.04%
	107B	109B	0.00	0.77	0.000	0.770	15.40	15.40	IMPERIAL	200	0.30	18.74	0.58	65.0	82.17%
	Plug	108B	0.05	0.05	0.050	0.050	1.00	1.00	IMPERIAL	200	3.50	64.01	1.97	16.5	1.56%
	108B	109B	0.00	0.05	0.000	0.050	1.00	1.00	IMPERIAL	200	4.00	68.43	2.11	30.0	1.46%
	Plug	109B	0.23	0.23	0.230	0.230	4.60	4.60	IMPERIAL	200	1.00	34.22	1.06	5.0	13.44%
	109B	110B	0.00	1.05	0.000	1.050	21.00	21.00	IMPERIAL	200	0.65	27.59	0.85	93.5	76.12%
	110B	118B	0.00	1.55	0.000	1.550	31.00	31.00	IMPERIAL	250	0.30	33.98	0.67	19.0	91.23%
	Plug	122B	0.04	0.04	0.040	0.040	0.80	0.80	IMPERIAL	200	3.00	59.26	1.83	23.0	1.35%
	122B	111B	0.00	0.04	0.000	0.040	0.80	0.80	IMPERIAL	200	0.20	15.30	0.47	71.5	5.23%
	Plug A	111B	0.06	0.06	0.060	0.060	1.20	1.20	IMPERIAL	200	5.00	76.51	2.36	4.5	1.57%
	Plug B	111B	0.06	0.06	0.060	0.060	1.20	1.20	IMPERIAL	200	5.00	76.51	2.36	9.0	1.57%
	111B	112B	0.00	0.16	0.000	0.160	3.20	3.20	IMPERIAL	200	0.20	15.30	0.47	79.5	20.91%
	Plug A	112B	0.04	0.04	0.040	0.040	0.80	0.80	IMPERIAL	200	3.00	59.26	1.83	14.0	1.35%
	Plug B	112B	0.06	0.06	0.060	0.060	1.20	1.20	IMPERIAL	200	5.00	76.51	2.36	14.0	1.57%
	112B	116B	0.00	0.26	0.000	0.260	5.20	5.20	IMPERIAL	200	0.20	15.30	0.47	42.5	33.98%
	Plug	113B	0.02	0.02	0.020	0.020	0.40	0.40	IMPERIAL	200	3.00	59.26	1.83	15.5	0.67%
	113B	114B	0.00	0.02	0.000	0.020	0.40	0.40	IMPERIAL	200	0.20	15.30	0.47	17.5	2.61%
	114B	115B	0.00	0.02	0.000	0.020	0.40	0.40	IMPERIAL	200	0.20	15.30	0.47	26.0	2.61%
	Plug	115B	0.03	0.03	0.032	0.032	0.63	0.63	IMPERIAL	200	3.80	66.70	2.06	8.0	0.94%
	115B	116B	0.00	0.05	0.000	0.052	1.03	1.03	IMPERIAL	200	0.20	15.30	0.47	24.5	6.73%
	Plug	116B	0.03	0.03	0.028	0.028	0.55	0.55	IMPERIAL	200	1.80	45.91	1.42	18.5	1.20%
	116B	117B	0.00	0.34	0.000	0.339	6.78	6.78	IMPERIAL	200	0.20	15.30	0.47	42.0	44.31%
	117B	118B	0.00	0.34	0.000	0.339	6.78	6.78	IMPERIAL	200	1.00	34.22	1.06	27.5	19.81%
	118B	119B	0.00	1.89	0.000	1.889	37.78	37.78	IMPERIAL	300	0.75	87.37	1.20	29.0	43.24%
	Plug	119B	0.03	0.03	0.030	0.030	0.60	0.60	IMPERIAL	200	5.00	76.51	2.36	9.5	0.78%
	119B	120B	0.00	1.92	0.000	1.919	38.38	38.38	IMPERIAL	300	3.00	174.73	2.39	25.0	21.96%
	120B	121B	0.00	1.92	0.000	1.919	38.38	38.38	IMPERIAL	300	3.00	174.73	2.39	14.5	21.96%
	Plug	121B	0.05	0.05	0.050	0.050	1.00	1.00	IMPERIAL	200	5.00	76.51	2.36	7.0	1.31%

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March 2022 - FSSR for ZBA

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

ROOFTOP DRAINAGE COLLECTOR SEWER DESIGN

			TOTAL DESIGN AREA		COMMERICAL			TOTAL FLOWS	PIPE DESIGN						
Street	Upstream Manhole	Downstream Manhole	Section Area (ha)	Cummulative Area (ha)	Rooftop Section Area (ha)	Cummulative Rooftop Area (ha)	Cummulative Rooftop Flow (l/s)	Cummulative Design Flow (l/s)	Pipe	Pipe Size (mm)	Grade (%)	Capacity (l/s)	Velocity (m/s)	Length	% Capacity
RDC AREA TRIBUTARY TO WEST CREEK HEADWALL															
	Plug	101B	0.08	0.08	0.080	0.080	1.60	1.60	IMPERIAL	200	0.50	24.19	0.75	19.0	6.61%
	101B	103B	0.00	0.08	0.000	0.080	1.60	1.60	IMPERIAL	200	0.20	15.30	0.47	37.0	10.46%
	Plug	103B	0.14	0.14	0.140	0.140	2.80	2.80	IMPERIAL	200	3.00	59.26	1.83	25.5	4.72%
	103B	102B	0.00	0.22	0.000	0.220	4.40	4.40	IMPERIAL	200	0.20	15.30	0.47	37.5	28.75%
	Plug	102B	0.09	0.09	0.090	0.090	1.80	1.80	IMPERIAL	200	3.70	65.82	2.03	25.0	2.73%
	102B	100B	0.00	0.31	0.000	0.310	6.20	6.20	IMPERIAL	200	0.20	15.30	0.47	38.0	40.52%
	Plug	100B	0.15	0.15	0.150	0.150	3.00	3.00	IMPERIAL	200	5.20	78.03	2.41	25.0	3.84%
	100B	150B	0.00	0.46	0.000	0.460	9.20	9.20	IMPERIAL	200	0.20	15.30	0.47	52.5	60.12%
	Plug	150B	0.26	0.26	0.260	0.260	5.20	5.20	IMPERIAL	200	5.00	76.51	2.36	26.0	6.80%
	150B	151B	0.00	0.72	0.000	0.720	14.40	14.40	IMPERIAL	250	0.20	27.74	0.55	61.0	51.90%
	Plug	151B	0.28	0.28	0.280	0.280	5.60	5.60	IMPERIAL	200	5.00	76.51	2.36	26.0	7.32%
	151B	162B	0.00	1.00	0.000	1.000	20.00	20.00	IMPERIAL	250	0.20	27.74	0.55	51.5	72.09%
	Plug	162B	0.13	0.13	0.130	0.130	2.60	2.60	IMPERIAL	200	5.00	76.51	2.36	26.0	3.40%
	162B	152B	0.00	1.13	0.000	1.130	22.60	22.60	IMPERIAL	300	0.20	45.12	0.62	17.5	50.09%
	Plug	152B	0.28	0.28	0.280	0.280	5.60	5.60	IMPERIAL	200	5.00	76.51	2.36	26.0	7.32%
	152B	153B	0.00	1.41	0.000	1.410	28.20	28.20	IMPERIAL	300	0.20	45.12	0.62	69.5	62.51%
	Plug	153B	0.12	0.12	0.120	0.120	2.40	2.40	IMPERIAL	200	5.00	76.51	2.36	26.0	3.14%
	153B	165B	0.00	1.53	0.000	1.530	30.60	30.60	IMPERIAL	300	0.20	45.12	0.62	23.5	67.83%
	Plug	165B	0.08	0.08	0.080	0.080	1.60	1.60	IMPERIAL	200	5.00	76.51	2.36	26.0	2.09%
	165B	154B	0.00	1.61	0.000	1.610	32.20	32.20	IMPERIAL	300	0.20	45.12	0.62	17.0	71.37%
	Plug	154B	0.08	0.08	0.080	0.080	1.60	1.60	IMPERIAL	200	5.00	76.51	2.36	26.0	2.09%
	154B	155B	0.00	1.69	0.000	1.690	33.80	33.80	IMPERIAL	300	0.20	45.12	0.62	52.0	74.92%
	Plug	155B	0.30	0.30	0.300	0.300	6.00	6.00	IMPERIAL	200	5.00	76.51	2.36	15.0	7.84%
	155B	156B	0.00	1.99	0.000	1.990	39.80	39.80	IMPERIAL	300	0.20	45.12	0.62	40.0	88.22%
	156B	157B	0.00	1.99	0.000	1.990	39.80	39.80	IMPERIAL	375	0.20	81.80	0.72	91.0	48.65%
	Plug	172B	0.34	0.34	0.338	0.338	6.76	125.40	IMPERIAL	375	1.90	252.13	2.21	12.0	49.74%
	172B	171B	0.04	0.38	0.040	0.378	7.56	139.81	IMPERIAL	450	0.50	210.32	1.28	36.5	66.48%
	Plug	170B	0.31	0.31	0.307	0.307	6.15	114.05	IMPERIAL	300	2.00	142.67	1.96	12.5	79.94%
	170B	171B	0.04	0.35	0.040	0.348	6.95	128.49	IMPERIAL	375	1.30	208.55	1.83	46.0	61.61%
	171B	173B	0.00	0.73	0.000	0.726	14.52	264.02	IMPERIAL	450	1.00	297.43	1.81	18.0	88.77%
	173B	Stormtech	0.00	0.73	0.000	0.726	14.52	262.24	IMPERIAL	450	1.00	297.43	1.81	3.0	88.17%
	Stormtech	174B	0.00	0.73	0.000	0.726	14.52	262.24	IMPERIAL	450	1.00	297.43	1.81	10.0	88.17%
	174B	157B	0.00	0.73	0.000	0.726	14.52	14.52	IMPERIAL	200	4.00	68.43	2.11	16.0	21.21%
	157B	159B	0.00	2.72	0.000	2.716	54.32	54.32	IMPERIAL	375	0.20	81.80	0.72	26.0	66.40%
	Plug	159B	0.42	0.42	0.420	0.420	8.40	8.40	IMPERIAL	200	2.00	48.39	1.49	10.0	17.36%
	159B	160B	0.00	3.14	0.000	3.136	62.72	62.72	IMPERIAL	375	0.20	81.80	0.72	80.5	76.67%
	160B	163B	0.00	3.14	0.000	3.136	62.72	62.72	IMPERIAL	375	0.20	81.80	0.72	97.0	76.67%
	163B	HW 3B	0.00	3.14	0.000	3.136	62.72	62.72	IMPERIAL	375	1.00	182.91	1.60	81.5	34.29%

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ROOFTOP DRAINAGE COLLECTOR SEWER DESIGN

			TOTAL DESIGN AREA		COMMERICAL			TOTAL FLOWS	PIPE DESIGN						
Street	Upstream Manhole	Downstream Manhole	Section Area (ha)	Cummulative Area (ha)	Rooftop Section Area (ha)	Cummulative Rooftop Area (ha)	Cummulative Rooftop Flow (l/s)	Cummulative Design Flow (l/s)	Pipe	Pipe Size (mm)	Grade (%)	Capacity (l/s)	Velocity (m/s)	Length	% Capacity
RDC AREA TRIBUTARY TO EAST CREEK HEADWALL															
	Plug A	201B	0.06	0.06	0.060	0.060	1.20	1.20	IMPERIAL	200	5.00	76.51	2.36	5.5	1.57%
	Plug B	201B	0.24	0.24	0.240	0.240	4.80	4.80	IMPERIAL	200	3.30	62.16	1.92	17.0	7.72%
	201B	204B	0.00	0.30	0.000	0.300	6.00	6.00	IMPERIAL	200	4.00	68.43	2.11	45.0	8.77%
	Plug A	319B	0.02	0.02	0.020	0.020	0.40	0.40	IMPERIAL	200	5.00	76.51	2.36	13.0	0.52%
	Plug B	319B	0.16	0.16	0.160	0.160	3.20	3.20	IMPERIAL	200	3.00	59.26	1.83	15.0	5.40%
	319B	318B	0.00	0.18	0.000	0.180	3.60	3.60	IMPERIAL	200	0.50	24.19	0.75	22.0	14.88%
	Plug A	318B	0.03	0.03	0.030	0.030	0.60	0.60	IMPERIAL	200	5.00	76.51	2.36	8.5	0.78%
	Plug B	318B	0.24	0.24	0.240	0.240	4.80	4.80	IMPERIAL	200	5.00	76.51	2.36	16.0	6.27%
	318B	202B	0.00	0.45	0.000	0.450	9.00	9.00	IMPERIAL	200	3.00	59.26	1.83	20.0	15.19%
	Plug A	202B	0.07	0.07	0.070	0.070	1.40	1.40	IMPERIAL	200	3.50	64.01	1.97	13.0	2.19%
	202B	203B	0.00	0.52	0.000	0.520	10.40	10.40	IMPERIAL	200	1.30	39.01	1.20	39.5	26.66%
	Plug A	203B	0.10	0.10	0.100	0.100	2.00	2.00	IMPERIAL	200	5.00	76.51	2.36	15.5	2.61%
	Plug B	203B	0.09	0.09	0.090	0.090	1.80	1.80	IMPERIAL	200	5.00	76.51	2.36	30.5	2.35%
	203B	204B	0.00	0.71	0.000	0.710	14.20	14.20	IMPERIAL	200	2.00	48.39	1.49	53.0	29.35%
	204B	219B	0.00	1.01	0.000	1.010	20.20	20.20	IMPERIAL	200	0.30	18.74	0.58	49.5	107.78%
	Plug	219B	0.19	0.19	0.190	0.190	3.80	3.80	IMPERIAL	200	5.00	76.51	2.36	17.5	4.97%
	219B	205B	0.00	1.20	0.000	1.200	24.00	24.00	IMPERIAL	200	2.40	53.01	1.63	62.0	45.28%
	Plug	205B	0.01	0.01	0.010	0.010	0.20	0.20	IMPERIAL	200	3.10	60.24	1.86	48.0	0.33%
	205B	208B	0.00	1.21	0.000	1.210	24.20	24.20	IMPERIAL	200	1.10	35.89	1.11	33.5	67.43%
	Plug	206B	0.06	0.06	0.060	0.060	1.20	1.20	IMPERIAL	200	5.00	76.51	2.36	7.0	1.57%
	206B	208B	0.00	0.06	0.000	0.060	1.20	1.20	IMPERIAL	200	4.00	68.43	2.11	40.5	1.75%
	Plug	207B	0.05	0.05	0.050	0.050	1.00	1.00	IMPERIAL	200	3.00	59.26	1.83	23.0	1.69%
	207B	208B	0.00	0.05	0.000	0.050	1.00	1.00	IMPERIAL	200	0.20	15.30	0.47	96.0	6.54%
	208B	211B	0.00	1.32	0.000	1.320	26.40	26.40	IMPERIAL	200	1.00	34.22	1.06	118.0	77.16%
	Plug	211B	0.16	0.16	0.160	0.160	3.20	3.20	IMPERIAL	200	5.00	76.51	2.36	11.0	4.18%
	Plug	209B	0.10	0.10	0.100	0.100	2.00	2.00	IMPERIAL	200	1.30	39.01	1.20	17.5	5.13%
	209B	210B	0.00	0.10	0.000	0.100	2.00	2.00	IMPERIAL	200	0.20	15.30	0.47	75.5	13.07%
	Plug	224B	0.19	0.19	0.190	0.190	3.80	3.80	IMPERIAL	200	2.50	54.10	1.67	28.0	7.02%
	Plug	224B	0.29	0.29	0.290	0.290	5.80	5.80	IMPERIAL	200	0.50	24.19	0.75	33.0	23.97%
	224B	210B	0.00	0.48	0.000	0.480	9.60	9.60	IMPERIAL	200	2.50	54.10	1.67	9.5	17.74%
	210B	211B	0.00	0.58	0.000	0.580	11.60	11.60	IMPERIAL	200	1.30	39.01	1.20	100.5	29.73%
	211B	214B	0.00	2.06	0.000	2.060	41.20	41.20	IMPERIAL	250	1.00	62.04	1.22	45.5	66.41%
	Plug	214B	0.27	0.27	0.270	0.270	5.40	5.40	IMPERIAL	200	5.00	76.51	2.36	18.0	7.06%
	214B	215B	0.00	2.33	0.000	2.330	46.60	46.60	IMPERIAL	250	1.00	62.04	1.22	51.5	75.11%
	Plug	212B	0.19	0.19	0.190	0.190	3.80	70.49	IMPERIAL	300	2.00	142.67	1.96	2.5	49.41%
	212B	222B	0.00	0.19	0.000	0.190	3.80	70.44	IMPERIAL	450	1.50	364.28	2.22	20.5	19.34%
	Plug	222B	0.39	0.39	0.390	0.390	7.80	144.69	IMPERIAL	375	2.00	258.68	2.27	2.5	55.93%
	222B	223B	0.00	0.58	0.000	0.580	11.60	213.89	IMPERIAL	450	1.50	364.28	2.22	16.0	58.72%
	Plug	223B	0.39	0.39	0.390	0.390	7.80	144.69	IMPERIAL	375	2.00	258.68	2.27	2.5	55.93%
	223B	213B	0.00	0.97	0.000	0.970	19.40	356.26	IMPERIAL	525	1.00	448.66	2.01	10.5	79.41%
	Plug	213B	0.19	0.19	0.190	0.190	3.80	70.49	IMPERIAL	300	2.00	142.67	1.96	2.5	49.41%
	213B	220B	0.00	1.16	0.000	1.160	23.20	424.78	IMPERIAL	600	0.60	496.18	1.70	49.0	85.61%
	220B	221B	0.00	1.16	0.000	1.160	23.20	417.99	IMPERIAL	600	0.60	496.18	1.70	12.0	84.24%
	221B	215B	0.00	1.16	0.000	1.160	23.20	23.20	IMPERIAL	200	4.00	68.43	2.11	17.0	33.90%
	215B	NEWB	0.00	3.49	0.000	3.490	69.80	69.80	IMPERIAL	375	1.00	182.91	1.60	30.0	38.16%
	NEWB	218B	0.00	3.49	0.000	3.490	69.80	69.80	IMPERIAL	375	1.00	182.91	1.60	56.5	38.16%
	218B	HW 5B	0.00	3.49	0.000	3.490	69.80	69.80	IMPERIAL	375	0.65	147.47	1.29	50.5	47.33%

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March 2022 - FSSR for ZBA

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

ROOFTOP DRAINAGE COLLECTOR SEWER DESIGN

			TOTAL DESIGN AREA		COMMERICAL			TOTAL FLOWS	PIPE DESIGN						
Street	Upstream Manhole	Downstream Manhole	Section Area (ha)	Cummulative Area (ha)	Rooftop Section Area (ha)	Cummulative Rooftop Area (ha)	Cummulative Rooftop Flow (l/s)	Cummulative Design Flow (l/s)	Pipe	Pipe Size (mm)	Grade (%)	Capacity (l/s)	Velocity (m/s)	Length	% Capacity
EAST OF BAYVIEW DRIVE															
	Plug	400B	0.07	0.07	0.070	0.070	1.40	1.40	IMPERIAL	200	1.00	34.22	1.06	22.0	4.09%
	400B	401B	0.00	0.07	0.000	0.070	1.40	1.40	IMPERIAL	200	0.50	24.19	0.75	43.0	5.79%
	Plug	401B	0.06	0.06	0.060	0.060	1.20	1.20	IMPERIAL	200	5.00	76.51	2.36	12.5	1.57%
	401B	402B	0.00	0.13	0.000	0.130	2.60	2.60	IMPERIAL	200	1.50	41.91	1.29	85.0	6.20%
	402B	404B	0.00	0.13	0.000	0.130	2.60	2.60	IMPERIAL	200	2.00	48.39	1.49	110.0	5.37%
	Plug	403B	0.16	0.16	0.160	0.160	3.20	3.20	IMPERIAL	200	5.00	76.51	2.36	16.0	4.18%
	403B	404B	0.00	0.16	0.000	0.160	3.20	3.20	IMPERIAL	200	0.50	24.19	0.75	38.0	13.23%
	404B	405B	0.00	0.29	0.000	0.290	5.80	5.80	IMPERIAL	250	0.20	27.74	0.55	14.0	20.90%
	405B	406B	0.00	0.29	0.000	0.290	5.80	5.80	IMPERIAL	250	0.20	27.74	0.55	96.0	20.90%
	406B	407B	0.00	0.29	0.000	0.290	5.80	5.80	IMPERIAL	250	0.20	27.74	0.55	55.0	20.90%
	407B	408B	0.00	0.29	0.000	0.290	5.80	5.80	IMPERIAL	250	0.20	27.74	0.55	74.0	20.90%
	408B	409B	0.00	0.29	0.000	0.290	5.80	5.80	IMPERIAL	250	0.20	27.74	0.55	102.5	20.90%
	409B	410B	0.00	0.29	0.000	0.290	5.80	5.80	IMPERIAL	250	0.20	27.74	0.55	113.0	20.90%
	410B	411B	0.00	0.29	0.000	0.290	5.80	5.80	IMPERIAL	250	0.20	27.74	0.55	88.0	20.90%
	411B	309B	0.00	0.29	0.000	0.290	5.80	5.80	IMPERIAL	250	0.20	27.74	0.55	69.5	20.90%
	External	309B	5.68	5.68	5.680	5.680	113.60	113.60	IMPERIAL	450	0.20	133.02	0.81	90.0	85.40%
	309B	501B	0.00	5.97	0.000	5.970	119.40	119.40	IMPERIAL	450	0.20	133.02	0.81	90.0	89.76%
	501B	502B	0.00	5.97	0.000	5.970	119.40	119.40	IMPERIAL	450	0.20	133.02	0.81	19.0	89.76%
	502B	504	0.00	5.97	0.000	5.970	119.40	119.40	IMPERIAL	450	0.20	133.02	0.81	75.0	89.76%

PROJECT TITLE:	Park Place Residential
PROJECT No.:	02:999
CLIENT:	North American (Park Place) Corporation
ISSUED FOR:	March 2022

SANITARY SEWER DESIGN SHEET
CITY OF BARRIE

ENGINEER'S SEAL

PREPARED BY:

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

NOTES, STANDARDS AND DESIGN INPUT PARAMETERS

Densities (persons/unit):

Low Density Residential	3.13
Medium Density Residential	2.34
High Density Residential	1.67
Other	3.0
Unplanned Developable Land (persons/hectare)	125

Harmon Peaking Factor:

Maximum: 4.0
Minimum: 2.0
Formula: $K_H = 1 + \frac{14}{(4 + P)^{1/2}}$

where; K_H = Harmon Peaking Factor
P = Population in Thousands

Design Flows:

Residential Flow	225	L/person/day
Infiltration Flow	8.64	m^3/ha/day (0.10L/s/ha)
Commercial Flow	56	m^3/ha/day (28*peak of 2)
Floor Space Index	1	of gross lot area
Institutional Flow	56	m^3/ha/day (28*peak of 2)
Industrial Flow	100	m^3/ha/day (50*peak of 2)

Note: PVC pipe is manufactured in metric dimensions, therefore, the pipe diameter stated is used to calculate capacity and velocity. However, since concrete pipe is manufactured in imperial dimensions, standard imperial equivalent sizes for the diameter stated have been used to calculate capacity and velocity.

Infiltration Flow Applied to: Total Area

				RESIDENTIAL											COMMERCIAL				INSTITUTIONAL			INDUSTRIAL			EXTERNAL FLOWS		TOTAL AREA		INFILTRATION			PIPE DESIGN								
PROPERTY	**STREET**	**Upstream Manhole**	**Downstream Manhole**	**Section Area (ha)**	**Cummulative Area (ha)**	**Low Density Units**	**Medium Density Units**	**High Density Units**	**Other (specified above) Units**	**Unplanned Land (ha)**	**Section Population**	**Cummulative Population (thousands)**	**Harmon Peaking Factor**	**Residential Flow (L/s)**	**Section Area (ha)**	**Gross Floor Area (ha)**	**Cummulative Gross Floor Area (ha)**	**Commercial Flow (L/s)**	**Section Area (ha)**	**Cummulative Area (ha)**	**Institutional Flow (L/s)**	**Section Area (ha)**	**Cummulative Area (ha)**	**Industrial Flow (L/s)**	**Total External Flow (L/s)**	**Cummulative External Flow (L/s)**	**Total Section Area (ha)**	**Total Cummulative Area (ha)**	**Applicable Area (ha) (select above)**	**Infiltration Flow (L/s)**	**Total Design Flow (L/s)**	**Type**	**Pipe (mm)**	**Grade (%)**	**Capacity (l/s)**	**Length (m)**	**Velocity (m/s)**	**Down-stream Velocity (m/s)**	**Change in Velocity (m/s)**	**Capacity (%)**
Phase 1		Plug	32A		0.00			296			495	0.495	3.98	**5.13**	0.13	0.13	0.13	**0.08**		0.00	**0.00**		0.00	**0.00**		**0.00**	0.13	0.13	0.13	**0.01**	**5.22**	PVC	200	1.00	32.80	10.0	1.04	N/A		16%
Phase 2		Plug	34A		0.00			179			299	0.299	4.00	**3.11**	0.11	0.11	0.11	**0.07**		0.00	**0.00**		0.00	**0.00**		**0.00**	0.11	0.11	0.11	**0.01**	**3.20**	PVC	200	1.00	32.80	8.0	1.04	N/A		10%

Park Place Residential
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March 2022 - FSSR for ZBA

Q commercial = 15 m^3/day/hectare (Level 3 - average flow rate)
Peaking Factor = 3.5
Extraneous Flow = 0.08 m^3/day/mm (diameter)/km
Peaking Factor = 2.25
Q flows are based on flow rate x peaking factor x area + Extraneous flow rate x peaking factor x diameter (mm) x length (km)

Q residential = 225 l/person/day x Harmon Peaking Factor

Harmon Peaking Factor:
Maximum: 4.0
Minimum: 2.0
Formula: $K_H = 1 + \frac{14}{(4 + P)^{1/2}}$
where; K_H = Harmon Peaking Factor
P = Population in Thousands

SANITARY SEWER DESIGN - PHASE 1

			TOTAL DESIGN AREA		COMMERCIAL					EXTRANEOUS FLOWS		TOTAL FLOWS	PIPE DESIGN				
Street	Upstream Manhole	Downstream Manhole	Section Area (ha)	Cummulative Area (ha)	Commercial Section Area (ha)	Cummulative Commercial Area (ha)	Peaking Factor	Cummulative Floor Area (ha)	Cummulative Commercial Flow (l/s)	Section Extraneous Flow (l/s)	Cummulative Extraneous Flow (l/s)	Cummulative Design Flow (l/s)	Pipe	Pipe Size (mm)	Grade (%)	Capacity (l/s)	% Capacity
WEST OF BAYVIEW DRIVE																	
	Plug	2A	0.41	0.41	0.410	0.410	3.500	1.435	0.25	0.01	0.006	0.26	METRIC	200	0.50	23.19	1.10%
	Plug	3A	0.33	0.33	0.330	0.330	3.500	1.155	0.20	0.01	0.009	0.21	METRIC	200	4.00	65.60	0.32%
	Plug	4A	0.33	0.33	0.330	0.330	3.500	1.155	0.20	0.01	0.009	0.21	METRIC	200	4.00	65.60	0.32%
	Plug	5A	0.30	0.30	0.300	0.300	3.500	1.050	0.18	0.01	0.008	0.19	METRIC	200	5.00	73.34	0.26%
	Plug	6A	0.08	0.08	0.080	0.080	3.500	0.280	0.05	0.01	0.013	0.06	METRIC	200	5.00	73.34	0.08%
	Plug	50A	0.08	0.08	0.080	0.080	3.500	0.280	0.05	0.01	0.013	0.06	METRIC	200	5.00	73.34	0.08%
	Plug	39A	0.12	0.12	0.120	0.120	3.500	0.420	0.07	0.01	0.013	0.09	METRIC	200	5.00	73.34	0.12%
	Plug	7A	0.28	0.28	0.280	0.280	3.500	0.980	0.17	0.01	0.013	0.18	METRIC	200	5.00	73.34	0.25%
	Plug	8A	0.14	0.14	0.140	0.140	3.500	0.490	0.09	0.01	0.013	0.10	METRIC	200	5.00	73.34	0.13%
	Plug	9A	0.29	0.29	0.290	0.290	3.500	1.015	0.18	0.01	0.013	0.19	METRIC	200	5.00	73.34	0.26%
	Plug	10A	0.26	0.26	0.260	0.260	3.500	0.910	0.16	0.01	0.013	0.17	METRIC	200	5.00	73.34	0.23%
	Plug	11A	0.15	0.15	0.150	0.150	3.500	0.525	0.09	0.01	0.013	0.10	METRIC	200	4.00	65.60	0.16%
	2A	3A	2.14	2.55	2.140	2.550	3.500	8.925	1.55	0.01	0.020	1.57	METRIC	200	0.50	23.19	6.77%
	3A	4A	0.93	3.81	0.930	3.810	3.500	13.335	2.32	0.03	0.064	2.38	METRIC	200	1.50	40.17	5.92%
	4A	5A	1.45	5.59	1.450	5.590	3.500	19.565	3.40	0.02	0.089	3.49	METRIC	200	0.50	23.19	15.03%
	5A	6A	0.43	6.32	0.430	6.320	3.500	22.120	3.84	0.02	0.118	3.96	METRIC	200	0.50	23.19	17.07%
	6A	50A	0.13	6.53	0.130	6.530	3.500	22.855	3.97	0.01	0.138	4.11	METRIC	200	0.50	23.19	17.70%
	50A	39A	0.30	6.91	0.300	6.910	3.500	24.185	4.20	0.01	0.160	4.36	METRIC	200	0.50	23.19	18.79%
	39A	7A	0.63	7.66	0.630	7.660	3.500	26.810	4.65	0.03	0.201	4.86	METRIC	200	0.50	23.19	20.94%
	7A	8A	0.19	8.13	0.190	8.130	3.500	28.455	4.94	0.01	0.221	5.16	METRIC	200	0.50	23.19	22.25%
	8A	9A	0.53	8.80	0.530	8.800	3.500	30.800	5.35	0.02	0.255	5.60	METRIC	200	0.50	23.19	24.16%
	9A	10A	0.27	9.36	0.270	9.360	3.500	32.760	5.69	0.01	0.277	5.96	METRIC	200	0.50	23.19	25.72%
	10A	11A	2.36	11.98	2.360	11.980	3.500	41.930	7.28	0.04	0.327	7.61	METRIC	200	0.50	23.19	32.80%
	11A	13A	0.10	12.23	0.100	12.230	3.500	42.805	7.43	0.01	0.353	7.78	METRIC	200	0.50	23.19	33.57%
	Plug	12A	0.08	0.08	0.080	0.080	3.500	0.280	0.05	0.01	0.009	0.06	METRIC	200	2.00	46.38	0.12%
	12A	44A	0.34	0.42	0.340	0.420	3.500	1.470	0.26	0.02	0.025	0.28	METRIC	200	1.00	32.80	0.86%
	Plug	44A	0.14	0.14	0.140	0.140	3.500	0.490	0.09	0.01	0.013	0.10	METRIC	200	3.80	63.94	0.15%
	44A	13A	0.39	0.95	0.390	0.950	3.500	3.325	0.58	0.02	0.056	0.63	METRIC	200	1.00	32.80	1.93%
	Plug	13A	0.09	0.09	0.090	0.090	3.500	0.315	0.05	0.01	0.013	0.07	METRIC	200	5.00	73.34	0.09%
	13A	14A	0.41	13.68	0.410	13.680	3.500	47.880	8.31	0.04	0.460	8.77	METRIC	200	0.50	23.19	37.82%
	14A	25A	0.09	13.77	0.090	13.770	3.500	48.195	8.37	0.01	0.474	8.84	METRIC	200	0.50	23.19	38.12%
	Plug	51A	1.17	1.17	1.170	1.170	3.500	4.095	0.71	0.01	0.008	0.72	METRIC	200	2.50	51.86	1.39%
	51A	53A	1.19	2.36	1.190	2.360	3.500	8.260	1.43	0.04	0.049	1.48	METRIC	200	1.00	32.80	4.52%
	Plug A	52A	0.06	0.06	0.060	0.060	3.500	0.210	0.04	0.00	0.004	0.04	METRIC	200	4.10	66.41	0.06%
	Plug B	52A	0.23	0.23	0.230	0.230	3.500	0.805	0.14	0.01	0.010	0.15	METRIC	200	1.50	40.17	0.37%
	52A	53A	0.18	0.47	0.180	0.470	3.500	1.645	0.29	0.02	0.029	0.31	METRIC	200	3.00	56.81	0.55%
	53A	54A	0.37	3.20	0.370	3.200	3.500	11.200	1.94	0.03	0.107	2.05	METRIC	200	1.00	32.80	6.25%
	Plug A	54A	0.10	0.10	0.100	0.100	3.500	0.350	0.06	0.01	0.006	0.07	METRIC	200	5.00	73.34	0.09%
	Plug B	54A	0.09	0.09	0.090	0.090	3.500	0.315	0.05	0.02	0.015	0.07	METRIC	200	3.00	56.81	0.12%
	54A	55A	0.18	3.57	0.180	3.570	3.500	12.495	2.17	0.01	0.143	2.31	METRIC	200	0.50	23.19	9.97%
	Plug A	55A	0.07	0.07	0.070	0.070	3.500	0.245	0.04	0.01	0.013	0.06	METRIC	200	5.00	73.34	0.08%
	Plug A	64A	0.03	0.03	0.030	0.030	3.500	0.105	0.02	0.00	0.003	0.02	METRIC	200	5.00	73.34	0.03%
	Plug B	64A	0.23	0.23	0.230	0.230	3.500	0.805	0.14	0.00	0.003	0.14	METRIC	200	5.00	73.34	0.20%
	Plug C	64A	0.02	0.02	0.020	0.020	3.500	0.070	0.01	0.00	0.004	0.02	METRIC	200	4.00	65.60	0.02%
	64A	55A	0.00	0.28	0.000	0.280	3.500	0.980	0.17	0.00	0.015	0.19	METRIC	200	5.00	73.34	0.25%
	55A	22A	0.22	4.14	0.220	4.140	3.500	14.490	2.52	0.01	0.185	2.70	METRIC	200	0.50	23.19	11.64%
	Plug A	22A	0.16	0.16	0.160	0.160	3.500	0.560	0.10	0.01	0.007	0.10	METRIC	200	5.00	73.34	0.14%
	22A	23A	0.26	4.56	0.260	4.560	3.500	15.960	2.77	0.02	0.213	2.98	METRIC	200	0.50	23.19	12.87%

Park Place Residential
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March 2022 - FSSR for ZBA

Q commercial = 15 m^3/day/hectare (Level 3 - average flow rate)
Peaking Factor = 3.5
Extraneous Flow = 0.08 m^3/day/mm (diameter)/km
Peaking Factor = 2.25
Q flows are based on flow rate x peaking factor x area + Extraneous flow rate x peaking factor x diameter (mm) x length (km)

Q residential = 225 l/person/day x Harmon Peaking Factor

Harmon Peaking Factor:
Maximum: 4.0
Minimum: 2.0
Formula: $K_H = 1 + \frac{14}{(4 + P)^{1/2}}$
where; K_H = Harmon Peaking Factor
P = Population in Thousands

SANITARY SEWER DESIGN - PHASE 1

			TOTAL DESIGN AREA		COMMERCIAL					EXTRANEOUS FLOWS		TOTAL FLOWS	PIPE DESIGN				
Street	Upstream Manhole	Downstream Manhole	Section Area (ha)	Cummulative Area (ha)	Commercial Section Area (ha)	Cummulative Commercial Area (ha)	Peaking Factor	Cummulative Floor Area (ha)	Cummulative Commercial Flow (l/s)	Section Extraneous Flow (l/s)	Cummulative Extraneous Flow (l/s)	Cummulative Design Flow (l/s)	Pipe	Pipe Size (mm)	Grade (%)	Capacity (l/s)	% Capacity
WEST OF BAYVIEW DRIVE																	
	Plug A	23A	0.11	0.11	0.110	0.110	3.500	0.385	0.07	0.01	0.006	0.07	METRIC	200	5.00	73.34	0.10%
	Plug B	23A	0.20	0.20	0.200	0.200	3.500	0.700	0.12	0.01	0.012	0.13	METRIC	200	4.00	65.60	0.20%
	23A	24A	0.52	5.39	0.520	5.390	3.500	18.865	3.28	0.04	0.270	3.54	METRIC	200	0.50	23.19	15.28%
	Plug A	24A	0.22	0.22	0.220	0.220	3.500	0.770	0.13	0.01	0.007	0.14	METRIC	200	5.00	73.34	0.19%
	Plug A	68A	0.11	0.11	0.110	0.110	3.500	0.385	0.07	0.01	0.006	0.07	METRIC	200	1.00	32.80	0.22%
	Plug B	68A	0.06	0.06	0.060	0.060	3.500	0.210	0.04	0.00	0.003	0.04	METRIC	200	0.50	23.19	0.17%
	68A	24A	0.00	0.17	0.000	0.170	3.500	0.595	0.10	0.01	0.020	0.12	METRIC	200	5.00	73.34	0.17%
	24A	63A	0.22	6.00	0.220	6.000	3.500	21.000	3.65	0.01	0.310	3.96	METRIC	200	0.50	23.19	17.06%
	Plug	63A	0.06	0.06	0.060	0.060	3.500	0.210	0.04	0.01	0.007	0.04	METRIC	200	5.00	73.34	0.06%
	63A	25A	0.18	6.24	0.180	6.240	3.500	21.840	3.79	0.01	0.330	4.12	METRIC	200	0.50	23.19	17.77%
	25A	26A	0.13	20.14	0.130	20.140	3.500	70.490	12.24	0.02	0.829	13.07	METRIC	200	0.50	23.19	56.34%
	Plug	26A	0.05	0.05	0.050	0.050	3.500	0.175	0.03	0.00	0.004	0.03	METRIC	200	5.00	73.34	0.05%
	26A	35A	0.14	20.33	0.140	20.330	3.500	71.155	12.35	0.03	0.859	13.21	METRIC	200	0.50	23.19	56.97%
	Plug	67A	0.19	0.19	0.190	0.190	3.500	0.665	0.12	0.01	0.012	0.13	METRIC	200	1.00	32.80	0.39%
	Plug	67A	0.29	0.29	0.290	0.290	3.500	1.015	0.18	0.01	0.015	0.19	METRIC	200	0.50	23.19	0.82%
	67A	56A	0.00	0.48	0.000	0.480	3.500	1.680	0.29	0.01	0.033	0.32	METRIC	200	2.00	46.38	0.70%
	56A	58A	1.38	1.86	1.380	1.860	3.500	6.510	1.13	0.02	0.050	1.18	METRIC	200	0.50	23.19	5.09%
	Plug	57A	0.15	0.15	0.150	0.150	3.500	0.525	0.09	0.01	0.010	0.10	METRIC	200	5.00	73.34	0.14%
	57A	58A	1.64	1.79	1.640	1.790	3.500	6.265	1.09	0.02	0.034	1.12	METRIC	200	3.00	56.81	1.97%
	Plug	58A	0.26	0.26	0.260	0.260	3.500	0.910	0.16	0.01	0.013	0.17	METRIC	200	5.00	73.34	0.23%
	58A	62A	0.35	4.26	0.350	4.260	3.500	14.910	2.59	0.02	0.117	2.71	METRIC	200	0.50	23.19	11.67%
	Plug	61A	0.10	0.10	0.100	0.100	3.500	0.350	0.06	0.01	0.006	0.07	METRIC	200	5.00	73.34	0.09%
	61A	62A	0.41	0.51	0.410	0.510	3.500	1.785	0.31	0.02	0.025	0.33	METRIC	200	1.20	35.93	0.93%
	62A	29A	0.65	5.42	0.650	5.420	3.500	18.970	3.29	0.02	0.163	3.46	METRIC	200	0.50	23.19	14.90%
	Plug	28A	0.05	0.05	0.050	0.050	3.500	0.175	0.03	0.01	0.006	0.04	METRIC	200	5.00	73.34	0.05%
	28A	29A	0.22	0.27	0.220	0.270	3.500	0.945	0.16	0.02	0.021	0.18	METRIC	200	3.00	56.81	0.33%
	29A	59A	0.87	6.56	0.870	6.560	3.500	22.960	3.99	0.02	0.207	4.19	METRIC	200	0.50	23.19	18.08%
	Plug	59A	0.05	0.05	0.050	0.050	3.500	0.175	0.03	0.01	0.007	0.04	METRIC	200	5.00	73.34	0.05%
	59A	30A	0.73	7.34	0.730	7.340	3.500	25.690	4.46	0.02	0.230	4.69	METRIC	200	0.50	23.19	20.22%
	Plug	66A	0.20	0.20	0.200	0.200	3.500	0.700	0.12	0.00	0.003	0.12	METRIC	200	5.00	73.34	0.17%
	66A	30A	0.61	0.81	0.610	0.810	3.500	2.835	0.49	0.02	0.027	0.52	METRIC	200	3.00	56.81	0.91%
	30A	65A	0.00	8.15	0.000	8.150	3.500	28.525	4.95	0.02	0.275	5.23	METRIC	200	0.50	23.19	22.54%
	PLUG	65A	0.41	0.41	0.410	0.410	3.500	1.435	0.25	0.00	0.004	0.25	METRIC	200	5.00	73.34	0.35%
	65A	32A	0.50	9.06	0.500	9.060	3.500	31.710	5.51	0.02	0.298	5.80	METRIC	200	0.50	23.19	25.02%
	Phase 1 Residential flows are calculated to be 5.13l/s based on 296 high-density residential units yielding a population of 495. Total Phase 1 residential + commercial flow = 5.22l/s																
	Phase 2 Residential flows are calculated to be 3.11l/s based on 179 high-density residential units yielding a population of 299. Total Phase 2 residential + commercial flow = 3.2l/s																
	Total Phase 1 and 2 flow = 8.42l/s																
	32A	34A	0.84	9.90	0.840	9.900	3.500	34.650	6.02	0.03	0.324	11.56	METRIC	200	0.50	23.19	49.84%
	Plug	33A	0.05	0.05	0.050	0.050	3.500	0.175	0.03	0.01	0.006	0.04	METRIC	200	1.00	32.80	0.11%
	33A	34A	0.00	0.05	0.000	0.050	3.500	0.175	0.03	0.01	0.018	0.05	METRIC	200	1.00	32.80	0.15%
	34A	35A	1.15	11.10	1.150	11.100	3.500	38.850	6.74	0.04	0.381	15.55	METRIC	200	0.50	23.19	67.03%
	35A	41A	0.00	31.43	0.000	31.430	3.500	110.005	19.10	0.01	1.253	28.77	METRIC	250	0.50	42.05	68.42%
	Plug	45A	0.04	0.04	0.040	0.040	3.500	0.140	0.02	0.01	0.008	0.03	METRIC	200	2.00	46.38	0.07%
	45A	36A	0.73	0.77	0.730	0.770	3.500	2.695	0.47	0.03	0.038	0.51	METRIC	200	0.50	23.19	2.18%
	Plug A	36A	0.06	0.06	0.060	0.060	3.500	0.210	0.04	0.00	0.005	0.04	METRIC	200	4.00	65.60	0.06%
	Plug B	36A	0.06	0.06	0.060	0.060	3.500	0.210	0.04	0.00	0.001	0.04	METRIC	200	5.00	73.34	0.05%
	36A	37A	0.78	1.67	0.780	1.670	3.500	5.845	1.01	0.03	0.077	1.09	METRIC	200	0.50	23.19	4.71%
	Plug A	37A	0.06	0.06	0.060	0.060	3.500	0.210	0.04	0.01	0.007	0.04	METRIC	200	4.00	65.60	0.07%
	Plug B	37A	0.04	0.04	0.040	0.040	3.500	0.140	0.02	0.00	0.005	0.03	METRIC	200	1.00	32.80	0.09%
	37A	60A	0.40	2.17	0.400	2.170	3.500	7.595	1.32	0.02	0.107	1.43	METRIC	200	0.50	23.19	6.15%
	Plug	38A	0.00	0.00	0.000	0.000	3.500	0.000	0.00	0.00	0.002	0.00	METRIC	200	3.00	56.81	0.00%
	38A	60A	0.00	0.00	0.000	0.000	3.500	0.000	0.00	0.01	0.010	0.01	METRIC	200	0.50	23.19	0.04%
	Cummulative flows for the Ultramar site provided by exp Services Inc. and indicated by shaded cell																
	Ultramar	60A	4.15	4.15	4.150	4.150	3.500	14.525	2.52	0.01	0.006	2.53	METRIC	200	1.00	32.80	7.71%
	60A	40A	0.00	6.32	0.000	6.320	3.500	22.120	3.84	0.02	0.140	3.98	METRIC	200	0.50	23.19	17.16%
	40A	41A	0.22	6.54	0.220	6.540	3.500	22.890	3.97	0.01	0.152	4.13	METRIC	200	0.50	23.19	17.79%
	41A	42A	0.30	38.27	0.300	38.270	3.500	133.945	23.25	0.01	1.417	33.09	METRIC	250	0.50	42.05	78.70%
	Plug A	42A	0.05	0.05	0.050	0.050	3.500	0.175	0.03	0.00	0.005	0.03	METRIC	200	5.00	73.34	0.05%
	Plug B	42A	0.03	0.03	0.030	0.030	3.500	0.105	0.02	0.00	0.003	0.02	METRIC	200	5.00	73.34	0.03%
	42A	43A	0.35	38.70	0.350	38.700	3.500	135.450	23.52	0.01	1.438	33.37	METRIC	250	0.50	42.05	79.37%
	Ultramar	46A	0.61	0.61	0.610	0.610	3.500	2.135	0.37	0.01	0.006	0.38	METRIC	200	4.00	65.60	0.57%
	46A	43A	0.00	0.61	0.000	0.610	3.500	2.135	0.37	0.03	0.038	0.41	METRIC	200	2.00	46.38	0.88%
	43A	EX MH	0.00	39.31	0.000	39.310	3.500	137.585	23.89	0.02	1.499	33.81	METRIC	250	2.00	84.10	40.20%

APPENDIX B

WATER SYSTEM ANALYSIS

Technical Memorandum

Date: 17 November 2021

Revision: Version 1 (Draft)

To: Steve Bishop, North American Development Group

From: Nikola Tomic and Fabian Papa

Subject: Park Place Water System Analysis
City of Barrie

HydraTek File No.: 21150

Introduction

HydraTek & Associates (HydraTek), a Division of FP&P HydraTek Inc., has been retained by North American Development Group, the "Client", to conduct a water system analysis in support of a Site Plan Application (SPA) for the proposed re-development of Areas 3 and 4 at Park Place in Barrie, Ontario. This report presents and discusses the results of a hydraulic field investigation of Park Place water system which is within of City of Barrie's (City's) local Pressure Zone 3 South water supply system. Pressures were recorded at four fire hydrants on 05 November 2021 from 08:30 AM to 11:30 AM, and two hydrant flow tests were performed during that period. Based on the results of the analysis presented herein, it is determined whether or not the existing water infrastructure is sufficient to support the development and what upgrades (if any) are required.

Located at West of Live Eight Way on North and South side of South Village Way (Area 3 and Area 4) in Park Place in Barrie, the site is currently occupied with parking lot for nearby amenities, as shown in Figure 1. The site comprises approximately 8,500 m^2 (0.85 ha) of land area and makes up the entire Site Plan Application. The development on Area 3 and Area 4 contemplates the construction of a residential and retail complex with 16-storey tower (Phase 1B), and 6-storey building (Phase 1A) on a common 5-storey podium, and 12-storey tower and 6-storey building on a common 5-storey podium (Phase 2). The site is bounded by retail and restaurant complex to the north, parking lot on the west and south, and Live Eight Way on the east, with South Village Way dividing the site to north and south areas.

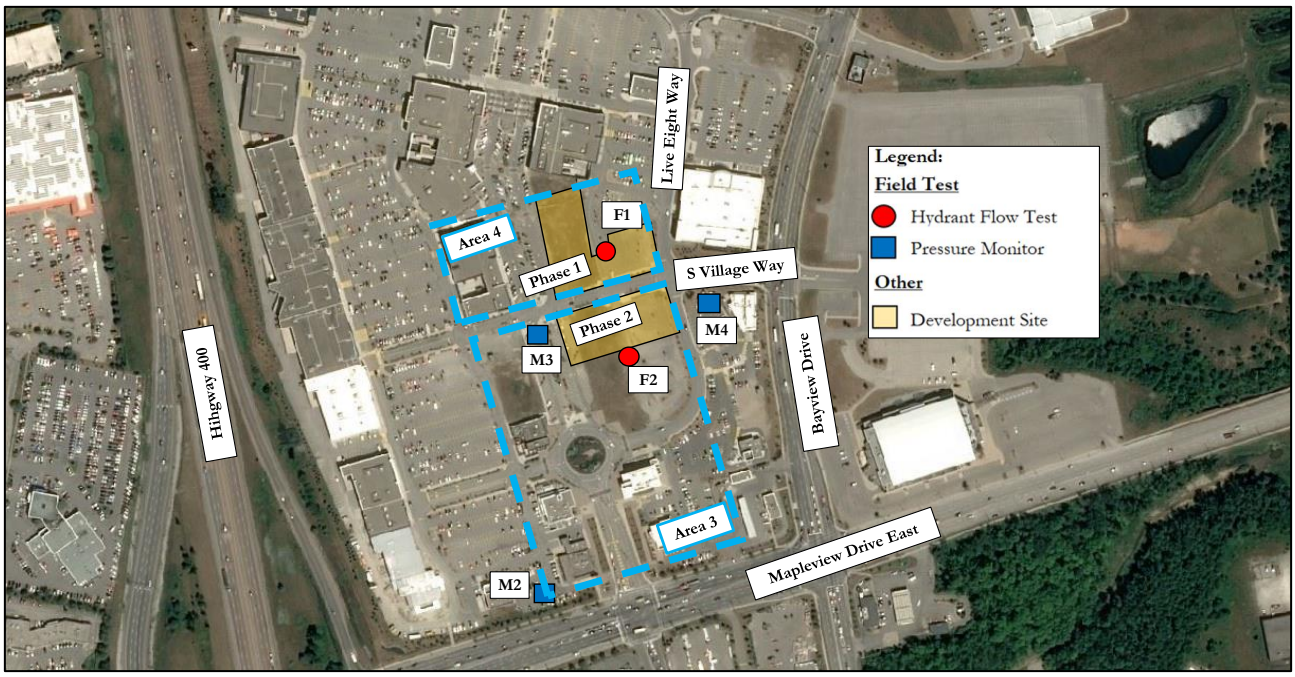

Figure 1: Location map of site, monitoring hydrants, and flow hydrants.

In conducting this water system analysis, the following information was used:

- Water Transmission and Distribution Policies and Design Standard by City of Barrie – Engineering Department, dated August 2021.
- Park Place Residential Redevelopment – Barrie, Phase 1 and Phase 2 Design Concept – Site Plan, by Petroff Partnership Architects, dated 8 July 2021.
- Site Servicing Plan – Phase 1, Park Place – Highway 400 and Mapleview Drive East, by Sabourin Kimble & Associates Ltd., dated 23 August 2019.
- Hydrant Flow Test Reports for Park Place hydrant #17, by Corix, dated 16 April 2019.
- Design Guidelines for Drinking-Water Systems, Ontario Ministry of Environment, Conservation and Parks (MECP), dated 2008.
- Hydrant Flow Test Reports for hydrants H1061 and H1065, by A1 Hydrant Services Limited, dated 19 April 2007.

Water System Design Criteria

This section summarizes the relevant design criteria applied in the construction and evaluation of the hydraulic model used to assess the existing water system for this development. The criteria considered in this analysis include the City's Water Transmission and Distribution Design Criteria and the MECP's Design Guidelines for Drinking Water Systems.

Water Demands

Table 1 shows unit population densities to be applied to the proposed development and Table 2 shows the relevant water demand rates and peaking factors, as outlined in the City's Water Transmission and Distribution Design Criteria and MECP Guidelines, as applicable.

Table 1: Population densities for residential unit types.

Residential Unit Type	Persons/Unit
Low Density (single detached, duplexes or semi-detached dwellings)	3.25
Medium Density (triplexes and fourplexes, cluster and/or block townhouses, walk-up apartments)	2.57
High Density (apartment dwellings)	1.67

Table 2: Water demand rates and peaking factors.

Criterion	Unit	Value
Average Day Demand (ADD) – Residential	L/capita/day	225
Average Day Demand (ADD) – Commercial	m^3/hectare/day	28
Minimum Hour Demand (MHD)	Peaking Factor	0.4
Maximum Day Demand (MDD)	Peaking Factor	2.75
Peak Hour Demand (PHD)	Peaking Factor	4.13

Watermain Sizing & Roughness

For the purpose of hydraulic calculations, Hazen-Williams roughness coefficients (C-Factors) assigned to the existing watermains are as outlined in Table 3. The City's criteria are consistent with that of the MECP in this respect.

Table 3: Hazen-Williams roughness coefficients (C-Factors) for different pipe sizes.

Nominal Pipe Diameter	C-Factor
150 mm	100
200 mm to 250 mm	110
300 mm to 600 mm	120
Over 600 mm	130

Pressure Requirements

The performance of the water supply network is evaluated with respect to minimum and maximum pressure criteria outlined in Table 4.

Table 4: Maximum and minimum pressures under different operating conditions.

Operating Condition	Pressure Limit by City Standard
Minimum Hour Demand (MHD)	Max. of 100 psi (700 kPa)
Peak Hour Demand (PHD)	Min. of 40 psi (275 kPa)
Maximum Day Demand + Fire Flow (MDD + FF)	Min. of 20 psi (140 kPa) anywhere in the system

It is further noted that the City's design criteria states that preferred operating pressures shall generally be in the range of 50 psi (345 kPa) to 70 psi (485) for maximum daily demand (MDD).

Fire Flow Requirements

The City's criteria stipulate minimum fire flow rates of 200 L/s for the apartments and 283 L/s for watermains servicing lands for commercial use as shown in Table 5. Additionally, the fire flow calculations for the proposed developments were performed in accordance with Fire Underwriters Survey (FUS 1999) with the results being shown in Table 6, and the calculations presented in the Appendix B.

Table 5: City's recommended fire flow rates for relevant land use types.

Land Use Type	Recommended Fire Flow Rate
Apartment	200 L/s
Commercial	283 L/s

Table 6: Calculated fire flows for specific floor plans for proposed development.

Floor Plan	Calculated Fire Flow Rate
Phase 1 - Podium	191 L/s
Phase 2 - Podium	141 L/s
Phase 1B – 6th Floor	124 L/s
Phase 1B – 7th to 16th Floor	91 L/s
Phase 2 – 6th Floor	91 L/s
Phase 2 – 7th to 12th Floor	91 L/s

Hydraulic Field Investigation

As noted, the site is located in Park Place within the City's Pressure Zone 3 South water system. This part of the system is primarily supplied by Harvey PS and Big Bay Point Road PS, and the pressure zone floats on storage from Mapleview Elevated Tank with top water level of 350.2 m. In order to develop a baseline level of performance for the existing system and to assess the available fire flow from the system at the connection point, a field monitoring exercise was conducted. During the investigation, two hydrant flow tests were performed to observe how the system responds under fire flow demands.

Four pressure loggers were supplied and installed by HydraTek on a single port at each of the four monitoring hydrants within Park Place. During the monitoring period, flow tests were completed (as per NFPA 291) at two flow hydrants. Figure 1 shows the monitoring hydrant and flow hydrant locations relative to the site, while Table 7 reports the hydrant details. The flow test and monitoring locations were selected based on their proximity to the site and on which mains the hydrants are connected. Photos of the hydrant flow tests are shown in Appendix A.

Table 7: List of hydrant locations.

Hydrant ID	Hydrant Type	Location	Watermain Diameter (mm)
M1	Monitoring	Concert Way, 1st W of Bayview Drive, S side	250
M2	Monitoring	Parking Lot between 2 Concert Way and 150 Park Place Blvd.	250
M3	Monitoring	South Village Way and Live Eight Way, SE corner	200
M4	Monitoring	South Village Way, 2nd W of Live Eight Way, S side	250
F1	Flow	NW Parking Lot at South Village Way and Live Eight Way, 1st N	250
F2	Flow	SW Parking Lot at South Village Way and Live Eight Way, 1st S	250

The initial HGLs (i.e., prior to hydrant flow tests) at monitoring hydrants were approximately 345.2 m. However, as soon as the hydrant flow test was commenced, pressure data shows that at least one pump was turned on at nearby pumping station in order to meet the increased demands and to maintain required pressure within Zone 3 South. Therefore, the final HGL (i.e., at the end of the test) was approximately 348.8 m. Table 8 presents initial and final pressures and HGLs recorded at monitoring hydrants, and, pressure and HGL during monitoring period are shown in Figure 2 and Figure 3 below.

Table 8: Summary statistics for pressure monitoring data during the monitoring period.

Monitoring Hydrant	Hydrant ID	Side Port Elevation (m)	Pressure (psi)		HGL (m)	
			Initial	Final	Initial	Final
M1	HY40	291.1	77.0	82.1	345.3	348.8
M2	HY4	294.3	72.3	77.5	345.2	348.8
M3	HY28	294.6	72.2	77.1	345.4	348.9
M4	HY33	292.6	74.7	80.0	345.1	348.8

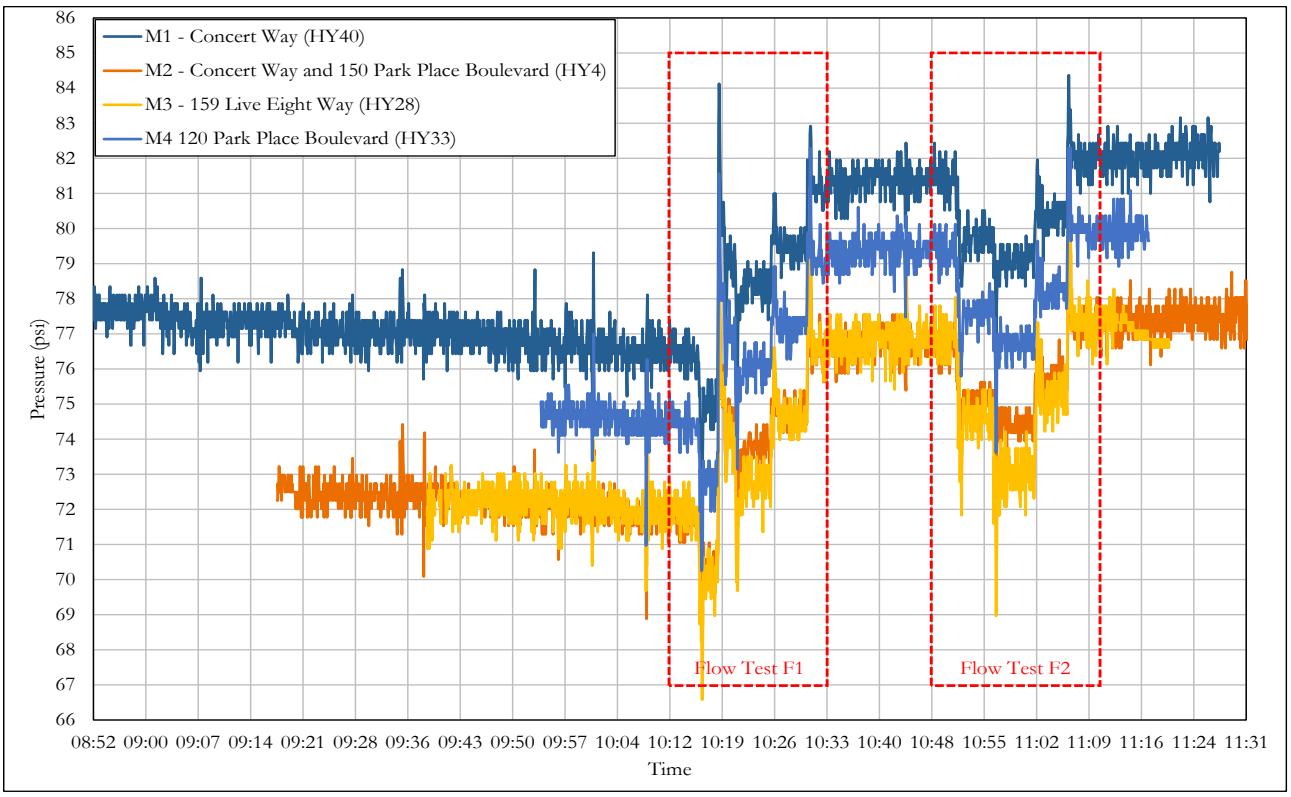

Figure 2: Pressure monitoring results during hydraulic field test conducted on 05 November 2021.

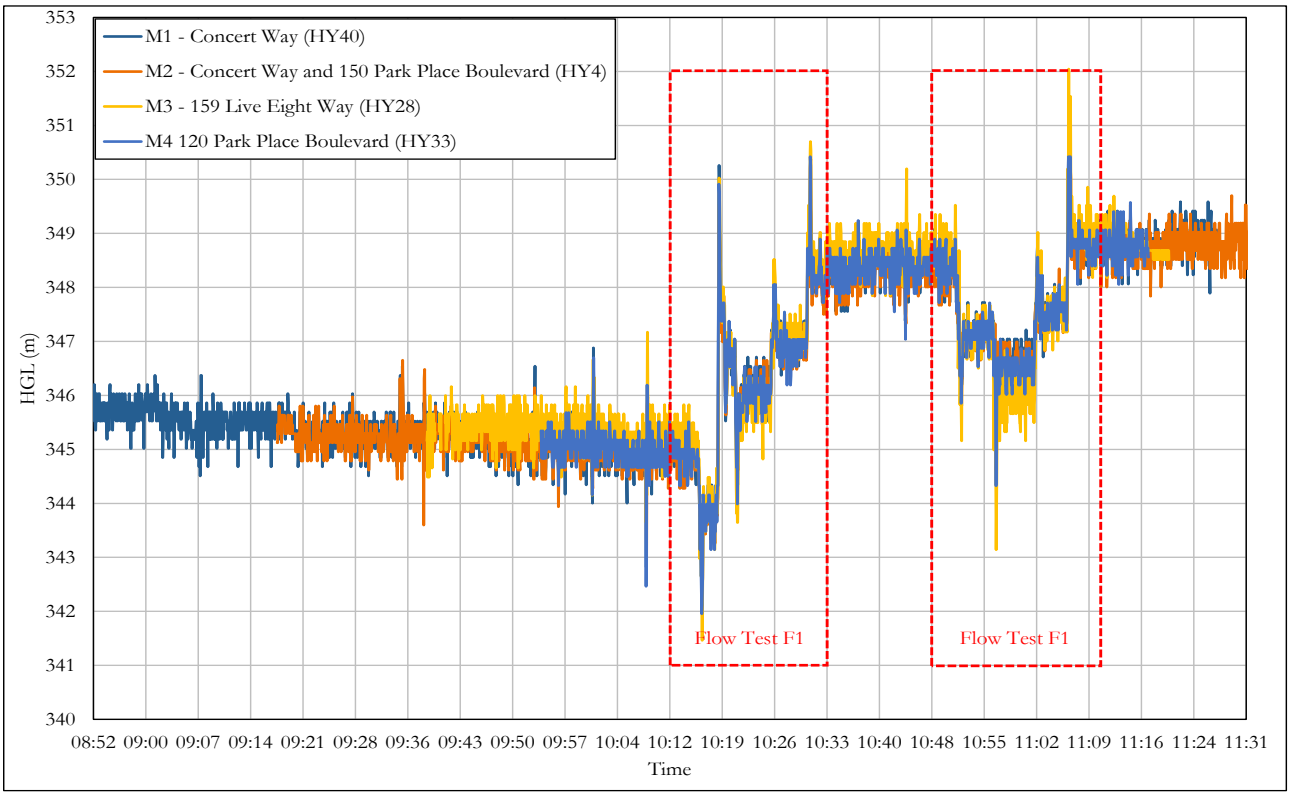

Figure 3: Pressure monitoring results (HGL) during hydraulic field test conducted on 05 November 2021.

Results for the hydrant flow tests are summarized in Table 9 which lists the tested flows from hydrants F1 and F2, along with the residual pressures recorded at monitoring hydrants M1, M2, M3 and M4, whereas full hydrant flow test reports are presented in Appendix C. Table 10 reports the drop in pressure at the monitoring hydrants during the hydrant flow tests, while Figure 4 compares the residual hydrant pressure v. flow curves. The hydrant flow test data is subsequently used in the modelling exercise to estimate maximum fire flow available for the proposed development in Park Place as well as to predict the impact of the proposed development on the local water system under design (maximum day demand plus fire flow) conditions.

Table 9: Hydrant flow test results and residual hydrant pressures.

Hydrant ID	No. Hydrant Ports*	Total Tested Flow (L/s)	Time		Residual Pressures (psi)			
			Start	End	M1	M2	M3	M4
F1 (HY29)	0 (Initial)	0	10:10:00	10:14:00	77	72	72	74
	1	86	10:19:42	10:20:42	79	74	74	77
	2	147	10:22:12	10:25:12	78	74	73	76
	0 (Final)	0	10:33:12	10:38:12	81	77	77	79
F2 (HY39)	0 (Initial)	0	10:39:12	10:50:42	81	77	77	79
	1	84	10:52:42	10:55:54	80	75	75	78
	2	140	10:57:54	11:01:24	79	74	73	77
	0 (Final)	0	11:09:54	11:17:54	82	77	77	80

* All hydrant flow tests used 2.5" port diffusers

Table 10: Monitoring hydrant pressure drops during hydrant flow test.

Hydrant ID	No. Hydrant Ports*	Total Tested Flow (L/s)	Pressure Drop (psi)			
			M1	M2	M3	M4
F1 (HY29)	0 (Initial)	0	0.0	0.0	0.0	0.0
	1	86	2.3	2.3	2.8	2.4
	2	147	2.9	2.9	4.0	3.2
	0 (Final)	0	0.0	0.0	0.0	0.0
F2 (HY39)	0 (Initial)	0	0.0	0.0	0.0	0.0
	1	84	2.0	2.0	2.4	2.1
	2	140	2.6	2.7	4.0	3.0
	0 (Final)	0	0.0	0.0	0.0	0.0

* All hydrant flow tests used 2.5" port diffusers

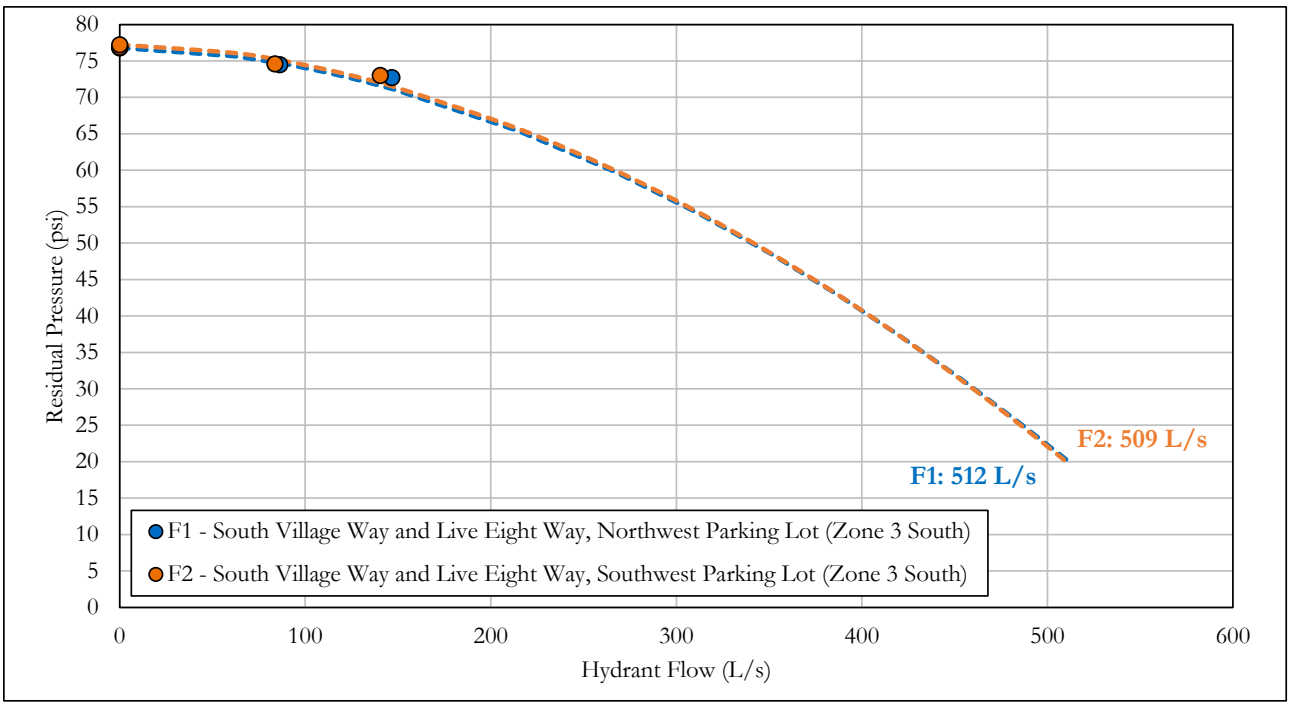

Figure 4: Plot of hydrant flow test results.

Hydraulic Model

A stand-alone hydraulic model, shown in Figure 5, was constructed for the purposes of this analysis. Pipe information for the local water system (i.e., diameters, lengths, material) were extracted from Park Place Servicing Plan, whereas node information (elevation) were either measured on site (e.g., for flow and monitoring hydrants during hydraulic field investigation) or extracted from the Servicing Plan.

The Park Place water system mostly comprises 250 mm PVC pipes, with some 200 mm PVC pipes, and its supply is derived from the 400 mm Bayview Drive watermain (two connections) and the 400 mm Mapleview Drive East watermain (one connection). The following sections further outline the methodology applied for the construction of the hydraulic model.

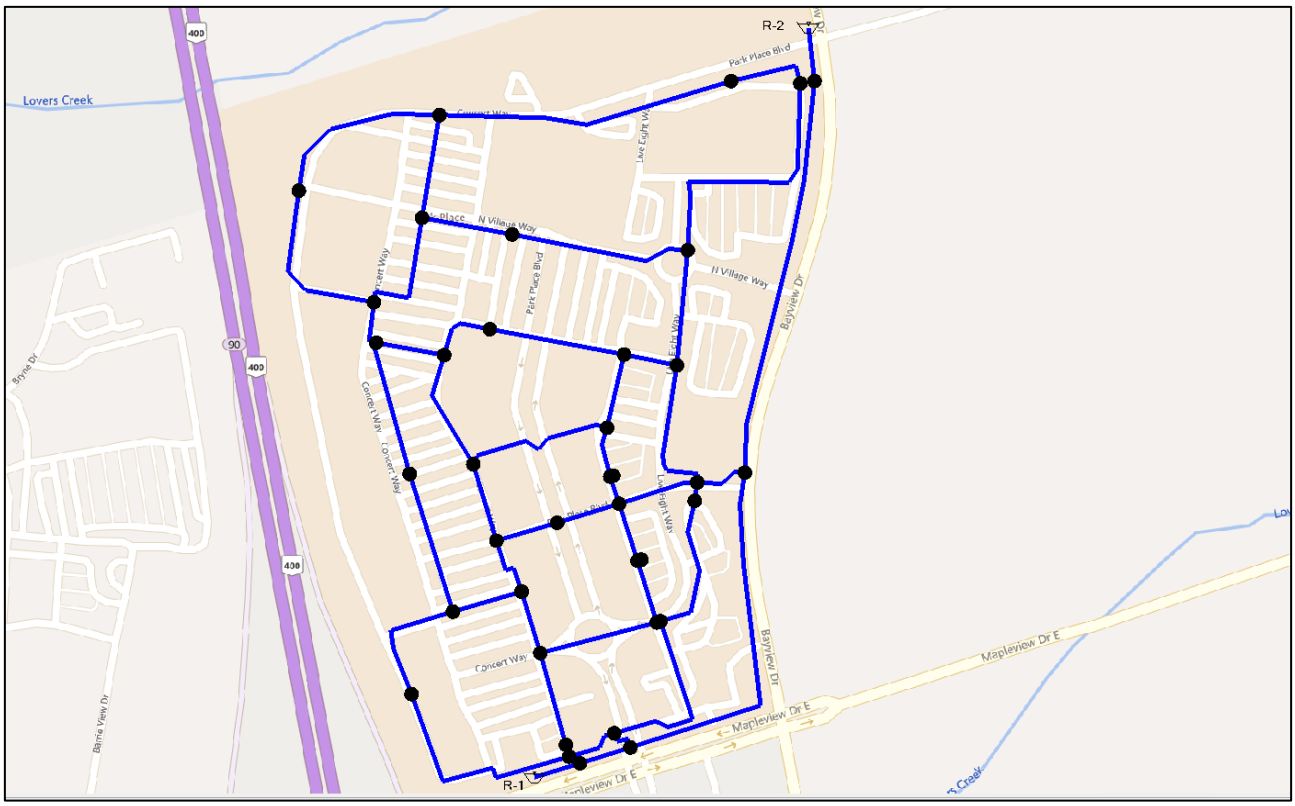

Figure 5: Screen capture of the hydraulic model.

Demand Calculations

Water demands for both the existing and the new development were calculated through enumeration of the consumers (i.e., retail and residential) on Park Place lands as shown in Servicing Plan drawings and applying the City's design criteria as described above. The calculations for the hydraulic model demands are summarized in Table 11 based on criteria presented in Table 1 and Table 2. All demands were allocated to the nearest node along the expected tributary pipe at each location.

Table 11: Summary of modelling demand calculations.

Hydraulic Model Junction*	Apartments (High Density) (Units)	Commercial/Retail (m^2)	Population	ADD (L/s)	MDD (L/s)	PHD (L/s)
J1	-	18216	-	0.59	1.62	2.44
J2	-	13346	-	0.43	1.19	1.79
J3 (M1)	-	7852	-	0.25	0.70	1.05
J4	-	12416	-	0.40	1.11	1.66
J5	-	4180	-	0.14	0.37	0.56
J6	-	15721	-	0.51	1.40	2.10
J7 (F1)	290	1284	484	1.30	3.58	5.38
J8 (M3)	-	4338		0.14	0.39	0.58
J9 (F2)	300	1106	501	1.34	3.69	5.54
J10 (M4)	-	4800	-	0.16	0.43	0.64
J11	-	4911	-	0.16	0.44	0.66
J12 (M2)	-	3470	-	0.11	0.31	0.46
Total:	**590**	**91640**	**985**	**5.54**	**15.2**	**22.9**

* See model node information are in Table 14 in Appendix D and model layout in Figure 15 Appendix F for reference

Boundary Conditions

A hydraulic model of the study area was created in order to estimate the maximum fire flow available to the development site for the various scenarios. The steady-state numerical model was created using Bentley Hammer. In attempting to replicate the test conditions numerically, the following assumptions were made in addition to those expressed in the previous sections of this report:

- Head losses are modelled as a combination of friction losses along pipes and local losses in the water system. For the former, pipes of a common diameter and material are assumed to have the same roughness (C-factor).
- The hydrant elevations were measured on site, or estimated based on the available Park Place Servicing Plan.

The hydraulic model was calibrated with a hydrant flow tests conducted by HydraTek at the hydrants indicated in Figure 1 and Figure 15 on 05 November 2021. The model was calibrated by introducing local loss coefficients ("K" values). As it appears that pump was turned on soon after the first hydrant flow test was started, the model was calibrated based on the final steady state pressures. However, the modeling results are based on the initial steady state pressures, as this approach yields more conservative results.

The American Water Works Association (AWWA) recommends that the HGLs predicted by a calibrated model for the purposes of this work should be within 2.2 psi of the data measured in the field. As such, the hydraulic model was calibrated to fall within this tolerance range. The results of the hydraulic model calibration are presented in Table 12, Figure 8, and Figure 7. Altogether, the hydraulic model is considered to provide a reasonable representation of the local Park Place water system for the purposes of this analysis.

Table 12: Tabular hydraulic model calibration results with 05 November 2021 hydrant flow test data.

Flow	Field Test - Pressure (psi)				Model - Pressure (psi)				Field Test v. Model - Pressure Difference (psi)			
	M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4
0	81.3	76.7	76.8	79.3	81.2	76.9	76.7	79.3	0.1	-0.2	0.1	0.0
86[1]	79.4	74.7	74.5	77.2	79.8	75.3	74.9	77.6	-0.4	-0.6	-0.4	-0.4
147[1]	78.4	73.7	72.7	76.1	78.3	73.4	72.7	75.7	0.1	0.3	0.0	0.4
84[2]	80.4	75.6	75.2	78.2	79.9	75.3	75.0	77.6	0.5	0.3	0.2	0.6
140[2]	79.1	74.4	73.0	76.7	78.5	73.6	73.2	75.9	0.6	0.8	-0.2	0.8

[1] F1 Test | [2] F2 Test

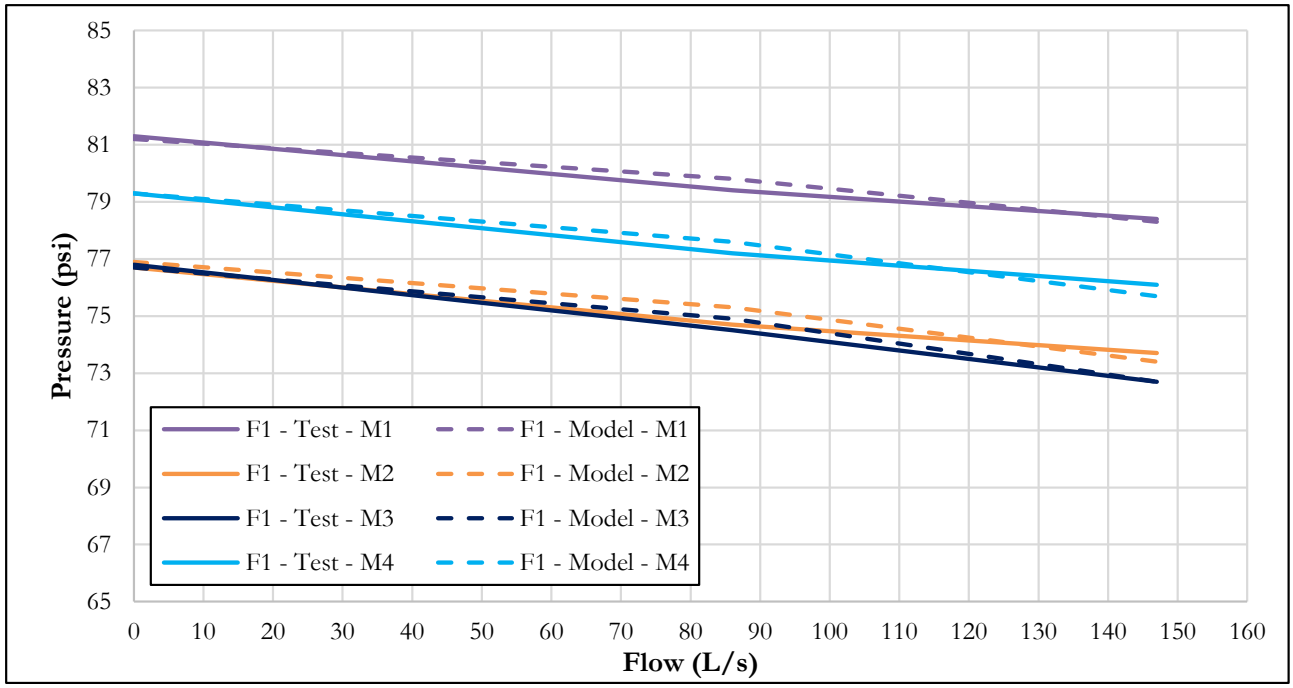

Figure 6: Graphical hydraulic model calibration results with 05 November 2021 F1 hydrant flow test data.

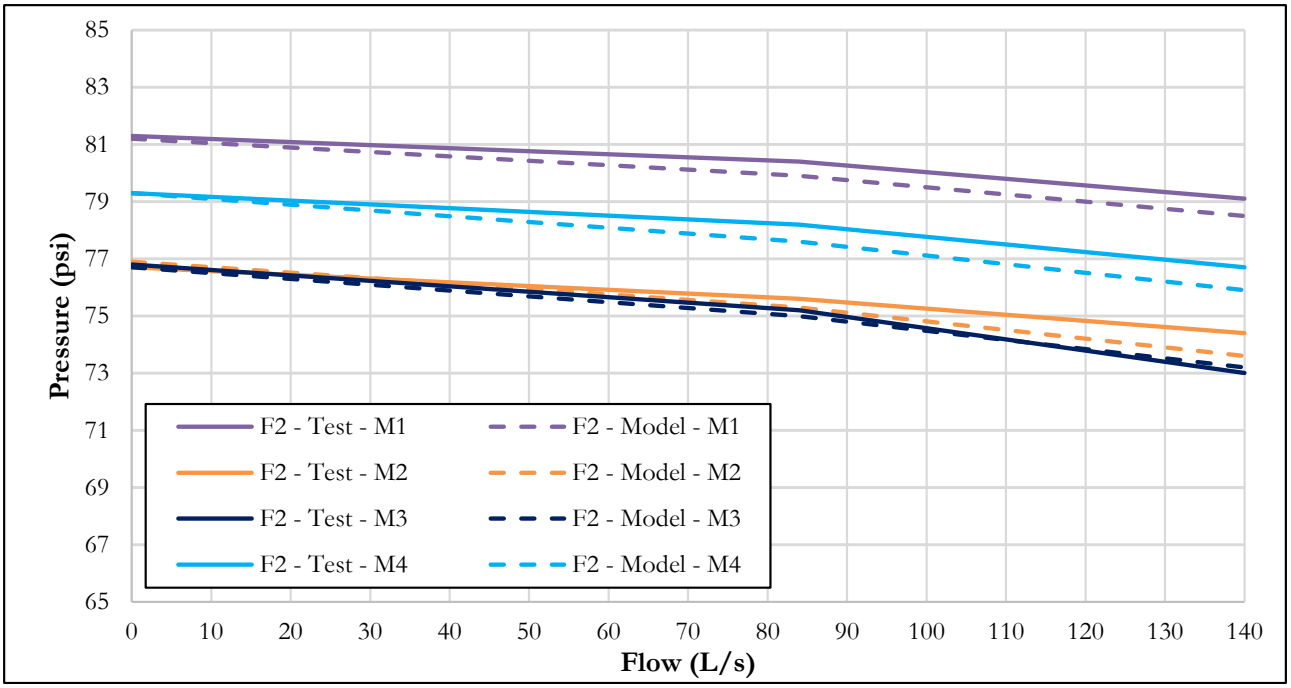

Figure 7: Graphical hydraulic model calibration results with 05 November 2021 F2 hydrant flow test data.

Modelling Results

This section discusses the simulation results of the hydraulic model using the boundary conditions mentioned above. Detailed tabular modelling results are provided in Appendix D and Appendix E.

Available Fire Flow

The model was used to estimate the pressure drops within the local Park Place water system for a fire demand at the proposed development site. In all cases, the residual pressure in local water system is expected to remain well above that required under emergency conditions (20 psi).

Fire flows were simulated during MDD demand conditions, and the available fire flows were determined on the basis that the minimum allowable pressure anywhere in the system is 20 psi (140 kPa). Based on the servicing design and fire flow calculations presented in Table 6, fire flow was simulated at F1 hydrant (HY29), as it is the closest hydrant to proposed development. The fire flow analysis results are presented in Table 13, and the results for two cases (e.g., 191 L/s and 405 L/s) are also shown in Figure 8 and Figure 9.

Table 13: Estimated residual pressures at monitoring hydrants for fire flows.

Scenario	Max Fire Flow (L/s)	Estimated Pressures (psi)					
		At Site Connection			Within Park Place Water System		
		Average Static Pressure	Pressure Drop	Residual Pressure	Min Static Pressure	Max Static Pressure	Min Residual Pressure
MDD + Fire	191	77	18	59	71	86	59
MDD + Fire	200	77	19	58	71	86	59
MDD + Fire	283	77	32	45	71	86	53
MDD + Fire	405*	77	57	20	71	86	39

* Maximum fire flow for the site based on the criteria of minimum pressure of 20 psi anywhere in the system.

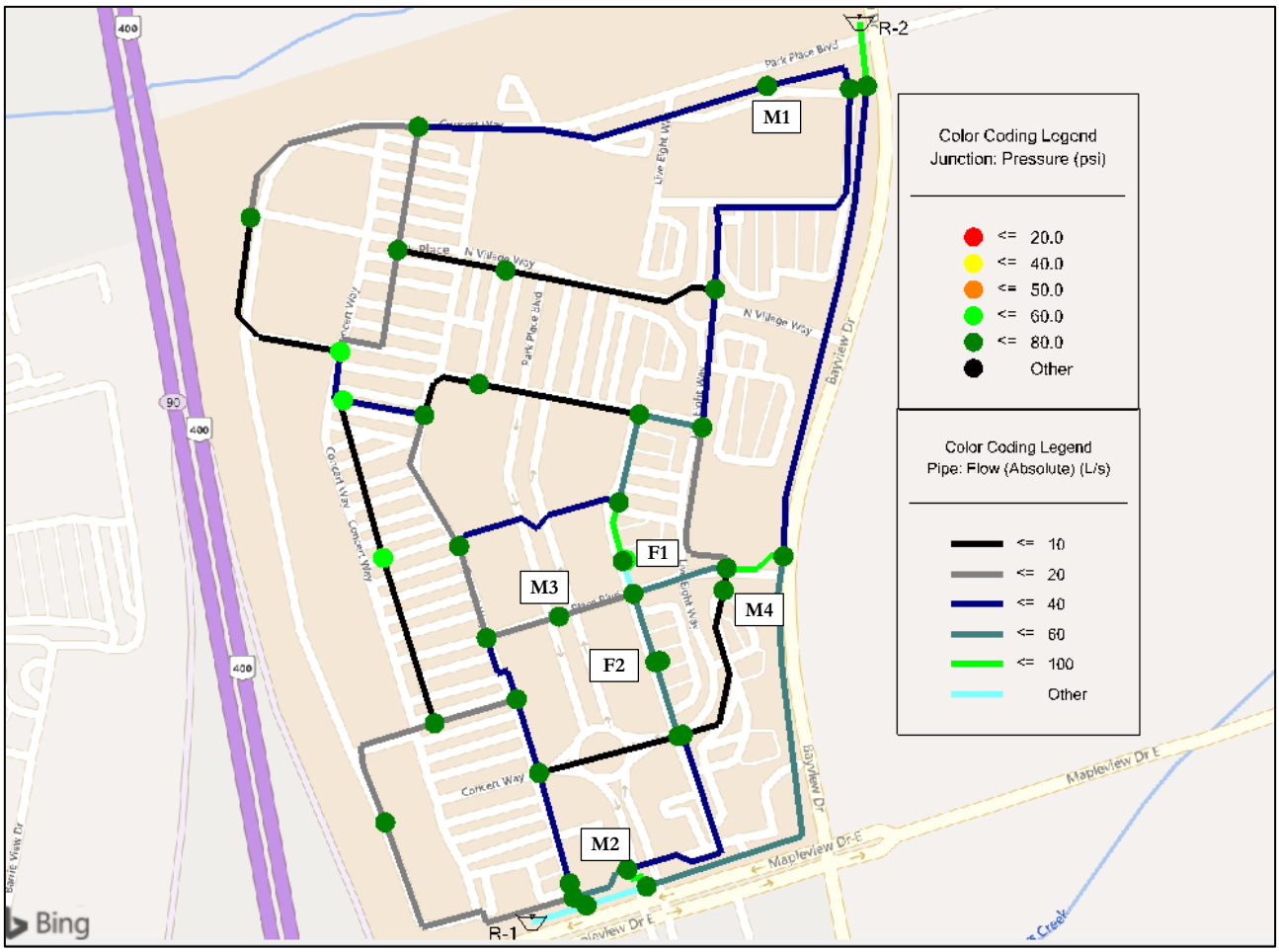

Figure 8: Flow and residual pressure results at Park Place in the event of fire flow of 191 L/s at proposed development (hydrant F1 – HY29).

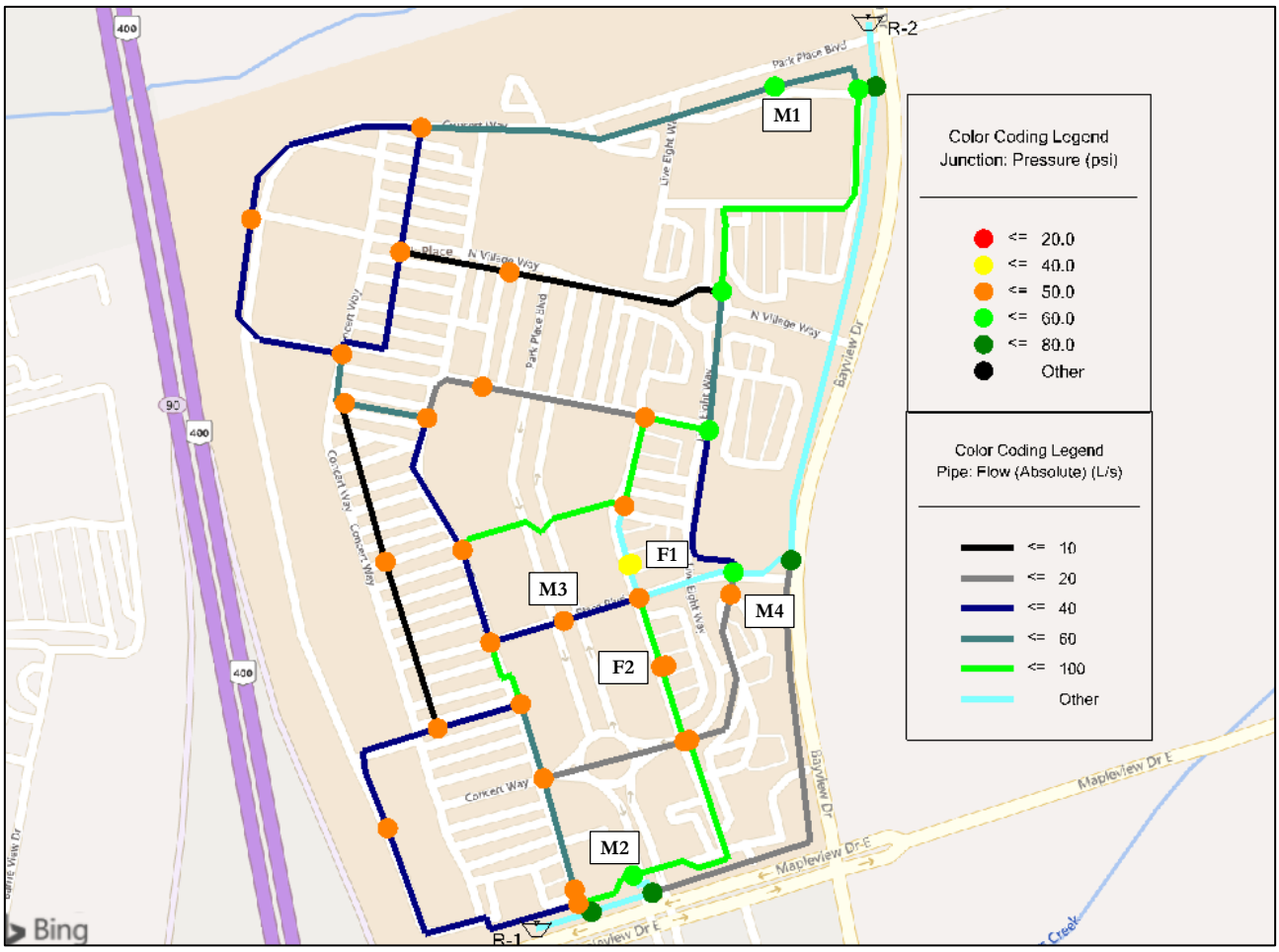

Figure 9: Flow and residual pressure results at Park Place in the event of maximum fire flow of 405 L/s at proposed development (hydrant F1 – HY29).

Conclusions

A water system analysis was conducted using a calibrated stand-alone hydraulic model which includes the proposed development and the existing Park Place water system within City's Zone 3 South network. Hydraulic simulations were conducted to determine the capacity of the existing water supply network to support the subject development and recommend upgrades (if required). Water system design criteria by the City and the MECP for this development area were considered in relation to the minimum/maximum service pressures and available fire flow. The results of the analysis are summarized and discussed below:

- The hydraulic model was calibrated based on results of field testing conducted by HydraTek on 05 November 2021.
- The predicted service pressures at Park Place with proposed development under MDD demand conditions are between 71 psi and 81 psi which is below maximum allowed pressure stipulated by City's design criteria (i.e., 100 psi).
- The minimum pressure at Park Place with proposed development under PHD demand conditions is 70 psi, which is considerably higher than the minimum pressure criteria of 40 psi stipulated by the City.
- Available fire flows within the proposed development are predicted to be in excess of required fire flow rates for corresponding residential and retail types of development recommended in City's design standards, as well as above the maximum fire flows calculated in accordance with Fire Underwriters Survey (FUS 1999).

Based on the foregoing, it is concluded that there is sufficient capacity to support the subject development and that as such the development can proceed without further upgrades or modifications to the water supply network.

Appendices

Appendix A Hydrant Flow Test Photos

Appendix B Fire Flow Calculations

Appendix C Hydrant Flow Test Reports

Appendix D Model Node IDs and Tabular Results

Appendix E Model Pipe IDs and Tabular Results

Appendix F Model Layout

ENGINEER'S CERTIFICATION

HYDRATEK & ASSOCIATES
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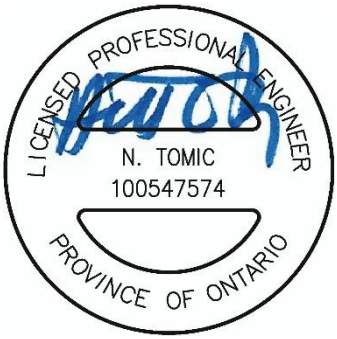

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Appendix A

Hydrant Flow Test Photos

Figure 10: Hydrant flow test at flow hydrant F1 (HY29) – NW parking lot at S Village Way and Live Eight Way, 1st N

Figure 11: Hydrant flow test at flow hydrant F2 (HY39) – SW parking lot at S Village Way and Live Eight Way, 1st S

Figure 12: Monitoring hydrant (M2 – HY4) – Parking lot between 2 Concert Way and 150 Park Place Boulevard.

Figure 13: Monitoring hydrant (M3 – HY28) – South Village Way and Live Eight Way, SE Corner.

Figure 14: Monitoring hydrant (M4 – HY33) – South Village Way, 2nd W of Live Eight Way. S side

Appendix B

Fire Flow Calculations

Park Place - Residential Development
Water Demand Calculations

Designed By: **Nikola Tomic**, P.Eng.
Checked By: Fabian Papa, P.Eng.
File No.: 21150
Date: 15 November 2021

PHASE 1 - PODIUM

Domestic Water Supply Demands:
Per City of Barrie Water Transmission and Distribution Policies and Design Standard
- assume Average Day demand is 225 L/capita/day for high density (apartment dwellings) uses
- assume Commercial / Institutional demand is 28 m^3/ha/day
- assume Population Density of 1.67 person/unit for high density (apartment dwellings) uses

Building	Building Data		Population	Ave. Day Flow	Peak Hour, ADxPH [1]	Max. Day, ADxMD [2]
	Units	(sq.m)	pers	(L/s)	(L/s)	(L/s)
1-Bed / 2-Bed	590	22,026	985	2.57	10.60	7.06
Retail	n/a	2,367	n/a	0.08	0.32	0.21
Total	590	24,393	985	2.64	10.91	7.27

[1] Peak Hour Factor, PH, is 4.13 for residential and commercial
[2] Max Day Factor, MD, is 2.75 for residential and commercial

Fire Protection Supply Demands:
Per Water Supply for Public Fire Protection Manual, 1999, by the Fire Underwriters Survey

STEP 1: Calculate Fire Flow

$$F = 220 \cdot C \cdot \sqrt{A} \cdot (\text{various adjustments}) \text{ L/min}$$

C = Coefficient related to type of construction:
= 1.5 for wood frame construction (Structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non combustible construction (unprotected metal structure components, masonry or metal walls)
= 0.6 for fire resistive construction (fully protected frame, floors, roof)

C =	1		
Largest Floor Area =	2810	m^2	2nd to 5th
Floor Area Above =	2810	m^2	
Floor Area Below =	2810	m^2	
A =	4,215	m^2	Largest Floor + 25% x (Floor Above + Floor Below)
F =	14,283	L/min	
F =	14,000	L/min	Round to the nearest 1000

STEP 2: Adjust for building occupancy (Note: Number shall not be less then 2000 L/min)
= - 25% (Non-Combustible)
= - 15% (Limited Combustible)
= 0 (Combustible)
= + 15% (Free Burning)
= + 25% (Rapid Burning)

Factor =	-15%	
F1 = F x Factor =	11,900	L/min

Park Place - Residential Development
Water Demand Calculations

STEP 3: Decrease F1 if building contains fire suppression system

= - 50% (Automatic Sprinklers)
= - 30% (Adequately Designed System)
= Additional -10% if the water supply is standard for the system and the fire department hose lines required
= Additional -10% if the system is fully supervised

Factor =	50%	
F2 = F1 x Factor =	5,950	L/min

STEP 4: Increase F1 due to exposure / close proximity to other buildings (Note: Total shall not exceed 75%)

= 25% (0m to 3m)
= 20% (3.1m to 10m)
= 15% (10.1m to 20m)
= 10% (20.1m to 30.1m)
= 5% (30.1m to 45m)
= 0% (Greater then 45m)

Distances =	N <20m / E<20 m / S <20m / W >45m	
Factors =	15% + 15% + 15% + 0%	
Factor =	45%	(max 75%)
F3 = F1 x Factor =	5,355	L/min

STEP 5: Calculate Fire Flow (Note: Fire flow shall not be less then 2000 L/min or greater then 45,000 L/min)

Fire Flow =	F1 - F2 + F3		
F1 =	11,900	L/min	
- F2 =	5,950	L/min	
+ F3 =	5,355	L/min	
Fire Flow =	11,305	L/min	
Fire Flow =	11,000	L/min	Round to the nearest 1000
Fire Flow =	183.3	L/s	

STEP 6: Calculate Total Water Demand (Max Day Demand + Fire Flow)

Recall Max Day Demand (from chart above) =	7.27	L/s
TOTAL Fire Demand =	190.6	L/s

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Park Place - Residential Development
Water Demand Calculations

Designed By: **Nikola Tomic**, P.Eng.
Checked By: Fabian Papa, P.Eng.
File No.: 21150
Date: 15 November 2021

PHASE 1B - 6TH FLOOR

Domestic Water Supply Demands:
Per City of Barrie Water Transmission and Distribution Policies and Design Standard
- assume Average Day demand is 225 L/capita/day for high density (apartment dwellings) uses
- assume Commercial / Institutional demand is 28 m^3/ha/day
- assume Population Density of 1.67 person/unit for high density (apartment dwellings) uses

Building	Building Data		Population	Ave. Day Flow	Peak Hour, ADxPH [1]	Max. Day, ADxMD [2]
	Units	(sq.m)	pers	(L/s)	(L/s)	(L/s)
1-Bed / 2-Bed	590	22,026	985	2.57	10.60	7.06
Retail	n/a	2,367	n/a	0.08	0.32	0.21
Total	590	24,393	985	2.64	10.91	7.27

[1] Peak Hour Factor, PH, is 4.13 for residential and commercial
[2] Max Day Factor, MD, is 2.75 for residential and commercial

Fire Protection Supply Demands:
Per Water Supply for Public Fire Protection Manual, 1999, by the Fire Underwriters Survey

STEP 1: Calculate Fire Flow

$$F = 220 \cdot C \cdot \sqrt{A} \cdot (\text{various adjustments}) \text{ L/min}$$

C = Coefficient related to type of construction:
= 1.5 for wood frame construction (Structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non combustible construction (unprotected metal structure components, masonry or metal walls)
= 0.6 for fire resistive construction (fully protected frame, floors, roof)

C =	1		
Largest Floor Area =	790	m^2	6th
Floor Area Above =	790	m^2	
Floor Area Below =	2810	m^2	
A =	1,690	m^2	Largest Floor + 25% x (Floor Above + Floor Below)
F =	9,044	L/min	
F =	9,000	L/min	Round to the nearest 1000

STEP 2: Adjust for building occupancy (Note: Number shall not be less then 2000 L/min)
= - 25% (Non-Combustible)
= - 15% (Limited Combustible)
= 0 (Combustible)
= + 15% (Free Burning)
= + 25% (Rapid Burning)

Factor =	-15%	
F1 = F x Factor =	7,650	L/min

Park Place - Residential Development
Water Demand Calculations

STEP 3: Decrease F1 if building contains fire suppression system

= - 50% (Automatic Sprinklers)
= - 30% (Adequately Designed System)
= Additional -10% if the water supply is standard for the system and the fire department hose lines required
= Additional -10% if the system is fully supervised

Factor =	50%	
F2 = F1 x Factor =	3,825	L/min

STEP 4: Increase F1 due to exposure / close proximity to other buildings (Note: Total shall not exceed 75%)

= 25% (0m to 3m)
= 20% (3.1m to 10m)
= 15% (10.1m to 20m)
= 10% (20.1m to 30.1m)
= 5% (30.1m to 45m)
= 0% (Greater then 45m)

Distances =	N <20m / E<20 m / S <20m / W >45m	
Factors =	15% + 15% + 15% + 0%	
Factor =	45%	(max 75%)
F3 = F1 x Factor =	3,443	L/min

STEP 5: Calculate Fire Flow (Note: Fire flow shall not be less then 2000 L/min or greater then 45,000 L/min)

Fire Flow =	F1 - F2 + F3		
F1 =	7,650	L/min	
- F2 =	3,825	L/min	
+ F3 =	3,443	L/min	
Fire Flow =	7,268	L/min	
Fire Flow =	7,000	L/min	Round to the nearest 1000
Fire Flow =	116.7	L/s	

STEP 6: Calculate Total Water Demand (Max Day Demand + Fire Flow)

Recall Max Day Demand (from chart above) =	7.27	L/s
TOTAL Fire Demand =	123.9	L/s

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Park Place - Residential Development
Water Demand Calculations

Designed By: **Nikola Tomic**, P.Eng.
Checked By: Fabian Papa, P.Eng.
File No.: 21150
Date: 15 November 2021

PHASE 1B - 7TH to 16TH FLOOR

Domestic Water Supply Demands:
Per City of Barrie Water Transmission and Distribution Policies and Design Standard
- assume Average Day demand is 225 L/capita/day for high density (apartment dwellings) uses
- assume Commercial / Institutional demand is 28 m^3/ha/day
- assume Population Density of 1.67 person/unit for high density (apartment dwellings) uses

Building	Building Data		Population	Ave. Day Flow	Peak Hour, ADxPH [1]	Max. Day, ADxMD [2]
	Units	(sq.m)	pers	(L/s)	(L/s)	(L/s)
1-Bed / 2-Bed	590	22,026	985	2.57	10.60	7.06
Retail	n/a	2,367	n/a	0.08	0.32	0.21
Total	590	24,393	985	2.64	10.91	7.27

[1] Peak Hour Factor, PH, is 4.13 for residential and commercial
[2] Max Day Factor, MD, is 2.75 for residential and commercial

Fire Protection Supply Demands:
Per Water Supply for Public Fire Protection Manual, 1999, by the Fire Underwriters Survey

STEP 1: Calculate Fire Flow

$$F = 220 \cdot C \cdot \sqrt{A} \cdot (\text{various adjustments}) \text{ L/min}$$

C = Coefficient related to type of construction:
= 1.5 for wood frame construction (Structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non combustible construction (unprotected metal structure components, masonry or metal walls)
= 0.6 for fire resistive construction (fully protected frame, floors, roof)

C =	1		
Largest Floor Area =	790	m^2	7th to 16th
Floor Area Above =	790	m^2	
Floor Area Below =	790	m^2	
A =	1,185	m^2	Largest Floor + 25% x (Floor Above + Floor Below)
F =	7,573	L/min	
F =	8,000	L/min	Round to the nearest 1000

STEP 2: Adjust for building occupancy (Note: Number shall not be less then 2000 L/min)
= - 25% (Non-Combustible)
= - 15% (Limited Combustible)
= 0 (Combustible)
= + 15% (Free Burning)
= + 25% (Rapid Burning)

Factor =	-15%	
F1 = F x Factor =	6,800	L/min

Park Place - Residential Development
Water Demand Calculations

STEP 3: Decrease F1 if building contains fire suppression system

= - 50% (Automatic Sprinklers)
= - 30% (Adequately Designed System)
= Additional -10% if the water supply is standard for the system and the fire department hose lines required
= Additional -10% if the system is fully supervised

Factor =	50%	
F2 = F1 x Factor =	3,400	L/min

STEP 4: Increase F1 due to exposure / close proximity to other buildings (Note: Total shall not exceed 75%)

= 25% (0m to 3m)
= 20% (3.1m to 10m)
= 15% (10.1m to 20m)
= 10% (20.1m to 30.1m)
= 5% (30.1m to 45m)
= 0% (Greater then 45m)

Distances =	N >45m / E<20 m / S <20m / W >45m	
Factors =	0% + 15% + 15% + 0%	
Factor =	30%	(max 75%)
F3 = F1 x Factor =	2,040	L/min

STEP 5: Calculate Fire Flow (Note: Fire flow shall not be less then 2000 L/min or greater then 45,000 L/min)

Fire Flow =	F1 - F2 + F3		
F1 =	6,800	L/min	
- F2 =	3,400	L/min	
+ F3 =	2,040	L/min	
Fire Flow =	5,440	L/min	
Fire Flow =	5,000	L/min	Round to the nearest 1000
Fire Flow =	83.3	L/s	

STEP 6: Calculate Total Water Demand (Max Day Demand + Fire Flow)

Recall Max Day Demand (from chart above) =	7.27	L/s
TOTAL Fire Demand =	90.6	L/s

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Park Place - Residential Development
Water Demand Calculations

Designed By: **Nikola Tomic**, P.Eng.
Checked By: Fabian Papa, P.Eng.
File No.: 21150
Date: 15 November 2021

PHASE 2 - PODIUM

Domestic Water Supply Demands:
Per City of Barrie Water Transmission and Distribution Policies and Design Standard
- assume Average Day demand is 225 L/capita/day for high density (apartment dwellings) uses
- assume Commercial / Institutional demand is 28 m^3/ha/day
- assume Population Density of 1.67 person/unit for high density (apartment dwellings) uses

Building	Building Data		Population	Ave. Day Flow	Peak Hour, ADxPH [1]	Max. Day, ADxMD [2]
	Units	(sq.m)	pers	(L/s)	(L/s)	(L/s)
1-Bed / 2-Bed	590	22,026	985	2.57	10.60	7.06
Retail	n/a	2,367	n/a	0.08	0.32	0.21
Total	590	24,393	985	2.64	10.91	7.27

[1] Peak Hour Factor, PH, is 4.13 for residential and commercial
[2] Max Day Factor, MD, is 2.75 for residential and commercial

Fire Protection Supply Demands:
Per Water Supply for Public Fire Protection Manual, 1999, by the Fire Underwriters Survey

STEP 1: Calculate Fire Flow

$$F = 220 \cdot C \cdot \sqrt{A} \cdot (\text{various adjustments}) \text{ L/min}$$

C = Coefficient related to type of construction:
= 1.5 for wood frame construction (Structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non combustible construction (unprotected metal structure components, masonry or metal walls)
= 0.6 for fire resistive construction (fully protected frame, floors, roof)

C =	1		
Largest Floor Area =	1875	m^2	2nd to 5th
Floor Area Above =	1875	m^2	
Floor Area Below =	1875	m^2	
A =	2,813	m^2	Largest Floor + 25% x (Floor Above + Floor Below)
F =	11,667	L/min	
F =	12,000	L/min	Round to the nearest 1000

STEP 2: Adjust for building occupancy (Note: Number shall not be less then 2000 L/min)
= - 25% (Non-Combustible)
= - 15% (Limited Combustible)
= 0 (Combustible)
= + 15% (Free Burning)
= + 25% (Rapid Burning)

Factor =	-15%	
F1 = F x Factor =	10,200	L/min

Park Place - Residential Development
Water Demand Calculations

STEP 3: Decrease F1 if building contains fire suppression system

= - 50% (Automatic Sprinklers)
= - 30% (Adequately Designed System)
= Additional -10% if the water supply is standard for the system and the fire department hose lines required
= Additional -10% if the system is fully supervised

Factor =	50%	
F2 = F1 x Factor =	5,100	L/min

STEP 4: Increase F1 due to exposure / close proximity to other buildings (Note: Total shall not exceed 75%)

= 25% (0m to 3m)
= 20% (3.1m to 10m)
= 15% (10.1m to 20m)
= 10% (20.1m to 30.1m)
= 5% (30.1m to 45m)
= 0% (Greater then 45m)

Distances =	N <20m / E>45 m / S <20m / W >45m	
Factors =	15% + 0% + 15% + 0%	
Factor =	30%	(max 75%)
F3 = F1 x Factor =	3,060	L/min

STEP 5: Calculate Fire Flow (Note: Fire flow shall not be less then 2000 L/min or greater then 45,000 L/min)

Fire Flow =	F1 - F2 + F3		
F1 =	10,200	L/min	
- F2 =	5,100	L/min	
+ F3 =	3,060	L/min	
Fire Flow =	8,160	L/min	
Fire Flow =	8,000	L/min	Round to the nearest 1000
Fire Flow =	133.3	L/s	

STEP 6: Calculate Total Water Demand (Max Day Demand + Fire Flow)

Recall Max Day Demand (from chart above) =	7.27	L/s
TOTAL Fire Demand =	140.6	L/s

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Park Place - Residential Development
Water Demand Calculations

Designed By: **Nikola Tomic**, P.Eng.
Checked By: Fabian Papa, P.Eng.
File No.: 21150
Date: 15 November 2021

PHASE 2 - 6TH FLOOR

Domestic Water Supply Demands:
Per City of Barrie Water Transmission and Distribution Policies and Design Standard
- assume Average Day demand is 225 L/capita/day for high density (apartment dwellings) uses
- assume Commercial / Institutional demand is 28 m^3/ha/day
- assume Population Density of 1.67 person/unit for high density (apartment dwellings) uses

Building	Building Data		Population	Ave. Day Flow	Peak Hour, ADxPH [1]	Max. Day, ADxMD [2]
	Units	(sq.m)	pers	(L/s)	(L/s)	(L/s)
1-Bed / 2-Bed	590	22,026	985	2.57	10.60	7.06
Retail	n/a	2,367	n/a	0.08	0.32	0.21
Total	590	24,393	985	2.64	10.91	7.27

[1] Peak Hour Factor, PH, is 4.13 for residential and commercial
[2] Max Day Factor, MD, is 2.75 for residential and commercial

Fire Protection Supply Demands:
Per Water Supply for Public Fire Protection Manual, 1999, by the Fire Underwriters Survey

STEP 1: Calculate Fire Flow

$$F = 220 \cdot C \cdot \sqrt{A} \cdot (\text{various adjustments}) \text{ L/min}$$

C = Coefficient related to type of construction:
= 1.5 for wood frame construction (Structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non combustible construction (unprotected metal structure components, masonry or metal walls)
= 0.6 for fire resistive construction (fully protected frame, floors, roof)

C =	1		
Largest Floor Area =	795	m^2	6th
Floor Area Above =	795	m^2	
Floor Area Below =	1875	m^2	
A =	1,463	m^2	Largest Floor + 25% x (Floor Above + Floor Below)
F =	8,413	L/min	
F =	8,000	L/min	Round to the nearest 1000

STEP 2: Adjust for building occupancy (Note: Number shall not be less then 2000 L/min)
= - 25% (Non-Combustible)
= - 15% (Limited Combustible)
= 0 (Combustible)
= + 15% (Free Burning)
= + 25% (Rapid Burning)

Factor =	-15%	
F1 = F x Factor =	6,800	L/min

Park Place - Residential Development
Water Demand Calculations

STEP 3: Decrease F1 if building contains fire suppression system

= - 50% (Automatic Sprinklers)
= - 30% (Adequately Designed System)
= Additional -10% if the water supply is standard for the system and the fire department hose lines required
= Additional -10% if the system is fully supervised

Factor =	50%	
F2 = F1 x Factor =	3,400	L/min

STEP 4: Increase F1 due to exposure / close proximity to other buildings (Note: Total shall not exceed 75%)

= 25% (0m to 3m)
= 20% (3.1m to 10m)
= 15% (10.1m to 20m)
= 10% (20.1m to 30.1m)
= 5% (30.1m to 45m)
= 0% (Greater then 45m)

Distances =	N <20m / E>45 m / S <20m / W >45m	
Factors =	15% + 0% + 15% + 0%	
Factor =	30%	(max 75%)
F3 = F1 x Factor =	2,040	L/min

STEP 5: Calculate Fire Flow (Note: Fire flow shall not be less then 2000 L/min or greater then 45,000 L/min)

Fire Flow =	F1 - F2 + F3		
F1 =	6,800	L/min	
- F2 =	3,400	L/min	
+ F3 =	2,040	L/min	
Fire Flow =	5,440	L/min	
Fire Flow =	5,000	L/min	Round to the nearest 1000
Fire Flow =	83.3	L/s	

STEP 6: Calculate Total Water Demand (Max Day Demand + Fire Flow)

Recall Max Day Demand (from chart above) =	7.27	L/s
TOTAL Fire Demand =	90.6	L/s

Park Place - Residential Development
Water Demand Calculations

Designed By: **Nikola Tomic**, P.Eng.
Checked By: Fabian Papa, P.Eng.
File No.: 21150
Date: 15 November 2021

PHASE 2 - 7TH to 12TH FLOOR

Domestic Water Supply Demands:
Per City of Barrie Water Transmission and Distribution Policies and Design Standard
- assume Average Day demand is 225 L/capita/day for high density (apartment dwellings) uses
- assume Commercial / Institutional demand is 28 m^3/ha/day
- assume Population Density of 1.67 person/unit for high density (apartment dwellings) uses

Building	Building Data		Population	Ave. Day Flow	Peak Hour, ADxPH [1]	Max. Day, ADxMD [2]
	Units	(sq.m)	pers	(L/s)	(L/s)	(L/s)
1-Bed / 2-Bed	590	22,026	985	2.57	10.60	7.06
Retail	n/a	2,367	n/a	0.08	0.32	0.21
Total	590	24,393	985	2.64	10.91	7.27

[1] Peak Hour Factor, PH, is 4.13 for residential and commercial
[2] Max Day Factor, MD, is 2.75 for residential and commercial

Fire Protection Supply Demands:
Per Water Supply for Public Fire Protection Manual, 1999, by the Fire Underwriters Survey

STEP 1: Calculate Fire Flow

$$F = 220 \cdot C \cdot \sqrt{A} \cdot (\text{various adjustments}) \text{ L/min}$$

C = Coefficient related to type of construction:
= 1.5 for wood frame construction (Structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non combustible construction (unprotected metal structure components, masonry or metal walls)
= 0.6 for fire resistive construction (fully protected frame, floors, roof)

C =	1		
Largest Floor Area =	750	m^2	7^{th} to 12^{th}
Floor Area Above =	750	m^2	
Floor Area Below =	750	m^2	
A =	1,125	m^2	Largest Floor + 25% x (Floor Above + Floor Below)
F =	7,379	L/min	
F =	7,000	L/min	Round to the nearest 1000

STEP 2: Adjust for building occupancy (Note: Number shall not be less then 2000 L/min)
= - 25% (Non-Combustible)
= - 15% (Limited Combustible)
= 0 (Combustible)
= + 15% (Free Burning)
= + 25% (Rapid Burning)

Factor =	-15%	
F1 = F x Factor =	5,950	L/min

Park Place - Residential Development
Water Demand Calculations

STEP 3: Decrease F1 if building contains fire suppression system

= - 50% (Automatic Sprinklers)
= - 30% (Adequately Designed System)
= Additional -10% if the water supply is standard for the system and the fire department hose lines required
= Additional -10% if the system is fully supervised

Factor =	50%	
F2 = F1 x Factor =	2,975	L/min

STEP 4: Increase F1 due to exposure / close proximity to other buildings (Note: Total shall not exceed 75%)

= 25% (0m to 3m)
= 20% (3.1m to 10m)
= 15% (10.1m to 20m)
= 10% (20.1m to 30.1m)
= 5% (30.1m to 45m)
= 0% (Greater then 45m)

Distances =	N <20m / E>45 m / S <20m / W >45m	
Factors =	15% + 0% + 15% + 0%	
Factor =	30%	(max 75%)
F3 = F1 x Factor =	1,785	L/min

STEP 5: Calculate Fire Flow (Note: Fire flow shall not be less then 2000 L/min or greater then 45,000 L/min)

Fire Flow =	F1 - F2 + F3		
F1 =	5,950	L/min	
- F2 =	2,975	L/min	
+ F3 =	1,785	L/min	
Fire Flow =	4,760	L/min	
Fire Flow =	5,000	L/min	Round to the nearest 1000
Fire Flow =	83.3	L/s	

STEP 6: Calculate Total Water Demand (Max Day Demand + Fire Flow)

Recall Max Day Demand (from chart above) =	7.27	L/s
TOTAL Fire Demand =	90.6	L/s

Appendix C

Hydrant Flow Test Reports

HydraTek & Associates

HYDRANT FLOW TEST REPORT

05 November 2021

PROJECT INFORMATION

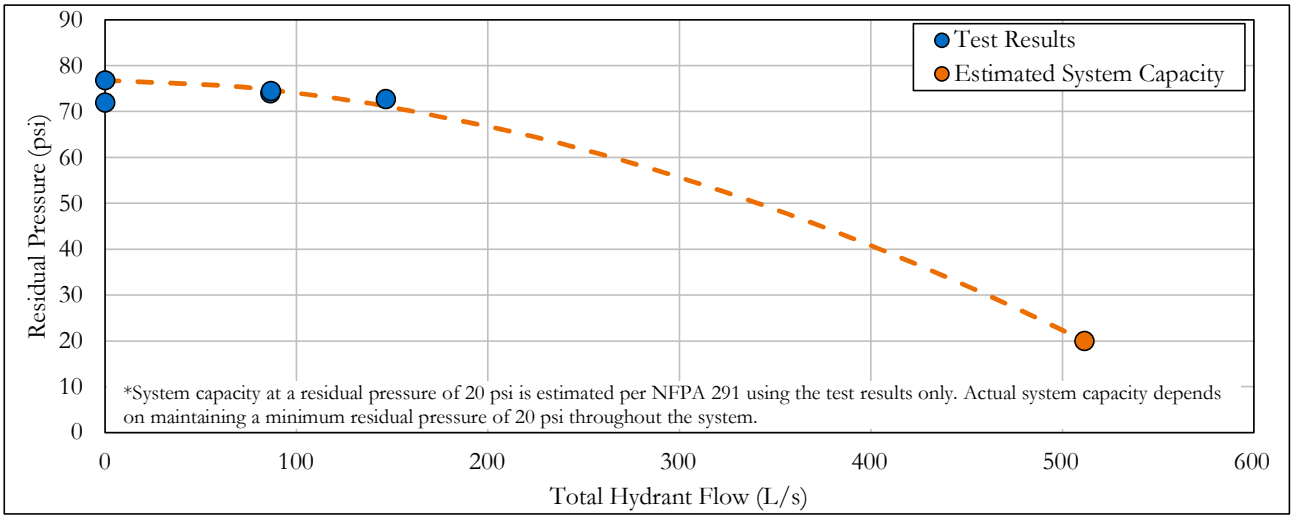
HydraTek Project No.:	21150
Project Name:	Park Place Hydrant Flow Test, City of Barrie
Client/Owner Name:	North American Development Group
Date and Time of Test:	05 November 2021 at 10:00 AM
Test Conducted By:	M. Papa and N. Tomic
Design Flow:	n/a
Municipality:	City of Barrie
Zone:	Zone 3 South

TEST INFORMATION

Location Description:	South Village Way and Live Eight Way, Park Place
Residual Hydrant:	South Village Way and Live Eight Way, SE corner, ID HY28
Flow Hydrant No. 1:	Northwest Parking Lot at S Village Way and Live Eight Way, 1st N of S Village Way, ID HY29
Flow Hydrant No. 2:	-
Watermain Size:	250 mm (10-in)

TEST RESULTS

Test No.	No. Ports and Size	Pitot Pressure (psi)				Total Flow (L/s)	Residual Pressure (psi)
		Flow Hydrant 1		Flow Hydrant 2			
		Port 1	Port 2	Port 1	Port 2		
1	Init. Static	-	-	-	-	0	72.0
2	1× 2.5-in	67	-	-	-	86	74.0
3	2× 2.5-in	47	49	-	-	147	72.7
4	1× 2.5-in	-	67	-	-	87	74.5
5	Final Static	-	-	-	-	0	76.8
					Estimated system capacity (L/s):	512	20



TEST COMMENTS

-With one flow hydrant, the test was unable to achieve a minimum 25% drop in residual pressure per NFPA 291 test requirements due to the high capacity of the local water system. However the design flow rate was exceeded.

-Estimated system capacity is based on NFPA 291 using the test results only. Actual system capacity depends on the maximum flow that can be withdrawn subject to maintaining a minimum residual pressure of 20 psi (14.3 m; 140 kPa) at the test location and throughout the rest of the water system.

- Initial residual pressure is not used in system capacity calculations, as operating conditions changed during the first tested point (i.e., additional pump turned on during 1st port testing).

PREPARED BY:

Name: Nikola Tomic Signature:

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HydraTek & Associates

HYDRANT FLOW TEST REPORT

05 November 2021

PROJECT INFORMATION

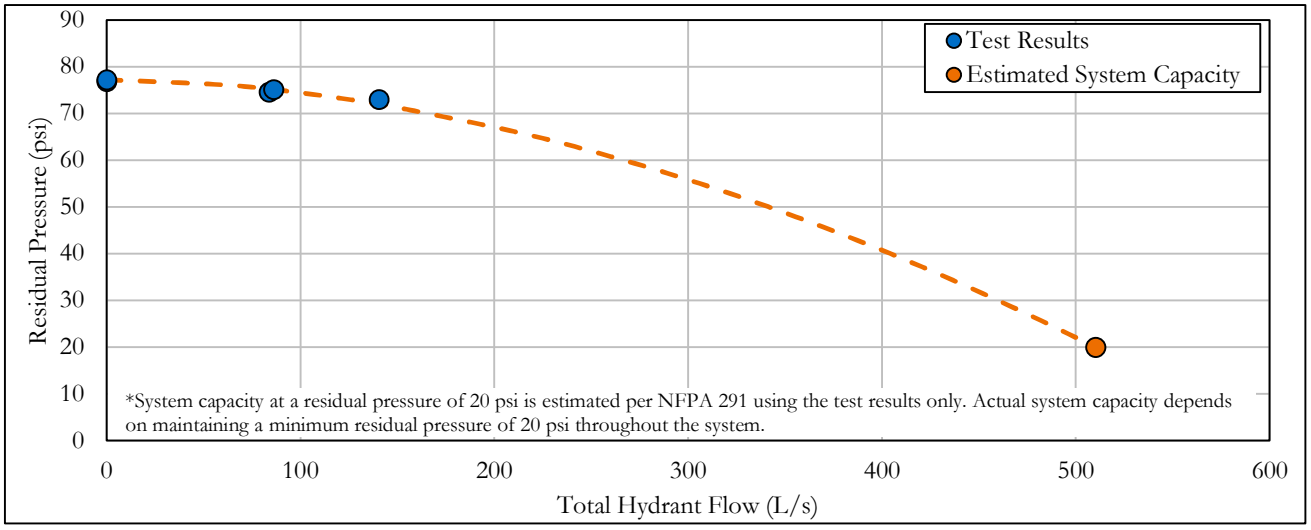
HydraTek Project No.:	21150
Project Name:	Park Place Hydrant Flow Test, City of Barrie
Client/Owner Name:	North American Development Group
Date and Time of Test:	05 November 2021 at 10:45 AM
Test Conducted By:	M. Papa and N. Tomic
Design Flow:	n/a
Municipality:	City of Barrie
Zone:	Zone 3 South

TEST INFORMATION

Location Description:	South Village Way and Live Eight Way, Park Place
Residual Hydrant:	South Village Way and Live Eight Way, SE corner, ID HY28
Flow Hydrant No. 1:	Southwest Parking Lot at S Village Way and Live Eight Way, 1st S of S Village Way, ID HY39
Flow Hydrant No. 2:	-
Watermain Size:	250 mm (10-in)

TEST RESULTS

Test No.	No. Ports and Size	Pitot Pressure (psi)				Total Flow (L/s)	Residual Pressure (psi)
		Flow Hydrant 1		Flow Hydrant 2			
		Port 1	Port 2	Port 1	Port 2		
1	Init. Static	-	-	-	-	0	76.9
2	1× 2.5-in	63	-	-	-	84	74.6
3	2× 2.5-in	44	45	-	-	140	73.0
4	1× 2.5-in	-	66	-	-	86	75.2
5	Final Static	-	-	-	-	0	77.2
					Estimated system capacity (L/s):	**509**	**20**



TEST COMMENTS

-With one flow hydrant, the test was unable to achieve a minimum 25% drop in residual pressure per NFPA 291 test requirements due to the high capacity of the local water system. However the design flow rate was exceeded.

-Estimated system capacity is based on NFPA 291 using the test results only. Actual system capacity depends on the maximum flow that can be withdrawn subject to maintaining a minimum residual pressure of 20 psi (14.3 m; 140 kPa) at the test location and throughout the rest of the water system.

PREPARED BY:

Name: Nikola Tomic

Signature:

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Appendix D

Model Node IDs and Tabular Results

Table 14: Node properties and hydraulic modeling results for nodal pressure heads.

Label	Elevation (m)	Pressure (psi)						
		ADD	MDD	PHD	MDD + Fire (191 L/s)	MDD + Fire (200 L/s)	MDD + Fire (283 L/s)	MDD + Fire (405 L/s)
F1 (HY29)	294.1	77.1	76.9	76.7	58.7	57.6	45.3	20.2
F2 (HY39)	293.6	77.9	77.6	77.5	65.7	65.2	59.0	46.1
H1065	287.5	85.6	85.6	85.5	79.7	79.6	79.4	78.9
H1153	295.6	76.7	76.6	76.6	69.9	69.9	69.0	67.1
H2529	289.9	83.1	82.9	82.8	75.9	75.8	74.5	71.4
J-1	296.8	73.2	73.0	72.8	61.8	61.4	55.9	44.5
J-2	294.5	76.5	76.3	76.1	65.1	64.7	59.2	47.9
J-4	296.3	74.0	73.8	73.6	62.0	61.4	55.4	42.8
J-5	293.9	77.4	77.2	77.0	65.3	64.8	58.7	46.0
J-6	298.5	70.9	70.7	70.5	59.3	58.8	53.1	41.4
J-11	297.0	73.1	72.8	72.7	61.5	61.0	55.5	43.9
J-16	293.9	77.5	77.2	77.1	65.8	65.3	59.6	47.7
J-17	294.9	76.0	75.8	75.6	64.3	63.7	57.9	45.9
J-18	292.5	79.4	79.2	79.1	67.7	67.2	61.5	49.5
J-19	293.9	77.6	77.4	77.2	66.6	66.1	61.0	50.4
J-20	293.6	77.9	77.6	77.5	65.3	64.8	58.2	44.6
J-21	292.5	79.4	79.2	79.1	67.7	67.2	61.5	49.5
J-22	291.8	80.4	80.2	80.0	68.8	68.3	62.6	50.6
J-23	291.5	80.8	80.6	80.4	69.1	68.6	62.8	50.7
J-24	295.7	74.9	74.6	74.5	62.7	62.2	56.0	43.2
J-25	293.9	77.4	77.2	77.0	64.7	64.2	57.5	43.6
J-26	293.4	78.2	78.0	77.8	66.8	66.4	61.0	49.7
J-27	294.9	76.0	75.8	75.6	64.0	63.4	57.4	44.7
J-28	296.4	73.9	73.6	73.5	61.9	61.3	55.3	42.7
J-29	298.2	71.3	71.1	70.9	59.7	59.2	53.6	41.8
J-30	298.2	71.2	71.0	70.8	59.8	59.3	53.8	42.2
J-31	295.9	74.5	74.3	74.1	63.2	62.7	57.4	46.2
J-32	296.8	73.2	73.0	72.8	61.9	61.4	55.9	44.6
J-34	289.7	83.1	82.9	82.8	72.8	72.4	67.9	58.3
J-35	291.8	80.3	80.1	79.9	69.0	68.5	63.0	51.7
J-36	297.3	72.6	72.4	72.2	61.0	60.5	54.8	43.1
J-38	294.0	77.8	77.7	77.6	70.4	70.2	68.8	65.7
J-41	294.1	77.1	76.9	76.7	63.4	62.8	55.0	39.2

Label	Elevation (m)	Pressure (psi)						
		ADD	MDD	PHD	MDD + Fire (191 L/s)	MDD + Fire (200 L/s)	MDD + Fire (283 L/s)	MDD + Fire (405 L/s)
J-42	294.1	77.2	76.9	76.8	65.0	64.4	58.2	45.4
M1 (HY40)	291.1	81.1	81.0	80.8	70.6	70.2	65.5	55.6
M2 (HY4)	294.3	76.9	76.7	76.5	65.5	65.1	59.6	48.3
M3 (HY28)	294.4	76.7	76.5	76.3	64.4	63.9	57.6	44.5
M4 (HY33)	292.6	79.3	79.1	78.9	67.6	67.1	61.4	49.5

Appendix E

Model Pipe IDs and Tabular Results

Table 15: Pipe properties and hydraulic modeling results for pipe flows.

Label	Length (m)	Inside Diameter (mm)	Hazen Williams C	Flow (L/s)						
				ADD	MDD	PHD	MDD + Fire (191 L/s)	MDD + Fire (200 L/s)	MDD + Fire (283 L/s)	MDD + Fire (405 L/s)
P-1	59	250	110	14	15	16	43	45	61	85
P-2	248	250	110	6	6	6	15	15	20	28
P-3	142	250	110	5	6	6	14	15	20	27
P-4	102	250	110	9	9	9	28	29	41	57
P-5	69	250	110	7	8	8	22	23	32	44
P-6	69	250	110	6	6	6	34	36	50	72
P-7	129	200	110	1	1	1	6	6	9	13
P-8	200	250	110	10	11	11	32	34	46	65
P-9	31	250	110	25	26	28	76	79	107	150
P-10	70	250	110	7	8	9	44	46	65	91
P-11	64	250	110	5	4	3	41	43	61	87
P-12	31	250	110	7	8	10	114	119	168	241
P-13	70	200	110	0	1	1	17	18	26	37
P-14	4	250	110	5	7	8	38	40	56	78
P-15	157	250	110	5	4	4	6	6	9	13
P-16	56	250	110	3	9	12	76	79	110	155
P-17	87	250	110	1	5	7	56	58	82	116
P-18	20	250	110	5	4	3	6	7	10	13
P-19	158	250	110	7	8	9	14	14	19	25
P-20	58	250	110	5	4	3	40	42	59	84
P-21	147	250	110	1	1	2	7	7	11	16
P-22	163	250	110	1	1	1	31	32	45	65
P-23	54	250	110	5	5	4	77	81	115	164
P-24	81	250	110	6	6	6	47	49	70	100
P-25	131	250	110	5	5	5	14	15	21	31
P-26	155	250	110	7	8	8	2	2	1	0
P-27	13	250	110	9	9	10	28	30	41	57
P-28	86	250	110	6	6	6	17	17	24	34
P-29	68	200	110	0	0	0	18	18	26	37
P-30	74	200	110	5	5	5	22	23	33	47
P-31	72	250	110	0	0	0	8	8	12	17
P-32	50	250	110	12	11	11	21	23	33	49
P-33	190	250	110	5	5	5	9	9	14	21

Label	Length (m)	Inside Diameter (mm)	Hazen Williams C	Flow (L/s)						
				ADD	MDD	PHD	MDD + Fire (191 L/s)	MDD + Fire (200 L/s)	MDD + Fire (283 L/s)	MDD + Fire (405 L/s)
P-34	197	250	110	5	4	3	10	11	16	22
P-35	135	250	110	7	6	6	13	13	19	28
P-36	112	250	110	6	5	5	12	13	18	27
P-37	194	250	110	1	1	1	2	2	2	3
P-38	98	250	110	1	1	0	1	1	1	2
P-39	320	250	110	10	9	8	22	23	34	49
P-40	15	250	110	23	20	17	51	54	77	112
P-41	91	250	110	10	8	7	23	24	35	50
P-42	291	250	110	13	11	10	28	30	43	62
P-43	124	250	110	12	12	12	26	28	41	59
P-44	146	250	110	6	6	6	1	1	0	2
P-45	77	200	110	2	2	2	12	13	19	27
P-54	3	150	100	1	4	5	191	200	283	405
P-55	4	150	100	1	4	6	4	4	4	4

Appendix F

Model Layout

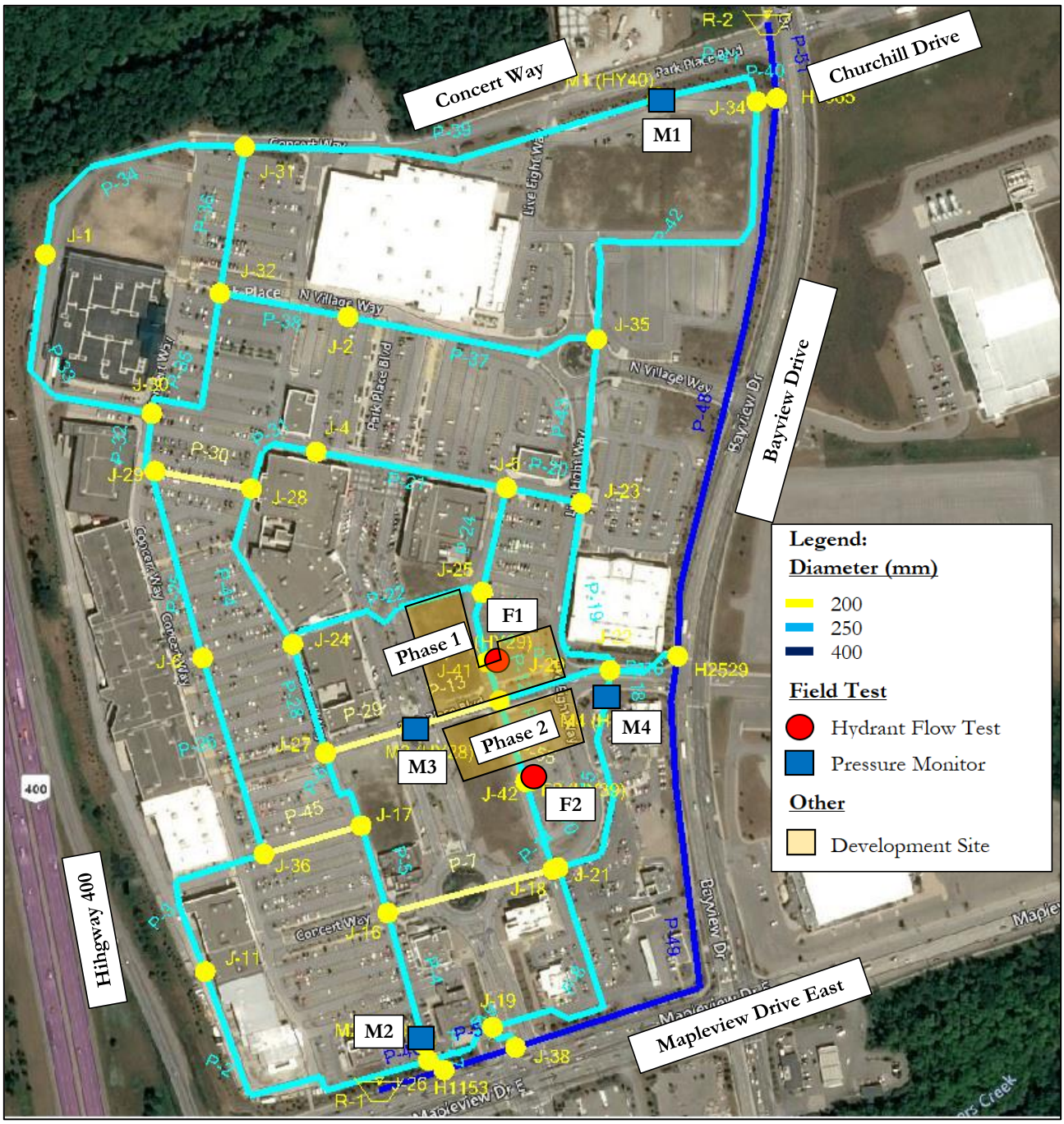


Figure 15: Model Layout and map of the Park Place proposed development.

APPENDIX C

PHOSPHORUS BUDGET

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

POST-DEVELOPMENT Phosphorus LOAD - BMPs applied

Subwatershed: Lovers Creek

Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		BMP P Load (kg/yr)
DEVELOPMENT:	**Park Place Residential**				
High Intensity - Comm/Industrial	0.47	1.82	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.11
Rooftop going to RDC perforated sewer					
High Intensity - Comm/Industrial	2	1.82	Wet Detention Ponds	63%	1.35
Pavement area going to SWM Pond					

	P Load (kg/yr)
Post-Development Load:	**4.50**
Post-Development (with BMP):	**1.46**

Therefore, the mitigated phosphorus generation rate from the previous approved land use was 1.46 kg/yr

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

POST-DEVELOPMENT Phosphorus LOAD - BMPs applied

Subwatershed: Lovers Creek

Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		BMP P Load (kg/yr)
DEVELOPMENT:	**Park Place Residential**				
High Intensity - Comm/Industrial	0.64	1.82	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.15
Rooftop going to RDC perforated sewer					
High Intensity - Comm/Industrial	1.83	1.82	Wet Detention Ponds	63%	1.23
Pavement area going to SWM Pond					

	P Load (kg/yr)
Post-Development Load:	**4.50**
Post-Development (with BMP):	**1.38**

The mitigated phosphorus generation rate from the revised land use is 1.38 kg/yr, which is less than the previously approved generation rate of 1.46kg/yr. Therefore, no further measures are required.

APPENDIX D

EXCERPTS FROM PREVIOUS STUDIES

Excerpts from Park Place Stormwater
Management Analysis and Preliminary
Servicing Study
Prepared by Sabourin Kimble & Associates Ltd.
December 2007

Volume control was not a requirement for the subject site as this overall report was approved in 2007 and the LSRCA's volume control policy did not come into effect until 2016.

5.0 STORMWATER MANAGEMENT CRITERIA

The stormwater management criterion for the subject site was determined as a combination of site-specific constraints and criterion established by the Lake Simcoe Region Conservation Authority and/or the City of Barrie. The overall criterion for the design of the stormwater management system is outlined in the following sections.

5.1 Water Quality Control

Based on downstream aquatic habitat, on-site water quality controls must be provided, which satisfy enhanced protection level (formerly level 1) constraints as outlined in the Ministry of Environment Stormwater Management Planning and Design Manual (March 2003).

5.2 Erosion Control

The minimum Lake Simcoe Region Conservation Authority requirements state that the runoff generated by a 25mm storm be discharged over a 24-hour period. However, the Conservation Authority has identified that the south tributary of Lovers Creek is subject to erosion and an appropriate hydrologic model should be developed to assess downstream erosion potential and any necessary mitigation practices.

5.3 Water Balance

In order to maintain the recharge characteristics of this area, appropriate stormwater management works must be provided to maintain the annual pre-development water balance under post development conditions.

5.4 Water Quantity Control

The Lake Simcoe Region Conservation Authority requires that post development flows be controlled to pre-development levels for all storms up to, and including the 100 year storm event.

Rooftop and parking lot flows from an area immediately south of Big Bay Point Road will be controlled on-site through rooftop and parking lot controls and discharge to the existing sewer on Bayview Drive. Water quality control for this small area will be provided by an oil/grit separator (Stormscepter or equal).

Post development drainage areas to each tributary are summarized in a table included in Figure 5.

6.4 Water Balance

6.4.1 General

The overall water balance for the entire site was calculated as part of a detailed soils investigation completed by Terraprobe. The water balance was completed on the average 10 year annual total rainfall from Environment Canada's Midhurst, Ontario station. Details and assumptions for the analysis are provided in the Terraprobe report.

Based on the Terraprobe evaluation, the average annual pre-development infiltration volume was calculated to be 193,305 cubic metres. Based on the requirement to match the average annual pre-development infiltration under post development conditions, the pre-development volume will be provided by a combination of infiltration from the rooftops, open space and central facilities. Assuming the coverage shown in the development concept, the required infiltration volumes are summarized in Table 3.

TABLE 3

Required Annual Infiltration Volumes

Coverage	Area (ha)	Annual Infiltration Volume (m^3)
Rooftops	13.4	63,181
Open Space	9.3	22,785
Parking Lots (Central Facilities)	50.8	107,339
	Total	193,305

A summary of the mass balance infiltration data as calculated by Terraprobe is enclosed in Appendix 'B'.

6.4.2 Rooftop Controls

As shown in section 6.4.1, the rooftops will provide approximately thirty percent (30%) of the required average annual infiltration volume. In order to discharge the rooftop runoff to the perforated storm sewer over an elongated period of time, it is proposed to implement rooftop runoff controls. Based on the provision of one (1) roof drain per 930 m^2 (10,000 ft^2) of roof and one (1) control weir per drain, rooftop controls will control the unit release rate to less than 20 *l*/sec/ha under 100 year storm conditions. This assumption was supported by the review of discharge rates for similar commercial/retail buildings in various municipalities. Table 4 provides a summary of that review.

The previously determined rooftop discharge rate is 20 l/sec/ha under 100-year storm conditions.

TABLE 4

Controlled Rooftop Flow Rates

Municipality	Roof Area (ha)	Number of Roof Drains	100 Year Storm Controlled Flow (*l*/sec)	Unit Flow Contact (*l*/sec/ha)
Brampton	1.09	20	15.22	13.96
Kingston	0.91	18	11.52	12.66
Barrie	1.00	23	16.90	16.90
Collingwood	0.48	6	4.48	9.33
Sudbury	0.44	8	5.97	13.56

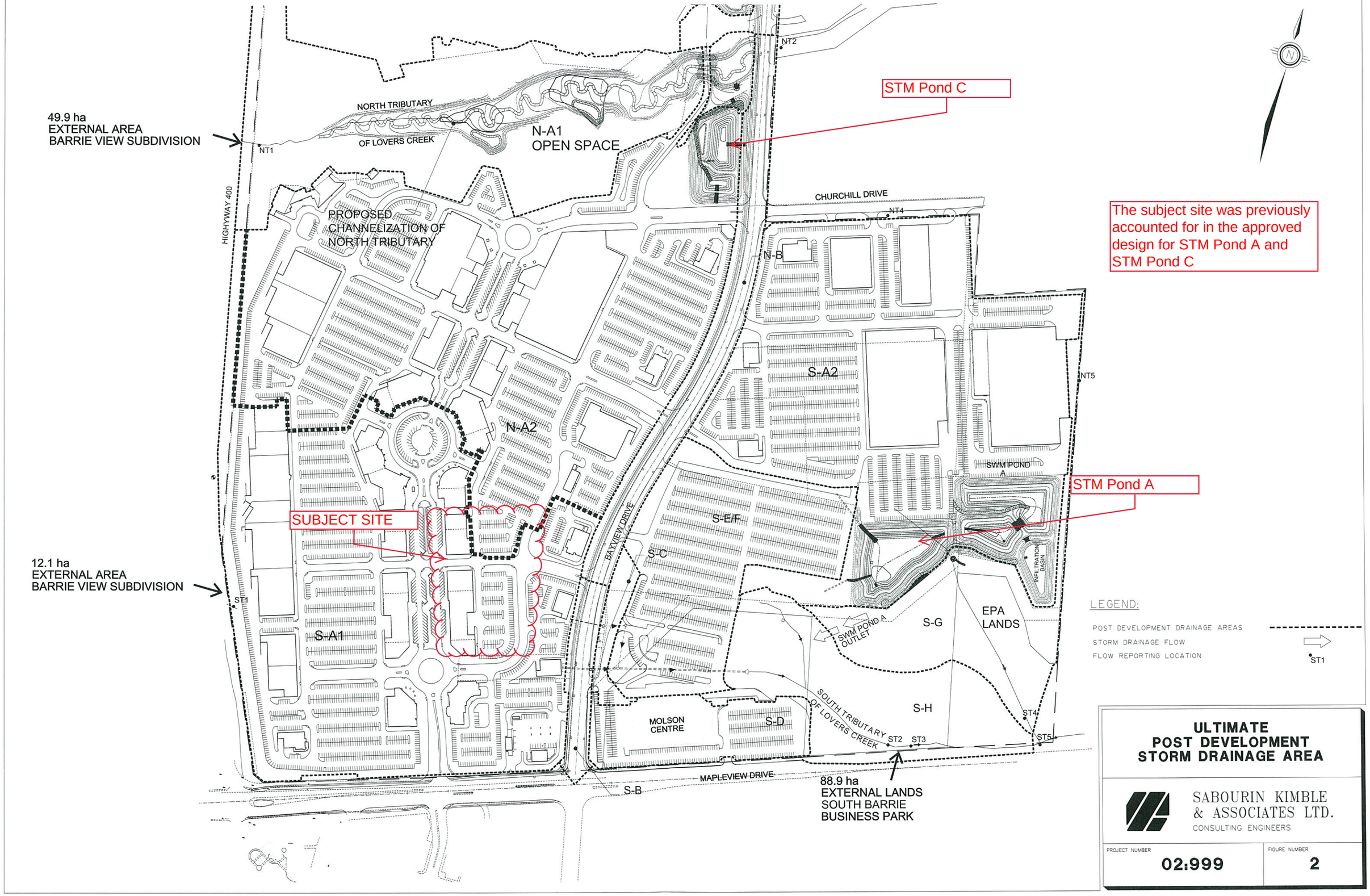
Therefore, based on the results shown in Table 4, it was assumed that the implementation of rooftop controls would control the unit release rate to 20 *l*/sec/ha of roof under 100 year storm conditions. The City of Barrie has also requested that the control rooftop flows be accounted for in the design of the central water quantity facilities by assuming that these flows do not infiltrate and are released to the downstream watercourse.

6.4.3 Infiltration Facilities

The design of infiltration facilities is based on the required infiltration volume capacity per event, hydraulic conductivity of the soil and the resultant surface contact area.

In order to determine the required infiltration volume capacity per event, the 10 years of rainfall data was reviewed and recorded into the number of events within ranges of rainfall depth. The average number of events over the ten (10) year period within the selected rainfall depth range are summarized in Table 5.

Excerpts from Park Place Phase 1 Stormwater Management Detailed Design Brief
Prepared by Sabourin Kimble & Associates Ltd.
February 2008


49.9 ha
EXTERNAL AREA
BARRIE VIEW SUBDIVISION
NT1
NORTH TRIBUTARY
OF LOVERS CREEK
N-A1
OPEN SPACE
NT2
STM Pond C
HIGHWAY 400
PROPOSED
CHANNELIZATION OF
NORTH TRIBUTARY
CHURCHILL DRIVE
NT4
N-B
S-A2
NT5
N-A2
SWM POND
A
STM Pond A
SUBJECT SITE
BAYVIEW DRIVE
S-E/F
S-C
INFILTRATION
BASIN
12.1 ha
EXTERNAL AREA
BARRIE VIEW SUBDIVISION
ST1
S-A1
EPA
LANDS
S-G
SWM POND A
OUTLET
S-H
MOLSON
CENTRE
S-D
SOUTH TRIBUTARY
OF LOVERS CREEK
ST2
ST3
ST4
ST5
MAPLEVIEW DRIVE
S-B
88.9 ha
EXTERNAL LANDS
SOUTH BARRIE
BUSINESS PARK
LEGEND:
POST DEVELOPMENT DRAINAGE AREAS
STORM DRAINAGE FLOW
FLOW REPORTING LOCATION
ST1
The subject site was previously accounted for in the approved design for STM Pond A and STM Pond C
ULTIMATE
POST DEVELOPMENT
STORM DRAINAGE AREA
SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS
PROJECT NUMBER
02.999
FIGURE NUMBER
2

As previously shown in the PSS excerpt, volume control was not a requirement for the subject site in the approved detailed design SWM brief for the Phase 1 lands, which encompasses the subject site.

5.0 STORMWATER MANAGEMENT DESIGN CRITERIA

The stormwater management design criteria as established in the PSS are as follows:

- Stormwater management ponds are to be constructed and designed to treat drainage from the entire Phase 1 development draining to Lovers Creek;

- As part of the phasing of this development, a temporary interim stormwater management pond will be constructed to treat drainage for areas discharging to the North Tributary;

- Permanent Pool volumes in the ponds are to be sized using the MOE Stormwater Management Planning and Design Manual for "Enhanced" fisheries level criteria (quality control) for the development site and "Normal" fisheries level criteria for external areas;

- Stormwater management Pond A is to provide 84 hour detention of the runoff generated from a 4 hour 25 mm event (first flush) for stream bank erosion control, while the Interim Pond will provide 24 hour detention;

- Appropriate stormwater management works must be provided to maintain the annual pre development water balance under post development conditions. This may be achieved through the infiltration of building rooftop runoff plus 5.3mm of runoff from the parking lot areas;

- Control of the 2 through 100-year post development flows to pre-development levels is to be provided in the stormwater management facilities.

POND A

subject site encompassed in Commercial area in the approved SWM pond design for STM Pond A.

DRAINAGE AREA COMPOSITION		
LOCATION	AREA (ha)	RUNOFF COEFFICIENT
Commercial	27.58	0.90
Open Space	1.06	0.20
Pond Block	2.62	0.46
External	12.14	0.79
Weighted Total	43.40	0.83

Note that rooftop area is not taken into account as the rooftops drain to a separate storm sewer system and bypass the pond

External	C	D	E	F
Area (ha)	2.200	1.520	1.910	6.510
TIMP	0.72	0.72	0.72	0.85

POND DETAILS			
Permanent Pool			
Permanent Pool Unit Storage Required (On site Area)	208.3	m^3/ha	Unit volumes taken from extrapolating values from Table 3.2 Water Quality Storage Requirements based on Receiving Waters, in Stormwater Management Planning and Design Manual, MOE; March 2003
Permanent Pool Unit Storage Required (External Area)	116.7	m^3/ha	
31.26 ha @	208.3	6511	m^3
12.14 ha @	116.7	1416	m^3
Total Permanent Pool Required		**7927**	**m^3**
Permanent Pool Depth	2.25	m	
Inlet Pipe A Capacity	6.719	m^3/s	
Inlet Pipe B Capacity	9.187	m^3/s	
Dispersion Length A (Dist.)	48	m	
Dispersion Length B (Dist.)	65	m	
Quality Control Peak Flow	0.051	m^3/s	
Settling Length A	22	m	
Dispersion Length Available	180	m	(includes flow-path for both headwalls)
Infiltration			
Surface Area Required	475	m^2	
Surface Area Available	1109	m^2	
Quality/Erosion Control (First Flush)			
Runoff (r)	25	mm	
Detention Time (t)	84	hr	
Detention Volume Required (V)	9005	m^3	
Peak Flow	0.051	m^3/s	
Orifice Plate Required (A_O)	180	mm	

$$Dist = \frac{8Q}{d\,v_F}$$

$$Dist = \sqrt{\frac{rQ_Q}{V_S}}$$

Where "r" is Length to Width ratio	3:1

$$V = ArC$$

$$A_O = \frac{2A_P}{Ct(2g)^{0.5}}\left(h_1^{0.5} - h_2^{0.5}\right)$$

9.005m^3 is the required permanent pool volume to provide 80% TSS removal for the tributary drainage area, which includes the subject site.

Park Place - Pond A

Stage-Storage

FOREBAY PERMANENT POOL					
Elevation (m)	Depth (m)	Area (m^2)	Avg. Area (m^2)	Volume (m^3)	Total Volume (m^3)
276.50		336			0
	0.50		898	449	
277.00		1,460			449
	0.50		1,727	863	
277.50		1,994			1,312
	0.25		2,133	533	
277.75		2,273			1,846
	0.50		2,708	1,354	
278.25		3,143			3,200

MAIN CELL PERMANENT POOL					
Elevation (m)	Depth (m)	Area (m^2)	Avg. Area (m^2)	Volume (m^3)	Total Volume (m^3)
276.00		102			0
	0.50		264	132	
276.50		425			132
	0.50		544	272	
277.00		662			404
	0.50		800	400	
277.50		937			804
	0.25		1010	252	
277.75		1082			1056
	0.50		1353	676	
278.25		1623			1732

DEEP POOL PERMANENT POOL					
Elevation (m)	Depth (m)	Area (m^2)	Avg. Area (m^2)	Volume (m^3)	Total Volume (m^3)
276.00		357			0
	0.50		1524	762	
276.50		2692			762
	0.50		2936	1468	
277.00		3181			2230
	0.50		3446	1723	
277.50		3712			3953
	0.25		3850	962	
277.75		3988			4916
	0.25		4238	1059	
278.00		4487			5975
	0.25		4749	1187	
278.25		5010			7162
TOTAL PERMANENT POOL					12095

Forebay Percent Volume 26%

Provided permanent pool volume is more than required, therefore appropriate quality control has been provided for the subject site by STM Pond A.

INFILTRATION VOLUMES					
Elevation (m)	Depth (m)	Area (m^2)	Avg. Area (m^2)	Volume (m^3)	Total Volume (m^3)
278.25		1,109			0
	0.25		1,173	293	
278.50		1,237			293
	0.50		1,361	680	
279.00		1,485			974
	0.50		1,616	808	
279.50		1,748			1,782
	0.50		1,887	943	
280.00		2,026			2,725
	0.50		2,174	1,087	
280.50		2,323			3,812

ACTIVE VOLUMES						
Elevation (m)	Depth (m)	Area (m^2)	Avg. Area (m^2)	Volume (m^3)	Total Volume (m^3)	Active & Infiltration Volume(m^3)
278.25		9,776			0	0
	0.50		11,109	5,555		
278.75		12,442			5,555	5,848
	0.25		12,789	3,197		
279.00		13,135			8,752	9,725
	0.50		13,798	6,899		
279.50		14,461			15,651	17,433
	0.50		16,121	8,060		
280.00		17,781			23,711	26,436
	0.50		18,670	9,335		
280.50		19,559			33,046	36,859
	0.50		20,606	10,303		
281.00		21,652			43,349	47,161
	0.50		22,225	11,113		
281.50		22,798			54,462	58,274
TOTAL ACTIVE STORAGE					54,462	58,274

INFILTRATION	
Infiltration Contact Area (m^2)	475
Elevation (m)	278.25

STORM EVENT	Volume (m^3)	Elevation (m)	Flux (m)
PERMANENT POOL	12,095	278.25	0.00
FIRST FLUSH	9,005	278.95	0.70
2 YEAR	10,948	279.08	0.83
5 YEAR	17,310	279.49	1.24
10 YEAR	19,952	279.64	1.39
25 YEAR	22,186	279.76	1.51
50 YEAR	22,770	279.80	1.55
100 YEAR	25,363	279.94	1.69

Quality/Erosion Control Orifice Sizing		
13007	m^2	Area at First Flush Elevation
0.0253	m^2	Orifice Area
180	mm	Orifice Diameter

02 999

POND OUTFLOW

Total outflow is equal to or less than the required outflow, therefore appropriate quantity controls have been provided for the subject site via STM Pond A.

$$Q = CA\sqrt{2gh}$$

	Orifice Plates			Emergency Weir Flow	
	Diameter (m)	0.180	0.533	0.303	
	Invert (m)	278.30	278.95	278.23	Invert (m) 280.65
	Sill Elevation (m)	278.30	278.95	279.64	Length (m) 20.00
	Sill Location	P.Pool	First Flush	10-Year	

Storm Event	Elevation (m)	Orifice Flow (m^3/s)	Orifice Flow (m^3/s)	Orifice Flow (m^3/s)	Total Orifice Flow (m^3/s)	Weir Flow (m^3/s)	Total Outflow (m^3/s)	Required Outflow (m^3/s)	Outflow Difference (m^3/s)	Percent Difference (%)
First Flush	278.95	0.051	0.000	0.000	0.051	0.00	0.051	N/A	N/A	N/A
2 Year	279.08	0.056	0.072	0.000	0.128	0.00	0.128	0.309	-0.181	-58.54%
5 Year	279.49	0.071	0.309	0.000	0.380	0.00	0.380	0.488	-0.108	-22.15%
10 Year	279.64	0.075	0.384	0.000	0.459	0.00	0.459	0.670	-0.211	-31.42%
25 Year	279.76	0.079	0.437	0.225	0.742	0.00	0.742	0.742	0.000	-0.06%
50 Year	279.80	0.080	0.450	0.228	0.758	0.00	0.758	0.764	-0.006	-0.79%
100 Year	279.94	0.084	0.503	0.239	0.826	0.00	0.826	0.841	-0.015	-1.74%
Emergency	281.45	0.000	0.000	0.000	0.000	23.90	23.899	16.341	7.558	46.25%

Weir Discharge

From Design Chart 2.09: Solving Weir Flow		
Head (designed)	0.80	m
C	2.94	
Q req	16.341	m^3/s
Length (required)	14.12	m

see attached design sheet

Interim Pond

subject site encompassed in Commercial area in the approved SWM pond design for the Interim Pond (SWM Pond C).

DRAINAGE AREA COMPOSITION		
LOCATION	AREA (ha)	RUNOFF COEFFICIENT
Commercial	14.15	0.90
Open Space	0.33	0.20
Pond Block	1.20	0.38
Weighted Total	15.68	0.85

Note that rooftop area is not taken into account as the rooftops drain to a separate storm sewer system and bypass the pond

POND DETAILS		
Permanent Pool		
Percent Impervious (%I)	85%	
Type of Pond	Wet Pond	
Protection Level	Level 1 - Enhanced	
Permanent Pool Unit Storage Required	209.2	m^3/ha
Permanent Pool Storage Required	3281	m^3
Permanent Pool Depth	2.00	m
Inlet Pipe Capacity	3.940	m^3/s
Dispersion Length (Dist.)	32	m
Quality Control Peak Flow	0.074	m^3/s
Settling Length A	27	m
Dispersion Length Available	45	m
Forebay Weir depth	0.20	m
Forebay Weir Length	26.4	m
Infiltration		
Surface Area Required	169	m^2
Surface Area Available	173	m^2
Quality/Erosion Control (First Flush)		
Runoff (r)	25	mm
Detention Time (t)	24	hr
Detention Volume Required (V)	3314	m^3
Peak Flow	0.074	m^3/s
Orifice Plate Required (A_O)	210	mm

$$Dist = \frac{8Q}{d\,v_s}$$

$$Dist = \sqrt{\frac{rQ_Q}{V_S}}$$

Where "r" is Length to Width ratio	3:1

$$V = ArC$$

$$A_O = \frac{2A_P}{Ct(2g)^{0.5}}\left(h_1^{0.5} - h_2^{0.5}\right)$$

3,314m^3 is the required permanent pool volume to provide 80% TSS removal for the tributary drainage area, which includes the subject site.

Park Place - Interim Pond

Stage-Storage

FOREBAY PERMANENT POOL					
Elevation (m)	Depth (m)	Area (m^2)	Avg. Area (m^2)	Volume (m^3)	Total Volume (m^3)
281.00		125			0
	0.50		194	97	
281.50		262			97
	0.50		348	174	
282.00		435			271
	0.50		541	271	
282.50		648			542
	0.50		841	420	
283.00		1,034			962

MAIN CELL PERMANENT POOL					
Elevation (m)	Depth (m)	Area (m^2)	Avg. Area (m^2)	Volume (m^3)	Total Volume (m^3)
280.00		95			0
	0.50		283	141	
280.50		471			141
	0.50		587	294	
281.00		704			435
	0.50		826	413	
281.50		949			848
	0.50		1090	545	
282.00		1232			1393
	0.50		1404	702	
282.50		1575			2095
	0.50		1799	900	
283.00		2023			2995
TOTAL PERMANENT POOL					3957

Provided permanent pool volume is more than required, therefore appropriate quality control has been provided for the subject site by STM Pond C.

Forebay Percent Volume
24%

INFILTRATION VOLUMES					
Elevation (m)	Depth (m)	Area (m^2)	Avg. Area (m^2)	Volume (m^3)	Total Volume (m^3)
283.00		161			0
	0.25		190	47	
283.25		218			47
	0.25		251	63	
283.50		284			110

ACTIVE VOLUMES						
Elevation (m)	Depth (m)	Area (m^2)	Avg. Area (m^2)	Volume (m^3)	Total Volume (m^3)	Active & Infiltration Volume(m^3)
283.00		3,057			0	0
	0.25		3,313	828		
283.25		3,570			828	876
	0.25		3,830	958		
283.50		4,091			1,786	1,896
	0.50		4,599	2,300		
284.00		5,107			4,085	4,196
	0.50		5,369	2,685		
284.50		5,631			6,770	6,880
	0.50		5,927	2,963		
285.00		6,222			9,733	9,844
TOTAL ACTIVE STORAGE					9,733	**9,844**

INFILTRATION	
Infiltration Contact Area (m^2)	169

STORM EVENT	Volume (m^3)	Elevation (m)	Flux (m)
PERMANENT POOL	3,957	283.00	0.00
FIRST FLUSH	3,314	283.81	0.81
2 YEAR	4,024	283.96	0.96
5 YEAR	6,292	284.39	1.39
10 YEAR	7,170	284.55	1.55
25 YEAR	7,245	284.56	1.56
50 YEAR	7,375	284.58	1.58
100 YEAR	7,991	284.69	1.69

Quality/Erosion Control Orifice Sizing		
4717	m^2	Area at First Flush Elevation
0.0346	m^2	Orifice Area
210	mm	Orifice Diameter

INTERIM POND OUTFLOW

Total outflow is equal to or less than the required outflow, therefore appropriate quantity controls have been provided for the subject site via STM Pond C.

$$Q = CA\sqrt{2gh}$$

	Orifice Plates				Emergency Weir Flow			
	Diameter (m)	0.210	0.414	0.507	Invert (m)	284.70		
	Invert (m)	283.05	283.81	283.15	Length (m)	20.00		
	Sill Elevation (m)	283.05	283.81	284.55				
	Sill Location	P.Pool	First Flush	10-Year				
Storm Event	Elevation (m)	Orifice Flow (m^3/s)	Orifice Flow (m^3/s)	Orifice Flow (m^3/s)	Total Orifice Flow (m^3/s)	Weir Flow (m^3/s)	Total Outflow (m^3/s)	Required Outflow (m^3/s)
First Flush	283.81	0.074	0.000	0.000	0.074	0.000	0.074	N/A
2 Year	283.96	0.083	0.061	0.000	0.143	0.000	0.143	0.143
5 Year	284.39	0.102	0.219	0.000	0.321	0.000	0.321	0.537
10 Year	284.55	0.109	0.261	0.000	0.370	0.000	0.370	0.759
25 Year	284.56	0.109	0.264	0.578	0.951	0.000	0.951	0.953
50 Year	284.58	0.110	0.270	0.583	0.963	0.000	0.963	1.073
100 Year	284.69	0.114	0.293	0.608	1.015	0.000	1.015	1.348
Emergency	284.99	0.000	0.000	0.000	0.000	5.216	5.216	5.057

Weir Discharge

From Design Chart 2.09: Solving Weir Flow		
Head (designed)	0.29	m
C	2.94	
Q req	5.057	m^3/s
Length (required)	20.0	m

see attached design sheet

MOE ECA Approval for the STM Ponds

U11-1405
" POND A & Interim "

Ontario

Ministry of the Environment
Ministère de l'Environnement

CERTIFICATE OF APPROVAL
MUNICIPAL AND PRIVATE SEWAGE WORKS
NUMBER 5366-7HPJ9C
Issue Date: August 28, 2008

North American (Park Place) Corporation
2851 John Street, Suite 1
Markham, Ontario
L3R 5R7

Site Location: Park Place Development-Phase 1
Part of Lots 7, 8 and 9, Concession 12
City of Barrie, County of Simcoe

You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:

the establishment of stormwater management Works to serve the Park Place Development-Phase 1 and external lands, in the City of Barrie, for the treatment and disposal of stormwater runoff from a total catchment area of 59.1 ha (43.4 ha to Pond A (26.5 ha of the Park Place Development-Phase 1, 4.8 ha of the existing Molson Centre parking lots and 12.1 ha of the external flows west of Highway 400) and 15.7 ha of the Park Place Development-Phase 1 to Interim Pond), to provide Enhanced Level water quality protection and erosion control and to attenuate post-development peak flows to pre-development levels, discharging to the South Tributary of Lovers Creek (Pond A) and the North Tributary of Lovers Creek (Interim Pond), for all storm events up to and including the 100-year return storm, consisting of the following:

Pond A
a stormwater management wet pond located north of Mapleview Drive, east of Bayview Drive and north of the southern tributary of Lovers Creek, having a permanent storage volume of 12,095 m^3, an extended detention storage volume of 9,005 m^3 and a total active storage volume of 58,274 m^3, complete with one (1) inlet structure consisting of 1,650 mm diameter, 1,200 mm diameter and 825 mm diameter inlet storm sewers, two (2) concrete headwalls and rip-rap, a sediment forebay complete with a dewatering sump, a sediment forebay berm complete with two (2)-300 mm diameter CSP pipes discharging to a main cell and a 5 m wide weir discharging to an infiltration basin, a permanent pool, the main cell complete with a 450 mm diameter CSP pipe discharging to a deep pool cell, the infiltration basin designed to infiltrate a minimum of 5.3 mm of runoff prior to any discharge from the stormwater management pond, having a contact area of 1,100 m^2 and an active storage volume of 3,812 m^3, complete with one (1) infiltration basin outlet/overflow structure consisting of rip-rap, a concrete headwall and a 300 mm diameter outlet pipe discharging via a manhole (STM MH 501), a 300 mm diameter outlet pipe, a concrete headwall and rip-rap to the main cell, the deep pool cell providing cooler water to a pond outlet structure via the bottom draw outlet configuration, a 300 mm diameter maintenance/outlet pipe

Received from S. Bishop May 3/10

incorporated into the pond outlet structure complete with a 300 mm diameter internal gate valve discharging via a manhole (STM MH 505) to a manhole (STM MH 503), a 4 m wide maintenance access road, a 20 m wide emergency overflow weir and one (1) pond outlet structure consisting of rip-rap, a concrete headwall, a 450 mm diameter reverse slope outlet pipe discharging a control manhole (STM MH 502) complete with a 180 mm diameter orifice plate, a 525 mm diameter outlet pipe operating as an orifice tube and a 450 mm diameter outlet pipe, all discharging to the manhole (STM MH 503), a ditch inlet catchbasin complete with a 303 mm diameter orifice plate discharging via a 375 mm diameter outlet pipe to the manhole (STM MH 503), together allowing a maximum discharge of 0.83 m^3/s (100-year return storm) via a 750 mm diameter outlet pipe located on Municipal Land, an outfall concrete headwall, a plunge pool and a riverstone flow spreader to the South Tributary of Lovers Creek;

Interim Pond
a stormwater management wet pond located north of Churchill Drive, west of Bayview Drive and south of the northern tributary of Lovers Creek, having a permanent storage volume of 3,957 m^3, an extended detention storage volume of 3,314 m^3 and a total active storage volume of 9,844 m^3, complete with one (1) inlet structure consisting of a 1,350 mm diameter inlet storm sewer, a concrete headwall and rip-rap, a sediment forebay complete with a dewatering sump, a sediment forebay berm complete with two (2)-300 mm diameter CSP pipes discharging to a main cell, a permanent pool, the main cell complete with a deep pool providing cooler water to a pond outlet structure via the bottom draw outlet configuration, an infiltration basin designed to infiltrate a minimum of 5.3 mm of runoff prior to any discharge from the stormwater management pond, having a contact area of 173 m^2 and an active storage volume of 110 m^3, complete with one (1) infiltration basin outlet/overflow structure consisting of a concrete headwall, a 300 mm diameter outlet pipe and a 300 mm diameter reverse slope outlet pipe discharging via a concrete headwall to the main cell, a 4 m wide maintenance access road, a 300 mm diameter maintenance/outlet pipe incorporated into the pond outlet structure complete with a 300 mm diameter internal gate valve discharging via a manhole (STM MH 704) to the manhole (STM MH 701), a 20 m wide emergency overflow weir and one (1) pond outlet structure consisting of rip-rap, a concrete headwall, a 450 mm diameter reverse slope outlet pipe discharging to a control manhole (STM MH 700) complete with a 210 mm diameter orifice plate, a 414 mm diameter orifice plate and two (2)-450 mm diameter outlet pipes, all discharging to a manhole (STM MH 701), a ditch inlet catchbasin complete with a 507 mm diameter orifice plate discharging via a 525 mm diameter outlet pipe to the manhole (STM MH 701), together allowing a maximum discharge of 1.0 m^3/s (100-year return storm) via a 600 mm diameter outlet pipe located on Municipal Land, an outfall concrete headwall, a plunge pool and a riverstone flow spreader to the North Tributary of Lovers Creek;

all in accordance with the application dated May 23, 2008 and received July 2, 2008, including report entitled "Stormwater Management Design Brief, Park Place Development-Phase 1, City of Barrie" dated August, 2007 and revised February, 2008, final plans and specifications prepared by Sabourin Kimble & Associates Ltd.

For the purpose of this Certificate of Approval and the terms and conditions specified below, the following definitions apply:

1. "Certificate" means this entire certificate of approval document, issued in accordance with Section 53 of the Ontario Water Resources Act, and includes any schedules;

2. "Director" means any Ministry employee appointed by the Minister pursuant to section 5 of the Ontario Water Resources Act;

3. "District Manager" means the District Manager of the Barrie District Office of the Ministry;

4. "Ministry" means the Ontario Ministry of the Environment;

5. "Owner" means North American (Park Place) Corporation, and includes its successors and assignees;

6 "Works" means the sewage works described in the Owner's application, this Certificate and in the supporting documentation referred to herein, to the extent approved by this Certificate.

You are hereby notified that this approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL PROVISIONS

1.1 Except as otherwise provided by these Conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with the description given in this Certificate, the application for approval of the Works and the submitted supporting documents and plans and specifications as listed in this Certificate.

1.2 Where there is a conflict between a provision of any submitted document referred to in this Certificate and the Conditions of this Certificate, the Conditions in this Certificate shall take precedence, and where there is a conflict between the listed submitted documents, the document bearing the most recent date shall prevail.

1.3 Where there is a conflict between the listed submitted documents, and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

2. EXPIRY OF APPROVAL

The approval issued by this Certificate will cease to apply to those parts of the Works which have not been constructed within five (5) years of the date of this Certificate.

3. CHANGE OF OWNER

The Owner shall notify the District Manager and the Director, in writing, of any of the following changes within thirty (30) days of the change occurring:

(a) change of Owner;

(b) change of address of the Owner;

(c) change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the Business Names Act, R.S.O. 1990, c.B17 shall be included in the notification to the District Manager; and

(d) change of name of the corporation where the Owner is or at any time becomes a corporation, and a copy of the most current information filed under the Corporations Information Act, R.S.O. 1990, c. C39 shall be included in the notification to the District Manager.

4. OPERATION AND MAINTENANCE

4.1 The Owner shall ensure that the design storage volumes are maintained at all times.

4.2 The Owner shall inspect the Works at least once a year and, if necessary, clean and maintain the Works to prevent the excessive buildup of sediments and/or vegetation.

4.3 The Owner shall maintain a logbook to record the results of these inspections and any cleaning and maintenance operations undertaken, and shall keep the logbook at the site for inspection by the Ministry. The logbook shall include the following:

(a) the name of the Works; and

(b) the date and results of each inspection, maintenance and cleaning, including an estimate of the quantity of any materials removed.

5. RECORD KEEPING

The Owner shall retain for a minimum of five (5) years from the date of their creation, all records and information related to or resulting from the operation and maintenance activities required by this Certificate.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the Works are built and operated in the manner in which they were described for review and upon which approval was granted. This condition is also included to emphasize the precedence of Conditions in the Certificate and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Condition 2 is included to ensure that, when the Works are constructed, the Works will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment.

3. Condition 3 is included to ensure that the Ministry records are kept accurate and current with respect to approved works and to ensure that subsequent owners of the Works are made aware of the Certificate and continue to operate the Works in compliance with it.

4. Condition 4 is included to require that the Works be properly operated and maintained such that the environment is protected.

5. Condition 5 is included to require that all records are retained for a sufficient time period to adequately evaluate the long-term operation and maintenance of the Works.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended, you may by written notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act , R.S.O. 1990, Chapter 0.40, provides that the Notice requiring the hearing shall state:

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the works are located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, 15th Floor
Toronto, Ontario
M5G 1E5

AND

The Director
Section 53, *Ontario Water Resources Act*
Ministry of the Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca**

The above noted sewage works are approved under Section 53 of the Ontario Water Resources Act.

DATED AT TORONTO this 28th day of August, 2008

Mansoor Mahmood, P.Eng.
Director
Section 53, *Ontario Water Resources Act*

KC/

c: District Manager, MOE Barrie District Office
Alan Kimble, P.Eng., Sabourin Kimble & Associates Ltd.
Dawn A. McAlpine, City Clerk, City of Barrie

LSRCA Permit Approval for the STM Ponds

Lake Simcoe Region Conservation Authority

120 Bayview Parkway, Box 282, Newmarket, Ont. L3Y 4X1

Telephone: (905) 895-1281 Website: www.lsrca.on.ca

Fax: (905) 853-5881 Email: info@lsrca.on.ca

PERMIT No. BAP.2008.018 **Date:** Tuesday, May 20, 2008

IN ACCORDANCE WITH ONTARIO REGULATION 179/06.

Permission has been granted to:

Owner: NORTH AMERICA (PARK PLACE) CORP.
MR. T. COUGHLIN
2851 JOHN STREET, SUITE 1
MARKHAM, ON L3R 5R7

Applicant: SABOURIN KIMBLE & ASSOIATES LTD.
ALAN KIMBLE, P. ENG.
110 OLD KINGSTON ROAD
AJAX, ON L1T 279

Location: LOT 8, CONCESSION 012, CITY BARRIE
MAPLEVIEW & BAYVIEW DRIVE, CITY BARRIE

For the: grading in a regulated area, construction of three stormwater management ponds as shown on plans submitted and marked "approved".

on the above property during the period of **Tuesday, May 20, 2008** to **Thursday, May 20, 2010**

subject to the following conditions:

a) All development subject to provincial, federal and municipal statutes, regulations and by-laws.

b) This permit does not confer upon you any right to occupy, develop or flood lands owned by other persons or agencies.

c) The applicant must maintain and comply with the local drainage requirements of the municipality.

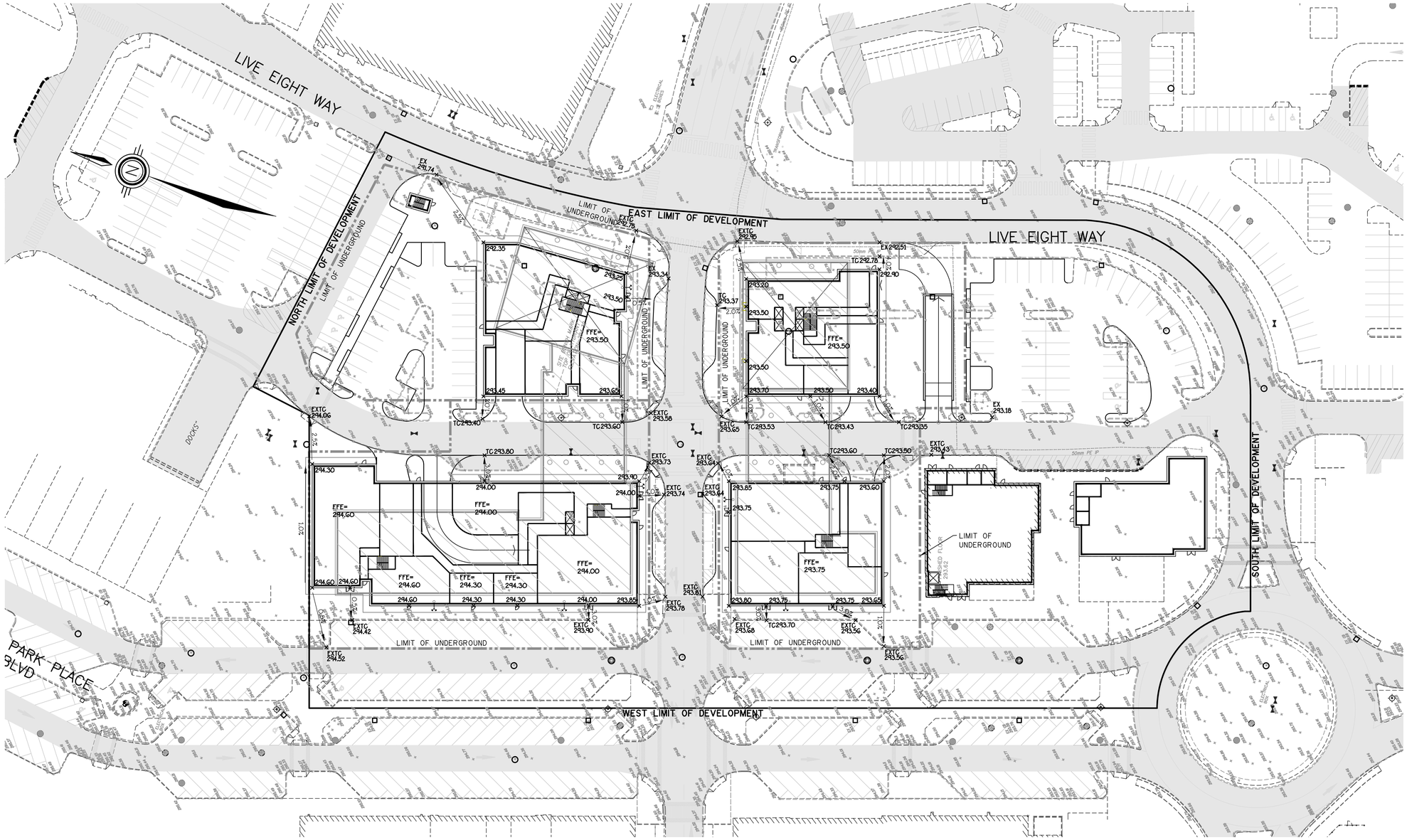
d) That all areas of exposed soil be stabilized immediately following construction.

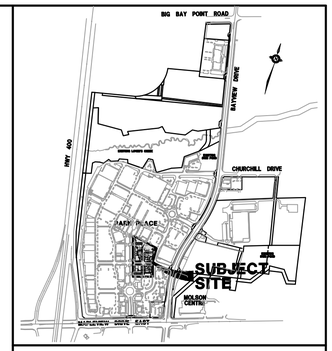
e) That sediment and erosion controls as shown on the attached plan be installed prior to the commencement of any works onsite. Silt controls are to be inspected after every rainfall event and maintained until all exposed areas have been stabilized in order to prevent silt from leaving the site or entering a watercourse or water body.

***NOTE** **The approved plans submitted with the application for this permit are hereby incorporated into and constitute part of this permit. Any construction, placement of fill or interference with a watercourse or body of water otherwise than in accordance with such plans, constitutes a breach of this permit which may then be revoked at the option of the Authority. In addition, any person responsible for such activity is liable to prosecution.**

- ✔ Owner
- ✔ Building Dept.
- Municipal Works Dept., Dir. of Municipal Works
- By-law Dept.
- ✔ File BAP.2008.018
- Health Unit, City of Barrie
- ✔ Other - Sabourin Kimble & Associates
- DFO, Peterborough, Ref. #
- MNR, Midhurst, Ref. #

Jackie Burkart
Senior Planner





KEYMAP N.T.S.

LEGEND:

- 130.50 / 131.53 — PROPOSED GRADE / EXISTING GRADE
- EXISTING CONTOURS
- 2.0% — LG ARROW & SLOPE
- PROPOSED SLOPE
- CURB DEPRESSION
- HEAVY DUTY ASPHALT
- PAINTED LINE CROSS WALK
- AREA OF RESTORATION
- SIDEWALK TO BE REPLACED

BENCHMARK

SITE BENCHMARK IS THE TOP OF THE CP AS SHOWN ON THE PLAN HAVING AN ELEVATION OF 289.87.
SITE BENCHMARK IS THE TOP OF THE HYDRANT AS SHOWN ON THE PLAN HAVING AN ELEVATION OF 294.32.

NOTE: ALL DIMENSIONS AND ELEVATIONS IN METRES UNLESS NOTED OTHERWISE. ALL PIPE SIZES IN MILLIMETRES.

No.	REVISIONS TO DRAWING	BY	DATE	APPR.

ALL PREVIOUS ISSUES OF THIS DRAWING ARE SUPERSEDED

CLIENT
NORTH AMERICAN

MUNICIPALITY
CITY OF BARRIE
SIMCOE COUNTY

PROJECT TITLE
PARK PLACE
RESIDENTIAL REDEVELOPMENT

SHEET TITLE
SITE GRADING PLAN

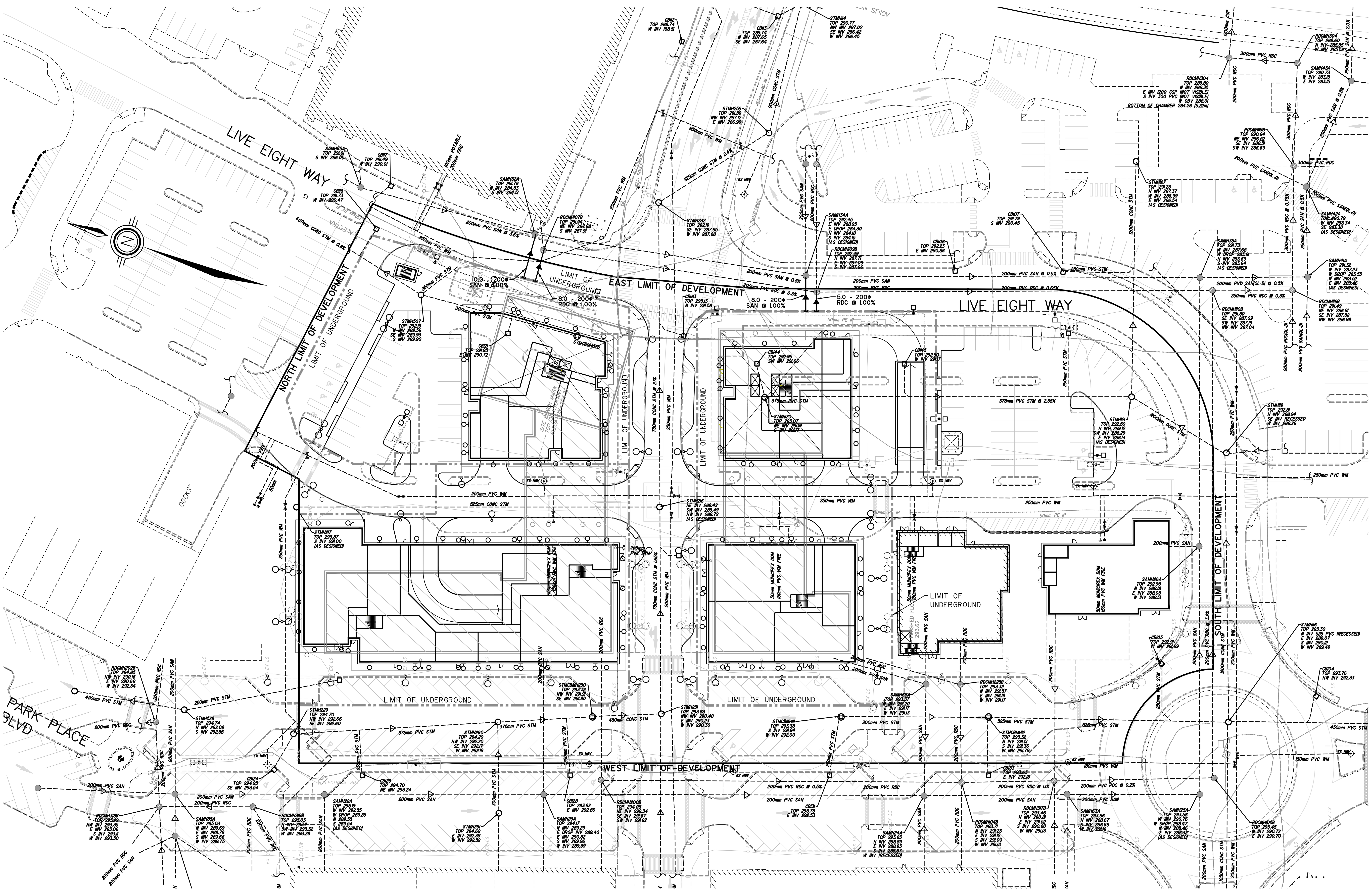
SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

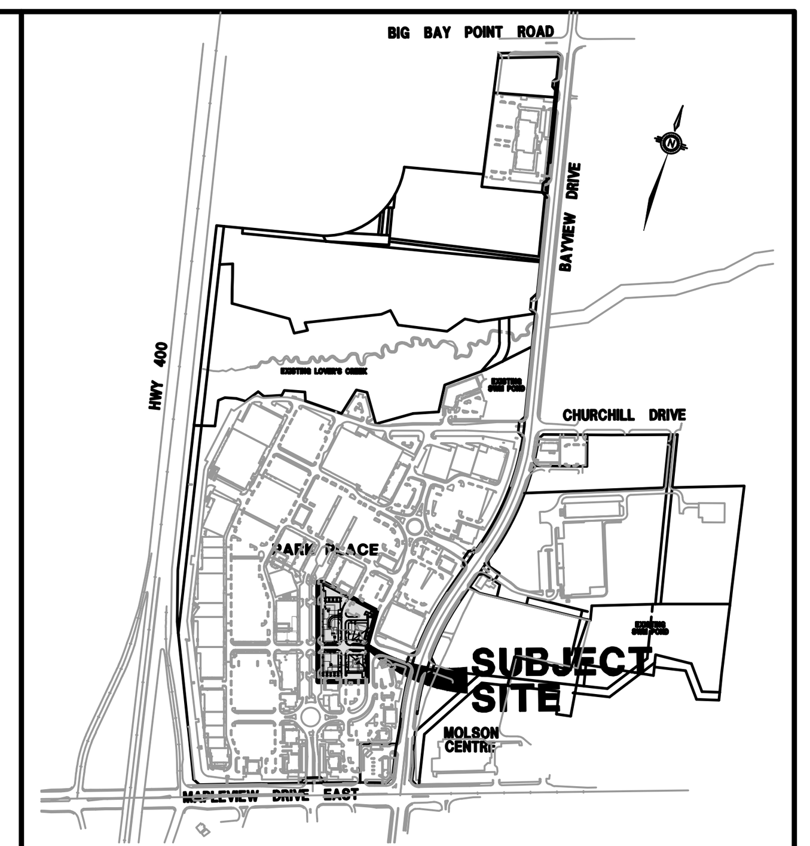
DESIGNED	DRAWN	CHECKED
MAG	RAV	MAG

SCALE	DATE
1:500	MARCH 2022

PROJECT NUMBER	DWG. NUMBER
02:999	SG

CAD FILE: P:\02-999\Drawing Files\Phase 1\Park Place Residential\999 SP - Residential.dwg





KEYMAP N.T.S.

LEGEND:

- CATCHBASIN
- DOUBLE CATCHBASIN
- STORM MANHOLE
- SANITARY MANHOLE
- RDC MANHOLE
- HYDRANT AND VALVE
- VALVE AND BOX
- EXISTING CATCHBASIN
- EXISTING DOUBLE CATCHBASIN
- EXISTING STORM MANHOLE
- EXISTING SANITARY MANHOLE
- EXISTING RDC MANHOLE
- EXISTING HYDRANT AND VALVE
- EXISTING VALVE AND BOX
- PHASE LIMIT
- STREETLIGHT

BENCHMARK

SITE BENCHMARK IS THE TOP OF THE CP AS SHOWN ON THE PLAN HAVING AN ELEVATION OF 289.87.
SITE BENCHMARK IS THE TOP OF THE HYDRANT AS SHOWN ON THE PLAN HAVING AN ELEVATION OF 294.32.

NOTE: ALL DIMENSIONS AND ELEVATIONS IN METRES UNLESS NOTED OTHERWISE. ALL PIPE SIZES IN MILLIMETRES.

No.	REVISIONS TO DRAWING	BY	DATE	APPR.

ALL PREVIOUS ISSUES OF THIS DRAWING ARE SUPERSEDED

CLIENT
NORTH AMERICAN

MUNICIPALITY
CITY OF BARRIE
SIMCOE COUNTY

PROJECT TITLE
PARK PLACE
RESIDENTIAL REDEVELOPMENT

SHEET TITLE
SITE SERVICING PLAN

SKA SABOURIN KIMBLE & ASSOCIATES LTD. CONSULTING ENGINEERS

DESIGNED MAG	DRAWN RAV	CHECKED MAG
SCALE 1:500	DATE MARCH 2022	
PROJECT NUMBER 02:999	DWG. NUMBER SS	