Functional Servicing Report for 71 Wyndham Street South, Guelph, ON

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Sign-off Sheet

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1.0 INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

This Functional Servicing Report has been prepared in support of the Zoning and Official Plan amendment and the Site Plan Application for the proposed development located at 71 Wyndham Street South (Site) in the City of Guelph (City). The subject property is approximately 0.38 ha in size, and is bounded to the north by Wyndham Street South, to the east by an existing commercial building, to the south by the Speed River, and to the west by an existing apartment building.

The conceptual site plan for the proposed development that forms the basis of this servicing assessment is a 14-story, 140 unit residential building with one level of underground parking and 3 levels of above ground parking. All parking is contained within the building envelope and is not exposed.

This report outlines how the proposed development can be supplied with adequate services, including sanitary, domestic water, storm drainage and includes the preliminary erosion and sediment control strategy to be implemented during construction.

1.2 BACKGROUND INFORMATION

A variety of sources have been referenced during the preparation of this report, and the following should be read in conjunction with this Report:

- *Phase II Environmental Site Assessment, 71 Wyndham Street Street, City of Guelph, Ontario* (XCG Consulting Ltd. August 2016)
- *Geotechnical Investigation, Proposed Residential Development, 71 Wyndham Street, Guelph, Ontario* (CMT Engineering Inc., April 2016)
- *Geotechnical Investigation, Proposed Two Story Apartment Building for Lammer Developments, 71 Wyndham Street, Guelph, Ontario* (CMT Engineering Inc., September 2009)
- *Low Impact Development Stormwater Management Planning and Design Guide* (Credit Valley Conservation Authority and Toronto and Region Conservation Authority, 2010)
- *Erosion & Sediment Control Guideline for Urban Construction*, (Greater Golden Horseshoe Area Conservation Authorities, December 2006)
- *Stormwater Management Planning and Design Manual (SWMPD Manual)*, (Ontario Ministry of the Environment, March 2003)

1.3 EXISTING INFRASTRUCTURE

A summary of the municipal infrastructure that currently exists near the Site is as follows:

- A 250mm sanitary sewer located on Wyndham Street South.
- A 400mm watermain on Wyndham Street South.
- A 300mm storm sewer on Wyndham Street South.

Wyndham Street South, fronting the Site, is a fully constructed municipal road that has recently undergone reconstruction through a City of Guelph contract. Top coat asphalt has not been installed at this time.

2.0 OVERALL GRADING AND DRAINAGE

2.1 DESIGN CONSTRAINTS AND PROCEDURES

Using existing topographic information provided by Van Harten Surveying Inc., the proposed Site grading will be design to generally meet the following criteria:

- Match existing grades all site boundaries.
- Match existing grades at existing tree driplines wherever possible to facilitate tree retention.
- Minimize grade change within the flood line setback line (as shown on the preliminary grading plan, C-400, in Appendix A)
- Match into existing road grades of Wyndham Street South.
- Have consideration for future pedestrian connections along the south of the site.
- Provide adequate cover over underground services.
- Ensure all building openings are protected from flooding.
- Comply with Municipal standards for minimum and maximum grades.

2.2 PROPOSED OVERALL SITE GRADING

The proposed building largely occupies the Site. Existing property line grades will be matched and existing grades within the flood line setback line (as obtained from the GRCA website) will be maintained wherever possible. Grades at the proposed building entrances are above the floodplain elevation of 311.9 as provided by the GRCA in the Development Review Committee meeting of September 7, 2016.

3.0 SANITARY SERVICING

Using the high-density apartment flow rate calculation of 7 L/s/ha for redevelopment areas (per the City of Guelph Development Engineering Manual v1.0) and a site area of 0.38ha yields a flow of 2.66 L/s including peaking factor.

A 150mm sanitary sewer is anticipated to have sufficient capacity to service the Site and it is proposed that the existing sanitary connection to Wyndham Street South be utilized to service this development.

4.0 WATER DISTRIBUTION

The existing water distribution system near the Site includes a 400mm watermain on Wyndham Street South and will be the source for the proposed development. It is anticipated that the following connections to the existing municipal infrastructure will be made:

- Tapping sleeve and valve connection to the 400mm Wyndham Street South watermain (150mm connection).

Please refer to the Preliminary Servicing plan (Drawing No. C-100) in Appendix A for an illustration of the watermain layout.

Based on building information currently available, a conservative fire flow requirement for the site is 150 L/s, based on typical OBC calculations as provided in Appendix B.

Fire protection will be provided by the existing hydrant located on the northwest corner of Wyndham Street South and Howitt Street in conjunction with a standpipe connection for the building sprinkler system. The City of Guelph will confirm the water servicing capacity is sufficient. No backflow prevention or pressure reducing valves (PRV) have been proposed for this development.

5.0 STORMWATER DRAINAGE

Storm drainage for the Site will discharge to the Speed River. Water quantity control is not required for the site and water quality and the existing site water balance were considered as part of the design process as provided by the GRCA in the Development Review Committee meeting of September 7, 2016. Please refer to the Preliminary Servicing Plan, Drawing No. C-100, included in the Appendix A for an illustration of the storm layout. The proposed stormwater outlet has been located based on the recommendations made in the *Speed River Geomorphic Assessment* (Stantec, 2017) found in Appendix C. For further details of the SWM Facility design refer to applicable section within this report.

The proposed storm sewer system is designed to convey all minor storm events or those less than 5-year return-period for the majority of the development, as per the City of Guelph standards. The conveyance system for major flow events or those greater than a 5-year return-period frequency will be overland flow to the Speed River and generally mimics the direction of the minor system.

6.0 STORMWATER MANAGEMENT FACILITIES

6.1 DESIGN CRITERIA

6.1.1 STUDY APPROACH

The objective of this SWM Plan is to ensure that the proposed development includes the necessary controls to protect the hydrology and water quality of the receiving water systems, primarily through adherence to SWM targets. This approach involved the following study components:

- Investigate water quality approach for the site
- Assess infiltration potential for the site as it relates to the existing water budget
- Summarize the study by identifying conclusions and recommendations

6.1.2 DESIGN CRITERIA

SWM criteria were established based on the *Hanlon Creek Watershed Study*, and the characteristics of the receiving systems. The SWM criteria applied to the site are as follows:

- Water Quantity – None if direct discharge to the Speed River, 0.0874 m^3/s during the 5-year design storm to City Sewers
- Infiltration – Propose measures to maintain or enhance groundwater recharge
- Erosion and Sediment Control – Provide appropriate erosion and sediment control during construction to protect neighboring properties and the downstream receivers from potential siltation

6.2 EXISTING CONDITIONS

6.2.1 Topography and Surface Drainage

The ground surface of the site is generally sloped towards the river with elevations ranging between approximately 309.9 m and 311.2 m AMSL (above mean sea level). The terrain generally slopes from to the south as shown on Figure 2.0.

The existing site comprises a split level commercial building with associated gravel/asphalt driveways and parking lot. A ramp in the parking lot provides access to the lower single story unit at the rear of the property.

6.2.2 Geotechnical Information

The *Geotechnical Investigation Report* (CMT, 2016) describes the site soils as comprised of asphalt or granular base overlying layers of gravelly silty sand, silty sand and gravel, silty sand, sand, sand and gravel and clayey silt fill. The fill is underlain by a layer of moist to saturated gravel sand and severely weathered / fractured bedrock. The groundwater table documented in the Geotechnical Investigation ranges between elevations of 308.82 m and 308.69 m. further groundwater monitoring is being performed by Stantec as part of the Hydrogeological investigation, with only preliminary results available at this time. These preliminary results indicate that groundwater is approximately 2.6 – 3.0 meters below ground surface at the rear of the lot close to the Speed River.

Looking at the groundwater information for both studies, it was decided to assume that the preliminary Stantec results both occurred during high groundwater conditions (April monitoring), and better reflected the location of the proposed green space and it was assumed the found water was approximately 2.6 m below the ground.

6.3 PROPOSED STORMWATER MANAGEMENT DESIGN

As this site is located directly beside the Speed River, the Grand River Conservation Authority (GRCA) has indicated that direct discharge to the Speed River requires water quality control only. The City also requires that the on-site infiltration potential be evaluated as it relates to the existing water budget, and recommend measures to maintain or enhance infiltration. As per the attached drawing, the proposed stormwater management scheme consists of the following elements:

- Direct connection of roof runoff to the Speed River; and
- Overland flow for major events and small impervious path areas over vegetated surfaces to the Speed River.

As discussed previously, the proposed development consists of a mix of green space and a high-density, multi-family residential unit. The site was modelled as one catchment. The site is 0.38 ha and conditions generally consist of the following:

- **Existing** – Encompasses the entire area of the site. Water drains uncontrolled across the impervious areas following the topography of the site. The site is 94% impervious, including the existing commercial and parking areas.
- **Post-Development** – Encompasses the entire area of the site. Runoff from the development is directed to the Speed River. The site is 75% impervious, which is an improvement to existing conditions.

As the only impervious surface on site is roof which generates only clean runoff, no explicit water quality feature has been recommended prior to discharge to the river. Small impervious path areas will sheet flow over vegetated surfaces, which will provide adequate treatment for these areas.

6.4 WATER QUALITY AND OVERALL SITE MONTHLY INFILTRATION AND GROUNDWATER WATER BALANCE

As previously noted in Section 6.2, various criteria exist for this site as it relates to water quality. This site is relatively unique in that it offers the following opportunities:

- Soils appropriate for infiltration.
- Moderately high groundwater levels.

As such, this site is a prime candidate to incorporate Low Impact Development (LID) features to achieve the identified stormwater management criteria.

The current site is 94% impervious surface and the proposed site removes some imperviousness and replaces it with green space (75%). The water balance was looked at with respect to the existing water balance and the proposed conditions.

An overall site monthly infiltration and groundwater water balance analysis for both existing and proposed development conditions was undertaken to assess the potential reduction in recharge associated with the decrease in impervious coverage using the Thornthwaite and Mather methodology. The existing topography and land cover were used to estimate an infiltration factor based on the approach presented in MOECC Stormwater Management Planning and Design (SWMPD) Manual (2003). Soil moisture capacities (also referred to as water holding capacity) were also obtained from the MOECC SWMPD Manual (2003) for soil types that were adopted based on the surficial geology.

Precipitation and temperature normals for the past 30 years (1981 to 2010) were obtained from the Environment Canada Website for the Waterloo Wellington Airport station, located approximately 15 km west of the Site.

These data were used to determine the saturation vapour pressure (e_{sat}) and monthly potential evapotranspiration (PET) using the following formulae (Dingman, 1994):

$$e_{sat} = 6.11\exp(17.3T/(T+23.7.3)),$$

Where T is temperature in degrees Celsius and e_{sat} is given in millibars (mb); and

$$PET=0.409(e_{sat}),$$

Where PET is given in cm.

To determine the actual soil moisture content (S_m) at the end of each month, the following approach was used (Physical Hydrology (Dingman, 1994)):

When precipitation was greater than PET,

$$S_m=\min\{[(Precip_m-PET_m)+S_{m-1}], S_{max}\}; \text{ and}$$

When precipitation was less than PET,

$$S_m = S_{m-1} + (Precip_m - PET_m).$$

The actual evapotranspiration (ET) was in turn calculated as follows:

When precipitation was greater than PET,

$$ET_m = PET_m; \text{ and,}$$

Otherwise,

$$ET_m = Precip_m + S_{m-1} - S_m.$$

In summary, the analysis indicates that the average annual groundwater recharge rate occurring on the full 0.38 ha site under existing conditions is approximately 224.6 mm/year, for a total of 52 m^3, with this rate remaining the same under post-development, but the pervious area increases (total site recharge of 205 m^3). The projected groundwater recharge surplus is 153 m^3, due entirely to the decrease in imperviousness.

No additional infiltration augmentation facilities are recommended at this time, as the proposed development will improve on the existing regime and site conditions (higher groundwater and fractured limestone bedrock) provide a challenging environment for infiltration.

Table 1: Summary Yearly Groundwater Recharge

Site Assumption	Expected Yearly Groundwater Surplus Volume
Existing	52
Post-development with increase green space	205

The detailed water balance spreadsheets can be seen in Appendix B.

7.0 EROSION AND SEDIMENT CONTROL PLAN

The erosion and sediment control (ESC) strategy has been developed to minimize the potential for offsite discharge of sediment and the resultant negative environmental impacts. This plan will focus on the protection of the Hanlon Creek watershed.

7.1 STUDY APPROACH

The *Greater Golden Horseshoe Area Conservation Authorities' Erosion and Sediment Control Guideline for Urban Construction* (2006) was used to determine the erosion potential of the site. The erosion potential is based on slope gradient, slope length and soil texture and is then used to determine the appropriate erosion control methods.

Site slope gradients for the site can be summarized as gently sloped (0-5%) with an average slope in the order of 2%. The slope lengths are considered long (greater than 30 m). Site soils are comprised primarily of silty sandy gravelly fill, thus, the erosion potential for the site is considered to be "high".

7.2 EROSION AND SEDIMENT CONTROL PLAN

The following approach to the ECS onsite has been prepared to minimize the potential impacts associated with onsite erosion and/or offsite transport of sediment to Hanlon Creek and other surrounding lands.

Prior to any grading or servicing works commencing onsite, ESC measures shall be implemented. The proposed erosion and sedimentation controls include the following items:

- Steep slopes (>3:1) shall have erosion blankets
- Light and/or heavy duty silt fencing will be erected on all site boundaries where there is potential for runoff to be discharged offsite, to protect adjacent and downstream lands from migration of sediment in overland flow. The location of this fencing will be adjacent to the limit of grading. Silt fencing should be erected before grading begins to protect adjacent and downstream areas from migration of sediment in overland flow
- Excavation de-watering will be discharged through a silt bag and/or sediment trap
- A construction entrance feature ("mud mat") will be provided at all site entrances to minimize the offsite transport of sediment via construction vehicles
- Runoff will be directed to temporary sediment basins via swales to minimize untreated runoff discharged from site

- Swales constructed onsite will have temporary rock check dams to help attenuate flows and encourage deposition of suspended sediment where appropriate

- All disturbed areas where construction is not expected for 30 days shall be re-vegetated with 50 mm of topsoil and hydro-seeded according to OPSS 572

- Following completion of construction and site stabilization, all erosion and sediment control measures and accumulated sediment are to be removed

The erosion control measures shall be maintained in good repair during the entire construction period, and shall only be removed as contribution drainage areas are restored and stabilized. In addition, the condition of erosion control works, their overall performance, and any repairs, replacement or modifications to the installed item shall be noted in monitoring reports submitted to the Grand River Conservation Authority (GRCA) and the City of Guelph. Monitoring Reports should be submitted bi-monthly (quarterly during periods of inactivity or house construction) and should be based on inspection completed bi-weekly or after any significant rainfall events (>13mm), whichever is more frequent.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the preceding report, the following conclusions can be drawn:

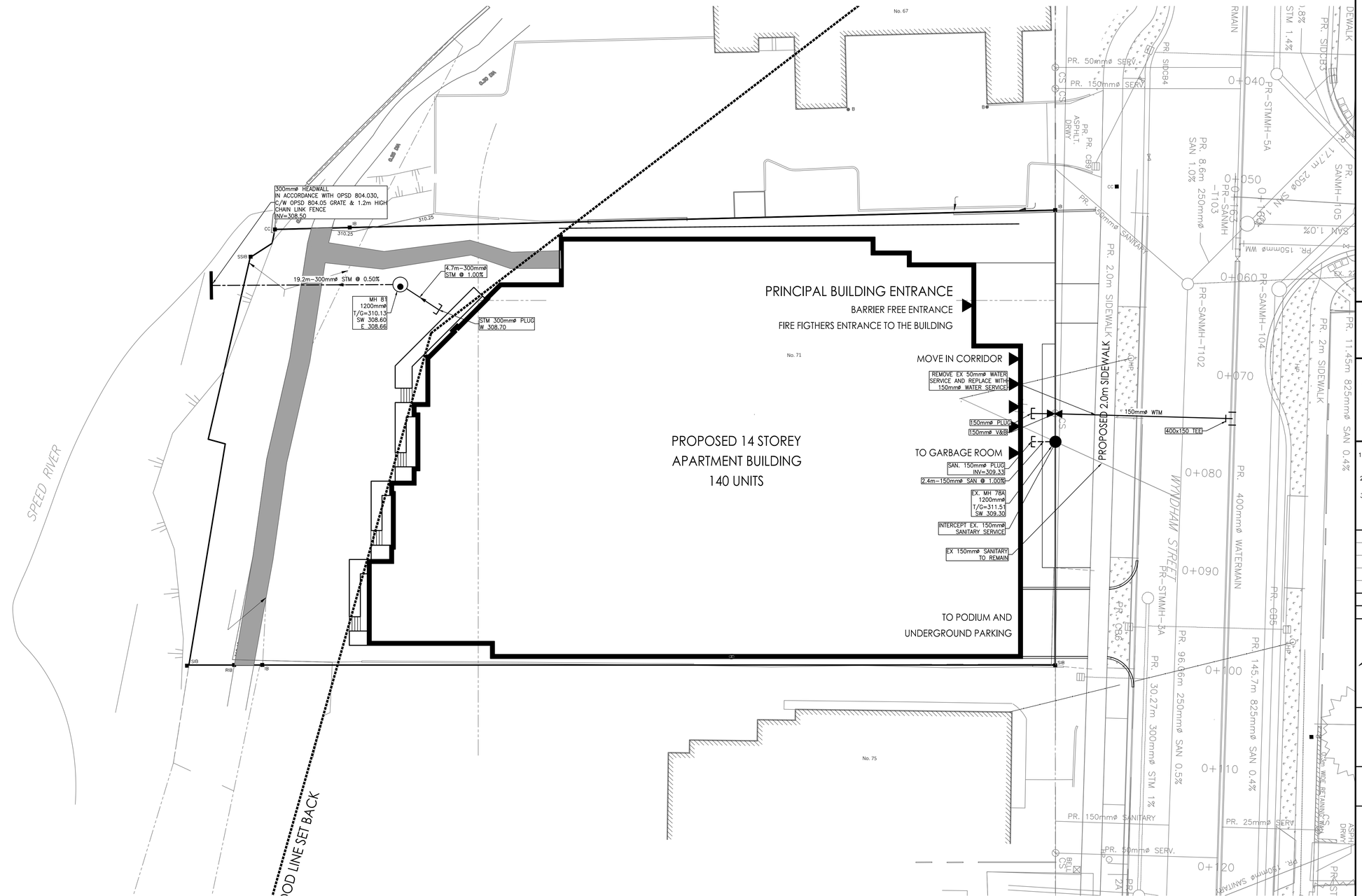
- Sanitary service is provided by the existing 250mm municipal sanitary sewer located on Wyndham Street South.
- Water service is provided by the existing 400mm watermain on Wyndham Street South.
- No additional water quality or water balance facilities are recommended for the clean roof runoff

Based on the findings of the report, the following recommendations are provided:

- The proposed SWM measures provided in this report be constructed as designed
- The ESC measures documented herein be implemented during construction
- The proposed development can be adequately serviced through the connection to the existing services
- Overall site grading will provide for "major" overland flow conveyance to the river, provide adequate cover over municipal services and generally match existing roads and boundary grades
- The servicing and grading have been designed to meet MOE and municipal standards.

APPENDIX A

Preliminary Servicing and Grading Plan



North:

LEGEND:

- STORM MANHOLE
- STORM CATCHBASIN MANHOLE
- CATCHBASIN
- DOUBLE CATCHBASIN
- SANITARY MANHOLE
- VALVE & BOX
- HYDRANT
- STORM SEWER
- SANITARY SEWER
- WATERMAIN

ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.

PIPE SIZES ARE IN MILLIMETRES.

The position of existing above ground and underground utilities and facilities are not necessarily shown on the drawings, and where shown, the accuracy of the position of such utilities and facilities is not guaranteed. Before starting work, the contractor shall confirm the exact location of all existing utilities and facilities, and shall assume all liability for damage to them. Drawings shall not be used for construction unless sealed. All work to be performed in accordance with the Occupational Health & Safety Act 1990.

GENERAL NOTES:

1. BENCHMARK: VERIFIED CITY OF GUELPH BENCHMARK 192 AT WYNDHAM ST BRIDGE AS 312.925m
2. LEGAL INFORMATION TAKEN FROM VAN HARTEN SURVEYING DATED SEPT. 22, 2009
3. TOPOGRAPHIC INFORMATION COMPLETED ON THE 12th DAY OF AUGUST, 2016. BOUNDARY INFORMATION WAS COMPILED FROM A SURVEY COMPLETED BY VAN HARTEN SURVEYING DATED, SEPT. 22, 2009 (P1) AND REGISTRY OFFICE INFORMATION.

SCHEDULE OF REVISIONS

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CONCEPTUAL SERVICING

NORTHERN HEIGHTS
SUBDIVISION – PHASE 1

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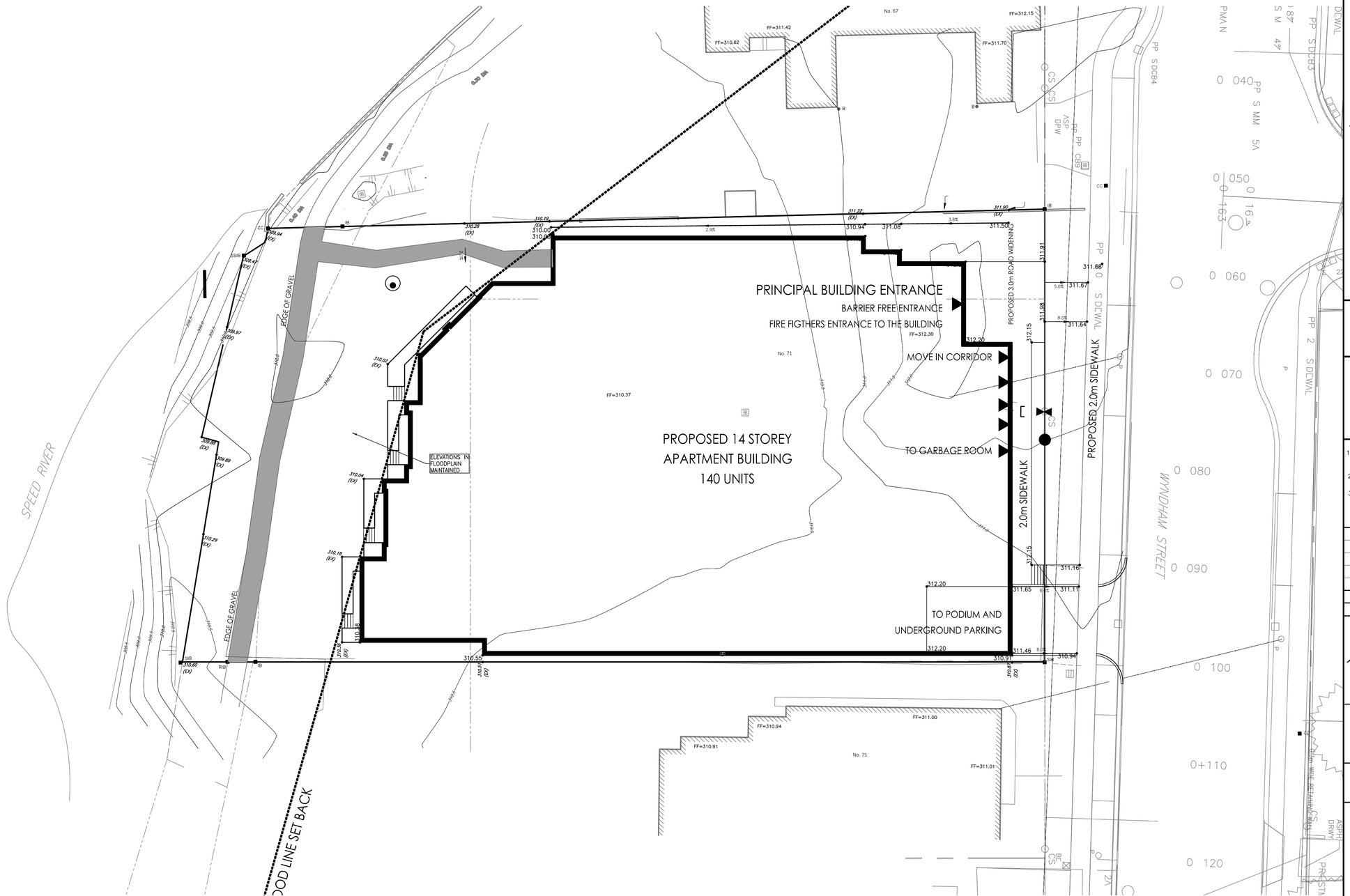

North:

LEGEND:

- FENCE
- SLOPE (3:1 UNLESS NOTED OTHERWISE)
- 352.90 ELEVATION
- 349.0 CONTOUR
- SWALE
- 3.2% GRADE

ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.

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SCHEDULE OF REVISIONS

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CONCEPTUAL GRADING

NORTHERN HEIGHTS
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APPENDIX B

Stormwater Design Calculations

MONTHLY WATER BALANCE

Monthly Water Balance Analysis - Groundwater Recharge
71 Wyndham Street South
Existing

Land Cover Descriptions

Land Description Factors	Site	Impervious		
Topography	0.2	-		
Soils	0.3	-		
Cover	0.05	-		
Sum (Infiltration Factor)	0.55	-		
Soil Moisture Capacity (mm)	75	-	*Check*	
Percentage of Total Site Area	6%	94%	**100%**	**OK**
Total Site Area (ha)	0.4			

Site Silt, Sand, Gravel, developed / Parking, rolling

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Climate Data (Data from Waterloo Wellington Airport - Climate Normals from 1981-2010)													
Average Daily Temperature (°C)	-6.5	-5.5	-1.0	6.2	12.5	17.6	20.0	18.9	14.5	8.2	2.5	-3.3	
Precipitation (mm)	65.2	54.9	61.0	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.4	71.2	**916.6**
Evapotranspiration Analysis													
Saturation Vapour Pressure (mb)	3.75	4.05	5.68	9.49	14.52	20.17	23.45	21.89	16.55	10.89	7.32	4.79	
PET (Malstrom, 1969) (mm/month)	0.00	0.00	0.00	38.82	59.39	82.51	95.89	89.54	67.67	44.54	29.93	0.00	**508.3**
Precipitation - PET (mm)	65.2	54.90	61.00	35.68	22.91	-0.11	2.71	-5.64	20.13	22.86	57.47	71.20	
Weighted Soil Storage Capacity (mm)	4.73	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	
Actual Soil Moisture (mm)	4.73	18.53	18.53	18.53	18.53	18.41	18.53	12.88	18.53	18.53	18.53	18.53	
Change in Soil Moisture (mm)	-13.80	13.80	0.00	0.00	0.00	-0.11	0.11	-5.64	5.64	0.00	0.00	0.00	
Actual Evapotranspiration (mm)	**0.00**	**0.00**	**0.00**	**38.82**	**59.39**	**82.51**	**95.89**	**89.54**	**67.67**	**44.54**	**29.93**	**0.00**	**508.3**
Recharge/Runoff Analysis													
Surplus	79.0	41.1	61.0	35.7	22.9	0.0	2.6	0.0	14.5	22.9	57.5	71.2	**408.3**
Deficit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Weighted Infiltration Factor	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	
Runoff (mm)	**0.00**	**0.00**	**0.00**	**129.59**	**10.31**	**0.00**	**1.17**	**0.00**	**6.52**	**10.29**	**25.86**	**0.00**	**183.7**
Recharge (mm)	**0.00**	**0.00**	**0.00**	**158.39**	**12.60**	**0.00**	**1.43**	**0.00**	**7.97**	**12.57**	**31.61**	**0.00**	**224.6**

Balance Check (should equal zero) 0

Volume-Based Balance (m^3)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation	241	203	226	276	305	305	365	310	325	249	323	263	3,391
Evapotranspiration	0	0	0	9	14	19	22	21	16	10	7	0	118
Runoff	0	0	0	118	9	0	1	0	6	9	24	0	168
Impervious Runoff	0	0	0	1,133	285	286	342	291	304	234	303	0	3,178
Total Runoff	0	0	0	1,251	295	286	343	291	310	243	327	0	3,346
Groundwater Recharge from Pervious Areas	**0**	**0**	**0**	**37**	**3**	**0**	**0**	**0**	**2**	**3**	**7**	**0**	**52**

Post Development

Land Cover Descriptions

Land Description Factors	Site	Impervious		
Topography	0.2	-		
Soils	0.3	-		
Cover	0.05	-		
Sum (Infiltration Factor)	0.55	-		
Soil Moisture Capacity (mm)	75	-	*Check*	
Percentage of Total Site Area	25%	75%	**100%**	**OK**
Total Site Area (ha)	0.4			

Site Silt, Sand, Gravel, developed/green space, rolling

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Climate Data (Data from Waterloo Wellington Airport - Climate Normals from 1981-2010)													
Average Daily Temperature (°C)	-6.5	-5.5	-1.0	6.2	12.5	17.6	20.0	18.9	14.5	8.2	2.5	-3.3	
Precipitation (mm)	65.2	54.9	61.0	74.5	82.3	82.4	98.6	83.9	87.8	67.4	87.4	71.2	**916.6**
Evapotranspiration Analysis													
Saturation Vapour Pressure (mb)	3.75	4.05	5.68	9.49	14.52	20.17	23.45	21.89	16.55	10.89	7.32	4.79	
PET (Malstrom, 1969) (mm/month)	0.00	0.00	0.00	38.82	59.39	82.51	95.89	89.54	67.67	44.54	29.93	0.00	**508.3**
Precipitation - PET (mm)	65.2	54.90	61.00	35.68	22.91	-0.11	2.71	-5.64	20.13	22.86	57.47	71.20	
Weighted Soil Storage Capacity (mm)	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	18.53	
Actual Soil Moisture (mm)	18.53	18.53	18.53	18.53	18.53	18.41	18.53	12.88	18.53	18.53	18.53	18.53	
Change in Soil Moisture (mm)	0.00	0.00	0.00	0.00	0.00	-0.11	0.11	-5.64	5.64	0.00	0.00	0.00	
Actual Evapotranspiration (mm)	**0.00**	**0.00**	**0.00**	**38.82**	**59.39**	**82.51**	**95.89**	**89.54**	**67.67**	**44.54**	**29.93**	**0.00**	**508.3**
Recharge/Runoff Analysis													
Surplus	65.2	54.9	61.0	35.7	22.9	0.0	2.6	0.0	14.5	22.9	57.5	71.2	**408.3**
Deficit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Weighted Infiltration Factor	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	
Runoff (mm)	**0.00**	**0.00**	**0.00**	**129.59**	**10.31**	**0.00**	**1.17**	**0.00**	**6.52**	**10.29**	**25.86**	**0.00**	**183.7**
Recharge (mm)	**0.00**	**0.00**	**0.00**	**158.39**	**12.60**	**0.00**	**1.43**	**0.00**	**7.97**	**12.57**	**31.61**	**0.00**	**224.6**

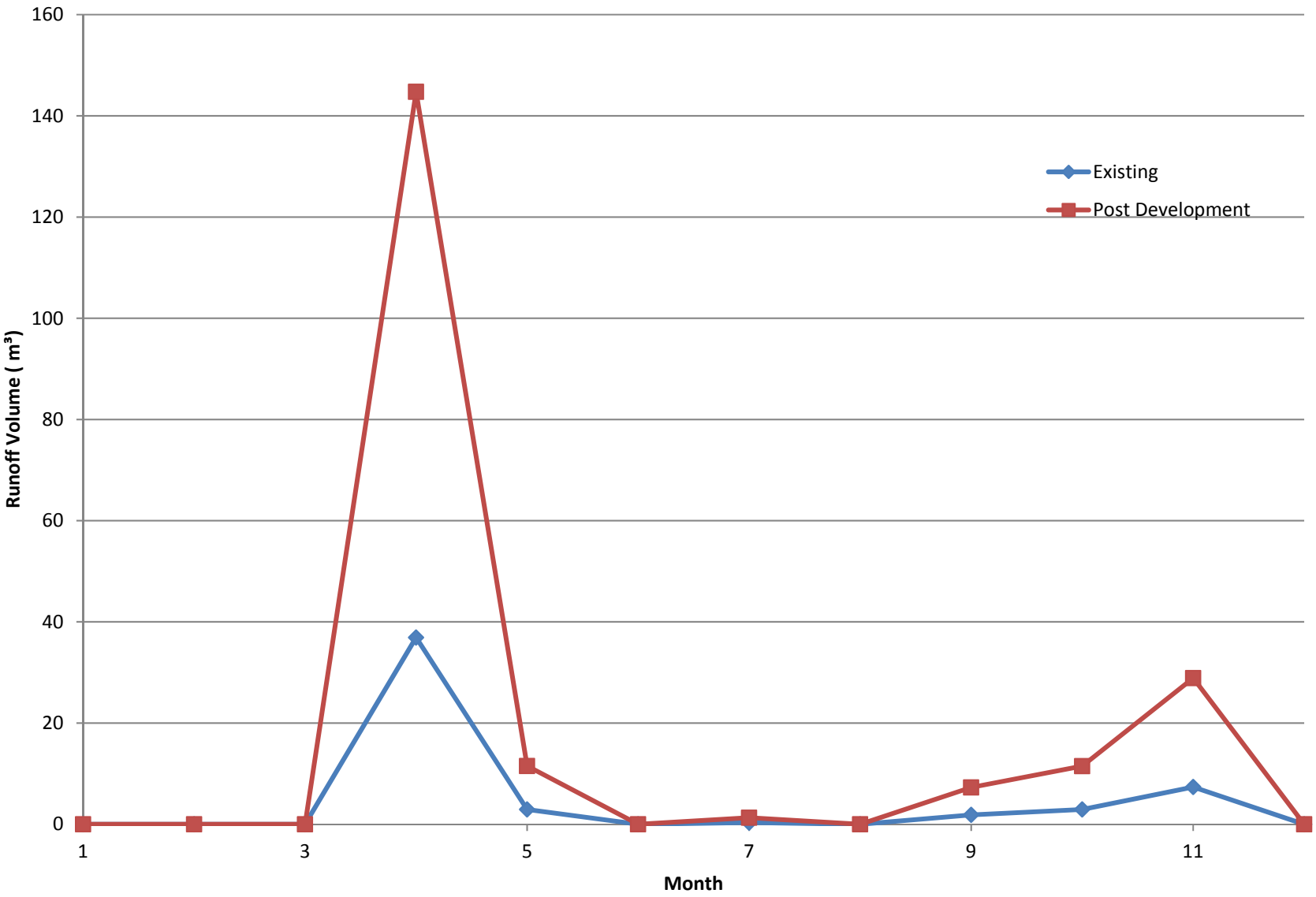
Balance Check (should equal zero) 0

Volume-Based Balance (m^3)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation	241	203	226	276	305	305	365	310	325	249	323	263	3,391
Evapotranspiration	0	0	0	35	54	75	88	82	62	41	27	0	465
Runoff	0	0	0	118	9	0	1	0	6	9	24	0	168
Impervious Runoff	0	0	0	910	229	230	275	234	245	188	244	0	2,554
Total Runoff	0	0	0	1,029	239	230	276	234	251	197	267	0	2,722
Groundwater Recharge from Pervious Areas	**0**	**0**	**0**	**145**	**12**	**0**	**1**	**0**	**7**	**11**	**29**	**0**	**205**

Balance Check (should equal zero) 0

Infiltration Augmentation - None													
Rooftop Runoff to Infiltration Trenches	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Groundwater Recharge	**0**	**0**	**0**	**145**	**12**	**0**	**1**	**0**	**7**	**11**	**29**	**0**	**205**
Final Recharge Surplus	0	0	0	108	9	0	1	0	5	9	22	0	153

Monthly Water Balance - Groundwater Recharge (Site)
71 Wyndham Street South



APPENDIX C

Speed River Geomorphic Assessment

Stantec

Memo

To:	Chris Hendrickson London, ON	From:	Trevor Chandler Waterloo
File:	161413363	Date:	February 1, 2017

Reference: Speed River Geomorphic Assessment

1.0 INTRODUCTION

A 129 unit condominium building is being proposed for 71 Wyndham Street South in Guelph, Ontario. The property (the Site) is located south of downtown Guelph between the Speed River to the west and Wyndham Street to the east (Figure 1, Attachment A). Stantec (2016) prepared the Environmental Impact Study Terms of Reference (EIS TOR, Stantec, 2016) which was reviewed by City of Guelph staff (City of Guelph, 2016). As part of this review, it was recommended that the scope of the EIS be expanded to include a geomorphological investigation of the Speed River in the proximity of the Site. This memo presents the findings of this investigation.

1.1 SCOPE

The fluvial geomorphology investigation was scoped to provide information to support the proposed location of a stormwater outfall which is required to facilitate the property development proposal. To this end, the following tasks were undertaken as part of the geomorphic assessment of the Speed River at this Site:

- Review of background information (including geological mapping, topographic mapping, aerial imagery, hydrology);
- Reach delineation;
- Historic assessment to evaluate change to channel planform throughout period of record;
- Field reconnaissance and synoptic survey of the Speed River at (and adjacent to) the Site; and
- Memo preparation.

2.0 METHODS

The geomorphic assessment consisted of a combination of desktop review and field reconnaissance.

2.1 REACH DELINEATION

Reaches are relatively uniform sections of watercourse with similar hydrology, slope, geology, valley setting, bank heights, sinuosity, and riparian vegetation. The reach selected for study was delineated using geologic and topographic mapping, and aerial photography.

2.2 HISTORICAL DESKTOP ASSESSMENT

A historical assessment is a review of changes to the channel and surrounding land use that have occurred over time that may have affected river morphology. Channel changes may be direct, and include change to the channel planform, such as those caused by gradual bank erosion, sudden avulsion, or artificial realignment. Channel change may be indirect, and include those brought on by dams, diversions, crossings, or changes in land use or land cover as a result of urbanization. To identify channel changes, archival aerial photography (1930, 1955, 2012) and mapping (1878, 1972, 1982, 1990) was reviewed. Imagery and mapping was brought into AutoCAD and overlaid and the channel mapped for successive years in order to illustrate changes to channel planform over time. Existing land use throughout the Speed River watershed was determined using OFAT (OMNRF, 2017).

2.3 GEOMORPHIC FIELD ASSESSMENT

A geomorphic field assessment was undertaken to evaluate the existing condition of the Speed River at the Site. The assessment involved a visual inspection of the site to evaluate stability as well as identifying fluvial forms, which provides insight into the operative processes. Measurements of the river were made with an engineering level, which was used to survey a channel cross-section to evaluate floodplain connection, and to measure channel slope.

Channel stability was assessed by applying the Rapid Geomorphic Assessment (Ontario MOE, 2003). The RGA is a systematic approach that involves walking the watercourse and recording evidence of the four fundamental processes that govern channel stability, which include:

- Evidence of Aggradation or excessive sediment deposition (Aggradation Index);
- Evidence of Degradation or excessive vertical erosion (Degradation Index);
- Evidence of Channel Widening or excessive lateral erosion (Widening Index); and
- Evidence of Planimetric Form Adjustment of excessive planform change (Planform Index)

The degree to which these four processes are operative is based on the presence or absence of a number of geomorphic indicators that are observed in the channel. For example, the degradation index has a total of ten geomorphic indicators, two of which include "headcutting due to knickpoint migration" and "channel worn into undisturbed overburden or bedrock. The four indices are averaged to determine the overall stability index (SI), which is used to classify and interpret channel condition (Table 1):

Reference: Speed River Geomorphic Assessment

Table 1. Interpretation of RGA From Stability Index Value (from Ontario MOE, 2003)

Stability Index (SI) Value	Classification	Interpretation
SI ≤ 0.2	Stable	Channel morphology is within a range of variance for streams of similar hydrographic characteristics – evidence of instability is isolated or associated with normal river meander propagation processes
0.21 ≤ SI ≤0.40	Moderately unstable or stressed	Channel morphology is within the range of variance for streams of similar hydrographic characteristics but the evidence of instability is frequent
SI > 0.40	Unstable	Channel morphology is not within the range of variance and evidence of instability is widespread

3.0 RESULTS

3.1 REACH DELINEATION

The delineated reach (Reach SR-1) extends from the confluence of the Speed and Eramosa River upstream to the Wyndham Street Bridge (Figure 1, Attachment A). Geology mapping (GRCA, 2017a) indicates that the surficial material along this part of the river consists of artificial fill. The channel slope in the reach is 0.3%, based on topographic mapping. The river is relatively straight with a sinuosity of approximately 1.05. There are no significant tributaries entering the reach.

3.1 HISTORIC ASSESSMENT

The Speed River watershed upstream of the Site remains in a relatively natural state. Land use upstream of the Site is predominantly agricultural (64%) or natural (29%). Urban development accounts for approximately 7% of land use, much of which is located in the City of Guelph. Land use near the Site consisted of a mix of uses in the past, although there has been a shift from industrial/commercial uses to urban residential over the past 20-30 years as the downtown core of the city is redeveloped.

Numerous small dams, millraces, and weirs were built along the river throughout the period of record. Many of these structures are now gone but others still exist, e.g. Allan's Dam, located at Macdonell Street 800 m upstream of Site, and the dam at McCrae Blvd, located 400 m downstream of Gordon Street. These relatively small dams are not designed to control flows but they may trap sediment that would otherwise be conveyed by the river.

An important dam in terms of fluvial geomorphology is the Guelph Dam, constructed 8 km upstream of Site in 1976 for the purposes of flood control, low flow augmentation, and hydro power (GRCA, 2017b). Guelph Dam has reduced peak flows in the Speed River system, which has likely reduced the amount of bank erosion and sediment transport in the river. This "stabilizing" effect has been observed downstream of similar dams in other large systems in southern Ontario (Stantec, 2007; Stantec, 2014).

Reference: Speed River Geomorphic Assessment

Changes to river planform were mapped throughout the period of record and are presented in Figure 2, Attachment A. A mill dam was present in 1878 near the Site, and much of the property at 71 Wyndham Street was under water. By 1930 this mill dam was gone and the course of the river at the Site has not changed appreciably since. The planform stability at the Site may be attributable to the effect of dams and/or bank protection.

Immediately downstream of the Site, the river planform at the confluence of the Speed and Eramosa Rivers has shifted somewhat since 1878. The most pronounced planform change occurred between 1930 and 1955 but has not changed appreciably since 1955. The 2012 aerial imagery shows that sediment deposition has occurred along the south side of the pool that is located at the confluence of the two rivers. Since 2012, vegetation does not appear to have colonized these sediments, likely due to seasonal inundation from the Wellington Street Dam. The confluence is flooded from spring to autumn by the Wellington Street Dam, located 550 m downstream of Gordon Street. The imagery indicated that this seasonally flooded area does not extend upstream to the Site.

3.2 GEOMORPHIC ASSESSMENT

A geomorphic assessment of the Speed River at the Site was conducted on January 21, 2017. Weather conditions were mild at this time and there was minimal ice/snow cover. Flow at the Guelph Dam discharge was 4.82 m3/s (GRCA, 2017b). The assessment focused on conditions at the Site, which is located along the left (east) bank when facing downstream. A Sketch map of site conditions is provided in Figure 1.

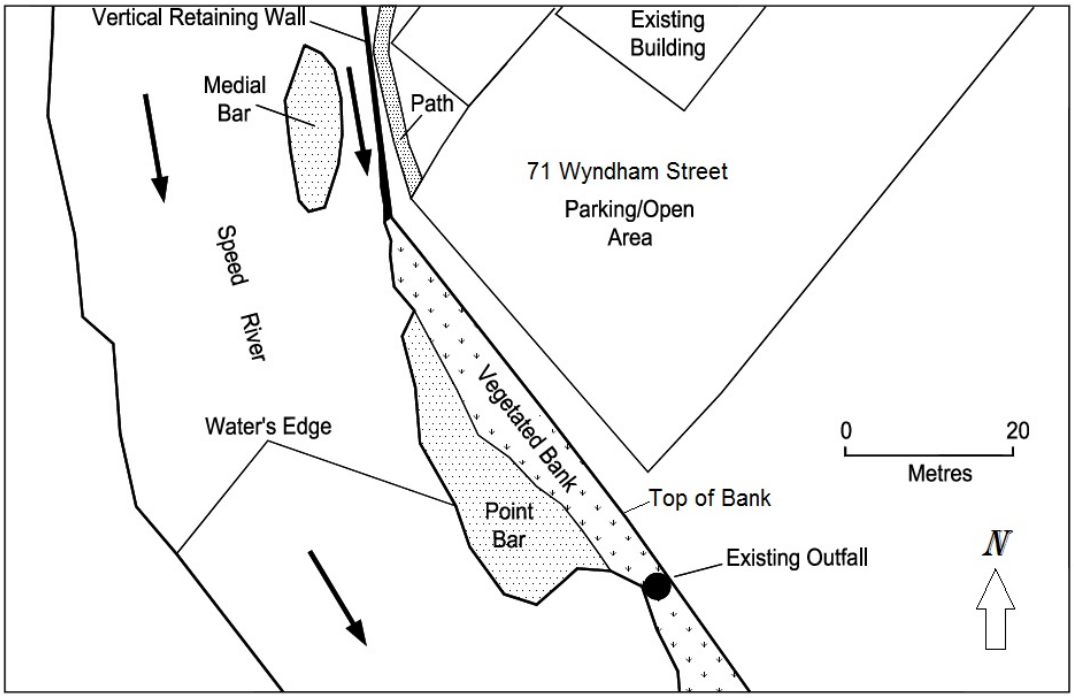


Figure 1. Sketch of the Speed River and the Site during January 21, 2017 field reconnaissance.

Reference: Speed River Geomorphic Assessment

The existing conditions are summarized below with site photographs presented in Attachment B:

- Site located approx. 200 m upstream of confluence of Speed Eramosa Rivers (Photo 1),
- Wetted width at site 35-40 m and maximum flow depth approximately 0.6 m,
- Channel top of bank width approx. 45 m,
- Water was relatively swift (mean velocity approx. 0.5 m/s) and clear,
- River substrate predominately cobble/gravel ,
- Rocky riffle with exposed bedrock immediately upstream of Site (Photo 2),
- Channel at Site consists of run that transitions to a pool near the confluence,
- Vertical concrete wall (1.2 m high) on left bank, immediately upstream of Site (Photo 3),
- Footing of concrete wall is exposed and an approximately 2 m section of wall has collapsed (Photo 4),
- Bank height approximately 2 m on both sides of river (Photo 5),
- Bank slope at Site approx. 20 degrees and well vegetated with grasses and small trees (Photo 6),
- Bank toe protected by 6-8 m wide point bar, vegetated with grasses and small trees (Photo 7),
- Lateral bar vegetated with grasses and scrub observed 30-40 m upstream of point bar (Photo 8),
- Bar sediments consist of mix of gravel and sand (Photo 9),
- Area of slow flow along left bank immediately downstream of point bar, sandy river bed (Photo 10),
- No bank erosion observed on either side of the channel (Photo 11),
- No areas of recent deposition observed (e.g., bare sand or gravel (Photo 12),
- Bankfull poorly defined, estimated to be approx. 0.4 m above water level (based in top of point bar),
- The thalweg is located slightly past the channel centerline toward the west (right) bank.

The riverbank along the Site is well-vegetated with grasses and trees and is in stable condition. The channel top of bank width is approximately 45 m and wetted with 35-40 m. The bank material consists of a mix of sand, gravel and rubble. Protection of the bank is further enhanced by a well-vegetated point bar. The channel thalweg is located near the center of the channel and near bank shear stress (left bank) is estimated as low. The cross-sections are shown below in Figure 2 and Figure 3.

A concrete retaining wall protects the riverbank on the adjacent property, immediately upstream of the Site. The wall appears to be in good condition, except for a 2 m section, which has collapsed. It is possible this section of wall failed due to the growth of a tree located at the top of the wall. There are no other indications of instability.

The observations of stability are supported by the Rapid Geomorphic Assessment score of 0.18, which indicate that channel in this reach is stable. The completed RGA form is presented in Attachment C.

Reference: Speed River Geomorphic Assessment

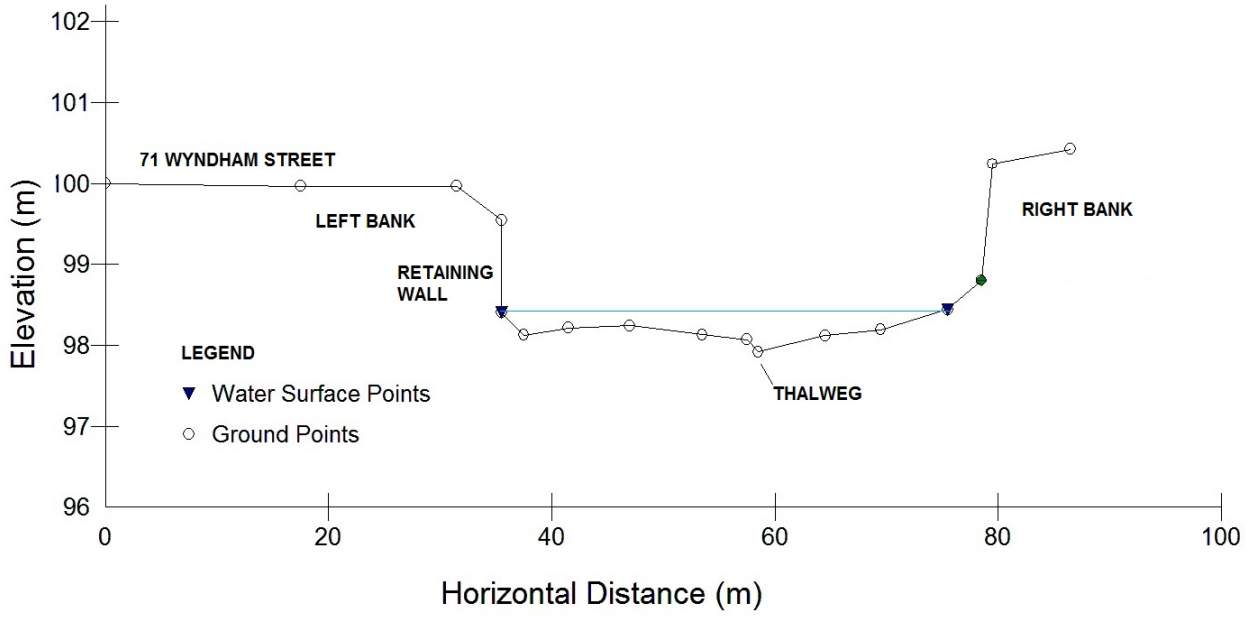


Figure 2. Speed River cross-section No.1 at upstream end of the Site. View downstream.

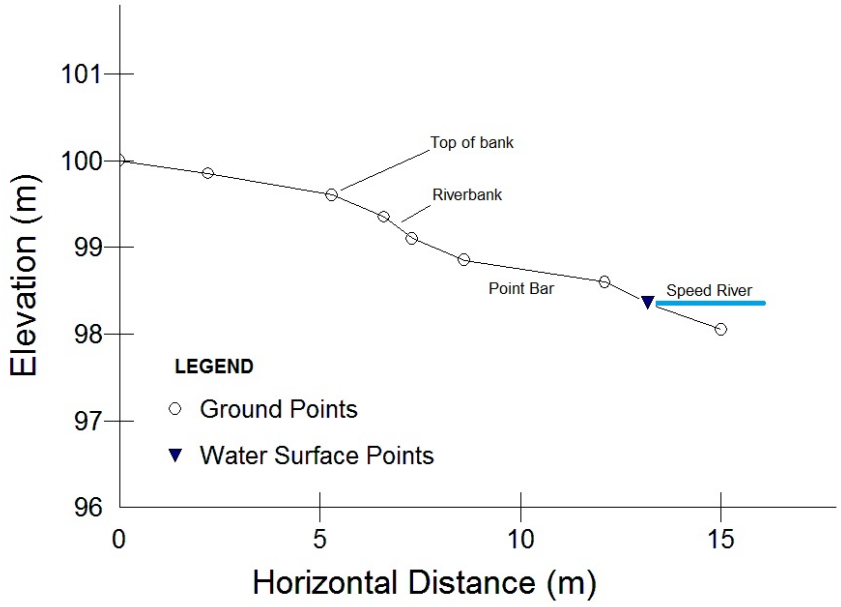


Figure 3. Typical bank section at the Site showing point bar feature. View downstream.

Reference: Speed River Geomorphic Assessment

4.0 DISCUSSION AND RECOMMENDATIONS

The Speed River at the Site has undergone considerable change in the past but the planform has been relatively stable since the 1950s. Channel stability was likely further enhanced by a reduction of peak flows from the Guelph Dam. Reconnaissance of the site indicated that the river bank was in stable condition with no evidence of excessive erosion or deposition. The Site is located on a point bar, which is typically an area of deposition. The point bar was observed to be well-vegetated and stable. There was no recent (fresh) sediment deposition observed. The lack of fresh deposition or bank erosion indicates that the reach is stable.

Construction of a stormwater outfall at this site is not expected to significantly disturb fluvial processes at this site. To minimize the potential for disturbance, the following is recommended:

- Locate the outfall upstream or downstream of the point bar, so that water discharged from the outfall does not flow across the point bar and increase the risk of erosion.

- Prepare an Erosion and Sediment Management Plan to minimize the disturbance of bank vegetation and a planting plan to re-establish vegetation as soon as possible.

5.0 REFERENCES

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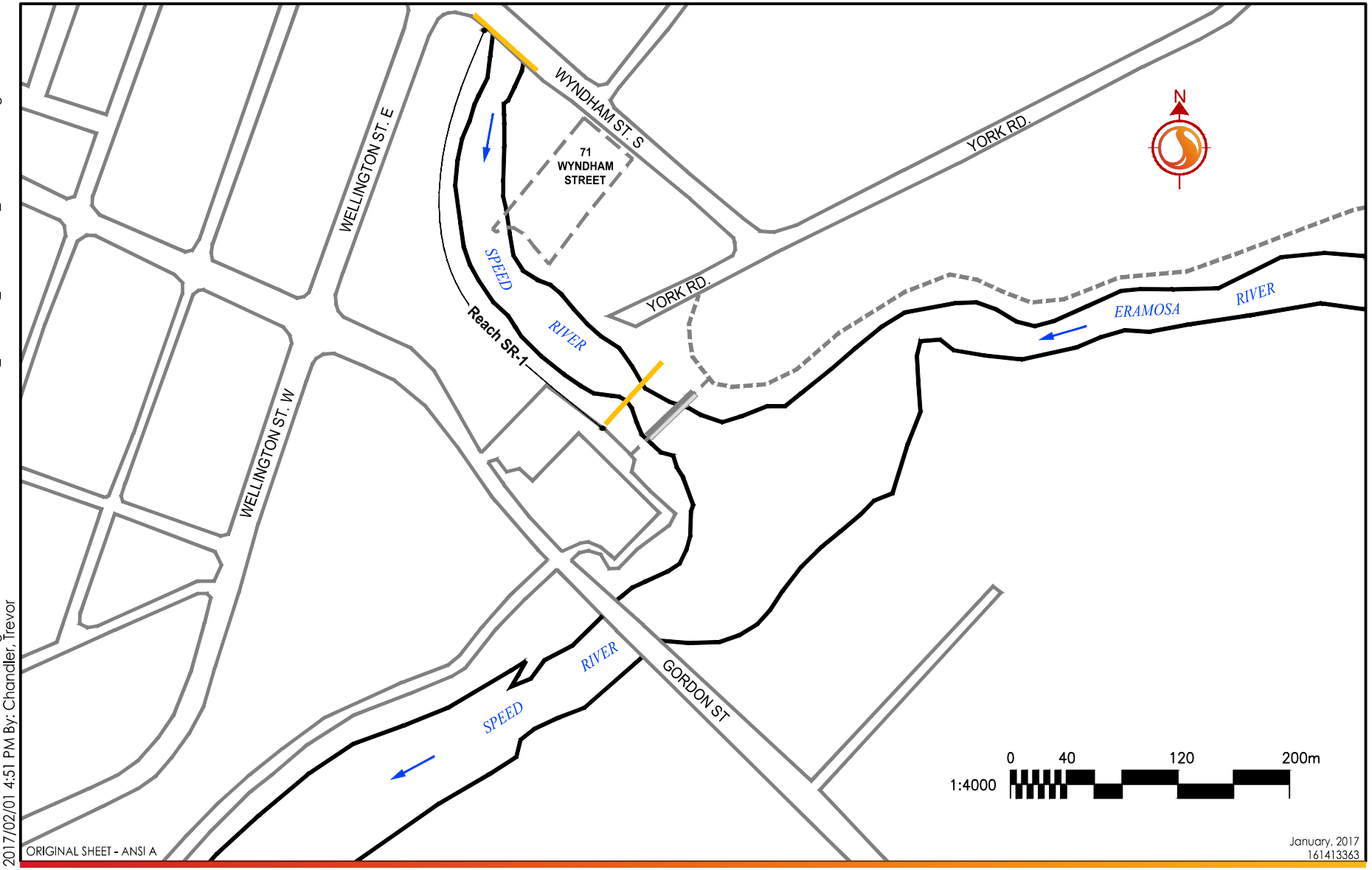
Attachments: A – Supplementary Figures; B – Site Photographs; C – Rapid Geomorphic Assessment

c.

ATTACHMENT A

SUPPLEMENTARY FIGURES



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2017/02/01 4:51 PM By: Chandler, Trevor

Stantec

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LEGEND

- Reach Break
- Subject Property (approximate boundary)
- City Trail
- Covered Bridge
- Flow Direction

Client/Project

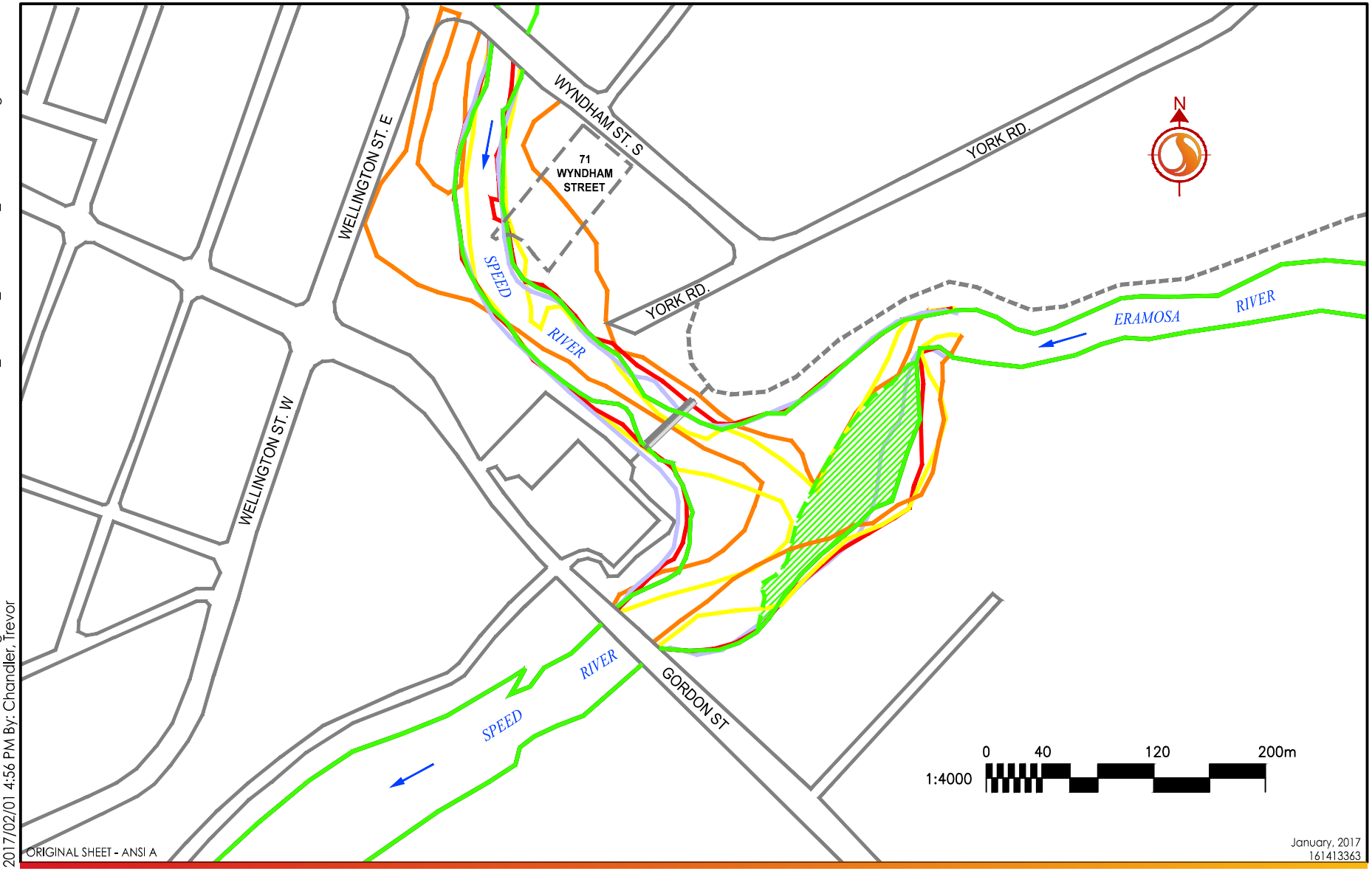
LAMMER DEVELOPMENTS
71 Wyndham Street S
Lot 172

Figure No.

Figure 1

Title

SPEED RIVER GEOMORPHIC ASSESSMENT
REACH DELINEATION



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2017/02/01 4:56 PM By: Chandler, Trevor

LEGEND

- Shoreline - 2012
- Shoreline - 1982
- Shoreline - 1955
- Shoreline - 1930
- Shoreline - 1878
- Flow Direction
- Sediment Deposition - 2012
- Subject Property (approximate boundary)
- City Trail
- Covered Bridge

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Client/Project
LAMMER DEVELOPMENTS
71 Wyndham Street S
Lot 172

Figure No.
Figure 2

Title
SPEED RIVER GEOMORPHIC ASSESSMENT
HISTORIC RIVER PLANFORM

ATTACHMENT B

SITE PHOTOGRAPHS

Photo 1 – Overview of site along the Speed River showing well-vegetated riverbank along inside of a meander. View downstream.

Photo 2 – Riffle located approximately 30 m upstream of the Site. Substrate is cobble/gravel with exposed bedrock. View upstream.

Photo 3 – Concrete retaining wall immediately upstream of the Site showing exposed footing. View downstream.

Photo 4 – Section of collapsed retaining wall at the upstream end of the Site. Arrow indicates approximate property line. View downstream.

Photo 5 – Bank height is approximately 2 m along the Site. View downstream.

Photo 6 – Bank slope is approximatley 20 degrees and densely vegetated with mix of grassy and woody vegetation. View upstream.

Photo 7 – Point bar located along river bank at the Site. Dashed line approximates location of bank toe. View downstream.

Photo 8 – Vegetated lateral bar observed immediately upstream of site. Arrow indicates approximate location of property line. View upstream.

Photo 9 – Point bar sediment consists of mainly gravel in sandy matrix with no evidence of recent deposition.

Photo 10 – Shallow embayment (arrow) at the downstream end of point bar and downstream end of the Site. View upstream.

Photo 11 – River bank at the Site consists of gravel and rubble material vegetated with woody vegetation. No indication of toe erosion.

Photo 12 – Flat, vegetated point bar surface (left side of image) at the toe of riverbank (right). Facing upstream.

ATTACHMENT C

RAPID GEOMORPHIC ASSESSMENT

STANTEC CONSULTING LIMITED				RAPID GEOMORPHIC ASSESSMENT	
Watercourse:	Speed River		**Date:**	January 21, 2017	
Location:	71 Wyndham Street South		**Reach:**	Eramosa River confluence to Wyndham Street Bridge	
FORM/ PROCESS	**GEOMORPHIC INDICATOR**		**PRESENT**		**FACTOR**
	NO (2)	**DESCRIPTION (3)**	**NO (4)**	**YES (5)**	**VALUE (6)**
Evidence of Aggradation (AI)	1	Lobate bar		x	
	2	Coarse material in riffles embedded	x		
	3	Siltation in pools		x	
	4	Medial bars		x	
	5	Accretion on point bars	x		
	6	Poor longitudinal sorting of bed materials	x		
	7	Deposition in overbank zone	x		
		SUM OF INDICES	4	3	0.43
Evidence of Degradation (DI)	1	Exposed bridge footings	x		
	2	Exposed sanitary/storm sewer/pipeline/etc.	x		
	3	Elevated stormsewer outfall(s)	x		
	4	Undermined gabion baskets/concrete aprons/etc.		x	
	5	Scour pools d/s of culverts/stormwater outlets	x		
	6	Cut face on bar forms	x		
	7	Head cutting due to knick point migration	x		
	8	Terrace cut through older bar material	x		
	9	Suspended armour layer visible in bank	x		
	10	Channel worn into undisturbed overburden/bedrock		x	
		SUM OF INDICES	8	2	0.20
Evidence of Widening (WI)	1	Fallen/leaning trees/fence posts/ect.	x		
	2	Occurrence of large organic debris	x		
	3	Exposed tree roots	x		
	4	Basal scour on inside meander bends	x		
	5	Basal scour on both sides of channel through riffle	x		
	6	Gabion baskets/concrete walls/ect. out flanked	x		
	7	Length of basal scour > 50% through subject reach	x		
	8	Exposed length of previously buried pipeline/cable/ect.	x		
	9	Fracture lines along top of bank	x		
	10	Exposed building foundation	x		
		SUM OF INDICES	10	0	0.00
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chutes	x		
	2	Single thread to multiple channel	x		
	3	Evolution of pool-riffle form to low bed relief form	x		
	4	Cutoff channel(s)	x		
	5	Formation of island(s)	x		
	6	Thalweg alignment out of phase with meander form	x		
	7	Bar forms poorly formed/reworked/removed	x		
		SUM OF INDICES	7	0	0.00
STABILITY INDEX (SI) = (AI + DI + WI + PI) / m					**0.16**

Source: MOE 2003

NOTES: Point bar feature observed in front of most of subject property. Vertical concrete retaining wall at upstream end of site. Footings of wall exposed somewhat. 2 m section of wall failed, likely due to tree roots. Fast flows coming off upstream riffle which gradually tranisition to run and then pool downstream of the site. Erosion or recent deposition is not apparent. Site appears stable. Channel relatively shallow (max. wetted depth approx 0.6 m). Siltation in pool feature d/s of Site