FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

THE CLUB WILLOWELLS

40 BLUE SPRINGS DRIVE
WATERLOO, ONTARIO
Project No.: 2014-0300-12

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1.0 INTRODUCTION

WalterFedy was retained by The Club Willowells to complete this Functional Servicing and Stormwater Management Report in support of a Official Plan Amendment/Zoning By-Law Amendment (OPA/ZBA) for a new residential development at the site with the municipal address 40 Blue Springs Drive in Waterloo ("the site"). The Club site, while not severed yet, will be about 2.5 acres in area.

The purpose of this servicing and stormwater management report is to identify how the site will be serviced, including sanitary, water and storm connections to existing municipal infrastructure. The report discusses the existing boundary servicing conditions and the availability in the municipal system to accommodate the development. Preliminary stormwater management design has been presented, demonstrating consistency with the City of Waterloo's design criteria.

1.1 Background and Reports

The site in question comprises approximately 4.8 hectares of land and water encompassing Four Wells Lake and the surrounding greens. Current development plans involve replacing the existing recreational facility and tennis courts with a high-density residential tower and its associated parking, a portion of which is currently proposed to be located below grade.

In the preparation of this functional servicing report, the following reports/drawings were referenced:

1. Site specific by-law 80-117
2. Plan, Profile, Storm, Sanitary and Watermain Information from the City of Waterloo and Region of Waterloo.
3. Waterloo Sanitary Master Plan Volume 1 by Stantec Consulting Ltd., dated August 2015.
4. The Official Plan Amendment 61 and Zone Change Application Z-04-13 450/460 Weber Street North and Part of 421 King Street North Loblaws Properties.
5. Preliminary Geotechnical Investigation Proposed Redevelopment of Willowells Recreation Centre by Chung & Vander Doelen Engineering Ltd., dated October 10, 2017

The current site is zoned G (Green Zone) as per the Zoning By-Law and has been designated as open space in the City of Waterloo Official Plan. The neighboring properties surrounding the site are zoned Multiple Residence (MR-25). Refer to figures in Appendix A for a depiction of existing zoning and official plan designations for the site.

Currently, it is proposed that the development area be severed at the limits of the Regional flood elevation for Forwell Creek, creating a 1 ha parcel of land separate from the Green Zone. The site will also be separated from the existing underground private infrastructure that runs along the northern and eastern extents of the development area.

2.0 EXISTING INFORMATION

2.1 Existing Topography, Soils, and Hydrogeology

Existing topographic information was obtained from a topographic survey completed by ACI Survey Consultants, dated August 28, 2017. Legal boundary information for the site was also obtained from the same survey.

The proposed development is to occupy a portion of the Green Zone, replacing the existing recreational facility and tennis courts. It is understood that the proposed development would occupy approximately 1 ha (2.45 acres) with the potential to develop a structure with 163 apartment units and 18 townhouse units.

Within the development area, the overall drainage occurs from southwest-to-northeast, directing flows towards the lake. Given the current use as tennis courts, the area appears to be generally flat before sloping down towards the lake. The paved areas around the existing structure have flows directed towards Blue Springs Drive. Drainage occurs from the building towards the southeast driveway and outlets to Blue Springs Drive.

A geotechnical investigation was conducted by Chung & Vander Doelen Engineering Ltd. (CVD) to determine the types of soils present, groundwater depths, bearing capacities, infiltration capacities, and pavement structures. The investigation revealed the presence of fill materials consisting of sand, gravel, fine granular deposits, silty clay till and sand and silt till. The investigation also established the groundwater depths to be between 3m and 5m below ground elevation. Based on surveyed elevations of water within Four Wells Lake and the boreholes completed by CVD, it is noted that ground water flow is from the southwest corner of the site to Four Wells Lake.

2.2 Existing Servicing and Utilities

Stormwater is conveyed to municipal sewers via two outlets from the site. A 200-mm-diameter outlet collects water from a catchbasin in the parking lot at the west side of the building, as well as from two downspouts from the building. A 200-mm-diameter storm sewer conveys this flow to a catchbasin maintenance hole on Blue Springs Drive fronting the property. The remainder of the flow from the building is directed towards Blue Springs Drive through a 450-mm-diameter storm sewer which conveys the overflow from the lake to Blue Springs Drive. It is noted that, as part of the redevelopment, the existing 450-mm-diameter storm sewer located at the eastern extent of the development area is to remain in operation, with the proposed building serviced independently.

The northern and western extents of the development area drain overland to Four Wells Lake.

The site is currently serviced by a 200-mm-diameter sanitary sewer located on Blue Springs Drive. This sewer increases in size to a 300-mm-diamater sanitary sewer at the first downstream maintenance hole, before eventually discharging to the Lower Forwell Trunk Sanitary Sewer. The sanitary sewer from the existing building is connected to a sewer that also conveys sanitary discharge from the residential development to the north of this proposed development. This sewer will remain as part of the development to service 30 Blue Springs Drive, but will not have any connections from the new residential tower.

The site is also serviced through a 200-mm-diameter water connection on the west side of the building, which connects to an existing 300-mm-diameter watermain along Blue Springs Drive.

3.0 REVIEW AGENCIES

3.1 City of Waterloo

The City of Waterloo will be responsible for the review and approval of this functional servicing design for the ZBA/OPA processes. The City of Waterloo will also be responsible for review and approval of the development during the site plan process, which would provide the City with the opportunity to review detailed grading, servicing, and stormwater management designs.

3.2 Region of Waterloo

The Region of Waterloo will be responsible for the review and approval of the official plan and zoning by-law amendment.

3.3 Ministry of the Environment and Climate Change (MOECC)

Any upgrades to municipal infrastructure as part of this application will necessitate an application for an Environmental Compliance Approval (ECA) from the MOECC. It is understood that works that do not include stormwater management can be handled through a transfer of review process through the Region of Waterloo.

3.4 Grand River Conservation Authority (GRCA)

Review and approval from the GRCA will be necessitated due to the proximity of the site to Forwell Creek. A fill permit from the GRCA will be required for any works within the GRCA regulation limits.

4.0 SITE SERVICING

Utilizing the conceptual plans developed by ABA Architects, schematic grading and servicing plans were prepared by WalterFedy for the purposes of this report.

4.1 Sanitary Servicing

Current development plans involve a 181 unit high-density development. The estimated sanitary flow from the development was calculated in accordance with the City of Waterloo Development Engineering Manual. The sanitary flow from the proposed development is summarized below in Table 1.

Table 1: Estimated Sanitary Discharge from Development

Total Units	181 units
Apartment Units	163 units
Townhouse Units	18 units
Persons per Unit (ppu)	1.76 ppu for apartments 2.18 ppu for townhouses
Average Daily Flow	275 L/cap/day
Equivalent Population	327 persons
Peak Flow Factor	4.06
Sanitary Peak Flow From Development	4.23 L/s
Extraneous Flows	0.25 L/s
Total Sanitary Flow	4.48 L/s

The proposed development is expected to be serviced via a new sanitary service connecting to the sanitary maintenance hole located on Blue Springs Drive fronting the property. A 200-mm-diameter pipe sloped at 1.00% is sufficient to service the development.

4.1.1 Downstream Constraints

The City of Waterloo Sanitary Master Plan by Stantec, dated August 2015, identified a downstream constraint that may exist in the 2029 Wet Weather flow conditions. The constraint is located in an environmentally-sensitive area and has no direct connections from any other developments; the existence of wetlands will also prevent such development from occurring in the area in the future. The constraint is physically located close to the Waste Water Treatment Plant and, as part of the Sanitary Master Plan, it was recommended that no further improvements be carried out to alleviate the Lower Forwell Capacity Constraint.

The peak sanitary flow of 4.48 L/s may pose further constraints on this surcharging sewer, although it is likely that the peak flow from this development may not align with the peak flow within the trunk sewer. It is

expected that the City of Waterloo will assist with assessing further impacts to the Lower Forwell Trunk as it relates to this development via the City-wide Sanitary Model.

4.2 Water Servicing

The existing development has a water service connecting to the municipal watermain on Blue Spring Drive that includes a valve near the property line. It is expected that the existing service will be removed back to the main and replaced with a new connection to the street.

4.2.1 Criteria

The *Tri-City Water Distribution Master Plan* (May 2009) completed for the Region of Waterloo states that the controlling criterion for all watermain distribution systems is that they must be able to transfer the larger of the maximum daily demand plus fire flow or the peak hour demand. In order to determine if a proposed watermain will be able to convey water in accordance with the criterion stipulated by the Region of Waterloo, modelling of the system is required to determine pressures in the system based on controlling water demands. As a result of water flow demand from any development, the minimum pressures within the watermain to convey the average daily demand and maximum daily demand shall be within the range of 350 kPa (50 psi) to 550 kPa (80 psi). The Region also stipulates that the minimum pressure under any non-fire demand scenario shall not be less than 275 kPa (40 psi).

With the inclusion of fire flow, the Region of Waterloo states that under no circumstances shall the minimum residual pressure during maximum daily demand plus fire flow scenarios be less than 140 kPa (20 psi) at any location in the water distribution system. Regional criteria also state that the maximum static pressure in the watermain system should not exceed 700 kPa (100 psi) and velocity within the pipe cannot exceed 5 m/s under any scenario.

As a result of the criteria stipulated by the Region of Waterloo, the demands on the system from the proposed development must be established in order to determine if the system will comply with the limitations outlined.

4.2.2 Domestic Water Demand

Calculations of the domestic water demand for the proposed development have been determined using the guidelines outlined within the *Tri-City Water Distribution Master Plan* (May 2009), DGSSMS, and the MOECC *Design Guidelines for Drinking-Water Systems 2008*.

The Water Master Plan states that the average residential demand for the Region of Waterloo is 225 L/cap/day which is less than the MOECC average of 275 L/cap/day. As a result, to be conservative, the MOECC average was used to determine the residential demand for the proposed development. In order to convert the average daily demands into maximum daily and peak hourly flows, a peaking factor was applied in accordance with Table 3-3 of the MOECC design guidelines for drinking-water systems serving fewer than 500 people.

Interpolating the data for a population of 327 results in a peak factor of 3.5 for maximum daily demand and a peak factor of 5.24 for peak hourly demand. Applying these peak factors results in a maximum daily demand of 3.63 L/s and a maximum hourly demand of 5.45 L/s. These values are summarized below in Table 2.

Table 2: Estimated Domestic Water Demand for Development

Total Units	181 units
Apartment Units	163 units
Townhouse Units	18 units
Persons per Unit (ppu)	1.76 ppu for apartments 2.18 ppu for townhouses
Residential Demand - MOECC	275 L/cap/day

Equivalent Population	327 persons
Maximum Day Peaking Factor	3.5
Maximum Hour Peaking Factor	5.24
Maximum Daily Demand	3.63 L/s
Maximum Hourly Demand	5.45 L/s

4.2.3 Fire Flow Demand

In addition to the daily demand from the proposed development, fire flow demands are required to assess the adequacy of any proposed watermain system. The Region of Waterloo specifies that all fire flow requirements shall be determined in accordance with the current issue of *Water Supply for Public Fire Protection* published by the Fire Underwriters Survey, and the Ontario Building Code. It is understood that this building will be fitted with sprinkler systems to be designed per NFPA 13 *Standard for Installation of Sprinkler Systems* (2013).

In accordance with the Fire Underwriters Survey requirements, the following is noted regarding the development:

- Construction type is fire-resistive, resulting in a coefficient (C) value of 0.6
- Largest two floors are ground level and the second level, both with an area of approximately 4445 m^2
- 16-storey building, with tenant parking one level underground, as well as on the first and second floors
- Floors 3-16 consist primarily of apartment units
- Floors 3-5 have an approximate area of 2317 m^2 of total floor space each, and floors 6-15 have an approximate area of 783 m^2 of floor space each
- Vertical openings and exterior vertical communications are not protected with minimum 1 hr rating
- Occupancies contain limited combustible contents
- Automated sprinkler protection designed to NFPA 13 standards, accommodated with standard water supply to sprinklers and standpipes. The system is not fully supervised
- East Side Mario's directly west of the site is approximately 35 m away from the proposed development, resulting in additional fire flow requirements
- No other surrounding buildings are within 45 m

The resulting fire flow demands are summarized below in Table 3.

Table 3: Estimated Fire Flow Demands for Development

Type of Construction: Fire-Resistive	C = 0.6
Floor Area	14321.3 m^2 of effective floor area
Occupancy Charge: Limited-Combustible Contents	Fire Flow Reduction of -15%
Initial Required Fire Flow	13600 L/min
Automated Sprinkler Protection:	
Designed to NFPA 13 Standard	Fire Flow Reduction of -30%
Standard Supply to Sprinklers and Standpipes	Fire Flow Reduction of -10%
Exposure: East Side Mario's 35m to the West	Fire Flow Increase of 5%
Total Required Fire Flow	9000 L/min (150 L/s)

The overall required flow for fire demand for the proposed development is 150 L/s. According to the DGSSMS, the proposed development must be able to convey the greater of the combined total of the domestic maximum hour flow plus the fire flow demand or the peak hourly demand. The addition of the

maximum day domestic water demand to the fire flow demand results in a peak water demand of 155.45 L/s to be conveyed. Such a flow can be conveyed using a 200mm-diameter main, resulting in pressure and flow values within the prescribed limits.

A hydrant flow test was conducted by Spira Fire Protection Ltd. on an existing hydrant on Blue Springs Drive to determine the available pressures and flows within the municipal system. Based on the results of this test, the rated capacity of the system at 20 psi was determined to be approximately 234.64 L/s. As such, it is understood that sufficient capacity exists within the municipal system to service the development.

The Demand and Fire Flow Modelling Results Table in Appendix B shows the resulting fire flow demands for the proposed development.

During detailed design of the building, a review by a Mechanical Engineer should be conducted to determine whether a fire pump will be required for the sprinkler system, or a booster pump for domestic water.

4.3 Storm Servicing and Stormwater Management

The existing site has two stormwater catchment areas. One drains into Four Wells Lake, while the other is directed towards Blue Springs Drive. The majority of the site drains to Four Wells Lake, with a contributing area of approximately 6931 m^2, 54.6% of this area being impervious. The catchment area draining towards Blue Springs Drive is approximately 2998 m^2 with 81.6% being impervious. Refer to Figure 1 for a depiction of the pre-development catchment areas.

As part of this development, it is proposed that the flows from the roof and front yard of the building be directed towards Blue Springs Drive, with the remainder of the site functioning as-is, sheet flowing towards Four Wells Lake. The catchment area draining towards Four Wells Lake is approximately 0.46 ha in size, with approximately 16.8% of this area impervious. The catchment area draining towards Blue Springs Drive has an approximate area of 0.53 ha. A section of the roof is to be designed to attenuate flow towards the municipal infrastructure utilizing flow control roof drains. The remaining roof area, comprising outdoor amenities, and the front yard of the development are to runoff directly to Blue Springs Drive. Refer to Figure 2 for a depiction of the post-development catchment areas.

Flow to Blue Springs Drive will be conveyed via a new storm service from the building, whereas the front yard is to be graded to sheet flow onto the municipal right-of-way. Similarly, the rear yard will continue to sheet flow into the lake.

Due to the proximity of the campus to Forwell Creek, the site is also subject to the guidelines and recommendations outlined in the *Laurel Creek Watershed Study* (LCWS) for new developments which include:

- maintaining baseflow in the Laurel Creek Watershed by closely matching the infiltration levels between the pre-development and post-development conditions;
- mitigating flood risks and ensuring no further downstream streambank erosion occurs by matching runoff volumes between the pre-development and post-development conditions; and
- protecting water quality by preventing and controlling discharges of heated water, phosphorus, sediment, bacteria, and oxygen-demanding substances.

Storm runoff from this site will be also be treated to achieve a 70% total suspended solids removal rate.

4.3.1 Quantity Control

As per the City of Waterloo requirements, stormwater runoff from the site is to be controlled to pre-development rates for the 2-year, 5-year, and 100-year design storms. Drainage areas were delineated and catchment parameters were determined for inclusion in pre-development and post-development modelling. Hydrologic modelling for the stormwater management design was completed using MIDUSS NET.

The current conditions were modeled to determine the existing peak release rates to Blue Springs Drive and to Four Wells Lake. The catchment parameters used in the MIDUSS modeling of the pre-development and post-development conditions are provided in Table 4.

Table 4: Catchment Parameters

Pre-Development			
#	**Area (ha)**	**% Impervious**	**Description**
101	0.30	81.6%	Catchment to Blue Springs Drive
102	0.69	54.6%	Catchment to Four Wells Lake
Post –Development			
#	**Area (ha)**	**% Impervious**	**Description**
201	0.38	100%	Roof of Building with Flow Control to Blue Springs Drive
202	0.07	100%	Roof of Building without Flow Control to Blue Springs Drive
203	0.09	23.6%	Front Yard to Blue Springs Drive
204	0.46	16.8%	Rear Yard to Four Wells Lake

4.3.2 Modelling Results

The peak flows from the drainage areas were modeled using MIDUSS hydrological software. The model outputs for each storm event are included in Appendix D. Peak flows are summarized below in Table 5.

Runoff to Blue Springs Drive is to be controlled to below the pre-development rates of 53 L/s, 74 L/s, and 144 L/s for the 2-year, 5-year, and 100-year design storms, respectively. The resulting peak outflow to Four Wells Lake is also controlled to below pre-development levels.

Table 5: Peak Flow Summary

	Pre-development			**Post-development**		
	2-Year	**5-Year**	**100-Year**	**2-Year**	**5-Year**	**100-Year**
Peak Flow Rates:	*(L/s)*	*(L/s)*	*(L/s)*	*(L/s)*	*(L/s)*	*(L/s)*
Flow to Blue Springs Drive	53	74	144	27	37	75
Flow to Four Wells Lake	78	106	205	16	24	64

By utilizing flow control roof drains, the post-development runoff towards Blue Springs Drive for the 2-year, 5-year, and 100-year storms are all less than the pre-development values. Therefore, there is sufficient capacity in the existing infrastructure to support the proposed development.

4.3.3 Quality Control

All runoff directed towards Blue Springs Drive can be considered to be relatively clean runoff from the roof and front yard of the building. As such, no further quality control is proposed for the development at this time.

The runoff directed towards Four Wells Lake is from the rear yard which primarily consists of landscaped area and is, therefore, also considered clean water.

4.3.4 Average Annual Water Balance

As part of the *Laurel Creek Watershed Master Plan* study, it was recommended that all new developments closely match post-development infiltration volumes to the pre-development conditions to maintain baseflow within the Laurel Creek Watershed.

In order to demonstrate compliance with this criterion, the approach outlined in the MOECC's *Stormwater Management Planning and Design Manual* was utilized to establish the groundwater recharge volume in both the pre-development and post-development conditions. Table 6 summarizes the water balance approach within the development.

AVERAGE ANNUAL WATER BALANCE				
	Precipitation (m^3)	Evapotranspiration (m^3)	Groundwater Recharge (m^3)	Runoff (m^3)
Pre-development	9073	3497	813	4764
Post-development	9073	3711	996	4367
Percent Change	0%	6.1%	22.6%	-8.3%

The results of the water balance demonstrate the average annual performance of the stormwater management strategy for the development. Using values representing the appropriate topography, land use, precipitation, and evaporation outlined in the MOECC manual, an average annual groundwater recharge rate of 813 m^3 was calculated for this site in the pre-development condition. The groundwater recharge rate for the post-development conditions was determined to be 916 m^3 using the same approach.

In general, the total imperviousness of the site is reduced in the post development conditions. As such, the average annual ground water recharge from the pervious areas is increased by approximately 23%, contributing to additional cold water to Laurel Creek baseflow and increasing the quality of discharge to the subwatershed. Similarly, the increase in perviousness on the site directly results in approximately an 8% reduction of runoff volumes on an average annual basis from the site, mitigating any further flood risks.

4.3.5 Site Grading

Currently, the major overland flow routes from this site are directed towards Four Wells Lake, while the paved areas are directed towards Blue Springs Drive. In the proposed conditions, the grading is to mimic the overland flow patterns of the existing conditions.

The design matches existing grades at either the property line or limit of development to ensure that overall drainage patterns are not impacted and no disruption is caused to adjacent lands.

5.0 EROSION AND SEDIMENT CONTROL

Any sediment tracked onto the roadway during the course of construction will be cleaned by the Contractor. To help minimize the amount of mud being tracked onto the roadway, a mud mat will be installed at the primary construction exit. Additionally, silt fence will be installed around the entire site to eliminate any sediment from leaving the site and will remain in place and be maintained until landscaping has been completed and soil has been vegetated. Silt fence will also be installed around any stockpiles on site, with the stockpiles kept a minimum 2.5 m from the property boundary.

Silt sacs in storm structures will be installed to prevent any silt or sediment-laden water entering inlets. These will be inspected to ensure that they have been properly installed and function as designed throughout construction.

It is assumed that the Contractor would keep in mind weather conditions when scheduling work to minimize dust to the neighboring residential properties due to construction activities.

The controls will be maintained and accumulated sediments removed once their capture capacity has been decreased by one third. It is proposed that, during construction activities, visual monitoring be conducted bi-weekly and within 24 hours of any rainfall event of 12 mm or greater. During the construction period, monitoring will consist of visual observation for the effectiveness of the sediment and erosion controls and sediment migration off site. Construction inspections will be conducted until such time as the construction

activities are complete and vegetation has established itself to a density equivalent to 70% of the background native vegetation density.

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6.0 CONCLUSIONS

Based on the analysis presented in this report, it is concluded that:

- A proposed 200-mm-diameter sanitary service connection to Blue Springs Drive can service the development.
- The existing 200-mm-diameter sanitary sewer on Blue Springs Drive has enough capacity to support the proposed development. Further assistance is required from the City of Waterloo to assess downstream capacity constraints on the Lower Forwell Trunk.
- The proposed 200-mm-diameter water service connection can supply fire and domestic service to the development.
- Stormwater peak flow control to the Forwell Creek storm system can be accommodated with the use of roof flow control drains. In the proposed design, minor and major peak flows are controlled to below existing levels.
- Normal Level stormwater quality control from the site can be accomplished without the need of any additional measures for enhancement.
- The proposed development will decrease the imperviousness from the site, thereby enhancing the overall quality of runoff directed to the Laurel Creek Subwatershed.
- The development will exceed groundwater recharge levels on an average annual basis contributing additional cold water to Laurel Creek baseflow.
- The development will result in a decrease in runoff volumes on an average annual basis, mitigating any potential additional flood risks.
- Perimeter silt fence, silt fence at the base of all stock piles, silt sacs in storm structures, and a construction entrance mud mat can provide erosion and sediment control.

All of which is respectfully submitted,

WALTERFEDY

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FIGURES

APPENDIX A – ZONING INFORMATION

Current Zoning
City of Waterloo Official Plan
GRCA Regulated Area

APPENDIX B – SANITARY SEWER CALCULATIONS

Sanitary Sewer Design Sheet

APPENDIX C – WATERMAIN DESIGN

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APPENDIX D – STORMWATER MANAGEMENT AND MODELING

Storm Sewer Design Sheet
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