# FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

## 14688210 CANADA INC.

177-179 ALBERT STREET DEVELOPMENT
Project No.: 2022-0400-10

November 10, 2023

WALTERFEDY

# 14688210 CANADA INC.

## FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

177 - 179 ALBERT STREET DEVELOPMENT

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# 1.0 INTRODUCTION

WalterFedy was retained by 14688210 Canada Inc. to provide civil engineering services in support of an Official Plan Amendment (OPA) and Zoning By-law Amendment (ZBA) for the proposed 24-storey, mixed-use development with municipal address 177-179 Albert Street in Waterloo, Ontario. The proposed building is to include ground floor recreational space, residential units in the stories above, outdoor and rooftop amenity space, and both underground and surface parking. The proposed development will amalgamate 177 Albert Street and 179 Albert Street.

The purpose of this Functional Servicing and Stormwater Management Report is to identify how the development will be serviced, including water, storm, and sanitary connections to the existing municipal infrastructure. The report will discuss existing servicing conditions surrounding the site and the available capacity in the municipal system to determine if it can adequately service the development. Preliminary stormwater management design has been presented, demonstrating consistency with the City of Waterloo and Ministry of the Environment, Conservation and Parks (MECP) design criteria.

## 1.1 Background

The site consists of 177 and 179 Albert Street, in Waterloo, Ontario, with an overall area of 0.162 ha. Both lots currently contain single detached dwellings, with one of them acting as office space. The site is bound by Albert Street to the east, Seagram Drive to the south, a 3-storey apartment to the west, and a vacant lot to the north. 177 Albert Street is accessed off Seagram Drive.

The development is to consist of a 24-storey, mixed-use building with a total above ground floor space of 14,330 $m^2$. This includes 172 $m^2$ of ground floor recreational space. The development will also include outdoor amenity space. A total of 146 units and 172 bedrooms are proposed. Associated surface and one level of underground parking will be accessed off Seagram Drive.

The site is currently zoned RMU-81 (residential mixed-use zone) with site specific by-law C-179. This current zoning only allows for a maximum of 750 bedrooms per hectare. It is being proposed that the zoning by-law be amended to allow for a density of 1156 bedrooms per hectare.

## 1.2 Reference Reports and Drawings

In preparation of this report, the following background information was referenced:

1. *Topographical Plan of Survey, All of Lots 4 & 5 Registered Plan 507, City of Waterloo, Regional Municipality of Waterloo,* Van Harten Surveying Inc., May 31, 2023
2. *Geotechnical Investigation – Proposed 25-Storey Apartment Building, 177 and 179 Albert Street, Waterloo, Ontario*, Chung & Vander Doelen Engineering Ltd., July 28, 2023
3. Plan and Profile Drawings of Albert Street and Seagram Drive provided by the City of Waterloo.
4. *Storm Layout, Sanitary Layout, Watermain Layout, G.C.T. No. 13-3*, provided by the City of Waterloo

The following guidance documents were also referenced in preparation of this report:

1. *Comprehensive Engineering and Landscape Manual,* City of Waterloo, 2023.
2. *Design Guidelines and Supplemental Specifications for Municipal Services (DGSSMS),* Region of Waterloo and Area Municipalities, February 2023
3. *Development Charges Background Study*, Region of Waterloo, April 2019
4. *Design Guidelines for Sewage Works*, Ministry of the Environment, Conservation and Parks, March 2019
5. *Stormwater Management Planning and Design Manual,* Ministry of the Environment, Conservation and Parks, May 2019

6. *Tri-City Water Distribution Master Plan,* Region of Waterloo, May 2009
7. *Water Supply for Public Fire Protection – A Guide to Recommended Practise in Canada,* Fire Underwriters Survey, 2020
8. *Standard for Installation of Sprinkler Systems,* National Fire Protection Association, 2013
9. Current Version of the Ontario Building Code (OBC).

# 2.0 EXISTING INFORMATION

## 2.1 Topography

The site currently exists as two separate parcels, both containing single detached dwellings. A 2.5-storey house, a 1-storey block garage, asphalt driveway, and a grass backyard with a few trees exists at 179 Albert Street. At 177 Albert Street, there is a 2-storey house with a retaining wall and asphalt parking lot that is accessed off Seagram Drive. A topographical and legal survey was completed by Van Harten Surveying Inc. in May 2023.

The site generally drains from northeast to southwest, with the elevation ranging from approximately 340.40 m at the northeastern corner along Albert Street, to 337.40 m at the southwestern corner along Seagram Drive. The southeastern corner of the site is at an elevation of approximately 339.50 m, and the northwestern corner is at an elevation of 338.70 m. Drainage from both properties appears to be directed towards the retaining wall along the western property line. Runoff from both properties drains along the base of the retaining wall and towards Seagram Drive.

## 2.2 Geotechnical Report

A geotechnical investigation was completed by Chung & Vander Doelen Engineering Ltd. (CVD), with field work being carried out in June 2023. Their subsequent report was completed in August 2023. Four boreholes were advanced within the site boundaries, and three monitoring wells were installed to establish groundwater depths.

Topsoil was encountered at surface level at Boreholes 1, 2 and 3, with a thickness between 200 and 250 mm. Asphalt was encountered at the surface of Borehole 4, with an asphalt thickness of 50 mm and a granular base thickness of 480 mm. Fill material was encountered beneath the topsoil and pavement layers, extending to depths between 0.7 m and 2.15 m below existing grade.

A layer of fine granular deposits was encountered beneath the fill material and extended to a depth between 5.95 m and 8.55 m below the existing grade. This fine material primarily consists of sand and silt. Clayey silt till was encountered beneath the fine granular deposits to depths between 24.60 m and 24.85 m below the surface, which is where the boreholes were terminated. Some sand deposits were encountered within this clayey silt till layer in Boreholes 1-3. These layers ranged between 8.40 m and 16.15 m below the surface.

Groundwater levels were measured from the three monitoring wells, with depths ranging between 3.75m and 5.22m below the surface, which correlates to an elevation between 344.06 m and 335.06 m. These water levels were observed in July 2023. Groundwater levels are expected to fluctuate seasonally and in response to weather events.

The report by CVD also provides hydraulic conductivity, analytical laboratory testing, and design recommendations for foundations, grading operations, floor slab construction, excavations for site services, and pavement structure.

## 2.3 Servicing and Utilities

Services within and surrounding the site were documented by Van Harten as part of the topographical survey. Additional servicing information was taken from Plan and Profile drawings provided by the City of Waterloo and available GIS data.

There is a 250-mm-diameter sanitary sewer within Albert Street that conveys flow toward the south. There are existing sanitary service laterals from the existing properties that are presumed to connect to Albert Street. This will be confirmed prior to construction and the services will be removed and capped at property line. A 200-mm-diameter sanitary exists along Seagram Drive but does not extend to the site frontage.

A 400-mm-diameter watermain and a 150-mm-diameter watermain exist within Seagram Drive. It appears that neighbouring developments are connected to this 400-mm-diameter watermain. There is a possibility that the 150-mm-diameter watermain is abandoned. There is also a 150-mm-diameter watermain along Albert Street fronting the site. The existing houses on site are assumed to be connected to the watermain on Albert Street. The location of these existing services will be verified prior to construction and will be appropriately decommissioned and removed back to the main. There is an existing municipal hydrant on Albert Street approximately 60 m to the north of the site, and another municipal hydrant on Seagram Drive approximately 50 m to the west.

There is a 300-mm-diameter storm sewer along Seagram Drive which conveys flow towards the west. A catch basin is located at the southeastern corner of the Albert and Seagram intersection that crosses Albert Street and connects to this sewer. Runoff of the property is primarily directed towards the Seagram Drive right-of-way.

Other services provided to the site include hydro, gas, and telecommunications.

# 3.0 REVIEW AGENCIES

## 3.1 City of Waterloo

The City of Waterloo will be responsible for the review and approval of the Site Plan Application, as well as site servicing, grading, and stormwater management designs for the overall development.

## 3.2 Authorities Having Jurisdiction

Local hydro, gas, and telecommunications suppliers will be circulated by the City as part of the Site Plan review process. They will be required to provide sign-off regarding potential plant disruption as well as capacity availability to service the proposed development.

# 4.0 SANITARY SERVICING

The City of Waterloo Comprehensive Engineering and Landscape Manual (CELM), the Region of Waterloo DGSSMS, and MECP Design Guidelines for Sewage Works were referenced to calculate the sanitary servicing demand for the proposed development. The DGSSMS stipulates that an average flow rate of 275 L/c/d is to be used for residential developments, peaked using the Harmon Formula. The City of Waterloo stipulates that population densities for sanitary demand calculations are based on the Region of Waterloo's current Development Charges Background Study. Apartments currently are assumed to have a people per unit (ppu) density of 1.73. The development is currently proposing 146 units, resulting in a design population of 253 people. The DGSSMS also states that an allowance of 0.25 L/s/ha is to be considered to account for extraneous flows.

Table I provides a summary of the sanitary flow expected from the proposed development.

**Table I: Proposed Sanitary Demand**

| | |
|---|---|
| Site Area | 0.162 ha |
| Average Daily Demand | 275 L/c/d |
| Peaking Factor (Residential) | 4.11 |
| Design Population | 253 people |
| **Residential Demand** | **3.31 L/s** |
| Extraneous Flow Allowance | 0.25 L/s/ha |
| **Extraneous Flow** | **0.04 L/s** |
| **Total Sanitary Demand** | **3.35 L/s** |

A total sanitary demand of 3.35 L/s is anticipated for the proposed development. Refer to the sanitary sewer design sheet in Appendix A for detailed calculations.

Refer to the sanitary sewer design sheet in Appendix A for detailed calculations. It is currently assumed that the sanitary sewer on Albert Street has sufficient capacity to support the proposed development. Should the City of Waterloo's modelling indicate otherwise, flow splitting alternatives or pipe upsizing will be explored, if necessary.

A 150-mm-diameter sanitary sewer sloped at 1% will have sufficient capacity to service the proposed development. Refer to Drawing C3-1 for the functional servicing design of the site.

# 5.0 WATER SERVICING

## 5.1 Design Criteria

The DGSSMS requires that watermain distribution systems be able to convey the larger of maximum daily demand and fire flow or the peak hourly demand. Additionally, it is recommended that the average daily flow from any development be conveyed with a resulting pressure within the range of 350 kPa (50 psi) to 550 kPa (80 psi).

The Region also stipulates that the minimum resultant pressure under any non-fire demand scenario shall not be less than 275 kPa (40 psi). With the inclusion of fire flows, the minimum residual pressure in the distribution system shall not be less than 140 kPa (20 psi) or shall not cause velocities in the system, at any point, to be greater than 5 m/s. If static pressure in the system exceeds 550 kPa (80 psi), the Region requires the use of individual pressure-reducing valves for new developments.

## 5.2 Domestic Water Demand

Calculations of the water demand for the proposed development have been performed using the guidelines outlined within the City of Waterloo's CELM, the DGSSMS and the MECP Design Guidelines for Drinking Water Systems.

In accordance with the DGSSMS, the residential domestic water demand for the proposed development was estimated using a rate of 225 L/c/day. The 146-unit development has a design population of 253 based on a ppu count of 1.73. In order to convert the average daily demands into maximum daily and peak hourly flows, a peaking factor was applied. The peak factor was in accordance with Table 3-3 of the MECP design guidelines, resulting in a peak factor of 3.6 for maximum daily demand and a peak factor of 5.4 for peak hourly demand for populations fewer than 500 people.

Table II summarizes the expected water demand for the proposed development.

**Table II: Proposed Domestic Water Demand**

| | |
|---|---|
| Site Area | 0.162 ha |
| Design Population | 253 |
| Average Residential Daily Demand | 225 L/cap/day |
| Residential Peak Factors | |
| Max Day | 3.60 |
| Max Hour | 5.40 |
| **Total Max Day Demand** | **2.38 L/s** |
| **Total Max Hour Demand** | **3.56 L/s** |

A maximum day domestic demand of 2.38 L/s and a peak hourly demand of 3.56 L/s are anticipated for the proposed development. Refer to Appendix B for a detailed calculation of domestic water demand for the site.

### 5.3 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 *Water Supply for Public Fire Protection* by Fire Underwriters Survey (FUS) and the OBC. This stipulation makes it necessary to determine whether the building is to be protected by a sprinkler system, as the resulting requirement for fire flow is calculated differently for buildings with or without sprinkler systems. Upon review of the proposed development, it has been determined that the building will be fitted with a sprinkler system. As such, the fire flow for the building will be designed as per NFPA 13 *Standard for Installation of Sprinkler Systems*, which stipulates the criteria used for determining fire flow for buildings with sprinklers.

The fire flow demand for the proposed development is presented in Appendix B and summarized in Table III.

**Table III: Proposed Fire Flow Demand**

| | |
|---|---|
| Type of Construction | Non-Combustible Construction (C=0.8) |
| Effective Floor Space | 4182 $m^2$ |
| Occupancy Charge | Limited-Combustible Contents (-15%) |
| Automated Sprinkler Protection | Yes (-50%) |
| Exposure Charges | Potential Neighbouring Properties (+15%) |
| **Fire Flow Demand** | **117 L/s (1849 usgpm)** |

The fire demand expected for the proposed development is 117 L/s. The required fire flows must be provided by the municipal system and hydrant network.

### 5.4 Service Design

As per the DGSSMS, the water service required shall be able to convey the combination of the Maximum Day Demand and the Fire Demand, within the pressure and velocity ranges as specified. For the proposed development, this combined flow rate is approximately 119.38 L/s. The existing municipal system is expected to have capacity based on demands of similar developments in the area. The capacity of the municipal system will be confirmed via a hydrant flow test prior to detailed engineering design.

A 150-mm-diameter service is proposed to accommodate the combined water demand for the site, within the velocity and pressure ranges stipulated by the DGSSMS. Metering and backflow prevention for the site will be provided within the mechanical room of the building.

There is a municipal hydrant fronting the Wilfrid Laurier University Library that is 45 m away from the proposed fire department connection. This hydrant will provide fire protection for the site, along with the automated sprinkler system. Booster pumps will be required to deliver adequate pressure to higher storeys.

It is currently proposed that the water service connect to 150-mm-diameter watermain on Albert Street for simpler constructability. Refer to Drawing C3-1 for the functional servicing design for the site.

# 6.0 STORM SERVICING AND STORMWATER MANAGEMENT

## 6.1 Stormwater Management Objectives and Design Criteria

As per City of Waterloo and MECP regulations, the following stormwater management criteria are expected to be applicable:

- 'Enhanced' water quality control with 80% long-term average-annual total suspended solids (TSS) removal.
- Post-to-pre-development peak flow control for the 2-year through the 100-year return period design storms.
- Limit surface ponding in hardscape areas to 30 cm and to a maximum of 48 hours.

Drainage areas were delineated, and catchment parameters were determined for inclusion in pre- and post-development hydraulic modelling. The stormwater management design was completed using MIDUSS.NET. Storm parameters were provided by the City of Waterloo's CELM. Storm catchment areas for pre-development conditions are shown in Figure 1. Post-development modelling will be completed during detailed design.

## 6.2 Existing Stormwater Control Rates

The existing conditions were modeled to determine the peak allowable release rate for post-development conditions. The entire site drains uncontrolled to the southwest and is represented by Catchment 101.

The pre-development peak runoff rates for the 2-year, 5-year and 100-year storm events are summarized in Table IV.

| Catchment ID | Description | Area (ha) | Percent Impervious | 2-year Peak Flow (L/s) | 5-year Peak Flow (L/s) | 100-year Peak Flow (L/s) |
|---|---|---|---|---|---|---|
| 101 | 177-179 Albert Street | 0.162 | 40% | 14 | 20 | 42 |

The MIDUSS output files for the pre-development conditions are included in Appendix C.

## 6.3 Storm Servicing and Stormwater Management Strategy

On-site controls are required in order to match pre-development peak flow rates. The underground parking for the proposed development is expected cover the majority of the site, so infiltration measures will not be possible. Peak flow rates in post-development conditions will be met using flow-control roof drains. The location and amount of roof drains will be coordinated with the mechanical engineer during detailed design. A maximum rooftop ponding depth of 0.15 m will be accounted for in the design.

Area drains will be installed within the proposed parking area and will convey runoff towards the mechanical plumbing system within the underground parking. An oil-grit-separator (OGS) unit is proposed to provide "Enhanced" water quality control. The OGS will treat runoff from the site prior to being conveyed towards the municipal system. A proposed storm service will convey the runoff from the building roof and parking area towards the 300-mm-diameter storm sewer on Seagram Drive.

The landscaped frontage of the site will drain directly to the municipal right-of-way.

Refer to Drawing C3-1 for the functional servicing design for the site.

# 7.0 SITE GRADING

The grading of the site will respect the existing grades along all property lines. The site will also be graded to comply with City of Waterloo standards, as well as the Accessibility for Ontarians with Disabilities Act (AODA).

Grading of the site will also allow for the majority of major overland flow from the site to drain towards the municipal right-of-way. Maximum ponding depth is limited to 30 cm or less and will be held to a maximum of 48 hours.

The proposed surface parking is all located on top of an underground parking structure. As such, all localized drainage will be captured through mechanical area drains and plumbing and directed to the municipal sewer system on Seagram Drive.

An existing retaining wall along the western property line will be maintained to prevent disturbance to the neighbouring property.

Refer to Drawing C2-1 for the functional grading design of the site.

## 7.1 Compliance with On-Site and Excess Soil Management Provincial Regulations

The MECP regulation O.Reg. 406/19 “On-Site and Excess Soil Management” under the Environmental Protection Act states that the excavation of excess material, and subsequent off-site disposal of excess soils from this site, will require testing and reporting in the MECP’s Environmental Activity and Sector Registry (EASR). The Owner and Contractor will be responsible for complying with all of the noted requirements.

# 8.0 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 access. Additionally, silt fence will be installed around the development limits 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 catchbasins will be installed to prevent silt or sediment-laden water from entering inlets. These will be inspected to ensure that they have been properly installed and function as designed throughout construction.

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 will be conducted bi-weekly and within 24 hours of any rainfall event of 25 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, the site has been stabilized and all vegetation has achieved a minimum 70% density.

# 9.0 CONCLUSIONS

Based on the analysis presented in this report, adequate services can be provided and implemented on site to support the proposed site plan application for the consolidated site. It is concluded that:

- A 150-mm-diameter sanitary service sloped at 1.0% is sufficient to support the development. The sanitary service will connect to the municipal sewer on Albert Street.
- A 150-mm-diameter water service connected to the existing 150-mm-diameter watermain on Albert Street is proposed to service the development. A new water meter and backflow preventer will be contained within the proposed mechanical room located in the underground parking structure.
- The existing municipal fire hydrants along Albert Street and Seagram Drive provide coverage to support fire protection for the proposed development.
- Post-development peak flow rates will be controlled to pre-development levels for the 2-year through the 100-year storm events through the use of rooftop ponding.
- A storm service from the proposed underground parking structure will connect to the municipal sewer on Seagram Drive. Runoff from the roof and the parking area will be directed to the mechanical plumbing system and then will be ultimately directed towards this new service.
- An OGS unit is proposed to provide stormwater quality control for the site. The unit will be installed to treat the runoff prior to entering the municipal system.
- Site grading will allow for major overland flow paths towards the municipal right-of-way. The site grading also ensures surface ponding does not exceed a depth of 30 cm, or a ponding time of 48 hours in hardscaped areas.
- Perimeter silt fence, silt fence at the base of all stockpiles, silt sacs in catchbasins, and construction entrance mud mats can provide erosion and sediment control. These will be included in detailed design in coordination with the proposed construction staging plan

All of which is respectfully submitted,

**WALTERFEDY**




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Associate
Civil Project Manager

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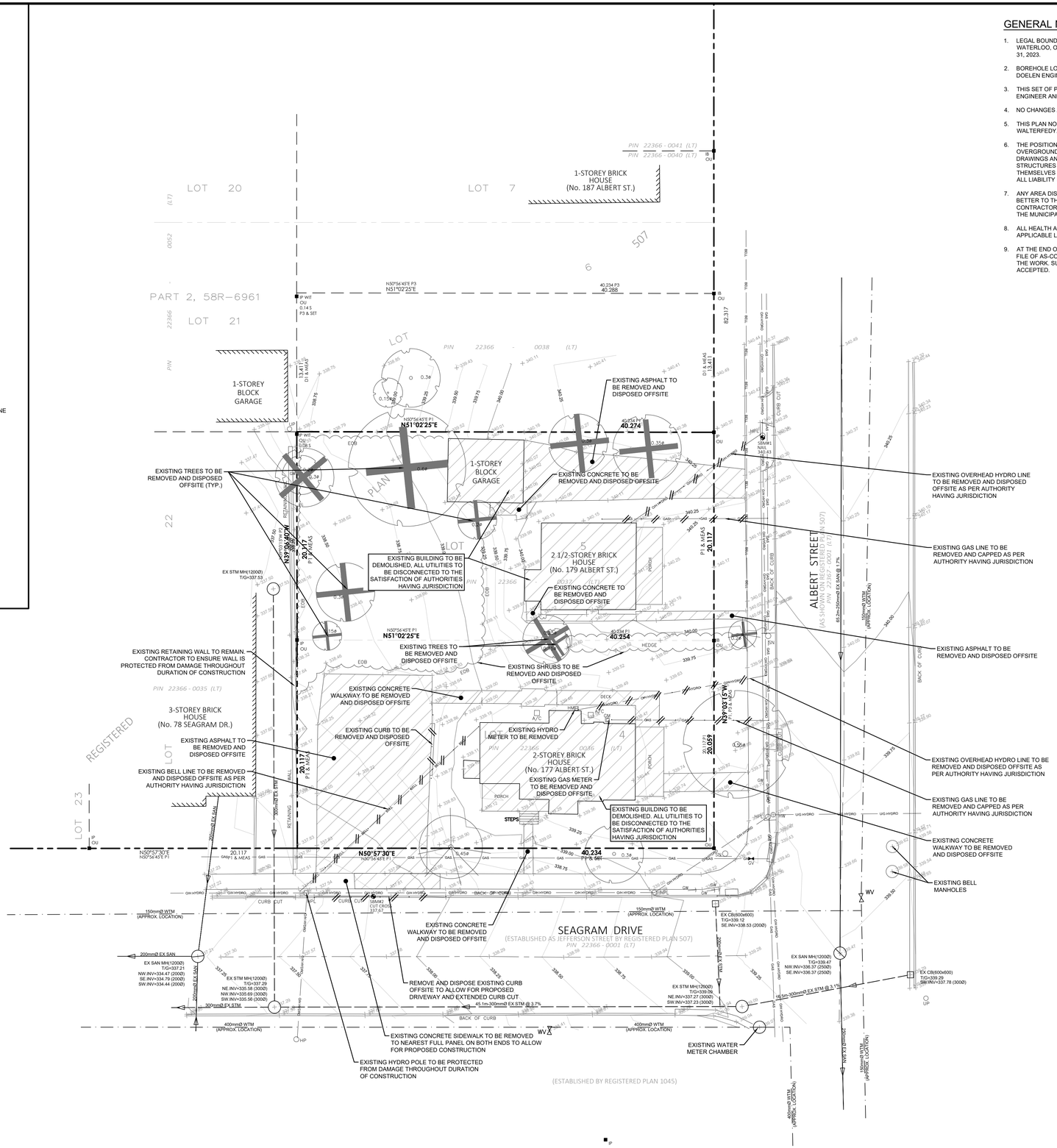
# DRAWINGS

## LEGEND

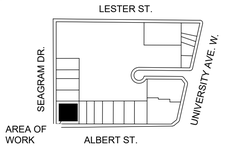
- PROPERTY LINE
- LOT LINE
- IB — IRON BAR
- SIB — STANDARD IRON BAR
- SSIB — SHORT STANDARD IRON BAR
- CC — CUT CROSS
- TBM — TEMPORARY BENCHMARK
- EX LS — EXISTING LAMP STANDARD
- EX UP — EXISTING UTILITY POLE
- EX HP — EXISTING HYDRO POLE
- EXISTING GUY WIRE
- EX SIGN — EXISTING SIGN
- EX BELL MH — EXISTING BELL MANHOLE
- EX BELL PED — EXISTING BELL PEDESTAL
- EX CB — EXISTING CATCHBASIN
- EX MH — EXISTING STORM MANHOLE
- EX CBMH — EXISTING CATCHBASIN MANHOLE
- EX SAN MH — EXISTING SANITARY MANHOLE
- EX HYD — EXISTING FIRE HYDRANT
- EX WV — EXISTING WATERMAIN VALVE
- BOREHOLE No. — EXISTING BOREHOLE LOCATION
- +ELEV — EXISTING SPOT ELEVATION
- 325.0 — EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 0.2m DIA — EXISTING DECIDUOUS TREE
- EXISTING CONIFEROUS TREE
- EXISTING TREE DRIPLINE AND/OR VEGETATION LINE
- EXISTING SANITARY SERVICE
- EXISTING STORM SERVICE
- EXISTING WATERMAIN
- GAS — EXISTING GASMAIN
- OH HYDRO — EXISTING OVERHEAD HYDRO LINE
- UG HYDRO — EXISTING UNDERGROUND HYDRO LINE
- BELL — EXISTING BELL LINE
- EXISTING ASPHALT
- EXISTING CONCRETE
- EXISTING CURB
- EXISTING CURB AND GUTTER
- REMOVALS
- SURFACE REMOVALS

## GENERAL NOTES

1. LEGAL BOUNDARY DATA AND TOPOGRAPHICAL INFORMATION FOR 177-179 ALBERT STREET, WATERLOO, ON FROM SURVEY BY VAN HARTEN SURVEYING INC. DATED MAY 4 2023 AND REVISED MAY 31, 2023.
2. BOREHOLE LOCATIONS AND GEOTECHNICAL INFORMATION FROM REPORT BY CHUNG & VANDER DOELEN ENGINEERING DATED JULY 2023.
3. THIS SET OF PLANS SHALL NOT BE USED FOR CONSTRUCTION UNTIL STAMPED BY THE DESIGN ENGINEER AND APPROVED BY THE LOCAL MUNICIPALITY.
4. NO CHANGES ARE TO BE MADE WITHOUT THE APPROVAL OF THE DESIGN ENGINEER.
5. THIS PLAN NOT TO BE REPRODUCED IN WHOLE OR IN PART WITHOUT THE PERMISSION OF WALTERFEDY.
6. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS, AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM THEMSELVES OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM AND THOSE NOT LOCATED PRIOR TO CONSTRUCTION.
7. ANY AREA DISTURBED DURING CONSTRUCTION SHALL BE RESTORED TO ITS ORIGINAL CONDITION OR BETTER TO THE SATISFACTION OF THE CONSULTANT AND AUTHORITY HAVING JURISDICTION. THE CONTRACTOR IS RESPONSIBLE FOR RESTORING ALL DAMAGED AND/OR DISTURBED PROPERTY WITHIN THE MUNICIPAL RIGHT-OF-WAY TO MUNICIPAL STANDARDS.
8. ALL HEALTH AND SAFETY RELATED SIGNAGE MUST BE POSTED AT THE SITE AS REQUIRED BY APPLICABLE LAW AND BEST MANAGEMENT PRACTICES.
9. AT THE END OF CONSTRUCTION, THE CONTRACTOR SHALL PROVIDE THE CONSULTANT WITH A DIGITAL FILE OF AS-CONSTRUCTED DRAWINGS. THE DRAWINGS MUST REFLECT THE CONSTRUCTED STATE OF THE WORK. SUBMISSION OF UNALTERED DESIGN DRAWINGS AND CONTRACT CHANGES WILL NOT BE ACCEPTED.




KEY PLAN




North

| DATE | ISSUANCE | NO. |
|---|---|---|
| 2023.11.10 | ISSUED FOR OPA / ZBA | |

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CLIENT

14688210 CANADA INC.

PROJECT

177-179 ALBERT STREET DEVELOPMENT

177-179 Albert Street, Waterloo, ON N2L 3T4

TITLE

EXISTING CONDITIONS AND REMOVALS PLAN


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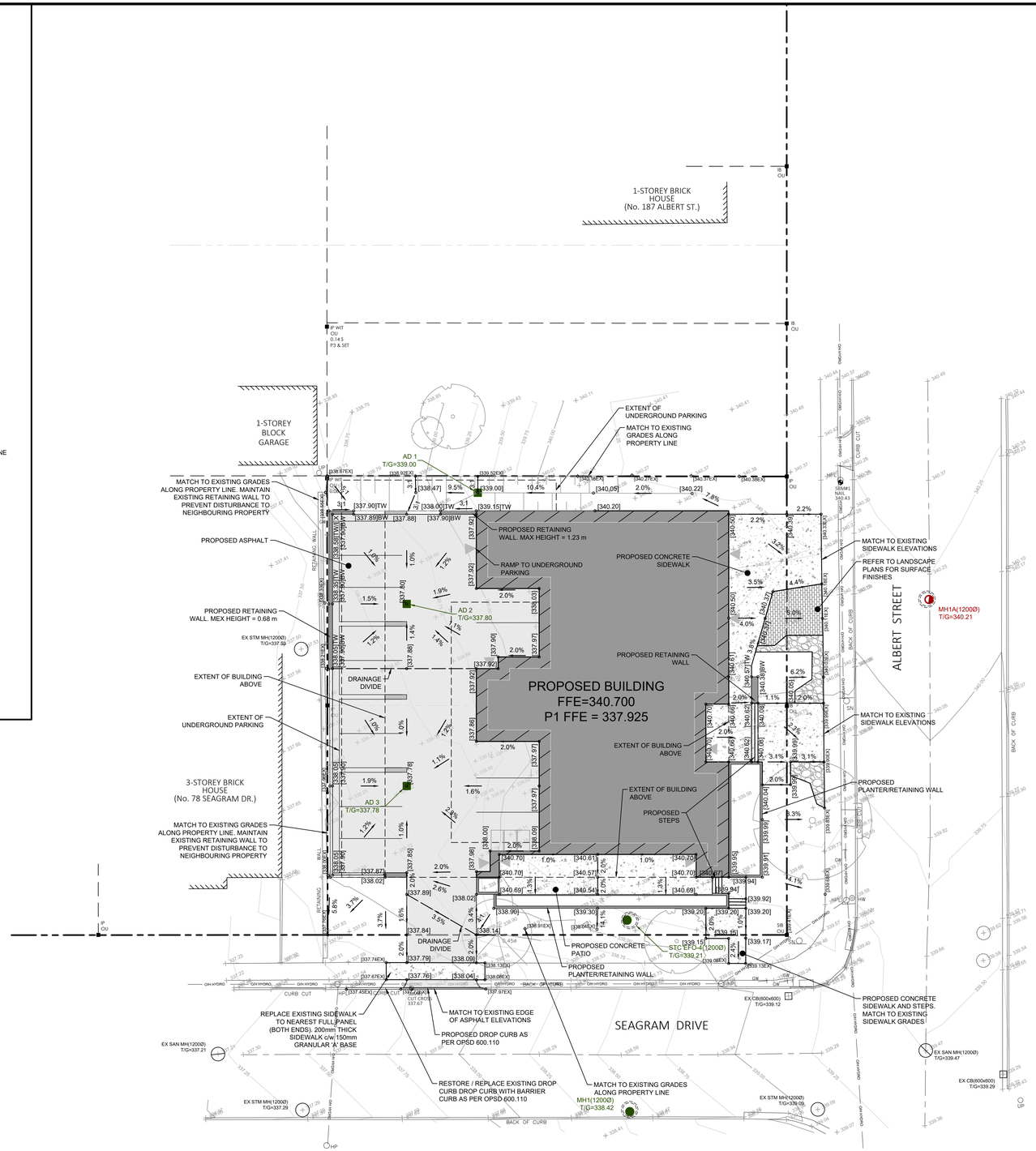

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| PROJECT NO.: | 2022-0400-10 |
| DRAWN BY: | TK |
| CHECKED BY: | JZ |

SHEET NO.: C101


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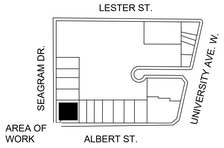
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- IB — IRON BAR
- SIB — STANDARD IRON BAR
- SSIB — SHORT STANDARD IRON BAR
- CC — CUT CROSS
- TBM — TEMPORARY BENCHMARK
- EX LS — EXISTING LAMP STANDARD
- EX UP — EXISTING UTILITY POLE
- EX HP — EXISTING HYDRO POLE
- EXISTING GUY WIRE
- EX SIGN — EXISTING SIGN
- EX BELL MH — EXISTING BELL MANHOLE
- EX BELL PED — EXISTING BELL PEDESTAL
- EX CB — EXISTING CATCHBASIN
- EX MH — EXISTING STORM MANHOLE
- EX CBMH — EXISTING CATCHBASIN MANHOLE
- EX SAN MH — EXISTING SANITARY MANHOLE
- EX HYD — EXISTING FIRE HYDRANT
- EX WV — EXISTING WATERMAIN VALVE
- BOREHOLE No. — EXISTING BOREHOLE LOCATION
- +ELEV — EXISTING SPOT ELEVATION
- 325.0 — EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 0.2m DIA — EXISTING DECIDUOUS TREE
- EXISTING CONIFEROUS TREE
- EXISTING TREE DRIPLINE AND/OR VEGETATION LINE
- OH HYDRO — EXISTING OVERHEAD HYDRO LINE
- EXISTING ASPHALT
- EXISTING CONCRETE
- EXISTING CURB
- EXISTING CURB AND GUTTER
- AD — PROPOSED AREA DRAIN
- MH — PROPOSED STORM MANHOLE
- MH — PROPOSED SANITARY MANHOLE
- [123.45] — PROPOSED GRADE
- 2.0% 2.0% — PROPOSED DRAINAGE ARROW/SLOPE
- PROPOSED OVERLAND FLOW ROUTE
- PROPOSED CURB
- PROPOSED DROP CURB
- PROPOSED ASPHALT SURFACE
- PROPOSED CONCRETE SURFACE




## GENERAL NOTES

1. LEGAL BOUNDARY DATA AND TOPOGRAPHICAL INFORMATION FOR 177-179 ALBERT STREET, WATERLOO, ON FROM SURVEY BY VAN HARTEN SURVEYING INC. DATED MAY 4 2023 AND REVISED MAY 31, 2023.
2. BOREHOLE LOCATIONS AND GEOTECHNICAL INFORMATION FROM REPORT BY CHUNG & VANDER DOELEN ENGINEERING DATED JULY 2023.
3. THIS SET OF PLANS SHALL NOT BE USED FOR CONSTRUCTION UNTIL STAMPED BY THE DESIGN ENGINEER AND APPROVED BY THE LOCAL MUNICIPALITY.
4. NO CHANGES ARE TO BE MADE WITHOUT THE APPROVAL OF THE DESIGN ENGINEER.
5. THIS PLAN NOT TO BE REPRODUCED IN WHOLE OR IN PART WITHOUT THE PERMISSION OF WALTERFEDY.
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8. ALL HEALTH AND SAFETY RELATED SIGNAGE MUST BE POSTED AT THE SITE AS REQUIRED BY APPLICABLE LAW AND BEST MANAGEMENT PRACTICES.
9. AT THE END OF CONSTRUCTION, THE CONTRACTOR SHALL PROVIDE THE CONSULTANT WITH A DIGITAL FILE OF AS-CONSTRUCTED DRAWINGS. THE DRAWINGS MUST REFLECT THE CONSTRUCTED STATE OF THE WORK. SUBMISSION OF UNALTERED DESIGN DRAWINGS AND CONTRACT CHANGES WILL NOT BE ACCEPTED.

KEY PLAN




North

| DATE | ISSUANCE | NO. |
|---|---|---|
| 2023.11.10 | ISSUED FOR OPA / ZBA | |

1:200 (0, 2.0, 4.0, 10.0)

CLIENT

14688210 CANADA INC.

PROJECT

177-179 ALBERT STREET DEVELOPMENT

177-179 Albert Street, Waterloo, ON N2L 3T4

TITLE

GRADING PLAN


WALTERFEDY

KITCHENER | HAMILTON | TORONTO | CALGARY

A PART OF WF GROUP

800.685.1378 walterfedy.com


LICENSED PROFESSIONAL ENGINEER
T. B. KELLER
100529026
2023.11.10
PROVINCE OF ONTARIO


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| | |
|---|---|
| SCALE: | 1:200 |
| DATE: | 2023-11-09 |
| PROJECT NO.: | 2022-0400-10 |
| DRAWN BY: | TK |
| CHECKED BY: | JZ |

SHEET NO.:

**C201**

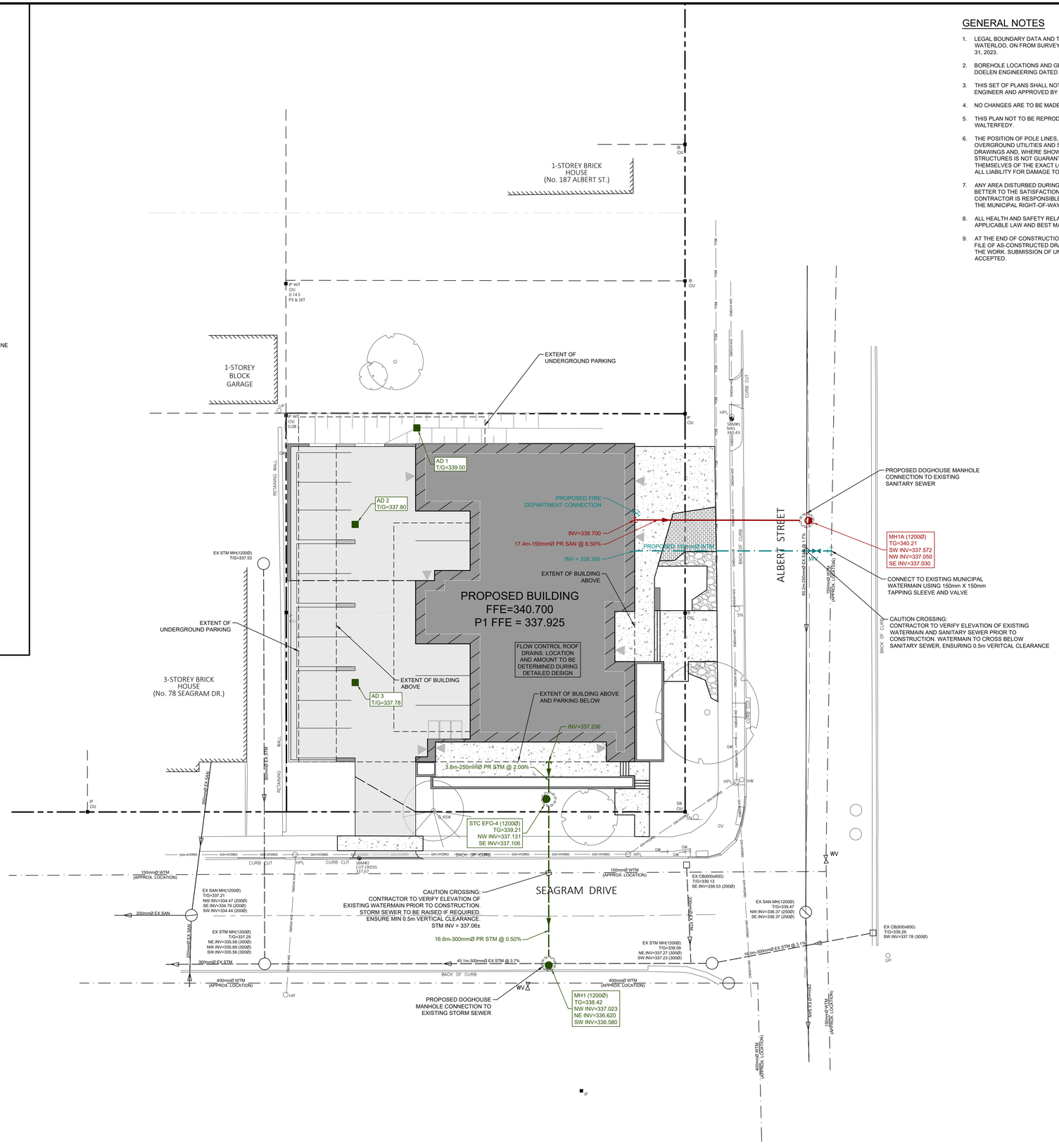

\\BELL1\Job_Files\2022\0400\10\06-DWGS\Civil\Plot Files\2022-0400-10_GRD_PLT; C201; None; Tyler Keller; 2023-11-10 8:30:38 AM

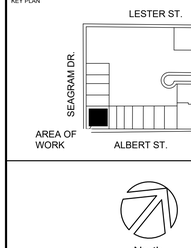
## LEGEND

- PROPERTY LINE
- LOT LINE
- IB — IRON BAR
- SIB — STANDARD IRON BAR
- SSIB — SHORT STANDARD IRON BAR
- CC — CUT CROSS
- TBM — TEMPORARY BENCHMARK
- EX LS — EXISTING LAMP STANDARD
- EX UP — EXISTING UTILITY POLE
- EX HP — EXISTING HYDRO POLE
- EXISTING GUY WIRE
- EX SIGN — EXISTING SIGN
- EX BELL MH — EXISTING BELL MANHOLE
- EX BELL PED — EXISTING BELL PEDESTAL
- EX CB — EXISTING CATCHBASIN
- EX MH — EXISTING STORM MANHOLE
- EX CBMH — EXISTING CATCHBASIN MANHOLE
- EX SAN MH — EXISTING SANITARY MANHOLE
- EX HYD — EXISTING FIRE HYDRANT
- EX WV — EXISTING WATERMAIN VALVE
- BOREHOLE No. — EXISTING BOREHOLE LOCATION
- EXISTING DECIDUOUS TREE (0.2m DIA)
- EXISTING CONIFEROUS TREE
- EXISTING TREE DRIPLINE AND/OR VEGETATION LINE
- EXISTING SANITARY SERVICE
- EXISTING STORM SERVICE
- EXISTING WATERMAIN
- GAS — EXISTING GASMAIN
- OH HYDRO — EXISTING OVERHEAD HYDRO LINE
- UG HYDRO — EXISTING UNDERGROUND HYDRO LINE
- BELL — EXISTING BELL LINE
- EXISTING ASPHALT
- EXISTING CONCRETE
- EXISTING CURB
- EXISTING CURB AND GUTTER
- AD — PROPOSED AREA DRAIN
- MH — PROPOSED STORM MANHOLE
- MH — PROPOSED SANITARY MANHOLE
- WV — PROPOSED WATERMAIN VALVE
- PROPOSED FIRE DEPARTMENT CONNECTION
- PROPOSED SANITARY SEWER/SERVICE
- PROPOSED STORM SEWER/SERVICE
- PROPOSED WATERMAIN/SERVICE
- PROPOSED CURB
- PROPOSED DROP CURB
- PROPOSED ASPHALT SURFACE
- PROPOSED CONCRETE SURFACE

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| DATE | ISSUANCE | NO. |
|---|---|---|
| 2023.11.10 | ISSUED FOR OPA / ZBA | |

1:200
0 2.0 4.0 10.0

CLIENT
14688210 CANADA INC.

PROJECT
177-179 ALBERT STREET DEVELOPMENT
177-179 Albert Street, Waterloo, ON N2L 3T4

TITLE
SERVICING PLAN


WALTERFEDY
KITCHENER | HAMILTON | TORONTO | CALGARY
A PART OF WF GROUP
800.685.1378 walterfedy.com


LICENSED PROFESSIONAL ENGINEER
T. B. KELLER
100529026
2023.11.10
PROVINCE OF ONTARIO

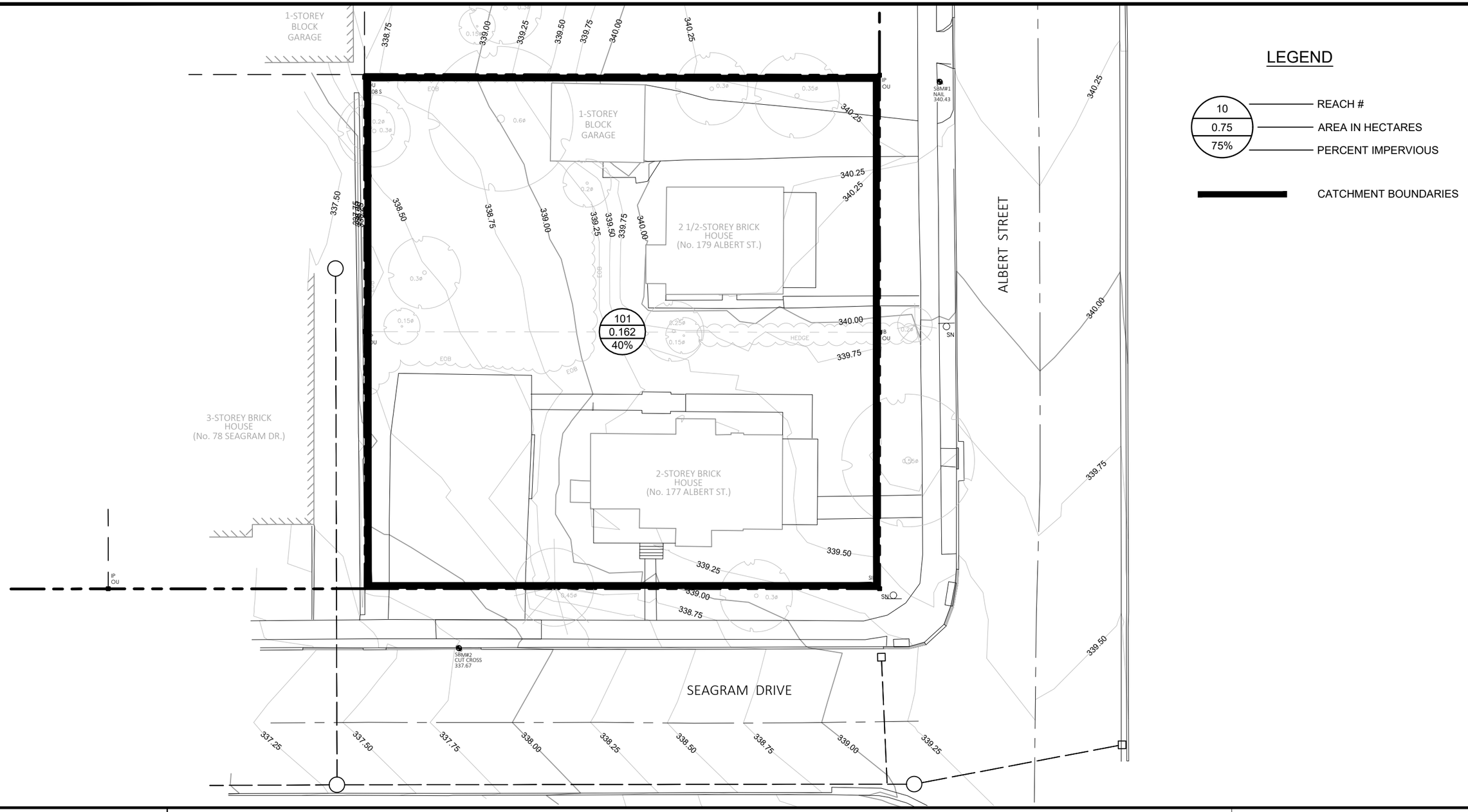

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| | |
|---|---|
| SCALE: | 1:200 |
| DATE: | 2023-07-04 |
| PROJECT NO.: | 2022-0400-10 |
| DRAWN BY: | TK |
| CHECKED BY: | JZ |

SHEET NO.:
C301


\\Del1\Jobs_Files\2022\0400\07\06-SWGS\Civil\Plot Files\2022-0400-10_SVC_PLT; C301; Nome; Tyler Keller; 2023-11-10 8:30:51 AM

# FIGURES




## LEGEND

10 — REACH #

0.75 — AREA IN HECTARES

75% — PERCENT IMPERVIOUS

CATCHMENT BOUNDARIES

PROJECT:

177-179 ALBERT STREET

TITLE:

EXISTING CATCHMENT AREAS

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REPORT ANY VARIATIONS FROM THE DIMENSIONS AND CONDITIONS SHOWN ON DRAWINGS TO WALTERFEDY.
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WALTERFEDY

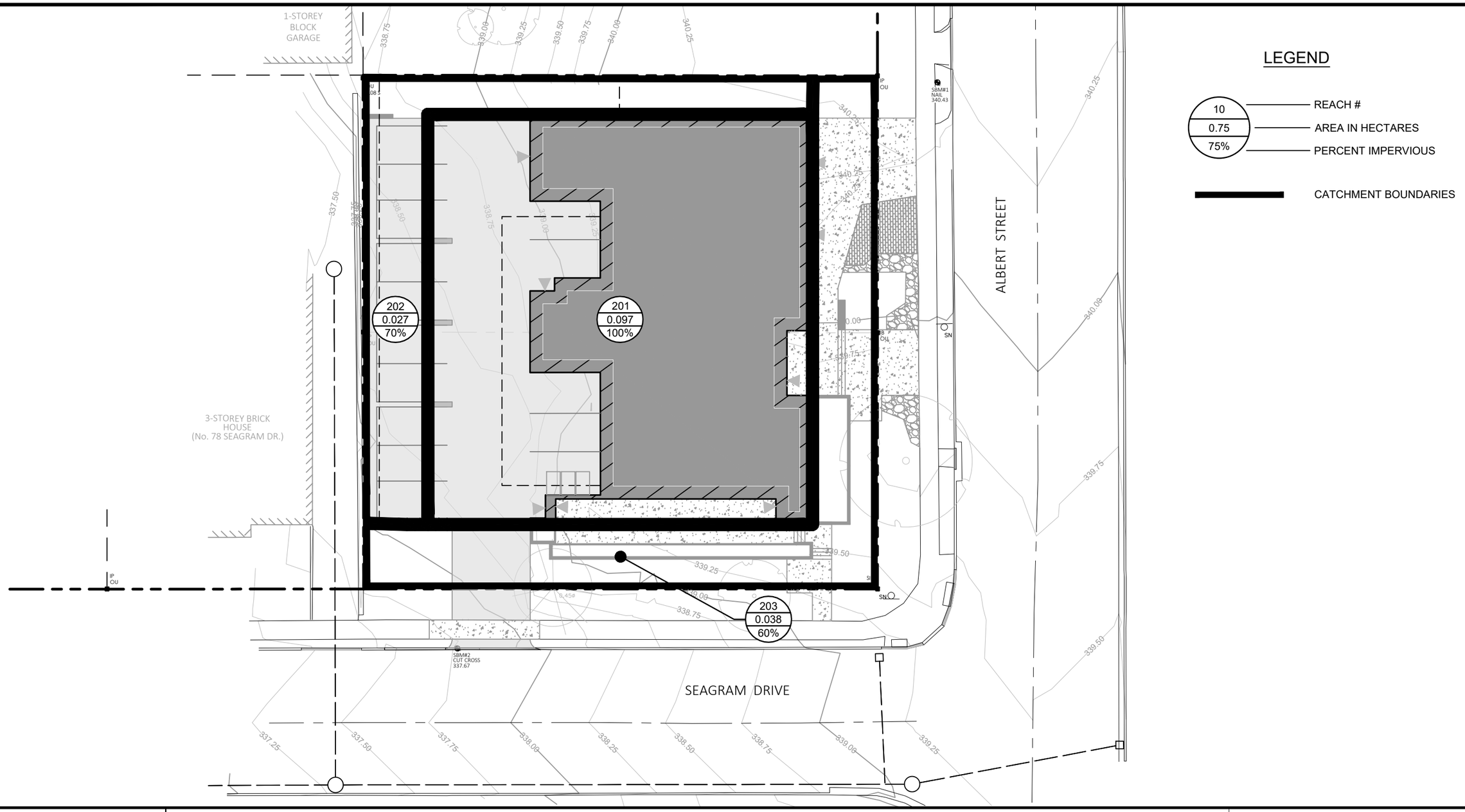
KITCHENER OFFICE
675 Queen Street South, Suite 111, Kitchener, Ontario N2M 1A1
T: 519.576.2150 F: 519.576.5499 walterfedy.com

| | | | |
|---|---|---|---|
| SCALE: | 1:300 | DATE: | 2023-10-16 |
| DRAWN BY: | AK | PROJECT NO.: | 2021-0400-10 |
| CHECKED BY: | TK | FILE: | 2022-0400-10 - SWM |

SHEET NO.:

**FIG-1**

\\BEL1\Job_Files\2022\0400\10\06-DWGS\CIVIL\2022-0400-10 - SWM; FIG-1; None; Tyler Keller; 2023-11-01 1:54:34 PM




PROJECT:

177-179 ALBERT STREET

TITLE:

PROPOSED CATCHMENT AREAS

REPRODUCTION OR DISTRIBUTION FOR PURPOSES OTHER THAN AUTHORIZED BY WALTERFEDY IS FORBIDDEN.
CONTRACTORS SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS AND CONDITIONS ON THE JOB AND
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| | | | |
|---|---|---|---|
| SCALE: | 1:300 | DATE: | 2023-10-16 |
| DRAWN BY: | AK | PROJECT NO.: | 2021-0400-10 |
| CHECKED BY: | TK | FILE: | 2022-0400-10 - SWM |

SHEET NO.:

FIG-2

\\BEL1\Job_Files\2022\0400\10\06-DWGS\CIVIL\2022-0400-10 - SWM; FIG-2; None; Keller; 2023-11-09 2:50:48 PM

# APPENDIX A

## Sanitary Design Calculations

# SANITARY SEWER DESIGN CALCULATIONS

| | |
|---|---|
| Project: | 177-179 Albert Street Development |
| Project No: | 2022-0400-10 |
| Date: | 2023-10-16 |
| Designed By: | AK |
| Checked By: | TK/JZ |

| Design Data | | |
|---|---|---|
| Min. Velocity | 0.8 | m/s |
| Max. Velocity | 3.0 | m/s |
| Manning's 'n' | 0.013 | |
| Infiltration | 0.25 | l/s/ha |

| Residential | | |
|---|---|---|
| Peaking Factor | Harmon | |
| Avg. Daily Flow | 275 | L/c/d |

| Commercial | | |
|---|---|---|
| Peaking Factor | 2.5 | |
| Avg. Daily Flow | 0.5 | L/s/ha |

| Pipe Data | | | Residential | | | | Cumulative | | | Commercial | | Infiltration | | Total | Design Data | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From | To | Length | Area | Units | Density | Population | Area | Population | Peak Factor | Area | Total Area | Area | Total Area | Flow | Diameter | Slope | $Q_{FULL}$ | $V_{FULL}$ |
| | | *(m)* | *(ha)* | | *(ppu)* | *(people)* | *(ha)* | *(people)* | | *(ha)* | *(ha)* | *(ha)* | *(ha)* | *(L/s)* | *(mm)* | *(%)* | *(L/s)* | *(m/s)* |
| | | | 0.162 | 146 | 1.73 | **253** | 0.162 | 253 | **4.11** | | | 0.162 | 0.162 | **3.35** | 150 | 1.00 | **15.23** | **0.86** |

# APPENDIX B

## Water Design Criteria
## Fire Demand Calculations (FUS 2020)

**REQUIRED DOMESTIC FLOW**

City of Waterloo, Region of Waterloo DGSSMS and MECP Standards

WALTERFEDY

| | |
|---|---|
| **Project** | 177-179 Albert Street Development |
| **Project #** | 2022-0400-10 |
| **Designer** | AK |
| **Address** | 177-179 Albert Street, Waterloo |
| **Description** | Overall Domestic Flows |

| Description | Site Area (ha) | Units | People/unit | Population | Operating Hours | Demand | Max Daily Peak Factor | Max Hourly Peak Factor | Max Daily Demand (L/s) | Max Hourly Demand (L/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| Residential | - | 146 | 1.73 | 253 | - | 225 L/cap/day | 3.60 | 5.40 | 2.38 | 3.56 |
| | | | | | | | **Overall Demand** | | **2.38** | **3.56** |

## REQUIRED FIRE FLOW

Water Supply for Public Fire Protection (FUS 2020)

WALTERFEDY

| | |
|---|---|
| **Project** | 177-179 Albert Street Development |
| **Project #** | 2022-0400-10 |
| **Designer** | AK |
| **Address** | 177-179 Albert Street, Waterloo |
| **Description** | Fire Demand |

$$F = 220 \times C \times \sqrt{A}$$

F = Required fire flow (LPM)
C = Coefficient related to type of construction
A = Total floor area (including all storeys but excluding any basement levels at least 50% below grade)

| | | | |
|---|---|---|---|
| **Type of Construction** | Non-Combustible Construction | **C =** | 0.8 |
| **Description** | **Unprotected Metal Structural Components, Masonry or Metal Walls. All Structural Members are Non-Combustible but does not qualify as Fire-Resisitive** | | |

| | | |
|---|---|---|
| **Total Floor Area** | 14330 | $m^2$ |
| **# Storeys** | 24 | |
| **Fire Resistant Building?** | NO | |

**Vertical Openings and Exterior Vertical Communications protected with minimum one (1) hr rating?** NO

| | | |
|---|---|---|
| **Area** | 4182 | $m^2$ |
| **Description** | Area of two largest floors + 50% of each of the floors above it<br>Floor 2-3 = 966, Floor 4-5 = 966,Floor 6-11 = 433 | |
| **Required Fire Flow** | 11000 | L/min |

| | | | | |
|---|---|---|---|---|
| **Occupancy Charge** | Limited-Combustible Contents | | | |
| **Fire Flow Reduction** | -15% | **OR** | -1650 | L/min |
| **Required Fire Flow** | 9350 | L/min | | |

| | | | |
|---|---|---|---|
| **Automated Sprinker Protection** | YES | | |
| Designed to NFPA 13 Standard | YES | -30% | |
| Standard Water Supply to Sprinklers and Standpipes | YES | -10% | |
| Fully Supervised System | YES | -10% | |
| **Fire Flow Adjustment** | | -4675 | L/min |

| | | | | | |
|---|---|---|---|---|---|
| **Exposure 1 (East)** | **Distance** | 45 | m | **Charge** | 0% |
| **Description** | Wilfrid Laurier University Library | | | | |
| **Exposure 2 (South)** | **Distance** | 36 | m | **Charge** | 0% |
| **Description** | 77 Seagram | | | | |
| **Exposure 3 (North)** | **Distance** | 32 | m | **Charge** | 0% |
| **Description** | 187 Albert | | | | |
| **Exposure 4 (West)** | **Distance** | 9 | m | **Charge** | 20% |
| **Description** | 78 Seagram | | | | |

| | | |
|---|---|---|
| **Total Exposure Charge** | 20% | |
| **Fire Flow Adjustment** | 1870 | L/min |

| | | |
|---|---|---|
| **Total Required Fire Flow** | 7000 | L/min |
| **Total Required Fire Flow** | 1849 | U.S. GPM |
| **Total Required Fire Flow** | 117 | L/s |

# APPENDIX C

## MIDUSS Output Files

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 467"
"                MIDUSS created                                    July 6, 2008"
"           10   Units used:                                        ie METRIC"
"                Job folder:        \\BEL1\Job_Files\2022\0400\10\05-DSGN\CIVL\"
"                                                                     SWM\MIDUSS"
"                Output filename:                                  2-YR-PRE.out"
"                Licensee name:                                    Tyler Keller"
"                Company                                             WalterFedy"
"                Date & Time last used:                2023-06-28 at 4:29:44 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1101.000   Coefficient A"
"        9.258   Constant B"
"        0.882   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           105.659    mm/hr"
"             Total depth                  32.400    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   101"
"       40.000   % Impervious"
"        0.162   Total Area"
"       40.000   Flow length"
"        3.000   Overland Slope"
"        0.097   Pervious Area"
"       40.000   Pervious length"
"        3.000   Pervious slope"
"        0.065   Impervious Area"
"       40.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.163   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.832   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                0.014     0.000     0.000     0.000 c.m/sec"
"            Catchment 101          Pervious   Impervious Total Area "
"            Surface Area           0.097      0.065      0.162      hectare"
"            Time of concentration  29.474     2.364      8.516      minutes"
"            Time to Centroid       134.615    89.875     100.027    minutes"
"            Rainfall depth         32.400     32.400     32.400     mm"
"            Rainfall volume        31.49      21.00      52.49      c.m"
"            Rainfall losses        27.128     5.454      18.458     mm"
"            Runoff depth           5.273      26.946     13.942     mm"
"            Runoff volume          5.12       17.46      22.59      c.m"
"            Runoff coefficient     0.163      0.832      0.430      "
"            Maximum flow           0.001      0.013      0.014      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                0.014     0.014     0.000     0.000"
" 40         HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                0.014     0.014     0.014     0.000"
" 40         HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
"               Existing Outlet to Seagram"
"            Maximum flow                0.014    c.m/sec"
"            Hydrograph volume           22.586    c.m"
"                0.014     0.014     0.014     0.014"
" 38         START/RE-START TOTALS 101"
"           3   Runoff Totals on EXIT"
"            Total Catchment area                    0.162    hectare"
"            Total Impervious area                   0.065    hectare"
"            Total % impervious                     40.000"
" 19         EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 467"
"                MIDUSS created                                    July 6, 2008"
"           10   Units used:                                        ie METRIC"
"                Job folder:        \\BEL1\Job_Files\2022\0400\10\05-DSGN\CIVL\"
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"                Company                                             WalterFedy"
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"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1755.000   Coefficient A"
"       12.347   Constant B"
"        0.895   Exponent C"
"        0.400   Fraction R"
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"        1.000   Time step multiplier"
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"            6   005hyd   Hydrograph extension used in this file"
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"            1   Equal length"
"            1   SCS method"
"          101   101"
"       40.000   % Impervious"
"        0.162   Total Area"
"       40.000   Flow length"
"        3.000   Overland Slope"
"        0.097   Pervious Area"
"       40.000   Pervious length"
"        3.000   Pervious slope"
"        0.065   Impervious Area"
"       40.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.259   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.878   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                  0.020     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.097      0.065      0.162      hectare"
"             Time of concentration  20.238     2.100      7.667      minutes"
"             Time to Centroid       122.581    88.774     99.149     minutes"
"             Rainfall depth         47.549     47.549     47.549     mm"
"             Rainfall volume        46.22      30.81      77.03      c.m"
"             Rainfall losses        35.219     5.778      23.442     mm"
"             Runoff depth           12.330     41.771     24.107     mm"
"             Runoff volume          11.99      27.07      39.05      c.m"
"             Runoff coefficient     0.259      0.878      0.507      "
"             Maximum flow           0.004      0.019      0.020      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.020     0.020     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                  0.020     0.020     0.020     0.000"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Existing Outlet to Seagram"
"             Maximum flow                 0.020    c.m/sec"
"             Hydrograph volume           39.053    c.m"
"                  0.020     0.020     0.020     0.020"
" 38          START/RE-START TOTALS 101"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                     0.162    hectare"
"             Total Impervious area                    0.065    hectare"
"             Total % impervious                      40.000"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 467"
"                MIDUSS created                                    July 6, 2008"
"           10   Units used:                                         ie METRIC"
"                Job folder:        \\BEL1\Job_Files\2022\0400\10\05-DSGN\CIVL\"
"                                                                      SWM\MIDUSS"
"                Output filename:                                 100-YR-PRE.out"
"                Licensee name:                                     Tyler Keller"
"                Company                                              WalterFedy"
"                Date & Time last used:                2023-06-28 at 4:05:10 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     4692.000   Coefficient A"
"       17.437   Constant B"
"        0.956   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           239.793    mm/hr"
"             Total depth                  89.960    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   101"
"       40.000   % Impervious"
"        0.162   Total Area"
"       40.000   Flow length"
"        3.000   Overland Slope"
"        0.097   Pervious Area"
"       40.000   Pervious length"
"        3.000   Pervious slope"
"        0.065   Impervious Area"
"       40.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.443   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        8.467   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.927   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                0.042     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.097      0.065      0.162      hectare"
"             Time of concentration  12.292     1.656      6.095      minutes"
"             Time to Centroid       108.553    86.312     95.595     minutes"
"             Rainfall depth         89.960     89.960     89.960     mm"
"             Rainfall volume        87.44      58.29      145.74     c.m"
"             Rainfall losses        50.115     6.525      32.679     mm"
"             Runoff depth           39.845     83.435     57.281     mm"
"             Runoff volume          38.73      54.07      92.79      c.m"
"             Runoff coefficient     0.443      0.927      0.637      "
"             Maximum flow           0.018      0.037      0.042      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                0.042     0.042     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                0.042     0.042     0.042     0.000"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Existing Outlet to Seagram"
"             Maximum flow                0.042    c.m/sec"
"             Hydrograph volume           92.795    c.m"
"                0.042     0.042     0.042     0.042"
" 38          START/RE-START TOTALS 101"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    0.162    hectare"
"             Total Impervious area                   0.065    hectare"
"             Total % impervious                     40.000"
" 19          EXIT"
```