PRELIMINARY FUNCTIONAL SERVICING REPORT

(Rev. 1)

132 College Street

JUNE 11, 2025

Township of West Lincoln

LandSmith ENGINEERING & CONSULTING LTD.

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LandSmith
ENGINEERING & CONSULTING LTD.

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1.0 Background & Information

1.1 Introduction

LandSmith Engineering & Consulting Ltd. have been retained by Phelps Homes Ltd. for the completion of a Functional Servicing Report in support of Zoning By-law applications for the lands located at 132 College Street, Smithville. A pre-consultation application (Official Plan Amendment No. 54) for the property was completed in 2020.

The purpose of this Functional Servicing Report is to review the existing municipal services currently available for the servicing of the proposed 157 residential units and ensure their suitability for the proposed Zoning By-law Amendment to accommodate the proposed development. In addition, this report will address the local Stormwater Management (SWM) context for the lot and the required stormwater quantity and quality control measures.

1.2 Site Location & Proposed Development

The 1.95-hectare site is located at municipal address 132 College Street, Smithville. The vacant College Street school is located on the western portion of the site with frontage on College Street (this school has since been demolished). The remainder of the site consists of an asphalt area, playgrounds, and grass fields at the rear of the school. The site is bound by single detached residential dwellings on Morgan Avenue to the north, a wooded area to the east, residential townhouses to the south, and residential townhouses fronting onto Morgan Avenue along with commercial properties to the west. Through the Township of West Lincoln's Official Plan Amendment No. 54, the site's zoning has been changed from Institutional to a Residential/Mixed Use Area. An R-Plan for the site prepared by A.T. McLaren Ltd. is attached in Appendix 'A' for reference.

The current proposal is for a total of 157 units, including 13 units fronting onto Morgan Avenue, and 144 units accessed off College Street. This is illustrated on the Concept Plan prepared by Fryett Turner Architects Inc. which is attached to this report within Appendix 'A' for reference purposes. The units fronting Morgan Avenue are 2-storey townhouse style units, with floor plans prepared by Capponi Lacroix Design Group Ltd. and attached within Appendix 'A' for reference. The units accessed from College Street include 9 apartment style blocks, with each block containing 3-storeys with 4 adjacent stacks and 4 units per stack. The floor plans for the apartment block units were prepared by Fryett Turner Architects Inc. and are attached within Appendix 'A' for reference purposes. The site location plan on the following page further illustrates the location of the proposed development in the context of the local Smithville area.

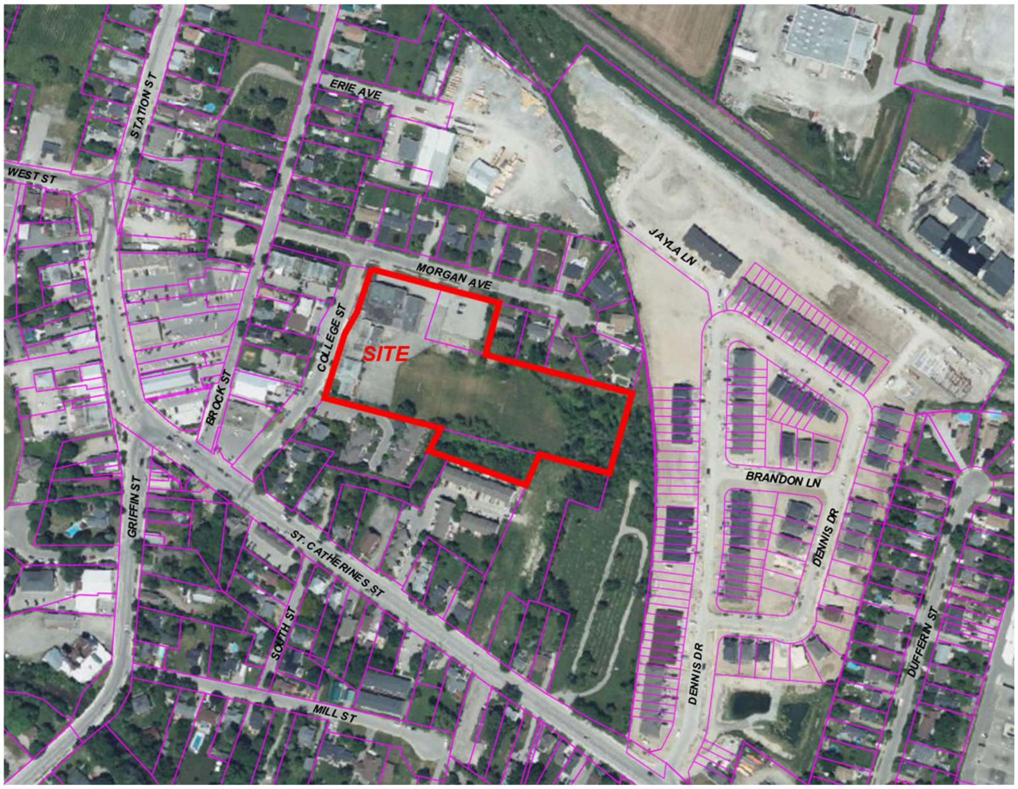

Figure 1: Site Location Plan (N.T.S.)

2.0 Servicing Analysis

2.1 Water Servicing

There is an existing 150mm diameter watermain along Morgan Avenue which serviced the now vacant College Street School. Along College Street there is a 150mm diameter watermain that begins at the southwest corner of the site and runs south to St. Catherines Street. As illustrated on the Site Servicing Plan attached in Appendix ‘A’, water service will be provided to the site by extending the existing 150mm watermain along College Street approximately 50m north to the proposed driveway entrance.

The Ontario Building Code has been utilized to calculate the expected maximum hydraulic load and associated peak domestic use flow rate for the proposed development. For the 13 units fronting Morgan Avenue, the calculations have been based on the floor plans provided by Capponi Lacroix Design Group Ltd. For the 144 units with access from College Street, the calculations have been based on the floor plans provided by Fryett Turner Architects Inc. Although these floor plans are not finalized, they can provide an estimation of the expected fixtures for the development.

Based on the fixture units method the proposed development will have a total of 2,042 fixture units. This is equivalent to a maximum hydraulic load for the development of 20.15 L/s. The supporting calculations describing how this value was determined have been attached in Appendix 'B' for reference purposes.

The Ontario Building Code has also been utilized to calculate the fire-flow demands for the development. Since there are two types of residential blocks within the development, fire-flow demand was calculated for each type of block at the location which would yield the highest fire-flow requirement based on proximity to neighbouring units. The supporting fire-flow demand calculations as well as a Fire Protection Plan have been attached in Appendix 'B' for reference purposes.

For the units fronting onto Morgan Avenue, the middle block was analyzed. Based on the average floor area and the building height the total building volume of 2,575 cubic meters was calculated. Taking into consideration the appropriate water supply and spatial coefficients this building size results in a required flow rate of 4,500 L/min or 75 L/s.

For the units accessed from College Street, Block 6 which is located at the northeast portion of the site was analyzed. Based on the average floor area and the building height the total building volume of 4,254 cubic meters was calculated. Taking into consideration the appropriate water supply and spatial coefficients this building size results in a required flow rate of 4,500 L/min or 75 L/s.

Attached in Appendix 'B' from the 2016 Niagara Region Master Servicing Plan is Figure 3.A.8 and Figure 3.A.9 which illustrate the watermain network in Smithville. These figures show that the existing maximum day demand pressure in the area surrounding the site is between 60-80 psi, and the available fire flow on College Street is 50-100 L/s. This indicates that the watermains adjacent to the site have the capacity to meet the domestic use and fire flows for the proposed development. However, prior to development, the existing watermains should be tested in order to determine the available pressures in the nearby system.

2.2 Sanitary Servicing

The existing Smithville sanitary sewer network surrounding the subject lands is illustrated in Figure S1 attached in Appendix 'C' for reference purposes. As can be seen, there is an existing 200mm diameter sanitary sewer to the north along Morgan Avenue, a 200mm diameter sanitary sewer to the south located on private property, and a 300mm diameter trunk sewer further south along St. Catherines Street. The existing sanitary sewers adjacent to the subject lands provide the opportunity for various sanitary servicing options for the site.

One option would be to connect to the 300mm trunk sewer along St. Catherines Street. However, this option is not economically feasible as it would require the installation of a sanitary sewer along College Street (where there is none) in order to connect to the trunk sewer on St. Catherines Street.

Another option would be to connect to the existing sanitary sewers to the south of the site. However, since these sewers are located in private property in which the subject lands do not border, connecting to them may not be economically feasible. This would require private agreements with the landowners whose lands would be affected by the service connection and may lead to legal issues or delays.

Based on the limitations of the previous options, it is proposed to connect to the Morgan Avenue sewer to provide sanitary service for the development. The Morgan Avenue sanitary sewer Plan & Profile drawing is detailed in Appendix 'C', and the proposed sanitary servicing for the site is illustrated on the Servicing Plan attached in Appendix 'A' for reference purposes.

The units fronting Morgan Avenue will be connected to the existing 200mm sanitary sewer with a proposed 150mm pipe entering from the north side of the townhouses. The remainder of the site (Blocks 1-9) will connect to the Morgan Avenue sewer with a 150mm diameter pipe at 0.50% slope through a 4m sanitary easement in between the northern townhouses. Blocks 1-5 will be connected to the municipal sewer with gravity flow, while Blocks 6-9 will be pumped through a forcemain.

For Blocks 6-9, we have consulted with Environment One Sewer Systems (E/One) to provide a sanitary pumping design. This design is detailed in Appendix 'C' and includes a Servicing Plan showing the pump station locations on site, pump station detailed drawings and performance curve, and a preliminary pressure sewer design analysis. The design specifies the installation of four WH484/WR484 grinder pump stations. With each station rated for flows of 26,498 L/day, this pumping capacity is sufficient for the sanitary flows that will be generated from Blocks 6-9 to be pumped to the gravity outlet at Sanitary Manhole 4.

2.2.1 Wastewater Assessment

A Sanitary Drainage Area Plan is attached in Appendix 'C' for reference purposes, which illustrates the contributing areas to the existing Morgan Avenue sanitary sewer in which the site will be connected to. The area upstream of the site was also analyzed in order to determine the sanitary flows which enter the Brock Street sewer north of the site and check the capacity of the receiving pipe. This upstream area is 36.6 hectares and is illustrated in Appendix 'C' for reference purposes.

A Post-Development Sanitary Sewer Design Sheet is attached in Appendix 'C' for reference purposes. As per the Niagara Region 2021 Water and Wastewater Master Servicing Plan, a daily per capita water demand of 240 L/cap/day was used. For the existing residential dwellings on Morgan Avenue (Areas 1A and 4A), a density of 40 persons/hectare was used. Based on the number of dwellings in the upstream area (Area 5), a conservative estimate of 30 persons/hectare was used. As per the Township of West Lincoln standards, for the proposed townhouse units fronting Morgan Avenue (Areas 1B and 4B) a density of 2.3 persons/unit was used, and for the apartment style units accessed off of College Street (Area 3) a density of 1.8 persons/unit was used.

The Post-Development Sanitary Sewer Design Sheet demonstrates that with the proposed development, the peak flows to the 200mm Morgan Avenue sewer will be 6.23 L/s, resulting in 23% full pipe capacity. Once these flows from the Morgan Avenue sewer connect to the 300mm Brock Street sanitary sewer and include flows from the entire upstream area, the peak flow is 30.45 L/s and results in 50% full pipe capacity. This indicates that there is ample capacity in the existing sanitary sewers to accommodate the flows from the proposed development

The downstream system flows to the Sanitary Pumping Station (SPS) at municipal address 214 St. Catherines Street which has an operational capacity of 104 L/s and can accommodate the peak flows from the site.

2.3 Stormwater Servicing

There is an existing storm sewer which flows east adjacent to the southern curb along Morgan Avenue and is illustrated on the Servicing Plan attached in Appendix 'A'. East of the catchbasin manhole at the intersection of Morgan Avenue and College Street, this sewer has a diameter of 375mm and a slope of 0.84%. The storm sewer continues east along Morgan Avenue and increases to a 450mm diameter pipe at 0.55% slope and then to a 525mm diameter pipe at 0.31% slope before connecting to the manhole at the end of the cul-de-sac at the eastern limit of Morgan Avenue. From this manhole the flow is conveyed 84m south through a 600mm diameter pipe at a 0.30% slope along an existing sewer easement before draining into a channel at the southeast of the site.

Flow continues southeast through this channel as it exits the site and drains towards the Old Town Gateway Estates development to the east, discharging into a ditch inlet catch basin (DICB) and connecting to the 750mm diameter pipe at 0.70% slope that runs easterly between the existing townhouses at 53 and 57 Dennis Drive. Flows continue south through the 1050mm pipe along Dennis Drive and eventually outlets into Twenty Mile Creek south of St. Catherines Street. This DICB is detailed on the General Services Plan for the Old Town Gateway Estates attached in Appendix 'D'.

The storm drainage area plan for the existing development to the east known as Old Town Gateway Estates is attached in Appendix 'D'. This plan illustrates that the subject lands at 132 College Street were included in catchment Area 2 for this development, which has a run-off coefficient of 0.33. As seen on the pre-development drainage area plan for the site attached in Appendix 'D', the areas of the existing site which drain towards Old Town Gateway Estates include pre-development drainage areas 1-3, which have a combined area of 1.89 hectares and are 34% impervious. This level of imperviousness is consistent with the run-off coefficient from catchment area 2 from the Old Town Gateway Estates drainage area plan.

In reviewing the extents of the Old Town Gateway Estates storm drainage area plan, it is evident that area 1 has been overstated by approximately 1 hectare. This area includes a portion of Brock Street, which has an existing storm sewer and overland flow route which is conveyed south towards St. Catherine Street, and not towards Morgan Avenue to the east. The Brock Street storm sewers do not connect to the Morgan Avenue storm sewers.

As illustrated on the Servicing Plan attached in Appendix 'A', it is proposed to connect to the existing 600mm diameter storm sewer which runs south from the Morgan Avenue cul-de-sac at a proposed manhole (STM MH 0) where the existing sewer easement meets the property line at the northeast corner of the site. From this manhole a proposed 675mm diameter pipe will continue south at a 0.30% slope until connecting to a proposed manhole (STM MH 1) at the southern property line. STM MH 1 is also connected to the outlet pipe from the proposed underground storage tank and a 750mm diameter pipe which will convey flows east out of the site. Flows will continue through the 750mm diameter pipe at a 0.38% slope and discharge through a proposed concrete headwall exiting the site into the existing channel.

Within the site there will be a proposed 4.5m wide storm sewer easement belonging to the Township from where the existing storm 600mm storm sewer connects to STM MH 0 and continues south and then east before exiting the site and discharging to the channel at the southeast corner.

Storm sewer calculation sheets are provided in Appendix 'D' which demonstrate that the proposed outlet pipe for the site will have capacity for all design storm events based on the Town of West Lincoln Standards and IDF Values. As can be seen, the 750mm diameter pipe which conveys stormwater out of the site reaches 41% capacity for the 5-year storm, and 98% capacity for the 100-year storm.

3.0 Stormwater Management

3.1 Quantity Criteria

The Pre-Development Drainage Area Plan attached in Appendix 'D' illustrates the existing drainage areas for the site. As seen on this plan, the majority of the site discharge ends up in the channel to the east of the site. Flows from Drainage Areas 1 and 3 drain north towards Morgan Avenue, where they enter the Morgan Avenue storm sewer and are conveyed east to the end of the cul-de-sac before continuing south through the existing 600mm storm sewer which then flows into a concrete headwall and continues east through a channel at the southeast of the site. Drainage Area 2, which includes the majority of the rear of the school and adjacent grass field, drains towards the southeast of the site where it also enters the existing channel and continues southeast, exiting the site through an existing 300mm CSP culvert. Drainage Area 4 includes the southwest portion of the existing school, and drains south along College Street where it enters the 250mm storm sewer and continues south towards St. Catherines Street.

The Post-Development Drainage Area Plan attached in Appendix 'D' illustrates the drainage areas for the proposed development. Post-development Drainage Area 1 includes the 13 units fronting onto Morgan Avenue as well as the landscaped areas along College Street adjacent to Block 1, and will flow north uncontrolled and enter the Morgan Avenue storm sewer. Post-development Drainage Area 2 includes the 144 units and parking areas that are accessed off College Street, and flows from this area will be controlled through a CULTEC Recharger 902HD underground storage tank located in the southeast corner of the parking lot. Post-development Drainage Area 3 includes the landscaped area adjacent to College Street to the west of Block 2, and will flow south uncontrolled along College Street. Post-development Drainage Area 4 includes the back half of Blocks 7 and 8, and will flow east uncontrolled into the adjacent channel.

Peak flows and runoff volumes for the pre- and post-development areas were found using MIDUSS v2 and the 3-Hour Chicago design storm distribution. The Township of West Lincoln's IDF Curve Values were used for the minor (5-year) and major (100-year) storm events. The pre-development peak flows are shown in Table 1, and the post-development flows are shown in Table 2 on the following page. For the post-development condition, the site was analyzed with no stormwater storage available. The MIDUSS output files are attached in Appendix 'D' for reference purposes.

Drainage Area	Area (ha)	% Impervious	5-Year Peak Runoff (m^3/s)	100-Year Peak Runoff (m^3/s)
1	0.270	94%	0.072	0.178
2	1.577	22%	0.101	0.267
3	0.043	95%	0.012	0.028
4	0.064	76%	0.014	0.035
Total Peak Runoff (m^3/s)			**0.199**	**0.508**

Table 1: Pre-Development Hydrologic Analysis Summary

Drainage Area	Area (ha)	% Impervious	5-Year Peak Runoff (m^3/s)	100-Year Peak Runoff (m^3/s)
1	0.281	48%	0.040	0.115
2	1.548	78%	0.346	0.819
3	0.011	57%	0.002	0.005
4	0.112	46%	0.016	0.046
Total Peak Runoff (m^3/s)			**0.404**	**0.985**

Table 2: Post-Development Hydrologic Analysis Summary, No SWM

Stormwater quantity control measures are to be designed to ensure that post-development flows are equal or less than the pre-development flows for all design storm events. Based on the post-development peak flows for the site increasing from the pre-development conditions 103% for the 5-year and 94% for 100-year storm events, on-site stormwater storage will be required.

3.2 Quality Criteria

The site is located within the Twenty Mile Creek subwatershed, which flows to Lake Ontario. As such, Normal stormwater quality treatment control (70% overall total suspended solids removal) has been applied for the proposed development considering treatment train design principles in accordance with the Township of West Lincoln and MECP's standards.

3.3 Stormwater Design

3.3.1 Quantity Control

A preliminary site Grading plan has been prepared for the development and as noted above is contained within Appendix ‘A’ for reference purposes. The drainage pattern for the site post-development includes controlling the majority of the site through underground storage with a controlled discharge to the eastern channel, while also having some uncontrolled areas on the perimeter of the site. Based on this grading plan it was proposed that a CULTEC Recharger 902HD system should be installed at the south-east area of the site underneath the proposed parking lot.

Based on the proposed grading the balance of the site can be routed through the proposed CULTEC system. In order to match the existing peak runoff from the development area in the proposed condition the uncontrolled flows are subtracted from the existing peak runoff rates. This gives the maximum allowable discharge from the CULTEC system as summarized in Table 3 on the following page. Note that once again the Chicago 3-hour storm was utilized together with the Township of West Lincoln’s IDF parameters for consistency with the existing conditions analysis.

Return Period (Year)	Pre-Dev. Areas 1-3 Existing Total Peak Runoff to Channel (m^3/s)	Post-Dev. Areas 1, 3, 4 Uncontrolled Peak Flow (m^3/s)	Post-Dev. Area 2 - CULTEC Peak Allowable Discharge Rate (m^3/s)
5	0.185	0.058	0.127
100	0.473	0.166	0.307

Table 3: Uncontrolled Flow Discharge and Allowable CULTEC Discharge Summary

MIDUSS v2 Hydrologic analysis was carried out for the routing of the storage system and it was determined that a minimum of 570 cubic meters of storage would be required within the system in order to limit discharge to the allowable rates.

A bed layout sized 52.32m x 11.43m was designed using software provided by CULTEC and the rating curve for the storage was determined based on the CULTEC sizing software. The total storage provided with this design is 613 cubic metres. This total storage volume does not take into account the approximately 73 cubic metres of storage provided by the stone base underneath the storage chambers, which will be conveyed to groundwater (with the infiltration rate subject to the soil conditions).

The storage volume provided was increased from the minimum required in order to ensure discharge rates would meet the flow targets for all design storm periods. The base of the stone for the CULTEC bed is to be set at 187.13m in elevation, and the chamber base at 187.43m, as described on the Site Servicing Plan attached in Appendix 'A' for reference.

It was determined that a two-orifice design would be required in order to meet the discharge targets for each of the return period events as follows:

- Orifice 1 – 290mm diameter Inv. Elevation 187.43m
- Orifice 2 – 210mm diameter Inv. Elevation 187.83m

These sizes and elevations of each of the orifices were utilized in the MIDUSS v2 analysis, as can be seen through review of the output files contained in Appendix 'D'. Based on the routing of the system the discharge from the proposed CULTEC Recharger 902HD is summarized via Table 4 below.

Return Period (Year)	Storage Required (m^3)	Peak Outflow (m^3/s)	Water Depth (m)	WSEL (m)	Flow Target (m^3/s)	% of Flow Target
5	274.2	0.122	0.556	187.986	0.127	96.1%
100	604.2	0.302	1.493	188.923	0.307	98.4%

Table 4: CULTEC Discharge Summary

Based on the foregoing analysis the total storage of 613 cubic metres provided by the CULTEC 902HD system is sufficient to ensure that the sum of the peak uncontrolled and controlled flows does not exceed the existing conditions for each of the noted return periods. Table 5 below summarizes the total flows from the site under the proposed design and compares them to the existing conditions. As can be seen the discharge from the development area to the channel to the east of the site is reduced by virtue of the proposed stormwater management design.

Return Period (Year)	Existing Total Peak Runoff to Channel (m^3/s)	Areas 1, 3, 4 - Uncontrolled Peak Flow (m^3/s)	Area 2 – CULTEC Peak Allowable Discharge Rate (m^3/s)	Area 2 - CULTEC Actual Discharge Rate (m^3/s)	Proposed Total Peak Runoff (m^3/s)	% Decrease
5	0.185	0.058	0.127	0.122	0.180	-2.7%
100	0.473	0.166	0.307	0.304	0.470	-0.6%

Table 5: Overall Site Stormwater Discharge Summary

The grading design ensures that the overland flow route is maintained in the post-development condition, with flows being conveyed south from the Morgan Avenue cul-de-sac and running behind the units of Blocks 7 and 8 before flowing east through the cemetery lands towards the existing DICB between Blocks 39 and 40 of the Old Town Gateway Estates development.

3.3.2 Quality Control

Runoff from the subject lands eventually discharge into Twenty Mile Creek. Once it enters the creek, it flows north before discharging into Lake Ontario. Given the ultimate receiver of stormwater is Jordan Harbour, MECP 'Normal' stormwater quality control protection is required for this development. This includes providing 70% total suspended solids (TSS) removal. In keeping with the Township of West Lincoln's criteria – the ETV particle size distribution must be used for sizing of such stormwater quality control measures.

Stormwater quality control can be provided for the site by multiple means through a treatment train approach. This includes the installation of an oil-grit-separation (OGS) manhole, installation of CB Shield devices within the proposed catch basins, and the inclusion of a separator row within the underground storage chamber.

Based on the contributing area the required, an OGS manhole has been proposed, as seen on the Site Servicing Plan in Appendix 'A'. The OGS has been sized as a HydroWorks HydroDome HD10 unit. The sizing of this OGS has been completed using the ETV particle size distribution for which the HydroWorks products are certified. The HydroWorks sizing report together with links to where the ETV certification for the product can be found are included in Appendix 'D' for reference. The testing of these units has been independently completed by third parties using the ETV particle size distribution and confirmed to provide 70% removal efficiency.

Preliminary analysis indicates that the installation of a CB Shields within all site catchbasin will provide approximately 50% TSS removal efficiency based on the ETV particle size distribution. A CB Shield operations manual and design chart, as well as the ETV verification statement is attached within Appendix 'D' for reference.

Additional stormwater quality can be provided through the inclusion of a Separator Row within the CULTEC storage tank. This will force stormwater entering the chambers to pass through a filter cloth with 0.300mm openings and reduce the amount of TSS exiting the site, as well as ensure that inflows to the storage chambers will not contaminate the groundwater. The separator row is an ETV verified technology that will provide approximately 80% long term TSS removal as a standalone feature for the CULTEC unit on site. The separator row filtration verification statement is attached in Appendix 'D' for reference purposes. Shop drawings with certification of the ability of the CULTEC storage tank to provide the 80% long term TSS removal will be provided prior to construction.

As noted above, the required level of long term TSS removal is 70%. The proposed OGS Hydroworks HD10 will provide 70% TSS removal and the CB Shields will provide 50% TSS removal. Further quality can be provided by a separator row within the underground storage tank. Together this treatment train approach will meet the noted quality control criteria for 'Normal' protection of 70% long term TSS removal.

3.4 Erosion and Sediment Control

Erosion and sediment control measures implemented during construction are vital to ensuring that downstream water quality is not degraded as a result of the proposed development. An Erosion and Sediment Control (ESC) Plan has been included as part of the engineering drawings set for this development (detailed in Appendix 'A') together with notes specifying the required maintenance of these measures during the construction period while the ground is disturbed.

Interim sediment control measures will be implemented during construction. These include the addition of mud mats at the entrances to the site, as well as silt sacks covering all nearby catch basins on College Street and Morgan Avenue.

The ESC measures should be inspected monthly and after every rainfall event, and maintained to ensure no sediment leaves the site during construction and until such time as ground cover is established after the construction period. This is an important part of stormwater quality control, and the requirements indicated on the ESC plan must be adhered to until the completion of the project.

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4.0 Conclusions

In conclusion, based on the foregoing analysis we recommend that the proposed development of 157 residential units on the site at 132 College Street can be completed in accordance with the requirements of the Township of West Lincoln as follows:

1. Water servicing can be provided through a proposed 150mm watermain entering the site off of College Street. Peak domestic demand is expected to be 20.15 L/s.

2. It is proposed to provide a 150mm sanitary sewer to service the proposed development which connects to the existing 200mm sanitary sewer on Morgan Avenue. A peak domestic sanitary flow rate of 6.23 L/s is expected to be generated from the site. Four sanitary grinder pumping stations will pump sanitary flows for Blocks 6-9.

3. On-site stormwater quantity controls will be provided by an underground storage chamber located in the southeast portion of the site underneath the parking lot. The storage tank will have control orifices sized 290mm and 210mm and provide 613 cubic metres of storage volume.

4. In order to ensure storm water quality control for the site, an oil-grit-separation manhole will be installed, along with CB shields in all proposed catch basins and a separator row within the underground storage chamber. This arrangement, in combination provides 70% long-term TSS removal and "Normal" level protection.

Thank you for your consideration of the above Functional Servicing Report. Should you have any questions or require clarification with respect to any part of the above please do not hesitate to contact the undersigned.

Respectfully submitted,

Andrew Smith

LICENSED PROFESSIONAL ENGINEER
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5.0 Attachments

Appendix 'A' – Background Information

Site Plan by Fryett Turner Architects Inc.

Topographic Survey by Kirkup Mascoe Ure Surveying Ltd.

Plan of Survey by Douglas G. Ure & Sons

R-Plan by A.T. McLaren Ltd.

Floor Plans for Units Fronting Morgan Ave. by Capponi Lacroix Design Group Ltd.

Floor Plans for Units Accessed off College St. by Fryett Turner Architects Inc.

Preliminary Grading Plan

Preliminary Servicing Plan

Preliminary Erosion and Sediment Control Plan

Appendix 'B' – Water Servicing Analysis

Domestic Water Demand Calculations

Fire Flow Requirement Calculations

Figure F1: Fire Protection Plan

Figure 3.A.8: Smithville Existing Max Day Demand Pressure (Region of Niagara, 2016 MSP)

Figure 3.A.9: Smithville Existing System Fire Flow (Region of Niagara, 2016 MSP)

Appendix 'C' – Sanitary Servicing Analysis

Figure S1: Smithville Existing Sanitary Sewers

132 College Street, Smithville - Upstream Sanitary Area

Sanitary Drainage Area Plan

Post-Development Sanitary Sewer Design Sheet

Morgan Avenue Sanitary Sewer Plan & Profile

Sanitary Grinder Pump Stations by E/One

- Servicing Plan
- Preliminary Design Analysis
- WH484/WR484 Detail Sheets
- Sanitary Grinder Pump Performance Curve

Appendix 'D' – Stormwater Management

Pre-Development Drainage Area Plan - Figure 1

Post-Development Drainage Area Plan - Figure 2

Old Town Gateway Estates Storm Drainage Area Plan by S. Llwellyn & Associates Ltd.

Old Town Gateway Estates As-Built General Services by S. Llwellyn & Associates Ltd.

Storm Sewer Design Sheet – 5-Year

Storm Sewer Design Sheet – 100-Year

MIDUSS v2 Output Files

CULTEC Recharger 902HD Design Sheets

CULTEC Separator Row Filtration System Verification Statement

Hydroworks HD Sizing Summary

Hydroworks HD ETV Verification Statement

Hydroworks HD Operations and Maintenance Manual

CB Shield Operations Manual and Design Chart

CB Shield ETV Verification Statement

APPENDIX 'A' – Background Information

Site Plan by Fryett Turner Architects Inc.

Topographic Survey by Kirkup Mascoe Ure Surveying Ltd.

Plan of Survey by Douglas G. Ure & Sons

R-Plan by A.T. McLaren Ltd.

Floor Plans for Units Fronting Morgan Ave. by Capponi Lacroix Design Group Ltd.

Floor Plans for Units Accessed off College St. by Fryett Turner Architects Inc.

Preliminary Grading Plan

Preliminary Servicing Plan

Preliminary Erosion and Sediment Control Plan

1 SITE PLAN
A1.0 1 : 300

PARKING SCHEDULE			
PARKING TYPE	SIZE (mm)	AREA (m^2)	COUNT
PARKING TYPICAL	2700 X 6000	16.2	202
PARALLEL PARKING TYPICAL A	2750 X 5500	15.1	4
PARALLEL PARKING TYPICAL B	2750 X 6700	18.4	4
ACCESSIBLE PARKING TYPICAL A	3400 X 6000 (WITH 1500 AISLE)	20.4	4
ACCESSIBLE PARKING TYPICAL B	2400 X 6000 (WITH 1500 AISLE)	14.4	4
TOTAL			218

REVISIONS | DATE

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Fax: 519-846-0343

THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN THE COURSE OF THE WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE ARCHITECT PRIOR TO THE COMMENCEMENT OF THE WORK. UNDER NO CIRCUMSTANCES SHALL THE CONTRACTOR PROCEED IN UNCERTAINTY.

SEAL

PROJECT NORTH

PROJECT
PHELPS STACKED TOWNHOUSES
College Street School

TITLE
Site Plan

STATUS	Feas
PROJECT #	24022
CHKD	RIT
DRAWN	RIT
SCALE	As indicated
DATE DWN	240819
ISSUED	240819

SHEET #
A1.0

2024-08-20 3:50:33 PM


MORGAN AVENUE
(BY PLAN No. M-90,
AS CONFIRMED BY PL 30BA1687)
PIN 46050-0117 (LT)
COLLEGE STREET
(BY PLAN No. M-90,
AS CONFIRMED BY PL 30BA1687)
PIN 46050-0012 (LT)
NIAGARA NORTH
CONDOMINIUM PLAN No. 1
NIAGARA NORTH CONDOMINIUM PLAN No. 42
REGISTERED PLAN No. M-90
ONE STOREY BRICK BUILDING
TWO STOREY BRICK BUILDING
LOT 30
LOT 29
LOT 28
PIN 46050-0114 (LT)
LOT 27
PIN 46050-0113 (LT)
LOT 26
PIN 46050-0112 (LT)
LOT 25
PIN 46050-0111 (LT)
LOT 31
PIN 46050-0263 (LT)
LOT 44
PIN 46050-0130 (LT)
LOT 52
PIN 46050-0250 (LT)
PART 1,
PLAN 30R-15159
PART 1,
PLAN 30R-2100
LOT 2, PLAN No. M-96
PIN 46050-0195 (LT)
BLOCK 48,
PLAN 30M-446
SUBJECT TO EASEMENT
AS IN INSTR. No. LT37951
SUBJECT TO EASEMENT
AS IN INSTR. No. LT37952
PLAYGROUND
ASPHALT AREA
CHAIN LINK FENCE
ONE STOREY ALUMINUM SIDED DWELLING
MUNICIPAL No. 160
TWO STOREY BRICK DWELLING
CONDO BLOCK 46801
STANDARD
LOT 14
LOT 15
LOT 16
LOT 17
LOT 18
LOT 19
LOT 20
LOT 21
LOT 22
LOT 23
LOT 24
LOT 35
LOT 36
LOT 37
LOT 38
LOT 39
LOT 43
LOT 44
LOT 45
LOT 46

BA-1687

M-90

Approved for Registration 30 January 1980

C. Szilagyi
Asst. Examiner of Surveys

Plan M-90 Registered Feb 6, 1980
and entered on Parcels
Section M-90

J. Payne
SUBDEP. Land Registrar

B-116

PLAN OF SURVEY OF

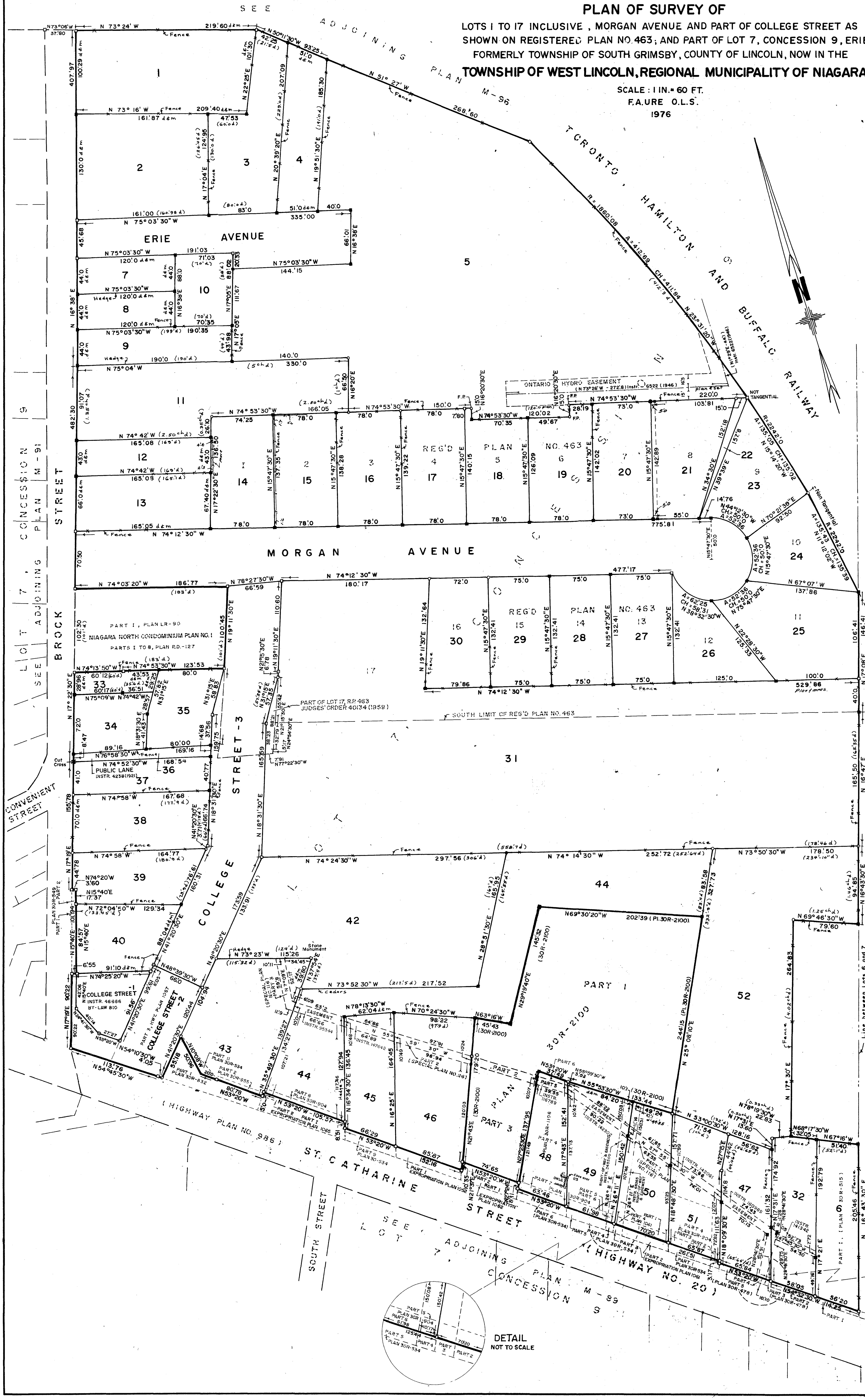
LOTS 1 TO 17 INCLUSIVE, MORGAN AVENUE AND PART OF COLLEGE STREET AS SHOWN ON REGISTERED PLAN NO. 463; AND PART OF LOT 7, CONCESSION 9, ERIE AVENUE FORMERLY TOWNSHIP OF SOUTH GRIMSBY, COUNTY OF LINCOLN, NOW IN THE

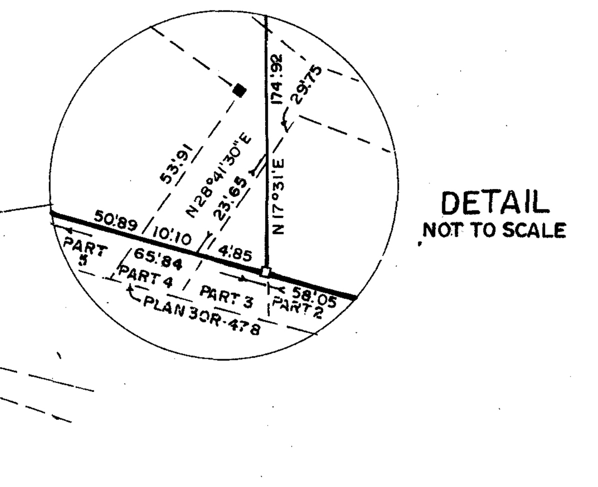
TOWNSHIP OF WEST LINCOLN, REGIONAL MUNICIPALITY OF NIAGARA

SCALE : 1 IN. = 60 FT.

F.A. URE O.L.S.

1976





Certificate Of Confirmation

I hereby certify that I did on the 26 day of Nov 1979 pursuant to Section 11 of the Boundaries Act, confirm the true location on the ground of the boundaries of each of the properties identified on this plan; the said boundaries being shown in solid outline hereon. 30 day of January 1980.

James N. Dardine
Deputy Director of Titles

Recorded in the office of the Director of Titles under B.A. 1687
Dated the 30 day of January 1980.

C. Szilagyi
Asst. Examiner of Surveys

Surveyor's Certificate

I hereby certify that

1. This survey and plan are correct and in accordance with The Surveys Act, The Land Titles Act, and The Boundaries Act and the regulations made thereunder.
2. I was present at and did personally supervise the survey represented by this plan.
3. The original field notes of survey are filed under No B-116 in the office of the Director of Titles at Toronto.
4. This survey was completed on the 1st day of March 1976.

Dated the 1st day of March 1976.

F.A. Ure
Ontario Land Surveyor

Bearing Note and Legend

Bearings are astronomic, derived from observations on Polaris on the road allowances between Lots 5 and 6, and Lots 9 and 10 at Longitudes 79°32'20" and 79°33'20" West and referred to the meridian through the South-East corner of the Township of South Grimsby (Longitude 79°30'30" West.).

- Indicates a Standard Iron Bar
- Indicates an Iron Bar
- Indicates an Iron Tube
- Indicates a Round Iron Bar, 5/8" dia.

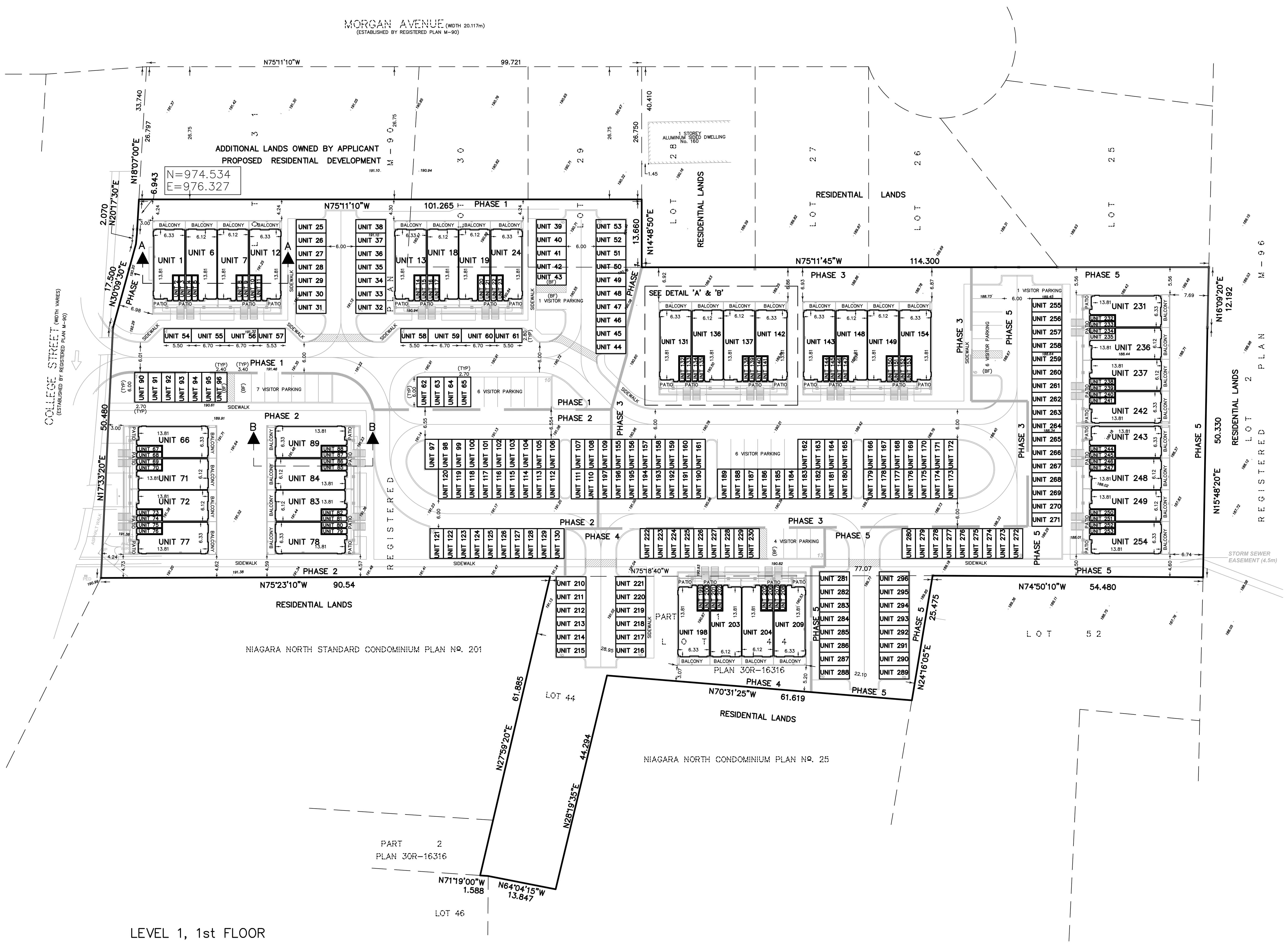
This Plan Consists Of The Following :

LOTS 1 to 40; Lots 42 to 52; College Street - 1; College Street - 2; College Street - 3; Morgan Ave; Erie Avenue.

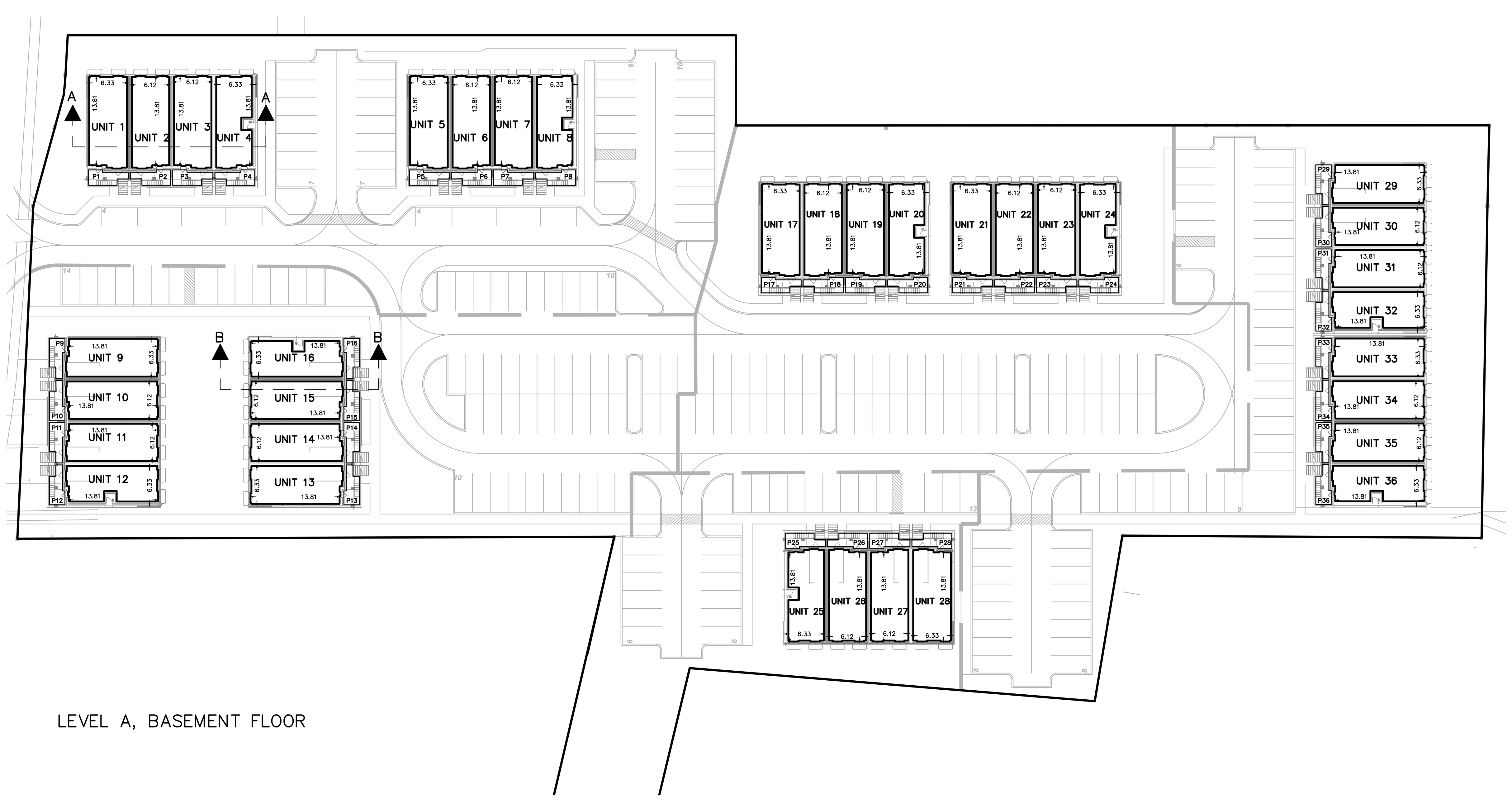
"CAUTION"

This plan is not a plan of subdivision within the meaning of The Planning Act.

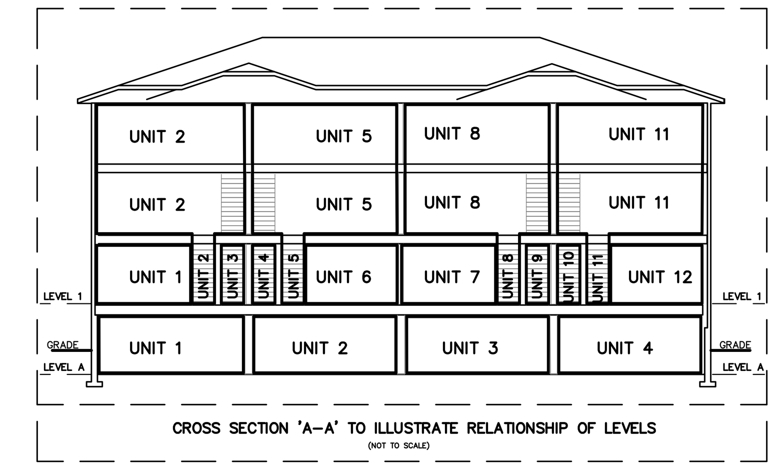
DOUGLAS G. URE & SONS
ONTARIO LAND SURVEYORS
ST. CATHARINES, ONTARIO



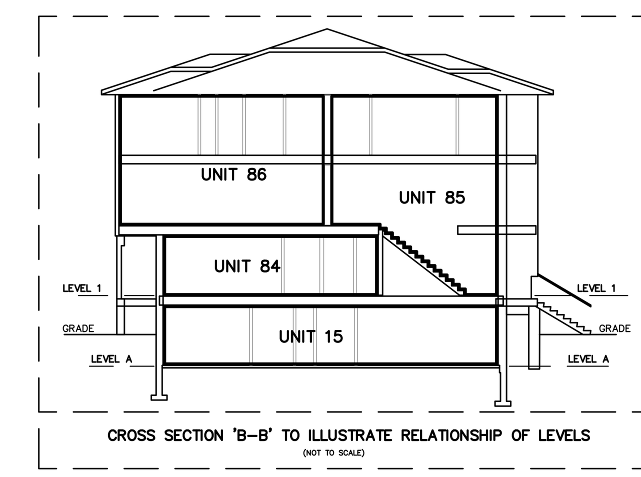
LEVEL 1, 1st FLOOR



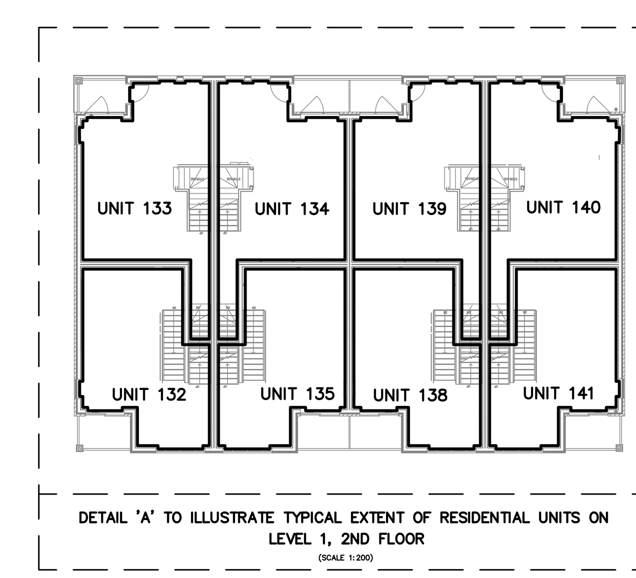
LEVEL A, BASEMENT FLOOR



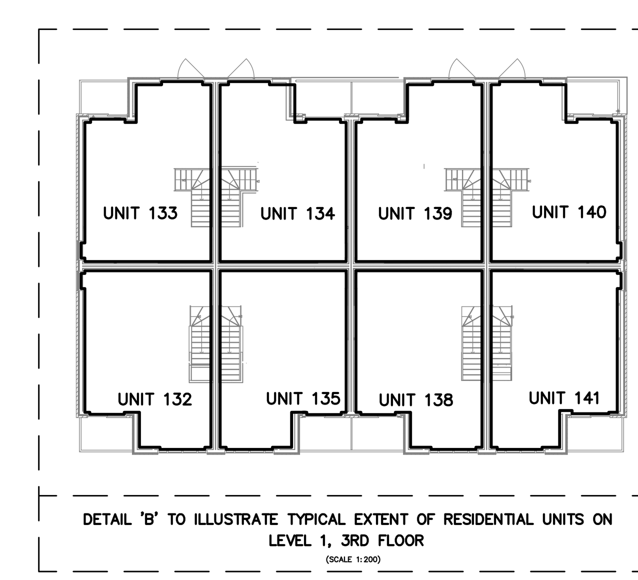
CROSS SECTION 'A-A' TO ILLUSTRATE RELATIONSHIP OF LEVELS



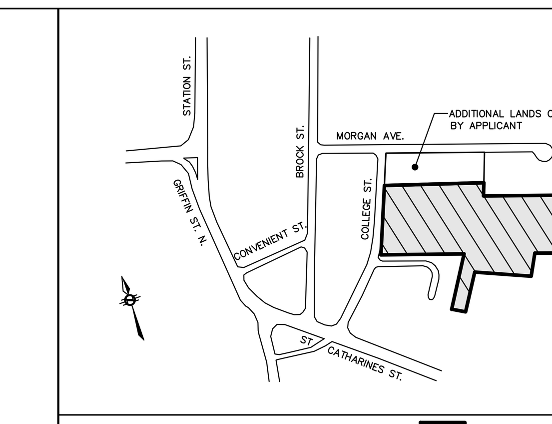
CROSS SECTION 'B-B' TO ILLUSTRATE RELATIONSHIP OF LEVELS



DETAIL 'A' TO ILLUSTRATE TYPICAL EXTENT OF RESIDENTIAL UNITS ON LEVEL 1, 2ND FLOOR



DETAIL 'B' TO ILLUSTRATE TYPICAL EXTENT OF RESIDENTIAL UNITS ON LEVEL 1, 3RD FLOOR



KEY PLAN NOT TO SCALE — SUBJECT LANDS

DRAFT PLAN OF PHASED CONDOMINIUM

OF PART OF

LOT 44

AND ALL OF

LOTS 29, 30, & 31

REGISTERED PLAN M-90

IN THE

TOWNSHIP OF WEST LINCOLN

REGIONAL MUNICIPALITY OF NIAGARA

SCALE 1:400 METRIC

R.A. McLAREN, O.L.S. – 2024

NOTE:

AREAS NOT DESIGNATED AS UNITS ARE PART OF THE COMMON ELEMENTS

NOTE

PORTIONS OF THE COMMON ELEMENT DESIGNATED WITH THE PREFIX 'P' ARE FOR THE EXCLUSIVE USE OF UNITS ON LEVEL 'A' WITH THE SAME NUMBER

METRIC NOTE

DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

SECTION 51 (17) PLANNING ACT – AS REVISED

(A) SHOWN ON PLAN
(B) SHOWN ON PLAN
(C) SHOWN ON PLAN
(D) SEE SCHEDULE
(E) SHOWN ON PLAN
(F) SHOWN ON PLAN
(G) SHOWN ON PLAN
(H) MUNICIPAL PIPED WATER AVAILABLE
(I) CLAY LOAM
(J) SHOWN ON PLAN
(K) EXISTING MUNICIPAL SANITARY AND STORM SERVICES AVAILABLE
(L) SHOWN ON PLAN

SCHEDULE

PHASE 1

TOTAL NUMBER OF RESIDENTIAL UNITS	=	32
TOTAL RESIDENTIAL PARKING	=	41
TOTAL VISITOR PARKING	=	7

PHASE 2

TOTAL NUMBER OF RESIDENTIAL UNITS	=	32
TOTAL RESIDENTIAL PARKING	=	41
TOTAL VISITOR PARKING	=	7

PHASE 3

TOTAL NUMBER OF RESIDENTIAL UNITS	=	32
TOTAL RESIDENTIAL PARKING	=	43
TOTAL VISITOR PARKING	=	6

PHASE 4

TOTAL NUMBER OF RESIDENTIAL UNITS	=	16
TOTAL RESIDENTIAL PARKING	=	21
TOTAL VISITOR PARKING	=	4

PHASE 5

TOTAL NUMBER OF RESIDENTIAL UNITS	=	32
TOTAL RESIDENTIAL PARKING	=	42
TOTAL VISITOR PARKING	=	7

TOTAL

TOTAL AREA OF SITE	=	16850.6m²
TOTAL NUMBER OF RESIDENTIAL UNITS	=	144
TOTAL RESIDENTIAL PARKING	=	188
TOTAL VISITOR PARKING	=	31
MAXIMUM BUILDING HEIGHT	=	3 STOREY
CONSTRUCTION TO COMMENCE IN	=	2025

SURVEYOR'S CERTIFICATE:

I CERTIFY THAT:

THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED AS SHOWN ON THIS PLAN AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DATE ____________ ROBERT A. McLAREN, O.L.S.

A.T. McLaren Limited
LEGAL AND ENGINEERING SURVEYS
69 JOHN STREET SOUTH, SUITE 230
HAMILTON, ONTARIO, L8N 2B9
PHONE (905) 527-8559 FAX (905) 527-0032

Drawn MM	Checked DG	Scale 1:400	Dwg.No. 37808-DC

ALL ELECTRICAL WIRING MUST BE INSPECTED BY THE ELECTRICAL SAFETY AUTHORITY. SEPARATE INSPECTION APPLICATIONS (PERMITS) MUST BE FILED, FOR MORE INFORMATION PLEASE CALL:
HAMILTON PROCESSING CENTRE
PHONE: (905) 318-4899 • 1-877-372-7233

SITE COPY

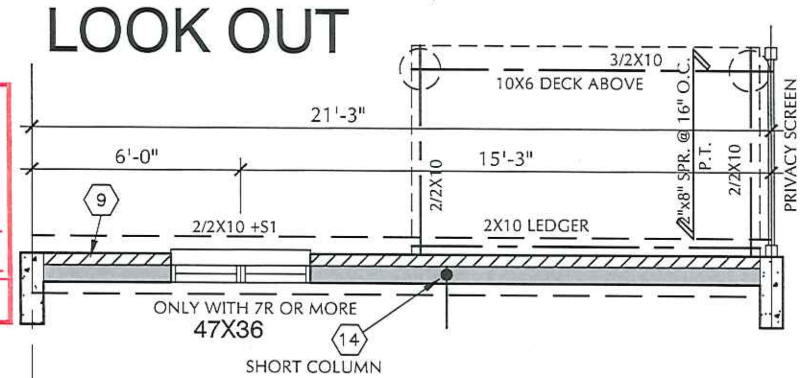
TOWN OF WEST LINCOLN
REVIEWED
PERMIT ISSUED SUBJECT TO ANY REVISIONS SHOWN IN COLOUR AND MARKED THEREON OR ON ATTACHED SHEET.
PERMIT NO. MODEL S21-01
DATE 8/28/17 SIGNED
CONSTRUCTION MUST CONFORM TO THE ONTARIO BUILDING CODE

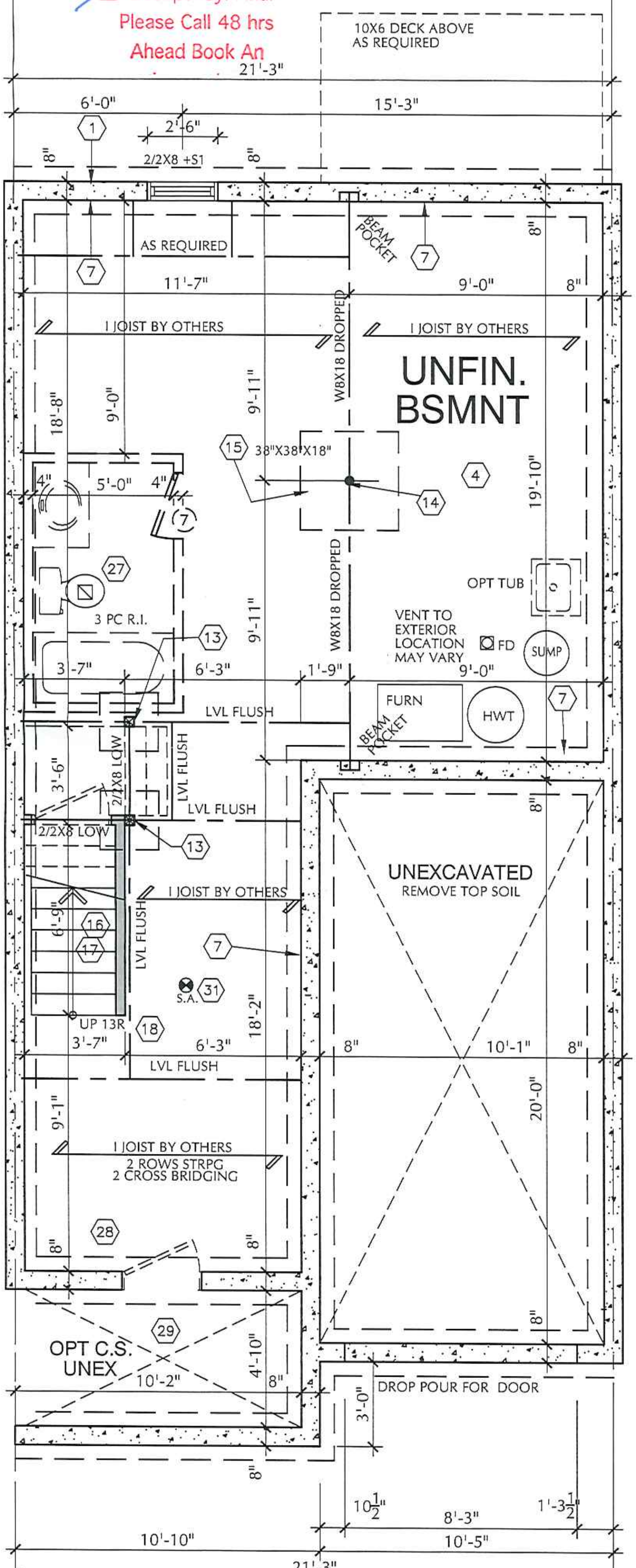
REQUIRED INSPECTIONS

- [x] Water / Sewer
- [x] Excavation / Ftg.
- [x] Pre-Backfill
- [x] U/G Plumbing
- [x] Plumbing Rough-in
- [x] HVAC Rough-in
- [x] Framing
- [x] Insulation
- [x] Occupancy/Final

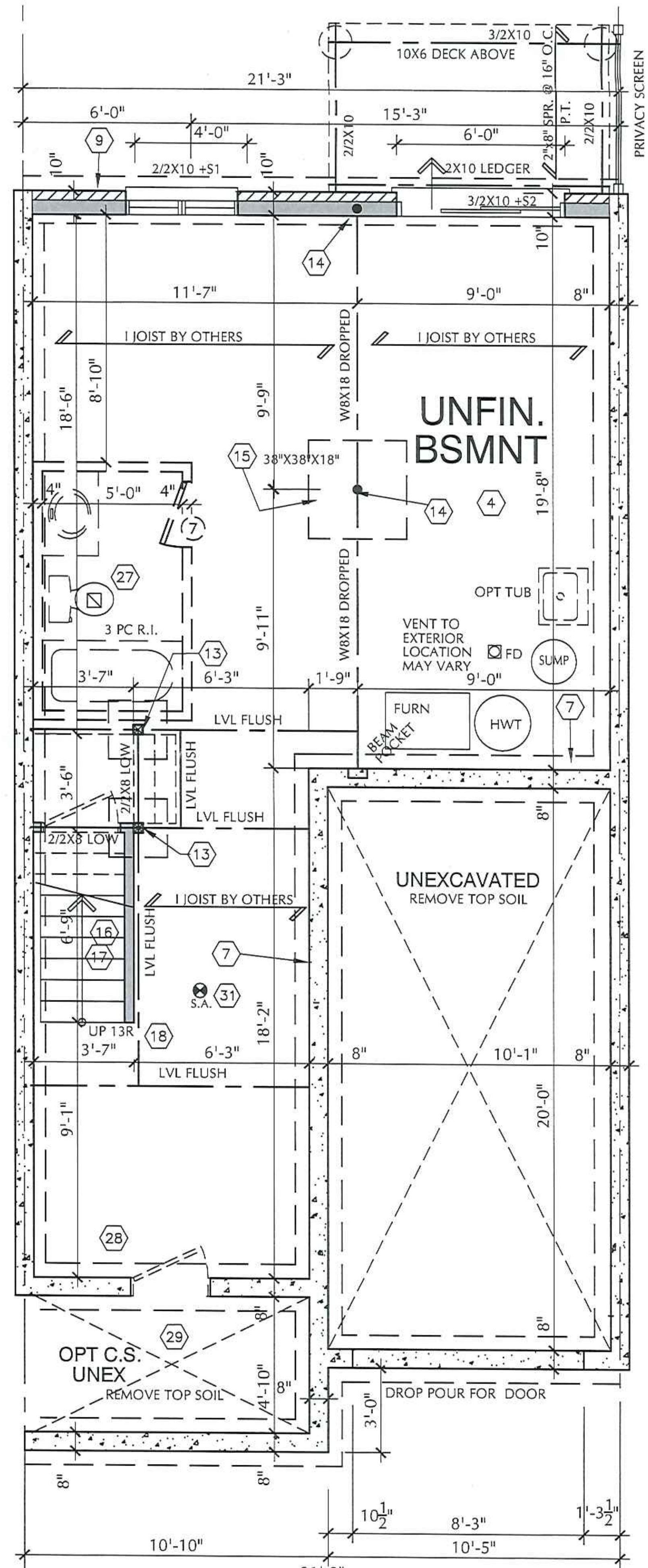
Please Call 48 hrs Ahead Book An

LOOK OUT





STANDARD
BASEMENT FLOOR S21-01
COVERAGE =921 SQ FT



STANDARD WALK OUT
BASEMENT FLOOR S21-01
COVERAGE =921 SQ FT

CAPPONI LACROIX DESIGN GROUP LTD.
37 Donlea Drive, HAMILTON, ON L8T 1K5
Tel.: 905 520 1428
E-MAIL: jcapponi@cldesigngroup.ca
www.cldesigngroup.ca

The undersigned has reviewed and takes responsibility for this design, and has the qualifications and meets the requirements set out in the Ontario Building Code to be a designer.

Qualification information
Required unless design is exempt under Div.C.3.2.5.1 of the bldg code

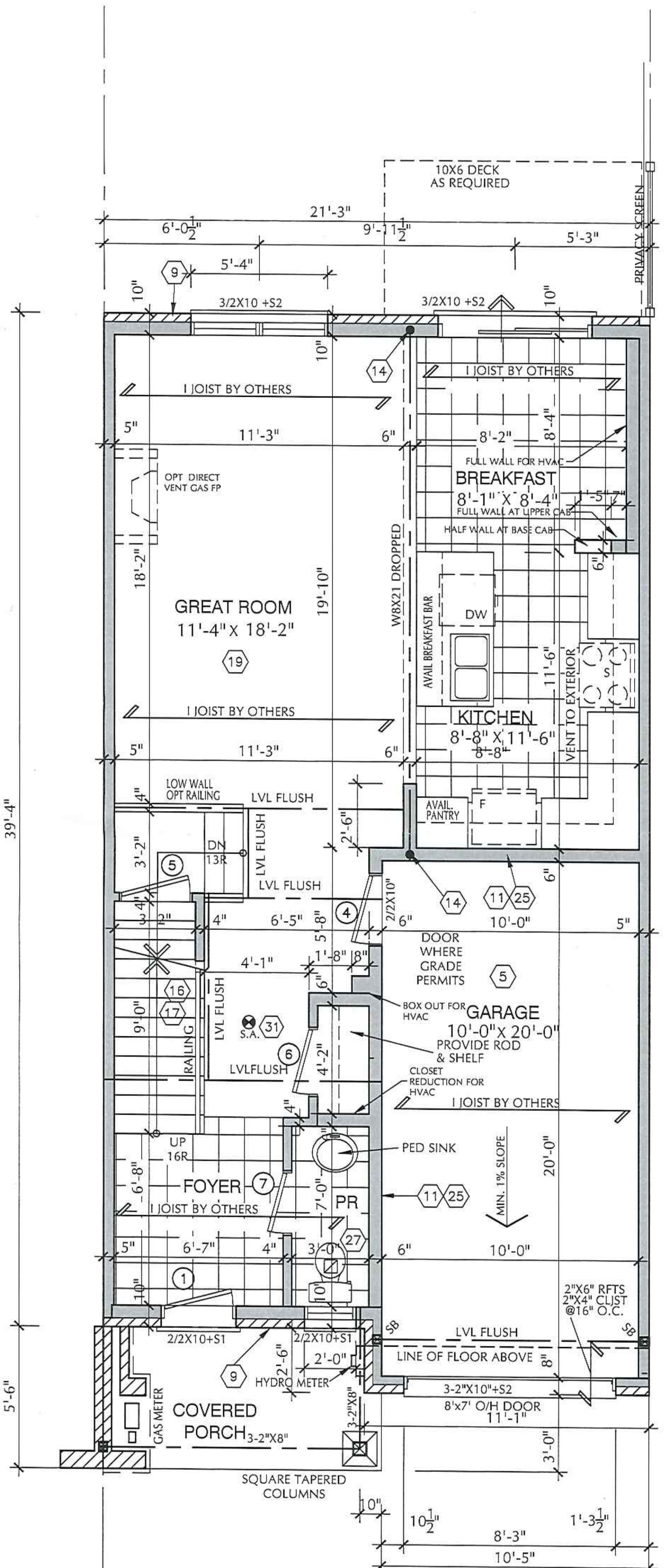
John Capponi — 23522
Name: Signature BCIN

Registration information
Required unless design is exempt under Div.C.3.2.5.1 of the bldg code

Capponi Lacroix Design Group Ltd. — 28804
Name: BCIN

NO.	DATE	DESCRIPTION
4	MAR 01/17	METER LOCATIONS
3	FEB 09/17	ISSUED FOR PERMIT
2	NOV 28/16	CLIENT COMMENTS
1	FEB 25/16	ISSUED FOR TENDER

Client: PHELPS HOMES
Project Location: SMITHVILLE
Model Name: S21-01 STANDARD
Title: BASEMENT FLOOR PLANS
Drawing No.: A1
Scale: 3/16"=1'-0"
Drawn by: JMC
Date: FEB 2016
Project No.: 1601



STANDARD GROUND FLOOR S21-01

647 SQ FT
GFA=1490 SQ FT

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Name:	Signature	BCIN

Registration information
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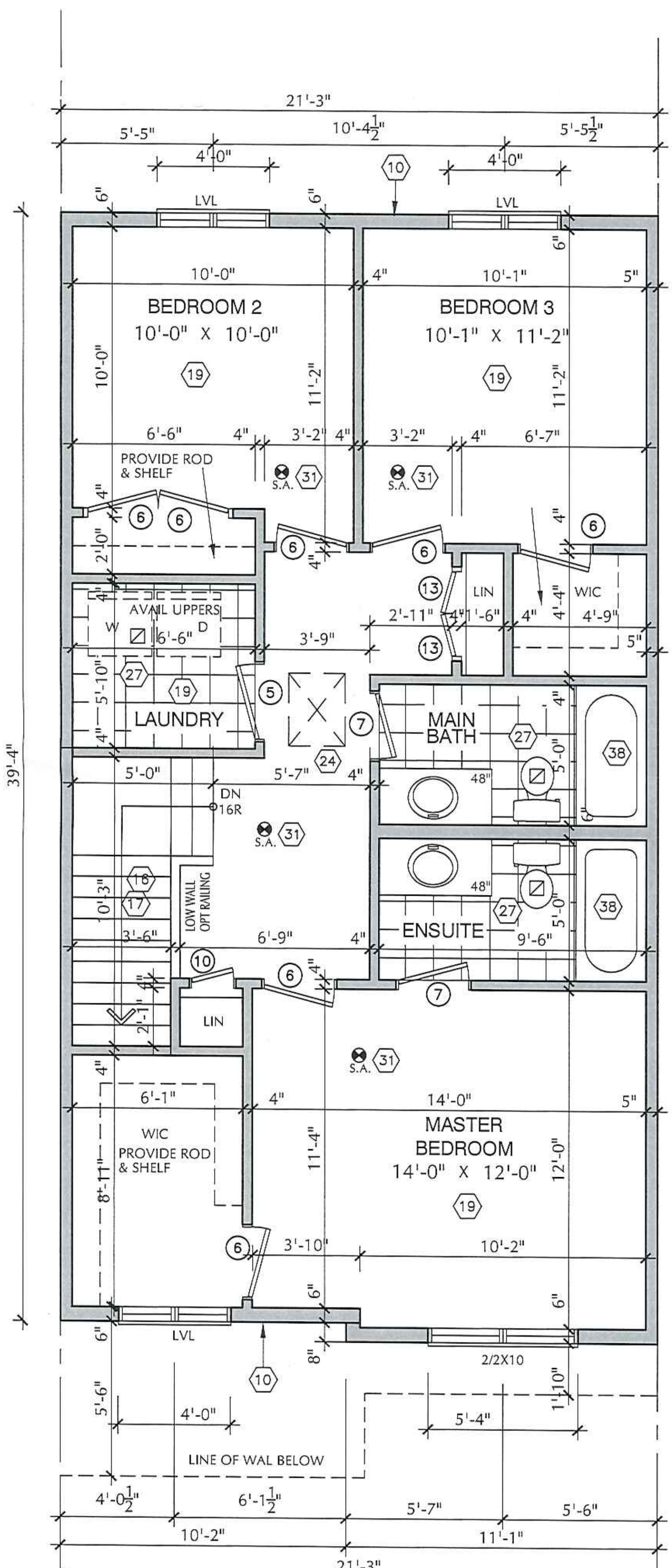
Capponi Lacroix Design Group Ltd.	28804
Name:	BCIN

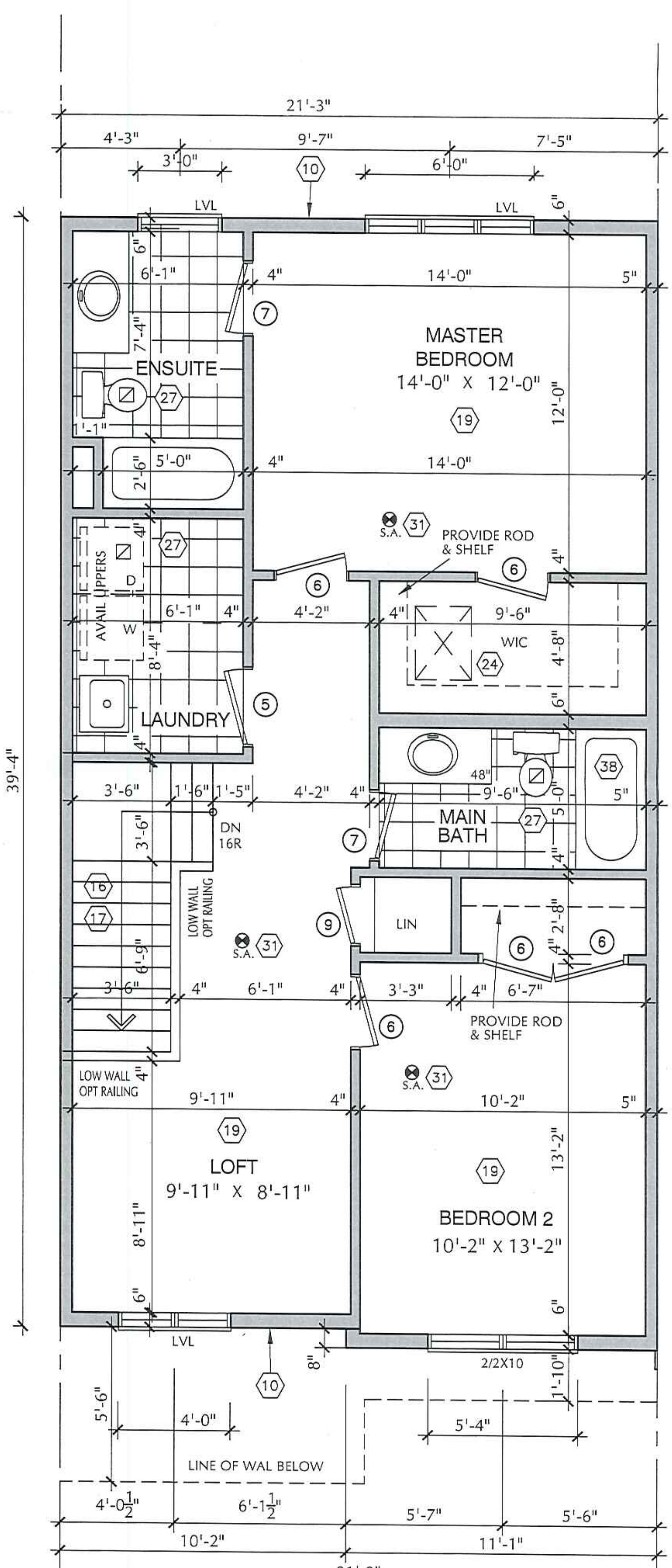
NO.	DATE	DESCRIPTION
4	MAR 01/17	METER LOCATIONS
3	FEB 09/17	ISSUED FOR PERMIT
2	NOV 28/16	CLIENT COMMENTS
1	FEB 25/16	ISSUED FOR TENDER

Client: PHELPS HOMES
Project Location: SMITHVILLE
Model Name: S21-01 STANDARD
Title: GROUND FLOOR PLAN
Drawing No.: A2
Scale: 3/16"=1'-0"
Drawn by: JMC
Date: FEB 2016
Project No.: 1601



STANDARD SECOND FLOOR S21-01

843 SQ FT



OPTIONAL 1 SECOND FLOOR S21-01

843 SQ FT

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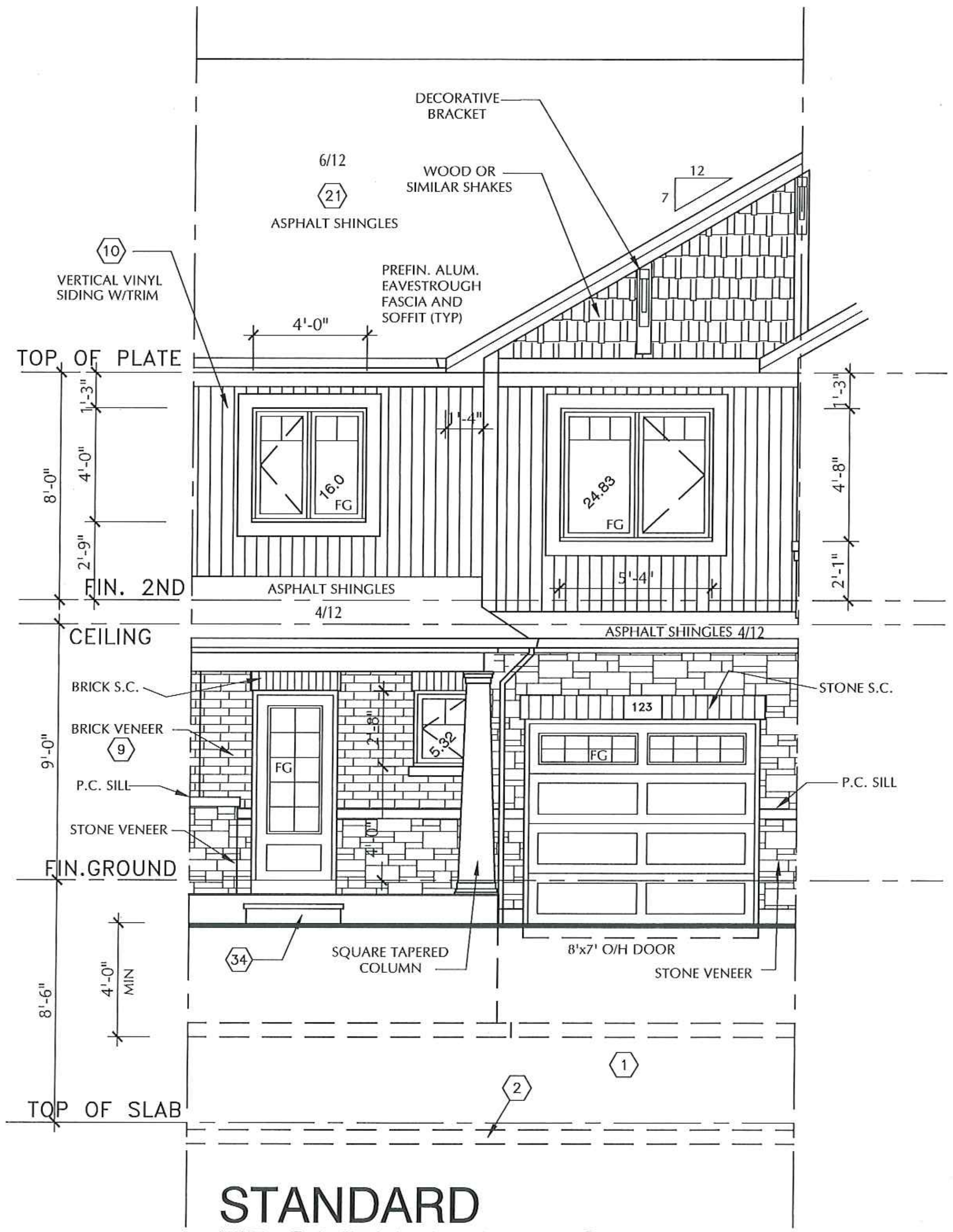
John Capponi		23522
Name:	Signature	BCIN

Registration information
Required unless design is exempt under Div.C.3.2.5.1 of the bldg code

Capponi Lacroix Design Group Ltd.	28804
Name:	BCIN

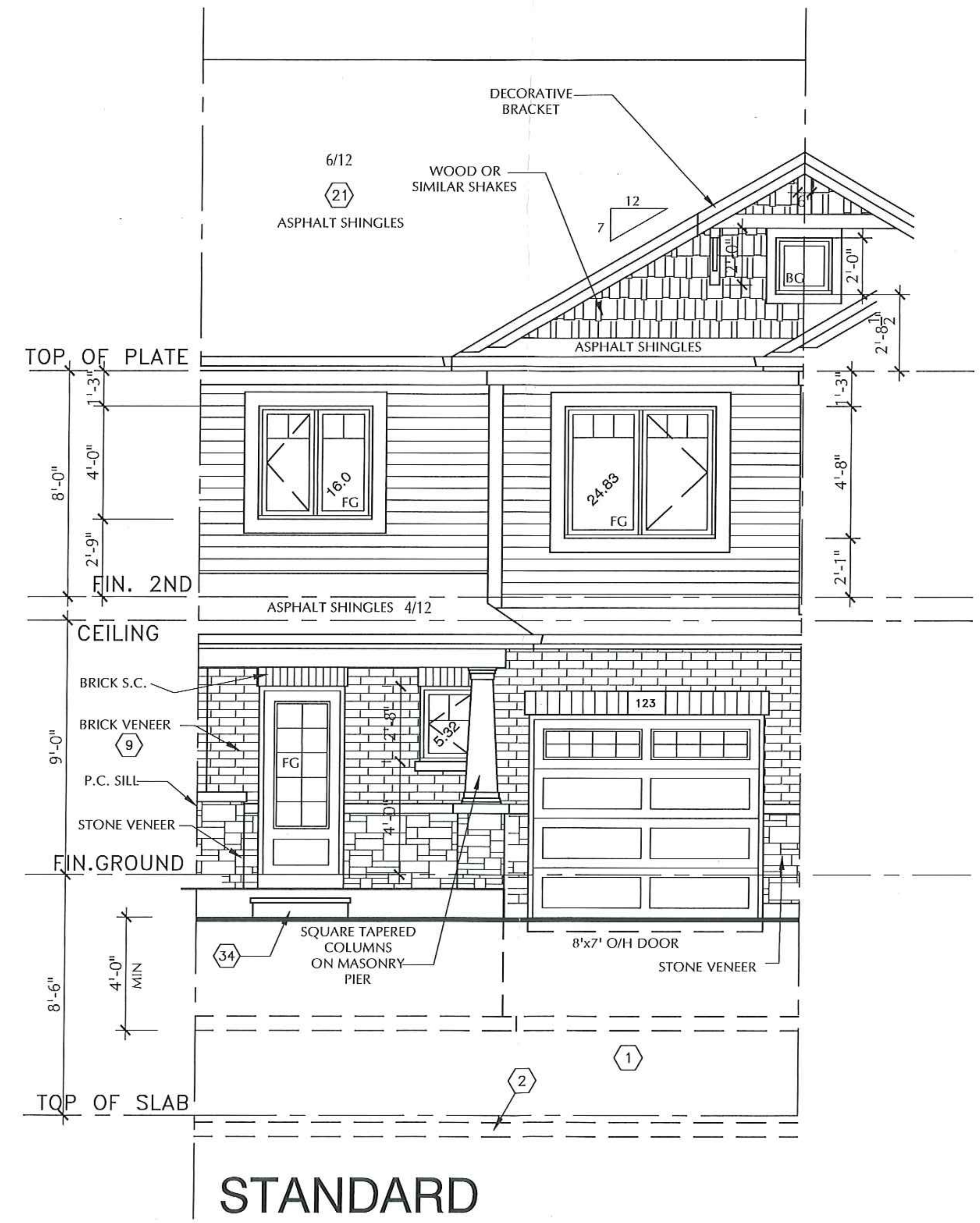
NO.	DATE	DESCRIPTION
4	MAR 01/17	METER LOCATIONS
3	FEB 09/17	ISSUED FOR PERMIT
2	NOV 28/16	CLIENT COMMENTS
1	FEB 25/16	ISSUED FOR TENDER

Client: PHELPS HOMES
Project Location: SMITHVILLE
Model Name: S21-01 STND/OPT
Title: SECOND FLOOR PLANS
Drawing No.: A3
Scale: 3/16"=1'-0"
Drawn by: JMC
Date: FEB 2016
Project No.: 1601



STANDARD
FRONT ELEV A S21-01

EEDS
PROPOSED WALL AREA = 410.83 SF (38.17 sm)
PROPOSED RSO= 46.15 SF (4.29 sm)



STANDARD
FRONT ELEV B S21-01

EEDS
PROPOSED WALL AREA = 410.83 SF (38.17 sm)
PROPOSED RSO= 46.15 SF (4.29 sm)

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Qualification information
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Name: John Capponi | Signature | 23522 BCIN

Registration information
Required unless design is exempt under Div.C3.2.5.1 of the bldg code

Name: Capponi Lacroix Design Group Ltd. | 28804 BCIN

NO.	DATE	DESCRIPTION
4	MAR 01/17	METER LOCATIONS
3	FEB 09/17	ISSUED FOR PERMIT
2	NOV 28/16	CLIENT COMMENTS
1	FEB 25/16	ISSUED FOR TENDER

Client: PHELPS HOMES

Project Location: SMITHVILLE

Model Name: S21-01

Title: FRONT ELEVATIONS A,B STANDARD

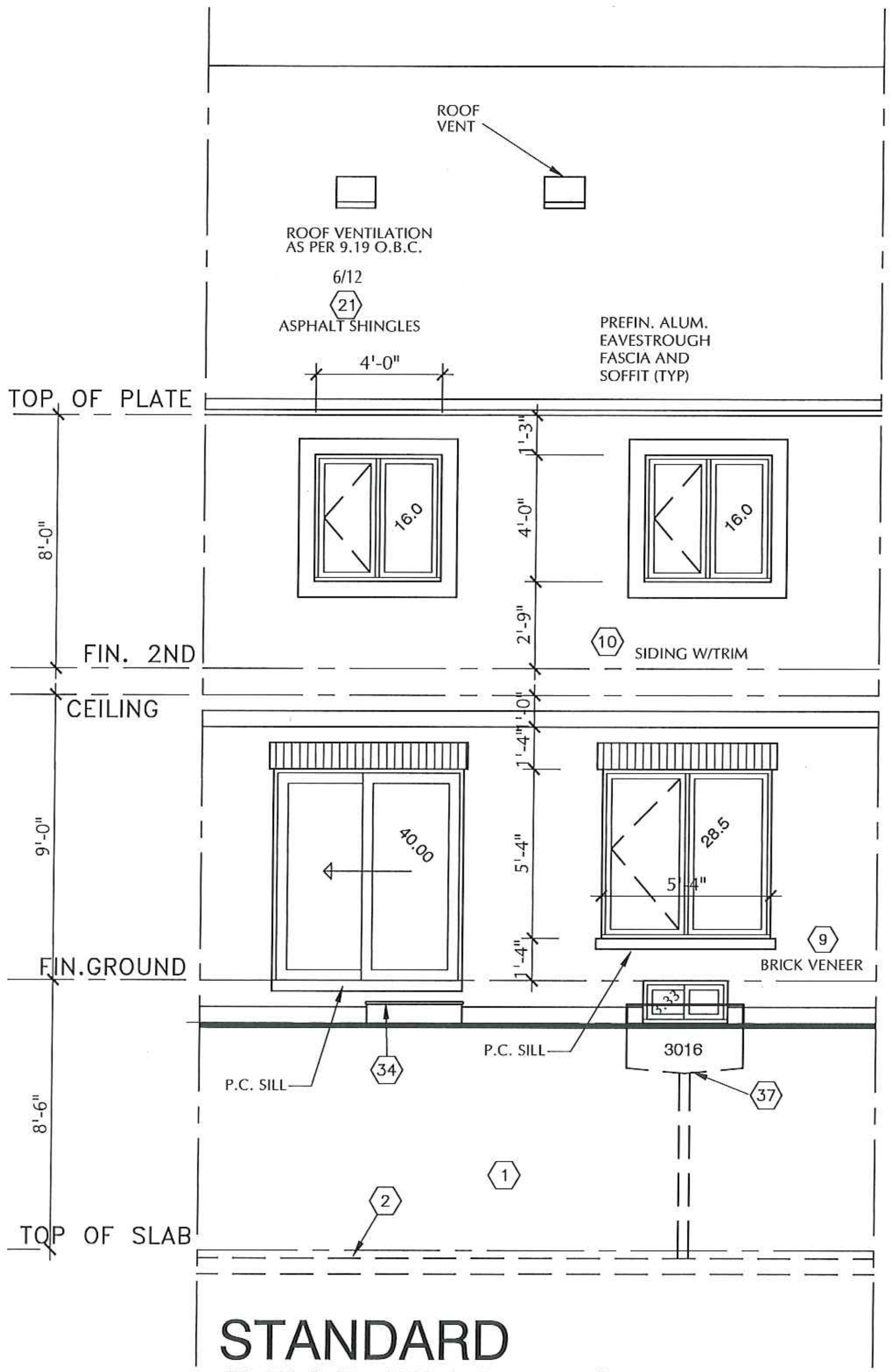
Drawing No.: A4

Scale: 3/16"=1'-0"

Drawn by: JMC

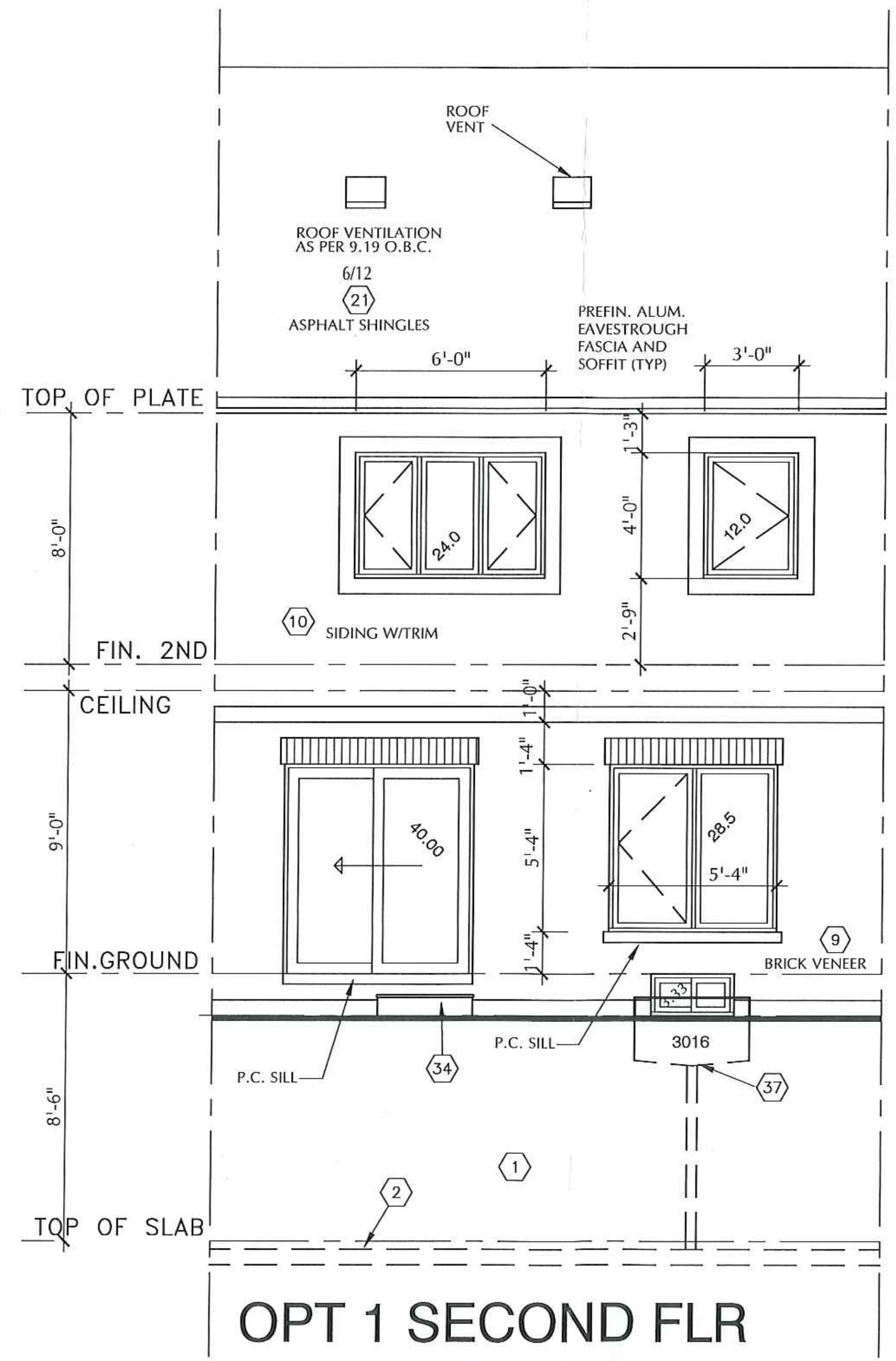
Date: FEB 2016

Project No.: 1601



STANDARD
REAR ELEV A S21-01

EEDS
PROPOSED WALL AREA = 407.27 SF (37.84 sm)
PROPOSED RSO= 118.93 SF (11.05 sm)



OPT 1 SECOND FLR
REAR ELEV A S21-01

EEDS
PROPOSED WALL AREA = 407.27 SF (37.84 sm)
PROPOSED RSO= 114.93 SF (10.68 sm)

CAPPONI LACROIX
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Qualification information
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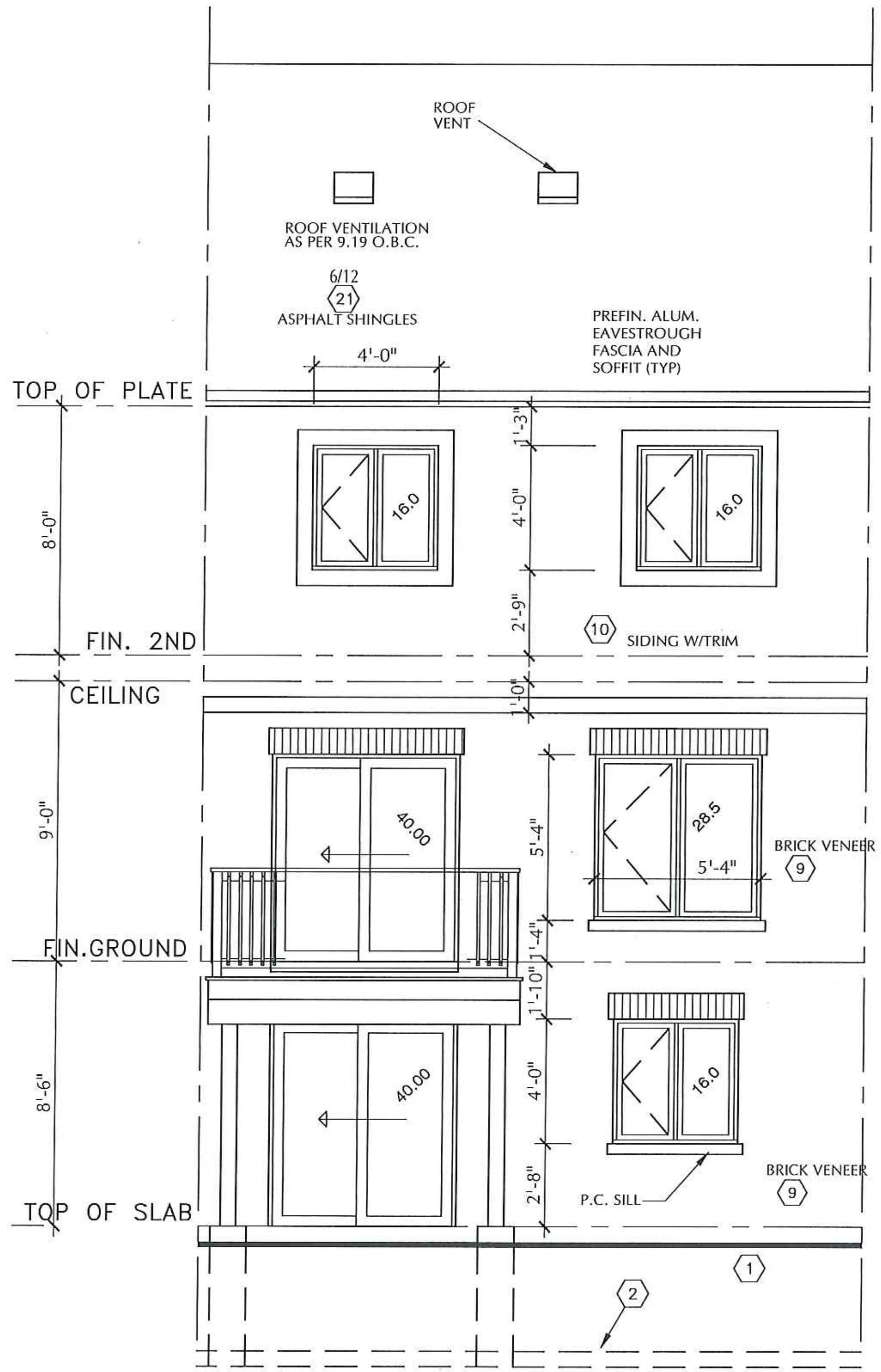
John Capponi		33522
Name:	Signature	BCIN

Registration information
Required unless design is exempt under Div.C:3.2.5.1 of the bldg code

Capponi Lacroix Design Group Ltd.	28804
Name:	BCIN

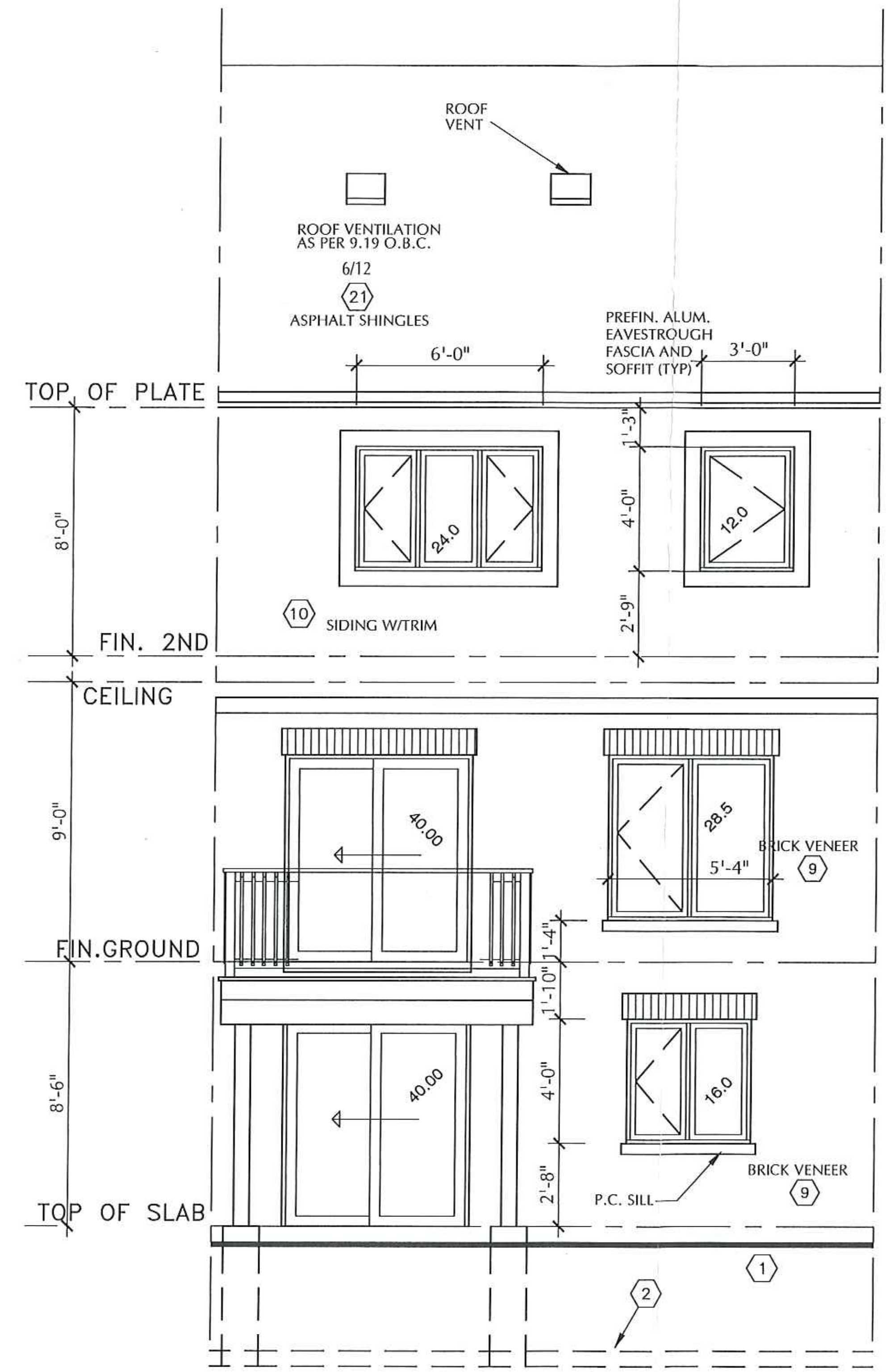
NO.	DATE	DESCRIPTION
4	MAR 01/17	METER LOCATIONS
3	FEB 09/17	ISSUED FOR PERMIT
2	NOV 28/16	CLIENT COMMENTS
1	FEB 25/16	ISSUED FOR TENDER

Client: PHELPS HOMES
Project Location: SMITHVILLE
Model Name: S21-01
Title: REAR ELEVATIONS STD, OPT
Drawing No.: A5
Scale: 3/16"=1'-0"
Drawn by: JMC
Date: FEB 2016
Project No.: 1601



STANDARD WALK OUT
REAR ELEV A S21-01

EEDS
PROPOSED WALL AREA = 570.23 SF (52.98 sm)
PROPOSED RSO= 171.60 SF (15.94 sm)



EEDS
PROPOSED WALL AREA = 570.23 SF (52.98 sm)
PROPOSED RSO= 175.60 SF (16.31 sm)

OPT 1 2ND FLOOR WALK OUT
REAR ELEV A S21-01

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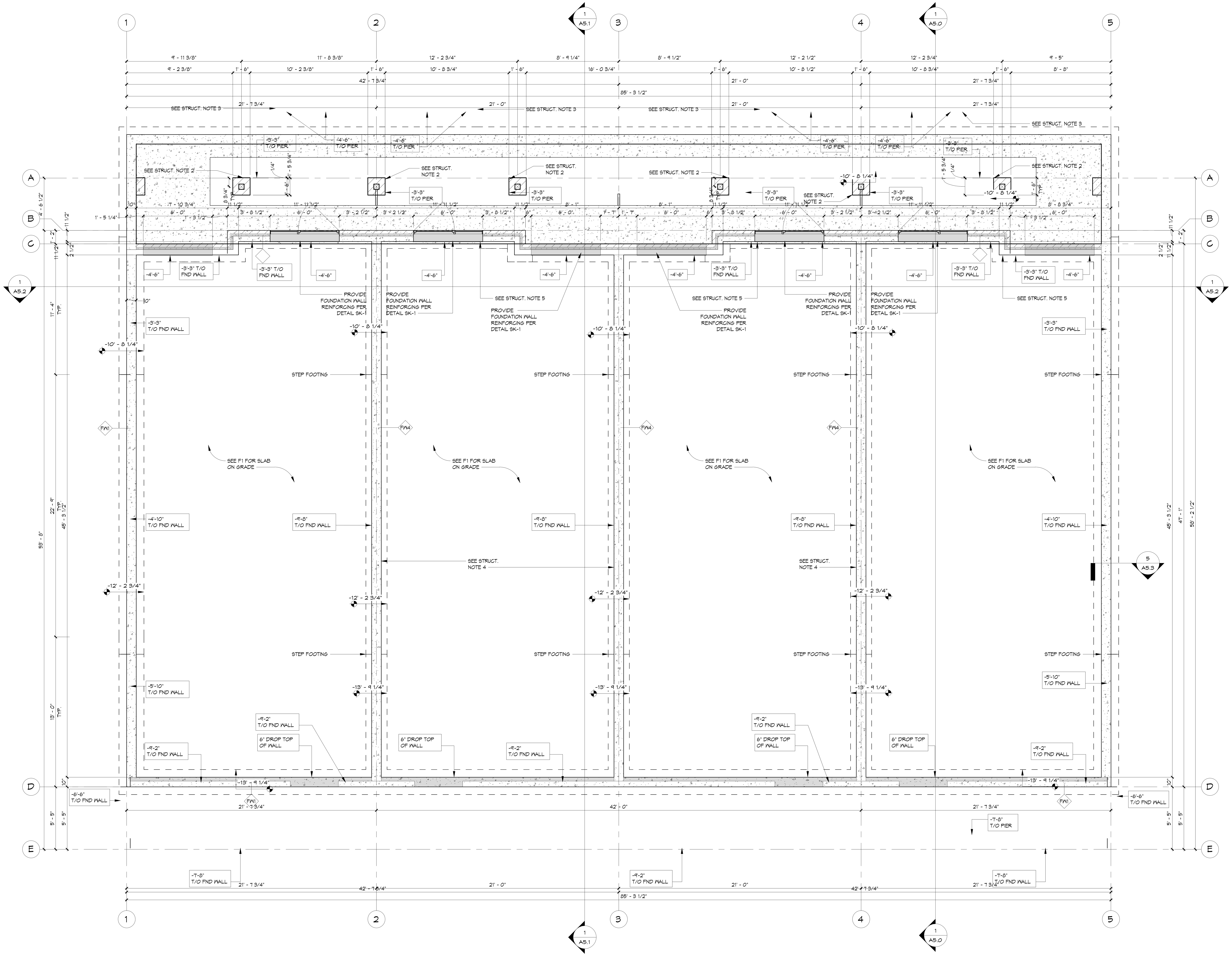
Name: John Capponi | Signature | 23522 BCIN

Registration information
Required unless design is exempt under Div.C.3.2.5.1 of the bldg code

Name: Capponi Lacroix Design Group Ltd. | 28804 BCIN

NO.	DATE	DESCRIPTION
4	MAR 01/17	METER LOCATIONS
3	FEB 09/17	ISSUED FOR PERMIT
2	NOV 28/16	CLIENT COMMENTS
1	FEB 25/16	ISSUED FOR TENDER

Client: PHELPS HOMES
Project Location: SMITHVILLE
Model Name: S21-01
Title: REAR W/O ELEVATIONS STD, OPT
Drawing No.: A6
Scale: 3/16"=1'-0"
Drawn by: JMC
Date: FEB 2016
Project No.: 1601



1 Foundation
A2.0 1/4" = 1'-0"

PRELIMINARY

PLAN LEGEND

- W1 xx HR. — WALL TYPES SEE A7.0; xx = FIRE RESISTANCE RATING
- A — WINDOW TYPES SEE A7.0
- D1 — DOOR TYPES SEE A7.0
- A3.0 — INTERIOR ELEVATIONS SEE A7.0
- E.F. — EXHAUST FAN
- S — SMOKE ALARM; NOTE: C/W STROBE AT EACH BEDROOM
- CO — CARBON MONOXIDE ALARM

NOTES:
1) STRUCTURAL ELEMENTS SHOWN FOR COORDINATION PURPOSES ONLY - REFER TO STRUCTURAL DWGS FOR ALL STRUCTURAL ITEMS.
2) ALL BEAMS, WALLS AND COLUMNS SUPPORTING 1-HR. RATED FLOORS ABOVE SHALL BE 1-HR. F.R.R.
3) ROD AND SHELF TYPICAL ALL CLOSETS.
4) ALL SHOWERS TO BE NO STEP TILE SHOWERS.
5) ALL TUBS TO BE STANDARD TUB AND TILE.
6) SHOP DRAWINGS STAMPED BY AN ENGINEER ARE TO BE PROVIDED FOR ALL GUARDS AND PRIVACY SCREENS FOR REVIEW PRIOR TO CONSTRUCTION.

STRUCTURAL NOTES

1) ALL EXTERIOR FOUNDATION WALLS ARE TO BE 10" PLAIN CONCRETE (U.N.O.) ON A MINIMUM 26"x8" CONCRETE STRIP FOOTING.
2) 18"x18" CONC. PIER (MINIMUM 48" DEEP) ON A MINIMUM 32"x32"x8" CONCRETE PAD FOOTING.
3) 12"x12" CONCRETE PIER (MINIMUM 48" DEEP) ON A MINIMUM 24"x24"x6" CONCRETE PAD FOOTING.
4) ALL PARTY WALL FOUNDATION WALLS ARE TO BE 10" PLAIN CONCRETE ON A MINIMUM 22"x6" CONCRETE STRIP FOOTING.
5) THE FRONT MOST FOUNDATION WALLS IS TO BE 12" PLAIN CONCRETE ON A MINIMUM 26"x8" CONCRETE STRIP FOOTING.
6) ALL WINDOW HEADERS ARE TO BE 2-2x10 (1JACK+1KING U.N.O.)

REVISIONS		DATE
1	For Client Review	20230403

Fryett Turner
ARCHITECTS INC
115 Metcalfe Street
Elora, Ontario N0B 1S0
www.ftarchitects.ca
Tel: 519-846-2201
Fax: 519-846-0343

SEAL

PROJECT NORTH

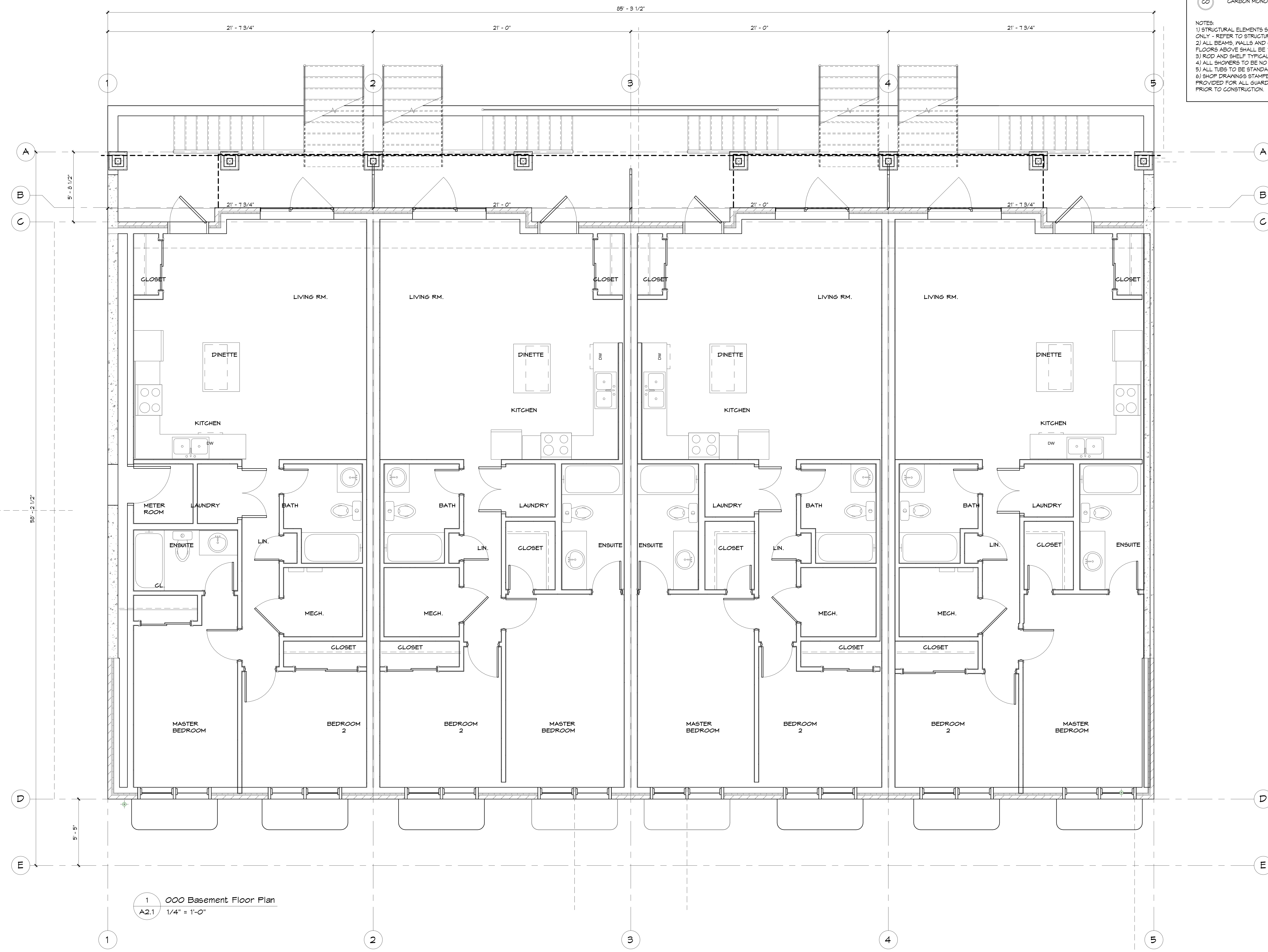
PROJECT
PHELPS HOMES STACKED TOWNS
College Street School

TITLE
Foundation Plan

STATUS	FEAS
PROJECT #	24022
CHKD	Checker
DRAWN	Author
SCALE	As indicated
DATE DWN	03/25/22
ISSUED	20240610

SHEET # A2.0

2024-08-26 3:36:34 PM



1 000 Basement Floor Plan
A2.1 1/4" = 1'-0"

PLAN LEGEND

- W1 xx HR. — WALL TYPES SEE A7.0; xx = FIRE RESISTANCE RATING
- A — WINDOW TYPES SEE A7.0
- D1 — DOOR TYPES SEE A7.0
- 1 A3.0 — INTERIOR ELEVATIONS SEE A7.0
- E.F. — EXHAUST FAN
- S — SMOKE ALARM; NOTE: C/W STROBE AT EACH BEDROOM
- CO — CARBON MONOXIDE ALARM

NOTES:
1) STRUCTURAL ELEMENTS SHOWN FOR COORDINATION PURPOSES ONLY - REFER TO STRUCTURAL DWGS FOR ALL STRUCTURAL ITEMS.
2) ALL BEAMS, WALLS AND COLUMNS SUPPORTING 1-HR. RATED FLOORS ABOVE SHALL BE 1-HR. F.R.R.
3) ROD AND SHELF TYPICAL ALL CLOSETS.
4) ALL SHOWERS TO BE NO STEP TILE SHOWERS.
5) ALL TUBS TO BE STANDARD TUB AND TILE.
6) SHOP DRAWINGS STAMPED BY AN ENGINEER ARE TO BE PROVIDED FOR ALL GUARDS AND PRIVACY SCREENS FOR REVIEW PRIOR TO CONSTRUCTION.

PRELIMINARY

REVISIONS	DATE

Fryett Turner
ARCHITECTS INC
115 Metcalfe Street
Elora, Ontario N0B 1S0
www.ftarchitects.ca
Tel: 519-846-2201
Fax: 519-846-0343

SEAL

PROJECT NORTH

PROJECT: PHELPS HOMES STACKED TOWNS
College Street School

TITLE: Basement Plan

STATUS	FEAS
PROJECT #	24022
CHKD	Checker
DRAWN	Author
SCALE	As indicated
DATE DWN	20230327
ISSUED	20240610

SHEET #
A2.1

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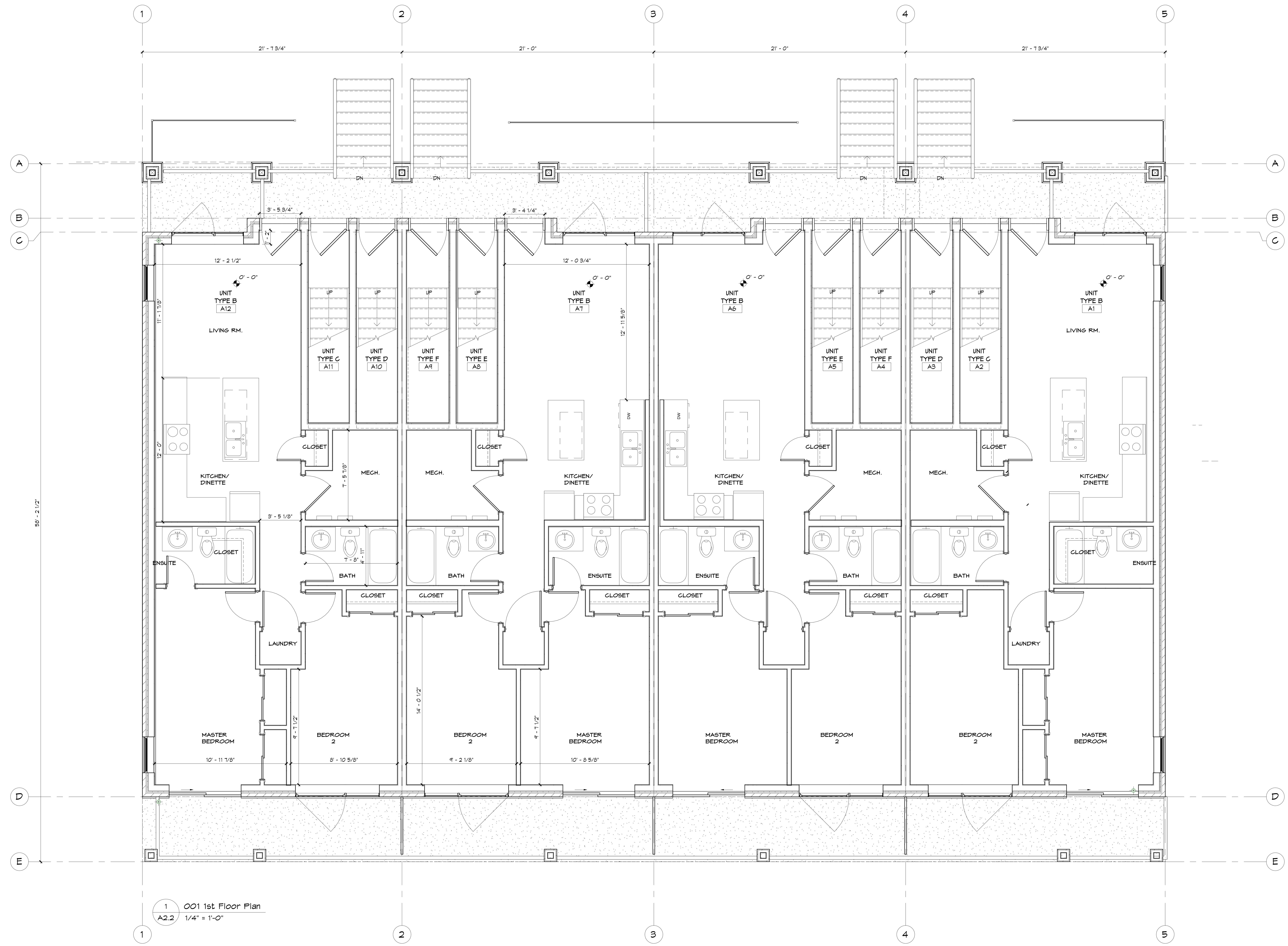


1 A2.2 001 1st Floor Plan
1/4" = 1'-0"

2024-08-26 3:36:35 PM

REVISIONS DATE

Fryett Turner
ARCHITECTS INC
115 Metcalfe Street
Elora, Ontario N0B 1S0
www.frarchitects.ca
Tel: 519-846-2201
Fax: 519-846-0343

THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN THE COURSE OF THE WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE ARCHITECT PRIOR TO THE COMMENCEMENT OF THE WORK. UNDER NO CIRCUMSTANCES SHALL THE CONTRACTOR PROCEED IN UNCERTAINTY.

SEAL

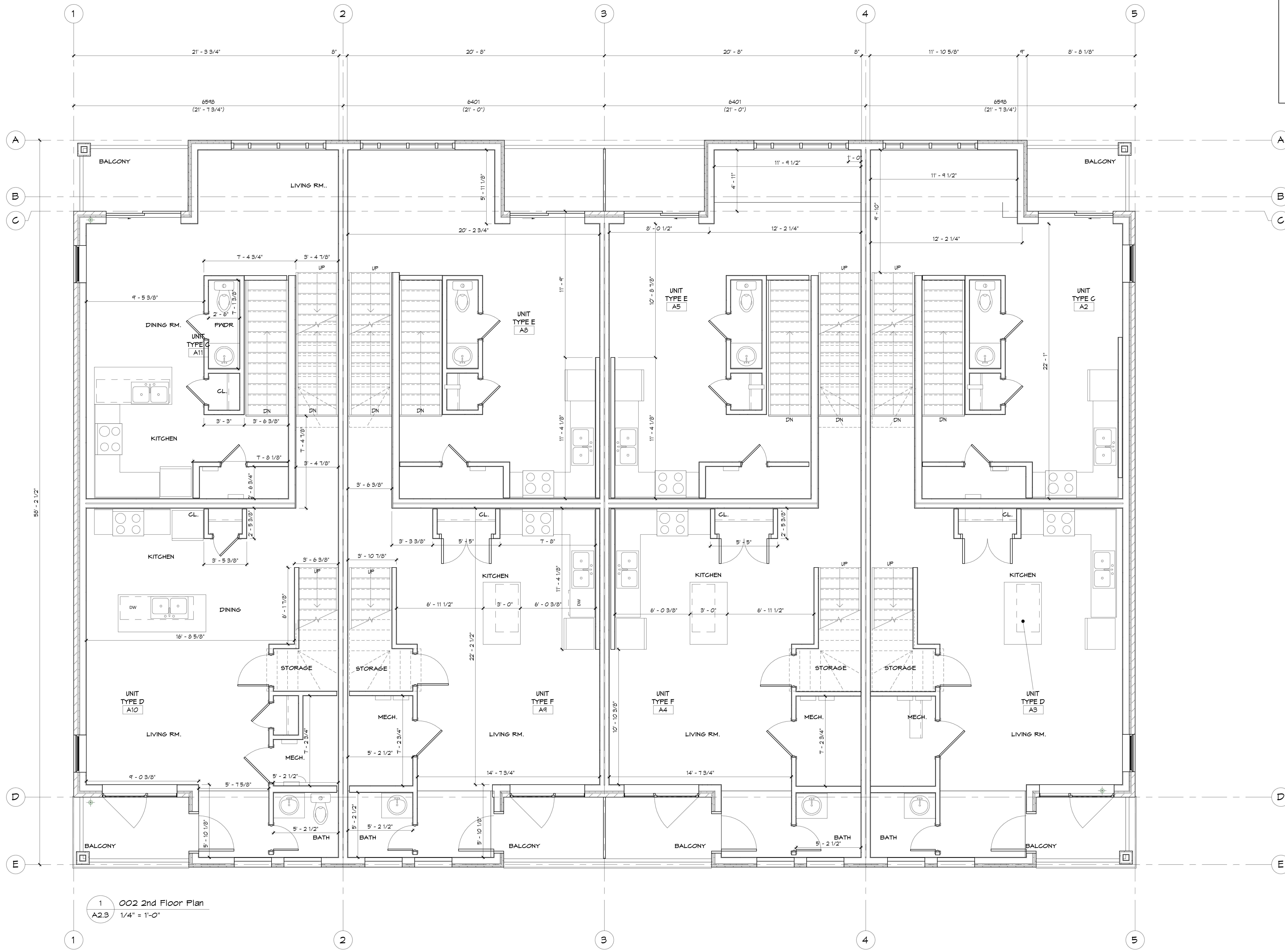
PROJECT NORTH

PROJECT
PHELPS HOMES STACKED TOWNS
College Street School

TITLE
1st Floor Plan

STATUS	FEAS
PROJECT #	24022
CHKD	Checker
DRAWN	Author
SCALE	1/4" = 1'-0"
DATE DWN	20200723
ISSUED	20240610

SHEET #
A2.2



1 A2.3 002 2nd Floor Plan
1/4" = 1'-0"

2024-08-26 3:36:36 PM

PLAN LEGEND

W1 xx HR.	WALL TYPES SEE A7.0 xx = FIRE RESISTANCE RATING
A	WINDOW TYPES SEE A7.0
D1	DOOR TYPES SEE A7.0
1 A3.0	INTERIOR ELEVATIONS SEE A7.0
E.F.	EXHAUST FAN
S	SMOKE ALARM NOTE: C/W STROBE AT EACH BEDROOM
CO	CARBON MONOXIDE ALARM

NOTES:
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3) ROD AND SHELF TYPICAL ALL CLOSETS.
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DO NOT SCALE DRAWINGS.

SEAL

PROJECT NORTH

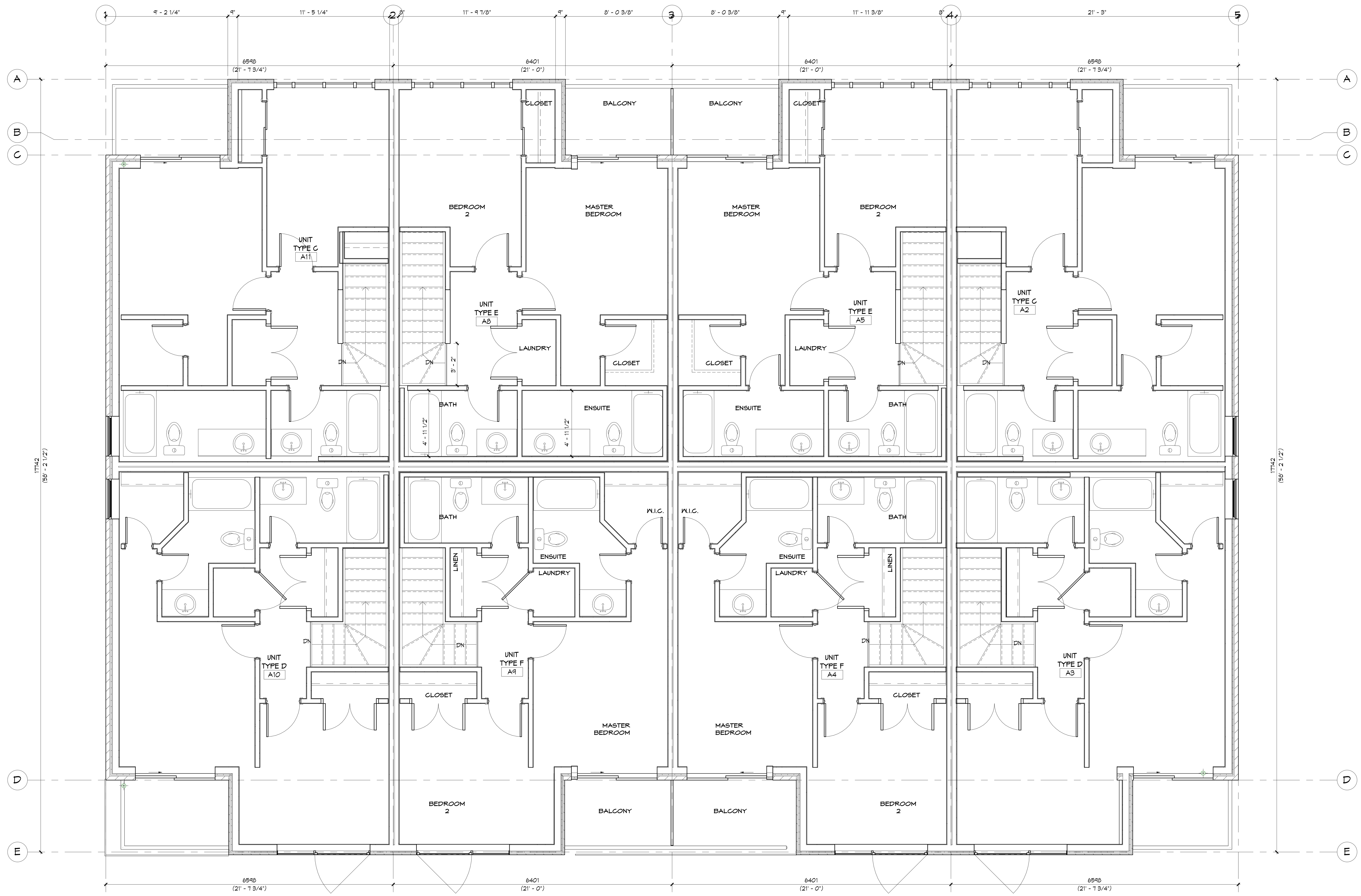
PROJECT
PHELPS HOMES STACKED TOWNS
College Street School

TITLE
2nd Floor Plan

STATUS	FEAS
PROJECT #	24022
CHKD	Checker
DRAWN	Author
SCALE	As indicated
DATE DWN	20200723
ISSUED	20240610

REVISIONS DATE

SHEET #
A2.3



1 / A2.4 — 003 3rd Floor Plan
1/4" = 1'-0"

PRELIMINARY

2024-08-26 3:36:37 PM

REVISIONS | DATE

THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN THE COURSE OF THE WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE ARCHITECT PRIOR TO THE COMMENCEMENT OF THE WORK. UNDER NO CIRCUMSTANCES SHALL THE CONTRACTOR PROCEED IN UNCERTAINTY.

ALL DRAWINGS AND SPECIFICATIONS PREPARED BY THE ARCHITECT ARE HIS PROPERTY AS INSTRUMENTS OF HIS SERVICE AND ARE TO BE RETURNED AT HIS REQUEST.

DO NOT SCALE DRAWINGS.

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Fax: 519-846-0343

SEAL

PROJECT NORTH

PROJECT: PHELPS HOMES STACKED TOWNS
College Street School

TITLE: 3rd Floor Plan

STATUS	FEAS
PROJECT #	24022
CHKD	Checker
DRAWN	Author
SCALE	1/4" = 1'-0"
DATE DWN	01/07/2022
ISSUED	20240610

SHEET # A2.4

GENERAL GRADING NOTES:

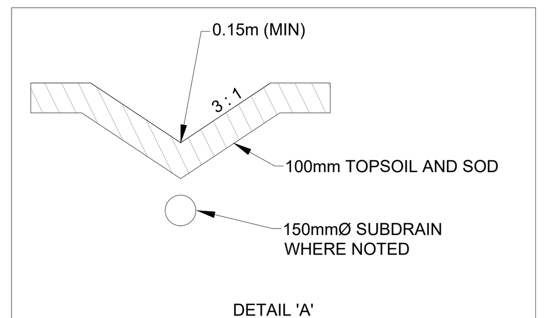
1. MATCH EXISTING GRADE AT PROPERTY / DEVELOPMENT LIMITS WITH SODDED SLOPES OF MAXIMUM 3:1 AND/OR RETAINING WALLS AS SPECIFIED.
2. SLOPES OF SWALES FOR BOTH "BACK-TO-FRONT" AND "SPLIT" DRAINAGE SHALL BE NO LESS THAN 2.0% AND NO GREATER THAN 33% (3:1).
3. MINIMUM GRADE FOR APRON "WRAP-AROUND" SWALE AT THE REAR OF THE UNIT SHALL BE 1.0%.
4. WHEN MATCHING TO EXISTING GRADE AT THE LIMITS OF THE DEVELOPMENT / PROPERTY WHERE 2.0% SLOPE CANNOT BE REASONABLY ACHIEVED A 1.5% GRADE IS PERMITTED PROVIDED A 150MM SUB-DRAIN IS INSTALLED WITH THE SWALE AS PER SMITHVILLE SWALE DETAIL AND CONNECTED TO A SUITABLE OUTLET.
5. DRIVEWAY SLOPES SHALL NOT BE LESS THAN 2.0% AND SHALL NOT BE MORE THAN 7.0%. REVERSED SLOPED DRIVEWAYS ARE NOT ALLOWED FOR ANY NEW CONSTRUCTION.
6. GARAGE FLOOR ELEVATION SHALL BE SET A MINIMUM OF 0.30M HIGHER THAN THE BACK OF WALK, UNLESS OTHERWISE SPECIFIED.
7. THE TOP OF FOUNDATION WALL FOR THE DWELLING UNIT SHALL BE A MINIMUM 150MM (6") ABOVE FINISHED GRADE.
8. UNLESS OTHERWISE NOTED, THE GROUND BETWEEN PROPOSED ELEVATIONS SHALL BE GRADED AS A STRAIGHT LINE.
9. IF GRADING IS REQUIRED ON LANDS ADJACENT TO THE PROPERTY / DEVELOPMENT WHICH ARE NOT OWNED BY THE DEVELOPER, THEN THE DEVELOPER MUST OBTAIN WRITTEN PERMISSION FROM THE ADJACENT PROPERTY OWNER, OTHERWISE RETAINING WALLS MUST BE USED.
10. ALL RETAINING WALLS SHALL BE PLACED A MINIMUM 0.45M FROM PROPERTY LINES.
11. ANY WALL OF GREATER HEIGHT THAN 1.0M MUST BE DESIGNED BY A PROFESSIONAL ENGINEER.
12. TOP OF RETAINING WALL ELEVATIONS SHALL BE SET A MINIMUM OF 150MM ABOVE THE PROPOSED SIDE-YARD SWALES.
13. RETAINING WALLS 0.60M AND HIGHER REQUIRE CONSTRUCTION OF A FENCE OR GUARD RAIL AT THE TOP OF THE REAR OF THE WALL. SUCH FENCES OR GUARD RAILS SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF THE ONTARIO BUILDING CODE.
14. ALL FILL COMPACTED ON THE LOT(S) SHALL BE COMPACTED TO A MINIMUM 95% SPD (UNLESS OTHERWISE RECOMMENDED BY A GEOTECHNICAL ENGINEER). MATERIALS SHALL BE PLACED IN LIFTS NOT EXCEEDING 300MM DEPTH.
15. FOR DELINEATION OF TREE PROTECTION ZONES, BUFFERS, REMOVALS, AND PROTECTION SCHEMATICS REFER TO THE TREE PROTECTION PLAN (IF APPLICABLE).

BACKYARD GRADING NOTES:

1. "REQUIRED BACKYARD" SHALL BE A MINIMUM OF 6.0 METRES UNLESS OTHERWISE DEFINED IN THE APPLICABLE ZONING BY-LAW.
2. THE MAXIMUM SLOPE IN THE BACKYARD ADJACENT TO THE BUILDING FOR A DISTANCE EQUAL TO THE REQUIRED BACKYARD SHALL BE 5% EXCEPT FOR SIDE OR REAR YARD SWALES AND RETAINING WALLS.
3. WHERE THE 5% RESTRICTION ON THE BACKYARD'S GRADES RESULTS IN ELEVATION DIFFERENCES BETWEEN ADJACENT PROPERTIES, RETAINING WALL SHALL BE CONSTRUCTED ALONG THE SIDES AND BACK OF THE LOT.
4. GENERALLY, SLOPES SHALL BE PLACED ON THE LOWER LOT, WHEREAS RETAINING WALLS SHALL BE PLACED ON THE HIGHER LANDS.
5. THE 5% RESTRICTION DOES NOT PRECLUDE RETAINING WALLS IN THE REQUIRED BACKYARDS PROVIDING THE TERRACES ARE MAINTAINED TO THE 5% GRADE AS SET OUT ABOVE. THE INTENTION OF THIS PROVISION IS TO PROVIDE FOR FLEXIBILITY OF HOUSE CONSTRUCTION.
6. BACK TO FRONT DRAINAGE SHALL ONLY BE PERMITTED WHERE THE COMBINED SIDE YARD SETBACK IS 2.0m OR MORE, PROVIDING A MINIMUM OF 2.0m BETWEEN FOUNDATION WALLS FOR DRAINAGE SWALES. A 1.2m SETBACK IS REQUIRED ON THE GARAGE SIDE OF THE LOT

SILTATION AND EROSION CONTROL NOTES:

1. SILTATION CONTROL BARRIERS SHALL BE PLACED AS DETAILED ON THE PLAN ACCORDING TO OPSD 219.110 (SEE DETAIL ON THIS SHEET).
2. ALL SILTATION CONTROL MEASURES SHALL BE CLEANED AND MAINTAINED AFTER EACH RAINFALL EVENT TO THE SATISFACTION OF THE CITY OF HAMILTON.
3. CATCH BASIN SEDIMENT CONTROL DEVICES SHALL BE SILTSACK BY ACF ENVIRONMENTAL OR APPROVED EQUIVALENT, TO BE PLACED AS PER THE MANUFACTURER'S RECOMMENDATIONS (IF APPLICABLE).
4. ADDITIONAL SILTATION CONTROL MEASURES MAY BE REQUIRED AS PER FIELD CONDITIONS AS DETERMINED BY THE CITY.



DETAIL 'A'
TYPICAL SWALE CROSS SECTION
N.T.S.

KEY PLAN N.T.S.

BENCHMARK NOTE:
ELEVATION =
MONUMENT:

SITE BENCHMARK :
ELEVATION =

GENERAL NOTES:

1. TENDERER SHALL SATISFY THEMSELVES AS TO THE NATURE OF THE GROUND AND BID ACCORDINGLY.
2. ALL ROCK LINE INDICATIONS SHOWN ON THE PLAN MUST BE VERIFIED BY THE CONTRACTOR.
3. CONTRACTOR SHALL VERIFY LOCATIONS AND INVERTS OF ALL EXISTING SANITARY AND STORM SEWERS AND WATERMAINS, PRIVATE DRAINS AND WATER SERVICES, GAS MAINS, CABLE TV, HYDRO AND TELEPHONE DUCTS ETC AT START OF CONSTRUCTION.

NO:	DATE:	DESCRIPTION:
2	2025-06-11	REVISED PER CITY COMMENTS
1	2024-09-26	SWM SUBMISSION
0	2024-08-12	FOR CLIENT REVIEW

REVISIONS

SEAL

LandSmith
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HAMILTON, ON L9C 3A6
ANDREW@LANDSMITHEC.COM
289-309-3632

CLIENT:
2853972 ONTARIO INC.

MUNICIPALITY:
TOWNSHIP OF WEST LINCOLN

PROJECT NAME:
COLLEGE STREET SCHOOL

TITLE:
SITE GRADING PLAN

SCALE: 1:400	DATE: 2022-09-27
CHECKED BY: AS	DESIGNED BY: AS
DWG No: 22046PHE	SHEET No: 1

DRAWING FILE: Z:\Project Files\PROJECTS_Smithville\132 College Street, Smithville_CAD\BASE PLAN – 132 College Street.dwg PLOTTED: Jun 11, 2025 – 11:19am PLOTTED BY: BrandonCole

KEY PLAN N.T.S.

BENCHMARK NOTE:

ELEVATION =
MONUMENT:

SITE BENCHMARK :
ELEVATION =

GENERAL NOTES:

1. TENDERER SHALL SATISFY THEMSELVES AS TO THE NATURE OF THE GROUND AND BID ACCORDINGLY.
2. ALL ROCK LINE INDICATIONS SHOWN ON THE PLAN MUST BE VERIFIED BY THE CONTRACTOR.
3. CONTRACTOR SHALL VERIFY LOCATIONS AND INVERTS OF ALL EXISTING SANITARY AND STORM SEWERS AND WATERMAINS, PRIVATE DRAINS AND WATER SERVICES, GAS MAINS, CABLE TV, HYDRO AND TELEPHONE DUCTS ETC AT START OF CONSTRUCTION.

NO:	DATE:	DESCRIPTION:
2	2025-06-11	REVISED PER CITY COMMENTS
1	2024-09-26	SWM SUBMISSION
0	2024-08-12	FOR CLIENT REVIEW

REVISIONS

SEAL

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LANDSMITH ENGINEERING & CONSULTING LTD.
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289-775-9374

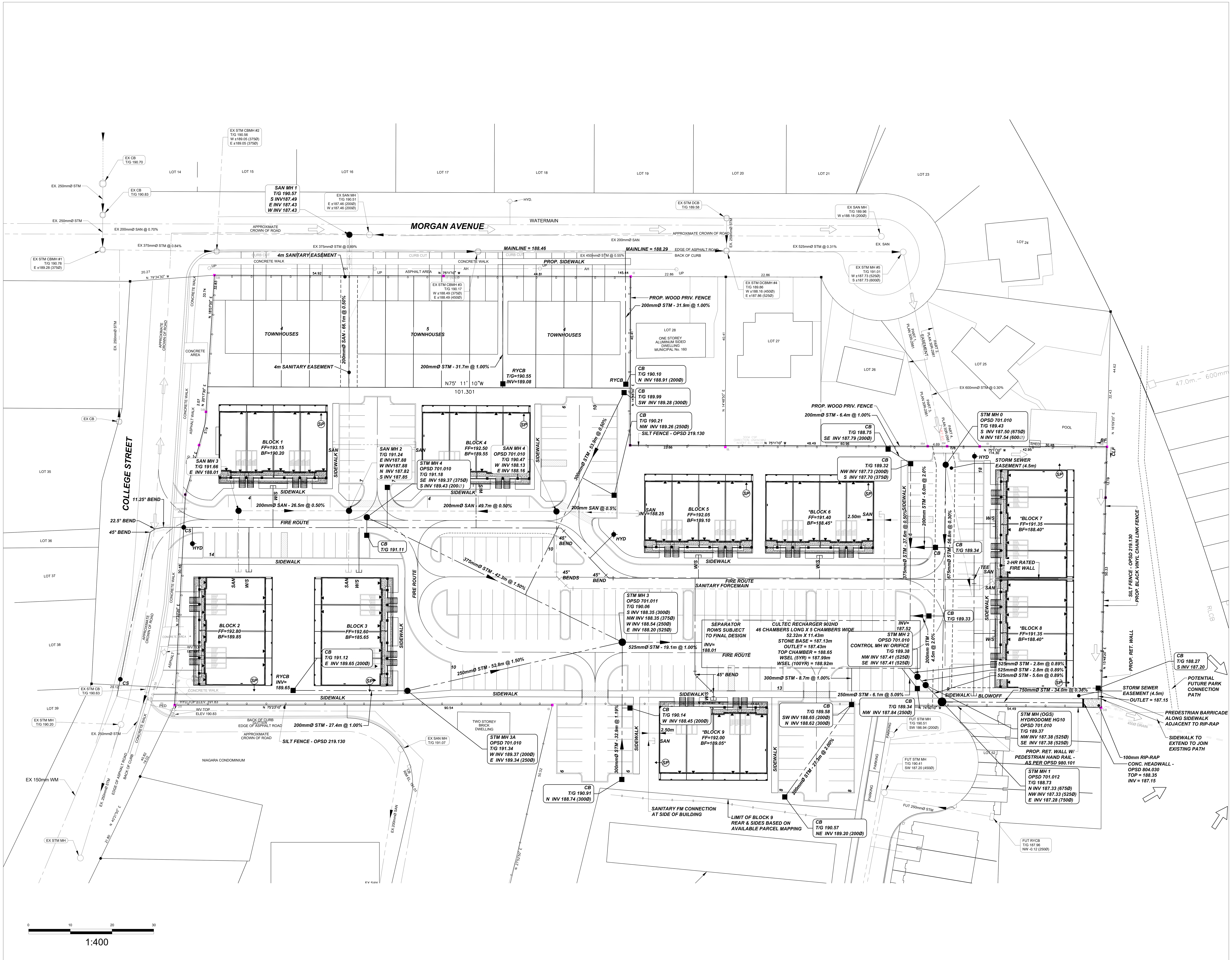
CLIENT:
2853972 ONTARIO INC.

MUNICIPALITY:
TOWNSHIP OF WEST LINCOLN

PROJECT NAME:
COLLEGE STREET SCHOOL

TITLE:
SITE SERVICING PLAN

SCALE: 1:400	DATE: 2022-10-06
CHECKED BY: AS	DESIGNED BY: AS
DWG No: 22046PHE	SHEET No: 4



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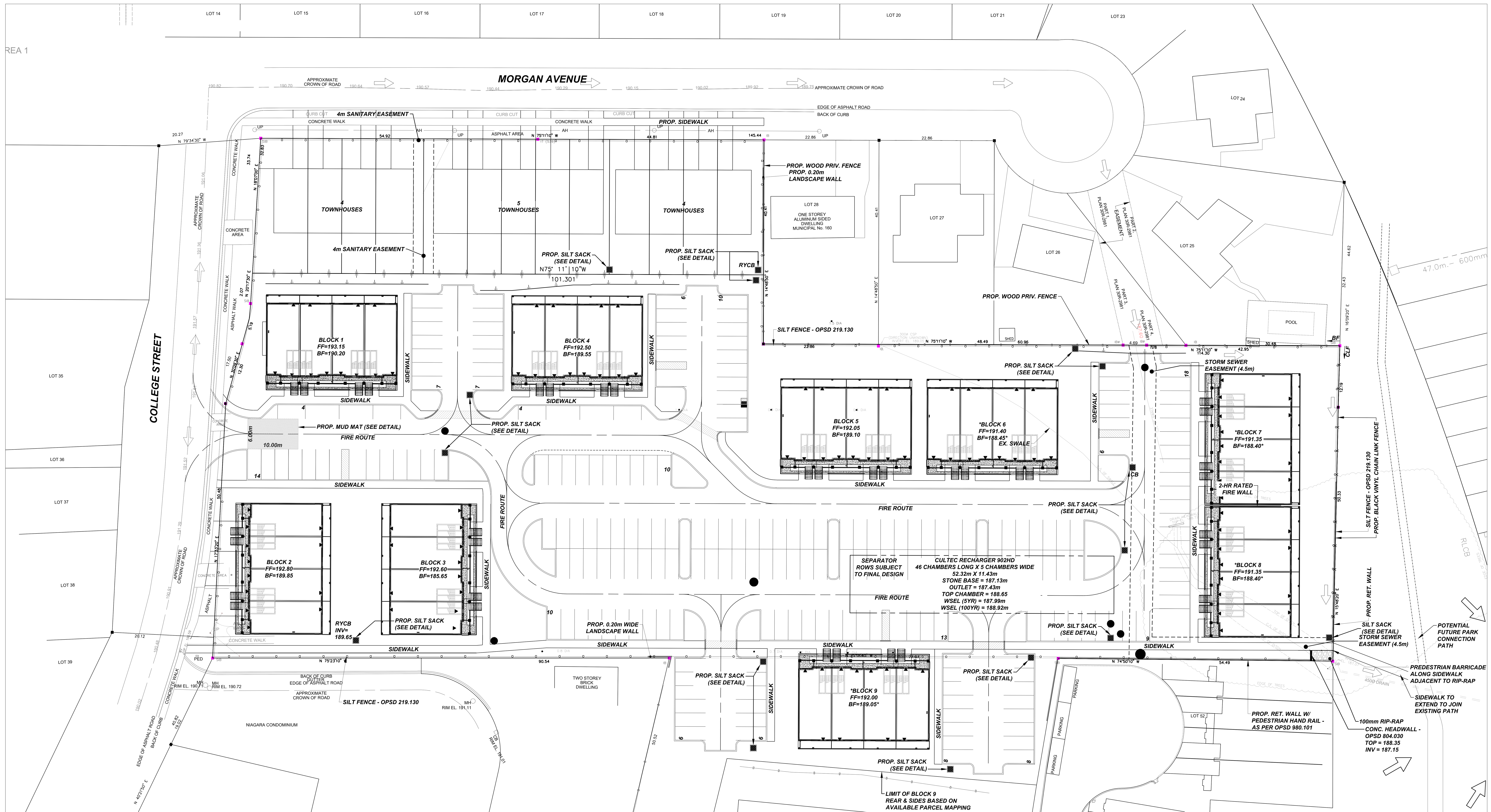


KEY PLAN N.T.S.

BENCHMARK NOTE:

ELEVATION =
MONUMENT:

SITE BENCHMARK :

ELEVATION =

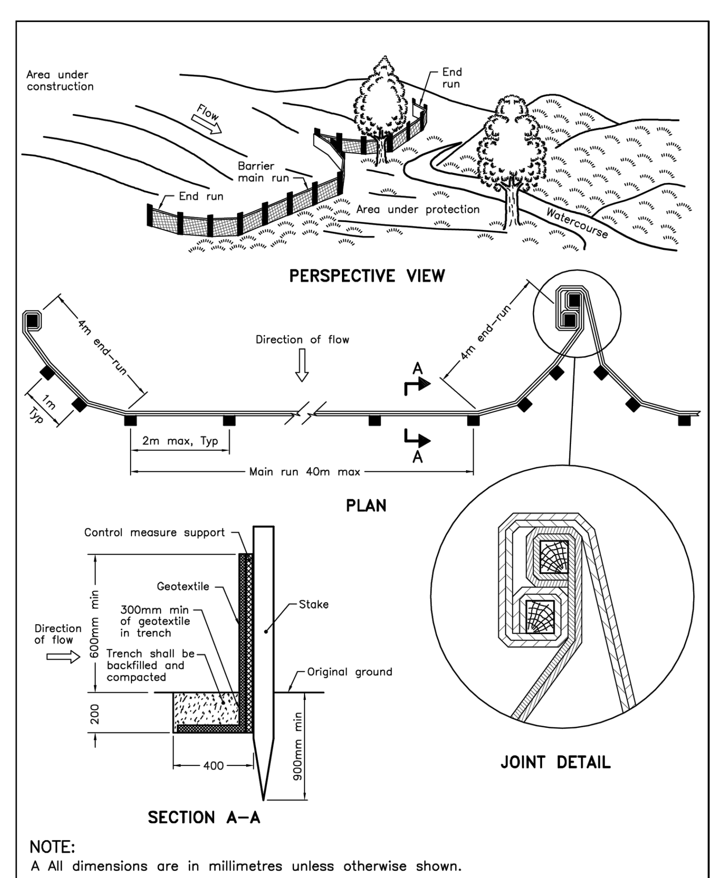
GENERAL NOTES:

1. TENDERER SHALL SATISFY THEMSELVES AS TO THE NATURE OF THE GROUND AND BID ACCORDINGLY.
2. ALL ROCK LINE INDICATIONS SHOWN ON THE PLAN MUST BE VERIFIED BY THE CONTRACTOR.
3. CONTRACTOR SHALL VERIFY LOCATIONS AND INVERTS OF ALL EXISTING SANITARY AND STORM SEWERS AND WATERMAINS, PRIVATE DRAINS AND WATER SERVICES, GAS MAINS, CABLE TV, HYDRO AND TELEPHONE DUCTS ETC AT START OF CONSTRUCTION.

NO:	DATE:	DESCRIPTION:
1	2025-06-11	REVISED PER CITY COMMENTS
0	2024-08-12	FOR CLIENT REVIEW

REVISIONS

SEAL

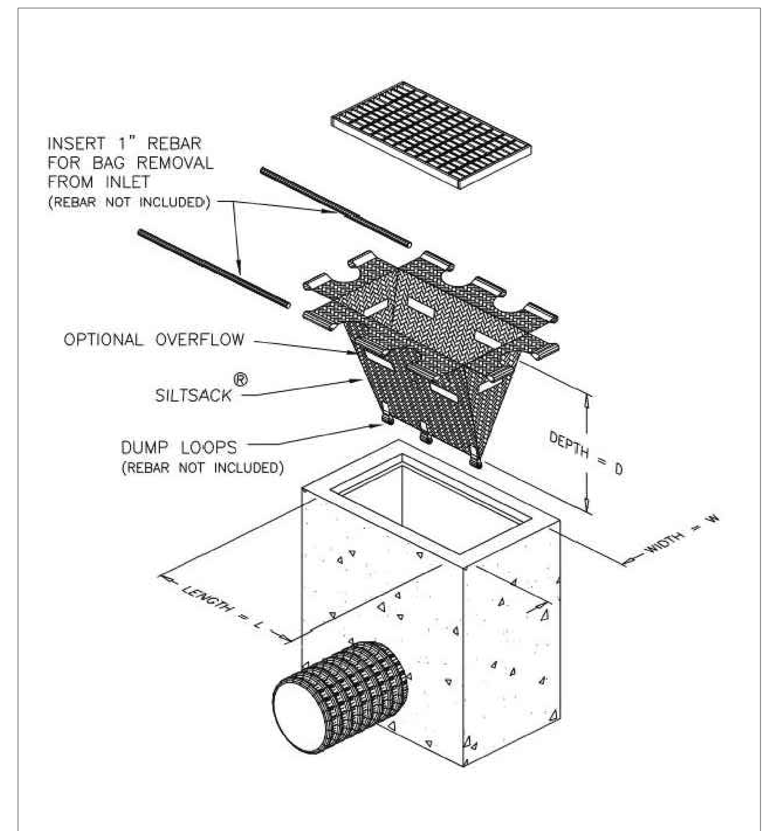


NOTE:
A All dimensions are in millimetres unless otherwise shown.

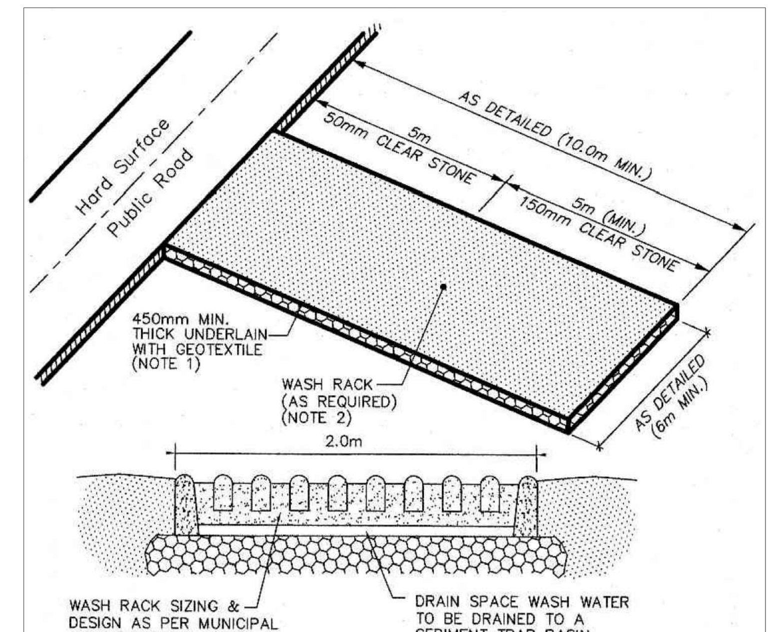
ONTARIO PROVINCIAL STANDARD DRAWING Nov 2015 Rev 2

HEAVY-DUTY SILT FENCE BARRIER

OPSD 219.130



SILT-SACK DETAIL



NOTES : 1. GEOTEXTILE FILTER FABRIC AS PER TERRAFIX 270R OR APPROVED EQUIVALENT
2. MAY BE REQUIRED AS DETERMINED BY THE CITY ENGINEER/CONSERVATION AUTHORITY.

MUD MAT

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ANDREW@LANDSMITHEC.COM
289-775-9374

CLIENT: 2853972 ONTARIO INC.

MUNICIPALITY: TOWNSHIP OF WEST LINCOLN

PROJECT NAME: COLLEGE STREET SCHOOL

TITLE: SITE EROSION & SEDIMENT CONTROL PLAN

SCALE: 1:400	DATE: 2022-10-06
CHECKED BY: AS	DESIGNED BY: AS
DWG No: 22046PHE	SHEET No: 4

DRAWING FILE: Z:\Project Files\PROJECTS_Smithville\132 College Street, Smithville_CAD\BASE PLAN - 132 College Street.dwg PLOTTED: Jun 11, 2025 - 11:24am PLOTTED BY: BrandonCole

APPENDIX 'B' – Water Servicing Analysis

Domestic Water Demand Calculations

Fire Flow Requirement Calculations

Figure F1: Fire Protection Plan

Figure 3.A.8: Smithville Existing Max Day Demand Pressure (Region of Niagara, 2016 MSP)

Figure 3.A.9: Smithville Existing System Fire Flow (Region of Niagara, 2016 MSP)

Date: 2024-09-19

LandSmith
ENGINEERING & CONSULTING LTD.

DOMESTIC WATER USEAGE REQUIREMENTS

Project: 132 COLLEGE STREET, SMITHVILLE
Method: Fixture Unit Method, Per OBC Table 7.6.3.2.A

Fixtures: The number of fixtures was estimated based on the Floor Plans provided by Fryett Turner Architects Inc. dated August 26, 2024, and Capponi Lacroix Design Group Ltd. dated March 2017.

Amount	Fixture Type	Fixture Units Per	Total
327	Private Bathroom Group	3.6	1177.2
157	Dishwasher	1.4	219.8
157	Kitchen Sink	1.4	219.8
157	Clothes Washer	1.4	219.8
26	Lavatory	0.7	18.2
85	Water Closet	2.2	187
	Total:		***2041.8***

1 - Reference Table 7.6.3.2.A, Ontario Building Code

Hydraulic Load: Fixture units are then transferred to Hydaulic Load based on Ontario Building Code Table 7.4.10.5.

Column 1	Column 2	Column 3	Column 4
Fixture Units in service	*Max Drainage Rate (Gal/m)*		
	Col. 1	Col. 1 × 10	Col. 1 × 100
100	53	174	900
90	51	164	835
80	49	153	750
70	47	140	680
60	44	128	600
50	41	115	520
40	38	102	435
30	33	88	350
20	27	72	262
10	21	53	174

Maximum hydraulic load is estimated to be 266 Imperial Gallons / Minute

2042 Fixture Units = 266 Imp Gal/min = 20.15 Lps

The estimated maximum hydraulic load for the proposed development is 20.15 Liters per second.

LandSmith
ENGINEERING & CONSULTING LTD.

Date: 2024-08-07

FIRE FLOW DEMAND REQUIREMENTS

Project: 132 COLLEGE STREET, SMITHVILLE
Method: OFM-TG-03-1999
FIRE PROTECTION WATER SUPPLY GUIDELINE FOR PART 3 IN THE ONTARIO BUILDING CODE
http://www.mcscs.jus.gov.on.ca/english/FireMarshal/Legislation/TechnicalGuidelinesandReports/TG-1999-03.html

Formula:

$$Q = K \times V \times S_{Tot}$$

Where:
Q = minimum supply of water in litres
K = water supply coefficient (Table 1)
V = total building volume in cubic meters
S_{Tot} = total of spacial coefficient tables

Volume (V)

Middle Block (fronting Morgan Avenue)

Ground Floor Area:	429.14	(sq.m)
Height:	6	(m)
Building Volume:	2574.84	(cu.m)

Water Supply Coefficient (K)

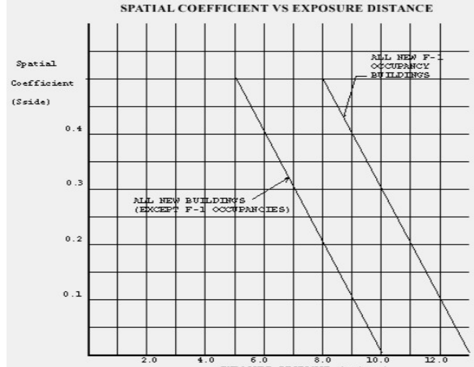
K: 18
OBC Part: C (Residential)
Construction Type: *Building is of combustible construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2. of the OBC, including loadbearing walls, columns and arches. Noncombustible construction may be used in lieu of fire-resistance rating where permitted in Subsection 3.2.2. of the OBC.*

Spacial Coefficients (S)

		Distance	
S_1	0	38.0	(North)
S_2	1.06	2.4	(East)
S_3	0	15.3	(South)
S_4	0.9	4	(West)

$S_{Tot} = 1.0 + S_1 + S_2 + S_3 + S_4 \quad = \quad 2.96$

FIGURE 1
SPATIAL COEFFICIENT VS EXPOSURE DISTANCE



Q = ***137,187***

Required Flow Rate = ***4,500*** **L / Min**
75 **L / Sec**

Table 2:
Minimum Water Supply Flow Rates

Building Code, Part 3 Buildings	**Required Minimum Water Supply Flow Rate (L/min.)**
One-storey building with building area not exceeding 600m² (excluding F-1 occupancies)	1800
All other buildings	2700 (If **Q** ≤ 108,000L)(1) 3600 (If **Q** > 108,000L **and** ≤ 135,000L)(1) 4500 (If **Q** > 135,000L **and** ≤ 162,000L)(1) 5400 (If **Q** > 162,000L **and** ≤ 190,000L)(1) 6300 (If **Q** > 190,000L **and** ≤ 270,000L)(1) 9000 (If **Q** > 270,000L)(1)

LandSmith ENGINEERING & CONSULTING LTD.

Date: 2024-08-07

FIRE FLOW DEMAND REQUIREMENTS

Project: 132 COLLEGE STREET, SMITHVILLE
Method: OFM-TG-03-1999
FIRE PROTECTION WATER SUPPLY GUIDELINE FOR PART 3 IN THE ONTARIO BUILDING CODE
http://www.mcscs.jus.gov.on.ca/english/FireMarshal/Legislation/TechnicalGuidelinesandReports/TG-1999-03.html

Formula:

$$Q = K \times V \times S_{Tot}$$

Where:
- Q = minimum supply of water in litres
- K = water supply coefficient (Table 1)
- V = total building volume in cubic meters
- S_{Tot} = total of spacial coefficient tables

Volume (V)

Block 6

Ground Floor Area:	397.57	(sq.m)
Height:	10.7	(m)
Building Volume:	4254.00	(cu.m)

Water Supply Coefficient (K)

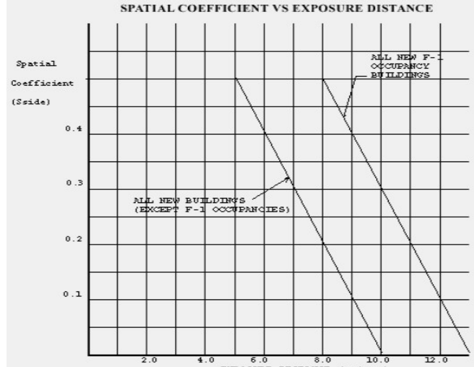
K: 18
OBC Part: C (Residential)
Construction Type: *Building is of combustible construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2. of the OBC, including loadbearing walls, columns and arches. Noncombustible construction may be used in lieu of fire-resistance rating where permitted in Subsection 3.2.2. of the OBC.*

Spacial Coefficients (S)

		Distance	
S_1	0	23.0	(North)
S_2	0	30.6	(East)
S_3	0	37.3	(South)
S_4	1	3	(West)

$S_{Tot} = 1.0 + S_1 + S_2 + S_3 + S_4$ = 2

FIGURE 1
SPATIAL COEFFICIENT VS EXPOSURE DISTANCE

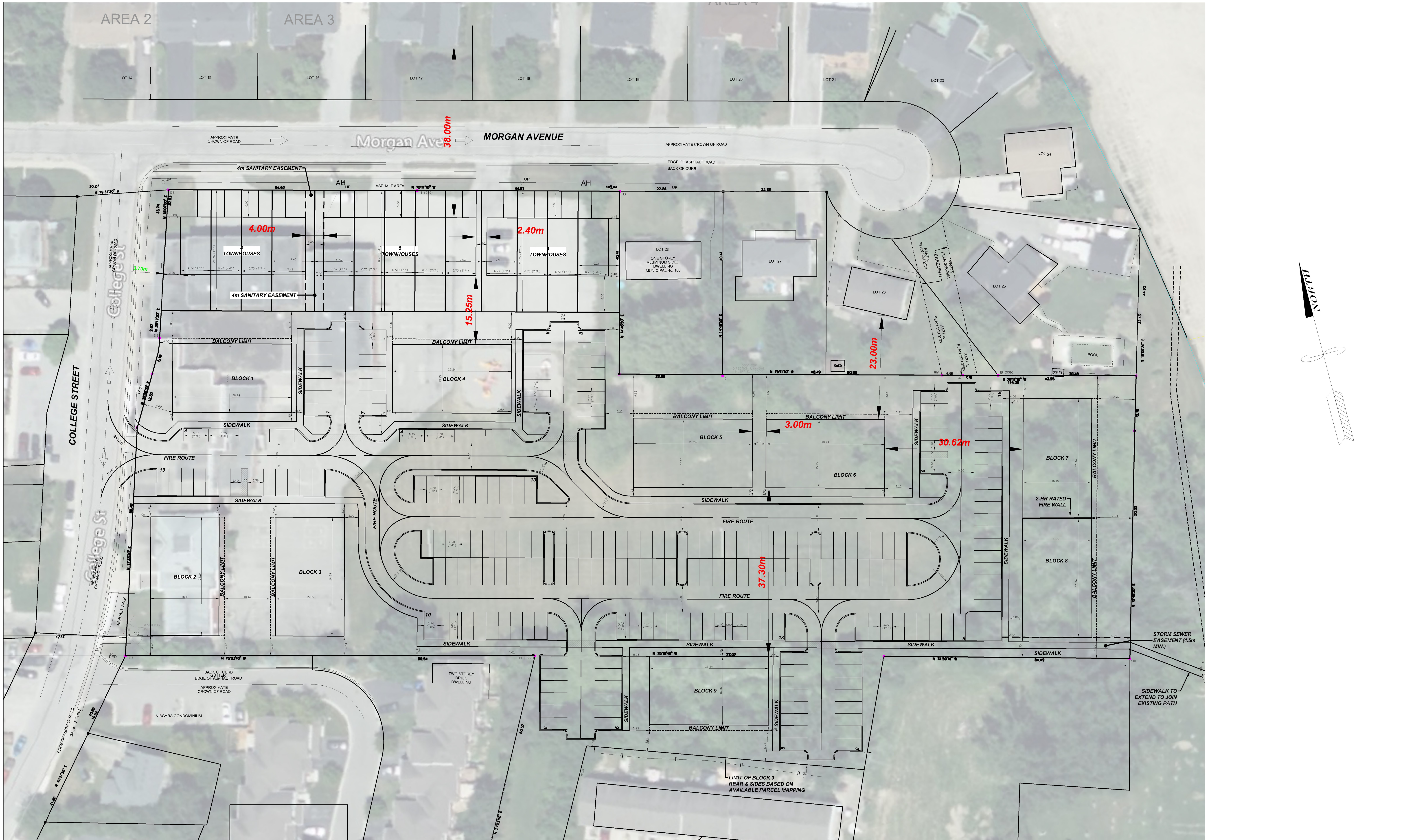


Q = ***153,144***

Required Flow Rate = ***4,500*** **L / Min**
75 **L / Sec**

Table 2:
Minimum Water Supply Flow Rates

Building Code, Part 3 Buildings	**Required Minimum Water Supply Flow Rate (L/min.)**
One-storey building with building area not exceeding 600m² (excluding F-1 occupancies)	1800
All other buildings	2700 (If **Q** ≤ 108,000L)(1) 3600 (If **Q** > 108,000L **and** ≤ 135,000L)(1) 4500 (If **Q** > 135,000L **and** ≤ 162,000L)(1) 5400 (If **Q** > 162,000L **and** ≤ 190,000L)(1) 6300 (If **Q** > 190,000L **and** ≤ 270,000L)(1) 9000 (If **Q** > 270,000L)(1)



SCALE:

0 10 20 30 40 50 60

1:750

LandSmith ENGINEERING & CONSULTING LTD.

PROJECT: 132 COLLEGE ST.

FIRE PROTECTION PLAN

FIGURE F1

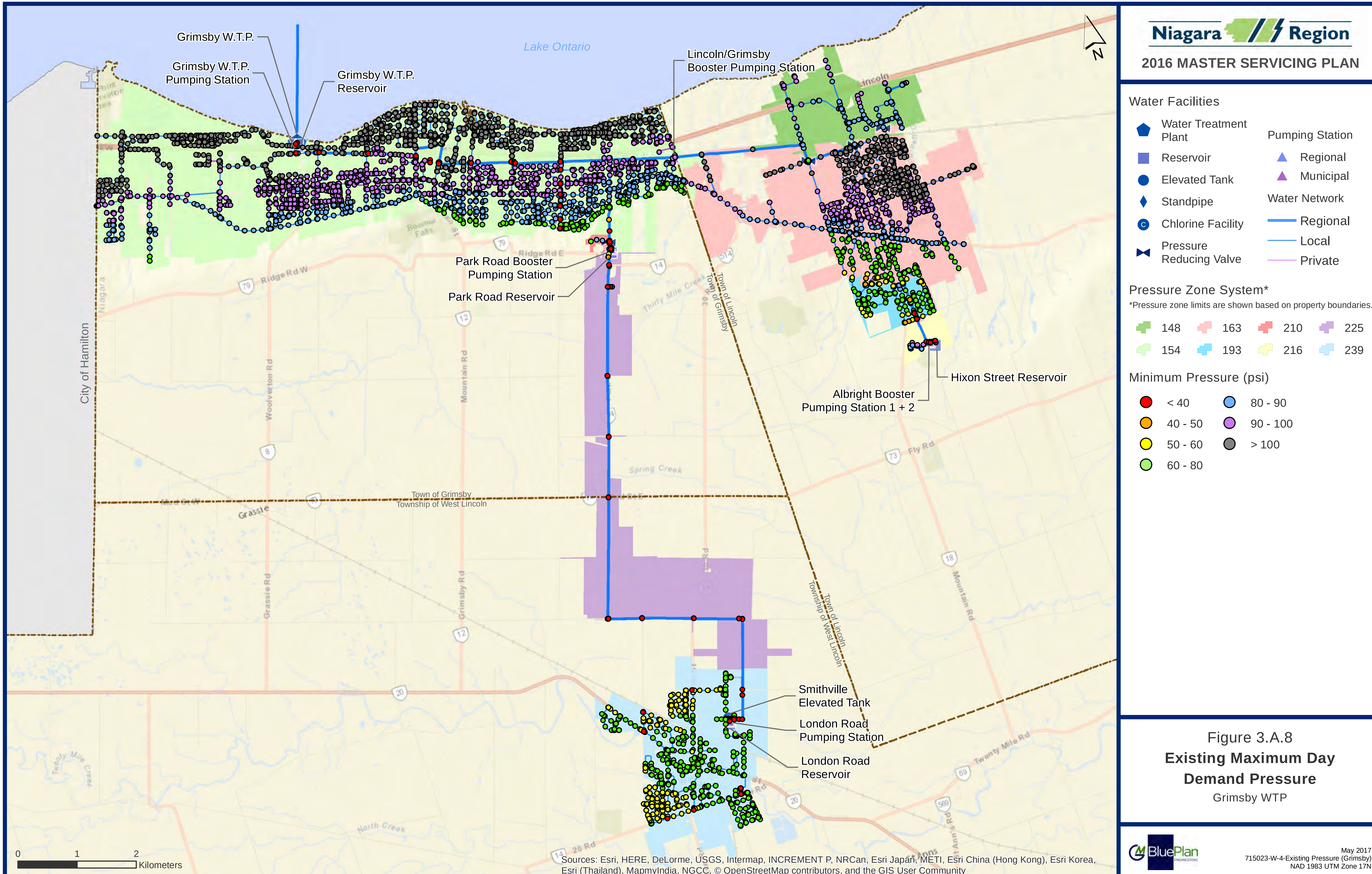


Figure 3.A.8
Existing Maximum Day Demand Pressure
Grimsby WTP

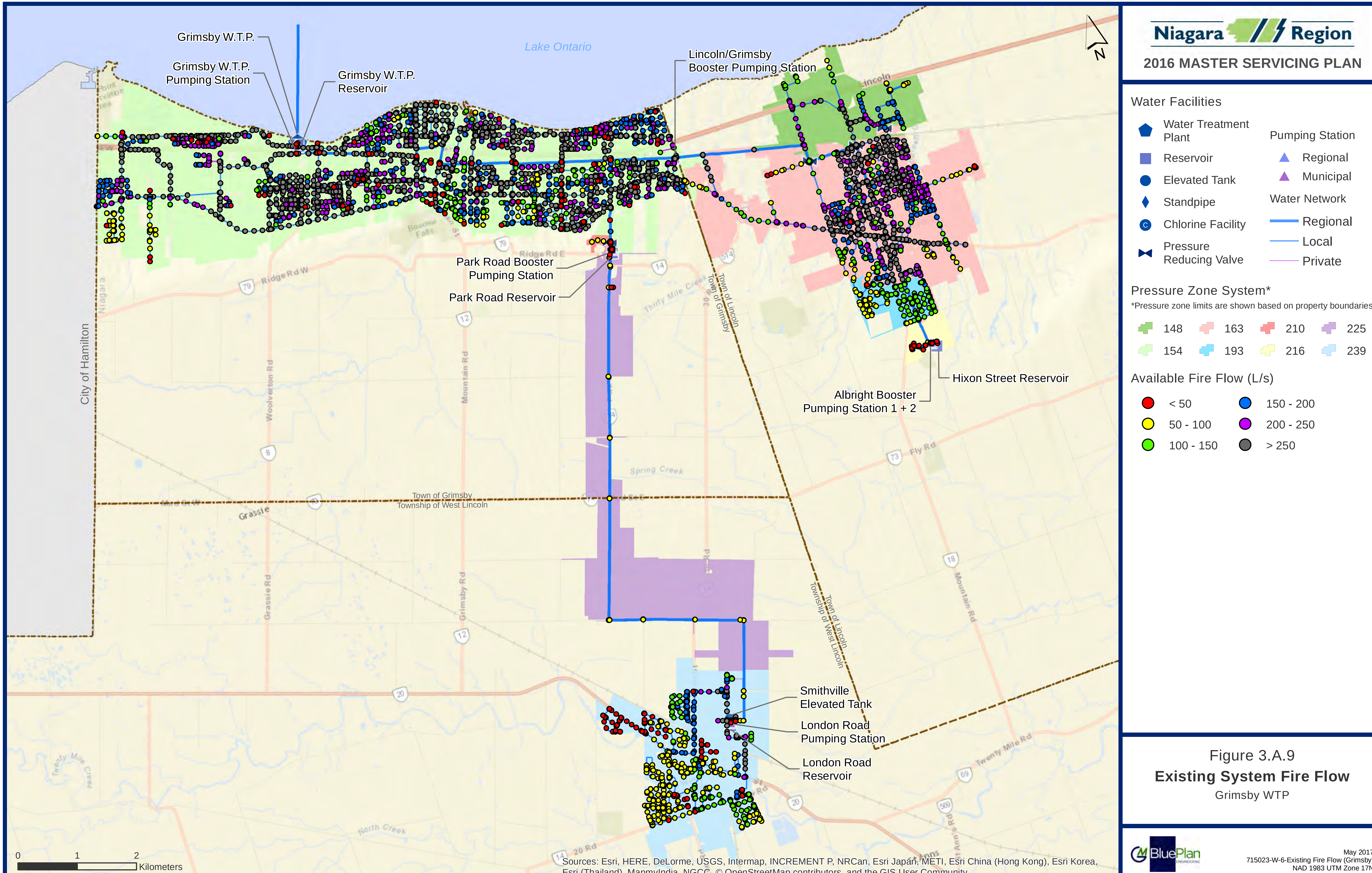


Figure 3.A.9
Existing System Fire Flow
Grimsby WTP

APPENDIX 'C' – Sanitary Servicing Analysis

Figure S1: Smithville Existing Sanitary Sewers

132 College Street, Smithville - Upstream Sanitary Area

Sanitary Drainage Area Plan

Post-Development Sanitary Sewer Design Sheet

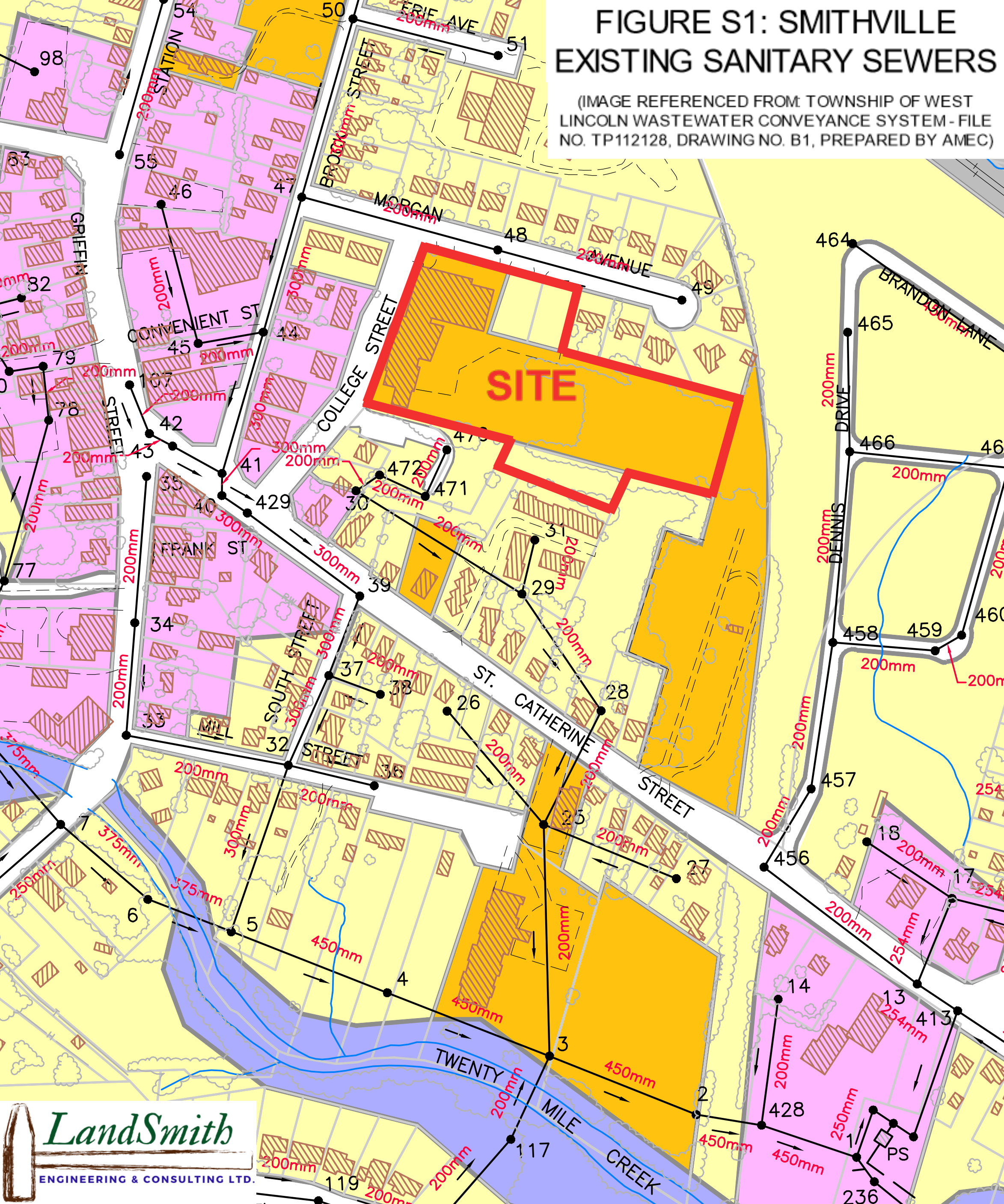
Morgan Avenue Sanitary Sewer Plan & Profile

Sanitary Grinder Pump Stations by E/One

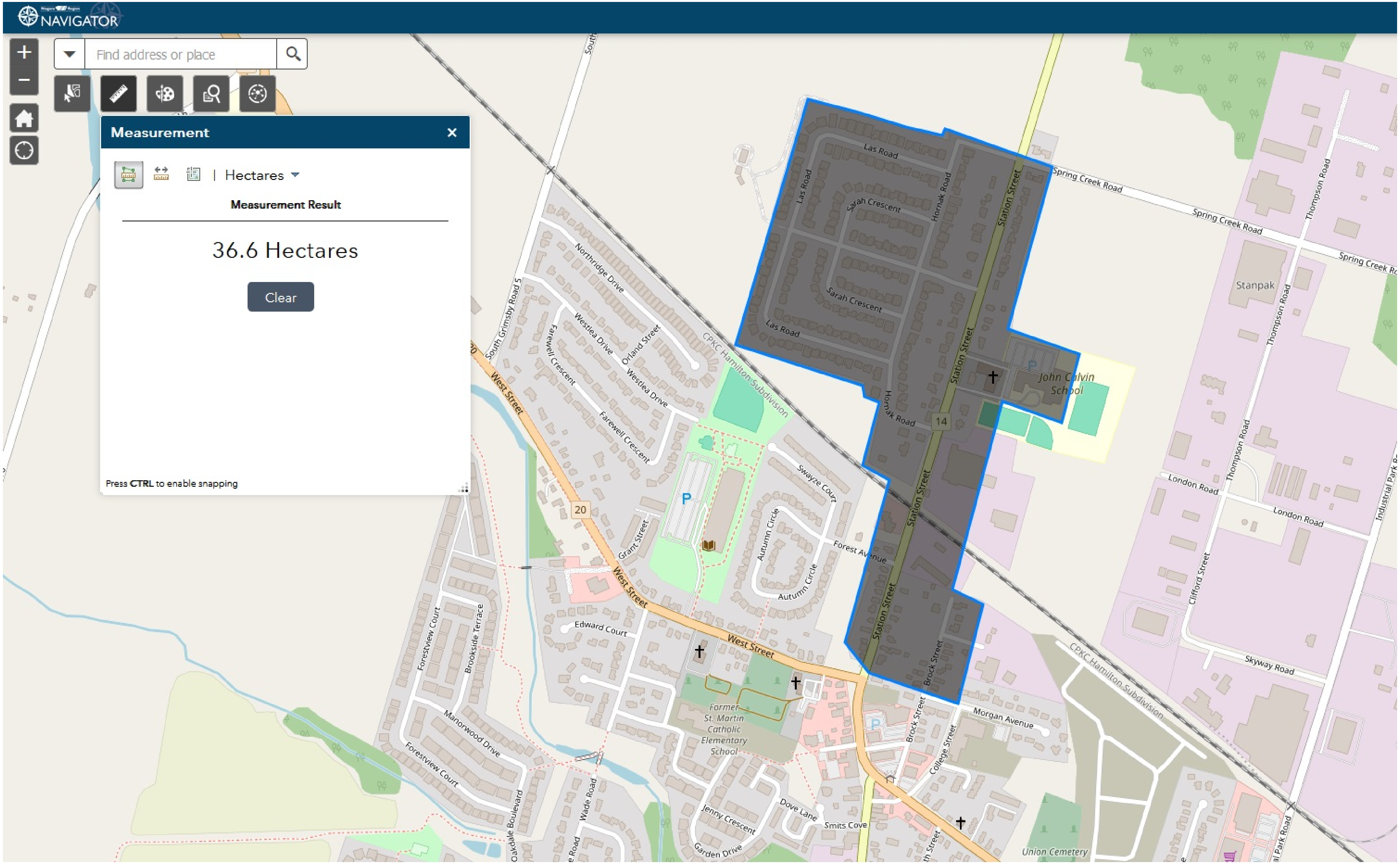
- Servicing Plan
- Preliminary Design Analysis
- WH484/WR484 Detail Sheets
- Sanitary Grinder Pump Performance Curve

FIGURE S1: SMITHVILLE EXISTING SANITARY SEWERS

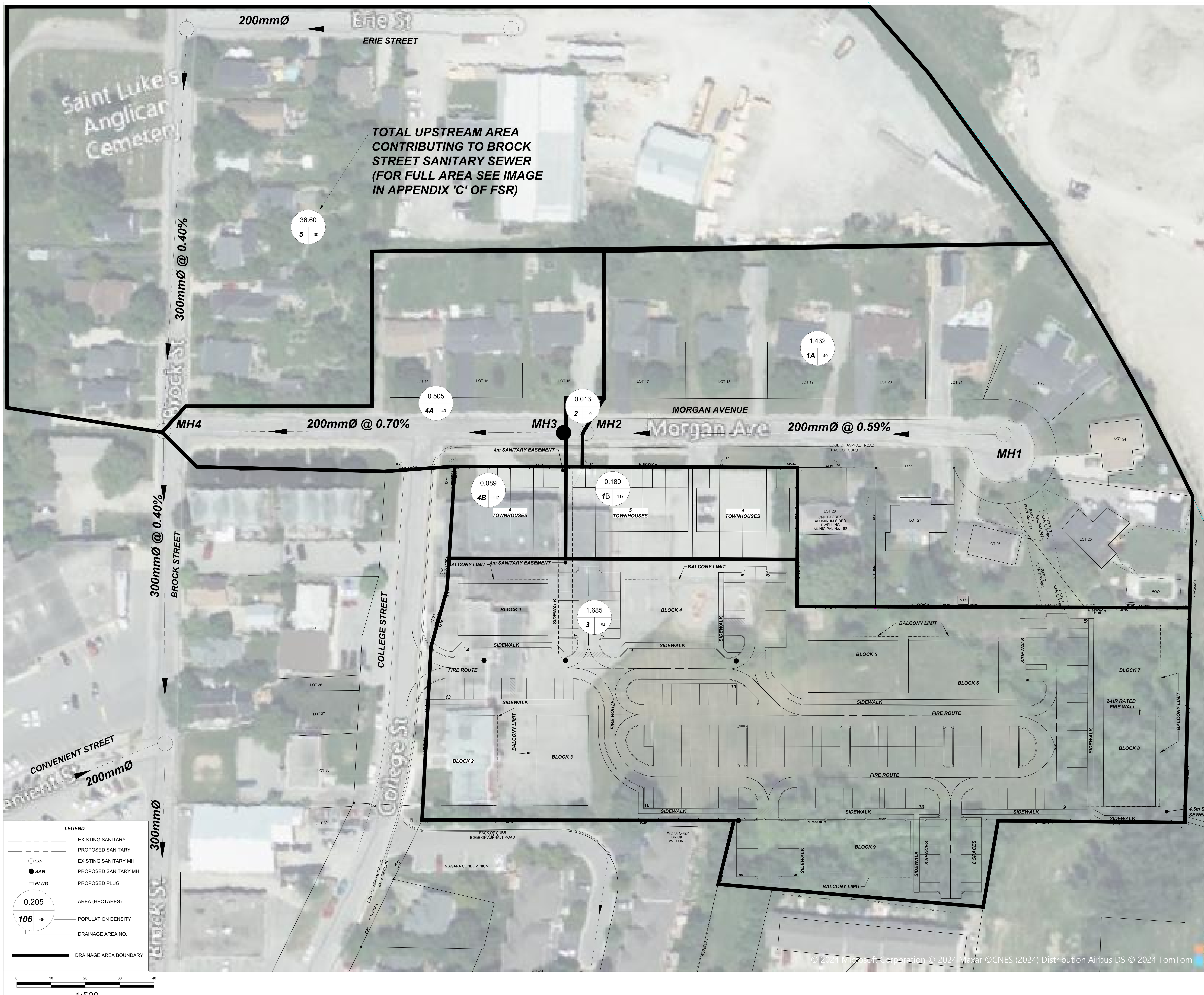
(IMAGE REFERENCED FROM: TOWNSHIP OF WEST LINCOLN WASTEWATER CONVEYANCE SYSTEM - FILE NO. TP112128, DRAWING NO. B1, PREPARED BY AMEC)



LandSmith
ENGINEERING & CONSULTING LTD.



Smithville, 132 College Street, Upstream Sanitary Area



KEY PLAN N.T.S.

GENERAL NOTES:

1. TENDERE'R SHALL SATISFY THEMSELVES AS TO THE NATURE OF THE GROUND AND BID ACCORDINGLY.
2. ALL ROCK LINE INDICATIONS SHOWN ON THE PLAN MUST BE VERIFIED BY THE CONTRACTOR.
3. CONTRACTOR SHALL VERIFY LOCATIONS AND INVERTS OF ALL EXISTING SANITARY AND STORM SEWERS AND WATERMAINS, PRIVATE DRAINS AND WATER SERVICES, GAS MAINS, CABLE TV, HYDRO AND TELEPHONE DUCTS ETC AT START OF CONSTRUCTION.

NO:	DATE:	DESCRIPTION:
0	2024-08-07	ISSUED WITH FSR

REVISIONS

NORTH

SEAL

LANDSMITH ENGINEERING & CONSULTING LTD.
UNIT 207, 1065 UPPER JAMES ST.
HAMILTON, ON L9C 3A6
ANDREW@LANDSMITHEC.COM
289-775-9374

CLIENT: 2853972 ONTARIO INC.

MUNICIPALITY: TOWNSHIP OF WEST LINCOLN

PROJECT NAME: 132 COLLEGE STREET

TITLE: SANITARY DRAINAGE AREA PLAN

SCALE: 1:500	DATE: 2022-10-06
CHECKED BY: AS	DESIGNED BY: AS
DWG No: 22046PHE	SHEET No: 2

POST-DEVELOPMENT SANITARY SEWER DESIGN SHEET

LandSmith ENGINEERING & CONSULTING LTD.

DATE: Aug. 04, 2024
DESIGNED: AS
CHECKED: AS
FILE No.: 22046Phe
PROJECT: 132 College Street, Smithville

q = average per capita daily flow 240
p = unit of population density 40.00

P = population
M = peaking factor (Babbit)
P = p x # units / 1000
M = 5 / (P/1000)^0.20
Q = (P x q x M) / 86.4

Q(p) = peak population flow (L/s)
Q(i) = peak extraneous flow (L/s)
Q(d) = peak design flow (L/s)

Low Density = 3 persons per unit
Medium Density = 2.3 persons per unit
High Denisty = 1.8 persons per unit

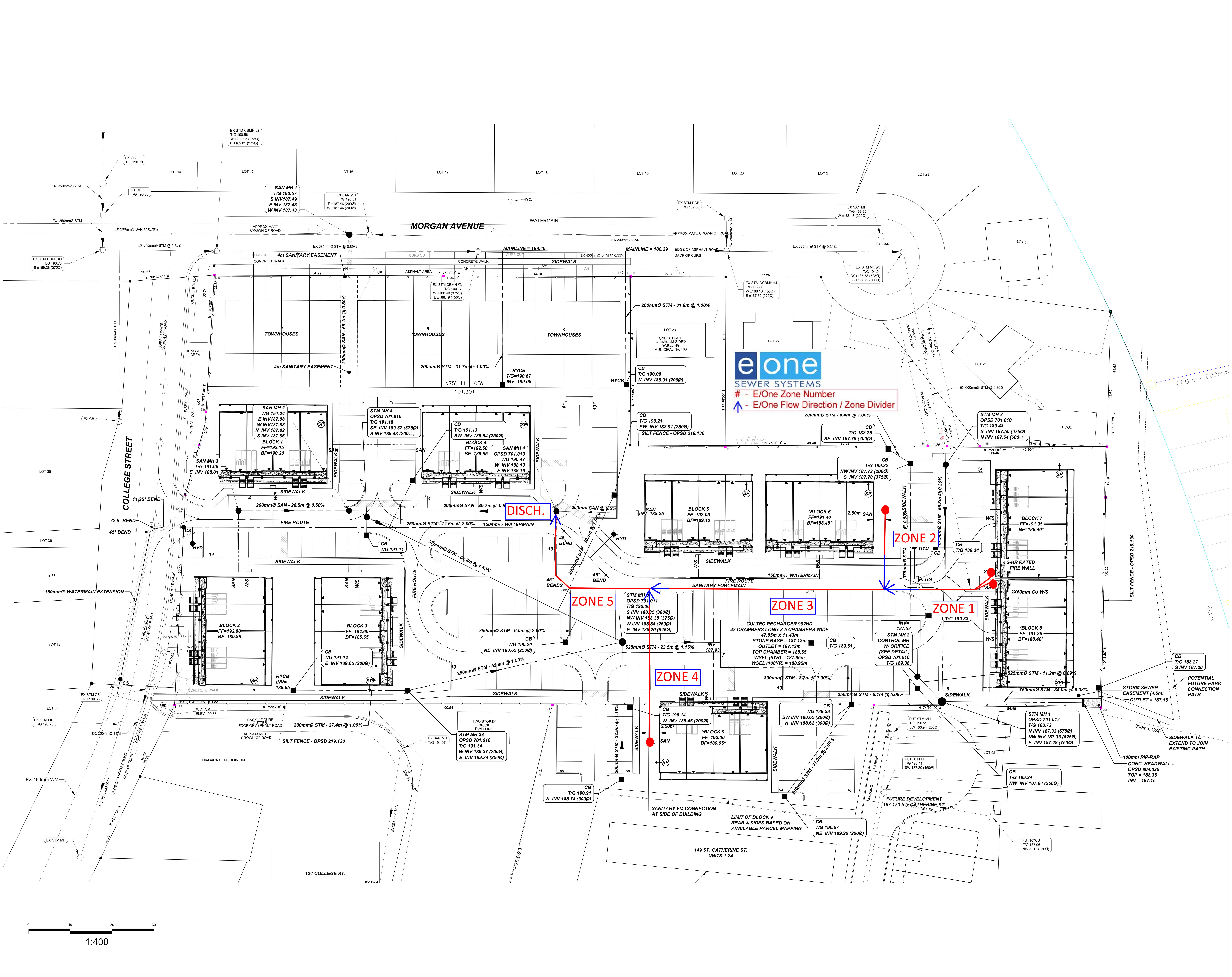
Infiltration Allowance: 0.286 L / s / ha

SHEET No.: 1 OF 1

LOCATION				INDIVIDUAL			CUMULATIVE						PROPOSED SANITARY SEWER							
Area #	STREET	FROM MH	TO MH	POP	AREA (ha)	Persons/Ha.*	POP	TOTAL AREA (ha)	PEAKING FACTOR (M)	POPULATION FLOW, Q(p) (L/s)	PEAK EXTRANEOUS FLOW, Q(i) (L/s)	PEAK DESIGN FLOW, Q(d) (L/s)	LENGTH (m)	PIPE SIZE DIAMETER (mm)	GRADE (%)	MANNING'S n	CAPACITY (L/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)	PERCENT FULL
1A	Morgan Avenue	1	2	57	1.43	40	57	1.43	5.00	0.80	0.41	1.21								
1B	Morgan Avenue	1	2	21	0.18	117	78	1.61	5.00	1.09	0.46	1.55	122.6	200	0.59%	0.013	25.2	0.80	0.43	6.1%
2	Morgan Avenue	2	3	0	0.01	0	78	1.63	5.00	1.09	0.46	1.55	4.8	200	0.70%	0.013	27.4	0.87	0.46	5.7%
3	Morgan Avenue	3	-	260	1.69	154	338	3.31	5.00	4.70	0.95	5.64								
4A	Morgan Avenue	3	4	20	0.51	40	358	3.82	5.00	4.98	1.09	6.07								
4B	Morgan Avenue	3	4	10	0.09	112	368	3.90	5.00	5.12	1.12	6.23	117.6	200	0.70%	0.013	27.4	0.87	0.67	22.7%
5	Brock Street	-	4	1098	36.60	30	1098	36.60	4.91	14.97	10.47	25.44	115.0	300	0.40%	0.013	61.2	0.87	0.79	41.6%
ALL	Brock Street	4	-				1466	40.50	4.63	18.87	11.58	30.45	88.0	300	0.40%	0.013	61.2	0.87	0.82	49.8%

Note: *40 persons/hectare for Areas 1A and 4A*
30 persons/hectare for Area 5
1.8 persons/unit for Site apartments (144 units)
2.3 persons/unit for Site townhouses (13 units)

MORGAN AVENUE
ERIE AVENUE
B.M. F.H. TOP PUMPER NOZZLE. EL. 630.27
6" TRANSITE WATER MAIN
SURFACE TREATED
BROCK STREET
GRAVEL ROAD
4' CONC. WALK
2" GAS MAIN
M.H. 47
BARN
2" M.P. GAS MAIN
6" TRANSITE WATER MAIN
GRAVEL ROAD
M.H. 48
M.H. 49
COLLEGE STREET
GRAVEL ROAD SURFACE TREATED
6" TRANSITE WATER MAIN
4' CONC. WALK
4" M.P. GAS MAIN
6" TRANSITE WATER MAIN
GRAVEL ROAD
M.H. 50
M.H. 51
GAS MAIN
2" GAS MAIN
OFFICE GREENMELK
REGISTERED PROFESSIONAL ENGINEER
CIVIL
F. A. URE
PROVINCE OF ONTARIO
PLAN
SCALE - 1 IN = 40 FT
PROFILE
SCALE - VERT - 1 IN = 4 FT
HORZ - 1 IN = 40 FT
10" SEWER PIPE
8" SEWER PIPE
400' AT 0.5% GRADE
400' AT 0.5% GRADE
8" SEWER PIPE
340' AT 0.5% GRADE
INVERT ELEVATION
CHAINAGE
0+00 613.0 628.3
1+00 628.1
2+00 627.1
3+00 626.2
4+00 615.0 625.8 615.17
5+00 625.1
6+00 624.6
7+00 623.8
8+00 617.17 623.1
0+00 613.3
0+10 628.4
1+10 628.5
2+10 630.1
3+10 629.3
3+40 629.0 M.H. 51
DOUGLAS G. URE & SONS
CONSULTING ENGINEERS & ONTARIO LAND SURVEYORS
ONTARIO WATER RESOURCES COMMISSION
SEWAGE WORKS PROJECT NO. 61-S-80
FOR
THE POLICE VILLAGE OF SMITHVILLE
MORGAN & ERIE AVENUE
DRAWING NO. 16
FILE L-42
JUN 4 1962



KEY PLAN N.T.S.

BENCHMARK NOTE:
ELEVATION =
MONUMENT:

SITE BENCHMARK :
ELEVATION =

GENERAL NOTES:

1. TENDERER SHALL SATISFY THEMSELVES AS TO THE NATURE OF THE GROUND AND BID ACCORDINGLY.
2. ALL ROCK LINE INDICATIONS SHOWN ON THE PLAN MUST BE VERIFIED BY THE CONTRACTOR.
3. CONTRACTOR SHALL VERIFY LOCATIONS AND INVERTS OF ALL EXISTING SANITARY AND STORM SEWERS AND WATERMAINS, PRIVATE DRAINS AND WATER SERVICES, GAS MAINS, CABLE TV, HYDRO AND TELEPHONE DUCTS ETC AT START OF CONSTRUCTION.

NO:	DATE:	DESCRIPTION:
1	2024-09-27	ISSUED FOR COORDINATION
0	2024-08-12	FOR CLIENT REVIEW

REVISIONS

SEAL

LandSmith
ENGINEERING & CONSULTING LTD.
LANDSMITH ENGINEERING & CONSULTING LTD.
UNIT 207, 1065 UPPER JAMES ST.
HAMILTON, ON L9C 3A6
ANDREW@LANDSMITHEC.COM
289-775-9374

CLIENT:
2853972 ONTARIO INC.

MUNICIPALITY:
TOWNSHIP OF WEST LINCOLN

PROJECT NAME:
COLLEGE STREET SCHOOL

TITLE:
SITE SERVICING PLAN

SCALE: 1:400	DATE: 2022-10-06
CHECKED BY: AS	DESIGNED BY: AS
DWG No: 22046PHE	SHEET No: 4

Environment One Corporation

Pressure Sewer Preliminary
Cost and Design Analysis
For
College St, ON

Prepared For:

ON **Canada**

Tel:
Fax:
Prepared By: M. Crowley
October 22, 2024

Y:\SSB\SSB Engineering Data\AE Projects\College St, ON\College St, ON.EOne

College St, ON

Prepared by : M. Crowley **On:** October 22, 2024

Notes :
Analysis based upon drawings and data provided. Station recommendations are preliminary.

LPD values impact retention times only, not line sizing or hydraulics. GP laterals to be 1.25".

Analysis valid only with pipe type listed.

General recommendations for valve placement are: clean out valves at intervals of approximately 305m and at branch ends and junctions; isolation valves at branch junctions; and air release valves at peaks of 8m or more and/or at intervals of 600 to 800 m. Lateral kits comprised of a ball and check valve are required to be installed between the pump discharge and street main on all installations. Laterals should be located as close to the public right of way as possible.

Quantities of grinder pumps, pipe, and valves are indicated on the cost page. The model of grinder pump(s) indicated is based upon the initial information provided to us but may not be the most appropriate for the specific location or requirements of the project. Costs of these items and their installation are best obtained from sources in your region. We recommend you contact your local distributor of Environment One products for additional recommendations.

<<<<< E N D O F N O T E S >>>>>

October 22, 2024

Budgetary Low Pressure Sewer System Costs

College St, ON

	Quantity	Description	Unit Cost	Installation	Sub Total
Valves	2	Clean Out	$0.00	0.00	$0.00
					$0.00
Pumps	4	Quadplex Grinder Pump Stations	$0.00	0.00	$0.00
	4	Lateral Kits (Includes Ball/Check Valve Assembly)	$0.00	0.00	$0.00
	4	Lateral (Boundary) Installation	$0.00	0.00	$0.00
	4	Pump/Panel Installation	$0.00	0.00	$0.00
					$0.00
Piping	56	2.00" Pipe	$0.00	0.00	$0.00
	122	3.00" Pipe	$0.00	0.00	$0.00
					$0.00

Number of Connections	**8**			
Total Per Connection	**$0.00**	**Total (w/o other)**	>>>>>>>>>>>>>	**$0.00**
Grand Total Per Connection	**$0.00**	**Grand Total (including other)**	>>>>>>>>>>>>>	**$0.00**

Note: The System Costs above are based on piping sized for, and Grinder Pumps manufactured by Environment One Corporation.

PRELIMINARY PRESSURE SEWER -- PIPE SIZING AND BRANCH ANALYSIS

Date : Oct-22-24

College St, ON

Prepared By:
M. Crowley

Zone Number	Number Of Cores Connected This Zone	Accumulated Total Of Cores This Zone	Maximum Number Of Simultaneous Operations	Maximum Flow In LPS	Pipe Size (in or mm)	Actual Pipe ID (mm)	Maximum Velocity (MPS)	Length Of Main This Zone	Friction Loss Factor (M/100 M)	Friction Loss This Zone	Accumulated Friction Loss (Meters)	Maximum Main Elevation	Minimum Pump Elevation	Static Head (Meters	Total Dynamic Head (M)
Pipe diameters used for :		SDR 11 PE Pipe (US)						Power: 240 Volt 60 Hz				Constant for inside roughness of "C" = 150			
1.00	4	4	4	2.78	3.00	71.78	0.69	26.3	0.69	0.18	0.84	190.7	189.7	1.0	1.84
2.00	2	2	2	1.39	2.00	48.69	0.75	18.8	1.27	0.24	0.90	190.7	189.6	1.1	2.00
3.00	0	6	4	2.78	3.00	71.78	0.69	56.7	0.69	0.39	0.66	190.7	189.8	0.9	1.56
4.00	2	2	2	1.39	2.00	48.69	0.75	36.7	1.27	0.47	0.73	190.7	190.4	0.3	1.03
5.00	0	8	4	2.78	3.00	71.78	0.69	38.8	0.69	0.27	0.27	190.7	190.0	0.7	0.97

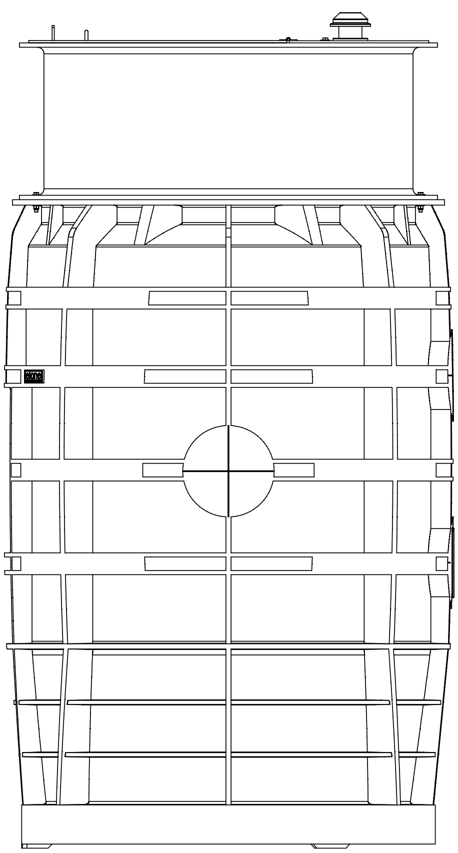
Note: This analysis valid only with the use of E|One positive displacement pumps.

Date : Oct-22-24 College St, ON Prepared By: M. Crowley

Zone Number	Accumulated Total Of Cores This Zone	Existing Pipe Size	Liters Per 100 Lineal Meters	Length of Zone Meters	Capacity of Zone Liters	Average Daily Flow	Average Fluid Changes Per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
Pipe diameters used for :	SDR 11 PE Pipe (US)						Liters / Day / Dwelling = 757		
1.00	4	3.00	404.67	26.30	106.43	24224	227.61	0.11	0.33
2.00	2	2.00	186.21	18.80	35.01	12112	345.98	0.07	0.30
3.00	6	3.00	404.67	56.70	229.45	36336	158.36	0.15	0.23
4.00	2	2.00	186.21	36.70	68.34	12112	177.23	0.14	0.21
5.00	8	3.00	404.67	38.80	157.01	48448	308.57	0.08	0.08

Note: This analysis valid only with the use of E|One positive displacement pumps.

WH484/WR484



General Features

The model WH484 or WR484 grinder pump station is a complete unit that includes: four grinder pumps, check valve, polyethylene tank, controls, and alarm panel. Designed for higher flow applications where local codes dictate higher storage requirements. The lower portion of the tank has a smaller diameter, tapered down to a dish-shaped bottom. The large tank access opening easily accommodates installation of the grinder pumps and equipment.

- Rated for flows of 7000 gpd (26,498 lpd)
- 486 gallons (1802 liters) of capacity
- Standard outdoor heights range from 75 inches to 122 inches

The WH484 is the “hardwired,” or “wired,” model where a cable connects the motor controls to the level controls through watertight penetrations.

The WR484 is the “radio frequency identification” (RFID), or “wireless,” model that uses wireless technology to communicate between the level controls and the motor controls.

Operational Information

Motor
1 hp, 1,725 rpm, high torque, capacitor start, thermally protected, 120/240V, 60 Hz, 1 phase

Inlet Connections
4-inch inlet grommet standard for DWV pipe. Other inlet configurations available from the factory.

Discharge Connections
Pump discharge terminates in 1.25-inch NPT female thread. Can easily be adapted to 1.25-inch PVC pipe or any other material required by local codes.

Discharge
15 gpm at 0 psig (0.95 lps at 0 m)
11 gpm at 40 psig (0.69 lps at 28 m)
7.8 gpm at 80 psig (0.49 lps at 56 m)

Accessories

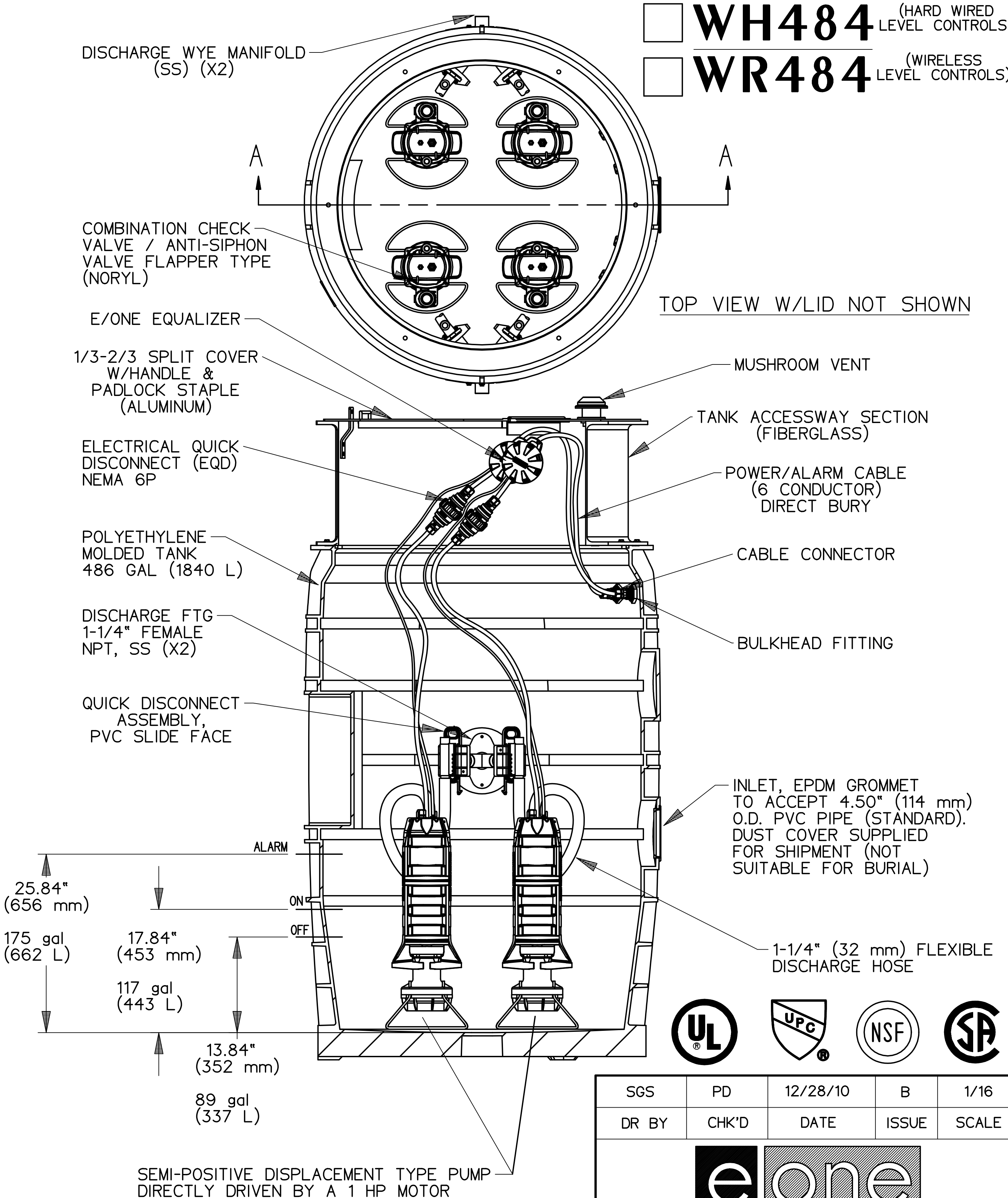
E/One requires that the Uni-Lateral, E/One’s own stainless steel check valve, be installed between the grinder pump station and the street main for added protection against backflow.

Alarm panels are available with a variety of options, from basic monitoring to advanced notice of service requirements.

The Remote Sentry is ideal for installations where the alarm panel may be hidden from view.

WH484 (HARD WIRED LEVEL CONTROLS)

WR484 (WIRELESS LEVEL CONTROLS)



CONCRETE BALLAST MAY BE REQUIRED
SEE INSTALLATION INSTRUCTIONS
FOR DETAILS

NOTE: DIMENSIONS ARE FOR REFERENCE ONLY

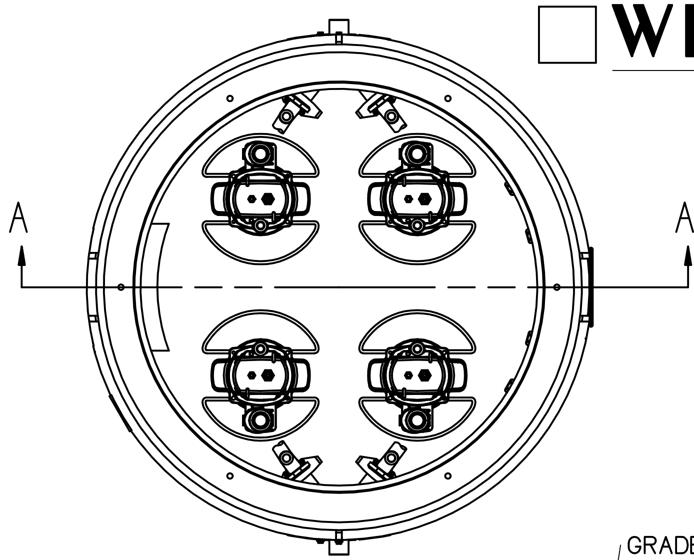
SGS	PD	12/28/10	B	1/16
DR BY	CHK'D	DATE	ISSUE	SCALE

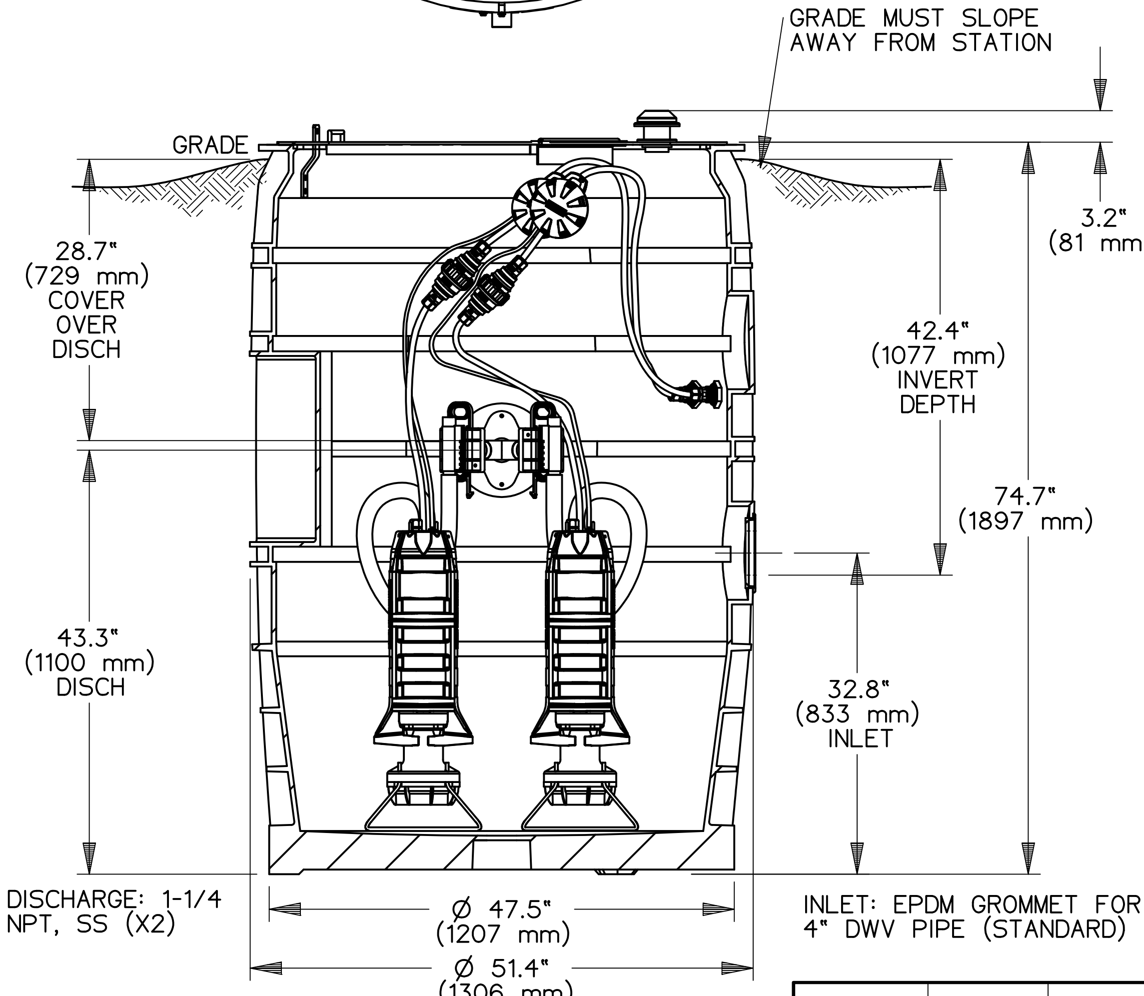
e one SEWER SYSTEMS

MODEL WH484 / WR484
DETAIL SHEET, QUAD

NA0215P02

WH484 -75 (HARD WIRED LEVEL CONTROLS)
WR484 -75 (WIRELESS LEVEL CONTROLS)





CONCRETE BALLAST MAY BE REQUIRED
SEE INSTALLATION INSTRUCTIONS
FOR DETAILS

NOTE: DIMENSIONS ARE FOR REFERENCE ONLY

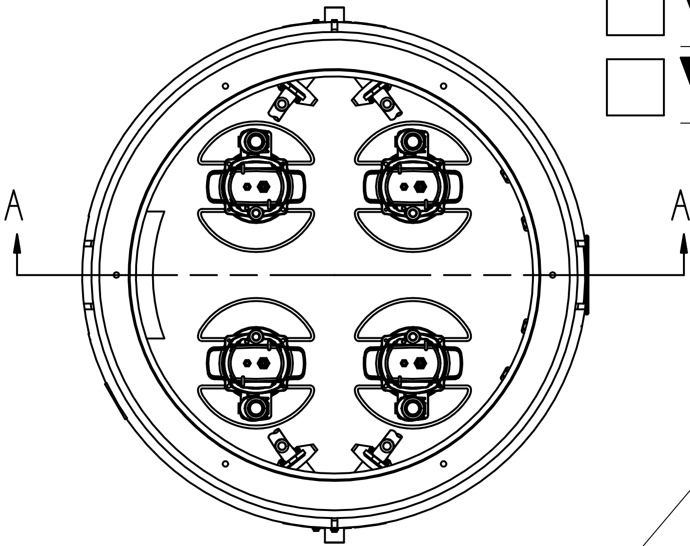
SGS	PD	12/28/10	B	1/16
DR BY	CHK'D	DATE	ISSUE	SCALE

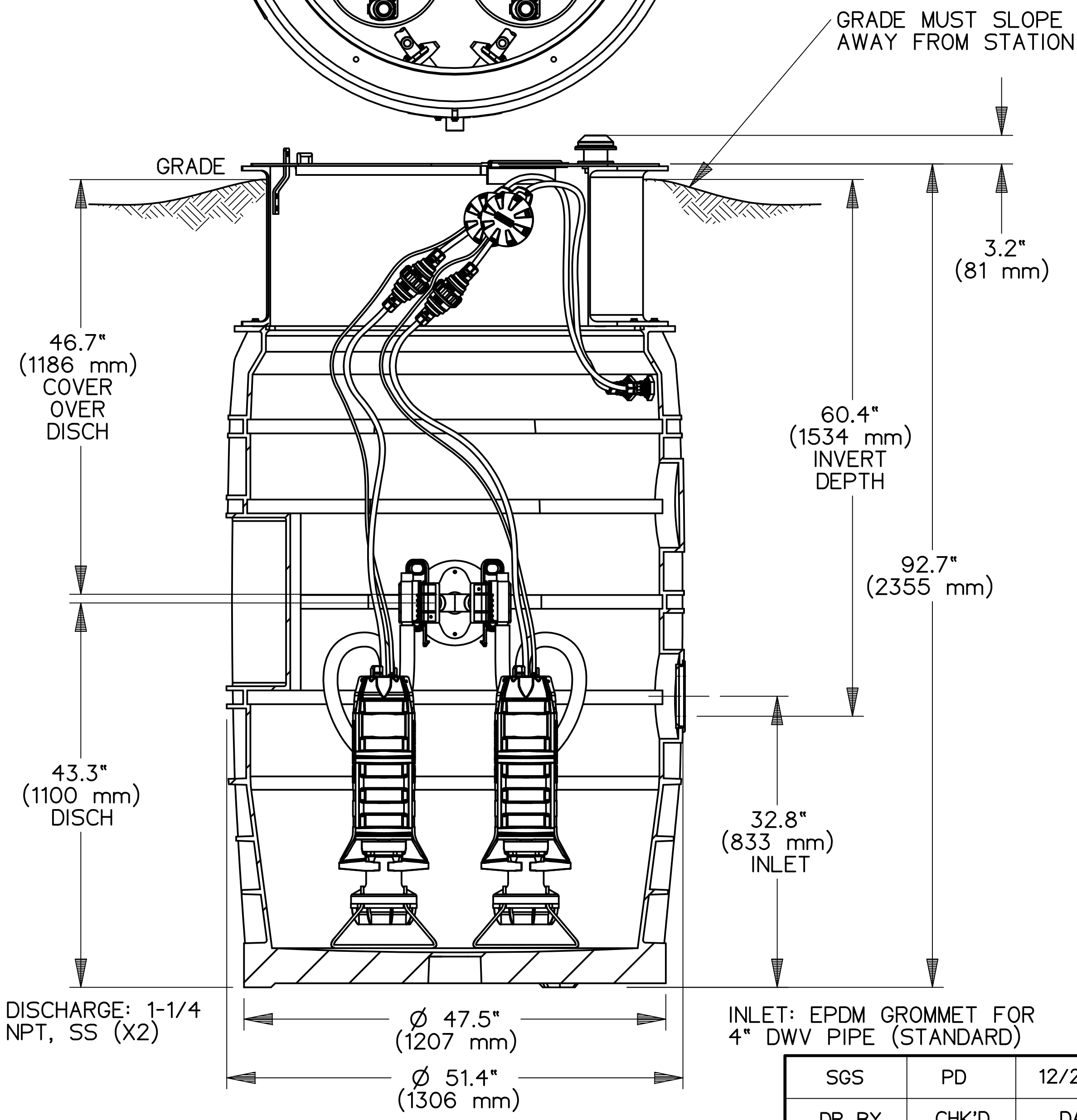
eone SEWER SYSTEMS

MODEL WH484-75 / WR484-75

NA0215P03

WH484-92 (HARD WIRED LEVEL CONTROLS)
WR484-92 (WIRELESS LEVEL CONTROLS)





CONCRETE BALLAST MAY BE REQUIRED
SEE INSTALLATION INSTRUCTIONS
FOR DETAILS

NOTE: DIMENSIONS ARE FOR REFERENCE ONLY

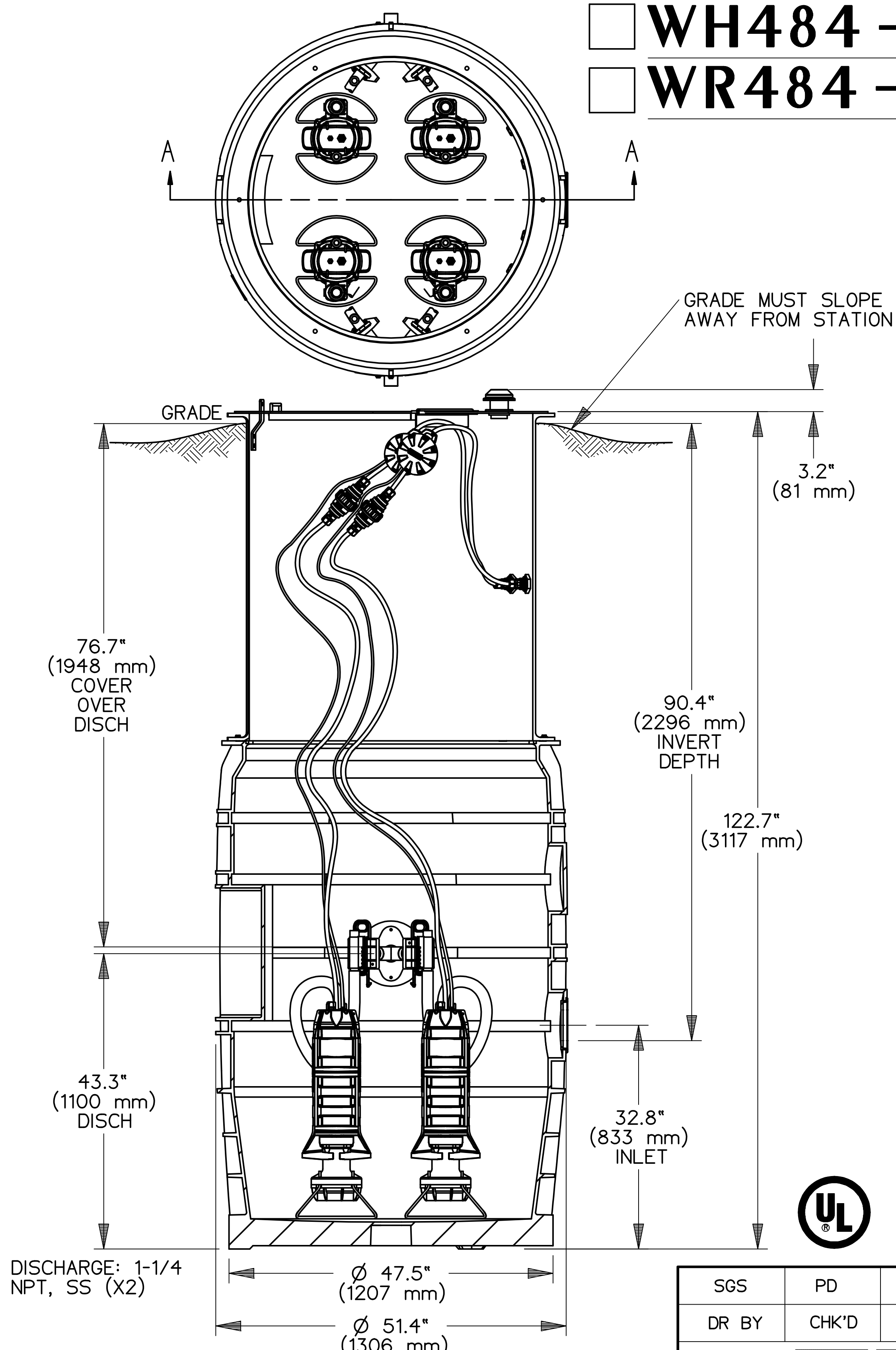
SGS	PD	12/28/10	B	1/16
DR BY	CHK'D	DATE	ISSUE	SCALE

e one SEWER SYSTEMS

MODEL WH484-92 / WR484-92

NA0215P04

WH484 -122 (HARD WIRED LEVEL CONTROLS)
WR484 -122 (WIRELESS LEVEL CONTROLS)



INLET: EPDM GROMMET FOR
4" DWV PIPE (STANDARD)

CONCRETE BALLAST MAY BE REQUIRED
SEE INSTALLATION INSTRUCTIONS
FOR DETAILS

NOTE: DIMENSIONS ARE FOR REFERENCE ONLY

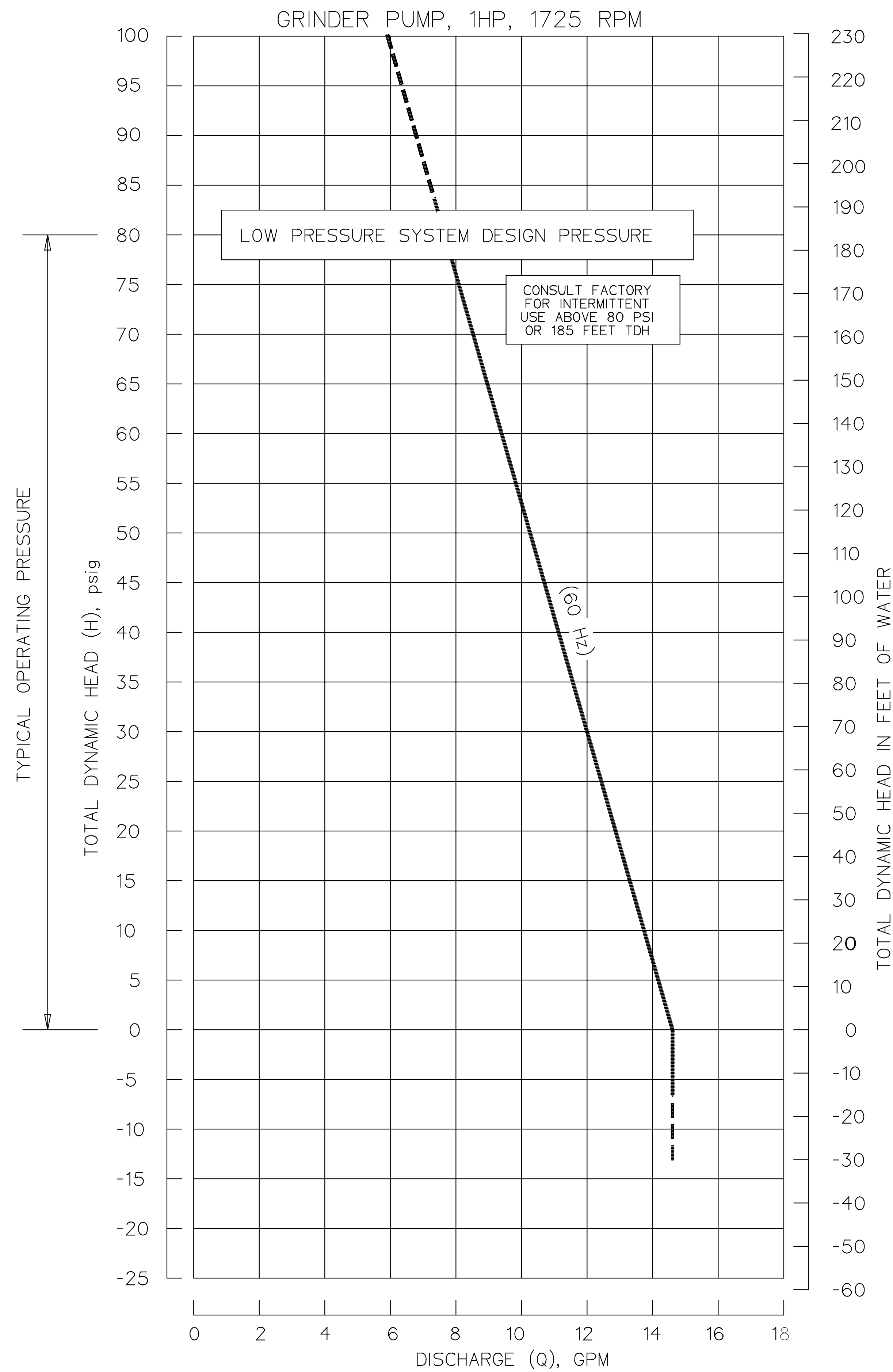
SGS	PD	12/28/10	B	1/16
DR BY	CHK'D	DATE	ISSUE	SCALE

SEWER SYSTEMS

MODEL WH484-122 / WR484-122

NA0215P05

E|ONE SPD PUMP PERFORMANCE CURVE



APPENDIX 'D' – Stormwater Management

Pre-Development Drainage Area Plan - Figure 1

Post-Development Drainage Area Plan - Figure 2

Old Town Gateway Estates Storm Drainage Area Plan by S. Llwellyn & Associates Ltd.

Old Town Gateway Estates As-Built General Services by S. Llwellyn & Associates Ltd.

Storm Sewer Design Sheet – 5-Year

Storm Sewer Design Sheet – 100-Year

MIDUSS v2 Output Files

CULTEC Recharger 902HD Design Sheets

CULTEC Separator Row Filtration System Verification Statement

Hydroworks HD Sizing Calculations

Hydroworks HD ETV Verification Statement

Hydroworks HD Operations and Maintenance Manual

CB Shield Operations Manual and Design Chart

CB Shield ETV Verification Statement

LEGEND

0.035 DRAINAGE AREA (HECTARES)

100% IMPERVIOUSNESS (%)

1 DRAINAGE AREA NUMBER

DRAINAGE AREA BOUNDARY

OVERLAND FLOW ROUTE

IMPERVIOUS SURFACE

SHEET FLOW DIRECTION

SCALE: 0 10 20 30 40 50 60

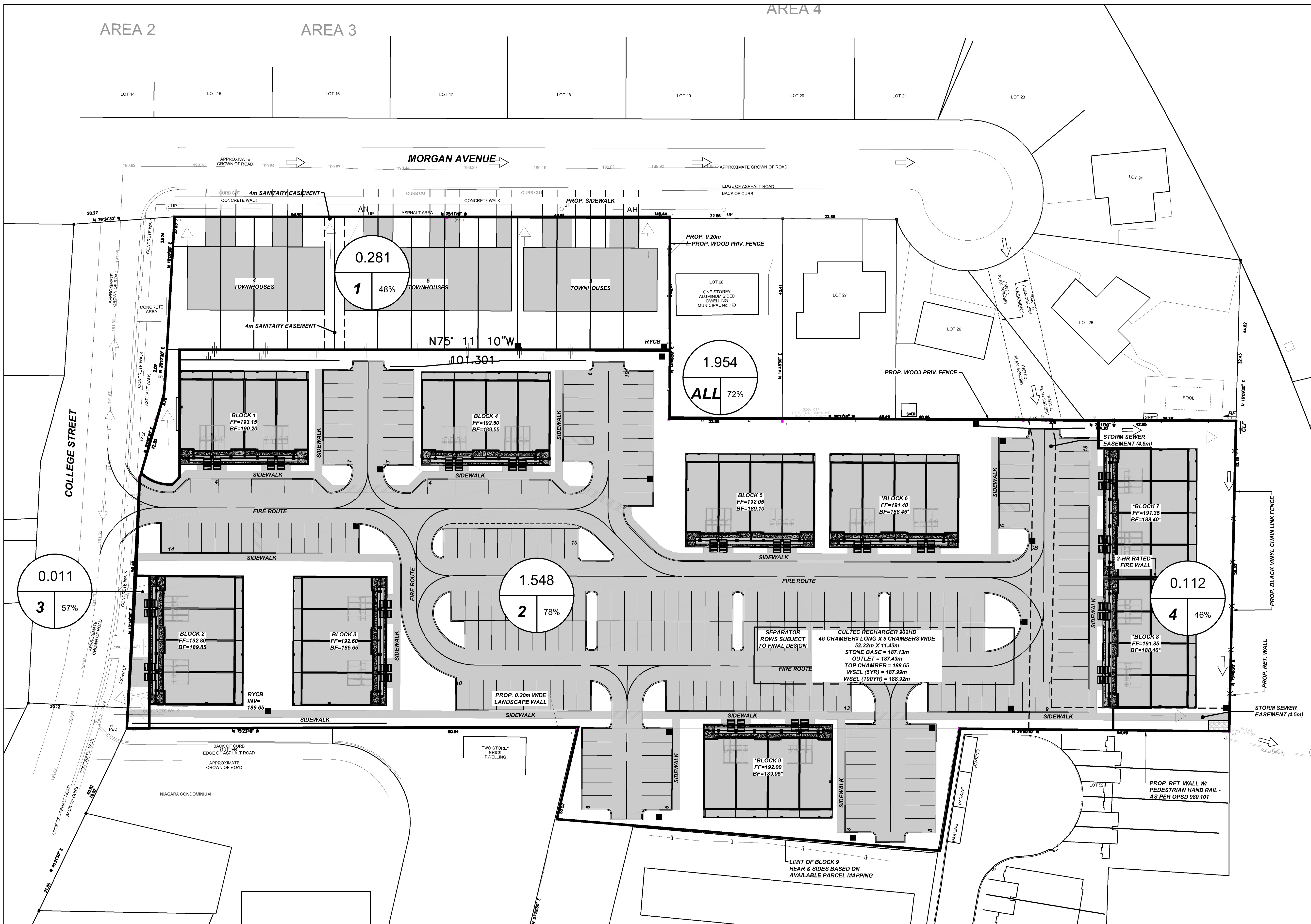
1:750

LandSmith ENGINEERING & CONSULTING LTD.

PROJECT: 132 COLLEGE ST.

PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN

FIGURE 1



LEGEND

0.035 — DRAINAGE AREA (HECTARES)

100% — IMPERVIOUSNESS (%)

1 — DRAINAGE AREA NUMBER

DRAINAGE AREA BOUNDARY

OVERLAND FLOW ROUTE

IMPERVIOUS SURFACE

SHEET FLOW DIRECTION

SCALE: 0 10 20 30 40 50 60

1:750

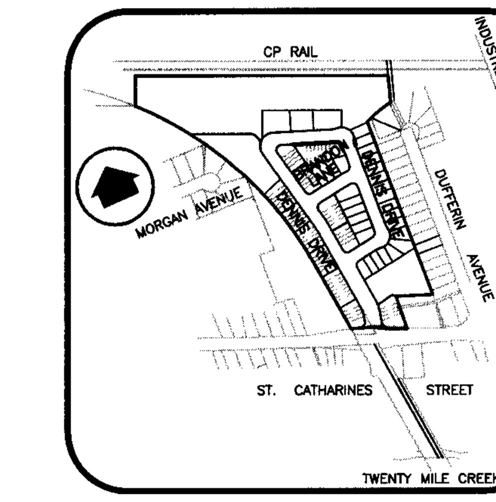
LandSmith ENGINEERING & CONSULTING LTD.

PROJECT: 132 COLLEGE ST.

POST-DEVELOPMENT STORM DRAINAGE AREA PLAN

FIGURE 2

SEE DWG. No. D2



KEY MAP
N.T.S.

LEGEND

0.80 / 0.40 — AREA IN HECTARES / RUN–OFF CO–EFFICIENT

STORM AREA DRAINAGE BOUNDARY

APPROVED as to conformance with Township of West Lincoln's development standards and guidelines and subject to servicing construction conforming to Township Standards and specifications.

Director of Public Works
TOWNSHIP OF WEST LINCOLN

Date

NOTES:

1. FOR GENERAL NOTES AND DETAILS SEE DWG. No. 1

NO.	DATE	BY	REVISIONS
10	MAY/18		REVISED AS PER TOWNSHIP COMMENTS
10	APRIL/18		REVISED AS PER TOWNSHIP COMMENTS
9	JAN/18		REVISED AS PER TOWNSHIP COMMENTS
8	AUG/17		REVISED WM. TO 300mm DIA. REVISED HYDRO
7	APRIL/17		REVISED BASED ON NEW CALC PLAN REVISED AS PER TOWNSHIP COMMENTS
6	JUNE/16		REVISED BASED ON NEW DRAFT PLAN
5	JUNE/13		REVISED AS PER TOWNSHIP COMMENTS
4	MAY/13		REVISED AS PER TOWNSHIP COMMENTS
3	NOV/12		REVISED AS PER TOWNSHIP COMMENTS
2	SEPT/12		REVISED AS PER TOWNSHIP COMMENTS
1	APR/12		REVISED AS PER TOWNSHIP COMMENTS

DESIGN	Z.P.	CHK'D	SL	DATE
DRAWN	B.E.K.	CHK'D	SL	APRIL 2007

SCALE
HORIZ. 25 20 15 10 5 0 25 1:1000

APPROVALS

DIRECTOR OF PUBLIC WORKS DATE:

STAMP

LICENSED PROFESSIONAL ENGINEER
B.S. LLEWELLYN
May 17/18
PROVINCE OF ONTARIO

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS
Tel. (905) 631–6978
Fax (905) 631–8927
email: info@sla.on.ca
3228 South Service Road, Suite #105 East Wing, Burlington, Ont., L7N 3H8

TOWNSHIP OF WEST LINCOLN
REGIONAL MUNICIPALITY OF NIAGARA

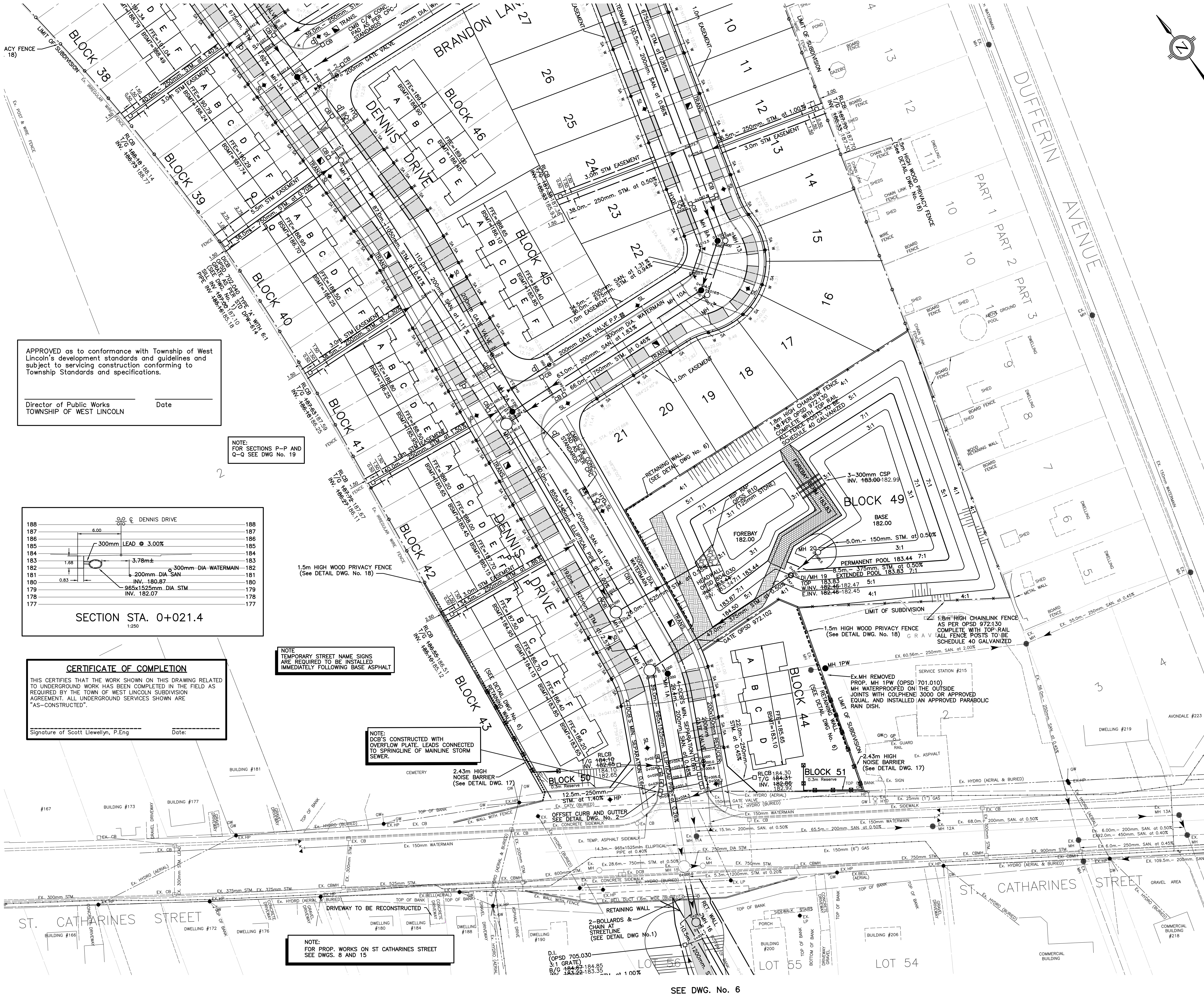
MARZ HOMES (SMITHVILLE STATION) INC.

OLD TOWN GATEWAY ESTATES

STORM DRAINAGE AREA PLAN

PROJECT	
16143	D1

SEE DWG. No. 3



APPROVED as to conformance with Township of West Lincoln's development standards and guidelines and subject to servicing construction conforming to Township Standards and specifications.

Director of Public Works
TOWNSHIP OF WEST LINCOLN

Date

NOTE:
FOR SECTIONS P-P AND Q-Q SEE DWG No. 19

SECTION STA. 0+021.4
1:250

NOTE
TEMPORARY STREET NAME SIGNS ARE REQUIRED TO BE INSTALLED IMMEDIATELY FOLLOWING BASE ASPHALT

CERTIFICATE OF COMPLETION

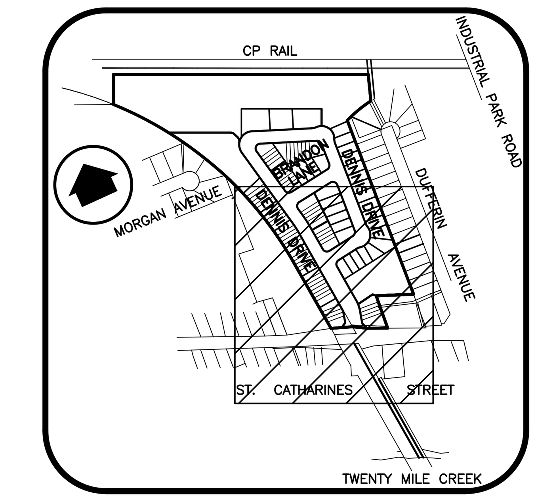
THIS CERTIFIES THAT THE WORK SHOWN ON THIS DRAWING RELATED TO UNDERGROUND WORK HAS BEEN COMPLETED IN THE FIELD AS REQUIRED BY THE TOWN OF WEST LINCOLN SUBDIVISION AGREEMENT. ALL UNDERGROUND SERVICES SHOWN ARE "AS-CONSTRUCTED".

Signature of Scott Llewellyn, P.Eng
Date:

NOTE:
DCB'S CONSTRUCTED WITH OVERFLOW PLATE. LEADS CONNECTED TO SPRINGLINE OF MAINLINE STORM SEWER.

NOTE:
FOR PROP. WORKS ON ST CATHARINES STREET SEE DWGS. 8 AND 15

SEE DWG. No. 6



KEY MAP
N.T.S.

LEGEND:

- PROPOSED FIRE HYDRANT AND VALVE
- PROPOSED WATER VALVE & VALVE BOX
- PROPOSED WATERMAIN PLUG & THRUST BLOCK
- STORM MANHOLE
- SANITARY MANHOLE
- CB CATCHBASIN
- * WHEELCHAIR RAMP TO BE CONSTRUCTED AS PER OPSD 310.030
- Ex. HP EXISTING HYDRO POLE
- SL PROPOSED STREET LIGHT LOCATION
- TRANS. PROPOSED TRANSFORMER LOCATION
- C.M.B. PROPOSED COMUNITY MAILBOX LOCATION
- EXISTING CHAINLINK FENCE
- EXISTING DITCH
- DRIVEWAY APPROACH
- NO PARKING SIGN (RB-51 AS PER ONTARIO TRAFFIC MANUAL)
- COMBINATION STOP AND STREET NAME SIGN

NOTES:
FOR GENERAL NOTES AND DETAILS SEE DWG. No. 1

NO.	DATE	BY	REVISIONS
A/C	MAR/19		AS-CONSTRUCTED INFO ADDED
11	MAY/18		REVISED AS PER TOWNSHIP COMMENTS
10	APRIL/18		REVISED AS PER TOWNSHIP COMMENTS
9	JAN/18		REVISED AS PER TOWNSHIP COMMENTS
8	AUG/17		REVISED WM. TO 300mm DIA. REVISED HYDRO
7	APRIL/17		REVISED BASED ON NEW CALC PLAN REVISED AS PER TOWNSHIP COMMENTS
6	JUNE/16		REVISED BASED ON NEW DRAFT PLAN
5	JUNE/13		REVISED AS PER TOWNSHIP COMMENTS
4	MAY/13		REVISED AS PER TOWNSHIP COMMENTS
3	JAN/13		REVISED AS PER TOWNSHIP COMMENTS
2	SEPT/12		REVISED AS PER TOWNSHIP COMMENTS
1	APR/12		REVISED AS PER TOWNSHIP COMMENTS

DESIGN	Z.P.	CHK'D	SL	DATE APRIL 2007
DRAWN	B.E.K.	CHK'D	SL	

SCALE
HORIZ. 15 10 5 0 15 1:500

AS-CONSTRUCTED

DIRECTOR OF PUBLIC WORKS
DATE:

STAMP
LICENSED PROFESSIONAL ENGINEER
B.S. LLEWELLYN
PROVINCE OF ONTARIO

S. LLEWELLYN & ASSOCIATES LIMITED
CONSULTING ENGINEERS
Tel. (905) 631-6978
Fax (905) 631-8927
email: info@sla.on.ca
3228 South Service Road, Suite #105 East Wing, Burlington, Ont., L7N 3H8

TOWNSHIP OF WEST LINCOLN
REGIONAL MUNICIPALITY OF NIAGARA

MARZ HOMES (SMITHVILLE STATION) INC.

OLD TOWN GATEWAY ESTATES

GENERAL SERVICES

PROJECT 16143

5

Consultant: LandSmith Engineering & Consulting Ltd.

Township of West Lincoln

STORM SEWER DESIGN CALCULATIONS
5-YEAR PROPOSED

Design By: A. Smith
Date: June 10, 2025

Location: 132 College Street, Smithville

DESIGN INFORMATION				
Design Storm Parameters				Pipe Roughness
Tci =	10 mins	A=	3175.00	n = 0.013
West Lincoln		B=	20.00	min. v = 0.9 m/s
5-Year		C=	1.00	max v = 3.65m/s

Location	Manhole Number U/S	Manhole Number D/S	Area "A" (ha)	Runoff Coeff "Ca"	Aa x Ca	Cumulative Area A = ΣAa (ha)	Cumulative A C = ΣAa x Ca	Time in Section "tcf" (min)	Initial Time of Conc. "tci" (min)	Time of Conc. tc = tcf + tci (min)	Rainfall Intensity "i" (mm/hr)	Quantity of Flow "Q" (m^3/s)	Type of Pipe	Manning's Roughness Coefficient "n"	Slope "S" (%)	Pipe Diameter "D" (mm)	Pipe Length "L" (m)	Pipe Velocity "V" (m/s)	Q_{FULL} (m^3/s)	% Full
Morgan Avenue	1	2	0.500	0.50	0.25	0.500	0.25	0.31	10.00	10.31	104.75	0.073	PVC	0.013	0.84	375	27.3	1.47	0.17	43%
Morgan Avenue	2	3	0.230	0.50	0.12	0.730	0.37	0.69	10.31	11.00	102.42	0.104	PVC	0.013	0.89	375	62.6	1.51	0.17	60%
Morgan Avenue	3	4	0.586	0.50	0.29	1.316	0.66	0.74	11.00	11.74	100.04	0.183	PVC	0.013	0.55	450	59.5	1.34	0.22	83%
Morgan Avenue	4	5	0.000	0.50	0.00	1.316	0.66	0.63	11.74	12.37	98.09	0.179	PVC	0.013	0.31	525	42.3	1.12	0.25	72%
Morgan Avenue	5	PROP. 2	0.000	0.50	0.00	1.316	0.66	0.67	12.37	13.04	96.09	0.176	PVC	0.013	0.30	600	48.5	1.20	0.35	50%
Morgan Avenue	PROP. 2	PROP. 1	0.000	0.50	0.00	1.316	0.66	0.73	13.04	13.77	94.02	0.172	PVC	0.013	0.30	675	56.8	1.30	0.48	36%
SITE	CULTEC	PROP. 1	0.000	0.50	0.00	1.316	0.66	0.10	13.77	13.87	93.74	0.122	PVC	0.013	0.89	525	11.3	1.89	0.42	29%
												Flows from CULTEC System								
SITE	PROP. 1	PROP. H/WALL	0.000	0.50	0.00	1.316	0.66	0.36	13.87	14.23	92.75	0.294	PVC	0.013	0.38	750	34.0	1.57	0.72	41%

Consultant: LandSmith ENGINEERING & CONSULTING LTD.

Township of West Lincoln

STORM SEWER DESIGN CALCULATIONS
100-YEAR PROPOSED

Design By: A. Smith
Date: June 10, 2025

Location: 132 College Street, Smithville

DESIGN INFORMATION				
Design Storm Parameters				Pipe Roughness
Tci =	10 mins	A=	6300.0	n = 0.013
West Lincoln		B=	15.000	min. v = 0.9 m/s
100-Year		C=	1.000	max v = 3.65m/s

Location	Manhole Number U/S	Manhole Number D/S	Area "A" (ha)	Runoff Coeff "Ca"	Aa x Ca	Cumulative Area A = ΣAa (ha)	Cumulative A C = ΣAa x Ca	Time in Section "tcf" (min)	Initial Time of Conc. "tci" (min)	Time of Conc. tc = tcf + tci (min)	Rainfall Intensity "i" (mm/hr)	Quantity of Flow "Q" (m^3/s)	Type of Pipe	Manning's Roughness Coefficient "n"	Slope "S" (%)	Pipe Diameter "D" (mm)	Pipe Length "L" (m)	Pipe Velocity "V" (m/s)	Q_{FULL} (m^3/s)	% Full
Morgan Avenue	1	2	0.500	0.50	0.25	0.500	0.25	0.31	10.00	10.31	248.92	0.173	PVC	0.013	0.84	375	27.3	1.47	0.17	103%
Morgan Avenue	2	3	0.230	0.50	0.12	0.730	0.37	0.69	10.31	11.00	242.31	0.246	PVC	0.013	0.89	375	62.6	1.51	0.17	142%
Morgan Avenue	3	4	0.586	0.50	0.29	1.316	0.66	0.74	11.00	11.74	235.62	0.431	PVC	0.013	0.55	450	59.5	1.34	0.22	195%
Morgan Avenue	4	5	0.000	0.50	0.00	1.316	0.66	0.63	11.74	12.37	230.19	0.421	PVC	0.013	0.31	525	42.3	1.12	0.25	168%
Morgan Avenue	5	PROP. 0	0.000	0.50	0.00	1.316	0.66	0.67	12.37	13.04	224.67	0.411	PVC	0.013	0.30	600	48.5	1.20	0.35	117%
Morgan Avenue	PROP. 0	PROP. 1	0.000	0.50	0.00	1.316	0.66	0.73	13.04	13.77	218.98	0.400	PVC	0.013	0.30	675	56.8	1.30	0.48	83%
SITE	CULTEC	PROP. 1	0.000	0.50	0.00	1.316	0.66	0.10	13.77	13.87	218.23	0.302	PVC	0.013	0.89	525	11.3	1.89	0.42	71%
												Flows from CULTEC System								
SITE	PROP. 1	PROP. H/WALL	0.000	0.50	0.00	1.316	0.66	0.36	13.87	14.23	215.53	0.702	PVC	0.013	0.38	750	34.0	1.57	0.72	98%

PRE-DEVELOPMENT – AREA 1 – 5-YEAR STORM:

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                         Version 2.25  rev. 473"
"               MIDUSS created                               February 7, 2010"
"          10   Units used:                                         ie METRIC"
"               Job folder:              Z:\Project Files\PROJECTS\_Smithville\"
"                        132 College Street, Smithville\FSR\SWM\MIDUSS\Pre-Dev"
"               Output filename:                                  PRE_A1_5.out"
"               Licensee name:                          andrew@landsmithec.com"
"               Company                  LandSmith Engineering & Consulting Ltd."
"               Date & Time last used:              2024-05-09 at 11:27:19 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3175.000   Coefficient A"
"       20.000   Constant B"
"        1.000   Exponent C"
"        0.500   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           105.833    mm/hr"
"             Total depth                  47.625    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   PRE-DEV A1"
"       94.000   % Impervious"
"        0.270   Total Area"
"       41.000   Flow length"
"        1.440   Overland Slope"
"        0.016   Pervious Area"
"       41.000   Pervious length"
"        1.440   Pervious slope"
"        0.254   Impervious Area"
"       41.000   Impervious length"
"        1.440   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.260   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."
"        0.873   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.072     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.016      0.254      0.270      hectare"
"             Time of concentration  23.998     2.916      3.309      minutes"
"             Time to Centroid       135.950    100.630    101.288    minutes"
"             Rainfall depth         47.625     47.625     47.625     mm"
"             Rainfall volume        7.72       120.87     128.59     c.m"
"             Rainfall losses        35.253     6.051      7.803      mm"
"             Runoff depth           12.372     41.574     39.822     mm"
"             Runoff volume          2.00       105.51     107.52     c.m"
"             Runoff coefficient     0.260      0.873      0.836      "
"             Maximum flow           0.001      0.072      0.072      c.m/sec"
```

PRE-DEVELOPMENT – AREA 1 - 100-YEAR STORM:

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                         Version 2.25  rev. 473"
"               MIDUSS created                               February 7, 2010"
"          10   Units used:                                         ie METRIC"
"               Job folder:             Z:\Project Files\PROJECTS\_Smithville\"
"                        132 College Street, Smithville\FSR\SWM\MIDUSS\Pre-Dev"
"               Output filename:                                PRE_A1_100.out"
"               Licensee name:                         andrew@landsmithec.com"
"               Company                    LandSmith Engineering & Consulting Ltd."
"               Date & Time last used:               2024-05-09 at 11:47:25 AM"
" 31          TIME PARAMETERS"
"       5.000   Time Step"
"     180.000   Max. Storm length"
"    1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"           1   Chicago storm"
"    6300.000   Coefficient A"
"      15.000   Constant B"
"       1.000   Exponent C"
"       0.500   Fraction R"
"     180.000   Duration"
"       1.000   Time step multiplier"
"            Maximum intensity           252.000    mm/hr"
"            Total depth                  96.923    mm"
"           6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         101   PRE-DEV A1"
"      94.000   % Impervious"
"       0.270   Total Area"
"      41.000   Flow length"
"       1.440   Overland Slope"
"       0.016   Pervious Area"
"      41.000   Pervious length"
"       1.440   Pervious slope"
"       0.254   Impervious Area"
"      41.000   Impervious length"
"       1.440   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious SCS Curve No."
"       0.465   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."
"       0.932   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                    0.178     0.000     0.000     0.000 c.m/sec"
"            Catchment 101          Pervious   Impervious Total Area "
"            Surface Area           0.016      0.254      0.270      hectare"
"            Time of concentration  13.490     2.046      2.399      minutes"
"            Time to Centroid       119.035    97.904     98.556     minutes"
"            Rainfall depth         96.923     96.923     96.923     mm"
"            Rainfall volume        15.70      245.99     261.69     c.m"
"            Rainfall losses        51.853     6.590      9.306      mm"
"            Runoff depth           45.070     90.333     87.617     mm"
"            Runoff volume          7.30       229.26     236.57     c.m"
"            Runoff coefficient     0.465      0.932      0.904      "
"            Maximum flow           0.004      0.176      0.178      c.m/sec"
```

PRE-DEVELOPMENT – AREA 2 - 5-YEAR STORM:

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                         Version 2.25  rev. 473"
"               MIDUSS created                               February 7, 2010"
"          10   Units used:                                         ie METRIC"
"               Job folder:             Z:\Project Files\PROJECTS\_Smithville\"
"                        132 College Street, Smithville\FSR\SWM\MIDUSS\Pre-Dev"
"               Output filename:                                   PRE_A2_5.out"
"               Licensee name:                          andrew@landsmithec.com"
"               Company                LandSmith Engineering & Consulting Ltd."
"               Date & Time last used:                 2024-05-09 at 2:05:46 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3175.000   Coefficient A"
"       20.000   Constant B"
"        1.000   Exponent C"
"        0.500   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"            Maximum intensity           105.833    mm/hr"
"            Total depth                  47.625    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   PRE-DEV A2"
"       22.000   % Impervious"
"        1.577   Total Area"
"      210.000   Flow length"
"        1.860   Overland Slope"
"        1.230   Pervious Area"
"      210.000   Pervious length"
"        1.860   Pervious slope"
"        0.347   Impervious Area"
"      210.000   Impervious length"
"        1.860   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.260   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."
"        0.883   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.101     0.000     0.000     0.000 c.m/sec"
"            Catchment 101          Pervious   Impervious Total Area "
"            Surface Area           1.230      0.347      1.577      hectare"
"            Time of concentration  59.224     7.197      33.774     minutes"
"            Time to Centroid       178.203    106.074    142.920    minutes"
"            Rainfall depth         47.625     47.625     47.625     mm"
"            Rainfall volume        585.82     165.23     751.05     c.m"
"            Rainfall losses        35.244     5.590      28.720     mm"
"            Runoff depth           12.381     42.035     18.905     mm"
"            Runoff volume          152.30     145.84     298.13     c.m"
"            Runoff coefficient     0.260      0.883      0.397      "
"            Maximum flow           0.027      0.096      0.101      c.m/sec"
```

PRE-DEVELOPMENT – AREA 2 - 100-YEAR STORM:

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                                February 7, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:            Z:\Project Files\PROJECTS\_Smithville\"
"                         132 College Street, Smithville\FSR\SWM\MIDUSS\Pre-Dev"
"                Output filename:                                PRE_A2_100.out"
"                Licensee name:                          andrew@landsmithec.com"
"                Company                  LandSmith Engineering & Consulting Ltd."
"                Date & Time last used:                 2024-05-09 at 2:07:39 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     6300.000   Coefficient A"
"       15.000   Constant B"
"        1.000   Exponent C"
"        0.500   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           252.000    mm/hr"
"             Total depth                  96.923    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   PRE-DEV A2"
"       22.000   % Impervious"
"        1.577   Total Area"
"      210.000   Flow length"
"        1.860   Overland Slope"
"        1.230   Pervious Area"
"      210.000   Pervious length"
"        1.860   Pervious slope"
"        0.347   Impervious Area"
"      210.000   Impervious length"
"        1.860   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.466   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."
"        0.939   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.267     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           1.230      0.347      1.577      hectare"
"             Time of concentration  33.291     5.049      23.057     minutes"
"             Time to Centroid       143.451    101.857    128.378    minutes"
"             Rainfall depth         96.923     96.923     96.923     mm"
"             Rainfall volume        1192.21    336.26     1528.48    c.m"
"             Rainfall losses        51.748     5.898      41.661     mm"
"             Runoff depth           45.175     91.025     55.262     mm"
"             Runoff volume          555.68     315.80     871.48     c.m"
"             Runoff coefficient     0.466      0.939      0.570      "
"             Maximum flow           0.176      0.237      0.267      c.m/sec"
```

PRE-DEVELOPMENT – AREA 3 - 5-YEAR STORM:

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                                February 7, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:             Z:\Project Files\PROJECTS\_Smithville\"
"                         132 College Street, Smithville\FSR\SWM\MIDUSS\Pre-Dev"
"                Output filename:                                   PRE_A3_5.out"
"                Licensee name:                          andrew@landsmithec.com"
"                Company                LandSmith Engineering & Consulting Ltd."
"                Date & Time last used:                2024-05-09 at 11:33:47 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3175.000   Coefficient A"
"       20.000   Constant B"
"        1.000   Exponent C"
"        0.500   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           105.833    mm/hr"
"             Total depth                  47.625    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   PRE-DEV A3"
"       95.000   % Impervious"
"        0.043   Total Area"
"       41.000   Flow length"
"        0.800   Overland Slope"
"        0.002   Pervious Area"
"       41.000   Pervious length"
"        0.800   Pervious slope"
"        0.041   Impervious Area"
"       41.000   Impervious length"
"        0.800   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.260   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."
"        0.868   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.012     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.002      0.041      0.043      hectare"
"             Time of concentration  28.626     3.479      3.869      minutes"
"             Time to Centroid       141.482    101.366    101.988    minutes"
"             Rainfall depth         47.625     47.625     47.625     mm"
"             Rainfall volume        1.02       19.45      20.48      c.m"
"             Rainfall losses        35.263     6.310      7.758      mm"
"             Runoff depth           12.362     41.315     39.867     mm"
"             Runoff volume          0.27       16.88      17.14      c.m"
"             Runoff coefficient     0.260      0.868      0.837      "
"             Maximum flow           0.000      0.012      0.012      c.m/sec"
```

PRE-DEVELOPMENT – AREA 3 - 100-YEAR STORM:

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                           Version 2.25  rev. 473"
"               MIDUSS created                                 February 7, 2010"
"          10   Units used:                                           ie METRIC"
"               Job folder:            Z:\Project Files\PROJECTS\_Smithville\"
"                        132 College Street, Smithville\FSR\SWM\MIDUSS\Pre-Dev"
"               Output filename:                                  PRE_A3_100.out"
"               Licensee name:                           andrew@landsmithec.com"
"               Company                   LandSmith Engineering & Consulting Ltd."
"               Date & Time last used:               2024-05-09 at 11:53:46 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     6300.000   Coefficient A"
"       15.000   Constant B"
"        1.000   Exponent C"
"        0.500   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          252.000    mm/hr"
"             Total depth                 96.923    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   PRE-DEV A3"
"       95.000   % Impervious"
"        0.043   Total Area"
"       41.000   Flow length"
"        0.800   Overland Slope"
"        0.002   Pervious Area"
"       41.000   Pervious length"
"        0.800   Pervious slope"
"        0.041   Impervious Area"
"       41.000   Impervious length"
"        0.800   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.465   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."
"        0.929   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.028     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.002      0.041      0.043      hectare"
"             Time of concentration  16.091     2.440      2.791      minutes"
"             Time to Centroid       122.250    98.408     99.020     minutes"
"             Rainfall depth         96.923     96.923     96.923     mm"
"             Rainfall volume        2.08       39.59      41.68      c.m"
"             Rainfall losses        51.867     6.858      9.108      mm"
"             Runoff depth           45.056     90.065     87.815     mm"
"             Runoff volume          0.97       36.79      37.76      c.m"
"             Runoff coefficient     0.465      0.929      0.906      "
"             Maximum flow           0.001      0.028      0.028      c.m/sec"
```

PRE-DEVELOPMENT – AREA 4 - 5-YEAR STORM:

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                         Version 2.25  rev. 473"
"               MIDUSS created                               February 7, 2010"
"          10   Units used:                                         ie METRIC"
"               Job folder:             Z:\Project Files\PROJECTS\_Smithville\"
"                        132 College Street, Smithville\FSR\SWM\MIDUSS\Pre-Dev"
"               Output filename:                                 PRE_A4_5.out"
"               Licensee name:                         andrew@landsmithec.com"
"               Company                 LandSmith Engineering & Consulting Ltd."
"               Date & Time last used:              2024-05-09 at 11:32:20 AM"
" 31         TIME PARAMETERS"
"       5.000   Time Step"
"     180.000   Max. Storm length"
"    1500.000   Max. Hydrograph"
" 32         STORM Chicago storm"
"           1   Chicago storm"
"    3175.000   Coefficient A"
"      20.000   Constant B"
"       1.000   Exponent C"
"       0.500   Fraction R"
"     180.000   Duration"
"       1.000   Time step multiplier"
"            Maximum intensity           105.833    mm/hr"
"            Total depth                  47.625    mm"
"           6   005hyd   Hydrograph extension used in this file"
" 33         CATCHMENT 101"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         101   PRE-DEV A4"
"      76.000   % Impervious"
"       0.064   Total Area"
"      50.000   Flow length"
"       1.520   Overland Slope"
"       0.015   Pervious Area"
"      50.000   Pervious length"
"       1.520   Pervious slope"
"       0.049   Impervious Area"
"      50.000   Impervious length"
"       1.520   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious SCS Curve No."
"       0.260   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."
"       0.871   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           0.015      0.049      0.064      hectare"
"            Time of concentration  26.598     3.232      5.243      minutes"
"            Time to Centroid       139.063    101.050    104.322    minutes"
"            Rainfall depth         47.625     47.625     47.625     mm"
"            Rainfall volume        7.32       23.16      30.48      c.m"
"            Rainfall losses        35.252     6.136      13.124     mm"
"            Runoff depth           12.373     41.489     34.501     mm"
"            Runoff volume          1.90       20.18      22.08      c.m"
"            Runoff coefficient     0.260      0.871      0.724      "
"            Maximum flow           0.001      0.014      0.014      c.m/sec"
```

PRE-DEVELOPMENT - AREA 4 - 100-YEAR STORM:

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                          Version 2.25  rev. 473"
"               MIDUSS created                                February 7, 2010"
"          10   Units used:                                          ie METRIC"
"               Job folder:            Z:\Project Files\PROJECTS\_Smithville\"
"                        132 College Street, Smithville\FSR\SWM\MIDUSS\Pre-Dev"
"               Output filename:                                PRE_A4_100.out"
"               Licensee name:                          andrew@landsmithec.com"
"               Company                 LandSmith Engineering & Consulting Ltd."
"               Date & Time last used:                2024-05-09 at 11:52:40 AM"
" 31         TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32         STORM Chicago storm"
"            1   Chicago storm"
"     6300.000   Coefficient A"
"       15.000   Constant B"
"        1.000   Exponent C"
"        0.500   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"            Maximum intensity           252.000    mm/hr"
"            Total depth                  96.923    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33         CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   PRE-DEV A4"
"       76.000   % Impervious"
"        0.064   Total Area"
"       50.000   Flow length"
"        1.520   Overland Slope"
"        0.015   Pervious Area"
"       50.000   Pervious length"
"        1.520   Pervious slope"
"        0.049   Impervious Area"
"       50.000   Impervious length"
"        1.520   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.466   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."
"        0.932   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.035     0.000     0.000     0.000 c.m/sec"
"            Catchment 101          Pervious   Impervious Total Area "
"            Surface Area           0.015      0.049      0.064      hectare"
"            Time of concentration  14.951     2.267      3.996      minutes"
"            Time to Centroid       120.843    98.194     101.281    minutes"
"            Rainfall depth         96.923     96.923     96.923     mm"
"            Rainfall volume        14.89      47.14      62.03      c.m"
"            Rainfall losses        51.784     6.605      17.448     mm"
"            Runoff depth           45.139     90.318     79.475     mm"
"            Runoff volume          6.93       43.93      50.86      c.m"
"            Runoff coefficient     0.466      0.932      0.820      "
"            Maximum flow           0.004      0.034      0.035      c.m/sec"
```

POST-DEVELOPMENT – AREA 1 - 5-YEAR STORM:

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                           Version 2.25  rev. 473"
"                MIDUSS created                                 February 7, 2010"
"           10   Units used:                                           ie METRIC"
"                Job folder:            Z:\Project Files\PROJECTS\_Smithville\"
"                        132 College Street, Smithville\FSR\SWM\MIDUSS\Post-Dev"
"                Output filename:                                  POST_A1_5.out"
"                Licensee name:                           andrew@landsmithec.com"
"                Company                   LandSmith Engineering & Consulting Ltd."
"                Date & Time last used:               2024-07-31 at 10:37:38 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3175.000   Coefficient A"
"       20.000   Constant B"
"        1.000   Exponent C"
"        0.500   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          105.833    mm/hr"
"             Total depth                 47.625    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   POST-DEV A1"
"       49.000   % Impervious"
"        0.281   Total Area"
"       26.000   Flow length"
"        1.000   Overland Slope"
"        0.143   Pervious Area"
"       26.000   Pervious length"
"        1.000   Pervious slope"
"        0.138   Impervious Area"
"       26.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.260   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."
"        0.877   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.040     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.143      0.138      0.281      hectare"
"             Time of concentration  20.371     2.475      6.695      minutes"
"             Time to Centroid       131.606    100.053    107.493    minutes"
"             Rainfall depth         47.625     47.625     47.625     mm"
"             Rainfall volume        68.25      65.57      133.83     c.m"
"             Rainfall losses        35.250     5.880      20.859     mm"
"             Runoff depth           12.375     41.745     26.766     mm"
"             Runoff volume          17.73      57.48      75.21      c.m"
"             Runoff coefficient     0.260      0.877      0.562      "
"             Maximum flow           0.007      0.039      0.040      c.m/sec"
```

POST-DEVELOPMENT – AREA 1 - 100-YEAR STORM:

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                         Version 2.25  rev. 473"
"               MIDUSS created                               February 7, 2010"
"          10   Units used:                                         ie METRIC"
"               Job folder:            Z:\Project Files\PROJECTS\_Smithville\"
"                       132 College Street, Smithville\FSR\SWM\MIDUSS\Post-Dev"
"               Output filename:                              POST_A1_100.out"
"               Licensee name:                          andrew@landsmithec.com"
"               Company               LandSmith Engineering & Consulting Ltd."
"               Date & Time last used:               2024-07-31 at 10:40:15 AM"
" 31          TIME PARAMETERS"
"       5.000   Time Step"
"     180.000   Max. Storm length"
"    1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"           1   Chicago storm"
"    6300.000   Coefficient A"
"      15.000   Constant B"
"       1.000   Exponent C"
"       0.500   Fraction R"
"     180.000   Duration"
"       1.000   Time step multiplier"
"            Maximum intensity           252.000    mm/hr"
"            Total depth                  96.923    mm"
"           6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         101   POST-DEV A1"
"      49.000   % Impervious"
"       0.281   Total Area"
"      26.000   Flow length"
"       1.000   Overland Slope"
"       0.143   Pervious Area"
"      26.000   Pervious length"
"       1.000   Pervious slope"
"       0.138   Impervious Area"
"      26.000   Impervious length"
"       1.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious SCS Curve No."
"       0.465   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."
"       0.932   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                    0.116     0.000     0.000     0.000 c.m/sec"
"            Catchment 101          Pervious   Impervious Total Area "
"            Surface Area           0.143      0.138      0.281      hectare"
"            Time of concentration  11.451     1.737      5.054      minutes"
"            Time to Centroid       116.505    97.515     104.000    minutes"
"            Rainfall depth         96.923     96.923     96.923     mm"
"            Rainfall volume        138.90     133.45     272.35     c.m"
"            Rainfall losses        51.900     6.548      29.677     mm"
"            Runoff depth           45.023     90.375     67.246     mm"
"            Runoff volume          64.52      124.44     188.96     c.m"
"            Runoff coefficient     0.465      0.932      0.694      "
"            Maximum flow           0.039      0.095      0.116      c.m/sec"
```

POST-DEVELOPMENT - AREA 2 - CULTEC SYSTEM ROUTING - 5-YEAR STORM:

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                         Version 2.25  rev. 473"
"               MIDUSS created                               February 7, 2010"
"          10   Units used:                                         ie METRIC"
"               Job folder:             Z:\Project Files\PROJECTS\_Smithville\"
"                       132 College Street, Smithville\FSR\SWM\MIDUSS\Post-Dev"
"               Output filename:                 POST_A2_5_cultec_UPDATE 1.out"
"               Licensee name:                         andrew@landsmithec.com"
"               Company                 LandSmith Engineering & Consulting Ltd."
"               Date & Time last used:              2025-06-10 at 11:23:58 AM"
" 31         TIME PARAMETERS"
"       5.000   Time Step"
"     180.000   Max. Storm length"
"    1500.000   Max. Hydrograph"
" 32         STORM Chicago storm"
"           1   Chicago storm"
"    3175.000   Coefficient A"
"      20.000   Constant B"
"       1.000   Exponent C"
"       0.500   Fraction R"
"     180.000   Duration"
"       1.000   Time step multiplier"
"            Maximum intensity          105.833    mm/hr"
"            Total depth                 47.625    mm"
"           6   005hyd   Hydrograph extension used in this file"
" 33         CATCHMENT 101"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         101   POST-DEV A2"
"      78.000   % Impervious"
"       1.548   Total Area"
"     180.000   Flow length"
"       1.000   Overland Slope"
"       0.341   Pervious Area"
"     180.000   Pervious length"
"       1.000   Pervious slope"
"       1.207   Impervious Area"
"     180.000   Impervious length"
"       1.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious SCS Curve No."
"       0.260   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."
"       0.888   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                    0.346     0.000     0.000     0.000 c.m/sec"
"            Catchment 101          Pervious   Impervious Total Area "
"            Surface Area           0.341      1.207      1.548      hectare"
"            Time of concentration  65.040     7.904      12.263     minutes"
"            Time to Centroid       185.179    106.986    112.952    minutes"
"            Rainfall depth         47.625     47.625     47.625     mm"
"            Rainfall volume        162.19     575.04     737.23     c.m"
"            Rainfall losses        35.244     5.344      11.922     mm"
"            Runoff depth           12.381     42.281     35.703     mm"
"            Runoff volume          42.17      510.51     552.68     c.m"
"            Runoff coefficient     0.260      0.888      0.750      "
"            Maximum flow           0.007      0.345      0.346      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                    0.346     0.346     0.000     0.000"
```

```
" 54          POND DESIGN"
"        0.346   Current peak flow    c.m/sec"
"        0.127   Target outflow    c.m/sec"
"        552.7   Hydrograph volume    c.m"
"          31.   Number of stages"
"      187.430   Minimum water level    metre"
"      188.960   Maximum water level    metre"
"      187.430   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"               187.430     0.000     0.000"
"               187.490   0.00210    25.900"
"               187.540   0.00744    51.900"
"               187.590   0.01470    77.500"
"               187.640   0.02356   102.900"
"               187.690   0.03381   128.300"
"               187.740   0.06296   153.300"
"               187.790   0.07525   178.400"
"               187.840   0.08580   203.200"
"               187.890   0.09709   227.700"
"               187.940    0.1097   251.900"
"               187.990    0.1231   276.000"
"               188.040    0.1371   299.900"
"               188.100    0.1621   323.500"
"               188.150    0.1748   346.900"
"               188.200    0.1863   369.800"
"               188.250    0.1971   392.100"
"               188.300    0.2071   414.200"
"               188.350    0.2167   435.500"
"               188.400    0.2258   456.100"
"               188.450    0.2346   476.100"
"               188.500    0.2429   494.800"
"               188.550    0.2510   512.100"
"               188.600    0.2589   527.000"
"               188.650    0.2665   540.200"
"               188.700    0.2738   552.300"
"               188.760    0.2824   564.500"
"               188.810    0.2894   576.600"
"               188.860    0.2962   588.800"
"               188.910    0.3028   601.000"
"               188.960    0.3093   613.100"
"           2.   ORIFICES"
"               Orifice   Orifice   Orifice Number of"
"                invert coefficie  diameter  orifices"
"               187.430     0.630    0.2900     1.000"
"               187.830     0.630    0.2100     1.000"
"            Peak outflow                 0.122    c.m/sec"
"            Maximum level              187.986    metre"
"            Maximum storage            274.247    c.m"
"            Centroidal lag               2.923   hours"
"                 0.346     0.346     0.122     0.000 c.m/sec"
```

POST-DEVELOPMENT - AREA 2 - CULTEC SYSTEM ROUTING - 100-YEAR STORM:

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                         Version 2.25  rev. 473"
"               MIDUSS created                               February 7, 2010"
"          10   Units used:                                         ie METRIC"
"               Job folder:            Z:\Project Files\PROJECTS\_Smithville\"
"                       132 College Street, Smithville\FSR\SWM\MIDUSS\Post-Dev"
"               Output filename:              POST_A2_100_cultec_UPDATE 1.out"
"               Licensee name:                         andrew@landsmithec.com"
"               Company                LandSmith Engineering & Consulting Ltd."
"               Date & Time last used:                2025-06-10 at 10:24:20 AM"
" 31          TIME PARAMETERS"
"       5.000   Time Step"
"     180.000   Max. Storm length"
"    1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"           1   Chicago storm"
"    6300.000   Coefficient A"
"      15.000   Constant B"
"       1.000   Exponent C"
"       0.500   Fraction R"
"     180.000   Duration"
"       1.000   Time step multiplier"
"             Maximum intensity           252.000    mm/hr"
"             Total depth                  96.923    mm"
"           6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         101   POST-DEV A2"
"      78.000   % Impervious"
"       1.548   Total Area"
"     180.000   Flow length"
"       1.000   Overland Slope"
"       0.341   Pervious Area"
"     180.000   Pervious length"
"       1.000   Pervious slope"
"       1.207   Impervious Area"
"     180.000   Impervious length"
"       1.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious SCS Curve No."
"       0.466   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."
"       0.940   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                    0.819     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.341      1.207      1.548      hectare"
"             Time of concentration  36.561     5.545      9.349      minutes"
"             Time to Centroid       147.480    102.506    108.023    minutes"
"             Rainfall depth         96.923     96.923     96.923     mm"
"             Rainfall volume        330.08     1170.29    1500.37    c.m"
"             Rainfall losses        51.743     5.788      15.898     mm"
"             Runoff depth           45.180     91.135     81.025     mm"
"             Runoff volume          153.87     1100.40    1254.26    c.m"
"             Runoff coefficient     0.466      0.940      0.836      "
"             Maximum flow           0.044      0.812      0.819      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                    0.819     0.819     0.000     0.000"
```

```
" 54          POND DESIGN"
"        0.819   Current peak flow    c.m/sec"
"        0.307   Target outflow    c.m/sec"
"       1254.3   Hydrograph volume    c.m"
"          31.   Number of stages"
"      187.430   Minimum water level    metre"
"      188.960   Maximum water level    metre"
"      187.430   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                 Level Discharge    Volume"
"               187.430     0.000     0.000"
"               187.490   0.00210    25.900"
"               187.540   0.00744    51.900"
"               187.590   0.01470    77.500"
"               187.640   0.02356   102.900"
"               187.690   0.03381   128.300"
"               187.740   0.06296   153.300"
"               187.790   0.07525   178.400"
"               187.840   0.08580   203.200"
"               187.890   0.09709   227.700"
"               187.940    0.1097   251.900"
"               187.990    0.1231   276.000"
"               188.040    0.1371   299.900"
"               188.100    0.1621   323.500"
"               188.150    0.1748   346.900"
"               188.200    0.1863   369.800"
"               188.250    0.1971   392.100"
"               188.300    0.2071   414.200"
"               188.350    0.2167   435.500"
"               188.400    0.2258   456.100"
"               188.450    0.2346   476.100"
"               188.500    0.2429   494.800"
"               188.550    0.2510   512.100"
"               188.600    0.2589   527.000"
"               188.650    0.2665   540.200"
"               188.700    0.2738   552.300"
"               188.760    0.2824   564.500"
"               188.810    0.2894   576.600"
"               188.860    0.2962   588.800"
"               188.910    0.3028   601.000"
"               188.960    0.3093   613.100"
"          2.   ORIFICES"
"               Orifice   Orifice   Orifice Number of"
"                invert coefficie  diameter  orifices"
"               187.430     0.630    0.2900     1.000"
"               187.830     0.630    0.2100     1.000"
"            Peak outflow                  0.302    c.m/sec"
"            Maximum level               188.923    metre"
"            Maximum storage             604.207    c.m"
"            Centroidal lag                2.551   hours"
"                 0.819     0.819     0.302     0.000 c.m/sec"
```

POST-DEVELOPMENT – AREA 3 - 5-YEAR STORM:

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                         Version 2.25  rev. 473"
"               MIDUSS created                               February 7, 2010"
"          10   Units used:                                         ie METRIC"
"               Job folder:            Z:\Project Files\PROJECTS\_Smithville\"
"                       132 College Street, Smithville\FSR\SWM\MIDUSS\Post-Dev"
"               Output filename:                                POST_A3_5.out"
"               Licensee name:                         andrew@landsmithec.com"
"               Company                LandSmith Engineering & Consulting Ltd."
"               Date & Time last used:              2024-07-31 at 10:49:26 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3175.000   Coefficient A"
"       20.000   Constant B"
"        1.000   Exponent C"
"        0.500   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           105.833    mm/hr"
"             Total depth                  47.625    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   POST-DEV A3"
"        0.000   % Impervious"
"        0.015   Total Area"
"       15.000   Flow length"
"        1.000   Overland Slope"
"        0.015   Pervious Area"
"       15.000   Pervious length"
"        1.000   Pervious slope"
"        0.000   Impervious Area"
"       15.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.260   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."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.001     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.015      0.000      0.015      hectare"
"             Time of concentration  14.644     1.780      14.644     minutes"
"             Time to Centroid       124.744    0.000      124.744    minutes"
"             Rainfall depth         47.625     47.625     47.625     mm"
"             Rainfall volume        7.14       0.00       7.14       c.m"
"             Rainfall losses        35.244     47.625     35.244     mm"
"             Runoff depth           12.381     0.000      12.381     mm"
"             Runoff volume          1.86       0.00       1.86       c.m"
"             Runoff coefficient     0.260      0.000      0.260      "
"             Maximum flow           0.001      0.000      0.001      c.m/sec"
```

POST-DEVELOPMENT - AREA 3 - 100-YEAR STORM:

```
"               MIDUSS Output ----------------------------------------------->"
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"               MIDUSS created                                 February 7, 2010"
"          10   Units used:                                           ie METRIC"
"               Job folder:             Z:\Project Files\PROJECTS\_Smithville\"
"                       132 College Street, Smithville\FSR\SWM\MIDUSS\Post-Dev"
"               Output filename:                                POST_A3_100.out"
"               Licensee name:                           andrew@landsmithec.com"
"               Company                  LandSmith Engineering & Consulting Ltd."
"               Date & Time last used:                2024-07-31 at 10:50:44 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     6300.000   Coefficient A"
"       15.000   Constant B"
"        1.000   Exponent C"
"        0.500   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           252.000    mm/hr"
"             Total depth                  96.923    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   POST-DEV A3"
"        0.000   % Impervious"
"        0.015   Total Area"
"       15.000   Flow length"
"        1.000   Overland Slope"
"        0.015   Pervious Area"
"       15.000   Pervious length"
"        1.000   Pervious slope"
"        0.000   Impervious Area"
"       15.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.465   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."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.005     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.015      0.000      0.015      hectare"
"             Time of concentration  8.232      1.248      8.232      minutes"
"             Time to Centroid       112.628    0.000      112.628    minutes"
"             Rainfall depth         96.923     96.923     96.923     mm"
"             Rainfall volume        14.54      0.00       14.54      c.m"
"             Rainfall losses        51.877     96.923     51.877     mm"
"             Runoff depth           45.046     0.000      45.046     mm"
"             Runoff volume          6.76       0.00       6.76       c.m"
"             Runoff coefficient     0.465      0.000      0.465      "
"             Maximum flow           0.005      0.000      0.005      c.m/sec"
```

POST-DEVELOPMENT – AREA 4 - 5-YEAR STORM:

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"               MIDUSS created                               February 7, 2010"
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"               Job folder:            Z:\Project Files\PROJECTS\_Smithville\"
"                       132 College Street, Smithville\FSR\SWM\MIDUSS\Post-Dev"
"               Output filename:                                 POST_A4_5.out"
"               Licensee name:                         andrew@landsmithec.com"
"               Company                 LandSmith Engineering & Consulting Ltd."
"               Date & Time last used:                 2024-08-01 at 10:34:38 AM"
" 31          TIME PARAMETERS"
"       5.000   Time Step"
"     180.000   Max. Storm length"
"    1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"           1   Chicago storm"
"    3175.000   Coefficient A"
"      20.000   Constant B"
"       1.000   Exponent C"
"       0.500   Fraction R"
"     180.000   Duration"
"       1.000   Time step multiplier"
"             Maximum intensity           105.833    mm/hr"
"             Total depth                  47.625    mm"
"           6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         101   POST-DEV A4"
"      39.000   % Impervious"
"       0.114   Total Area"
"      15.000   Flow length"
"       1.000   Overland Slope"
"       0.070   Pervious Area"
"      15.000   Pervious length"
"       1.000   Pervious slope"
"       0.044   Impervious Area"
"      15.000   Impervious length"
"       1.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      75.000   Pervious SCS Curve No."
"       0.260   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."
"       0.880   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           0.070      0.044      0.114      hectare"
"             Time of concentration  14.644     1.780      5.844      minutes"
"             Time to Centroid       124.744    99.183     107.260    minutes"
"             Rainfall depth         47.625     47.625     47.625     mm"
"             Rainfall volume        33.12      21.17      54.29      c.m"
"             Rainfall losses        35.244     5.701      23.722     mm"
"             Runoff depth           12.381     41.924     23.903     mm"
"             Runoff volume          8.61       18.64      27.25      c.m"
"             Runoff coefficient     0.260      0.880      0.502      "
"             Maximum flow           0.004      0.013      0.014      c.m/sec"
```

POST-DEVELOPMENT – AREA 4 - 100-YEAR STORM:

```
"                MIDUSS Output ----------------------------------------------->"
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"                MIDUSS created                                February 7, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:             Z:\Project Files\PROJECTS\_Smithville\"
"                        132 College Street, Smithville\FSR\SWM\MIDUSS\Post-Dev"
"                Output filename:                                POST_A4_100.out"
"                Licensee name:                          andrew@landsmithec.com"
"                Company                LandSmith Engineering & Consulting Ltd."
"                Date & Time last used:               2024-08-01 at 10:36:11 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     6300.000   Coefficient A"
"       15.000   Constant B"
"        1.000   Exponent C"
"        0.500   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           252.000    mm/hr"
"             Total depth                  96.923    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   POST-DEV A4"
"       39.000   % Impervious"
"        0.114   Total Area"
"       15.000   Flow length"
"        1.000   Overland Slope"
"        0.070   Pervious Area"
"       15.000   Pervious length"
"        1.000   Pervious slope"
"        0.044   Impervious Area"
"       15.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       75.000   Pervious SCS Curve No."
"        0.465   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."
"        0.921   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.044     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           0.070      0.044      0.114      hectare"
"             Time of concentration  8.232      1.248      4.328      minutes"
"             Time to Centroid       112.628    96.895     103.833    minutes"
"             Rainfall depth         96.923     96.923     96.923     mm"
"             Rainfall volume        67.40      43.09      110.49     c.m"
"             Rainfall losses        51.877     7.618      34.616     mm"
"             Runoff depth           45.046     89.305     62.307     mm"
"             Runoff volume          31.32      39.70      71.03      c.m"
"             Runoff coefficient     0.465      0.921      0.643      "
"             Maximum flow           0.025      0.030      0.044      c.m/sec"
```

CULTEC Stormwater Design Calculator

Please Fill in the Shaded Cells

Project Information:

Project Name	
Address	132 College Street
City	Smithville
State/Province	ON
ZIP/Postal Code	
Country	

Calculations Performed By:

Name	Andrew Smith
Company Name	LandSmith
Address	1059 Upper James St, Suite 207
City	Hamilton
State/Province	Ontario
ZIP/Postal Code	L9C 3A6
Country	Canada
Phone	289-309-3632
Email	andrew@landsmithec.com

Date:
June 11, 2025

Project Number:
22046PHE

Input Project Requirements

Unit of Measure	**Metric**	
Select Model	Recharger 902HD	
Stone Porosity	40%	
Number of HVLV Internal Manifolds	1 Internal Manifold	
Stone Depth **Above** Chamber	305	mm
Stone Depth **Below** Chamber	305	mm
Stone **Between** Chamber rows	229	mm
☑ Include Separator Row		
Workable Bed Depth	2.06	meters
Max. Bed Width	12.00	meters
Storage Volume Required	680.00	cu. meters
Stone Base Elevation	187.13	meters

Additional Information:

Other models are available if products above do not meet your requirements. Contact CULTEC for further design assistance.
Call CULTEC at 203-775-4416 for pricing information.

Hyperlinks to product specific webpages:

Please visit our website for more information such as CAD details, spec information, brochures, installation instructions, and other design tools on certain models.

Contactor Field Drain C-4HD
Contactor 100HD
Recharger 150XLHD
Recharger 180HD
Recharger 280HD
Recharger 330XLHD
Recharger 360HD
Recharger 902HD
HVLV SFCx2 Feed Connector
HVLV FC-24 Feed Connector
HVLV FC-48 Feed Connector
CULTEC No. 4800 Woven Geotextile
CULTEC No. 410 Non-Woven Geotextile

For design assistance, drawings and pricing send these calculations to:
mailto:tech@cultec.com

Website:
www.cultec.com

CULTEC Stormwater Design Calculator

Date:	June 11, 2025

Project Number:	22046PHE

Project Information:

132 College Street
Smithville
ON

Calculations Performed By:

Andrew Smith
LandSmith
1059 Upper James St, Suite 207
Hamilton Ontario
L9C 3A6
Canada
289-309-3632
andrew@landsmithec.com

RECHARGER 902HD

Recharger 902HD Chamber Specifications

Height	**1219**	mm
Width	**1981**	mm
Length	**1.25**	meters
Installed Length	**1.12**	meters
Bare Chamber Volume	**1.80**	cu. meters
Installed Chamber Volume	**2.89**	cu. meters

Breakdown of Storage Provided by Recharger 902HD Stormwater System

Within Chambers	**414.15**	cu. meters
Within Feed Connectors	**0.08**	cu. meters
Within Stone	**271.81**	cu. meters
Total Storage Provided	**686.0**	**cu. meters**
Total Storage Required	680.00	cu. meters

Materials List

Recharger 902HD

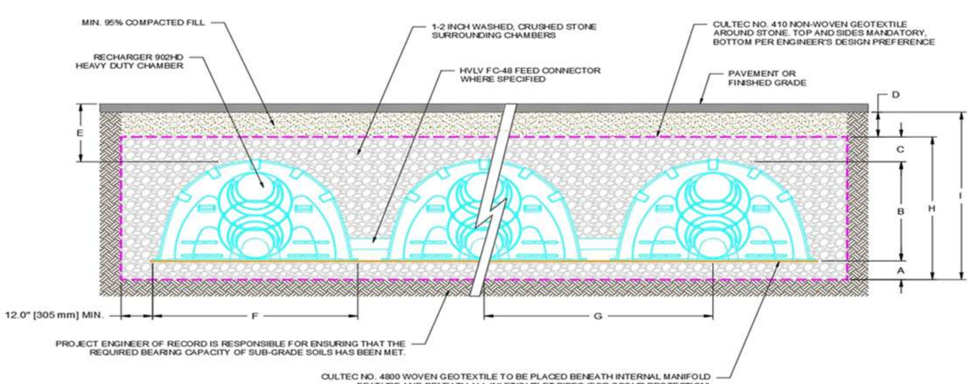
Total Number of Chambers Required	**230**	**pieces**	
Separator Row Chambers	**46**	pieces	Separator Row Qty Included in Total
Chamber Units	**230**	pieces	
End Caps	**10**	pieces	
HVLV FC-48 Feed Connectors	**4**	pieces	*Based on 1 Internal Manifold*
CULTEC No. 410 Non-Woven Geotextile	**1787**	sq. meters	
CULTEC No. 4800 Woven Geotextile	**66**	meters	
Stone	**680**	cu. meters	

Bed Detail

Bed Layout Information

Number of Rows Wide	**5**	pieces
Number of Chambers Long	**46**	pieces
Chamber Row Width	**10.82**	meters
Chamber Row Length	**51.72**	meters
Bed Width	**11.43**	meters
Bed Length	**52.32**	meters
Bed Area Required	**598.07**	sq. meters
Length of Separator Row	**51.72**	meters

Bed detail for reference only. Not project specific. Not to scale.



Conceptual graphic only. Not job specific.

Cross Section Table Reference

A	Depth of Stone Base	**305**	mm
B	Chamber Height	**1219**	mm
C	Depth of Stone Above Units	**305**	mm
D	Depth of 95% Compacted Fill	**305**	mm
E	Max. Depth Allowed Above the Chamber	**2.54**	meters
F	Chamber Width	**1981**	mm
G	Center to Center Spacing	**2.21**	meters
H	Effective Depth	**1.83**	meters
I	Bed Depth	**2.13**	meters

CULTEC Stage-Storage Calculations

Date:	June 11, 2025

Project Information:

132 College Street
Smithville
ON

Project Number: 22046PHE

Chamber Model -	**Recharger 902HD**	
Number of Rows-	5	units
Total Number of Chambers -	230	units
HVLV FC-48 Feed Connectors-	4	units
Stone Void -	40	%
Stone Base -	305	mm
Stone Above Units -	305	mm
Area -	598.07	m2
Base of Stone Elevation -	187.13	

Recharger 902HD Incremental Storage Volumes

Height of System		Chamber Volume		HVLV Feed Connector Volume		Stone Volume		Cumulative Storage Volume		Total Cumulative Storage Volume		Elevation		
in	mm	ft^3	m^3	ft3	m3	ft^3	m^3	ft^3	m^3	ft^3	m^3	ft	m	
72.0	1829	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	24226.73	686.02	193.13	188.96	Top of Stone Elevation
71.0	1803	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	24012.15	679.95	193.05	188.93	
70.0	1778	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	23797.56	673.87	192.96	188.91	
69.0	1753	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	23582.97	667.79	192.88	188.88	
68.0	1727	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	23368.39	661.72	192.80	188.86	
67.0	1702	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	23153.80	655.64	192.71	188.83	
66.0	1676	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	22939.22	649.57	192.63	188.81	
65.0	1651	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	22724.63	643.49	192.55	188.78	
64.0	1626	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	22510.04	637.41	192.46	188.76	
63.0	1600	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	22295.46	631.34	192.38	188.73	
62.0	1575	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	22080.87	625.26	192.30	188.70	
61.0	1549	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	21866.29	619.18	192.21	188.68	
60.0	1524	17.1	0.5	0.0	0.0	207.8	5.9	224.822	6.4	21651.70	613.11	192.13	188.65	Top of Chamber Elevation
59.0	1499	42.5	1.2	0.0	0.0	197.6	5.6	240.060	6.8	21426.88	606.74	192.05	188.63	
58.0	1473	59.3	1.7	0.0	0.0	190.9	5.4	250.180	7.1	21186.82	599.94	191.96	188.60	
57.0	1448	101.6	2.9	0.0	0.0	174.0	4.9	275.538	7.8	20936.64	592.86	191.88	188.58	
56.0	1422	135.4	3.8	0.0	0.0	160.4	4.5	295.837	8.4	20661.10	585.06	191.80	188.55	
55.0	1397	169.1	4.8	0.0	0.0	147.0	4.2	316.018	8.9	20365.26	576.68	191.71	188.53	
54.0	1372	186.0	5.3	0.0	0.0	140.2	4.0	326.197	9.2	20049.24	567.73	191.63	188.50	
53.0	1346	202.9	5.7	0.0	0.0	133.4	3.8	336.317	9.5	19723.05	558.49	191.55	188.48	
52.0	1321	228.2	6.5	0.0	0.0	123.3	3.5	351.497	10.0	19386.73	548.97	191.46	188.45	
51.0	1295	228.2	6.5	0.0	0.0	123.3	3.5	351.497	10.0	19035.24	539.02	191.38	188.43	
50.0	1270	245.1	6.9	0.0	0.0	116.6	3.3	361.617	10.2	18683.74	529.06	191.30	188.40	
49.0	1245	253.6	7.2	0.0	0.0	113.2	3.2	366.735	10.4	18322.12	518.82	191.21	188.37	
48.0	1219	261.9	7.4	0.0	0.0	109.8	3.1	371.737	10.5	17955.39	508.44	191.13	188.35	
47.0	1194	278.8	7.9	0.0	0.0	103.1	2.9	381.857	10.8	17583.65	497.91	191.05	188.32	
46.0	1168	287.3	8.1	0.0	0.0	99.7	2.8	386.975	11.0	17201.79	487.10	190.96	188.30	
45.0	1143	295.7	8.4	0.0	0.0	96.3	2.7	391.977	11.1	16814.82	476.14	190.88	188.27	
44.0	1118	295.7	8.4	0.0	0.0	96.3	2.7	391.977	11.1	16422.84	465.04	190.80	188.25	
43.0	1092	304.2	8.6	0.0	0.0	92.9	2.6	397.095	11.2	16030.87	453.94	190.71	188.22	
42.0	1067	312.5	8.8	0.0	0.0	89.6	2.5	402.097	11.4	15633.77	442.70	190.63	188.20	
41.0	1041	321.1	9.1	0.0	0.0	86.1	2.4	407.273	11.5	15231.68	431.31	190.55	188.17	
40.0	1016	329.4	9.3	0.0	0.0	82.8	2.3	412.217	11.7	14824.40	419.78	190.46	188.15	
39.0	991	329.5	9.3	0.0	0.0	82.8	2.3	412.275	11.7	14412.19	408.11	190.38	188.12	
38.0	965	337.9	9.6	0.0	0.0	79.4	2.2	417.335	11.8	13999.91	396.43	190.30	188.10	
37.0	940	337.8	9.6	0.0	0.0	79.5	2.3	417.277	11.8	13582.58	384.62	190.21	188.07	
36.0	914	346.3	9.8	0.0	0.0	76.0	2.2	422.395	12.0	13165.30	372.80	190.13	188.04	
35.0	889	346.3	9.8	0.0	0.0	76.0	2.2	422.395	12.0	12742.91	360.84	190.05	188.02	
34.0	864	346.4	9.8	0.0	0.0	76.0	2.2	422.453	12.0	12320.51	348.88	189.96	187.99	
33.0	838	354.8	10.0	0.0	0.0	72.7	2.1	427.455	12.1	11898.06	336.91	189.88	187.97	
32.0	813	354.8	10.0	0.0	0.0	72.7	2.1	427.455	12.1	11470.60	324.81	189.80	187.94	
31.0	787	354.8	10.0	0.0	0.0	72.7	2.1	427.455	12.1	11043.15	312.71	189.71	187.92	
30.0	762	363.2	10.3	0.0	0.0	69.3	2.0	432.515	12.2	10615.69	300.60	189.63	187.89	
29.0	737	363.2	10.3	0.0	0.0	69.3	2.0	432.515	12.2	10183.18	288.36	189.55	187.87	
28.0	711	371.7	10.5	0.0	0.0	65.9	1.9	437.633	12.4	9750.66	276.11	189.46	187.84	
27.0	686	371.6	10.5	0.0	0.0	65.9	1.9	437.575	12.4	9313.03	263.72	189.38	187.82	
26.0	660	380.1	10.8	0.0	0.0	62.6	1.8	442.635	12.5	8875.46	251.32	189.30	187.79	
25.0	635	380.1	10.8	0.0	0.0	62.6	1.8	442.635	12.5	8432.82	238.79	189.21	187.77	
24.0	610	380.2	10.8	0.0	0.0	62.5	1.8	442.700	12.5	7990.19	226.26	189.13	187.74	
23.0	584	380.1	10.8	0.1	0.0	62.5	1.8	442.690	12.5	7547.49	213.72	189.05	187.71	
22.0	559	388.6	11.0	0.2	0.0	59.1	1.7	447.861	12.7	7104.80	201.19	188.96	187.69	
21.0	533	388.6	11.0	0.2	0.0	59.1	1.7	447.884	12.7	6656.94	188.50	188.88	187.66	
20.0	508	388.6	11.0	0.2	0.0	59.0	1.7	447.899	12.7	6209.05	175.82	188.80	187.64	
19.0	483	388.6	11.0	0.3	0.0	59.0	1.7	447.906	12.7	5761.15	163.14	188.71	187.61	
18.0	457	396.9	11.2	0.3	0.0	55.7	1.6	452.915	12.8	5313.25	150.45	188.63	187.59	
17.0	432	397.0	11.2	0.3	0.0	55.7	1.6	452.980	12.8	4860.33	137.63	188.55	187.56	
16.0	406	405.5	11.5	0.3	0.0	52.3	1.5	458.044	13.0	4407.35	124.80	188.46	187.54	
15.0	381	405.6	11.5	0.3	0.0	52.2	1.5	458.106	13.0	3949.31	111.83	188.38	187.51	
14.0	356	405.5	11.5	0.3	0.0	52.3	1.5	458.051	13.0	3491.20	98.86	188.30	187.49	
13.0	330	405.6	11.5	0.3	0.0	52.2	1.5	458.122	13.0	3033.15	85.89	188.21	187.46	
12.0	305	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	2575.03	72.92	188.13	187.43	Bottom of Chamber Elevation
11.0	279	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	2360.44	66.84	188.05	187.41	
10.0	254	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	2145.86	60.76	187.96	187.38	
9.0	229	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	1931.27	54.69	187.88	187.36	
8.0	203	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	1716.69	48.61	187.80	187.33	
7.0	178	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	1502.10	42.53	187.71	187.31	
6.0	152	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	1287.52	36.46	187.63	187.28	
5.0	127	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	1072.93	30.38	187.55	187.26	
4.0	102	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	858.34	24.31	187.46	187.23	
3.0	76	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	643.76	18.23	187.38	187.21	
2.0	51	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	429.17	12.15	187.30	187.18	
1.0	25	0.0	0.0	0.0	0.0	214.6	6.1	214.586	6.1	214.59	6.08	187.21	187.16	
0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.00	0.00	187.13	187.13	Bottom of Stone Elevation
-1.0														
-2.0														
-3.0														
-4.0														
-5.0														
-6.0														
-7.0														
-8.0														

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Cultec Separator™ Row Filtration System

Developed by Cultec, Inc.
Brookfield, Connecticut, USA

Registration: GPS-ETV_VR2021-03-31_v2

In accordance with

ISO 14034:2016

Environmental Management —
Environmental Technology Verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

March 31, 2021
Vancouver, BC, Canada

GLOBE
VERIFIED VÉRIFIÉ

GLOBE PERFORMANCE SOLUTIONS

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Technology description and application

Cultec Recharger and Contactor chambers are used for infiltration, detention and/or retention of stormwater underground. The system is comprised of thermoplastic arch-shaped chambers surrounded by clear crushed stone. Water enters the system through a Separator row and then flows through the stone and into a Chamber row prior to exiting. The Cultec stormwater system is sized based on the volume of stormwater which is stored in the voids created by the chamber and the voids in the clear stone surround, with a void ratio of 40%. The entire system is wrapped in a non-woven geotextile and/or impermeable geomembrane. In order to minimize fine particles and silts from blinding the voids in the clear stone surround, a single chamber row is wrapped in non-woven geotextile and placed on a woven geotextile. This row is connected to the inlet pipe of the Cultec system providing a filtration function as the surface stormwater run-off passes through the geotextile wrapped inlet row. Sediment is trapped within the Cultec Separator™ Row and may be removed through back flushing of this row. A typical system installation is illustrated in Figure 1 and Figure 2 below.

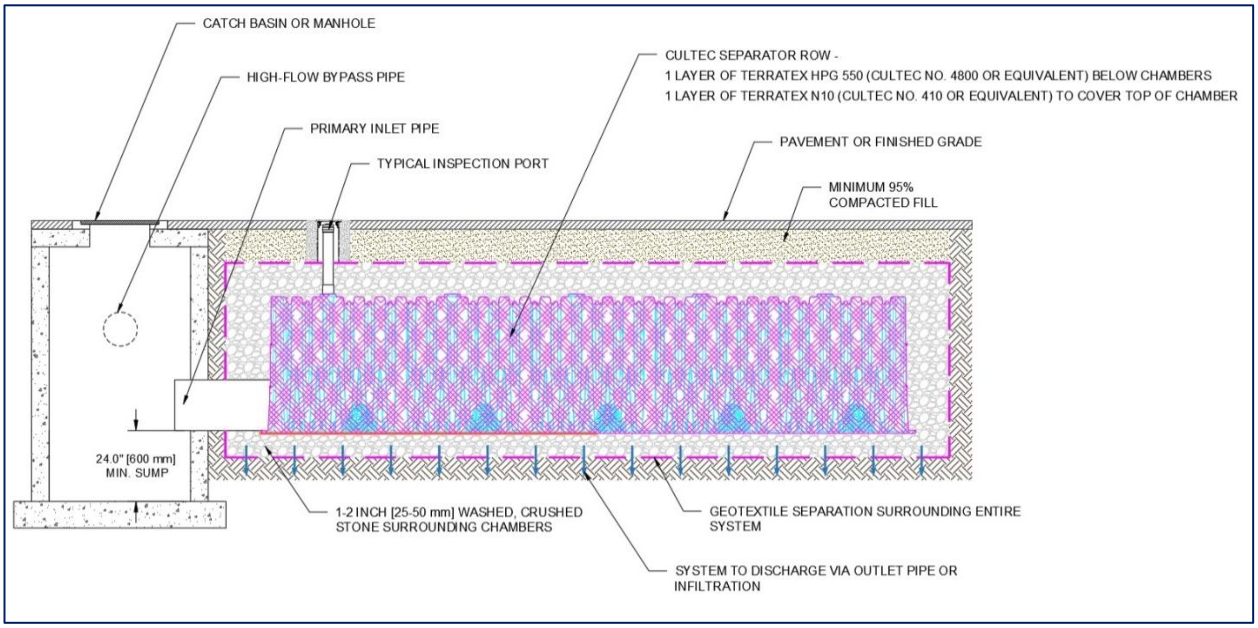


Figure 1: Cultec Separator™ Row Filtration System – Cross-Sectional View

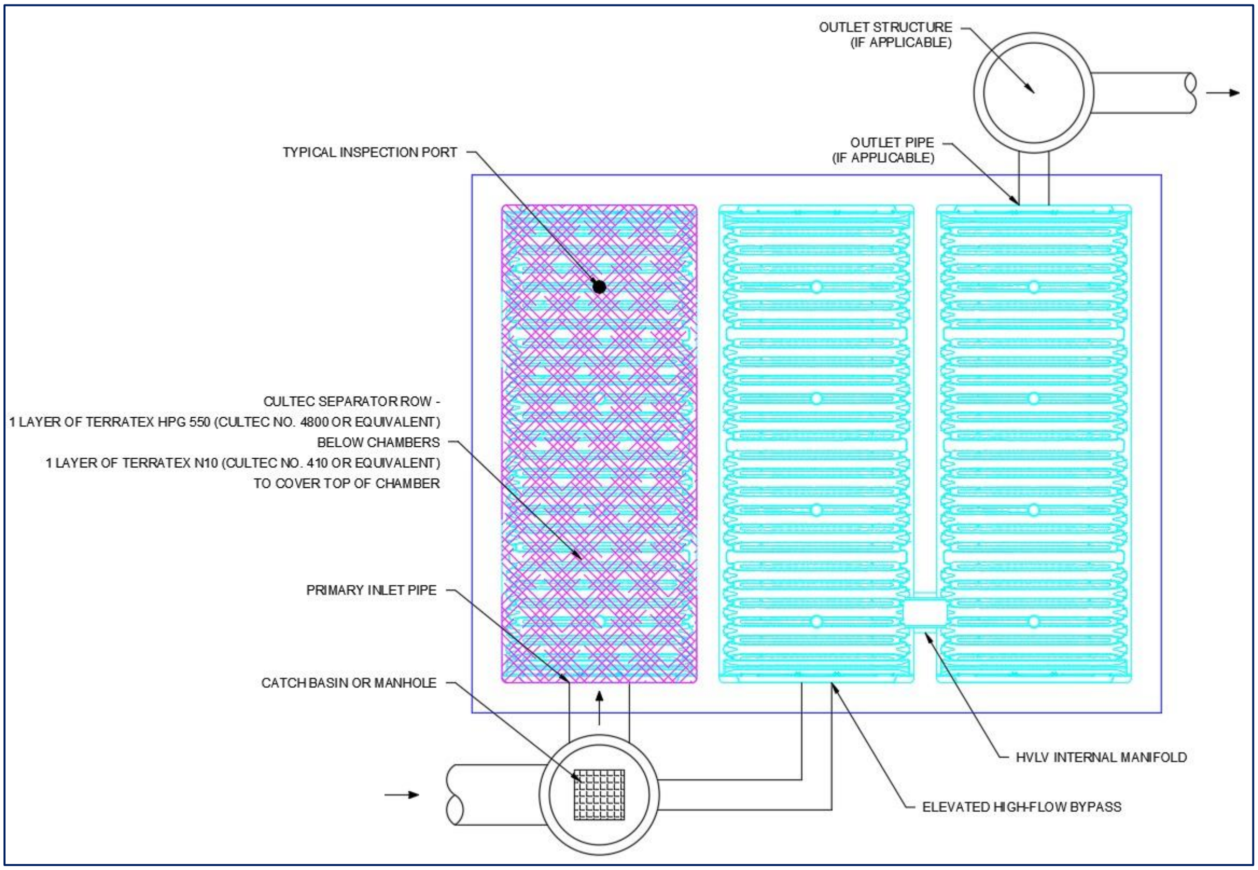


Figure 2: Cultec Separator™ Row Filtration System – Plan View

Performance & testing conditions

The data and results published in this Verification Statement were obtained from the testing program conducted on the Cultec Separator™ Row in accordance with a technology specific test plan (TSTP) developed and approved by the client and test lab (Good Harbour Laboratories, Mississauga, Ontario), and reviewed by Verification Expert and Verifying Organization, in compliance with ISO/IEC 14034.

The device tested was a Cultec Recharger 150XLHD R chamber with a base width of 838 mm (33″) and height of 470 mm (18.5″).

Test Setup

Two chambers were used for this study, a receiving chamber and a separation chamber. The two chambers were housed in a containment cell constructed out of wood, lined with an impermeable membrane. The dimensions of the test cell were 142" X 71" X 23.5" (3.58 m X 1.80 m X 0.60 m, L X W X H). The chambers were set up in the test cell in a manner consistent with a normal installation. The floor of the cell was covered with approximately 76 mm (3") of washed, crushed, clear stone[1] which in turn was covered by one layer of woven geotextile fabric as required for the installation of the system. The two chambers sat next to each other, in parallel. Washed crushed stone filled in the space around the test units up to a height of approximately 51 mm (2") from the base.[2] The test set-up is illustrated in Figure 3.

The geotextiles used for this study were:

Woven: Terratex HPG 550
Nonwoven: Terratex N10

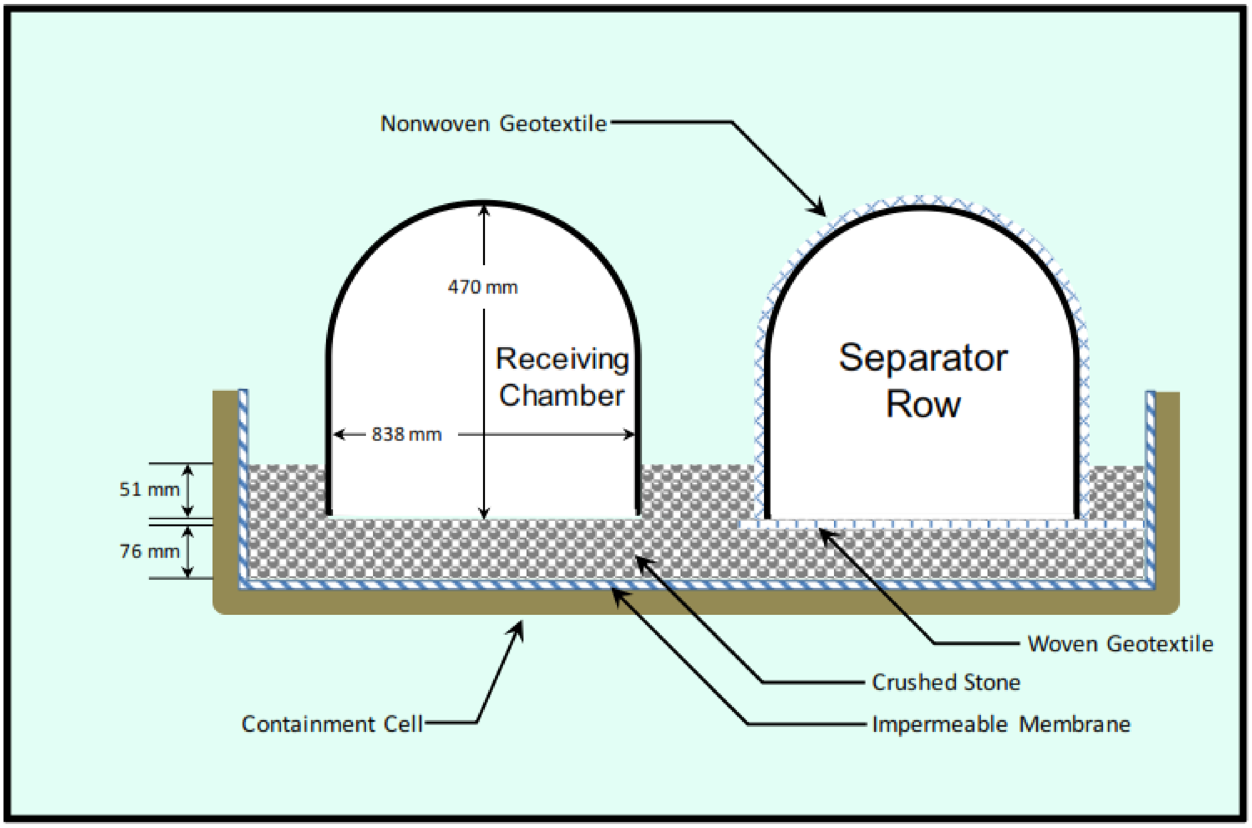


Figure 3: Test Cell Cross-Section for Model Recharger® 150XLHD R

[1] A normal installation would typically have a crushed stone depth of 150 mm (6″).

[2] For a normal installation, the stone completely fills the column between chamber rows and up to a minimum of 6″ above the top of the crown of the chamber.

The laboratory test set-up was a water flow loop, capable of moving water at a rate of up to 900 L/min. The loop was comprised of water reservoirs, pumps, stand pipe, receiving tank and a flow meter, in addition to the test cell.

Fresh water was pumped from the storage tank through a flow meter to the stand pipe, and from there it flowed by gravity through an inlet pipe to the separation chamber in the test cell. Sediment was added at an addition port in the inlet pipe upstream of the separation chamber.

From the water supply tanks, water was pumped by a centrifugal pump. Flow measurement was done using an electromagnetic type flow meter with an accuracy of ± 0.5% of reading (1 – 200 gpm). The data logger was configured to record a flow measurement once every minute.

The influent pipe was 100 mm (4 inches) in diameter and sediment addition was done through a port at the crown of the influent pipe, 4 pipe diameters (406 mm) upstream of the containment cell. The sediment feeder was a volumetric screw feeder with vibratory hopper.

Water flow exited the receiving chamber and terminated with a free-fall into the Receiving Tank. Water was pumped from the Receiving Tank back to the storage tanks to complete the flow loop.

Sample Collection & Parameter Measurement

Background water samples were collected in 1L jars from the standpipe. The sample was taken by submerging the jar below the surface of the water until full.

Effluent samples were also grabbed by hand. The effluent pipe drained freely into the Receiving Tank and the effluent sample was taken at that point. The sampling technique was to take the grab sample by sweeping a wide-mouth 1 L jar through the stream of effluent flow such that the jar was full after a single pass.

Effluent water temperature was taken using a data logger submerged into the receiving tank during each run and configured to take a temperature reading once every minute. Run and sampling times were measured using NIST traceable stopwatches. The sediment feed samples that were taken during the run were collected in 500 mL jars and weighed on an analytical balance.

Test Sediment

The final test sediment particle size distribution (PSD) met the required tolerances of the Canada ETV Procedure for Laboratory Testing of Oil-Grit Separators (Rev. June 6, 2014 – Ver. 3.0). Three replicate samples of the test sediment blend were sent to a qualified 3rd party analytical laboratory for analysis of the sediment PSD in a manner consistent with ASTM method D422-63 (Reapproved 2007), "Standard Test Method for Particle-Size Analysis of Soils". The samples were composite samples created by taking samples throughout the blending process and in various positions within the blending drum.

Removal Efficiency Testing

The objective of this study was to establish a baseline for treatment performance (removal efficiency) over a range of flow rates up to 125% of the maximum treatment flow rate (MTFR) with an influent suspended sediment concentration (SSC) of 200 mg/L. Sediment removal efficiency testing was conducted at 25%, 50%, 75%, 100% and 125% MTFR. The sediment feed rate had a coefficient of variance (COV) ≤ 0.10 and the influent sediment concentration was maintained within ± 20 mg/L of target, based on the average sediment feed rate and water flow rate for the run. The water flow rates were held within 10% of target with a COV of 0.03 and water temperatures were maintained below 25°C.

A minimum of eight influent background samples were taken at regular intervals. A minimum of 15 effluent samples were collected during each test run. The first sample was collected after a minimum of 3 detention times (DT), at which time a constant flow and sediment feed were established. The interval between sequential effluent samples was evenly spaced; however, when the test sediment feed was interrupted for measurement, the next effluent sample was collected after waiting at least 3 DT to re-establish equilibrium conditions.

The system detention time was determined empirically by measuring the height of water in the containment cell during clean water flow at the chosen flow rate. The wet volume of the system was calculated and the approximate volume of the stones was subtracted. The remaining volume was the estimated water volume in the containment cell, which was divided by the flow rate to give detention time.

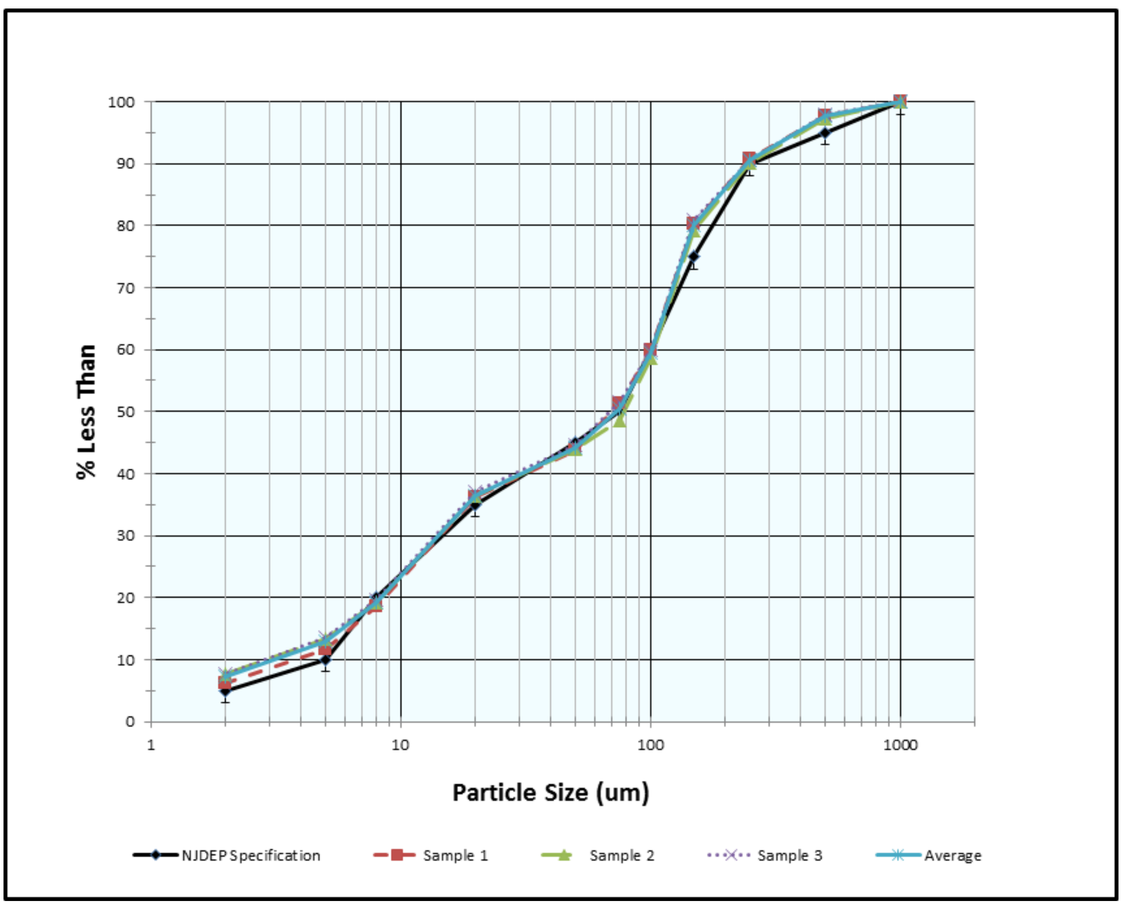
The sediment feed rate was checked using six calibration samples taken at evenly spaced intervals over the duration of each test run. Each sample was collected over an interval timed to the nearest 0.01 second and was a minimum of 0.1 liters, or the collection interval did not exceed one minute, whichever came first. The COV of the samples was < 0.10. The feed rate samples were also used to calculate an influent concentration in order to double check the concentration calculated by mass balance.

Performance claims

When installed with Terratex HPG 550 and Terratex N10 geotextiles, and tested with silica sediment having a particle size distribution conforming to the *Canadian Environmental Technology Verification Program Procedure for Laboratory Testing of Oil-Grit Separators*, the Cultec Recharger® 150XLHD Separator Row™ will remove at least the following fractions of suspended sediment at the corresponding flow rates: 80% at 24 gpm, 77% at 49 gpm, 73% at 73 gpm, 70% at 97 gpm, and 65% at 121 gpm. These performance claims are verified statistically at a 95% level of confidence.

Performance results

TEST SEDIMENT PARTICLE SIZE DISTRIBUTION IN RELATION TO SPECIFIED PSD



SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 24 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	39.6	38.7	39.2	39.8	39.1	39.5	41.7	41.9	41.1	42.4	43.2	41.6	40.8	41.1	41.6
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	37.6	36.7	37.2	37.8	37.1	37.5	39.7	39.9	39.1	40.4	41.2	39.6	38.8	39.1	39.6
Average Adjusted Effluent Concentration				38.8 mg/L			Removal Efficiency					80.2%			

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 48 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	47.1	47.0	47.1	46.8	47.3	47.3	49.0	50.1	49.5	50.4	49.1	50.2	52.2	49.7	51.8
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	45.1	45.0	45.1	44.8	45.3	45.3	47.0	48.1	47.5	48.4	47.1	48.2	50.2	47.7	49.8
Average Adjusted Effluent Concentration				47.0 mg/L			Removal Efficiency					76.9%			

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 73 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	54.3	55.2	53.3	53.8	55.8	55.8	55.3	54.5	53.5	56.2	56.4	56.5	58.4	56.8	57.7
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	52.3	53.2	51.3	51.8	53.8	53.8	53.3	52.5	51.5	54.2	54.4	54.5	56.4	54.8	55.7
Average Adjusted Effluent Concentration				53.6 mg/L			Removal Efficiency					73.3%			

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 97 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	58.4	59.4	59.0	61.2	61.6	61.1	58.9	60.4	59.9	63.9	63.3	62.5	61.9	61.0	61.0
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	56.4	57.4	57.0	59.2	59.6	59.1	56.9	58.4	57.9	61.9	61.3	60.5	59.9	59.0	59.0
Average Adjusted Effluent Concentration				58.9 mg/L			Removal Efficiency					70.0 %			

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 121 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	72.0	72.8	71.7	72.1	70.1	72.1	69.3	72.3	77.2	71.0	70.7	72.7	71.1	70.4	73.0
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	70.0	70.8	69.7	70.1	68.1	70.1	67.3	70.3	75.2*	69.0	68.7	70.7	69.1	68.4	71.0
Average Adjusted Effluent Concentration				69.9 mg/L			Removal Efficiency					65.3%			

*Note: This data point was considered to be a significant outlier and was therefore omitted as part of the overall statistical calculations to verify performance at a 95% level of confidence.

Verification

This verification was completed by the Verification Expert, the Centre for Advancement of Water and Wastewater Technologies ("CAWT"), contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental Management -- Environmental Technology Verification (ETV)***. Data and information provided by Cultec, Inc. to support the performance claim included the final test report prepared by Good Harbour Laboratories of Mississauga, Ontario and dated November 9, 2017. The test report is based on testing completed in compliance with the requirements of ISO/IEC 17025.

What is ISO14034:2016 Environmental Management – Environmental Technology Verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

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For more information on ISO 14034:2016 / ETV please contact:

GLOBE Performance Solutions
404 – 999 Canada Place
Vancouver, BC
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Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com
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Limitation of verification: Registration: GPS-ETV_VR2021-03-31_v2
GLOBE Performance Solutions and the Verification Expert provide the verification services solely on the basis of the information supplied by the applicant or vendor and assume no liability thereafter. The responsibility for the information supplied remains solely with the applicant or vendor and the liability for the purchase, installation, and operation (whether consequential or otherwise) is not transferred to any other party as a result of the verification.

Hydroworks Sizing Summary

132 College Street, Smithville

OGS

08-08-2024

Recommended Size: HydroDome HD 10

Hydroworks Sizing Program Version 5.8.5

A HydroDome HD 10 is recommended to provide 80 % annual TSS removal based on a drainage area of 1.95 (ha) with an imperviousness of 67 % and Hamilton Airport, Ontario rainfall for the ETV particle size distribution.

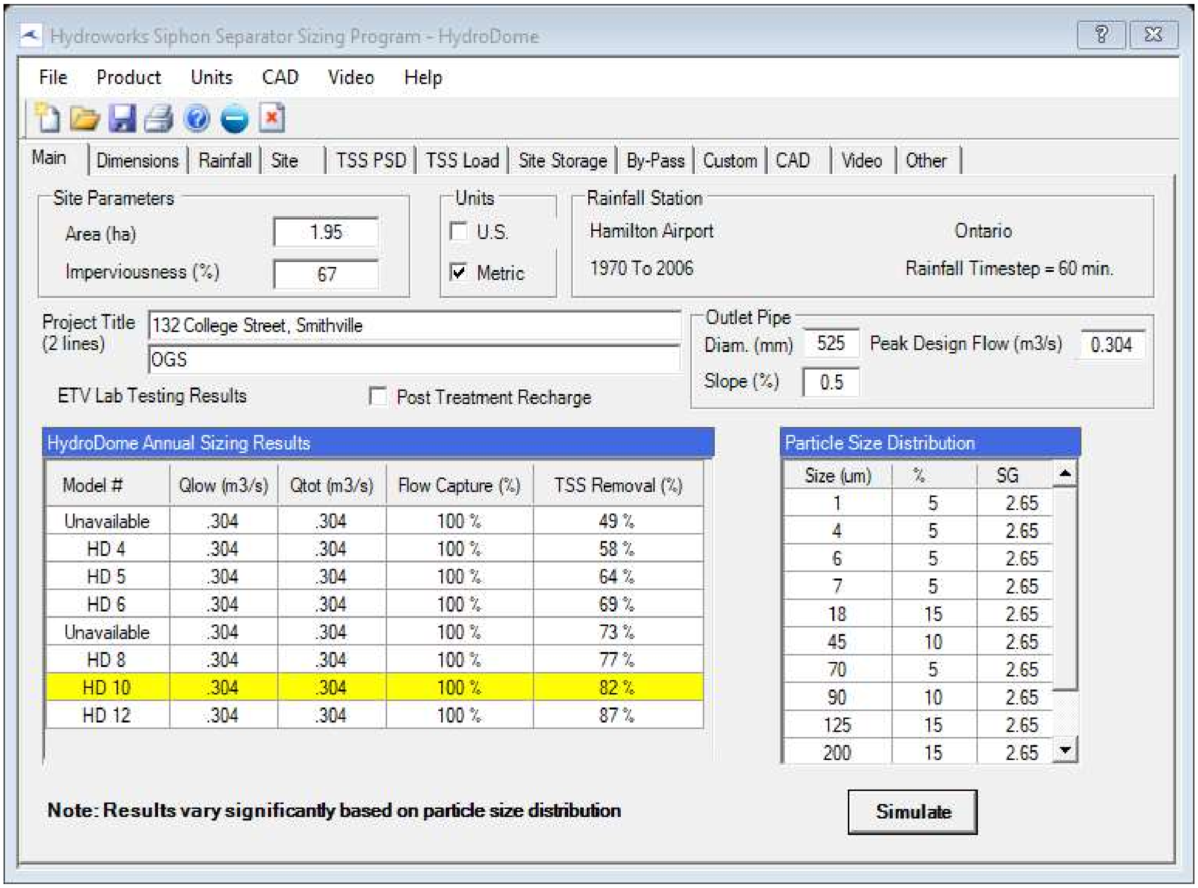
The recommended HydroDome HD 10 treats 100 % of the annual runoff and provides 82 % annual TSS removal for the Hamilton Airport rainfall records and ETV particle size distribution.

The HydroDome has a siphon which creates a discontinuity in headloss. The given peak flow of .304 (m3/s) Is less than the full pipe flow of .3 (m3/s) indicating free flow in the pipe during the peak flow assuming no tailwater condition. Partial pipe flow was assumed for the headloss calculations. The headloss was calculated to be 338 (mm) above the crown of the 525 (mm) outlet pipe.

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

TSS Removal Sizing Summary



Hydroworks Siphon Separator Sizing Program - HydroDome

File Product Units CAD Video Help

Main | Dimensions | Rainfall | Site | TSS PSD | TSS Load | Site Storage | By-Pass | Custom | CAD | Video | Other

Site Parameters
Area (ha) 1.95
Imperviousness (%) 67

Units
U.S.
Metric (checked)

Rainfall Station
Hamilton Airport Ontario
1970 To 2006 Rainfall Timestep = 60 min.

Project Title (2 lines) 132 College Street, Smithville
OGS

ETV Lab Testing Results
Post Treatment Recharge

Outlet Pipe
Diam. (mm) 525 Peak Design Flow (m3/s) 0.304
Slope (%) 0.5

HydroDome Annual Sizing Results

Model #	Qlow (m3/s)	Qtot (m3/s)	Flow Capture (%)	TSS Removal (%)
Unavailable	.304	.304	100 %	49 %
HD 4	.304	.304	100 %	58 %
HD 5	.304	.304	100 %	64 %
HD 6	.304	.304	100 %	69 %
Unavailable	.304	.304	100 %	73 %
HD 8	.304	.304	100 %	77 %
HD 10	.304	.304	100 %	82 %
HD 12	.304	.304	100 %	87 %

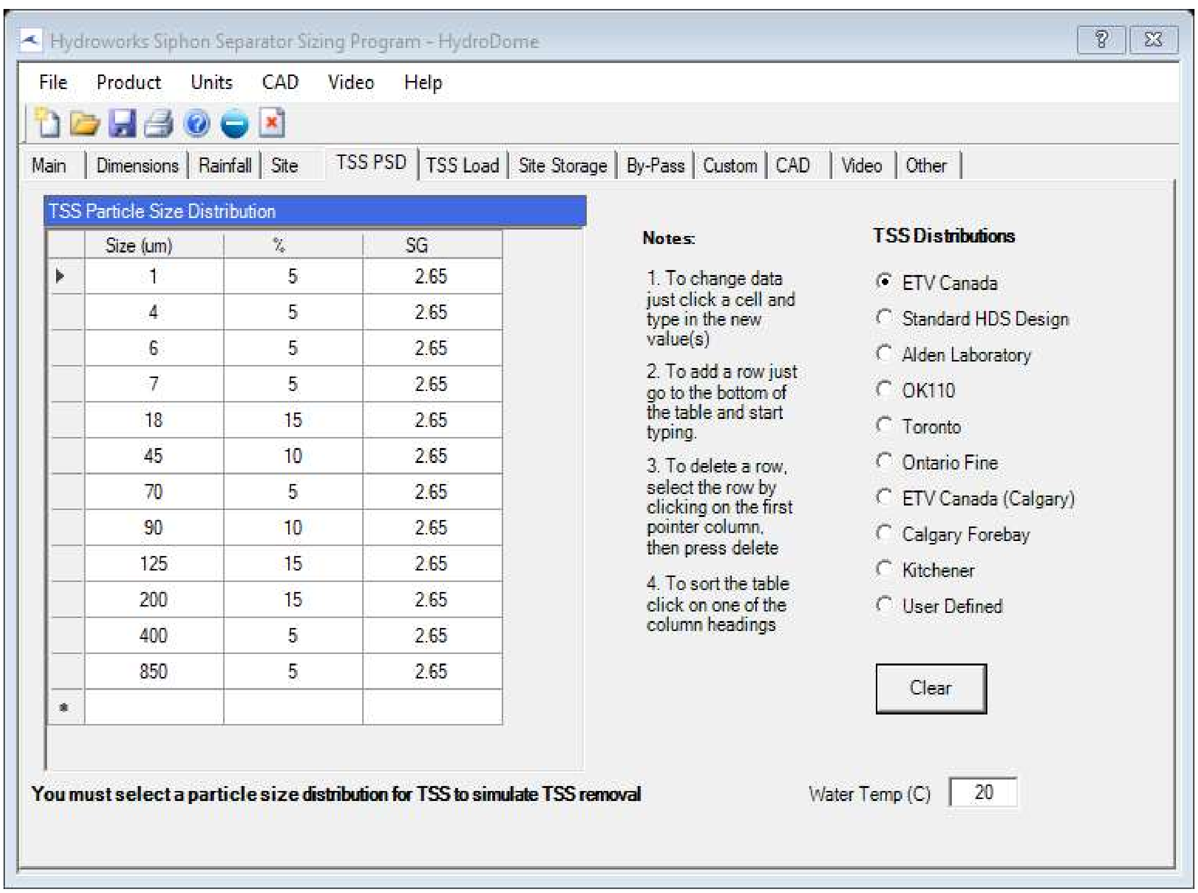
Particle Size Distribution

Size (um)	%	SG
1	5	2.65
4	5	2.65
6	5	2.65
7	5	2.65
18	15	2.65
45	10	2.65
70	5	2.65
90	10	2.65
125	15	2.65
200	15	2.65

Note: Results vary significantly based on particle size distribution

Simulate

TSS Particle Size Distribution



Hydroworks Siphon Separator Sizing Program - HydroDome

File Product Units CAD Video Help

Main | Dimensions | Rainfall | Site | TSS PSD | TSS Load | Site Storage | By-Pass | Custom | CAD | Video | Other

TSS Particle Size Distribution

Size (um)	%	SG
1	5	2.65
4	5	2.65
6	5	2.65
7	5	2.65
18	15	2.65
45	10	2.65
70	5	2.65
90	10	2.65
125	15	2.65
200	15	2.65
400	5	2.65
850	5	2.65

Notes:

1. To change data just click a cell and type in the new value(s)
2. To add a row just go to the bottom of the table and start typing.
3. To delete a row, select the row by clicking on the first pointer column, then press delete
4. To sort the table click on one of the column headings

TSS Distributions

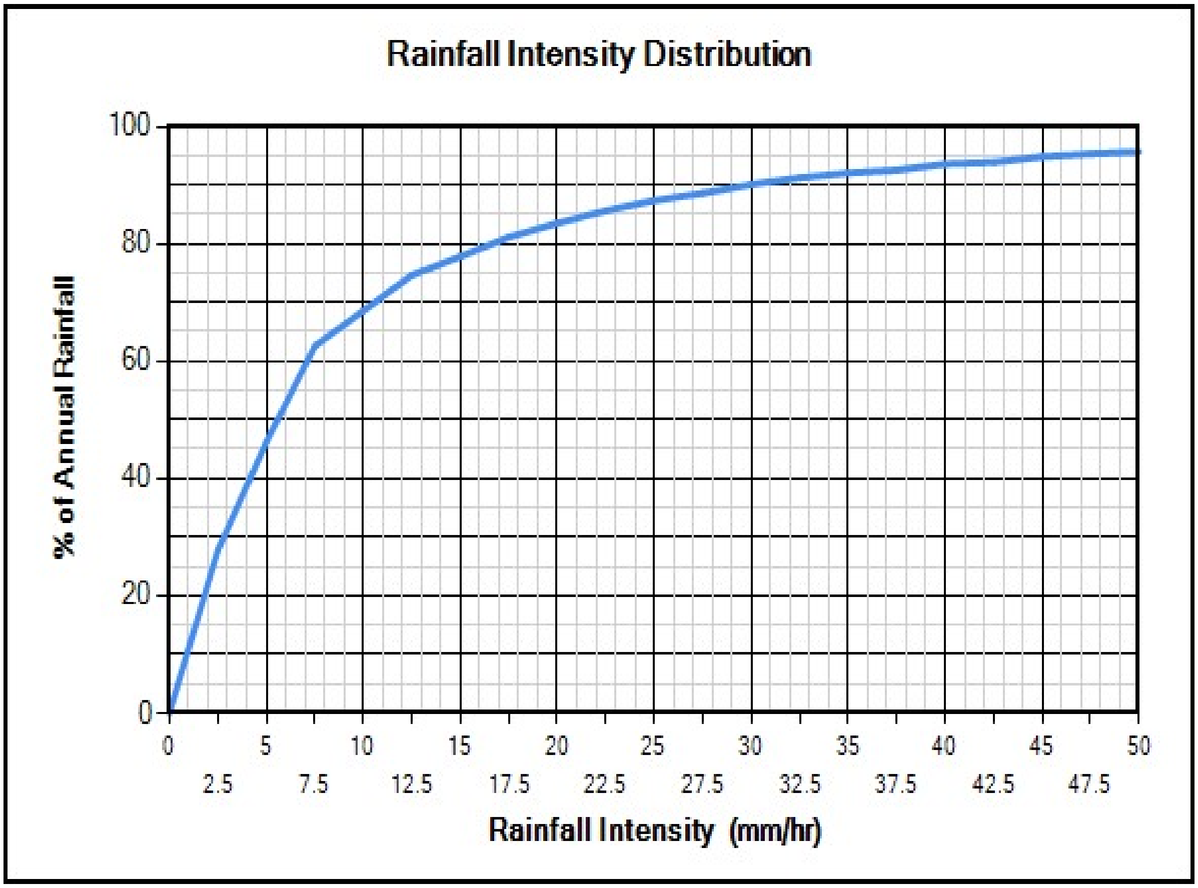
- ETV Canada (selected)
- Standard HDS Design
- Alden Laboratory
- OK110
- Toronto
- Ontario Fine
- ETV Canada (Calgary)
- Calgary Forebay
- Kitchener
- User Defined

Clear

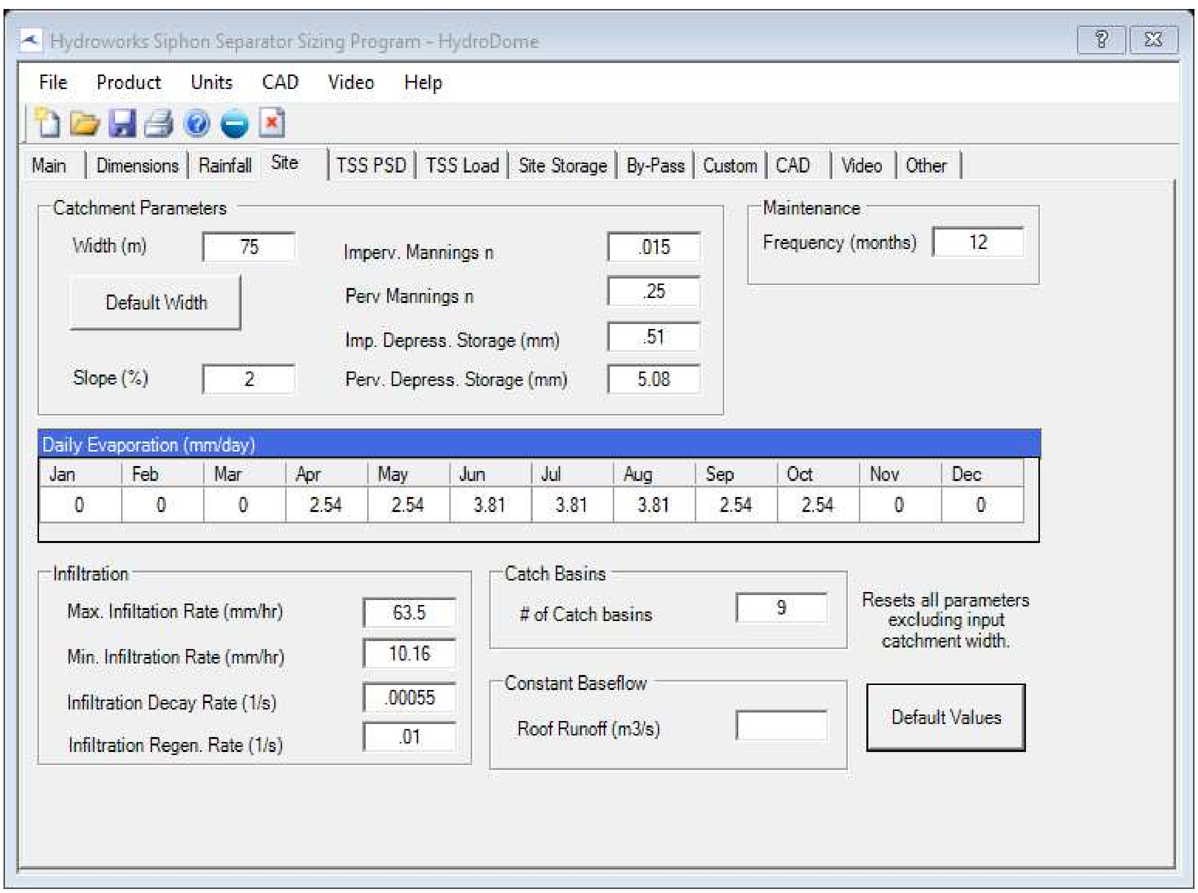
You must select a particle size distribution for TSS to simulate TSS removal

Water Temp (C) 20

Rainfall Station - Hamilton Airport, Ontario(1970 To 2006)



Site Physical Characteristics



Dimensions And Capacities

Hydroworks Siphon Separator Sizing Program - HydroDome

File Product Units CAD Video Help

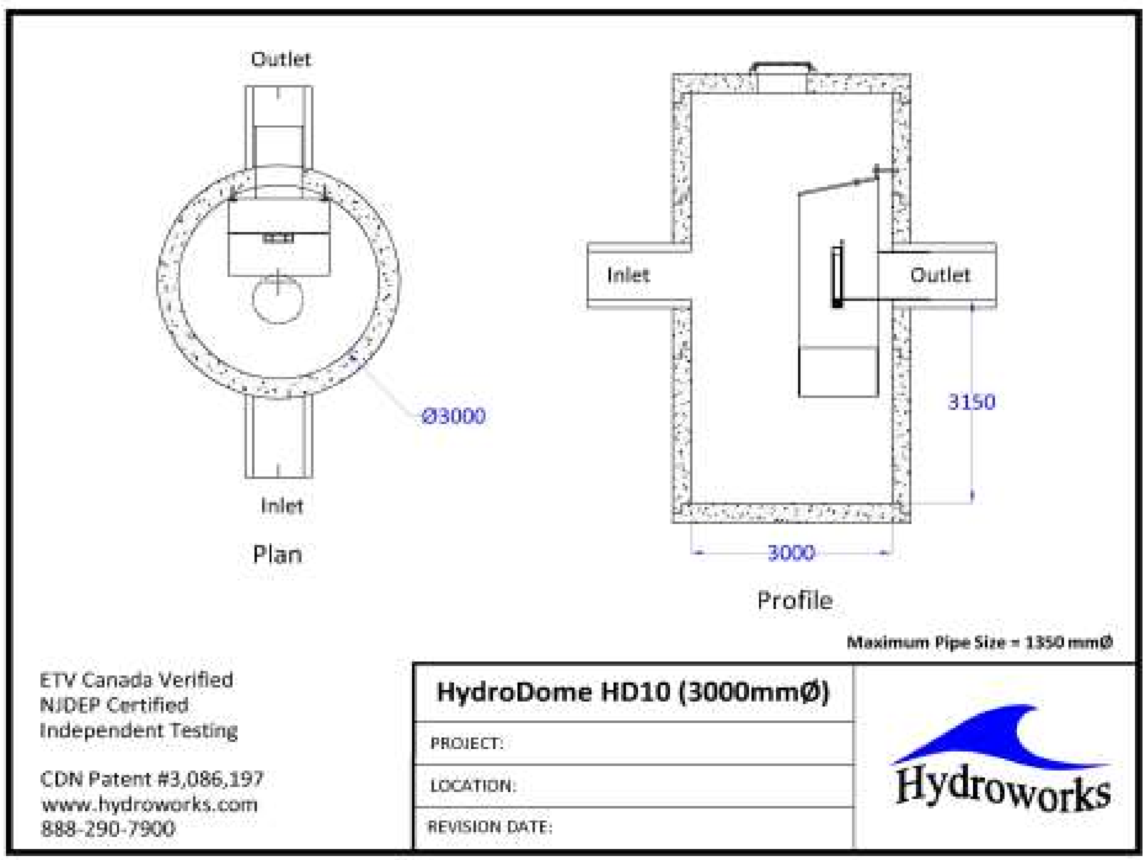
Main | Dimensions | Rainfall | Site | TSS PSD | TSS Load | Site Storage | By-Pass | Custom | CAD | Video | Other

Dimensions and Capacities

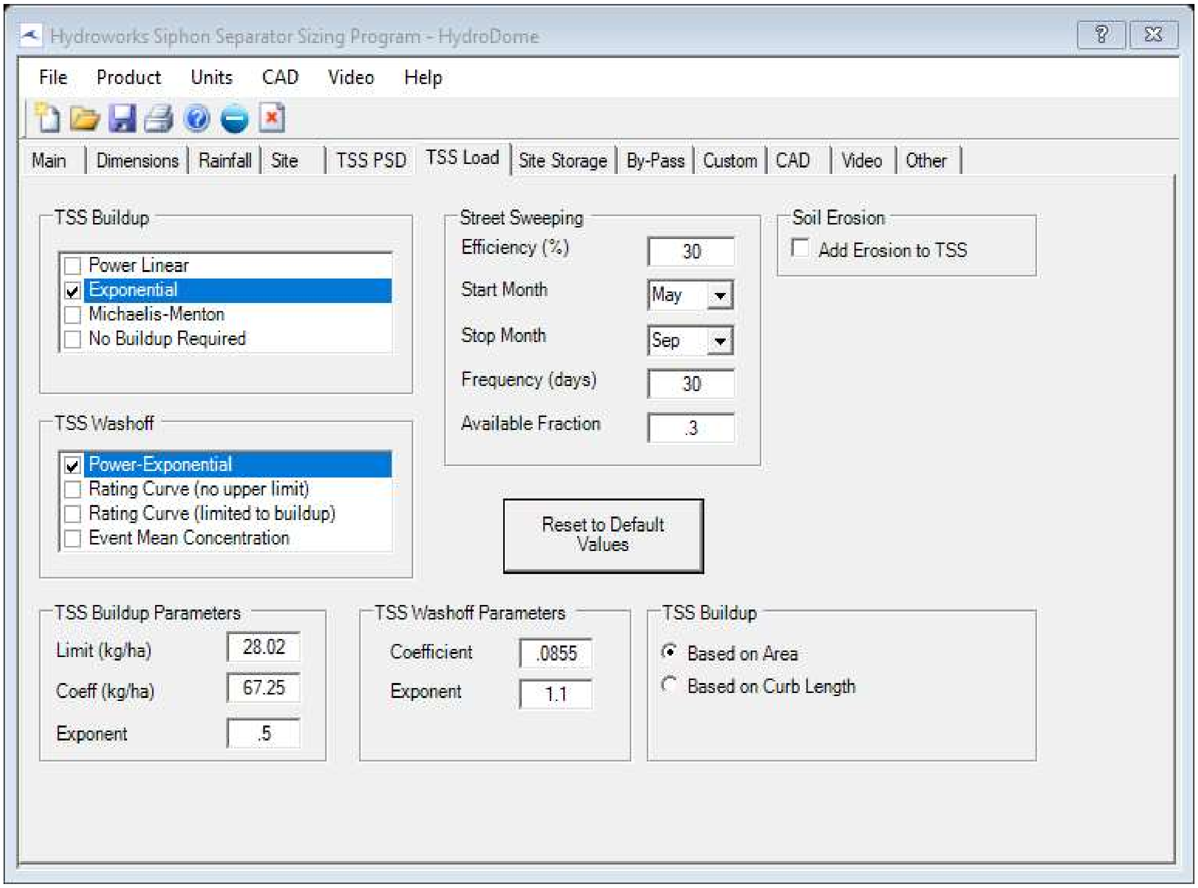
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
HD 3	0.91	1.22	123	0.5	0.8
HD 4	1.22	1.37	266	0.9	1.6
HD 5	1.52	1.68	483	1.7	3.1
HD 6	1.83	1.98	803	2.9	5.2
HD 7	2.13	2.29	1226	4.6	8.2
HD 8	2.44	2.59	1863	6.8	12.1
HD 10	3.05	3.2	3617	13	23.3
HD 12	3.66	3.81	6224	22.2	40

Depth = Depth from outlet invert to inside bottom of tank

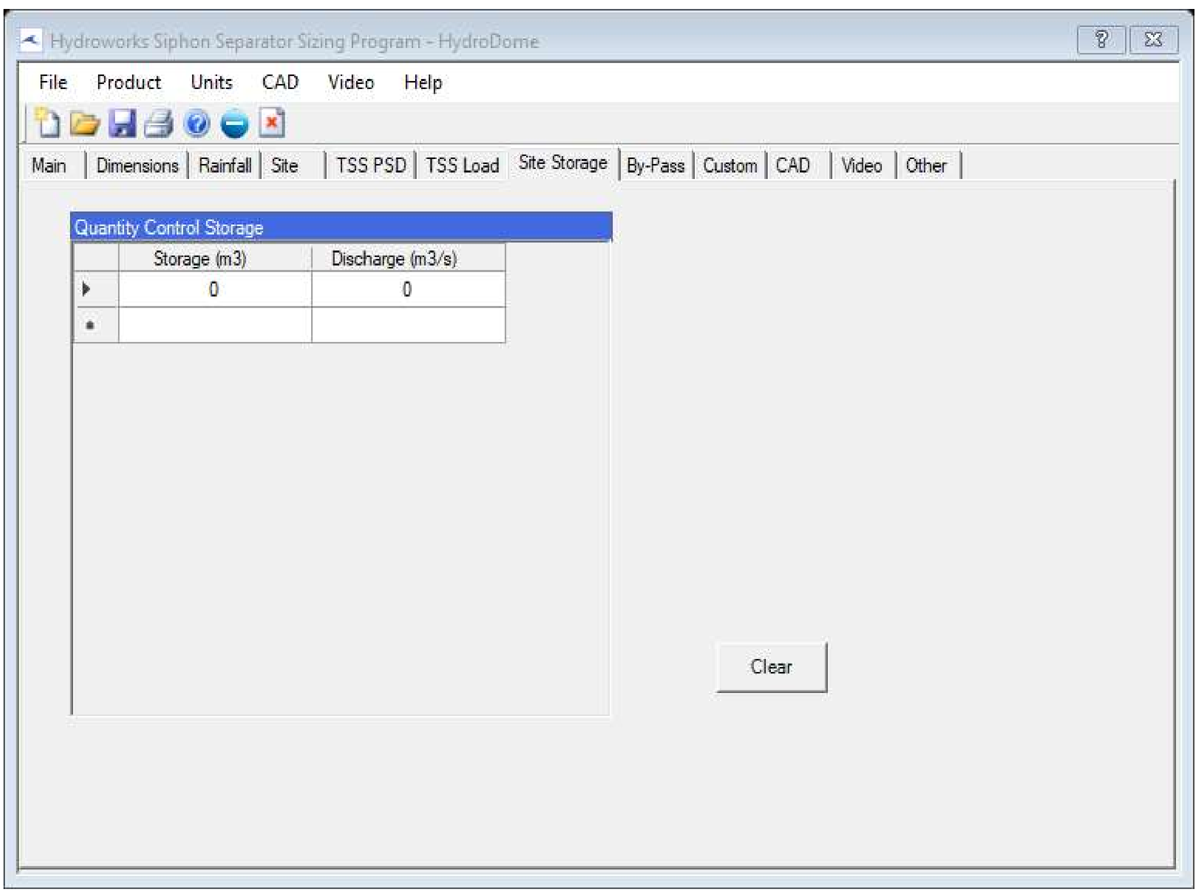
Generic HD 10 CAD Drawing



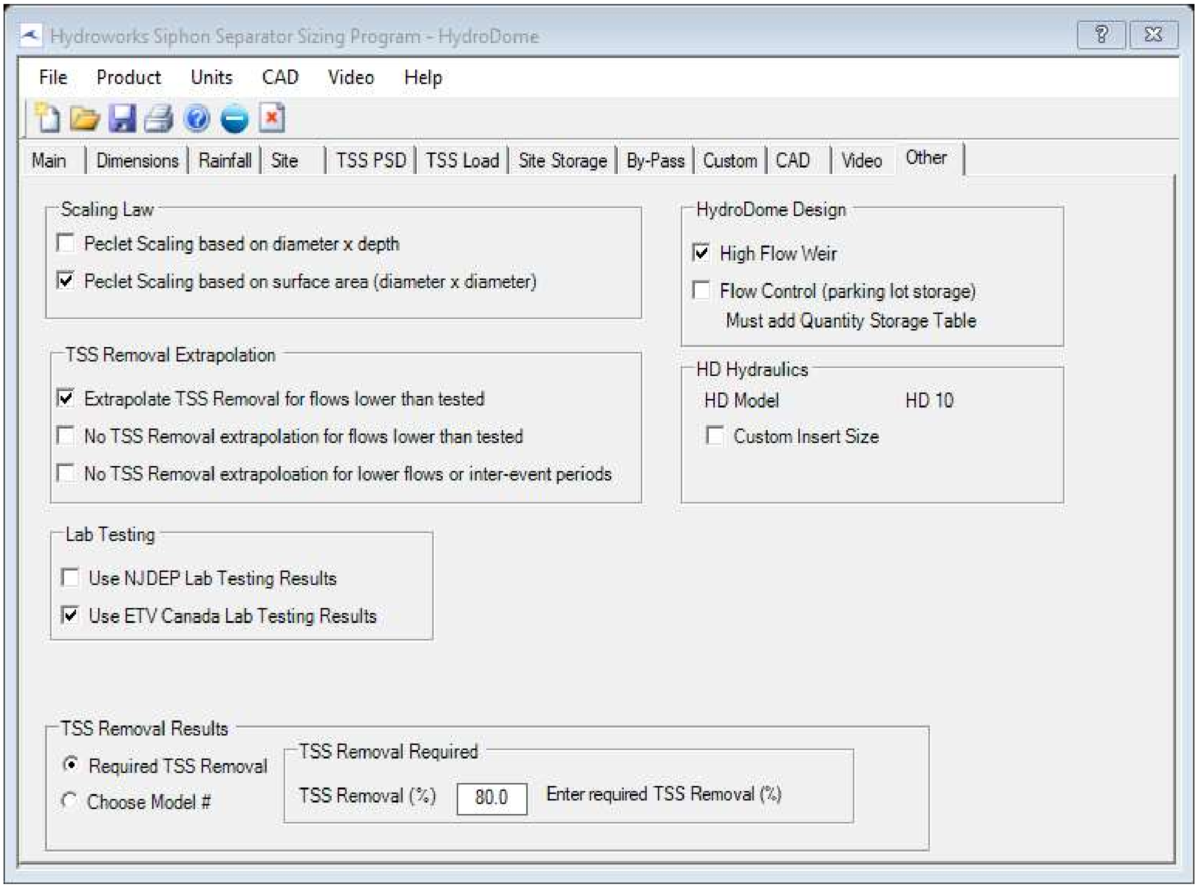
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

If there is underground detention storage upstream of the HydroDome please contact Hydroworks to ensure it has been modeled correctly.

Hydroworks Sizing Program - Version 5.8.5

1-800-290-7900
www.hydroworks.com

Verification Statement

Hydroworks HydroDome HD3 Oil-Grit Separator
Registration number: (V-2021-09-02)
Date of re-issue: 2023-05-17

Technology type	Oil-Grit Separator		
Application	Technology to remove oil, sediment, trash and debris from storm-water and snowmelt runoff as well as other pollutants that attach to sediment particles, such as nutrients and metals.		
Company	Hydroworks, LLC.		
Address	257 Cox St., Roselle, NJ 07203 USA	**Phone**	+1-888-290-7900
Website	https://hydroworks.com	**E-mail**	gbryant@hydroworks.com

Verified Performance Claims

The Hydroworks HydroDome HD3 Oil-Grit Separator (OGS) was tested by Alden Research Laboratory, Holden, Massachusetts, USA in 2021. The performance test results were verified by 'The Sir Sandford Fleming College of Applied Arts and Technology's Centre for Advancement of Water and Wastewater Technologies' (CAWT) following the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol. The following performance claims were verified:

Sediment removal test: The Hydroworks HydroDome HD3 OGS device, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L and particle size distribution of 1-1000 µm, removed 83.9, 77.6, 68.4, 66.9, 59.4, 52.4, and 46.0 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2 respectively.

Scour test: The Hydroworks HydroDome HD3 OGS device with 15.2 cm (6 inch) of test sediment preloaded onto a false floor reaching 50% of the manufacturer's recommended maximum sediment sump storage depth, generated corrected effluent sediment concentrations on average of 0.54, 0.70, 0.0, 0.0, and 0.11 mg/L at 5-min duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

Light liquid re-entrainment test: The Hydroworks HydroDome HD3 OGS with surrogate low-density polyethylene beads preloaded within the inner chamber, representing a floating light-liquid volume equal to a depth of 50.8 mm (2 inch) over the sedimentation area, retained 100, 100, 100, 100, and 99.7 percent of loaded beads by mass during the 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

The above verified claims can be applied to other units smaller or larger than the tested unit, provided that the untested units meet the scaling rule specified in the Procedure for Laboratory Testing of Oil Grit Separators (Version 3.0, June 2014)

Technology Application

HydroDome is a hydrodynamic separator that provides benefits for both water quality and water quantity (i.e., flow control). HydroDome combines the function of separator, hood, and flow control with active storage to provide a multi-purpose stormwater management solution in one structure. HydroDome also functions as an oil separator due to the submerged inlet design and the fact that the design raises the water level with flow to maximize the distance between any floatables (oil, trash) and the discharge entrance to the HydroDome.

Technology Description

HydroDome comes complete and slides into the outlet pipe from a drainage structure and is secured to the wall with anchor bolts. It consists of a siphon with flow control, that regulates the water level in the structure and the flow rate in the outflow, and an optional high flow weir. A schematic of the Hydroworks HydroDone OGS is shown in Figure 1.

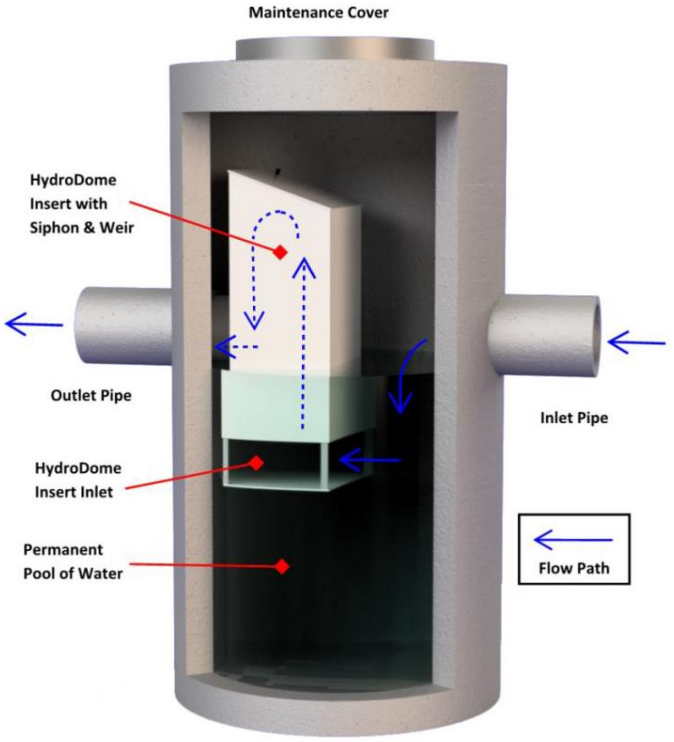


Figure 1: Schematic of the Hydroworks HydroDome Oil-Grit Separator

The siphon raises the water level to a pre-determined level without allowing water to exit the structure. The raised water level provides:
- Greater time for initial total suspended solids (TSS) removal and for floatables to prevent re-entrainment in the flow,
- Additional dilution to reduce effluent concentrations of any pollutants, and
- A greater volume, or buffer, of water to prevent scour of previously settled solids.

Water flows into the device through horizontal openings at the bottom of the HydroDome. Water then must travel upwards through the siphon. A coarse foam screen is located at the entrance to the siphon inlet to provide secondary protection from its clogging (the outer housing of the HydroDome and submerged inlet provide primary protection). Once the water level reaches a pre-determined height, the siphon begins to engage, and water flows out of the structure downstream. The siphon flow is controlled by an orifice, whose size can be changed to provide the desired flow control. The water level continues to rise or begins to lower depending on the rate of flow from the orifice compared to the inflow of water to the structure.

An optional weir above the siphon provides a high flow path to prevent the system from surcharging. In cases where parking lot storage is desired, there would not be a high flow weir. A scour protection plate minimizes scour by preventing upward velocities/flow from the structure floor during periods of peak flow. Therefore, HydroDome combines the function of separator, hood, and flow control with active storage to provide a multi-purpose stormwater management solution in one structure.

Description of Test Procedure

For the purposes of this verification, a Hydroworks HydroDome 3-ft diameter (HD3) stormwater treatment unit was tested. The HD3 test unit was a full-scale 3 ft (0.91 m) diameter tank with an internal treatment hood that included a high flow weir. The test tank was fabricated from plastic and included 18-inch (457 mm) diameter inlet and outlet pipes, oriented along the center-line of the tank. The pipe inverts were located 48 inches (1.22 m) above the sump floor and were set with 1% slopes. The 100% and 50% sediment sump storage depths were 12 inches (0.305 m) and 6 inches (0.152 m), respectively. The effective treatment sedimentation area was 7.07 ft^2 (0.656 m^2).

The test data and results for this verification were obtained from independent testing conducted at Alden Research Laboratory in accordance with the *Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014)*[1]. Use of this procedure is intended to ensure that technologies in this category are subjected to stringent requirements in generating verifiable performance test data.

The verification plan was followed with one minor variance from the *Procedure*. This variance includes the required minimum amount of test sediment to be fed into the test unit for each tested surface loading rate (SLR). Although the *Procedure* requires a minimum of 11.3 kg of test sediment, during the 40 L/min/m^2 SLR test, only 6.45 kg was fed into the unit, which is 4.85 kg less than the specified minimum. This variance to the *Procedure* was agreed to by Toronto and Region Conservation Authority (TRCA), the author of the *Procedure*, based on previous conversations with Alden Labs, noting that the length of time to conduct the test with 11.3 kg of sediment at 40 L/min/m^2 would be over 36 hours.

Verification Results

CAWT verified the performance test data and other information pertaining to the HydroDome HD3 Oil-Grit Separator. A Verification Plan was prepared to guide the verification process based on the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol.

The test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution specified in the testing procedure.

The "*Procedure for Laboratory Testing of Oil Grit Separators"* (TRCA, 2014) requires that the three-sample average of the test sediment particle size distribution (PSD) meet the specified PSD. The allowable tolerance of 6% variation from the specified PSD curve was met at each discrete particle size tested and the d50 was finer than 75 µm.

Comparison of the individual sample and average test sediment PSD to the specified PSD is shown in Figure 2. This figure indicates that the test sediment used for the removal and scour tests met the above-mentioned criteria. The median particle size was 64 µm.

Samples from test sediment batches used for each run met the specified PSD within the required tolerance thresholds.

The capacity of the HydroDome HD3 device to retain sediment was determined at seven surface loading rates using the modified mass balance method. This method involved measuring the mass and particle size distribution of the injected and retained sediment for each test run.

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[1] The *Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014)* was originally prepared by the Toronto and Region Conservation Authority (TRCA) in association with a 31 member advisory committee from various stakeholder groups.

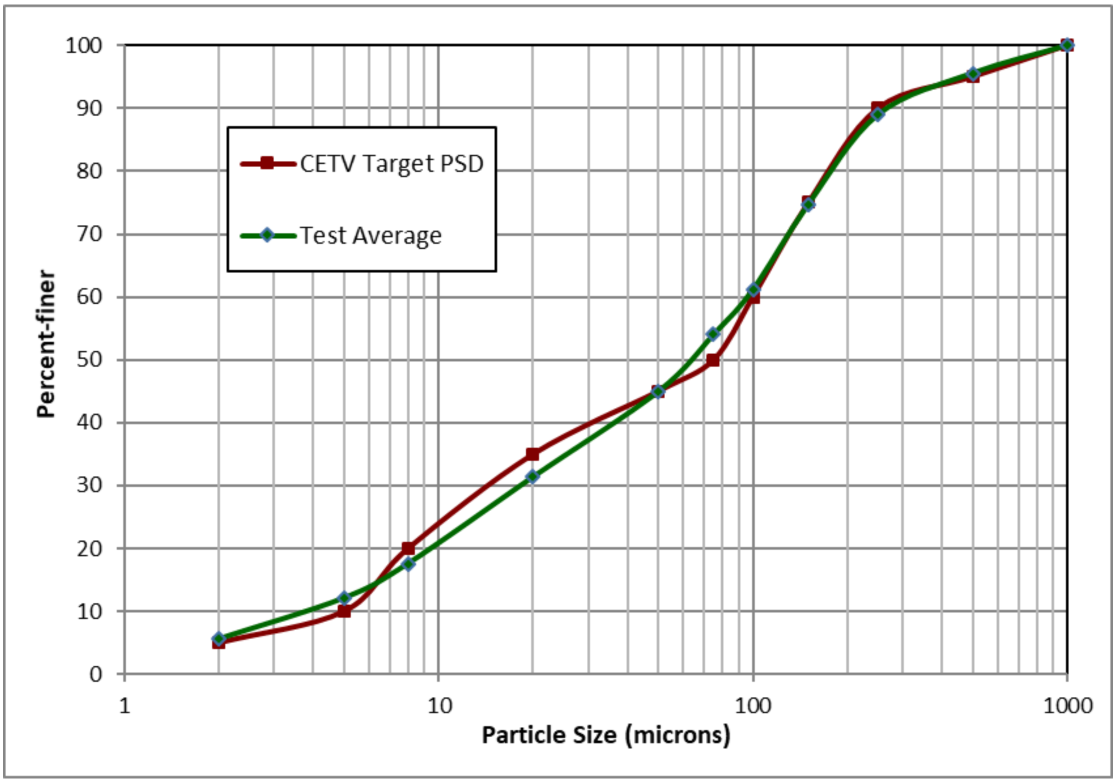


Figure 2 - Average particle size distribution (PSD) of the test sediment used for the sediment removal and scour test compared to the specified PSD

Performance was evaluated with a false floor simulating the technology filled to 50% of the manufacturer's recommended maximum sediment storage depth. The test was carried out with clean water that maintained a sediment concentration below 20 mg/L. Based on these conditions, removal efficiencies for individual particle size classes and for the test sediment, as a whole, were determined for each of the tested surface loading rates (Table 1).

In some instances, the removal efficiencies were above 100% for certain particle size fractions. These discrepancies are not unique to any one test laboratory and are attributed to errors relating to the blending of sediment, collection of representative samples for laboratory submission, and laboratory analysis of PSD. Due to these errors, caution should be exercised in applying the removal efficiencies by particle size fraction for the purposes of sizing the tested device (see Bulletin # CETV 2016-11-0001).

Particle Range (µm)	40 L/min/m^2	80 L/min/m^2	200 L/min/m^2	400 L/min/m^2	600 L/min/m^2	1000 L/min/m^2	1400 L/min/m^2	Average
>500	100%	125%	140%	140%	200%	200%	180%	155%
250-500	114%	129%	150%	143%	143%	183%	217%	154%
150-250	150%	136%	157%	153%	179%	221%	220%	174%
100-150	116%	126%	129%	148%	157%	162%	139%	140%
75-100	136%	155%	178%	190%	180%	170%	133%	163%
50-75	91%	100%	128%	270%	126%	82%	75%	125%
20-50	111%	97%	93%	51%	58%	42%	73%	75%
8-20	75%	79%	38%	34%	29%	17%	26%	42%
5-8	53%	34%	16%	7%	0%	0%	23%	19%
2-5	37%	29%	14%	0%	0%	0%	1%	12%

Table 1 - Removal efficiencies (%) of the HydroDome HD3 Oil-Grit Separator for individual particle size classes at specified surface loading rates

Figure 3 compares the particle size distribution (PSD) of the three-sample average of the test sediment to the PSD of the sediment retained by the HydroDome HD3 OGS device at each of the tested surface loading rates. As expected, the capture efficiency for fine particles was generally found to decrease as surface loading rates increased, particularly in the 400 to 1400 L/min/m^2 range.

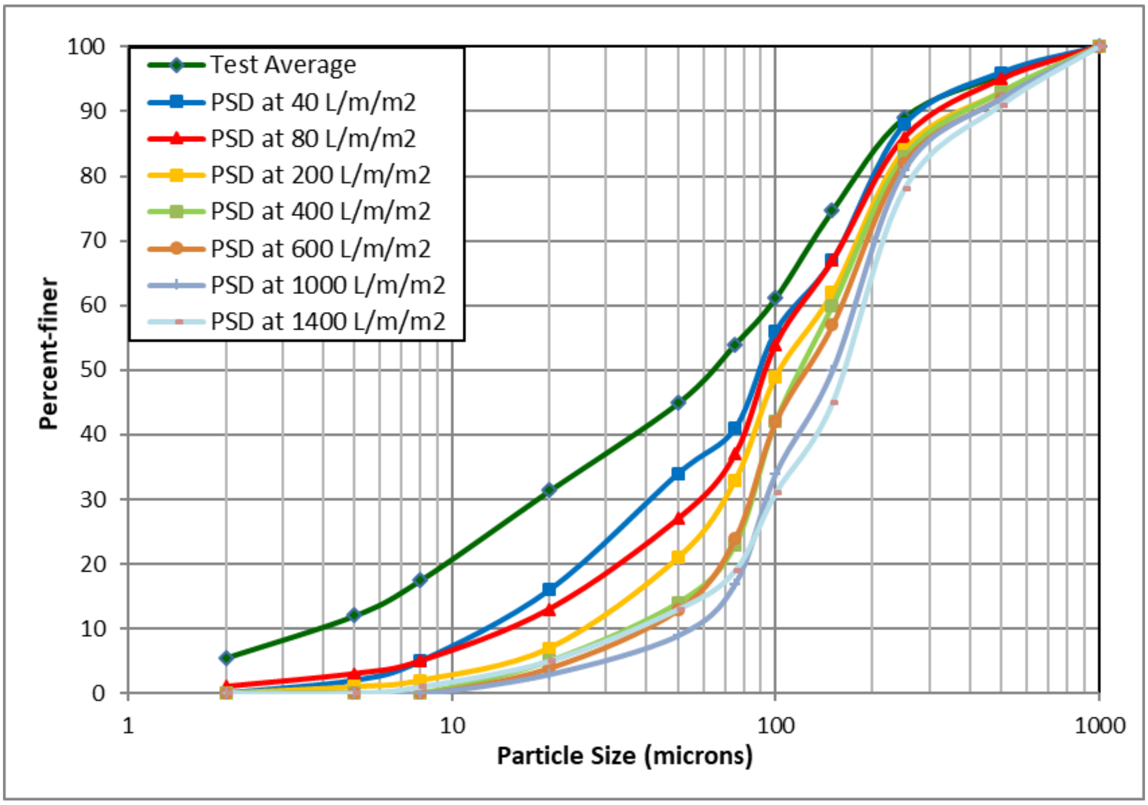


Figure 3 - Particle size distribution of sediment retained in the HydroDome HD3 Oil-Grit Separator in relation to the injected test sediment average

Table 2 shows the results of the sediment scour and re-suspension test for the HydroDome HD3 Oil-Grit Separator unit. The scour test involved preloading 15.2 cm (6 inches) of fresh test sediment into the sedimentation sump of the device. The sediment was placed on a false floor to mimic a device filled to 50% of the maximum recommended sediment storage depth.

Measured Concentration at Each surface Loading Rate					
Effluent Sample No.	200 L/min/m^2	800 L/min/m^2	1400 L/min/m^2	2000 L/min/m^2	2600 L/min/m^2
1	1.2	0.3	0.0	0.0	0.0
2	0.7	0.0	0.0	0.0	0.0
3	0.5	0.0	0.0	0.0	0.5
4	0.1	3.2	0.0	0.0	0.0
5	0.3	0.0	0.0	0.0	0.0
Average	**0.5**	**0.7**	**0.0**	**0.0**	**0.1**

Table 2 - Scour test adjusted effluent sediment concentration at each surface loading rate

Clean water was run through the device at five surface loading rates over a 30-minute period. Each flow rate was maintained for 5 minutes with a one-minute transition time between flow rates. Effluent samples were collected at one minute sampling intervals and analyzed for suspended solids concentration (SSC) and PSD by recognized methods. The effluent samples were subsequently adjusted based on the background concentration of the influent water.

Results showed average adjusted effluent sediment concentrations below 0.7 mg/L at all surface loading rates. The magnitude of scour is dependent on the internal flow patterns (velocity and turbulence) and water volume within the unit, which is related to the depth below the inlet and outlet. The HD3 possessed a large water volume in the sump and consequently, low velocity, which prevented incipient motion of the sediment of sufficient magnitude for scour to occur.

The average measured effluent scour sediment concentrations (adjusted for background) for each tested SLR were not adjusted for particle size based on the D5 of particles captured for the 40 L/min/m^2 removal efficiency test since there was negligible scour.

The capacity of the device to retain light liquid was determined at five surface loading rates in a range between 200 and 2600 L/min/m^2 using low-density polyethylene beads, Dow Chemical Dowlex^{tm} 2517, with a density of 0.917 g/cm^3. This material was specified as the acceptable surrogate to represent floating liquid for a qualitative assessment of liquid behaviour during operation.

Performance was evaluated with a total of 32.8 litres (18.94 kg) of pellets preloaded into the treatment vault by introducing them into the crown of the influent pipe, to a volume equal to a depth of 50.8 mm (2 inch) over the sedimentation area of 0.66 m^2. The effluent was collected in flow-designated nets to allow for quantification of any re-entrained pellets for each test SLR. The collected pellets were dried and the mass of collected pellets was quantified for each SLR, as well as the overall test.

The recorded average flow data, as well as quantified volume and mass of collected pellets for each target SLR and overall test, is shown in Table 3. The maximum re-entrainment of 0.3% occurred at 2600 L/min/m^2. The total retention rate was 99.7%.

Light-liquid Re-Suspension Data				**Starting Volume**	(Liters) 32.8	**Starting Mass**	(grams) 18938
Action	**Time Stamp** (minutes)	**Meter**	**Target Flow** (L/min/m^2)	**Recorded Flow** (L/min/m^2)	**COV**	**Collected Mass** (grams)	**Retained Mass**
Start D.A. Recording	0.0						
Flow set	1.0	4"	200	**207**	0.057	0	**100.0%**
Stop Collection	6.0			3.4%			
Flow set	7.0	4"	800	**826**	0.008	0	**100.0%**
Stop Collection	12.0			3.2%			
Flow set	13.0	6"	1400	**1407**	0.009	0	**100.0%**
Stop Collection	18.0			0.5%			
Flow set	19.0	6"	2000	**2022**	0.004	0.3	**100.0%**
Stop Collection	24.0			1.1%			
Flow set	25.0	6"	2600	**2599**	0.003	54.9	**99.7%**
Stop Collection	30.0			-0.1%			
Hydroworks HD 3				Interim Collection Net		1.3	
					Total	**56.5**	**99.7%**

Table 3 - Light-liquid recorded flow and re-entrainment data

Quality assurance

Performance testing and verification of the HydroDome HD3 Oil Grit Separator were performed in accordance with the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol. The verifier, CAWT, has confirmed that quality assurance requirements were addressed throughout the performance testing process and in the generation of performance test results. This includes reviewing all data sheets and data downloads, as well as overall management of the test system, quality control and data integrity.

In addition, QA/QC measures are documented in the *"Procedure for Laboratory Testing of Oil-Grit Separators"* (TRCA, 2014) to ensure results are accurate and precise, and that testing conducted by multiple vendors of the same category of technology are employing the same test method. The QA/QC measures include the use of certified laboratories, established test methods, calibration of equipment, tolerance limits for results variation, data checks during testing, and stringent documentation requirements.

Table 4 provides a summary of the acceptance criteria for particle size distribution, solids concentration in test water, water temperature, flow measurement equipment, flow rate variation, sediment feed, sediment moisture content, and sample analysis.

QC Parameter	**Acceptance Criteria**
Particle Size Distribution	Analyzed by a certified laboratory in accordance with ASTM D422-63(2007)e1. Percentages for size ranges vary by <6%, median < 75 um. PSD in water determined by ASTM D422-63(2007)e1 upon prior drying in designated pre-weighed nonferrous trays in compliance with ASTM D4959-07.
Solids concentration in test water	Suspended solids concentration (SSC) concentration of test water of less than 20 mg/L.
Water temperature	Temperature of water less than 25ºC.
Flow measurement equipment	Equipment calibration reports submitted to confirm that reported flow rate match actual flow rate. Flow rates from calibrated flow instruments recorded at no longer than 30 second intervals over the duration of the test.
Flow rate variation	Flow rates have COV < 0.04; maintained with ±10% of target flow rate.
Sediment feed	TSS concentration target = 200 mg/L with a tolerance limit of ±25 mg/L. Injection location is 5 pipe diameters upstream of the inlet to the device, as per the *Procedure*. Six calibration samples taken over duration of each test run. The allowed Coefficient of Variance (COV) for the measured samples was 0.10.
Sediment moisture content	Determined by ASTM D4959-07 "Standard Test Method for Determination of Water (Moisture) Content of Soil By Direct Heating".
Sample analysis	Conducted by qualified laboratories using standard methods and meeting the requirements of ISO.

Table 4. Validation of QA/QC procedures

Summary of Verification Results and Verified Performance Claim for Hydroworks HydroDome HD3 Oil-Grit Separator (OGS)

In summary, the HydroDome HD3 Oil Grit Separator is designed to remove oil, sediment, trash and debris from stormwater and snowmelt runoff as well as other pollutants that attach to sediment particles, such as nutrients and metals. Verification of performance claims for the Hydroworks HydroDome HD3 Oil Grit Separator was conducted by CAWT based on independent third-party performance test results provided by Alden Research Laboratory, as well as additional information provided by Hydroworks.

Table 5 summarizes the verification results in relation to the technology performance parameters that were identified to determine the efficacy of the HydroDome HD3 Oil Grit Separator. The claims stated in Table 5 were verified using the modified mass balance method for sediment removal by measuring the total mass of sediment entering the unit and retained by the unit at prescribed surface loading rates. Effluent sampling was conducted every minute over a 30-minute duration for the scour test, using approved sampling methods as per the verification procedure. The light liquid re-entrainment test was conducted using a mass balance methodology which accounted for all the beads input, captured, and scoured from the separator.

Parameters	Verified Claims	Accuracy
Sediment Removal	During the sediment removal test, the Hydroworks HydroDome HD3 OGS device, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L and particle size distribution of 1-1000 µm, removed 83.9, 77.6, 68.4, 66.9, 59.4, 52.4, and 46.0 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2 respectively	The sediment removal characteristics were quantified at various surface loading rates (SLRs), including particle size fractions, using a modified mass balance methodology. Performance results are presented as the true values.
Sediment Scour	During the scour test, the Hydroworks HydroDome HD3 OGS device with 15.2 cm (6 inch) of test sediment preloaded onto a false floor reaching 50% of the manufacturer's recommended maximum sediment sump storage depth, generated corrected effluent sediment concentrations on average of 0.54, 0.70, 0.0, 0.0, and 0.11 mg/L at 5-min duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m2, respectively.	5 samples analyzed for sediment (n=5) at each flow rate There was negligible scour once corrected for background concentrations.
Light Liquid Re-entrainment	During the light-liquid re-entrainment test, the Hydroworks HydroDome HD3 OGS with surrogate low-density polyethylene beads preloaded within the inner chamber, representing a floating light-liquid volume equal to a depth of 50.8 mm (2 inch) over the sedimentation area, retained 100, 100, 100, 100, and 99.7 percent of loaded beads by mass during the 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.	Performance results are presented as the true values. Under the "Procedure for Laboratory Testing of Oil-Grit Separators" (TRCA, 2014), the light-liquid re-entrainment test is also not amenable to statistical analysis as the tests were only conducted once at various flow rates following a mass balance procedure.

Table 5. Verified performance claims

What is ISO 14034?

The purpose of environmental technology verification is to provide a credible and impartial account of the performance of environmental technologies. Environmental technology verification is based on a number of principles to ensure that verifications are performed and reported accurately, clearly, unambiguously and objectively. The International Organization for Standardization (ISO) standard for environmental technology verification (ETV) is ISO 14034, which was published in November 2016.

Benefits of ETV

ETV contributes to protection and conservation of the environment by promoting and facilitating market uptake of innovative environmental technologies, especially those that perform better than relevant alternatives. ETV is particularly applicable to those environmental technologies whose innovative features or performance cannot be fully assessed using existing standards. Through the provision of objective evidence, ETV provides an independent and impartial confirmation of the performance of an environmental technology based on reliable test data. ETV aims to strengthen the credibility of new, innovative technologies by supporting informed decision-making among interested parties.

For more information on the HydroDome Oil Grit Separator, contact:	For more information on VerifiGlobal, contact:
Hydroworks LLC. 257 Cox St., Roselle, NJ 07203 USA T: +1-888-290-7900 E: gbryant@hydroworks.com W: https://hydroworks.com	VerifiGlobal c/o ETA-Danmark A/S Göteborg Plads 1, DK-2150 Nordhaven T: +45 7224 5900 E: info@verifiglobal.com W: www.verifiglobal.com
Signed for Hydroworks: Graham Bryant Owner	Signed for VerifiGlobal: Thomas Bruun Managing Director John Neate Managing Director

NOTICE: Verifications are based on an evaluation of technology performance under specific, predetermined operational conditions and parameters and the appropriate quality assurance procedures. VerifiGlobal and the Verification Expert, CAWT, make no expressed or implied warranties as to the performance of the technology and do not certify that a technology will always operate as verified. The end user is solely responsible for complying with any and all applicable regulatory requirements. Mention of commercial product names does not imply endorsement.

VerifiGlobal and the Verification Expert, CAWT, provide the verification services solely on the basis of the information supplied by the applicant or vendor and assume no liability thereafter. The responsibility for the information supplied remains solely with the applicant or vendor and the liability for the purchase, installation, and operation (whether consequential or otherwise) is not transferred to any other party as a result of the verification.

Hydroworks® HydroDome

Operations & Maintenance Manual

Version 1.0

Please call Hydroworks at 888-290-7900 or email us at support@hydroworks.com if you have any questions regarding the Inspection Checklist. Please email a copy of the completed checklist to Hydroworks at support@hydroworks.com for our records.

Introduction

The HydroDome (Figure 1) is a state-of-the-art hydrodynamic separator. HydroDome can be used for water quality and quantity flow control if desired.

Hydrodynamic separators remove solids, debris and lighter than water (oil, trash, floating debris) pollutants from stormwater. Hydrodynamic separators and other water quality measures are mandated by regulatory agencies (Town/City, State, Federal Government) to protect storm water quality from pollution generated by urban development (traffic, people) as part of new development permitting requirements.

As storm water treatment structures fill up with pollutants they become less and less effective in removing new pollution. Therefore, it is important that storm water treatment structures be maintained on a regular basis to ensure that they are operating at optimum performance. The HydroDome is no different in this regard and this manual has been assembled to provide the owner/operator with the necessary information to inspect and coordinate maintenance of their HydroDome.

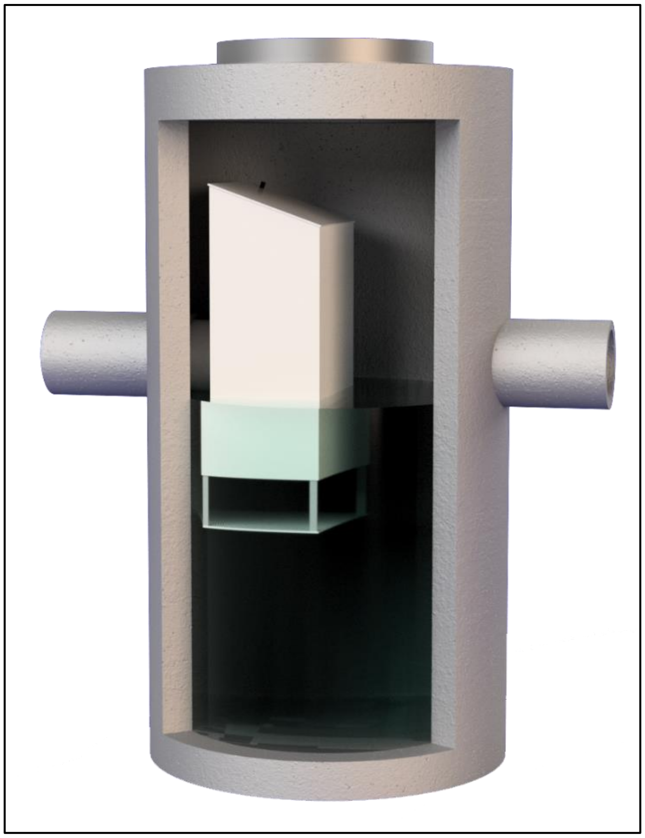


Figure 1. Hydroworks HydroDome

Hydroworks

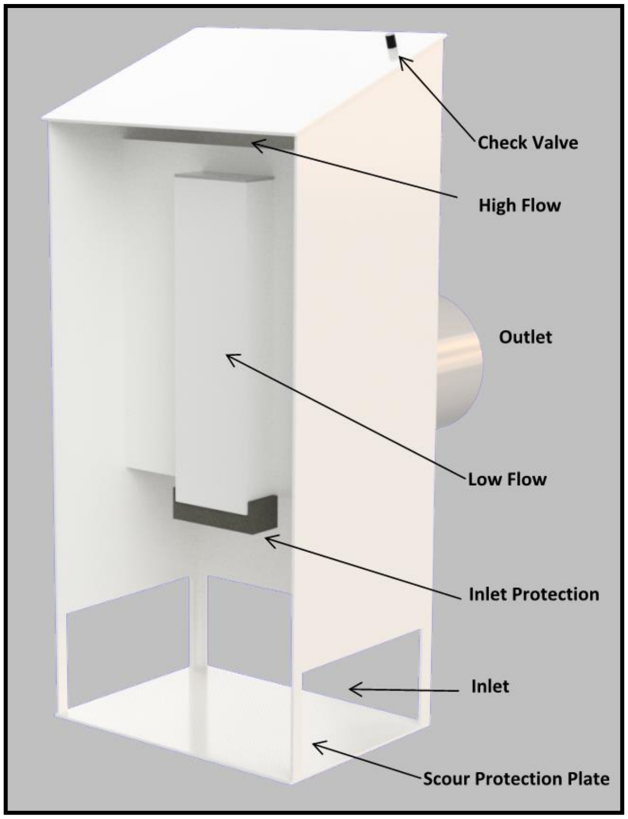


Figure 2 HydroDome Internal Components

Inspection

Procedure

Floatables

A visual inspection can be conducted for floatables by removing the cover/grate and looking down into the separator.

TSS/Sediment

Inspection for TSS build-up can be conducted using a Sludge Judge®, Core Pro®, AccuSludge® or equivalent sampling device that allows the measurement of the depth of TSS/sediment in the unit. These devices typically have a ball valve at the bottom of the tube that allows water and TSS to flow into the tube when lowering the tube into the unit. Once the unit touches the bottom of the device, it is quickly pulled upward such that the water and TSS in the tube forces the ball valve closed allowing the user to see a full core of water/TSS in the unit. Several readings (2 or 3) should be made at different locations of the structure to ensure that an accurate TSS depth measurement is recorded.

Operation

The water level during periods without rain should be near the outlet invert of the structure. If the water level remains near the top of the HydroDome this may suggest that there is an obstruction downstream of the HydroDome or that the inlet protection at the HydroDome may need to be cleaned.

Frequency

Construction Period

The HydroDome separator should be inspected every four weeks and after every large storm (over 0.5” (12.5 mm) of rain) during the construction period.

Post-Construction Period

The Hydroworks HydroDome separator should be inspected during the first year of operation for normal stabilized sites (grassed or paved areas). If the unit is subject to oil spills or runoff from unstabilized areas (storage piles, exposed soils), the HydroDome separator should be inspected more frequently (4 times per year). The initial annual inspection will indicate the required frequency of inspection and maintenance if the unit was maintained after the construction period.

Reporting

Reports should be prepared as part of each inspection and include the following information:

1. Date of inspection
2. GPS coordinates of Hydroworks unit
3. Time since last rainfall
4. Date of last inspection
5. Installation deficiencies (missing parts, incorrect installation of parts)
6. Structural deficiencies (concrete cracks, broken parts)
7. Operational deficiencies (leaks, elevated water level)
8. Presence of oil sheen or depth of oil layer
9. Estimate of depth/volume of floatables (trash, leaves) captured
10. Sediment depth measured
11. Recommendations for any repairs and/or maintenance for the unit
12. Estimation of time before maintenance is required if not required at time of inspection

A sample inspection checklist is provided at the end of this manual.

Maintenance

Procedure

The Hydroworks HydroDome unit is typically maintained using a vacuum truck. There are numerous companies that can maintain the HydroDome separator. Maintenance with a vacuum truck involves removing all of the water and sediment together. The water is then separated from the sediment on the truck or at the disposal facility.

The area around the HydroDome provides clear access to the bottom of the structure (Figure 3). This is the area where a vacuum hose would be lowered to clean the unit.

In instances where a vacuum truck is not available other maintenance methods (i.e. clamshell bucket) can be used, but they will be less effective. If a clamshell bucket is used the water must be decanted prior to cleaning since the sediment is under water and typically fine in nature.

The local municipality should be consulted for the allowable disposal options for both water and sediments prior to any maintenance operation. Once the water is decanted the sediment can be removed with the clamshell bucket.

Maintenance of a Hydroworks HydroDome unit will typically take 1 to 2 hours depending on size of unit and using a vacuum truck. Cleaning may take longer for other cleaning methods (i.e. clamshell bucket).

Inlet protection (Figure 2) in the form of a coarse foam screen is located at the inlet to the siphon opening in the HydroDome to ensure the opening does not become clogged. Although it is not anticipated that the inlet protection will have to be replaced on a regular basis since the inlet protection is protected by the submerged entrance to the HydroDome and is backflushed by the siphon after each storm , the inlet protection should be checked each time the HydroDome is inspected or maintained. The inlet protection is removable and should be rinsed with water to ensure any debris caught on the protection is discarded. Unless damaged, the inlet protection can be reinstalled. A replacement piece can be bought through Hydroworks and/or retail stores. Hydroworks can provide information on the inlet protection and where it can be bought. A sign that the inlet protection needs cleaning/replacement would be a water level near the crown of the outlet pipe in the structure during periods with no flow (i.e. unit does not drain down to the pipe invert).

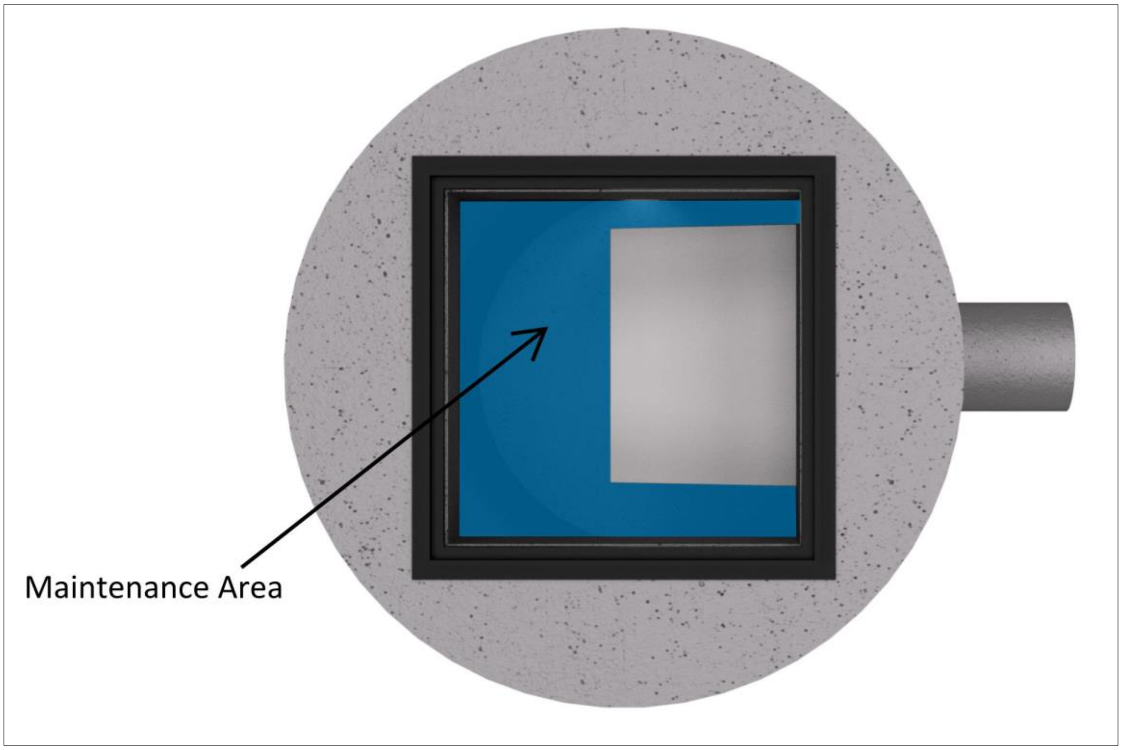


Figure 3. HydroDome Maintenance Access

Frequency

<u>Construction Period</u>

A HydroDome separator can fill with construction sediment quickly during the construction period. The HydroDome must be maintained during the construction period when the depth of TSS/sediment reaches 24" (600 mm). It must also be maintained during the construction period if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the area of the separator

The HydroDome separator should be maintained at the end of the construction period, prior to operation for the post-construction period.

<u>Post-Construction Period</u>

The maintenance for sediment accumulation is required if the depth of sediment is 1 ft or greater in separators with standard water (sump) depths (Table 1).

There will be designs with increased sediment storage based on specifications or site-specific criteria. Please contact Hydroworks at 888-290-7900 to inquire whether your HydroDome was designed with extra sump depth to extend the frequency of maintenance.

The HydroDome separator must also be maintained if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 75% of the water surface of the separator.

Table 1 Standard Dimensions for Hydroworks HydroDome Models

Model	Diameter ft (mm)	Maintenance Sediment Depth in (mm)
HD 3	3 (900)	12 (300)
HD 4	4 (1200)	12 (300)
HD 5	5 (1500)	12 (300)
HD 6	6 (1800)	12 (300)
HD 7	7 (2100)	12 (300)
HD 8	8 (2400)	12 (300)
HD 10	10 (3000)	12 (300)
HD 12	12 (3600)	12 (300)

HYDRODOME INSPECTION SHEET

Date ______________________________
Date of Last Inspection ______________________________

Site ______________________________
City ______________________________
State ______________________________
Owner ______________________________

GPS Coordinates ______________________________

Date of last rainfall ______________________________

Site Characteristics	**Yes**	**No**
Soil erosion evident	☐	☐
Exposed material storage on site	☐	☐
Large exposure to leaf litter (lots of trees)	☐	☐
High traffic (vehicle) area	☐	☐

HydroDome	**Yes**	**No**
Obstructions in the inlet	☐ *	☐
Damage to HydroDome (cracked, broken, loose pieces)	☐ **	☐
Improperly installed outlet pipe	☐ ***	☐
Internal component damage (cracked, broken, loose pieces)	☐ **	☐
Floating debris in the separator (oil, leaves, trash)	☐	☐
Large debris visible in the separator	☐ *	☐
Concrete cracks/deficiencies	☐ ***	☐
Exposed rebar	☐ **	☐
Raised water level (water level close to top of HydroDome)	☐ ***	☐
Water seepage (water level not at outlet pipe invert)	☐ ***	☐
Water level depth below outlet pipe invert ________ "		

Routine Measurements				
Floating debris depth	**< 0.5" (13mm)**	☐	**>0.5" 13mm)**	☐ *
Floating debris coverage	**< 75% of surface area**	☐	**> 75% surface area**	☐ *
Sludge depth	**< 12" (300mm)**	☐	**> 12" (300mm)**	☐ *

* Maintenance required
** Repairs required
*** Further investigation is required

Note: Inspections should not be made within 24 hours of a storm to allow the water to drain from the structure to assess a raised water level or water level seepage

Hydroworks

Other Comments:

Hydroworks

Hydroworks® HydroDome

One Year Limited Warranty

Hydroworks, LLC warrants, to the purchaser and subsequent owner(s) during the warranty period subject to the terms and conditions hereof, the Hydroworks HydroDome to be free from defects in material and workmanship under normal use and service, when properly installed, used, inspected and maintained in accordance with Hydroworks written instructions, for the period of the warranty. The standard warranty period is 1 year.

The warranty period begins once the separator has been manufactured and is available for delivery. Any components determined to be defective, either by failure or by inspection, in material and workmanship will be repaired, replaced or remanufactured at Hydroworks' option provided, however, that by doing so Hydroworks, LLC will not be obligated to replace an entire insert or concrete section, or the complete unit. This warranty does not cover shipping charges, damages, labor, any costs incurred to obtain access to the unit, any costs to repair/replace any surface treatment/cover after repair/replacement, or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to any material that has been disassembled or modified without prior approval of Hydroworks, LLC, that has been subjected to misuse, misapplication, neglect, alteration, accident or act of God, or that has not been installed, inspected, operated or maintained in accordance with Hydroworks, LLC instructions and is in lieu of all other warranties expressed or implied. Hydroworks, LLC does not authorize any representative or other person to expand or otherwise modify this limited warranty.

The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 136 Central Ave., Clark, NJ 07066 or any other address as supplied by Hydroworks, LLC. (888-290-7900).

This limited warranty is exclusive. There are no other warranties, express or implied, or merchantability or fitness for a particular purpose and none shall be created whether under the uniform commercial code, custom or usage in the industry or the course of dealings between the parties. Hydroworks, LLC will replace any goods that are defective under this warranty as the sole and exclusive remedy for breach of this warranty.

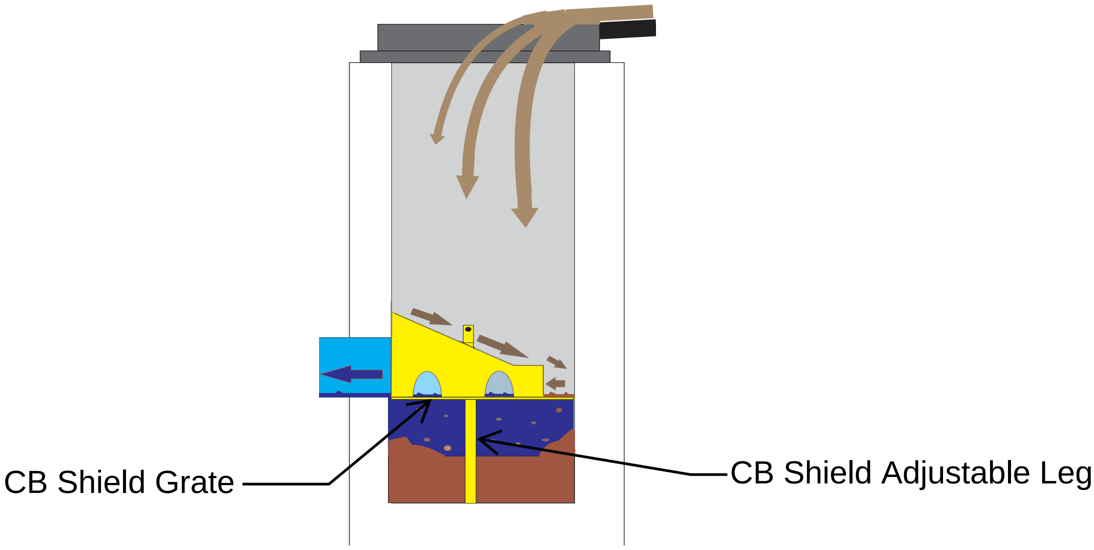
Subject to the foregoing, all conditions, warranties, terms, undertakings or liabilities (including liability as to negligence), expressed or implied, and howsoever arising, as to the condition, suitability, fitness, safety, or title to the Hydroworks HydroDome are hereby negated and excluded and Hydroworks, LLC gives and makes no such representation, warranty or undertaking except as expressly set forth herein. Under no circumstances shall Hydroworks, LLC be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the HydroDome, or the cost of other goods or services related to the purchase and installation of the HydroDome. For this Limited Warranty to apply, the HydroDome must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Hydroworks' written installation instructions.

Hydroworks, LLC expressly disclaims liability for special, consequential or incidental damages (even if it has been advised of the possibility of the same) or breach of expressed or implied warranty. Hydroworks, LLC shall not be liable for penalties or liquidated damages, including loss of production and profits; labor and materials; overhead costs; or other loss or expense incurred by the purchaser or any third party. Specifically excluded from limited warranty coverage are damages to the HydroDome arising from ordinary wear and tear; alteration, accident, misuse, abuse or neglect; improper maintenance, failure of the product due to improper installation of the concrete sections or improper sizing; or any other event not caused by Hydroworks, LLC. This limited warranty represents Hydroworks' sole liability to the purchaser for claims related to the HydroDome, whether the claim is based upon contract, tort, or other legal basis.

CB Shield Operations Manual

Installing CB Shield

It is important the catch basin frame and cover is aligned properly with the catch basin below
If it is misaligned it may be difficult to install the CB Shield insert
Determine the depth of the sump (i.e. the distance from the invert of the outlet pipe to the bottom of the catch basin). If the catch basin is in service the sump depth will be the depth of the water. The grate section of the CB Shield insert should be the same elevation as the water depth in the sump.



Adjust the leg of the CB Shield to achieve the appropriate elevation
The CB Shield is lowered into place with the rope attached to the top of the leg. The high side of the sloped plate should face the wall with the outlet pipe. (The incoming water should be directed to the wall furthest from the outlet)
The flexible plastic skirt around the outer edges of the CB Shield insert may interfere with some misaligned frame and grates. If so a slice can be cut into the skirt with a utility knife at the point of interference.
Make sure the grate is at the desired level or remove CB Shield and re-adjust the leg length.

Inspecting a CB Shield Enhanced Catch Basin

Open grate
A lifting rope is attached to the top of the centered leg of the CB Shield insert. Lift and remove the insert.
Inspect CB Shield for any possible damage. Quite often leaves will accumulate on the grate. This can actually improve the Shield's ability to capture sediment and assist in preventing leave litter from being washed down stream.
Use a Sludge Judge to measure the sediment depth in 4 - 6 locations of the sump.
If the sediment depth is 300mm – 600mm deep it is recommended that the unit be cleaned.

Cleaning a CB Shield Enhanced Catch Basin

Open grate and remove CB Shield with lift rope.
Clean catch basin as usual with a Vacuum truck.
Clean CB Shield (if needed) and re-install into catch basin.
If there is any significant damage to a CB Shield please send a picture and its location to CB Shield Inc. (info@cbshield.com).

Average Annual Sediment Removal Rates (%) using a CB Shield
(based on ETV Sediment - 1 to 1000 micron Particle Size Distribution)

Area to CB (ha)	Imperviousness[1] (%)					
	20%	35%	50%	65%	80%	100%
0.02	57%	57%	57%	57%	56%	56%
0.05	56%	56%	56%	55%	55%	54%
0.10	56%	55%	54%	53%	52%	51%
0.20	54%	53%	51%	49%	48%	46%
0.30	53%	50%	48%	46%	45%	43%
0.40	51%	48%	46%	44%	42%	40%
0.50	50%	47%	44%	42%	40%	38%
0.60	49%	45%	43%	40%	39%	36%

Notes:

1. Runoff Coefficient 'C' is approximately equal to 0.05 + 0.9*Impervious Fraction.
2. Above chart is based on long term continuous hydrologic analysis of Toronto, Ontario (Bloor St) rainfall data.
3. Assumes 0.6 m sump in CB and that maintenance is performed (i.e. CB cleaning) when required by sediment/pollutant build-up or otherwise.
4. See accompanying chart for suggested maintenance scheduling - AND - get CB Shield Inc. to monitor it for you in field.
5. Sediment/Pollutant removal rates based on third party certified laboratory testing using ETV sediment (PSD analysis available on request).
6. See additional discussion regarding scour protection from CB Shield during more infrequent runoff events.

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

CB Shield® Stormwater Quality Device

Developed by CB Shield Inc.
Oakville, Ontario, Canada

Registration: GPS-ETV_VR2022-10-31

In accordance with

ISO 14034:2016

Environmental Management —
Environmental Technology Verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

October 31, 2022
Vancouver, BC, Canada

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Technology description and application

The CB Shield® technology provides an environmental benefit of controlling sediment wash off at upstream locations. A standard catch basin has a 1.2 m waterfall inflow that churns up sediment in the sump below causing a very poor rate of sediment retention. The CB Shield is a flow deflection device that is inserted into a standard catch basin. It contains a sloped plate to direct runoff to the back wall of the catch basin, thereby dissipating the energy of stormwater inflows. The dissipation of inflow energy allows time for settling of sediment in stormwater runoff, increasing capture and reducing scour/ re-suspension of previously deposited sediment. Installation involves lowering the unit into a standard sized catch basin, and adjusting the height of the unit to the height of the permanent pool in the sump. The unit is manufactured with durable fiberglass requiring little maintenance and is estimated to be operated on the same cleanout schedule set for the catch basin. Due to high rates of scour in a standard catch basin, they are seldom filled beyond 40% of sump capacity. Clean out routines and expenses are optimized when the CB Shield captures and retains more sediment within the sump.

In an urban setting, there are typically approximately 5 catch basins installed per hectare. Assuming an equal distribution of overland flow, the tested flow rates for the scour and capture tests are meaningful in the context of 78 L/s per hectare and 42 L/s per hectare, respectively. The CB Shield's scour prevention performance has been evaluated in a laboratory setting relative to a standard unshielded catch basin for flows of 1.2 to15.6 L/s. The device's sediment capture performance was evaluated for flows of 0.24 to 8.4 L/s. Hydraulically, the CB Shield has been tested to pass flows up to 60 L/s without any negative impacts (i.e., surcharging).

Performance conditions

Claim 1: Capture test

The capture test is carried out in a laboratory with a constructed simulated street scape (1 % slope along its 2.4 m (96 inch) length, 2 % slope along its 1.2 m (48 inch) width). The catch basin was clean of any litter or debris. Capture performance was tested by comparing the mass of retained sediment with the influent sediment mass for each of six inflow rates: 0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/s. The test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution specified in the *Procedure for Laboratory Testing of Oil Grit Separators (TRCA, 2014)*. Sediment was injected onto the street scape at a point just upstream of the catch basin to allow mixing prior to discharge while avoiding excessive buildup of sediment on the street scape. The sediment feed rate was adjusted for each flow rate to keep the influent concentrations consistent at 200 mg/L. The tests were conducted with a false floor set at 300 mm below the outlet invert simulating a catch basin that is filled to 50% of the manufacturer's recommended maximum sediment storage.

Claim 2: Scour test

The scour test was carried out in a laboratory on catch basins with and without the CB Shield® insert with a constructed simulated street scape (1 % slope along its 2.4 m (96 inch) length, 2 % slope along its 1.2 m (48 inch) width) and the catch basins clean of any litter or debris. A false floor was set in the catch basins at 254 mm below the outlet invert and preloaded with the test sediment (1- 1000 micron silica blend) test up to 150 mm below the outlet invert simulating a catch basin that is ¾ full of sediment. Water was filled to the effluent pipe and sediments were allowed to settle for 12-24 hours. Flows of 1.2, 4.8, 8.4, 12, and 15.6 L/s were tested on a continuous run with flow rates maintained at 5 minutes and a one minute transition time between flow rates. A minimum effluent grab sample of 500 mL was collected in 1000 mL jars by holding it under the entire effluent stream. A sample was taken at 30 seconds during the flow transitions to account for scour during the transition. Background samples were also taken at least once every flow rate and effluent concentrations were corrected accordingly. Effluent flow was filtered using a 10μm filter and was recycled during the continuous 30 min test.

Performance claim(s)

Claim 1: Capture test

During the sediment capture test, for a catch basin with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent sediment concentration of 200 mg/L, the catch basin with a CB Shield® insert removed 64, 59.9, 52.4, 42.6, 25.2, and 26.7 percent of influent test sediment by mass at inflow rates of 0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/s, respectively.

Claim 2: Scour test

For a catch basin filled to three quarters of the manufacturer's recommended maximum sediment storage depth, with the CB Shield® insert, scouring of test sediment is at most 8% of the control catch basin during a continuous 30 minute scour test run with 5 minute duration inflows of 1.2, 4.8, 8.4, 12.0, and 15.6 L/s.

Performance results

The test sediment used to evaluate the CB Shield® technology was the same as that required by CETV for the evaluation of Oil Grit Separators. The comparison of the average test sediment PSD to the CETV specified PSD in Figure 1 indicates that the test sediment was finer than the specified PSD, with a median particle size of approximately 50 microns.

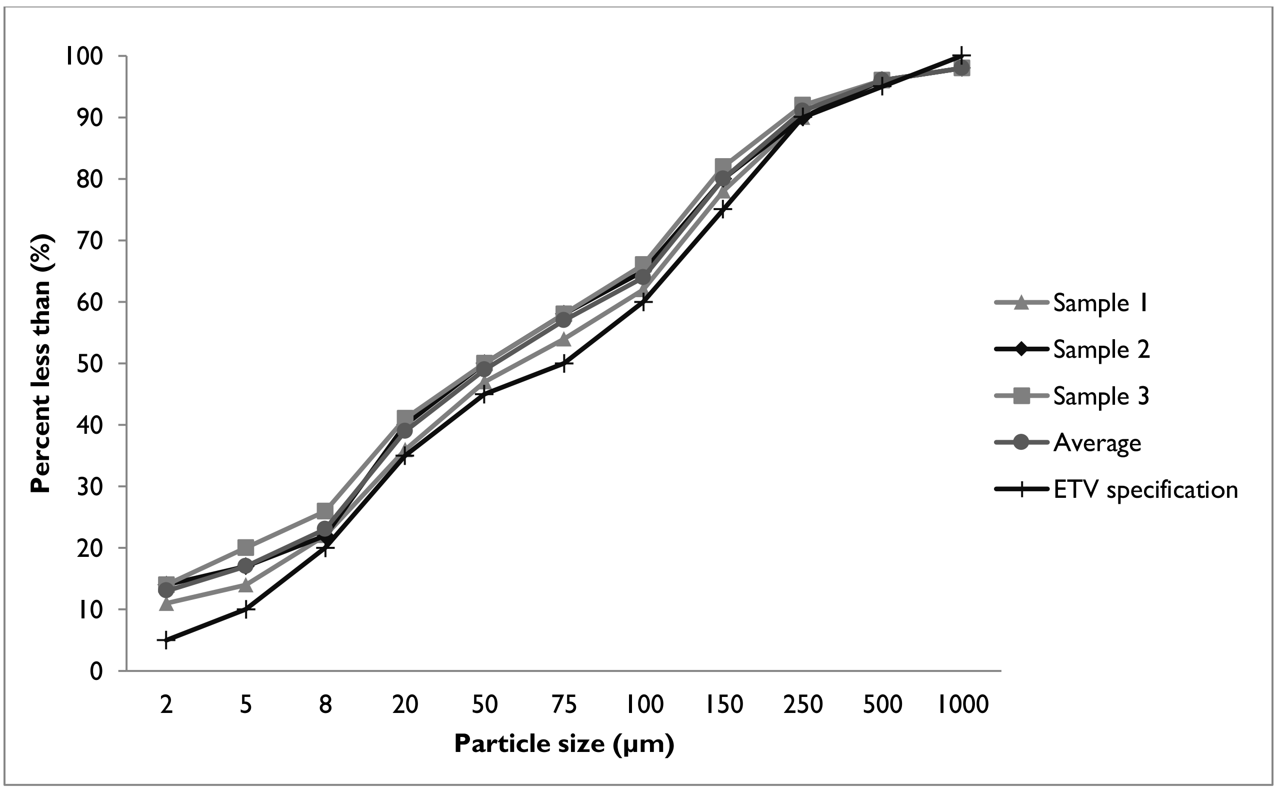


Figure 1. Test sediment particle size distribution (PSD) in relation to specified PSD.

The capacity of the device to retain sediment was determined at six surface loading rates using the modified mass balance method (see TRCA, 2014). During each of the tested flow rates, a known quantity of sediment was injected at a constant rate onto a simulated street scape just upstream of the catch basin containing the CB Shield® technology. Based on these results, removal efficiencies were determined for each of the tested surface loading rates (Table 1).

Table 1. Removal efficiencies (%) based on modified mass balance results at specified surface loading rates.

Flow rate	**(L/s)**	0.24	0.48	1.20	2.40	6.00	8.40
Surface loading rate	**(L/min/m^2)**	40	80	200	400	1000	1400
Total mass added	**(kg)**	1.217	2.302	5.072	5.150	4.921	4.812
Total mass captured	**(kg)**	0.778	1.378	2.659	2.196	1.238	1.287
Removal efficiency	**(%)**	64.0	59.9	52.4	42.6	25.2	26.7

Table 2 shows the results of the sediment scour and re-suspension test. This test involved preloading fresh test sediment into the sedimentation area of two catch basins with and without the CB Shield technology, as described in Performance Conditions section above. Effluent samples were collected at one-minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC). The mean sediment scour load of the catch basin with the CB shield insert was shown to be only 5% that of the control catch basin.

Table 2. Scour test effluent sediment concentration and loads.

Run	Flow rates (L/sec)	Surface loading rate (L/min/m²)	CB Shield® Run time (min)	CB Shield® Effluent suspended sediment concentration (mg/L)	CB Shield® Sediment load (g)	Control Run time (min)	Control Effluent suspended sediment concentration (mg/L)	Control Sediment load (g)
			1:00	17.7	1.3	1:00	129.2	9.7
			2:00	6.5	0.47	2:00	185.3	13.9
			3:00	2.7	0.19	3:00	206.0	15.5
			4:00	3.1	0.22	4:00	176.0	13.2
			5:00	4.6	0.33	5:00	523.6	39.4
			6:00	0.6	0.04	6:00	495.7	41.8
1	1.2	200	**Sum**		**2.6**	**Sum**		**133.5**
			7:00	8.2	2.4	7:00	7164.0	2069.0
			8:00	4	1.2	8:00	8094.0	2338.0
			9:00	0.6	0.2	9:00	6762.0	1950.0
			10:00	0.6	0.2	10:00	4842.0	1393.0
			11:00	1.7	0.5	11:00	5266.0	1517.0
			12:00	0.6	0.2	12:00	4768.0	1457.0
2	4.8	800	**Sum**		**4.7**	**Sum**		**10724.0**
			13:00	5.4	2.7	13:00	5429.0	2725.0
			14:00	10.0	5.0	14:00	6648.0	3332.0
			15:00	9.5	4.8	15:00	5025.0	2528.0
			16:00	10.0	5.0	16:00	5859.0	2939.0
			17:00	8.4	4.2	17:00	5019.0	2515.0
			18:00	8.2	4.1	18:00	3249.0	1628.0
3	8.4	1400	**Sum**		**25.8**	**Sum**		**15667.0**
			19:00	38.4	27.6	25:30	1886.0	1347.0
			20:00	79.4	57.2	26:30	1432.0	1027.0
			21:00	113.0	81.3	27:30	1167.0	844.0
			22:00	103.0	74.2	28:30	1508.0	1089.0
			23:00	114.0	82.1	29:30	1100.0	795.0
			24:00	92.3	66.5	30:30	708.0	512.0
4	12	2000	**Sum**		**388.9**	**Sum**		**5614.0**
			25:00	117.4	166.0	52:30	386.9	364.8
			26:00	211.6	198.1	53:30	252.7	237.8
			27:00	220.3	206.2	54:30	372.5	349.6
			28:00	187.8	175.8	55:30	332.4	311.7
			29:00	224.4	210.0	56:30	279.8	262.6
			30:00	199.2	186.5	57:30	310.2	290.9
5	15.6	2600	**Sum**		**1142.6**	**Sum**		**1817.4**
Total load					**1564.6**			**33956.0**

Potential sources of error

1. Background concentrations during the scour test were measured to be generally under 5 mg/L for both CB Shield® and Control treatments. However, background concentrations for the Control treatment at flow rates of 12.0 L/s and 15.6 L/s were substantially higher than the expected threshold of 20 mg/L as a result of inefficient recycling of water in the laboratory. Effluent samples were corrected based on the measured background concentrations since it was assumed that background sediments consisted of fine particles that were not captured in the device and flowed through as effluent concentration. If instead, some of the background sediments settled, the correction for all background sediments would bias against the relative performance of the CB Shield and therefore result in a more conservative evaluation of the CB Shield technology performance.

2. The reduction in scour at higher flow rates for the Control treatment suggested that the amount of preloaded sediment (10.2 cm depth) may have been insufficient to provide a continuous supply of fine particles for scour throughout the test. A similar decrease in scour at high flow rates was not observed for the CB Shield® treatment. This interpretation of the data implies that preloading both catch basins with additional sediment would likely have shown increased relative scour for the Control treatment, particularly at high flow rates. Although further testing would be required to verify this interpretation, it is reasonable to suggest that the test as conducted may have produced a smaller relative difference, resulting in a more conservative claim for the CB Shield technology.

Verification

This verification was first completed in October, 2016 and is considered valid for subsequent renewal periods every three (3) years thereafter. Data and information provided by CB Shield Inc. to support the performance claim included the following: Performance test report prepared by Good Harbour Laboratories of Mississauga, Ontario, dated 24 August 2016; the report was based on testing completed in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014).

The original verification was completed by the Toronto and Region Conservation Authority, contracted by GLOBE Performance Solutions, using the Canadian ETV Program's General Verification Protocol (June 2012) and taking into account ISO/FDIS 14034:2015(E). This ETV renewal is considered to meet the equivalency of an ETV verification completed using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***.

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV) and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

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Limitation of verification - Registration: GPS-ETV_VR2022-10-31
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