Functional Servicing Study

Havelock South Development Area
Township of Havelock-Belmont-Methuen
Engage Project No. 18039

Engage Engineering Ltd.

November 2018

Issued for Review

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1.0 Introduction

1.1 Purpose

Engage Engineering Limited (Engage) has been retained by the Township of Havelock-Belmont-Methuen (HBM) to prepare a Functional Servicing Study to identify the servicing requirements for a large mixed-use development area in the south part of the Village of Havelock. This report is being prepared to confirm the following:

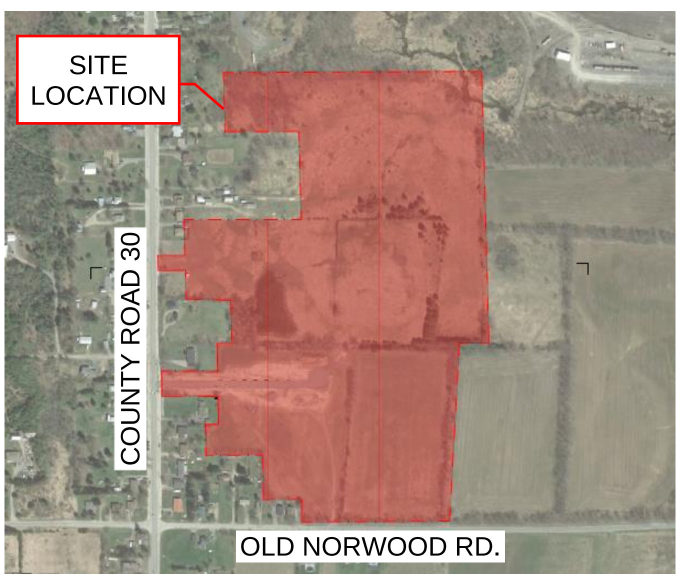
- Water servicing capacity and configuration
- Sanitary servicing capacity and configuration
- Stormwater management requirements and configuration

Recommendations made in this report will be in accordance with the MOECC and Township of Havelock-Belmont Methuen requirements.

1.2 Site Description

The proposed development area is located on the south side of the Village of Havelock, in the Township of HBM, County of Peterborough. The existing site is vacant agricultural land which consists of grassed and treed areas. The subject site is bounded to the south by Old Norwood Road, to the west by County Road 30 and residential homes, and to the north and east by farm land. The location of the subject property is identified on the Location Plan included as **Figure 1**.

Figure 1 - Location Plan



The proposed preliminary concept plan for the development area includes a mixture of residential and institutional land uses. The plan includes three phases of residential homes as well as the Peterborough Housing Development and Long-Term Care Facility. Phase 1 of the development consists of Smith Drive and the construction of seven (7) residential homes. In conjunction with the Phase 1 homes is the construction of the Peterborough Housing Development. Services have already been provided for this phase. Phase 2 consists of the extension of Smith Drive and the construction of 23 residential homes. The Havelock Long-Term Care Facility is anticipated to be constructed in a similar time frame to Phase 2. Phase 3 consists of the construction of 101 residential homes and associated roadways. The Havelock Long-Term Care Facility and Peterborough Housing Development will have their own services; however, they have been considered in analyzing the overall capacity of the water and wastewater treatment plants. The preliminary concept plan outlining the development is included as **Figure 2**.

2.0 Water Servicing

2.1 Existing Conditions

The existing water distribution system that services the Village of Havelock is owned by the Township of Havelock-Belmont-Methuen and operated by the Ontario Clean Water Agency (OCWA). The municipal drinking water system is comprised of the following infrastructure:

- Three municipal wells, with low lift pumping stations and treatment systems
- One municipal water tower with a capacity of 1276 m^3/day

County Road 30 currently has an existing 200mm diameter PVC watermain. The watermain is on the east side of County Road 30 and extends to the south towards Old Norwood Road. Additionally, there is an existing 200mm diameter PVC watermain on Old Norwood Road to the south of the site.

The Township provided as-built drawings showing the details of the existing 200mm diameter PVC watermain on County Road 30 and the 200mm diameter PVC watermain on Old Norwood Road. The watermains were installed in 2013 during the reconstruction of County Road 30. As-built plan and profile drawings are included in **Appendix A**.

The Township provided current water capacity and daily water consumption data for the last 5 years of operation (2013 to 2018). The municipal drinking water system in Havelock operates at a capacity of 2,333 m^3/day, with Wells 1 & 4 having a capacity of 1,020 m^3/day and Well 3 having a capacity of 1,313 m^3/day. Current records show a 5-year average daily flow of 589 m^3/day for all three wells. Therefore, the plant is currently operating at 25% capacity. Currently Well 3 is undergoing maintenance and is not operating daily. Wells 1 & 4 have a 5-year average daily flow of 571 m^3/day and is operating at 56% capacity. Refer to **Appendix B** for Norwood water capacity and consumption rates.

2.2 Proposed Conditions

Proposed 200mm diameter PVC watermain will provide service for Phase 2 and Phase 3 of the development. The watermain for Phase 2 will connect to the Phase 1 watermain at the end of Smith Drive. The watermain for Phase 3 will connect to the existing 200mm diameter PVC watermain on County Road 30. It is recommended that the watermain servicing Phase 3 be looped through Phases 1 and 2 to provide redundancy and to eliminate dead ends in the system. The proposed watermain will be installed at a minimum depth of 1.8m below grade and will consist of 200mm PVC DR18 watermain with a pressure class rating of 1034 kPa (150 psi). A service connection will be provided for each lot.

Fire hydrants will be provided at a maximum spacing of 150m between hydrants. Water valves will be proposed at each leg of the intersections to ensure sections of the watermain can be isolated for maintenance and repair in the future. The water servicing plan is included as **Figure 3 – Water Servicing Plan**. The layout is schematic and will be revised based on the proposed lot layout for Phase 3.

The Peterborough Housing Development will connect to the 200mm diameter watermain on Smith Drive via a 150mm diameter watermain. The Long-Term Care Facility is expected to have a 200mm diameter watermain which will connect to the existing 200mm diameter watermain on Old Norwood Road. The water services can be seen on **Figure 3 – Water Servicing Plan**.

2.3 Design Criteria

The design criteria to analyze the municipal water system includes:

- Residential water demand of 450 L/person/day.
- Single detached residential lots to have capacity of 3.5 persons/unit
- Phase 1 unit count – 7; Phase 2 unit count – 23; Phase 3 unit count – 101
- Peterborough Housing Unit Count – 32, Long-Term Care unit count – 136
- Maximum day factor of 2.50 (based on population of 1175)
- Peak hour factor of 3.75 (based on population of 1175)
- Minimum fire flow of 2000 L/min

2.4 Design Flow Rates

Based on a Statistics Canada Census Profile from 2016 the Village of Havelock has a current population of 1,175. Actual water consumption rates of users have been collected over the past 5 years from 2013 to 2018. For the purposes of this report collected data from the highest demand year (2015) will be used. This information is summarized in **Table 1** below.

Table 1 – Existing Water Consumption

Year	Average Daily Flow Well 1 & 4 (m³/day)	Average Daily Flow Well 3 (m³/day)	Maximum Daily Flow Well 1 & 4 (m³/day)	Maximum Daily Flow Well 3 (m³/day)
2015	649	11	748	74

Based on the design criteria listed above, calculations for the domestic water demand for the proposed development have been provided in **Appendix C**. These results have been summarized in **Table 2** below.

Table 2 – Proposed Domestic Water Flow

Flow Type	Phase 1 & 2 & 3 (L/min)	HLTC (L/min)	Ptbo Housing Development (L/min)	Total (L/min)
Average Day Flow	142.2	42.5	20.0	204.7
Maximum Day Flow	355.5	106.3	50.0	511.8
Peak Hour Flow	533.2	159.4	75.0	767.6
Fire Flow	2000.0	2000.0	2000.0	2000.0
Maximum Day + Fire Flow	**2355.5**	**2106.3**	**2050.0**	**2511.8**

Existing flow data was combined with calculated water flow to provide the total future flow. These results are summarized in **Table 3** below.

Table 3 – Total Future Flow

Flow Type	Existing Flow (L/min)	Total Development Flow (L/min)	Total Future Flow (L/min)	Total Future Flow (m³/day)
Average Day Flow	458.3	204.7	663.0	955
Maximum Day Flow	570.8	511.8	1082.6	1559
Peak Hour Flow	1718.6	767.6	2486.2	3580
Fire Flow	2000.0	2000.0	2000.0	2880
Maximum Day + Fire Flow	**2570.8**	**2511.8**	**3082.6**	**4439**

The capacity of the existing Havelock drinking water system was analyzed to confirm that it can accommodate the additional flows required to service the development. The results are presented in **Table 4** below.

Table 4 – Havelock Drinking Water System Capacity

Flow Type	Average Daily Flow (m^3/day)	Rated Capacity of Drinking Water System (m^3/day)	Drinking Water System Capacity (%)
Existing Flows (to date)	660	2,333	28
Existing + Phase 1 & 2 & 3	865	2,333	37
Existing + All Development	955	2,333	41

The proposed development including Phase 1, 2 and 3 of residential homes in addition to the Peterborough Housing Development and Long-Term Care Facility do not create a capacity problem for the drinking water system in the Village of Havelock. Water flows for all developments can be accommodated within the current water system capacity. If Well 3 is not operational when these developments are constructed, Wells 1 & 4 will be operating at 88% capacity.

3.0 Sanitary Servicing

3.1 Existing Conditions

The existing sanitary collection system and wastewater treatment plant that services the Village of Havelock is owned by the Township of Havelock-Belmont-Methuen and operated by the Ontario Clean Water Agency (OCWA). The wastewater system is comprised of the following infrastructure:

- One wastewater treatment plant located off Old Norwood Road.
- One main pumping station located on Highway 7.
- Gravity collection system and forcemain.

The sanitary collection system consists of various sizes of gravity sewer which flow to the main pumping station located on Highway 7. From the pumping station, sewage is pumped via forcemain to manhole 113 on County Road 30 (CR 30), just south of Smith Drive, where it discharges to a gravity sewer. The gravity sewer on CR 30 south of Smith Drive takes all flows to the wastewater treatment plant south of Old Norwood Road. A map of the existing sanitary sewerage system outlining this information is included in **Appendix A**.

The Township provided as-built drawings showing details of the existing PVC sanitary sewers. These drawings detail the size of the sewers, pipe slopes, structure inverts and direction of flow. These sections of sewer were installed in 1975 and as-built drawings of the sanitary sewer system are included in **Appendix A**.

There is an existing 250mm diameter sanitary sewer on County Road 30 fronting the site. This is a gravity sewer which flows north towards the pumping station on Highway 7. There is also a forcemain on County Road 30 which flows from the pumping station to manhole 113 on County Road 30 south of Smith Drive, where it discharges to the gravity sewer. Phase 1 of the development is connected to manhole 113 within County Road 30. Flows from the development flow to the wastewater treatment plant south of Old Norwood Road. The sanitary sewer installed for Phase 1 of the development consists of 200mm PVC and contains a stub terminated at the east connection point for continuation into Phase 2.

The Township provided current wastewater treatment plant capacity and daily sewage flow data for the last 5 years of operation (2013 to 2018). The sewage treatment plant in Havelock has a capacity of 1,200m³/day (maximum capacity) with current records showing a 5-year average daily flow of 857m³/day. Therefore, the plant is currently operating at 72% capacity. It should be noted that there are several cases where the maximum daily flows exceed the capacity of the wastewater treatment plant. Refer to **Appendix B** for Havelock treatment plant capacity and sewage flows.

3.2 Proposed Conditions

A proposed sanitary sewer network will be required to provide service for the subject lands. The proposed sanitary sewer for Phase 2 will connect to the existing 200mm diameter sanitary sewer stub from Phase 1 along Smith Drive. The sanitary sewer for Phase 3 will connect to the existing 250mm diameter sanitary sewer through existing Manhole 109 within County Road 30 at an approximate invert of 215.00m.

The proposed sanitary sewer will be installed along the centerline of the proposed roadways at a depth of approximately 2.5m to provide gravity service to the basements of the proposed homes. Some fill will be required in the northeast region of the site to raise the site to an approximate elevation of 220.00 to provide gravity service. The same pipe material and pipe characteristics will be carried throughout Phase 2 and Phase 3 which will include the installation of a 200mm PVC DR35 pipe with a hydrostatic rating of 345 kPa (50 psi). A service connection will be provided for each lot.

Sanitary maintenance holes will be provided at all intersections, change in pipe direction and straight runs exceeding 120m. Refer to **Figure 3 – Sanitary Drainage Area Plan**.

The Peterborough Housing Development will be serviced by connecting to the 200mm diameter sanitary sewer on Smith Drive via a 150mm diameter sewer. The Long-Term Care Facility is expected to have a 200mm diameter sanitary service which will connect to the existing 200mm diameter sanitary sewer on Old Norwood Road.

3.3 Design Criteria

The design criteria to analyze the sanitary sewer system includes:

- Residential sewage flow of 450 L/person/day.
- Commercial sewage flow of 28 m³/ha/day (0.33 L/ha/s)
- Single detached residential lots to have capacity of 3.5 persons/unit
- Phase 1 unit count – 7; Phase 2 unit count – 23; Phase 3 unit count – 101

- Harmon peaking formula to be applied to residential flows
- Infiltration rate of 0.28 L/ha/s

3.4 Sewage Flow Rates and WWTP Capacity

Sewage flow rates for the existing and proposed conditions were analyzed based on the guidelines above and the existing sewage flow data that was provided by the Township. Actual wastewater flow data has been collected over the past 5 years from 2013 to 2018. For the purposes of this report, collected data from the highest demand year was used (2018), which shows that the flows exceed the capacity of the wastewater treatment plant. See **Table 5** below and refer to **Appendix B** for wastewater flow data.

Table 5 – Existing Wastewater Flow

Year	Average Day Flow (m^3/day)	Maximum Day Flow (m^3/day)	Rated Capacity of Sewage Treatment Plant (m^3/day)
2018	1314	1659	1,200

Based on the design criteria, the sewage flows for the proposed development have been calculated and summarized in **Table 6** below. The proposed sewage flow calculations are included in **Appendix D**.

Table 6 – Proposed Wastewater Flow

Flow Type	Residential (m^3/day)			HLTC (m^3/day)	Ptbo Housing Development (m^3/day)	Total (m^3/day)
	Ph.1	Ph.2	Ph.3			
Average Flow	11.0	36.2	159.1	61.2	28.8	296.3
Peak Flow	48.2	154.6	643.8	257.4	123.6	1227.6
Infiltration Flow	24.4	55.6	304.8	73.8	28.3	486.9
Average Design Flow	35.4	91.8	463.9	135.0	57.1	783.2
Peak Design Flow	**72.6**	**210.3**	**948.6**	**331.1**	**151.9**	**1714.5**

The capacity of the existing Havelock sewage treatment plant was analyzed to confirm if it can accommodate the additional flows required to service the development. The results are presented in **Table 7** below.

Table 7 – Havelock Wastewater Treatment Plant Capacity

Flow Type	Average Daily Flow (m^3/day)	Rated Capacity of Wastewater Treatment Plant (m^3/day)	Wastewater Plant Capacity (%)
Existing Flows (to date)	1314	1,200	110%
Existing + Phase 1 + Peterborough Housing Dev.	1407	1,200	117%
Existing + Phase 1 + Peterborough Housing Dev. + Phase 2	1499	1,200	125%
Existing + Phase 1 + Peterborough Housing Dev. + Phase 2 + HLTC	1634	1,200	136%
Existing + All Development	2098	1,200	175%

As anticipated, the results indicate that there is not sufficient capacity at the wastewater treatment plant to support the proposed development. The capacity of the plant is exceeded in the existing conditions (2018) therefore adding additional flows will only further exceed the plant capacity. When comparing the average daily flow of the wastewater treatment plant to the average daily flow of the water treatment plant it is evident that the wastewater treatment plant is experiencing an excess amount of infiltration into the system on a daily basis. The average daily flow of the water treatment plant is 660m^3/day which indicates that approximately 50% of the average daily wastewater flow is from inflow and infiltration. It is recommended that the Township complete an inflow and infiltration study to determine the source of these flows in order to recover some of the capacity in the existing wastewater treatment plant. If some residual capacity can be achieved by reducing inflow and infiltration, it will allow some of the near-term developments to occur. However, in the longer-term, improvements will be required to the wastewater treatment system to provide sufficient capacity for all of the proposed development.

3.5 Existing Sewer Capacity Analysis

The capacity of the existing sanitary sewer system was analyzed to confirm capacity for the proposed development area. **Figure 4 – Sanitary Drainage Area Plan** shows the existing sewer location as well as the proposed sewers to service the development lands. Sanitary sewer design sheets were prepared for both existing conditions and for the total proposed development to document flows, resultant pipe capacities and sewer velocities. Pipe material, slope and lengths were obtained from the as-built drawings provided by the Township. The existing and proposed conditions sanitary sewer design sheets are included in **Appendix D**.

The results of the analysis are summarized in **Table 8** below. The table identifies the range of existing and proposed capacities for a stretch of manholes. The specific capacities for each section are included in the sanitary sewer design sheets in **Appendix D**.

Table 8 – Sanitary Sewer Capacity Summary

Sewer Location	Manhole ID	Direction of Flow	Existing Pipe Diameter (mm)	Capacity Existing Conditions	Capacity Proposed Conditions
County Road 30	MH 111 to MH 95	North to Pumping Station	250 PVC	2 – 20%	2 – 49%
Ottawa St.	MH 96 to MH 1	East to Pumping Station	200-300 PVC	10 – 69%	10 – 85%
County Road 30	MH 113 to MH 116	South to Treatment Plant	250 PVC	74 – 98%	90 – 120%
Old Norwood Road	MH NOR to MH 116	West to Treatment Plant	200 PVC	5%	11%
County Road 30	MH 116 to MH 122	South to Treatment Plant	375 PVC	54 – 65%	67 – 81%
County Road 30	MH 122 to MH 132	South to Treatment Plant	375 PVC	70%	88%

The results indicate that under existing conditions all runs of sewer are below 100% capacity. Under the total proposed conditions there are two sections of sewer which exceed 100% capacity. These sections were further analyzed to identify at which phase in the development the upgrades will be required. It was determined that the section of sewer between MH115 and MH116 exceed capacity once Phase 1 is developed and thus should be replaced with 300 mm diameter sewer in 2019, prior to connection of all Phase 1 units. Similarly, it was found that the section of sewer between MH113 and MH114 will need to be replaced with 300 mm diameter sewer to allow development of Phase 3. The sections of sewer that require upgrading can be seen in **Figure 4A – Sanitary Drainage Phasing Plan**. Sanitary sewer design sheets outlining this information are included in **Appendix D**.

The remaining sections of the existing sewer have capacity to accept the future flows from the subject lands.

Pipe flow velocities were also verified for both the existing and proposed conditions. There are sections in both the existing and proposed conditions that do not exceed the minimum of 0.6 m/s required for self-cleansing. All sections are below the maximum velocity of 3.0 m/s.

4.0 Stormwater Management

4.1 Existing Conditions

Phase 1 of the development has stormwater controls implemented within the Smith Drive road allowance. Additionally, the Peterborough Housing Development and Long-Term Care Facility will have their own stormwater controls which will be submitted under separate cover by the proposed developers. The following analysis has been performed to determine an approximate size and location for the required SWM block for Phase 2 and Phase 3 of the proposed residential development.

The existing site for Phase 2 and Phase 3 is a 14.9 hectare parcel of land located on the northeast side of the County Road 30 and Old Norwood Road intersection. The site generally slopes towards the northeast corner of the site towards Plato Creek.

The general topography of the property was obtained through GIS information. A detailed topographic survey will be required to confirm the existing topography during detailed design. The site has a mixture of vegetated cover consisting of grassed and treed areas. Based on the topography, runoff flows via sheet flow across the site from southwest to northeast and drains to Plato Creek.

For the preliminary analysis, the site has been considered as one drainage area. The existing catchment area has been identified on the **Stormwater Drainage Plan** included as **Figure 5**.

Existing catchment area **EX1** is 14.9ha and includes drainage for the development of Phase 2 and Phase 3. This area drains from the south to north and consists of grassed areas.

The existing characteristics of the drainage area is summarized in **Table 9** below.

Table 9 – Existing Drainage Areas (ha)

Catchment ID	Wooded	Grass	Impervious	Total
EX1	0.00	14.90	0.00	14.90

4.2 Proposed Conditions

Under the proposed condition, the topography will change to include the development of 23 homes in Phase 2 and 101 homes in Phase 3 as seen in **Figure 2**. A runoff coefficient of 0.65 has been assumed for the single family homes in the development. The proposed drainage catchment area is identified on the **Stormwater Drainage Plan** included as **Figure 5**.

Proposed catchment area **PR1** consists of 14.9ha that includes Phase 2 and Phase 3. The catchment is comprised of grassed area and impervious area for the future homes and roadways. This catchment will drain to the northeast corner of the site towards Plato Creek.

The characteristics of the proposed drainage area is summarized in **Table 10** below.

Table 10 – Proposed Drainage Areas (ha)

Surface Type	Grass	Wooded	Impervious	Total
PR1	5.10	0.00	9.80	14.90

4.3 Hydrologic Parameters

The hydrologic parameters for the site under existing and proposed conditions were developed based on the site conditions and topography. The parameters are summarized in **Table 11** below. Detailed spreadsheets are included in **Appendix E**.

Table 11 – Existing and Proposed Hydrologic Parameters

Catchment ID	Area (ha)	% Impervious	Runoff Coefficient	Tc (Calc.)
EX1	14.90	0.00%	0.17	51.2
PR1	14.90	65.77%	0.65	17.0

The peak runoff for the existing and proposed conditions were calculated for the 2-year through 100-year return periods using the Rational Method and the hydrologic parameters identified above. Spreadsheets with the Rational Method calculations are included in **Appendix E** and the calculations are summarized in **Table 12** below.

Table 12 – Pre and Post Development Peak Flows

Catchment ID	Peak Flows (m3/s)					
	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
EX1	**0.187**	**0.254**	**0.307**	**0.394**	**0.487**	**0.553**
PR1	**1.422**	**1.909**	**2.252**	**2.897**	**3.520**	**4.015**

The results indicate that in the absence of any quantity controls, the peak flows from area PR1 will increase under the proposed conditions when compared with EX1 and that some form of quantity control is required.

4.4 Stormwater Management Requirements

Some form of on-site stormwater management facility is required for the proposed development to provide quantity and quality control due to the increase in impervious area that accompanies a proposed residential development. Quantity control will be required to limit peak flows to pre-development levels thereby protecting downstream properties from flooding. An “enhanced” level of quality control as defined in the MOE SWM Planning and Design Manual is required due to the increase in sediment and contaminants and downstream wetland. A preliminary analysis has been completed for the site in order to determine an approximate size for the SWM block required for the development. In consultation with the Township, it was requested that a single SWM facility be provided for the Phase 2 and Phase 3 residential lands for ease of future maintenance.

4.5 Quantity Control

There are many stormwater management options available for the proposed site however for the preliminary analysis, a wet pond is being specified to provide the required quantity control. The pond will be located within the specified SWM block at the northeast of the site as shown on the **Stormwater Drainage Plan** included as **Figure 5**. GIS information was used to determine the general topography of the site which indicate that the pre-development flows drain to the northeast corner of the site to Plato Creek. The SWM block was therefore located in this low region of the site where the flows will be released from the pond at pre-development rates to Plato Creek. The location of the SWM block will necessitate modifications to the preliminary concept plan and could result in a reduction in the total amount of lots being proposed. The SWM block could be located elsewhere on the site however would require extensive regrading to the lands.

The Modified Rational Method was used to calculate the storage volume required to limit post-development flows to the pre-development levels. Supporting calculations are included in **Appendix E** and summarized in **Table 13** below.

Table 13 – Storage Requirements for PR2

Design Storm (years)	Drainage Area (ha)	Runoff Coefficient	Discharge Rate (m^3/sec)	Total Storage Required (m^3)
2	14.90	0.65	0.187	**1629.1**
5	14.90	0.65	0.254	**2212.4**
10	14.90	0.65	0.307	**2671.5**
25	14.90	0.72	0.394	**3469.7**
50	14.90	0.78	0.487	**4255.3**
100	14.90	0.81	0.553	**4803.4**

4.6 Quality Control

For the site, quality control to an "Enhanced" level can be provided through the proposed wet pond.

Per table 3.2 of the MOE SWM Planning & Design Manual, the quality storage volume requirements for a wet pond facility with 66% site imperviousness is 216 m^3/ha. Of this volume, 40 m^3/ha is extended detention while the remainder represents the permanent pool. For the entire 14.9 ha site a total of 3213 m^3 of storage is required for enhanced quality control, of which should be 2617 m^3 permanent pool and 596 m^3 extended detention.

The preliminary volume required for the SWM pond is **8,016m^3** to provide for quantity and quality control. The SWM block identified in **Figure 5** has an approximate area of **10,000m^2** which will provide adequate space to accommodate a wet pond which can be used for quantity and quality control for the proposed development.

5.0 Summary

The proposed development lands in the south part of Havelock include a mixture of residential and institutional land uses. It is expected that there will be three phases for residential homes, a Peterborough Housing Affordable Housing Development and a Long-Term Care Facility. Phase 1 of the development consists of the construction of Smith Drive and 7 residential homes, where services have already been provided. In conjunction with this phase is the construction of the Peterborough Housing Development. Phase 2 consists of the extension of Smith Drive and the construction of 23 residential homes. The construction of the Long-Term Care Facility is expected to be in a similar time frame to Phase 2. Phase 3 consists of the construction of 101 residential homes and associated roadways. To support the development of the subject lands the services available to the site were reviewed, as well as the capacities of the water and wastewater systems.

5.1 Water Servicing

Smith Drive currently has a 200mm diameter watermain which services Phase 1 and the Peterborough Housing Development. This watermain will be extended with a 200mm diameter watermain to provide service for Phase 2. Phase 3 will be serviced by connecting to the 200mm diameter watermain on County Road 30. This watermain is recommended to be looped through Phases 1 and 2 of the development to eliminate dead ends in the system and provide redundancy. The Long-Term Care Facility will be serviced from the existing 200mm diameter watermain on Old Norwood Road. The study has found that no upgrades are required to existing watermains to support the proposed development. New sections of watermain will be required to support Phase 2 and 3 of the residential development; the design and construction of these mains should be the responsibility of the developer.

The Village of Havelock water treatment system was analyzed based on actual flow data collected over the past 5 years and calculated water demands for the future development. There is adequate capacity in the drinking water system and no upgrades are required to support the proposed development.

5.2 Sanitary Servicing

Smith Drive currently has a 200mm diameter sanitary sewer which services Phase 1 and the Peterborough Housing Development. Phase 2 of the residential development will be serviced by extending this sewer into the Phase 2 lands. Phase 3 will be serviced by connecting to the 250mm diameter sanitary sewer within County Road 30. The Long Term-Care Facility will connect into the existing 200mm diameter sanitary sewer on Old Norwood Road.

The wastewater treatment plant is currently operating above its rated capacity. The additional flows from the proposed development will further exceed the capacity of the treatment plant. When comparing the average daily flows of wastewater to drinking water, it is evident that the wastewater treatment plant is experiencing an excess amount of infiltration into the system. It is recommended that the Township complete an inflow and infiltration study to determine the source of these flows and implement the required mitigation measures. It is expected that this will recover some of the capacity in the wastewater treatment plant and allow some of the near term (Phase 1) development to occur. Once these upgrades are completed, the flows at the WWTP should be monitored and the available capacity reassessed to determine when upgrades are required to the WWTP.

The existing gravity sanitary sewer system was analyzed from the proposed connection at Phase 3 to the main pumping station on Highway 7 and to the wastewater treatment plant off Old Norwood Road. Under the existing conditions, all runs of sewer are operating under 100% capacity. Under the proposed conditions, there are two sections of the existing sanitary infrastructure that are above 100% capacity and cannot accept additional flow from the future development. The section of sewer between MH115 and MH116 needs to be upgraded immediately, as prior to construction of Phase 1 it is at 98% capacity. This sewer should be replaced with 300 mm diameter sewer. Based on the way this development has occurred, the Township will need to upgrade this sewer. The section of sewer between MH113 and MH114 is required to be upgraded prior to the completion of Phase 3. This sewer should be replaced with 300 mm diameter sewer. The cost of this sewer replacement should be the responsibility of the developer of Phase 3. The remaining sections of sewer are adequate to accept future flows from the subject lands.

5.3 Stormwater Management

The proposed development of all of the lands will increase site imperviousness and increase post-development runoff rates. To mitigate these effects, a stormwater management strategy is required to provide quantity and quality controls. Phase 1, Peterborough Housing Development and Long-Term Care Facility will have individual stormwater management controls within their respective sites, therefore SWM controls are only required for Phases 2 and 3. A preliminary size and location for the stormwater management block has been established in the northeast portion of Phase 3 lands. A single pond can service both phases and is desirable to reduce the number of facilities the Township needs to be maintain. A wet pond is the most suitable facility type to provide the required quantity and quality control for Phase 2 and Phase 3 of the development. The detailed design of the pond will be the responsibility of the developer of the Phase 2 and 3 lands, however the pond should be designed to control the post-development flows to pre-development levels and to provide an Enhanced Level of quality control.

Prepared by:	Reviewed by:
Mackenzie Craig	Paul Hurley, P.Eng
EIT	Principal

Figure 2: Preliminary Concept Plan

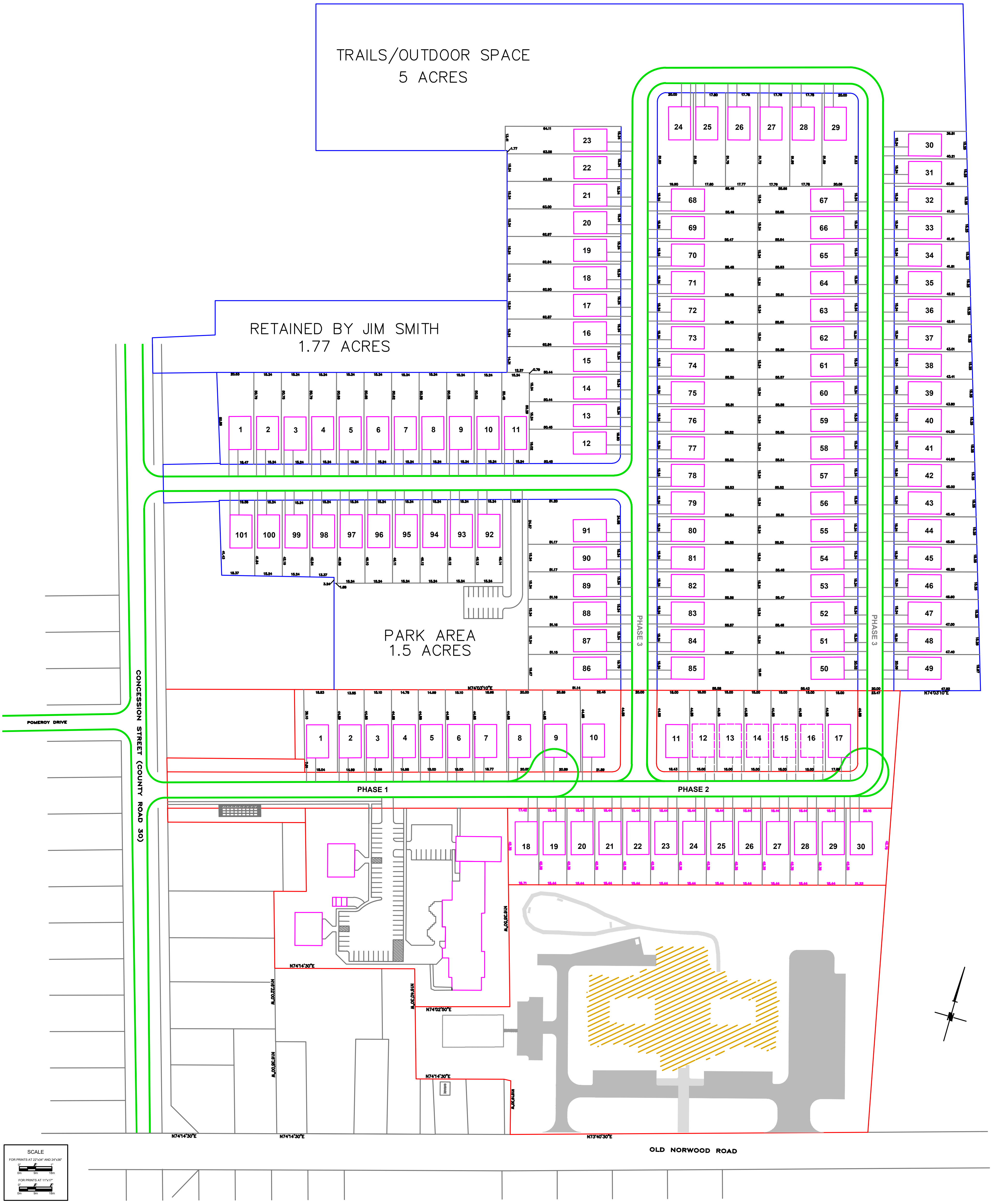
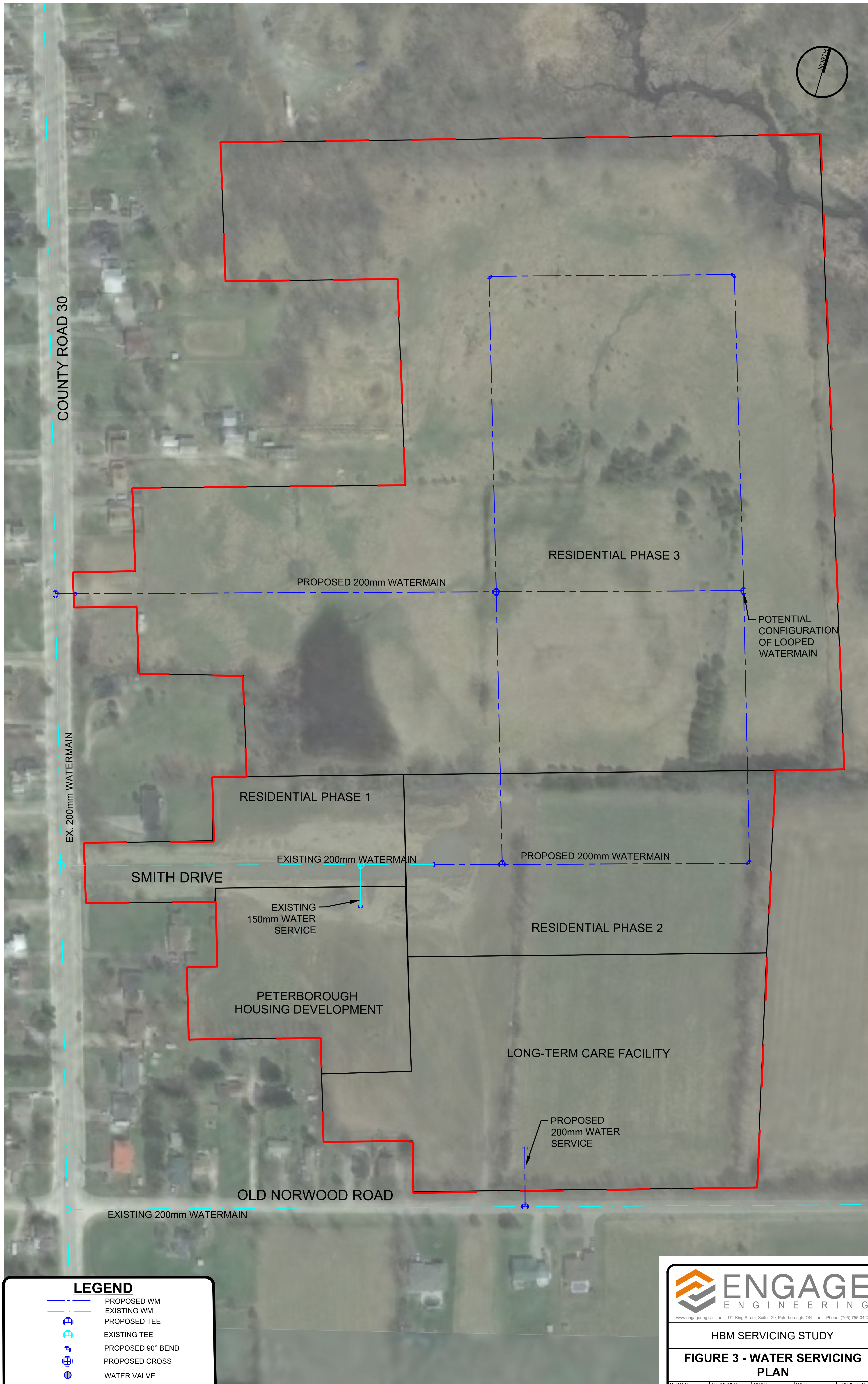

TRAILS/OUTDOOR SPACE
5 ACRES
RETAINED BY JIM SMITH
1.77 ACRES
PARK AREA
1.5 ACRES
PHASE 1
PHASE 2
PHASE 3
PHASE 3
CONCESSION STREET (COUNTY ROAD 30)
POMEROY DRIVE
OLD NORWOOD ROAD
SCALE

Figure 3: Water Distribution Plan



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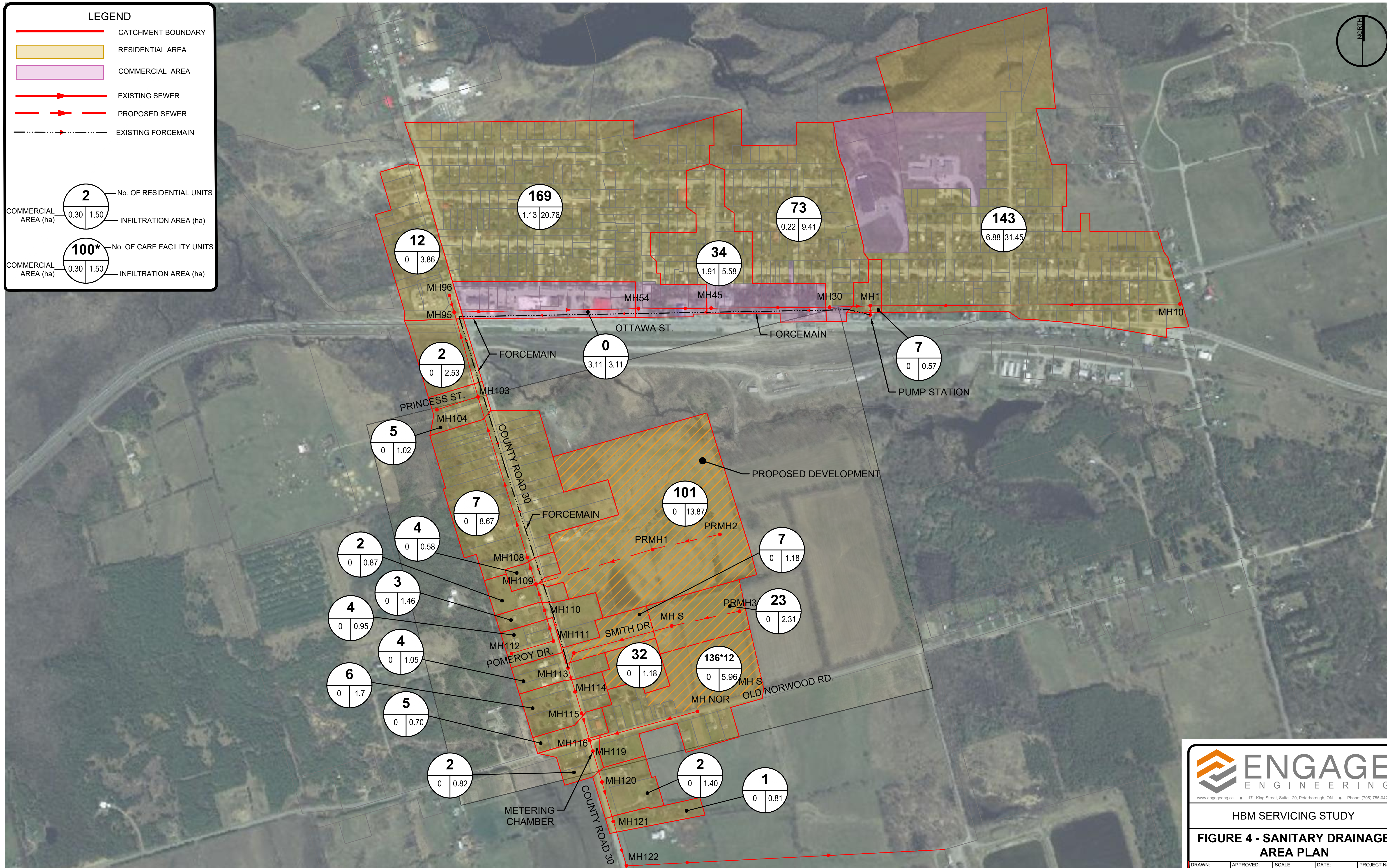
HBM SERVICING STUDY

FIGURE 3 - WATER SERVICING PLAN

DRAWN:	APPROVED:	SCALE:	DATE:	PROJECT No.:
A.FRANKLIN	P.HURLEY	1:2000	29-10-18	18039

Figure 4: Sanitary Drainage Area Plan



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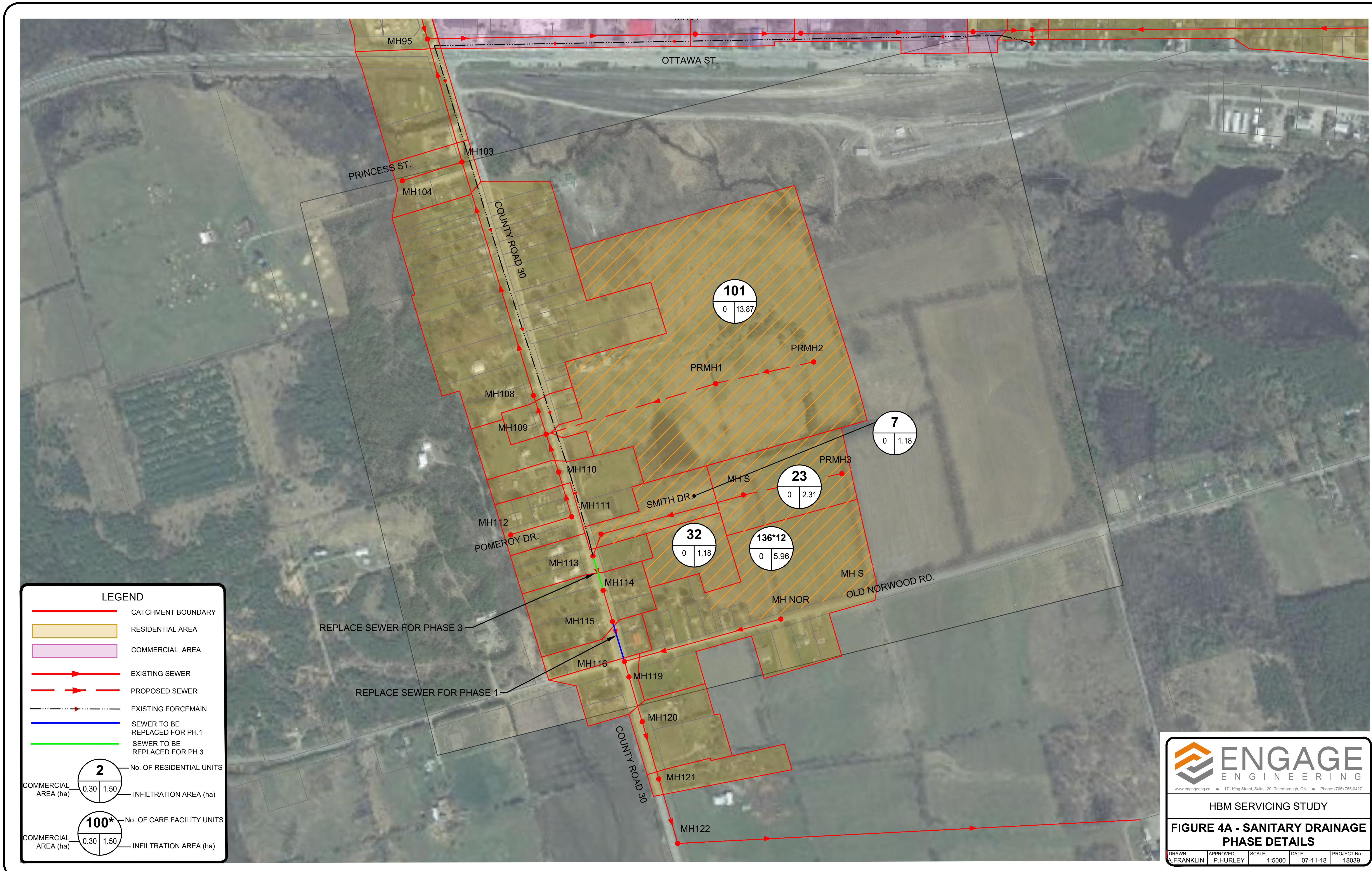
HBM SERVICING STUDY

FIGURE 4 - SANITARY DRAINAGE AREA PLAN

DRAWN:	APPROVED:	SCALE:	DATE:	PROJECT No.:
A.FRANKLIN	P.HURLEY	1:7500	29-10-18	18039

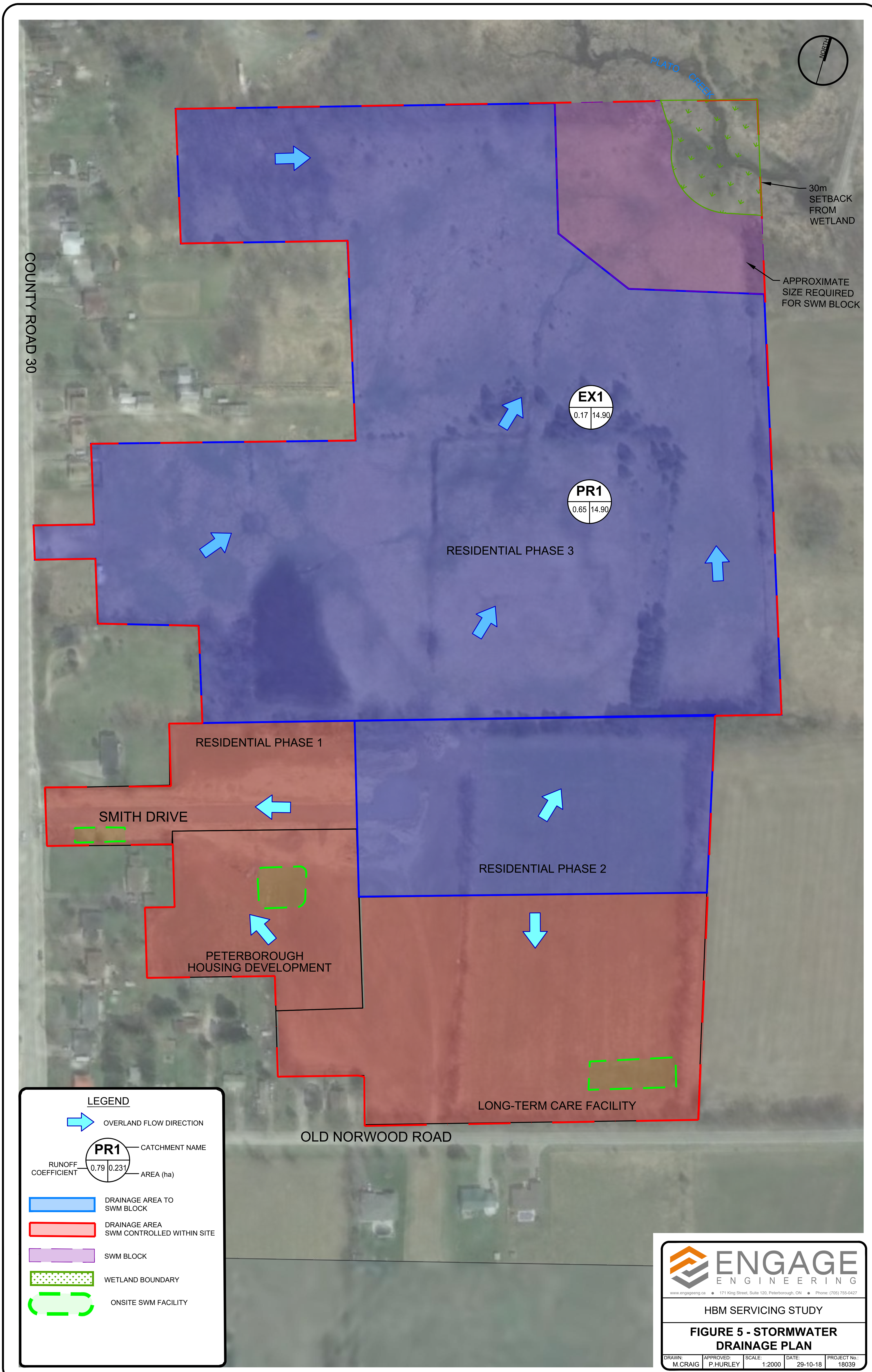
S:\01 - Projects\18000\18039 HBM Servicing Study\02 Design\01 - Drawings\Current Drawings\18039-SA1.dwg PRINTED: Nov 13, 2018

Figure 4A: Sanitary Drainage Phasing Plan



S:\01 - Projects\18000\18039 HBM Servicing Study\02 Design\01 - Drawings\Current Drawings\18039-SA1.dwg PRINTED: Nov 13, 2018

Figure 5: Stormwater Drainage Area Plan



S:\01 - Projects\18000\18039 HBM Servicing Study\02 Design\01 - Drawings\Current Drawings\18039-ST1.dwg PRINTED: Nov 07, 2018

Appendix A: As-Built Drawings

TOTTEN SIMS HUBICKI AND ASSOCIATES LTD.

CONSULTING ENGINEERS

COBOURG KINGSTON WHITBY TORONTO

1	JAN. 75	D.S.	AS CONSTRUCTED
No.	DATE	BY	REVISIONS

DESIGN J.D.H.
DRAWN B.E.
CHECKED R.B.B.
APPROVED
SCALE 1" = 400'

ONTARIO WATER RESOURCES COMMISSION

PROJECT No. 1 - 0115 - 67

VILLAGE OF HAVELOCK — SANITARY SEWERAGE SYSTEM

GENERAL PLAN

DATE SEPT.
PROJECT W.

DRAWING G1

TOTTEN SIMS HUBICKI AND ASSOCIATES LTD.
CONSULTING ENGINEERS
COBOURG KINGSTON
WHITBY TORONTO

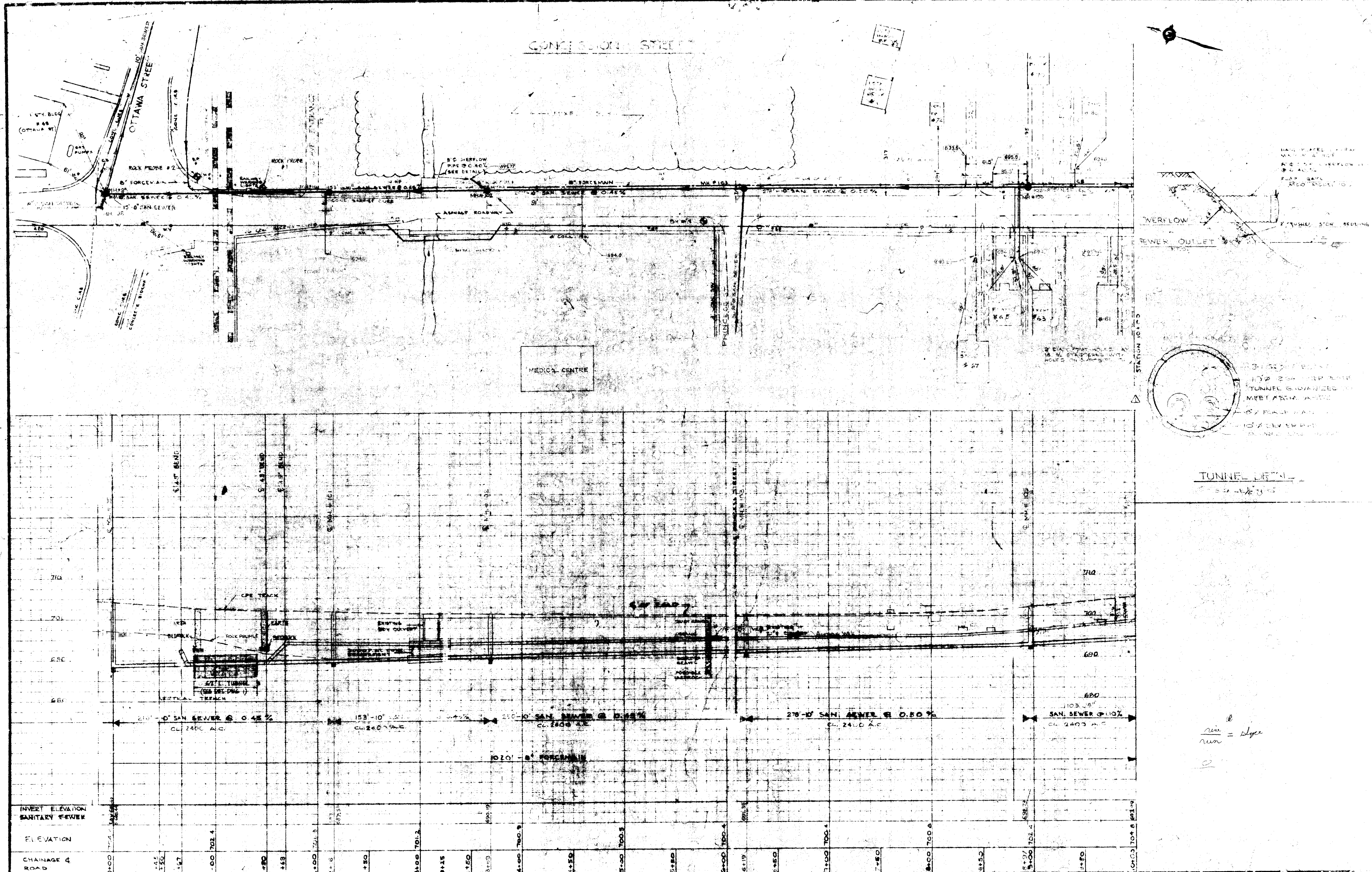
P. C. EBERLEE — CIVIL — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO
R. B. BAKER — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

No.	DATE	BY	REVISIONS
1	JAN. 75	D.S.	AS CONSTRUCTED

DESIGN J.D.H.
DRAWN B.E.
CHECKED R.B.B.
APPROVED
SCALE 1"=200'

ONTARIO WATER RESOURCES COMMISSION
PROJECT Nº 1-0115-67
VILLAGE OF HAVELOCK — SANITARY SEWERAGE SYSTEM
STABILIZATION POND — GENERAL PLAN

DATE SEPT. 73
PROJECT W417
DRAWING G2



TOTTEN SIMS HUBICKI AND ASSOCIATES LTD.

CONSULTING ENGINEERS

COBOURG KINGSTON | WHITBY TORONTO

No.	DATE	BY	REVISIONS
2	MAY 75	P.G.B.D.S.	AS CONSTRUCTED
1	16/10/73	L.R.H.	ALTERNATE TUNNEL DETAIL

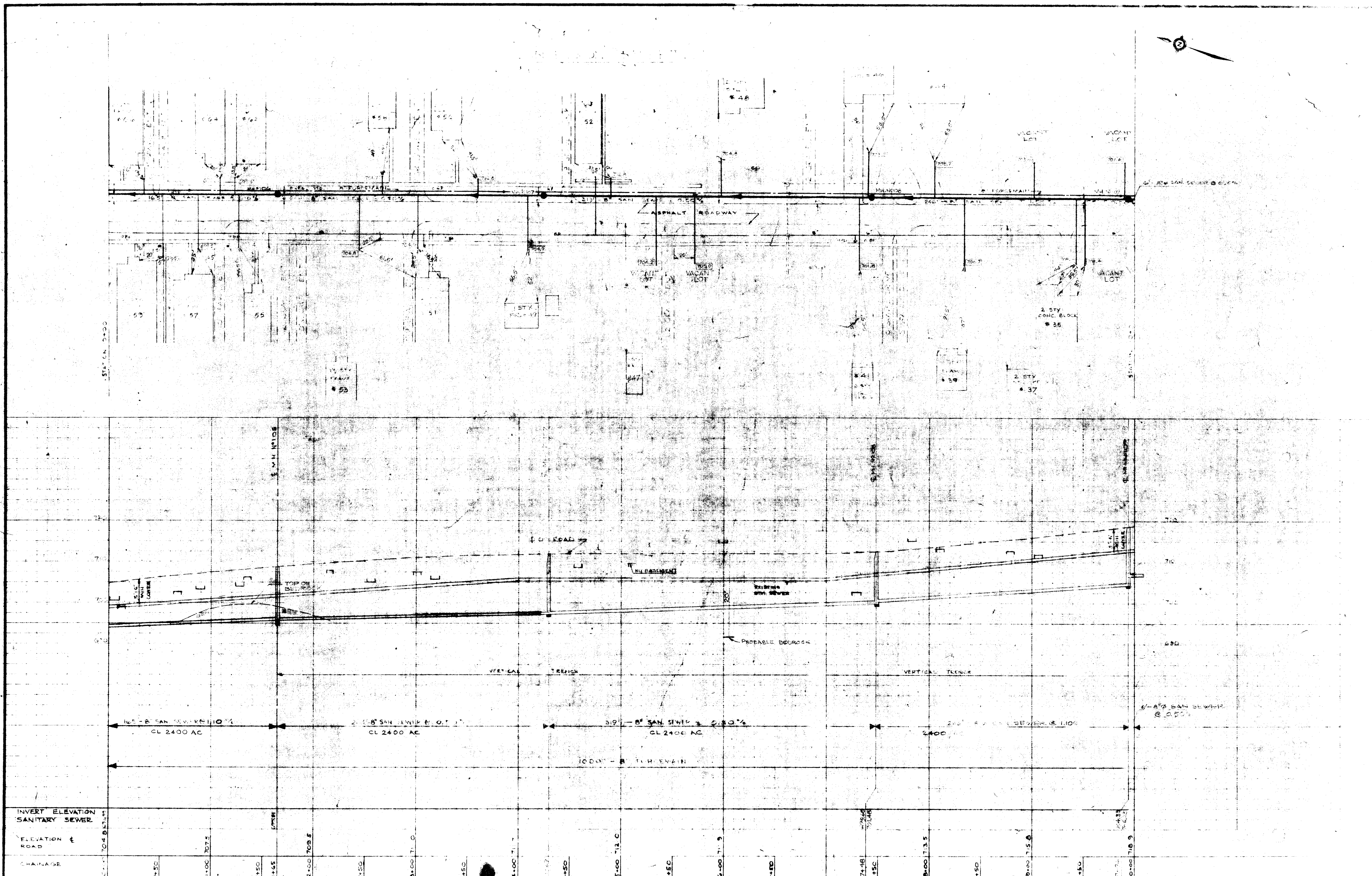
DESIGN J.D.H.
DRAWN B.E.
CHECKED R.B.B.
APPROVED
SCALE HORIZ 1" = 40' VERT 1" = 10'

ONTARIO WATER RESOURCES COMMISSION

PROJECT № 1-0115-67

VILLAGE OF HAVELOCK — SANITARY SEWERAGE SYSTEM

PLAN & PROFILE — CONCESSION ST. SOUTH 0+00 TO 10+00



TOTTEN SIMS HUBICKI AND ASSOCIATES LTD.

CONSULTING ENGINEERS

COBOURG KINGSTON

WHITBY TORONTO

No	DATE	BY	REVISIONS
1	MAY '75		AS CONSTRUCTED

DESIGN J D H
DRAWN B E
CHECKED R B B
APPROVED
SCALE HORIZ 1" = 40' VERT 1" = 10'

ONTARIO WATER RESOURCES COMMISSION

PROJECT No 1 - 0115 - 67

VILLAGE OF HAVELOCK — SANITARY SEWERAGE SYSTEM

PLAN & PROFILE — CONCESSION ST. SOUTH 10+00 TO 20+00

DRAWING 2

TOTTEN SIMS HUBICKI AND ASSOCIATES LTD.

CONSULTING ENGINEERS

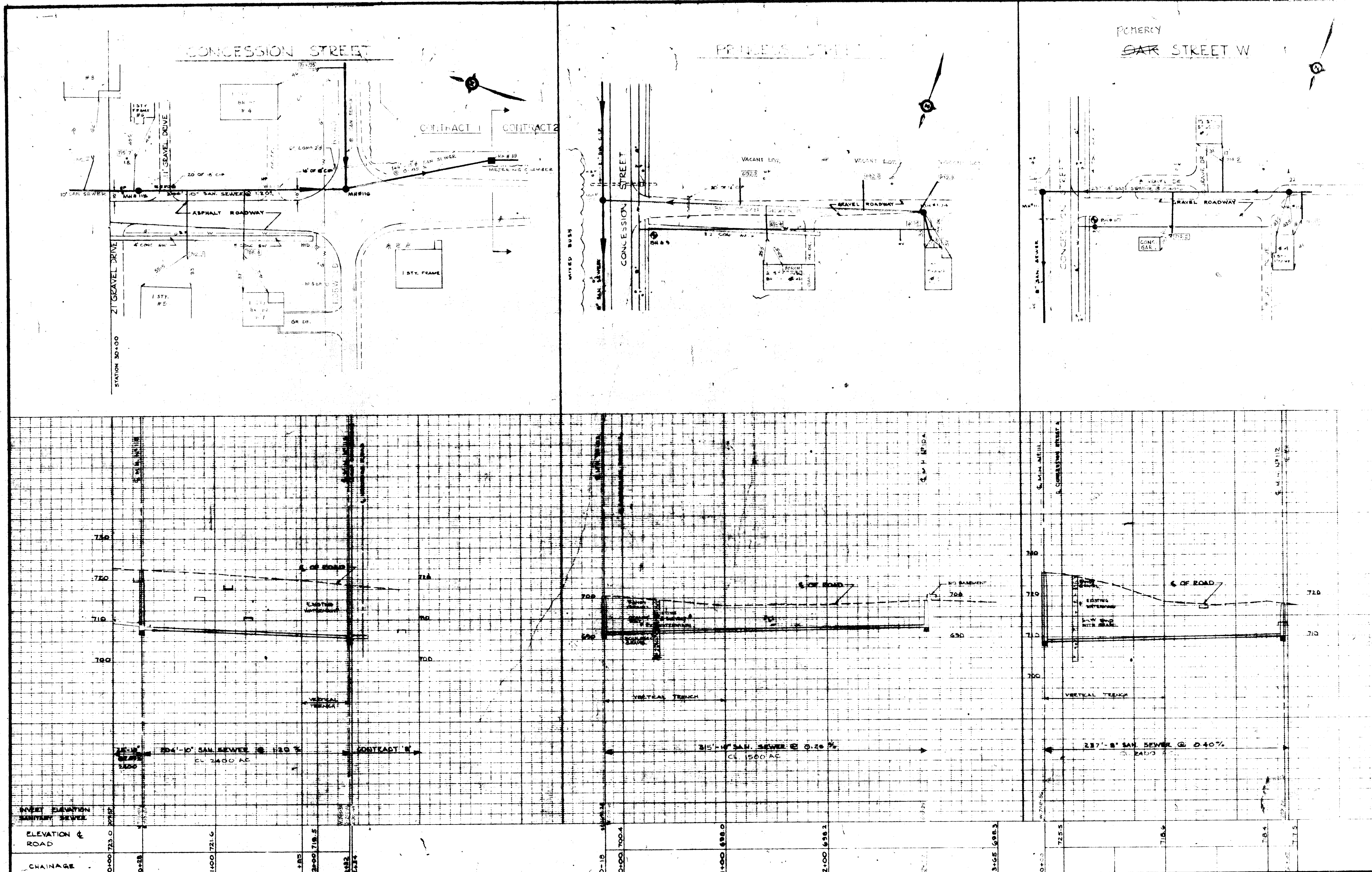
COBOURG KINGSTON WHITBY TORONTO

No	DATE	BY	REVISIONS
2	MAY '75	D.S.	AS CONSTRUCTED
1	22·1·74	V.T.	REMOVE "PROPOSED" AND ADD EXISTING TO 10" Ø SEWER STA 26+30 TO 30+00

DESIGN J.D.H.
DRAWN B.E.
CHECKED R.B.B.
APPROVED
SCALE H. 1" = 40' V. 1" = 10'

ONTARIO WATER RESOURCES COMMISSION
PROJECT No 1-0115-67
VILLAGE OF HAVELOCK — SANITARY SEWERAGE SYSTEM
PLAN & PROFILE — CONCESSION ST. SOUTH 20+00 TO 30+00

DATE SEPT
PROJECT W
DRAWING 3



TOTTEN SIMS HUBICKI AND ASSOCIATES LTD.

CONSULTING ENGINEERS

COBOURG KINGSTON **WHITBY TORONTO**

No.	DATE	BY	REVISIONS
1	MAY '75	K.D.M.	AS CONSTRUCTED

DESIGN J.D.H.
DRAWN B.E.
CHECKED R.B.B.
APPROVED
SCALE H. - 40' V - 10'

ONTARIO WATER RESOURCES COMMISSION

PROJECT № 1-0115-67

VILLAGE OF HAVELOCK — SANITARY SEWERAGE SYSTEM

PLAN & PROFILE — CONCESSION STREET SOUTH 30+00 TO 32+32
PRINCESS STREET 0-18 TO 2+97
OAK STREET WEST 0+00 TO 2+37

DATE SEPT. 7?
PROJECT W 417
DRAWING 4

COUNTY ROAD No. 30

WATER VALVE LOCATIONS	
STATION	LOCATION
0+093.32	5.13m RT OF CL
0+160.76	1.75m LT OF CL
0+164.76	15.28m RT OF CL
0+180.89	1.75m LT OF CL

GENERAL CONSTRUCTION NOTE:

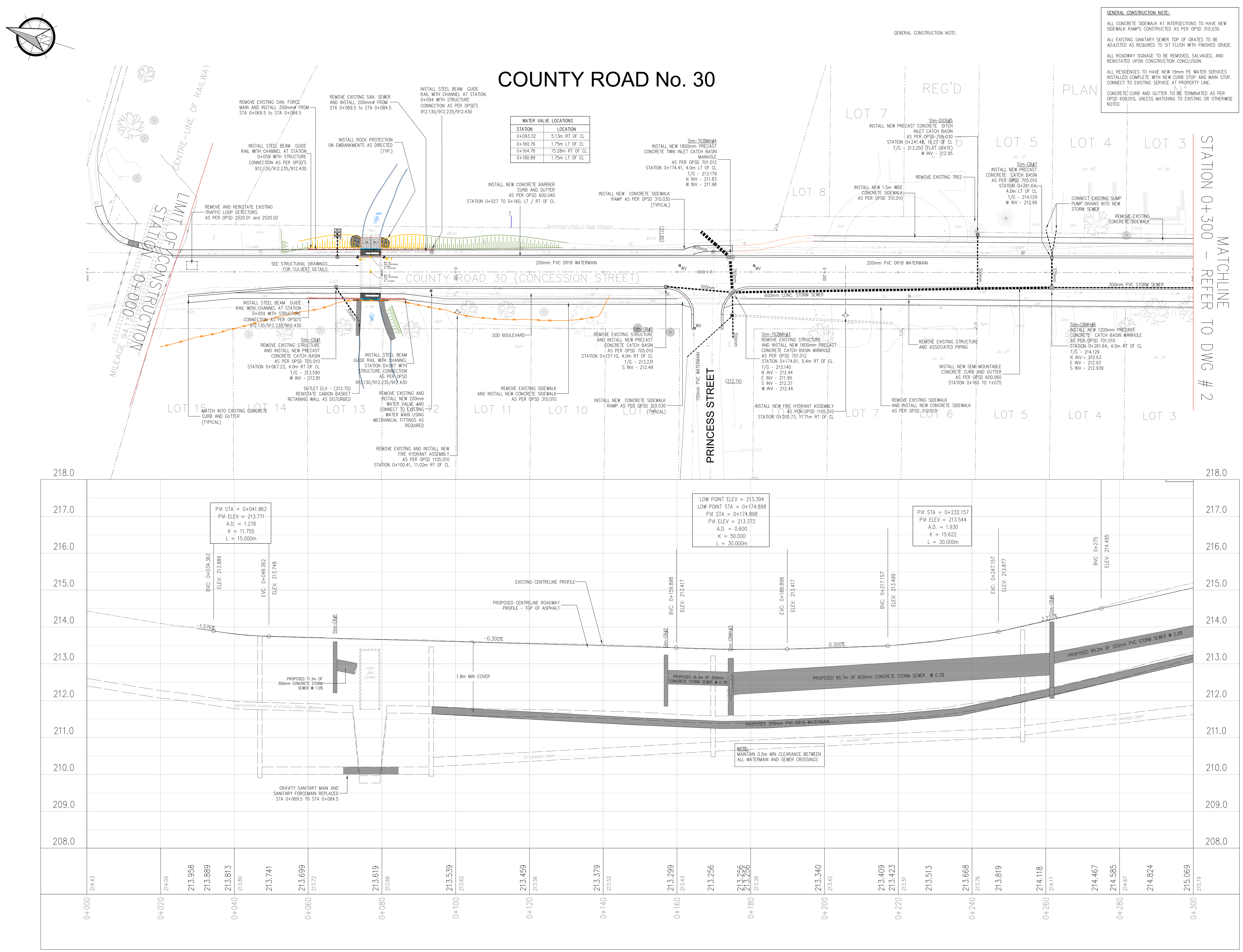
ALL CONCRETE SIDEWALK AT INTERSECTIONS TO HAVE NEW SIDEWALK RAMPS CONSTRUCTED AS PER OPSD 310.030.

ALL EXISTING SANITARY SEWER TOP OF GRATES TO BE ADJUSTED AS REQUIRED TO SIT FLUSH WITH FINISHED GRADE.

ALL ROADWAY SIGNAGE TO BE REMOVED, SALVAGED, AND REINSTATED UPON CONSTRUCTION CONCLUSION.

ALL RESIDENCES TO HAVE NEW 19mm PE WATER SERVICES INSTALLED COMPLETE WITH NEW CURB STOP AND MAIN STOP. CONNECT TO EXISTING SERVICE AT PROPERTY LINE.

CONCRETE CURB AND GUTTER TO BE TERMINATED AS PER OPSD 608.010, UNLESS MATCHING TO EXISTING OR OTHERWISE NOTED.



GENERAL NOTES:

ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.

ALL UTILITY LOCATIONS SHOWN ON THE DRAWINGS ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM THE LOCATION ON SITE AND ASSUME ALL LIABILITY FOR DAMAGE TO ALL UTILITIES.

EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

ALL DIMENSIONS SHOWN ARE IN METRES OR MILLIMETRES UNLESS OTHERWISE NOTED.

** DRAWINGS ARE NOT TO BE SCALED **

R E V I S I O N S

No.	Date	Description	By
1	05/14/12	REVISED AS PER CLIENT COMMENTS - ISSUED FOR PIC	
2	06/21/12	ISSUED FOR COUNTY REVIEW	
3	06/27/12	ISSUED FOR TENDER	
4	09/18/12	REVISED VERTICAL ALIGNMENT	
5	10/21/13	AS BUILT DRAWINGS	

EXISTING | DESCRIPTION | PROPOSED

SPOT ELEVATION
WATERMAIN
SANITARY SEWER
STORM SEWER
DITCH
SANITARY MANHOLE
STORM MANHOLE
CATCH BASIN
FIRE HYDRANT AND VALVE
CURB STOP
WATER GATE VALVE
BLOW-OFF ASSEMBLY
UTILITY POLE
UTILITY POLE ANCHOR
LIGHT STANDARD
VEGETATION
SIGNAGE
DECIDUOUS TREE
CONIFEROUS TREE

COUNTY OF PETERBOROUGH

Township of HAVELOCK-BELMONT-METHUEN

REGISTERED PROFESSIONAL ENGINEER 06/27/12 G.D. Jewell PROVINCE OF ONTARIO

G.D. JEWELL ENGINEERING INC.
CONSULTING ENGINEERS

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FAX: (613) 389-2754
Email: kingston@jewelleng.ca

BELLEVILLE
TEL: (613) 969-1111
FAX: (613) 969-8988
Email: info@jewelleng.ca

MISSISSAUGA
TEL: (905) 855-1592
FAX: (905) 855-5428
Email: mississauga@jewelleng.ca

TOLL FREE 1-800-966-4338
www.jewelleng.ca

COUNTY OF PETERBOROUGH
RECONSTRUCTION OF COUNTY ROAD 30

CONTRACT No. T-16-2012

PLAN AND PROFILE
STATION 0+000 TO 0+300

Drawn by: PMS/SM/DFM
Project No: 1103175
Designed by: JWF / PMS
Date: OCTOBER 2013
Checked by: JWF
Scale - Hor: 1:500
Vert: 1:50
Approved by:
Contract No: T-16-2012
Drawing No: 1

COUNTY ROAD No. 30

GENERAL CONSTRUCTION NOTE:

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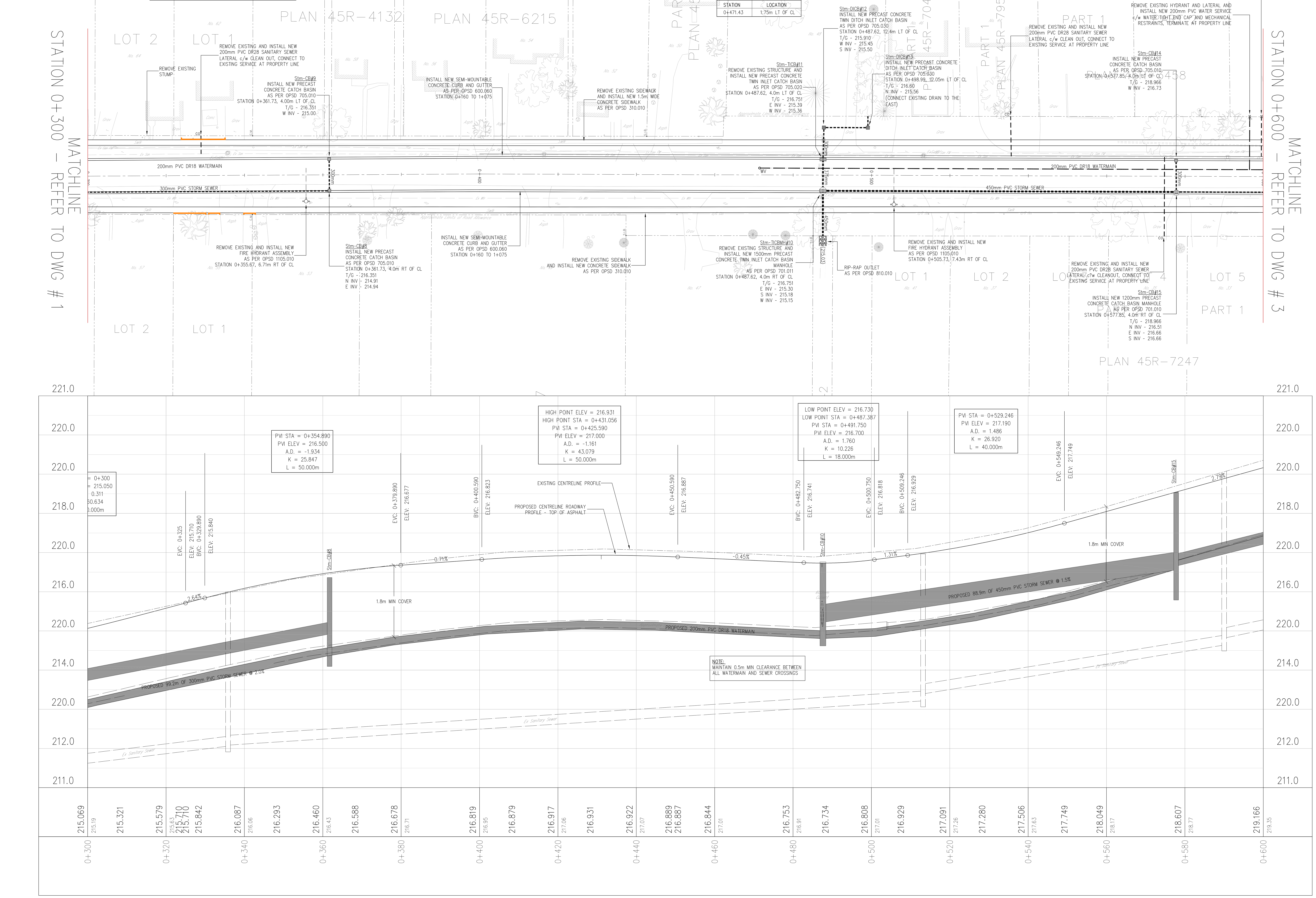

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R E V I S I O N S

No.	Date	Description	By
1	05/14/12	REVISED AS PER CLIENT COMMENTS - ISSUED FOR PIC	
2	06/21/12	ISSUED FOR COUNTY REVIEW	
3	06/27/12	ISSUED FOR TENDER	
4	10/21/13	AS BUILT DRAWINGS	

EXISTING | DESCRIPTION | PROPOSED

SPOT ELEVATION
WATERMAIN
SANITARY SEWER
STORM SEWER
DITCH
SANITARY MANHOLE
STORM MANHOLE
CATCH BASIN
FIRE HYDRANT AND VALVE
CURB STOP
WATER GATE VALVE
BLOW-OFF ASSEMBLY
UTILITY POLE
UTILITY POLE ANCHOR
LIGHT STANDARD
VEGETATION
SIGNAGE
DECIDUOUS TREE
CONIFEROUS TREE

COUNTY OF PETERBOROUGH

Township of HAVELOCK • BELMONT • METHUEN

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BELLEVILLE: TEL: (613) 969-1111 FAX: (613) 969-8988 Email: info@jewelleng.ca
MISSISSAUGA: TEL: (905) 855-1592 FAX: (905) 855-5428 Email: mississauga@jewelleng.ca

TOLL FREE 1-800-966-4338
www.jewelleng.ca

COUNTY OF PETERBOROUGH
RECONSTRUCTION OF COUNTY ROAD 30

CONTRACT No. T-16-2012

PLAN AND PROFILE
STATION 0+300 TO 0+600

Drawn by: PMS/SM/DFM	Project No: 1103175
Designed by: JWF / PMS	Date: OCTOBER 2013
Checked by: JWF	Scale - Hor: 1:500 Vert: 1:50
Approved by:	Contract No: T-16-2012 Drawing No: 2

COUNTY ROAD No. 30

GENERAL CONSTRUCTION NOTE:

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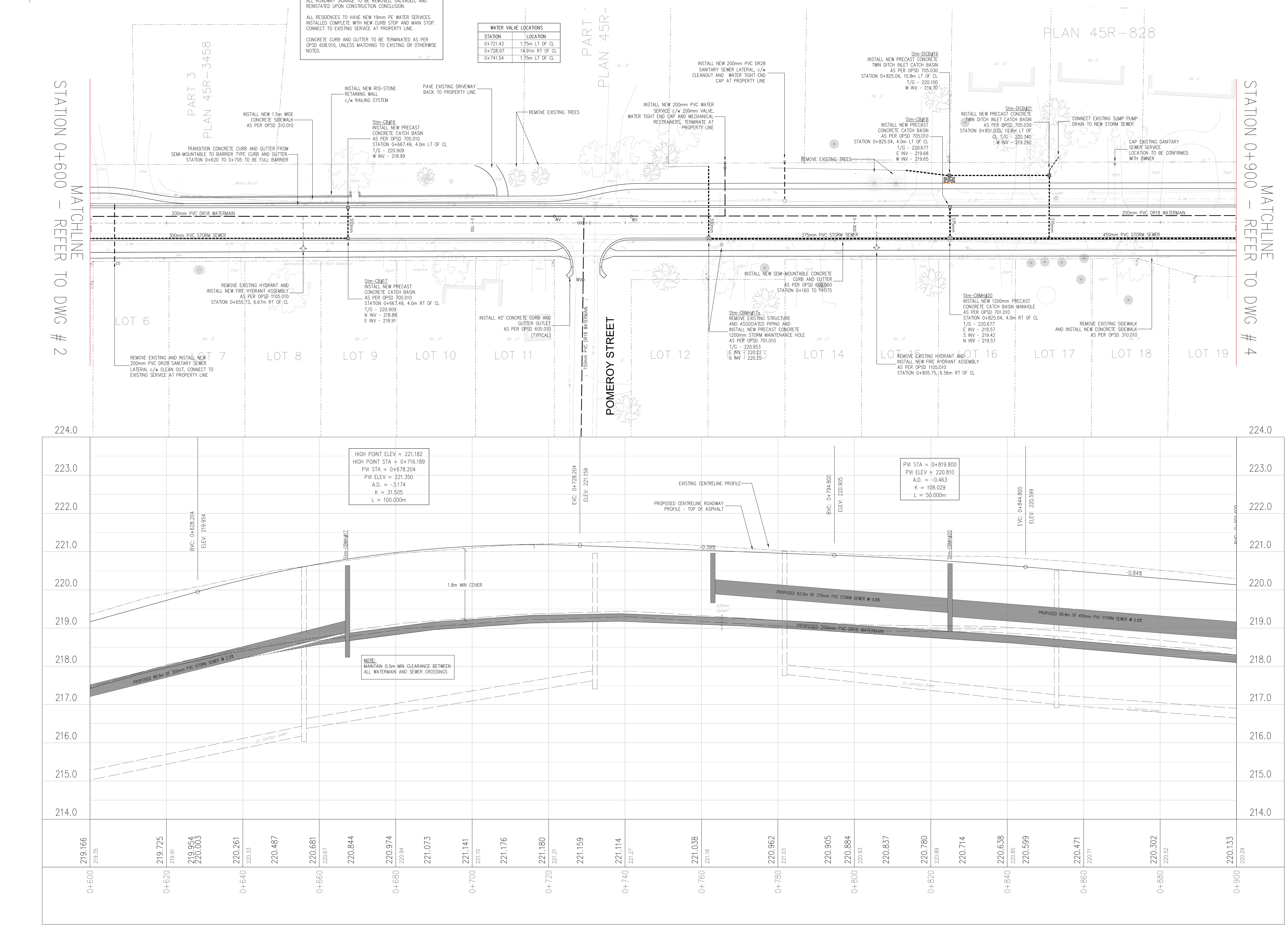
WATER VALVE LOCATIONS	
STATION	LOCATION
0+721.43	1.75m LT OF CL
0+728.97	14.91m RT OF CL
0+741.54	1.75m LT OF CL



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2	06/21/12	ISSUED FOR COUNTY REVIEW	
3	06/27/12	ISSUED FOR TENDER	
4	10/21/13	AS BUILT DRAWINGS	

EXISTING	DESCRIPTION	PROPOSED
110.250	SPOT ELEVATION	(110.250)
Ex. WATERMAIN	WATERMAIN	WATERMAIN
Ex. SANITARY SEWER	SANITARY SEWER	SANITARY SEWER
	STORM SEWER	
	DITCH	
	SANITARY MANHOLE	
	STORM MANHOLE	
	CATCH BASIN	
	FIRE HYDRANT AND VALVE	
	CURB STOP	
	WATER GATE VALVE	
	BLOW-OFF ASSEMBLY	
	UTILITY POLE	
	UTILITY POLE ANCHOR	
	LIGHT STANDARD	
	VEGETATION	
	SIGNAGE	
	DECIDUOUS TREE	
	CONIFEROUS TREE	

COUNTY OF PETERBOROUGH

Township of HAVELOCK · BELMONT · METHUEN

REGISTERED PROFESSIONAL ENGINEER
06/27/12
G.D. Jewell
PROVINCE OF ONTARIO

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TEL: (905) 855-1592
FAX: (905) 855-5428
Email: mississauga@jewelleng.ca

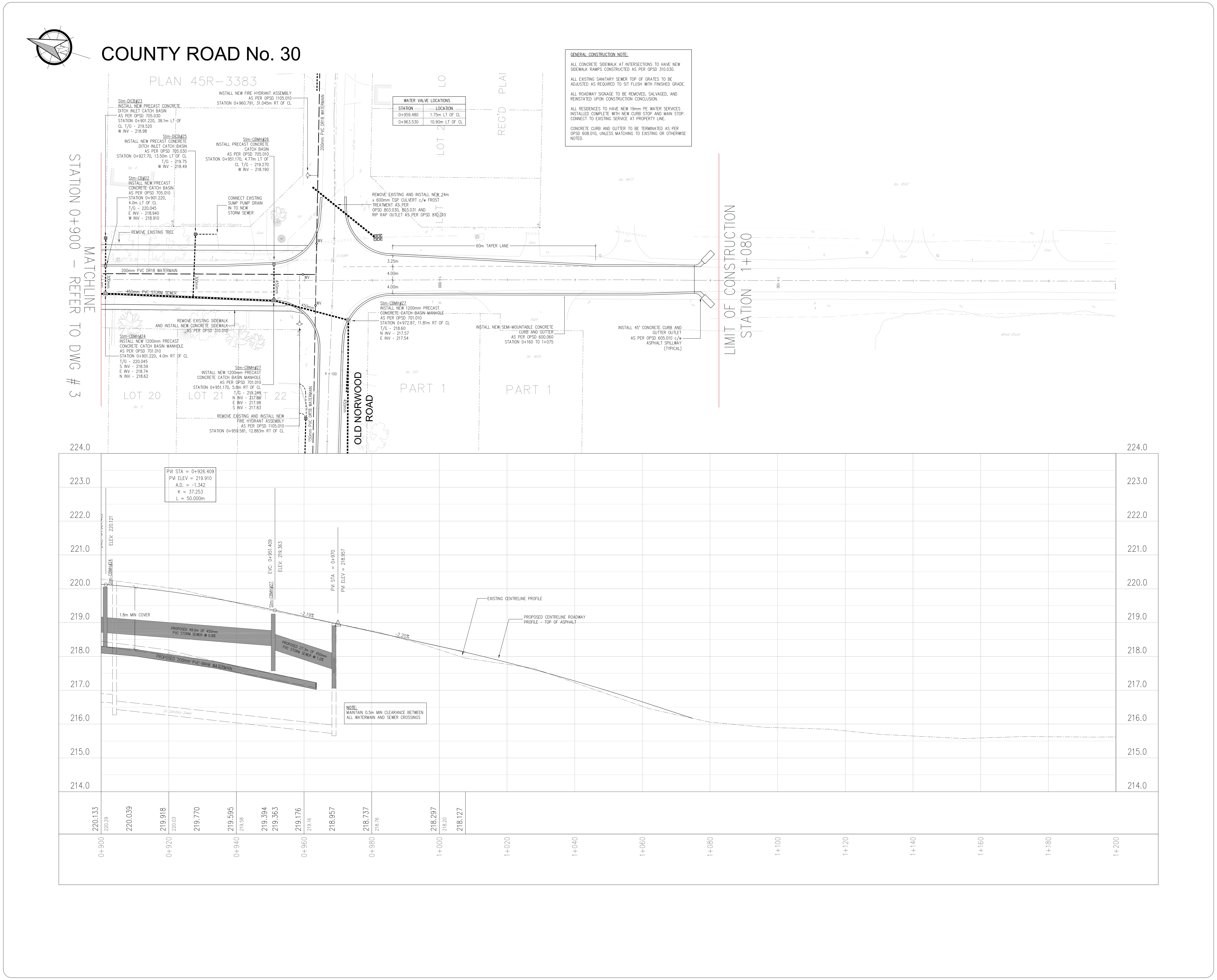
TOLL FREE 1-800-966-4336
www.jewelleng.ca

COUNTY OF PETERBOROUGH
RECONSTRUCTION OF COUNTY ROAD 30

CONTRACT No. T-16-2012

PLAN AND PROFILE
STATION 0+600 TO 0+900

Drawn by: PMS/SM/DFM	Project No: 1103175
Designed by: JWF / PMS	Date: OCTOBER 2013
Checked by: JWF	Scale - Hor: 1:500 Vert: 1:50
Approved by:	Contract No: T-16-2012 Drawing No: 3



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R E V I S I O N S

No.	Date	Description	By
1	05/14/12	REVISED AS PER CLIENT COMMENTS - ISSUED FOR PIC	
2	06/21/12	ISSUED FOR COUNTY REVIEW	
3	06/27/12	ISSUED FOR TENDER	
4	10/21/13	AS BUILT DRAWINGS	

EXISTING	DESCRIPTION	PROPOSED
	SPOT ELEVATION	
	WATERMAIN	
	SANITARY SEWER	
	STORM SEWER	
	DITCH	
	SANITARY MANHOLE	
	STORM MANHOLE	
	CATCH BASIN	
	FIRE HYDRANT AND VALVE	
	CURB STOP	
	WATER GATE VALVE	
	BLOW-OFF ASSEMBLY	
	UTILITY POLE	
	UTILITY POLE ANCHOR	
	LIGHT STANDARD	
	VEGETATION	
	SIGNAGE	
	DECIDUOUS TREE	
	CONIFEROUS TREE	

COUNTY OF PETERBOROUGH

Township of HAVELOCK·BELMONT·METHUEN

REGISTERED PROFESSIONAL ENGINEER 06/27/12 G.D. Jewell PROVINCE OF ONTARIO

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www.jewelleng.ca

COUNTY OF PETERBOROUGH
RECONSTRUCTION OF COUNTY ROAD 30

CONTRACT No. T-16-2012

PLAN AND PROFILE
STATION 0+900 TO 1+000

Drawn by: PMS/SM/DFM	Project No: 1103175
Designed by: JWF / PMS	Date: OCTOBER 2013
Checked by: JWF	Scale - Hor: 1:500 Vert: 1:50
Approved by:	Contract No: T-16-2012 Drawing No: 4

Appendix B: Recorded Havelock Water Consumption and Wastewater Flow Data

From:	Mackenzie Craig
To:	Mackenzie Craig
Subject:	RE: 18039 - HBM Servicing Study - Information Request
Date:	November 5, 2018 8:37:07 AM

From: Jessica Cronkright <JCronkright@ocwa.com>
Sent: Wednesday, September 26, 2018 8:38 AM
To: Paul Hurley <paul@engageeng.ca>
Cc: Pat Kemp <PKemp@hbmtwp.ca>; Amber Bevan <ABevan@ocwa.com>
Subject: 18039 - HBM Servicing Study - Information Request

Good Morning Paul,

Please find attached the requested information for The Township of Havelock;

1. Existing capacity of the water treatment plant and water tower
   - Water Treatment Plant Well 1&4 – **1,020 m3/day**, Well 3 – **1,313 m3/day**
   - Water Tower – **1,276 m3/day**
2. Historical flow data (average and max daily) for the water treatment plant
   - Attached (Havelock Water Treatment Plant Flow Data 2013-2018)
3. Capacity for the wastewater treatment plant
   - Wastewater Treatment Plant – **1,200 m3/day**
4. Flow data (average and max daily) for the wastewater treatment plant
   - Attached (Havelock Wastewater Treatment Plant Flow Data 2013-2018)
5. Capacity and flow data for the main pumping station at Hwy 7
   - Rated Capacity for the sewage pump is **31 L/s**

If you have anything further please let me know ☺

Thank you,

Jessica Cronkright
Process & Compliance Technician
Ontario Clean Water Agency, Kawartha Trent Hub
T: 613-962-5454 *23
C: 613-848-0611
E: jcronkright@ocwa.com

Average Yearly Flows

	Well 1 & 4 Flow (m^3)		Well 3 Flow (m3)			Well 1&4&3 (m3)	Well 1&4&3 (m3)
	Average Flow	Max Flow	Average Flow	Max Flow		Total Average Flow	Total Max Flow
2013	458	586	67	157		525	743
2014	549	663	28	112		577	775
2015	649	748	11	74		660	822
2016	615	733	3	42		618	775
2017	550	668	0	3		550	671
2018	607	731	0	2		607	733
5-year Average	571	688	18	65		589	753
5-Year Max	649	748	67	157		660	822

Average Yearly Flows

	Average Flow	Max Flow
2013	683	816
2014	756	930
2015	688	847
2016	743	916
2017	957	1282
2018	1314	1659
5-year Average	857	1075
5-Year Max	1314	1659

Appendix C: Water Demand Calculations

Water Demand

ENGAGE ENGINEERING

Project Name: HBM Servicing Study
Project No: 18039
Designed By: MC
Date: 2018-10-30

Residential Phases 1, 2 & 3

Design Criteria			
Domestic Water Demand:	450	L/p/day	A
No. of Units (Single Family):	130		B
No. of Persons/Unit (Single Family):	3.5	p/unit	C
Max. Day Peak Factor (MOE):	2.50		D
Peak Hour Peak Factor (MOE):	3.75		E
Fire Flow:	2,000	L/min	F

Calculations

Average Day Demand				
	Q_{AVG}	=	A x B x C	
		=	204750	L/day
		=	142.2	L/min
		=	204.8	m^3/day
Maximum Day Demand				
	Q_{MDD}	=	Q_{AVG} x D	
		=	511875	L/day
		=	355.5	L/min
		=	511.9	m^3/day
Peak Hour Demand				
	Q_{PHD}	=	Q_{AVG} x E	
		=	767813	L/day
		=	533.2	L/min
		=	767.8	m^3/day
Total Demand (MDD + Fire Flow)				
	Q_{TD}	=	Q_{MDD} + F	
		=	3391875	L/day
		=	2355.5	L/min
		=	**3391.9**	**m^3/day**

Water Demand

ENGAGE ENGINEERING

Project Name:	HBM Servicing Study	**Designed By:**	MC
Project No:	18039	**Date:**	2018-10-30

Peterborough Housing Development

Design Criteria			
Domestic Water Demand:	450	L/p/day	A
No. of Units (Apartment):	32		B
No. of Persons/Unit (Apartment):	2.0	p/unit	C
Max. Day Peak Factor (MOE):	2.50		D
Peak Hour Peak Factor (MOE):	3.75		E
Fire Flow:	2,000	L/min	F

Calculations

Average Day Demand				
	Q_{AVG}	=	A x B x C	
		=	28800	L/day
		=	20.0	L/min
		=	28.8	m³/day
Maximum Day Demand				
	Q_{MDD}	=	Q_{AVG} x D	
		=	72000	L/day
		=	50.0	L/min
		=	72.0	m³/day
Peak Hour Demand				
	Q_{PHD}	=	Q_{AVG} x E	
		=	108000	L/day
		=	75.0	L/min
		=	108.0	m³/day
Total Demand (MDD + Fire Flow)				
	Q_{TD}	=	Q_{MDD} + F	
		=	2952000	L/day
		=	2050.0	L/min
		=	**2952.0**	**m³/day**

Water Demand

Project Name:	HBM Servicing Study	**Designed By:**	MC
Project No:	18039	**Date:**	2018-10-30

Long-Term Care Facility

Design Criteria			
Domestic Water Demand:	450	L/p/day	A
No. of Long-Term Care Beds:	136		B
No. of Persons/Unit:	1.0	p/unit	C
Max. Day Peak Factor (MOE):	2.50		D
Peak Hour Peak Factor (MOE):	3.75		E
Fire Flow:	2,000	L/min	F

Calculations

Average Day Demand

Q_{AVG}	=	A x B x C	
	=	61200	L/day
	=	42.5	L/min
	=	61.2	m^3/day

Maximum Day Demand

Q_{MDD}	=	Q_{AVG} x D	
	=	153000	L/day
	=	106.3	L/min
	=	153.0	m^3/day

Peak Hour Demand

Q_{PHD}	=	Q_{AVG} x E	
	=	229500	L/day
	=	159.4	L/min
	=	229.5	m^3/day

Total Demand (MDD + Fire Flow)

Q_{TD}	=	Q_{MDD} + F	
	=	3033000	L/day
	=	2106.3	L/min
	=	**3033.0**	**m^3/day**

Appendix D: Sanitary Flow Calculations & Sewer Design Sheets

Sewage Flows

Project Name:	HBM Servicing Study		**Designed By:**	MC
Project No:	18039		**Date:**	2018-10-31

Residential Phase 1

Design Criteria			
Residential Sewage Flows:	450	L/p/day	A
No. of Units (Single Family):	7	units	B
No. of Persons/Unit (Single Family):	3.5	PPU	C
Draiange Area:	1.01	ha	D
Inflow and Infiltration Rate	0.28	L/s/ha	E

Calculations

Peaking Factor

K_H = 1+(14 / 4+(B*C)^1/2)

K_H = 4.37

Residential Sewage Flows

F_{RES} = (B x C)*A

= 11025 L/day

= 0.13 L/s

Peaked Residential Sewage Flows

F_{PEAK} = (B x C)*A*K_H

= 48157 L/day

= 0.56 L/s

Inflow and Infiltration Flows

$F_{I\&I}$ = D x E

= 24434 L/day

= 0.28 L/s

Total Proposed Sewage Flows

F_{TOT} = F_{PEAK} + $F_{I\&I}$

= 72591 L/day

= 0.84 L/s

= **72.59** **m^3/day**

Sewage Flows

Project Name:	HBM Servicing Study	**Designed By:**	MC
Project No:	18039	**Date:**	2018-10-31

Residential Phase 2

Design Criteria			
Residential Sewage Flows:	450	L/p/day	A
No. of Units (Single Family):	23	units	B
No. of Persons/Unit (Single Family):	3.5	PPU	C
Draiange Area:	2.3	ha	D
Inflow and Infiltration Rate	0.28	L/s/ha	E

Calculations

Peaking Factor

K_H = 1+(14 / 4+(B*C)^1/2)

K_H = 4.27

Residential Sewage Flows

F_{RES} = (B x C)*A

= 36225 L/day

= 0.42 L/s

Peaked Residential Sewage Flows

F_{PEAK} = (B x C)*A*K_H

= 154608 L/day

= 1.79 L/s

Inflow and Infiltration Flows

$F_{I\&I}$ = D x E

= 55642 L/day

= 0.64 L/s

Total Proposed Sewage Flows

F_{TOT} = F_{PEAK} + $F_{I\&I}$

= 210250 L/day

= 2.43 L/s

= **210.25** **m^3/day**

Sewage Flows

ENGAGE ENGINEERING

Project Name:	HBM Servicing Study	**Designed By:**	MC
Project No:	18039	**Date:**	2018-10-31

Residential Phase 3

Design Criteria				
Residential Sewage Flows:		450	L/p/day	A
No. of Units (Single Family):		101	units	B
No. of Persons/Unit (Single Family):		3.5	PPU	C
Draiange Area:		12.6	ha	D
Inflow and Infiltration Rate		0.28	L/s/ha	E
Calculations				
Peaking Factor				
K_H	=	1+(14 / 4+(B*C)^1/2)		
K_H	=	4.05		
Residential Sewage Flows				
F_{RES}	=	(B x C)*A		
	=	159075	L/day	
	=	1.84	L/s	
Peaked Residential Sewage Flows				
F_{PEAK}	=	(B x C)*A*K_H		
	=	643777	L/day	
	=	7.45	L/s	
Inflow and Infiltration Flows				
$F_{I\&I}$	=	D x E		
	=	304819	L/day	
	=	3.53	L/s	
Total Proposed Sewage Flows				
F_{TOT}	=	F_{PEAK} + $F_{I\&I}$		
	=	948596	L/day	
	=	10.98	L/s	
	=	**948.60**	**m^3/day**	

Sewage Flows

Project Name:	HBM Servicing Study		**Designed By:**	MC
Project No:	18039		**Date:**	2018-10-31
Peterborough Housing				

Design Criteria			
Residential Sewage Flows:	450	L/p/day	A
No. of Units (Single Bed Rooms):	32	units	B
No. of Persons/Unit (Single Bed Rooms):	2.0	PPU	C
Draiange Area:	1.17	ha	D
Inflow and Infiltration Rate	0.28	L/s/ha	E

Calculations

Peaking Factor

K_H = 1+(14 / 4+(B*C)^1/2)

K_H = 4.29

Residential Sewage Flows

F_{RES} = (B x C)*A

= 28800 L/day

= 0.33 L/s

Peaked Residential Sewage Flows

F_{PEAK} = (B x C)*A*K_H

= 123610 L/day

= 1.43 L/s

Inflow and Infiltration Flows

$F_{I\&I}$ = D x E

= 28305 L/day

= 0.33 L/s

Total Proposed Sewage Flows

F_{TOT} = F_{PEAK} + $F_{I\&I}$

= 151914 L/day

= 1.76 L/s

= **151.91** **m^3/day**

Sewage Flows

Project Name:	HBM Servicing Study	**Designed By:**	MC
Project No:	18039	**Date:**	2018-10-31

HLTC

Design Criteria			
Residential Sewage Flows:	450	L/p/day	A
No. of Units (Single Bed Rooms):	136	units	B
No. of Persons/Unit (Single Bed Rooms):	1.0	PPU	C
Draiange Area:	3.05	ha	D
Inflow and Infiltration Rate	0.28	L/s/ha	E

Calculations

Peaking Factor

K_H = 1+(14 / 4+(B*C)^1/2)

K_H = 4.21

Residential Sewage Flows

F_{RES} = (B x C)*A

= 61200 L/day

= 0.71 L/s

Peaked Residential Sewage Flows

F_{PEAK} = (B x C)*A*K_H

= 257346 L/day

= 2.98 L/s

Inflow and Infiltration Flows

$F_{I\&I}$ = D x E

= 73786 L/day

= 0.85 L/s

Total Proposed Sewage Flows

F_{TOT} = F_{PEAK} + $F_{I\&I}$

= 331132 L/day

= 3.83 L/s

= **331.13 m^3/day**

Existing Sanitary Sewer Design Sheet

ENGAGE ENGINEERING

Project Name:	HBM Servicing Study	**Flow Rate:**	450 L/person/day	**Designed By:**	AF
Project Number:	18039	**Infiltration:**	0.28 L/s/ha	**Date:**	10/12/2018
		Max Capacity:	80 %		

Flow	Type	Value	Unit
Single Family	Residence	3.5	person/unit
Hotel Rooms	Residence	1.6	person/unit
Medium Density	Residence	1	person/unit
Commercial	Peak Flow	0.33	L/s/ha
School	Peak Flow	0.52	L/s/100 Students
Apartments	Residence	2	person/unit

Location			Single Family		Hotel Rooms		Medium Density		Commercial		School		Apartments		Area		Population		Flow					Pipe Properties					Hydraulics			
Location/Street Name	From Structure	To Structure	Number of Units	Population	Number of Units	Population	Number of Units	Population	Commercial Area(ha)	Cumulative Commercial Area (ha)	School Population	Cumulative School Population (Per 100 Students)	Number of Units	Population	Catchment Area (ha)	Cumulative Catchment Area (ha)	Cumulative Population	Harmon Factor	Resedential Peak Flow (L/s)	Commercial Peak Flow (L/s)	School Peak Flow (L/s)	Infiltration Flow (L/s)	Total Peak Flow (L/s)	Pipe Diameter (mm)	Pipe Slope (%)	Pipe Length (m)	Pipe Material	Mannings 'n'	Velocity in Sewer (m/s)	Pipe Capacity (L/s)	% Capacity	Actual Velocity (m/s)
Pomeroy Dr.	MH 112	MH 111	4	14	0	0	0	0	0.000	0.000	0	0	0	0	0.950	0.950	14	4.40	0.32	0.00	0.00	0.27	0.59	200	0.40	35.0	PVC	0.013	0.66	20.7	3%	0.29
County Road 30	MH 111	MH 110	3	11	0	0	0	0	0.000	0.000	0	0	0	0	1.460	2.410	25	4.37	0.56	0.00	0.00	0.67	1.23	250	0.50	80.0	PVC	0.013	0.86	42.1	3%	0.38
County Road 30	MH 110	MH 109	2	7	0	0	0	0	0.000	0.000	0	0	0	0	0.870	3.280	32	4.35	0.71	0.00	0.00	0.92	1.63	250	0.50	80.0	PVC	0.013	0.86	42.1	4%	0.41
County Road 30	MH 109	MH 108	4	14	0	0	0	0	0.000	0.000	0	0	0	0	0.580	3.860	46	4.32	1.02	0.00	0.00	1.08	2.11	250	1.00	60.0	PVC	0.013	1.21	59.5	4%	0.57
County Road 30	MH 108	MH 103	27	95	0	0	0	0	0.000	0.000	0	0	0	0	8.670	12.530	140	4.20	3.06	0.00	0.00	3.51	6.57	250	0.50	370.0	PVC	0.013	0.86	42.1	16%	0.62
Princess St.	MH 104	MH 103	5	18	0	0	0	0	0.000	0.000	0	0	0	0	1.020	1.020	18	4.39	0.40	0.00	0.00	0.29	0.69	250	0.25	44.0	PVC	0.013	0.61	29.7	2%	0.25
County Road 30	MH 103	MH 95	2	7	0	0	0	0	0.000	0.000	0	0	0	0	2.530	16.080	165	4.18	3.58	0.00	0.00	4.50	8.08	250	0.45	190.0	PVC	0.013	0.81	39.9	20%	0.64
Ottawa St.	MH 96	MH 95	12	42	0	0	0	0	0.000	0.000	0	0	0	0	3.860	3.860	42	4.33	0.95	0.00	0.00	1.08	2.03	200	0.40	5.0	PVC	0.013	0.66	20.7	10%	0.42
Ottawa St.	MH 95	MH 54	0	0	0	0	0	0	3.370	3.370	0	0	0	0	22.990	42.930	207	4.14	4.46	1.11	0.00	12.02	17.59	250	0.45	375.0	PVC	0.013	0.81	39.9	44%	0.79
Ottawa St.	MH 54	MH 45	169	592	0	0	0	0	1.190	4.560	0	0	0	0	4.860	47.790	798	3.86	16.05	1.50	0.00	13.38	30.93	300	0.40	160.0	PVC	0.013	0.87	61.2	51%	0.87
Ottawa St.	MH 45	MH 30	34	119	0	0	0	0	1.810	6.370	0	0	0	0	11.000	58.790	917	3.82	18.26	2.10	0.00	16.46	36.83	300	0.40	260.0	PVC	0.013	0.87	61.2	60%	0.90
Ottawa St.	MH 30	MH 1	80	280	0	0	0	0	0.000	6.370	0	0	0	0	0.570	59.360	1197	3.75	23.37	2.10	0.00	16.62	42.09	300	0.40	70.0	PVC	0.013	0.87	61.2	69%	0.93
Ottawa St.	MH 10	MH 1	143	501	0	0	0	0	6.880	6.880	0	0	0	0	31.450	31.450	501	3.97	10.36	2.27	0.00	8.81	21.44	250	0.40	500.0	PVC	0.013	0.77	37.6	57%	0.79
County Road 30 (forcemain)	MH 1	MH 113	0	0	0	0	0	0	0.000	13.250	0	0	0	0	0.000	90.810	1698	3.64	32.18	4.37	0.00	25.43	61.98									
County Road 30	MH 113	MH 114	4	14	0	0	0	0	0.000	13.250	0	0	0	0	1.050	91.860	1712	3.64	32.42	4.37	0.00	25.72	62.51	250	1.60	50.0	PVC	0.013	1.53	75.2	83%	1.71
County Road 30	MH 114	MH 115	6	21	0	0	0	0	0.000	13.250	0	0	0	0	1.700	93.560	1733	3.63	32.78	4.37	0.00	26.20	63.35	250	2.10	50.0	PVC	0.013	1.76	86.2	74%	1.92
County Road 30	MH 115	MH 116	5	18	0	0	0	0	0.000	13.250	0	0	0	0	0.700	94.260	1750	3.63	33.09	4.37	0.00	26.39	63.85	250	1.20	50.0	PVC	0.013	1.33	65.2	98%	1.51
Norwood Road	MH NOR	MH 116	12	42	0	0	0	0	0.000	0.000	0	0	0	0	5.960	5.960	42	4.33	0.95	0.00	0.00	1.67	2.62	200	2.50	50.0	PVC	0.013	1.65	51.9	5%	0.85
County Road 30	MH 116	MH 119	0	0	0	0	0	0	0.000	13.250	0	0	0	0	0.000	100.220	1792	3.62	33.81	4.37	0.00	28.06	66.24	375	0.45	10.0	PVC	0.013	1.07	117.6	56%	1.09
County Road 30	MH 119	MH 120	2	7	0	0	0	0	0.000	13.250	0	0	0	0	0.820	101.040	1799	3.62	33.93	4.37	0.00	28.29	66.59	375	0.50	50.0	PVC	0.013	1.12	124.0	54%	1.14
County Road 30	MH 120	MH 121	2	7	0	0	0	0	0.000	13.250	0	0	0	0	1.400	102.440	1806	3.62	34.05	4.37	0.00	28.68	67.11	375	0.35	50.0	PVC	0.013	0.94	103.7	65%	1.00
County Road 30	MH 121	MH 122	1	4	0	0	0	0	0.000	13.250	0	0	0	0	0.810	103.250	1810	3.62	34.11	4.37	0.00	28.91	67.39	375	0.35	50.0	PVC	0.013	0.94	103.7	65%	1.00
County Road 30	MH 122	MH 132	0	0	0	0	0	0	0.000	13.250	0	0	0	0	0.000	103.250	1810	3.62	34.11	4.37	0.00	28.91	67.39	375	0.30	200.0	PVC	0.013	0.87	96.0	70%	0.94

Proposed Phase 1 and PTBO Housing Sanitary Sewer Design Sheet

ENGAGE ENGINEERING

Project Name: HBM Servicing Study
Project Number: 18039

Flow Rate: 450 L/person/day
Infiltration: 0.28 L/s/ha
Max Capacity: 80 %

Designed By: AF
Date: 10/12/2018

Flow	Type	Value	Unit
Single Family	Residence	3.5	person/unit
Hotel Rooms	Residence	1.6	person/unit
Medium Density	Residence	1	person/unit
Commercial	Peak Flow	0.33	L/s/ha
School	Peak Flow	0.52	L/s/100 Students
Apartments	Residence	2	person/unit

Location			Single Family		Hotel Rooms		Medium Density		Commercial		School		Apartments		Area		Population		Flow					Pipe Properties					Hydraulics			
Location/Street Name	From Structure	To Structure	Number of Units	Population	Number of Units	Population	Number of Units	Population	Commercial Area(ha)	Cumulative Commercial Area (ha)	School Population	Cumulative School Population (Per 100 Students)	Number of Units	Population	Catchment Area (ha)	Cumulative Catchment Area (ha)	Cumulative Population	Harmon Factor	Resedential Peak Flow (L/s)	Commercial Peak Flow (L/s)	School Peak Flow (L/s)	Infiltration Flow (L/s)	Total Peak Flow (L/s)	Pipe Diameter (mm)	Pipe Slope (%)	Pipe Length (m)	Pipe Material	Mannings 'n'	Velocity in Sewer (m/s)	Pipe Capacity (L/s)	% Capacity	Actual Velocity (m/s)
Pomeroy Dr.	MH 112	MH 111	4	14	0	0	0	0	0.000	0.000	0	0	0	0	0.950	0.950	14	4.40	0.32	0.00	0.00	0.27	0.59	200	0.40	35.0	PVC	0.013	0.66	20.7	3%	0.29
County Road 30	MH 111	MH 110	3	11	0	0	0	0	0.000	0.000	0	0	0	0	1.460	2.410	25	4.37	0.56	0.00	0.00	0.67	1.23	250	0.50	80.0	PVC	0.013	0.86	42.1	3%	0.38
County Road 30	MH 110	MH 109	2	7	0	0	0	0	0.000	0.000	0	0	0	0	0.870	3.280	32	4.35	0.71	0.00	0.00	0.92	1.63	250	0.50	80.0	PVC	0.013	0.86	42.1	4%	0.41
County Road 30	MH 109	MH 108	4	14	0	0	0	0	0.000	0.000	0	0	0	0	0.580	3.860	46	4.32	1.02	0.00	0.00	1.08	2.11	250	1.00	60.0	PVC	0.013	1.21	59.5	4%	0.57
County Road 30	MH 108	MH 103	27	95	0	0	0	0	0.000	0.000	0	0	0	0	8.670	12.530	140	4.20	3.06	0.00	0.00	3.51	6.57	250	0.50	370.0	PVC	0.013	0.86	42.1	16%	0.62
Princess St.	MH 104	MH 103	5	18	0	0	0	0	0.000	0.000	0	0	0	0	1.020	1.020	18	4.39	0.40	0.00	0.00	0.29	0.69	250	0.25	44.0	PVC	0.013	0.61	29.7	2%	0.25
County Road 30	MH 103	MH 95	2	7	0	0	0	0	0.000	0.000	0	0	0	0	2.530	16.080	165	4.18	3.58	0.00	0.00	4.50	8.08	250	0.45	190.0	PVC	0.013	0.81	39.9	20%	0.64
Ottawa St.	MH 96	MH 95	12	42	0	0	0	0	0.000	0.000	0	0	0	0	3.860	3.860	42	4.33	0.95	0.00	0.00	1.08	2.03	200	0.40	5.0	PVC	0.013	0.66	20.7	10%	0.42
Ottawa St.	MH 95	MH 54	0	0	0	0	0	0	3.110	3.110	0	0	0	0	3.110	23.050	207	4.14	4.46	1.03	0.00	6.45	11.94	250	0.45	375.0	PVC	0.013	0.81	39.9	30%	0.71
Ottawa St.	MH 54	MH 45	169	592	0	0	0	0	1.130	4.240	0	0	0	0	20.670	43.720	798	3.86	16.05	1.40	0.00	12.24	29.69	300	0.40	160.0	PVC	0.013	0.87	61.2	49%	0.86
Ottawa St.	MH 45	MH 30	34	119	0	0	0	0	1.910	6.150	0	0	0	0	5.580	49.300	917	3.82	18.26	2.03	0.00	13.80	34.10	300	0.40	260.0	PVC	0.013	0.87	61.2	56%	0.89
Ottawa St.	MH 30	MH 1	80	280	0	0	0	0	0.220	6.370	0	0	0	0	9.410	58.710	1197	3.75	23.37	2.10	0.00	16.44	41.91	300	0.40	70.0	PVC	0.013	0.87	61.2	69%	0.93
Ottawa St.		MH 1	7	25	0	0	0	0	0.000	0.000	0	0	0	0	0.570	0.570	25	4.37	0.56	0.00	0.00	0.16	0.72	200	0.40	30.0	PVC	0.013	0.66	20.7	3%	0.30
Ottawa St.	MH 10	MH 1	143	501	0	0	0	0	6.880	6.880	0	0	0	0	31.450	31.450	501	3.97	10.36	2.27	0.00	8.81	21.44	250	0.40	500.0	PVC	0.013	0.77	37.6	57%	0.79
County Road 30 (forcemain)	MH 1	MH 113	0	0	0	0	0	0	0.000	13.250	0	0	0	0	0.000	90.730	1722	3.64	32.60	4.37	0.00	25.40	62.38									
Smith Drive	MH S	MH 113	7	25	0	0	0	0	0.000	0.000	0	0	32	64	2.360	2.360	89	4.26	1.96	0.00	0.00	0.66	2.62	200	0.50	197.4	PVC	0.013	0.74	23.2	11%	0.49
County Road 30	MH 113	MH 114	4	14	0	0	0	0	0.000	13.250	0	0	0	0	1.050	94.140	1825	3.62	34.36	4.37	0.00	26.36	65.09	250	1.60	160.0	PVC	0.013	1.53	75.2	87%	1.72
County Road 30	MH 114	MH 115	6	21	0	0	0	0	0.000	13.250	0	0	0	0	1.700	95.840	1846	3.61	34.73	4.37	0.00	26.84	65.94	250	2.10	50.0	PVC	0.013	1.76	86.2	77%	1.93
County Road 30	MH 115	MH 116	5	18	0	0	0	0	0.000	13.250	0	0	0	0	0.700	96.540	1863	3.61	35.03	4.37	0.00	27.03	66.43	250	1.20	50.0	PVC	0.013	1.33	65.2	102%	1.51
Norwood Road	MH NOR	MH 116	12	42	0	0	0	0	0.000	0.000	0	0	0	0	5.960	5.960	42	4.33	0.95	0.00	0.00	1.67	2.62	200	2.50	50.0	PVC	0.013	1.65	51.9	5%	0.85
County Road 30	MH 116	MH 119	0	0	0	0	0	0	0.000	13.250	0	0	0	0	0.000	102.500	1905	3.60	35.74	4.37	0.00	28.70	68.81	375	0.45	10.0	PVC	0.013	1.07	117.6	58%	1.10
County Road 30	MH 119	MH 120	2	7	0	0	0	0	0.000	13.250	0	0	0	0	0.820	103.320	1912	3.60	35.86	4.37	0.00	28.93	69.16	375	0.50	50.0	PVC	0.013	1.12	124.0	56%	1.15
County Road 30	MH 120	MH 121	2	7	0	0	0	0	0.000	13.250	0	0	0	0	1.400	104.720	1919	3.60	35.98	4.37	0.00	29.32	69.68	375	0.35	50.0	PVC	0.013	0.94	103.7	67%	1.01
County Road 30	MH 121	MH 122	1	4	0	0	0	0	0.000	13.250	0	0	0	0	0.810	105.530	1923	3.60	36.04	4.37	0.00	29.55	69.96	375	0.35	50.0	PVC	0.013	0.94	103.7	67%	1.01
County Road 30	MH 122	MH 132	0	0	0	0	0	0	0.000	13.250	0	0	0	0	0.000	105.530	1923	3.60	36.04	4.37	0.00	29.55	69.96	375	0.30	200.0	PVC	0.013	0.87	96.0	73%	0.95

Proposed Phase 2 and LTC Sanitary Sewer Design Sheet

ENGAGE ENGINEERING

Project Name:	HBM Servicing Study	**Flow Rate:**	450 L/person/day	**Designed By:**	AF
Project Number:	18039	**Infiltration:**	0.28 L/s/ha	**Date:**	10/12/2018
		Max Capacity:	80 %		

Flow	Type	Value	Unit
Single Family	Residence	3.5	person/unit
Hotel Rooms	Residence	1.6	person/unit
Medium Density	Residence	1	person/unit
Commercial	Peak Flow	0.33	L/s/ha
School	Peak Flow	0.52	L/s/100 Students
Apartments	Residence	2	person/unit

Location			Single Family		Hotel Rooms		Medium Density		Commercial		School		Apartments		Area		Population		Flow					Pipe Properties					Hydraulics			
Location/Street Name	From Structure	To Structure	Number of Units	Population	Number of Units	Population	Number of Units	Population	Commercial Area(ha)	Cumulative Commercial Area (ha)	School Population	Cumulative School Population (Per 100 Students)	Number of Units	Population	Catchment Area (ha)	Cumulative Catchment Area (ha)	Cumulative Population	Harmon Factor	Resedential Peak Flow (L/s)	Commercial Peak Flow (L/s)	School Peak Flow (L/s)	Infiltration Flow (L/s)	Total Peak Flow (L/s)	Pipe Diameter (mm)	Pipe Slope (%)	Pipe Length (m)	Pipe Material	Mannings 'n'	Velocity in Sewer (m/s)	Pipe Capacity (L/s)	% Capacity	Actual Velocity (m/s)
Pomeroy Dr.	MH 112	MH 111	4	14	0	0	0	0	0.000	0.000	0	0	0	0	0.950	0.950	14	4.40	0.32	0.00	0.00	0.27	0.59	200	0.40	35.0	PVC	0.013	0.66	20.7	3%	0.29
County Road 30	MH 111	MH 110	3	11	0	0	0	0	0.000	0.000	0	0	0	0	1.460	2.410	25	4.37	0.56	0.00	0.00	0.67	1.23	250	0.50	80.0	PVC	0.013	0.86	42.1	3%	0.38
County Road 30	MH 110	MH 109	2	7	0	0	0	0	0.000	0.000	0	0	0	0	0.870	3.280	32	4.35	0.71	0.00	0.00	0.92	1.63	250	0.50	80.0	PVC	0.013	0.86	42.1	4%	0.41
County Road 30	MH 109	MH 108	4	14	0	0	0	0	0.000	0.000	0	0	0	0	0.580	3.860	46	4.32	1.02	0.00	0.00	1.08	2.11	250	1.00	60.0	PVC	0.013	1.21	59.5	4%	0.57
County Road 30	MH 108	MH 103	27	95	0	0	0	0	0.000	0.000	0	0	0	0	8.670	12.530	140	4.20	3.06	0.00	0.00	3.51	6.57	250	0.50	370.0	PVC	0.013	0.86	42.1	16%	0.62
Princess St.	MH 104	MH 103	5	18	0	0	0	0	0.000	0.000	0	0	0	0	1.020	1.020	18	4.39	0.40	0.00	0.00	0.29	0.69	250	0.25	44.0	PVC	0.013	0.61	29.7	2%	0.25
County Road 30	MH 103	MH 95	2	7	0	0	0	0	0.000	0.000	0	0	0	0	2.530	16.080	165	4.18	3.58	0.00	0.00	4.50	8.08	250	0.45	190.0	PVC	0.013	0.81	39.9	20%	0.64
Ottawa St.	MH 96	MH 95	12	42	0	0	0	0	0.000	0.000	0	0	0	0	3.860	3.860	42	4.33	0.95	0.00	0.00	1.08	2.03	200	0.40	5.0	PVC	0.013	0.66	20.7	10%	0.42
Ottawa St.	MH 95	MH 54	0	0	0	0	0	0	3.110	3.110	0	0	0	0	3.110	23.050	207	4.14	4.46	1.03	0.00	6.45	11.94	250	0.45	375.0	PVC	0.013	0.81	39.9	30%	0.71
Ottawa St.	MH 54	MH 45	169	592	0	0	0	0	1.130	4.240	0	0	0	0	20.760	43.810	798	3.86	16.05	1.40	0.00	12.27	29.71	300	0.40	160.0	PVC	0.013	0.87	61.2	49%	0.86
Ottawa St.	MH 45	MH 30	34	119	0	0	0	0	1.910	6.150	0	0	0	0	5.580	49.390	917	3.82	18.26	2.03	0.00	13.83	34.12	300	0.40	260.0	PVC	0.013	0.87	61.2	56%	0.89
Ottawa St.	MH 30	MH 1	73	256	0	0	0	0	0.220	6.370	0	0	0	0	9.410	58.800	1173	3.75	22.92	2.10	0.00	16.46	41.49	300	0.40	70.0	PVC	0.013	0.87	61.2	68%	0.93
Ottawa St.		MH 1	7	25	0	0	0	0	0.000	0.000	0	0	0	0	0.570	0.570	25	4.37	0.56	0.00	0.00	0.16	0.72	200	0.40	30.0	PVC	0.013	0.66	20.7	3%	0.30
Ottawa St.	MH 10	MH 1	143	501	0	0	0	0	6.880	6.880	0	0	0	0	31.450	31.450	501	3.97	10.36	2.27	0.00	8.81	21.44	250	0.40	500.0	PVC	0.013	0.77	37.6	57%	0.79
County Road 30 (forcemain)	MH 1	MH 113	0	0	0	0	0	0	0.000	13.250	0	0	0	0	0.000	90.820	1698	3.64	32.18	4.37	0.00	25.43	61.98									
Smith Drive	PRMH 3	MH S	23	81	0	0	0	0	0.000	0.000	0	0	0	0	2.310	2.310	81	4.27	1.79	0.00	0.00	0.65	2.44	200	0.50	100.0	PVC	0.013	0.74	23.2	11%	0.48
Smith Drive	MH S	MH 113	7	25	0	0	0	0	0.000	0.000	0	0	32	64	2.360	4.670	169	4.17	3.67	0.00	0.00	1.31	4.98	200	0.50	100.0	PVC	0.013	0.74	23.2	21%	0.59
County Road 30	MH 113	MH 114	4	14	0	0	0	0	0.000	13.250	0	0	0	0	1.050	96.540	1881	3.61	35.32	4.37	0.00	27.03	66.72	250	1.60	160.0	PVC	0.013	1.53	75.2	89%	1.73
County Road 30	MH 114	MH 115	6	21	0	0	0	0	0.000	13.250	0	0	0	0	1.700	98.240	1902	3.60	35.68	4.37	0.00	27.51	67.56	250	2.10	50.0	PVC	0.013	1.76	86.2	78%	1.94
County Road 30	MH 115	MH 116	5	18	0	0	0	0	0.000	13.250	0	0	0	0	0.700	98.940	1919	3.60	35.98	4.37	0.00	27.70	68.06	250	1.20	50.0	PVC	0.013	1.33	65.2	104%	1.51
Norwood Road	MH NOR	MH 116	12	42	0	0	136	136	0.000	0.000	0	0	0	0	5.960	5.960	178	4.17	3.86	0.00	0.00	1.67	5.53	200	2.50	50.0	PVC	0.013	1.65	51.9	11%	1.07
County Road 30	MH 116	MH 119	0	0	0	0	0	0	0.000	13.250	0	0	0	0	0.000	104.900	2097	3.57	38.99	4.37	0.00	29.37	72.74	375	0.45	10.0	PVC	0.013	1.07	117.6	62%	1.12
County Road 30	MH 119	MH 120	2	7	0	0	0	0	0.000	13.250	0	0	0	0	0.820	105.720	2104	3.57	39.11	4.37	0.00	29.60	73.08	375	0.50	50.0	PVC	0.013	1.12	124.0	59%	1.17
County Road 30	MH 120	MH 121	2	7	0	0	0	0	0.000	13.250	0	0	0	0	1.400	107.120	2111	3.57	39.22	4.37	0.00	29.99	73.58	375	0.35	50.0	PVC	0.013	0.94	103.7	71%	1.02
County Road 30	MH 121	MH 122	1	4	0	0	0	0	0.000	13.250	0	0	0	0	0.810	107.930	2115	3.57	39.28	4.37	0.00	30.22	73.88	375	0.35	50.0	PVC	0.013	0.94	103.7	71%	1.02
County Road 30	MH 122	MH 132	0	0	0	0	0	0	0.000	13.250	0	0	0	0	0.000	107.930	2115	3.57	39.28	4.37	0.00	30.22	73.88	375	0.30	200.0	PVC	0.013	0.87	96.0	77%	0.96

Proposed Phase 3
Sanitary Sewer Design Sheet

Project Name:	HBM Servicing Study	**Flow Rate:**	450 L/person/day	**Designed By:**	AF
Project Number:	18039	**Infiltration:**	0.28 L/s/ha	**Date:**	10/12/2018
		Max Capacity:	80 %		

Flow	Type	Value	Unit
Single Family	Residence	3.5	person/unit
Hotel Rooms	Residence	1.6	person/unit
Medium Density	Residence	1	person/unit
Commercial	Peak Flow	0.33	L/s/ha
School	Peak Flow	0.52	L/s/100 Students
Apartments	Residence	2	person/unit

Location			Single Family		Hotel Rooms		Medium Density		Commercial		School		Apartments		Area		Population		Flow					Pipe Properties					Hydraulics			
Location/Street Name	From Structure	To Structure	Number of Units	Population	Number of Units	Population	Number of Units	Population	Commercial Area(ha)	Cumulative Commercial Area (ha)	School Population	Cumulative School Population (Per 100 Students)	Number of Units	Population	Catchment Area (ha)	Cumulative Catchment Area (ha)	Cumulative Population	Harmon Factor	Resedential Peak Flow (L/s)	Commercial Peak Flow (L/s)	School Peak Flow (L/s)	Infiltration Flow (L/s)	Total Peak Flow (L/s)	Pipe Diameter (mm)	Pipe Slope (%)	Pipe Length (m)	Pipe Material	Mannings 'n'	Velocity in Sewer (m/s)	Pipe Capacity (L/s)	% Capacity	Actual Velocity (m/s)
Pomeroy Dr.	MH 112	MH 111	4	14	0	0	0	0	0.000	0.000	0	0	0	0	0.950	0.950	14	4.40	0.32	0.00	0.00	0.27	0.59	200	0.40	35.0	PVC	0.013	0.66	20.7	3%	0.29
County Road 30	MH 111	MH 110	3	11	0	0	0	0	0.000	0.000	0	0	0	0	1.460	2.410	25	4.37	0.56	0.00	0.00	0.67	1.23	250	0.50	80.0	PVC	0.013	0.86	42.1	3%	0.38
County Road 30	MH 110	MH 109	2	7	0	0	0	0	0.000	0.000	0	0	0	0	0.870	3.280	32	4.35	0.71	0.00	0.00	0.92	1.63	250	0.50	80.0	PVC	0.013	0.86	42.1	4%	0.41
New Subdivision, Phase 3	PRMH1	MH 109	101	354	0	0	0	0	0.000	0.000	0	0	0	0	13.870	13.870	354	4.05	7.45	0.00	0.00	3.88	11.33	200	0.50	150.0	PVC	0.013	0.74	23.2	49%	0.73
County Road 30	MH 109	MH 108	4	14	0	0	0	0	0.000	0.000	0	0	0	0	0.580	17.730	399	4.02	8.36	0.00	0.00	4.96	13.32	250	1.00	60.0	PVC	0.013	1.21	59.5	22%	0.97
County Road 30	MH 108	MH 103	27	95	0	0	0	0	0.000	0.000	0	0	0	0	8.670	26.400	494	3.98	10.22	0.00	0.00	7.39	17.61	250	0.50	370.0	PVC	0.013	0.86	42.1	42%	0.82
Princess St.	MH 104	MH 103	5	18	0	0	0	0	0.000	0.000	0	0	0	0	1.020	1.020	18	4.39	0.40	0.00	0.00	0.29	0.69	250	0.25	44.0	PVC	0.013	0.61	29.7	2%	0.25
County Road 30	MH 103	MH 95	2	7	0	0	0	0	0.000	0.000	0	0	0	0	2.530	29.950	518	3.97	10.70	0.00	0.00	8.39	19.09	250	0.45	190.0	PVC	0.013	0.81	39.9	48%	0.80
Ottawa St.	MH 96	MH 95	12	42	0	0	0	0	0.000	0.000	0	0	0	0	3.860	3.860	42	4.33	0.95	0.00	0.00	1.08	2.03	200	0.40	5.0	PVC	0.013	0.66	20.7	10%	0.42
Ottawa St.	MH 95	MH 54	0	0	0	0	0	0	3.110	3.110	0	0	0	0	3.110	36.920	560	3.95	11.52	1.03	0.00	10.34	22.88	250	0.45	375.0	PVC	0.013	0.81	39.9	57%	0.84
Ottawa St.	MH 54	MH 45	169	592	0	0	0	0	1.130	4.240	0	0	0	0	20.760	57.680	1152	3.76	22.55	1.40	0.00	16.15	40.10	300	0.40	160.0	PVC	0.013	0.87	61.2	66%	0.92
Ottawa St.	MH 45	MH 30	34	119	0	0	0	0	1.910	6.150	0	0	0	0	5.580	63.260	1271	3.73	24.69	2.03	0.00	17.71	44.43	300	0.40	260.0	PVC	0.013	0.87	61.2	73%	0.94
Ottawa St.	MH 30	MH 1	80	280	0	0	0	0	0.220	6.370	0	0	0	0	9.410	72.670	1551	3.67	29.63	2.10	0.00	20.35	52.08	300	0.40	70.0	PVC	0.013	0.87	61.2	85%	0.97
Ottawa St.		MH 1	7	25	0	0	0	0	0.000	0.000	0	0	0	0	0.570	0.570	25	4.37	0.56	0.00	0.00	0.16	0.72	200	0.40	30.0	PVC	0.013	0.66	20.7	3%	0.30
Ottawa St.	MH 10	MH 1	143	501	0	0	0	0	6.880	6.880	0	0	0	0	31.450	31.450	501	3.97	10.36	2.27	0.00	8.81	21.44	250	0.40	500.0	PVC	0.013	0.77	37.6	57%	0.79
County Road 30 (forcemain)	MH 1	MH 113	0	0	0	0	0	0	0.000	13.250	0	0	0	0	0.000	104.690	2076	3.57	38.62	4.37	0.00	29.31	72.31									
Smith Drive	PRMH 3	MH S	23	81	0	0	0	0	0.000	0.000	0	0	0	0	2.310	2.310	81	4.27	1.79	0.00	0.00	0.65	2.44	200	0.50	100.0	PVC	0.013	0.74	23.2	11%	0.48
Smith Drive	MH S	MH 113	7	25	0	0	0	0	0.000	0.000	0	0	32	64	2.360	4.670	169	4.17	3.67	0.00	0.00	1.31	4.98	200	0.50	100.0	PVC	0.013	0.74	23.2	21%	0.59
County Road 30	MH 113	MH 114	4	14	0	0	0	0	0.000	13.250	0	0	0	0	1.050	110.410	2259	3.54	41.69	4.37	0.00	30.91	76.98	250	1.60	160.0	PVC	0.013	1.53	75.2	102%	1.75
County Road 30	MH 114	MH 115	6	21	0	0	0	0	0.000	13.250	0	0	0	0	1.700	112.110	2280	3.54	42.04	4.37	0.00	31.39	77.80	250	2.10	50.0	PVC	0.013	1.76	86.2	90%	1.99
County Road 30	MH 115	MH 116	5	18	0	0	0	0	0.000	13.250	0	0	0	0	0.700	112.810	2297	3.54	42.33	4.37	0.00	31.59	78.29	250	1.20	50.0	PVC	0.013	1.33	65.2	120%	1.33
Norwood Road	MH NOR	MH 116	12	42	0	0	136	136	0.000	0.000	0	0	0	0	5.960	5.960	178	4.17	3.86	0.00	0.00	1.67	5.53	200	2.50	50.0	PVC	0.013	1.65	51.9	11%	1.07
County Road 30	MH 116	MH 119	0	0	0	0	0	0	0.000	13.250	0	0	0	0	0.000	118.770	2475	3.51	45.27	4.37	0.00	33.26	82.90	375	0.45	10.0	PVC	0.013	1.07	117.6	70%	1.15
County Road 30	MH 119	MH 120	2	7	0	0	0	0	0.000	13.250	0	0	0	0	0.820	119.590	2482	3.51	45.39	4.37	0.00	33.49	83.24	375	0.50	50.0	PVC	0.013	1.12	124.0	67%	1.20
County Road 30	MH 120	MH 121	2	7	0	0	0	0	0.000	13.250	0	0	0	0	1.400	120.990	2489	3.51	45.50	4.37	0.00	33.88	83.75	375	0.35	50.0	PVC	0.013	0.94	103.7	81%	1.04
County Road 30	MH 121	MH 122	1	4	0	0	0	0	0.000	13.250	0	0	0	0	0.810	121.800	2493	3.51	45.57	4.37	0.00	34.10	84.04	375	0.35	50.0	PVC	0.013	0.94	103.7	81%	1.05
County Road 30	MH 122	MH 132	0	0	0	0	0	0	0.000	13.250	0	0	0	0	0.000	121.800	2493	3.51	45.57	4.37	0.00	34.10	84.04	375	0.30	200.0	PVC	0.013	0.87	96.0	88%	0.98

Appendix E: Hydrologic Parameters

Rational Method Calculations

Project Name: HBM Servicing Study
Project No: 18039

Rain Gauge: Peterborough

Designed By: MC
Date: 2018-10-26

Catchment Name and Description		Land Use and Areas (Ha)							Catchment Characteristics								Runoff Coefficient						Peak Flows (m^3/s)					
Name	Description	Wetland (C=0.05)	Woods (C=0.12)	Grass (C=0.17)	Range (C=0.25)	Gravel (C=0.65)	Impervious (C=0.90)	**Total**	% Imperviousness	Soils Group	Composite Runoff Coefficient	Length (m)	Average Slope (%)	Calculated Time of Concentration (min)	Minimum Time of Concentration (min)	Time to Peak (min)	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
EX1	Phase 2 & 3		0.000	14.900			0.000	**14.900**	0.00%		0.17	450.0	2.0	51.2	10.0	34.1	0.17	0.17	0.17	0.19	0.20	0.21	0.187	0.254	0.307	0.394	0.487	0.553
PR1	Phase 2 & 3		0.000	5.100			9.800	**14.900**	65.77%		0.65	450.0	2.0	17.0	10.0	11.4	0.65	0.65	0.65	0.72	0.78	0.81	1.422	1.909	2.252	2.897	3.520	4.015

Notes:

Runoff Coefficients

1. Runoff coefficients for Land Uses taken from MTO Drainage Manual Design Chart 1.07.
2. Runoff coefficients have been adjusted for storms exceeding the 10-year return period as follows: 25 Year - 1.10; 50-Year: 1.20; 100-Year: 1.25

Time of Concentration

1.Tc calculcated using Airport equation for C<0.4 and Bransby Willisams for C>0.4
2. Tp calculated as 0.67Tc.

Modified Rational Method Storage

ENGAGE ENGINEERING

Project Name: HBM Servicing Study
Project No: 18039
Designed By: MC
Date: 2018-10-26

Rainfall Data					
Design Storm:	2 Year		IDF Parameters:	A =	662
Rain Station:	Peterborough			B =	7.5
				C =	0.79

Catchment Area Parameters			
Catchment ID:	PR1	Discharge Rate (m^3/s):	0.187
Drainage Area (ha):	14.900		
Runoff Coefficient:	0.65		

Modified Rational Method Calculations

Time (minutes)	Intensity (mm/hr)	Peak Runoff (m^3/s)	Volume (m^3) Inflow	Released	Storage
0	134.76	3.628	0.0	0.0	0.0
5	90.01	2.424	727.1	56.1	671.0
10	69.00	1.858	1114.7	112.2	1002.5
15	56.58	1.523	1370.9	168.3	1202.6
20	48.28	1.300	1560.0	224.4	1335.6
25	42.31	1.139	1708.9	280.5	1428.4
30	37.79	1.017	1831.4	336.6	1494.8
35	34.23	0.922	1935.5	392.7	1542.8
40	31.35	0.844	2025.9	448.8	1577.1
45	28.97	0.780	2105.9	504.9	1601.0
50	26.96	0.726	2177.6	561.0	1616.6
55	25.24	0.680	2242.7	617.1	1625.6
60	23.75	0.640	2302.3	673.2	**1629.1**
65	22.45	0.604	2357.2	729.3	1627.9
70	21.30	0.573	2408.3	785.4	1622.9
75	20.27	0.546	2455.9	841.5	1614.4
80	19.35	0.521	2500.7	897.6	1603.1
85	18.52	0.499	2542.8	953.7	1589.1
90	17.76	0.478	2582.8	1009.8	1573.0
95	17.08	0.460	2620.6	1065.9	1554.7
100	16.45	0.443	2656.7	1122.0	1534.7
105	15.87	0.427	2691.1	1178.1	1513.0
110	15.33	0.413	2724.1	1234.2	1489.9

Modified Rational Method Storage

Project Name: HBM Servicing Study
Project No: 18039
Designed By: MC
Date: 2018-10-26

Rainfall Data					
Design Storm:	5 Year		IDF Parameters:	A =	1098
Rain Station:	Peterborough			B =	10.1
				C =	0.83
Catchment Area Parameters					
Catchment ID:	PR1		Discharge Rate (m^3/s):		0.254
Drainage Area (ha):	14.900				
Runoff Coefficient:	0.65				

Modified Rational Method Calculations

Time (minutes)	Intensity (mm/hr)	Peak Runoff (m^3/s)	Volume (m^3)		
			Inflow	Released	Storage
0	161.07	4.337	0.0	0.0	0.0
5	115.36	3.106	931.8	76.2	855.6
10	90.98	2.450	1469.8	152.4	1317.4
15	75.66	2.037	1833.4	228.6	1604.8
20	65.07	1.752	2102.4	304.8	1797.6
25	57.28	1.542	2313.3	381.0	1932.3
30	51.29	1.381	2485.5	457.2	2028.3
35	46.52	1.253	2630.3	533.4	2096.9
40	42.63	1.148	2754.8	609.6	2145.2
45	39.40	1.061	2863.9	685.8	2178.1
50	36.66	0.987	2960.8	762.0	2198.8
55	34.30	0.924	3047.8	838.2	2209.6
60	32.26	0.869	3126.8	914.4	**2212.4**
65	30.47	0.820	3199.1	990.6	2208.5
70	28.88	0.778	3265.7	1066.8	2198.9
75	27.46	0.739	3327.5	1143.0	2184.5
80	26.19	0.705	3385.1	1219.2	2165.9
85	25.04	0.674	3439.0	1295.4	2143.6
90	24.00	0.646	3489.6	1371.6	2118.0
95	23.05	0.621	3537.5	1447.8	2089.7
100	22.18	0.597	3582.7	1524.0	2058.7
105	21.38	0.576	3625.7	1600.2	2025.5
110	20.63	0.556	3666.7	1676.4	1990.3

Modified Rational Method Storage

Project Name: HBM Servicing Study
Project No: 18039
Designed By: MC
Date: 2018-10-26

Rainfall Data

Design Storm:	10 Year	IDF Parameters:	A =	1560
Rain Station:	Peterborough		B =	13
			C =	0.86

Catchment Area Parameters

Catchment ID:	PR1	Discharge Rate (m^3/s):	0.307
Drainage Area (ha):	14.900		
Runoff Coefficient:	0.65		

Modified Rational Method Calculations

Time (minutes)	Intensity (mm/hr)	Peak Runoff (m^3/s)	Volume (m^3)		
			Inflow	Released	Storage
0	171.84	4.627	0.0	0.0	0.0
5	129.89	3.497	1049.2	92.1	957.1
10	105.21	2.833	1699.6	184.2	1515.4
15	88.83	2.392	2152.6	276.3	1876.3
20	77.13	2.077	2491.9	368.4	2123.5
25	68.31	1.839	2759.0	460.5	2298.5
30	61.42	1.654	2976.9	552.6	2424.3
35	55.88	1.505	3159.5	644.7	2514.8
40	51.32	1.382	3315.9	736.8	2579.1
45	47.49	1.279	3452.1	828.9	2623.2
50	44.23	1.191	3572.4	921.0	2651.4
55	41.42	1.115	3679.8	1013.1	2666.7
60	38.96	1.049	3776.7	1105.2	**2671.5**
65	36.81	0.991	3864.8	1197.3	2667.5
70	34.89	0.939	3945.6	1289.4	2656.2
75	33.18	0.893	4020.0	1381.5	2638.5
80	31.64	0.852	4089.0	1473.6	2615.4
85	30.25	0.814	4153.2	1565.7	2587.5
90	28.98	0.780	4213.3	1657.8	2555.5
95	27.82	0.749	4269.7	1749.9	2519.8
100	26.76	0.720	4322.9	1842.0	2480.9
105	25.78	0.694	4373.1	1934.1	2439.0
110	24.88	0.670	4420.7	2026.2	2394.5

Modified Rational Method Storage

ENGAGE ENGINEERING

Project Name: HBM Servicing Study
Project No: 18039
Designed By: MC
Date: 2018-07-13

Rainfall Data

Design Storm:	25 Year	IDF Parameters:	A =	2010
Rain Station:	Peterborough		B =	14
			C =	0.88

Catchment Area Parameters

Catchment ID:	PR1	Discharge Rate (m^3/s):	0.394
Drainage Area (ha):	14.900		
Runoff Coefficient:	0.72		

Modified Rational Method Calculations

Time (minutes)	Intensity (mm/hr)	Peak Runoff (m^3/s)	Volume (m^3) Inflow	Released	Storage
0	197.06	5.877	0.0	0.0	0.0
5	150.62	4.492	1347.7	118.2	1229.5
10	122.63	3.657	2194.4	236.4	1958.0
15	103.82	3.096	2786.7	354.6	2432.1
20	90.26	2.692	3230.3	472.8	2757.5
25	79.99	2.386	3578.6	591.0	2987.6
30	71.94	2.145	3861.8	709.2	3152.6
35	65.44	1.952	4098.3	827.4	3270.9
40	60.07	1.792	4300.0	945.6	3354.4
45	55.57	1.657	4474.8	1063.8	3411.0
50	51.73	1.543	4628.5	1182.0	3446.5
55	48.42	1.444	4765.3	1300.2	3465.1
60	45.53	1.358	4888.1	1418.4	**3469.7**
65	42.98	1.282	4999.3	1536.6	3462.7
70	40.72	1.214	5100.9	1654.8	3446.1
75	38.70	1.154	5194.1	1773.0	3421.1
80	36.88	1.100	5280.2	1891.2	3389.0
85	35.24	1.051	5360.1	2009.4	3350.7
90	33.74	1.006	5434.6	2127.6	3307.0
95	32.38	0.966	5504.3	2245.8	3258.5
100	31.13	0.928	5569.7	2364.0	3205.7
105	29.97	0.894	5631.4	2482.2	3149.2
110	28.91	0.862	5689.7	2600.4	3089.3

Modified Rational Method Storage

Project Name: HBM Servicing Study
Project No: 18039
Designed By: MC
Date: 2018-10-26

Rainfall Data					
Design Storm:	50 Year		IDF Parameters:	A =	2200
Rain Station:	Peterborough			B =	14.6
				C =	0.87

Catchment Area Parameters			
Catchment ID:	PR1	Discharge Rate (m^3/s):	0.487
Drainage Area (ha):	14.900		
Runoff Coefficient:	0.78		

Modified Rational Method Calculations

Time (minutes)	Intensity (mm/hr)	Peak Runoff (m^3/s)	Volume (m^3) Inflow	Released	Storage
0	213.52	6.899	0.0	0.0	0.0
5	165.26	5.339	1601.8	146.1	1455.7
10	135.62	4.382	2629.0	292.2	2336.8
15	115.45	3.730	3357.1	438.3	2918.8
20	100.79	3.257	3907.8	584.4	3323.4
25	89.62	2.896	4343.5	730.5	3613.0
30	80.82	2.611	4700.0	876.6	3823.4
35	73.68	2.381	4999.2	1022.7	3976.5
40	67.77	2.190	5255.4	1168.8	4086.6
45	62.80	2.029	5478.3	1314.9	4163.4
50	58.55	1.892	5675.0	1461.0	4214.0
55	54.87	1.773	5850.5	1607.1	4243.4
60	51.66	1.669	6008.5	1753.2	**4255.3**
65	48.82	1.577	6152.0	1899.3	4252.7
70	46.30	1.496	6283.3	2045.4	4237.9
75	44.05	1.423	6404.0	2191.5	4212.5
80	42.01	1.357	6515.7	2337.6	4178.1
85	40.17	1.298	6619.6	2483.7	4135.9
90	38.50	1.244	6716.6	2629.8	4086.8
95	36.96	1.194	6807.5	2775.9	4031.6
100	35.56	1.149	6893.0	2922.0	3971.0
105	34.26	1.107	6973.7	3068.1	3905.6
110	33.06	1.068	7050.0	3214.2	3835.8

Modified Rational Method Storage

Project Name: HBM Servicing Study
Project No: 18039
Designed By: MC
Date: 2018-10-26

Rainfall Data				
Design Storm:	100 Year	IDF Parameters:	A =	2507
Rain Station:	Peterborough		B =	14.8
			C =	0.88

Catchment Area Parameters			
Catchment ID:	PR1	Discharge Rate (m^3/s):	0.553
Drainage Area (ha):	14.900		
Runoff Coefficient:	0.81		

Modified Rational Method Calculations

Time (minutes)	Intensity (mm/hr)	Peak Runoff (m^3/s)	Volume (m^3) Inflow	Released	Storage
0	234.06	7.853	0.0	0.0	0.0
5	181.17	6.079	1823.6	165.9	1657.7
10	148.61	4.986	2991.6	331.8	2659.8
15	126.43	4.242	3817.7	497.7	3320.0
20	110.30	3.701	4440.8	663.6	3777.2
25	98.01	3.288	4932.5	829.5	4103.0
30	88.31	2.963	5333.6	995.4	4338.2
35	80.46	2.700	5669.3	1161.3	4508.0
40	73.97	2.482	5956.0	1327.2	4628.8
45	68.49	2.298	6204.9	1493.1	4711.8
50	63.82	2.141	6424.0	1659.0	4765.0
55	59.78	2.006	6619.0	1824.9	4794.1
60	56.25	1.887	6794.2	1990.8	**4803.4**
65	53.14	1.783	6953.0	2156.7	4796.3
70	50.37	1.690	7097.9	2322.6	4775.3
75	47.89	1.607	7231.0	2488.5	4742.5
80	45.66	1.532	7353.9	2654.4	4699.5
85	43.64	1.464	7468.0	2820.3	4647.7
90	41.81	1.403	7574.4	2986.2	4588.2
95	40.13	1.346	7673.9	3152.1	4521.8
100	38.58	1.295	7767.3	3318.0	4449.3
105	37.16	1.247	7855.4	3483.9	4371.5
110	35.85	1.203	7938.6	3649.8	4288.8

Water Quality Sizing Criteria

ENGAGE ENGINEERING

Project Name: HBM Servicing Study
Project No: 18039
Designed By: MC
Date: 2018-10-26

Site Data			
Protection Level:		Enhanced	
Facility Type:		Wet Pond	
Area	=	14.9	ha
% Impervious Calculated	=	66.00	%
Impervious Area	=	9.83	ha
Required Extended Detention Volume (Ved)			
Ved	=	40	m^3/ha
	=	596	m^3
Ved_{25mm}	=	172	m^3
Required Storage Volume (Vs)			
Vs	=	216	m^3/ha
	=	3213	m^3
Required Permanent Pool Volume (Vpp)			
Vpp	=	176	m^3/ha
	=	2617	m^3
Pernanent Pool Volume Provided	=		m^3
Final Volumes			
Quantity Control Volume Required	=	4803.0	m^3
Quantity Control Volume Provided	=		m^3
Total Pond Volume Required	=	7420	m^3
Total Pond Volume Provided	=	0	m^3

Notes:
Table 3.2: Water Quality Storage Requirements based on Receiving Waters (MOE SWMPD Manual)

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level				
		0%	35%	55%	70%	85%
Enhanced 80% long-term S.S. removal	Infiltration	15	25	30	35	40
	Wetlands	40	80	105	120	140
	Hybrid Wet Pond/Wetland	10	110	150	175	195
	Wet Pond	10	140	190	225	250
Normal 70% long-term S.S. removal	Infiltration	20	20	20	25	30
	Wetlands	40	60	70	80	90
	Hybrid Wet Pond/Wetland	45	75	90	105	120
	Wet Pond	50	90	110	130	150
Basic 60% long-term S.S. removal	Infiltration	20	20	20	20	20
	Wetlands	60	60	60	60	60
	Hybrid Wet Pond/Wetland	40	60	70	75	80
	Wet Pond	30	60	75	85	95
	Dry Pond (Continuous Flow)	0	90	150	200	240