FUNCTIONAL SERVICING REPORT

SHINING HILL COLLECTION INC.
PHASE 3
RESIDENTIALSUBDIVISION

Town of Aurora / Town of Newmarket

Project: 2019-4750 **September 2019**

Submission	Description	Prepared		Checked	
		By	Date	By	Date
0.	Original Report	G.Volpe	2019	K.Shahbikian	2019

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1 INTRODUCTION

1.1 Objective and Location

Schaeffers Consulting Engineers has been retained by Bazil Developments, care of Condor Properties, to prepare a Functional Servicing Report (FSR) in support of a proposed subdivision development which is located within both the Town of Aurora and the Town of Newmarket. The site is roughly located within the boundaries of Yonge Street to the east, St. John's Sideroad to the south, Bathurst Street to the west. A site location plan is provided in **Figure 1.1**.

This FSR proposes a municipal servicing scheme that demonstrates the viability of stormwater drainage, sanitary and water supply servicing for the proposed development, with consideration for applicable guidelines, policies, and design criteria.

1.2 Background

The following key background documents were reviewed and consulted in preparation of this FSR:

- Engineering Design Standards and Criteria, Town of Newmarket, September 2018.
- South Georgian Bay Lake Simcoe Source Protection Region, Approved Source Protection Plan, Amended: February 2018.
- Design Criteria Manual for Engineering Plans, by Town of Aurora, Infrastructure and Environmental Services Department, February 2017.
- LSRCA Technical Guidelines for Stormwater Management Submissions, June 2016.
- MOE Stormwater Management Planning and Design Manual, March 2003.

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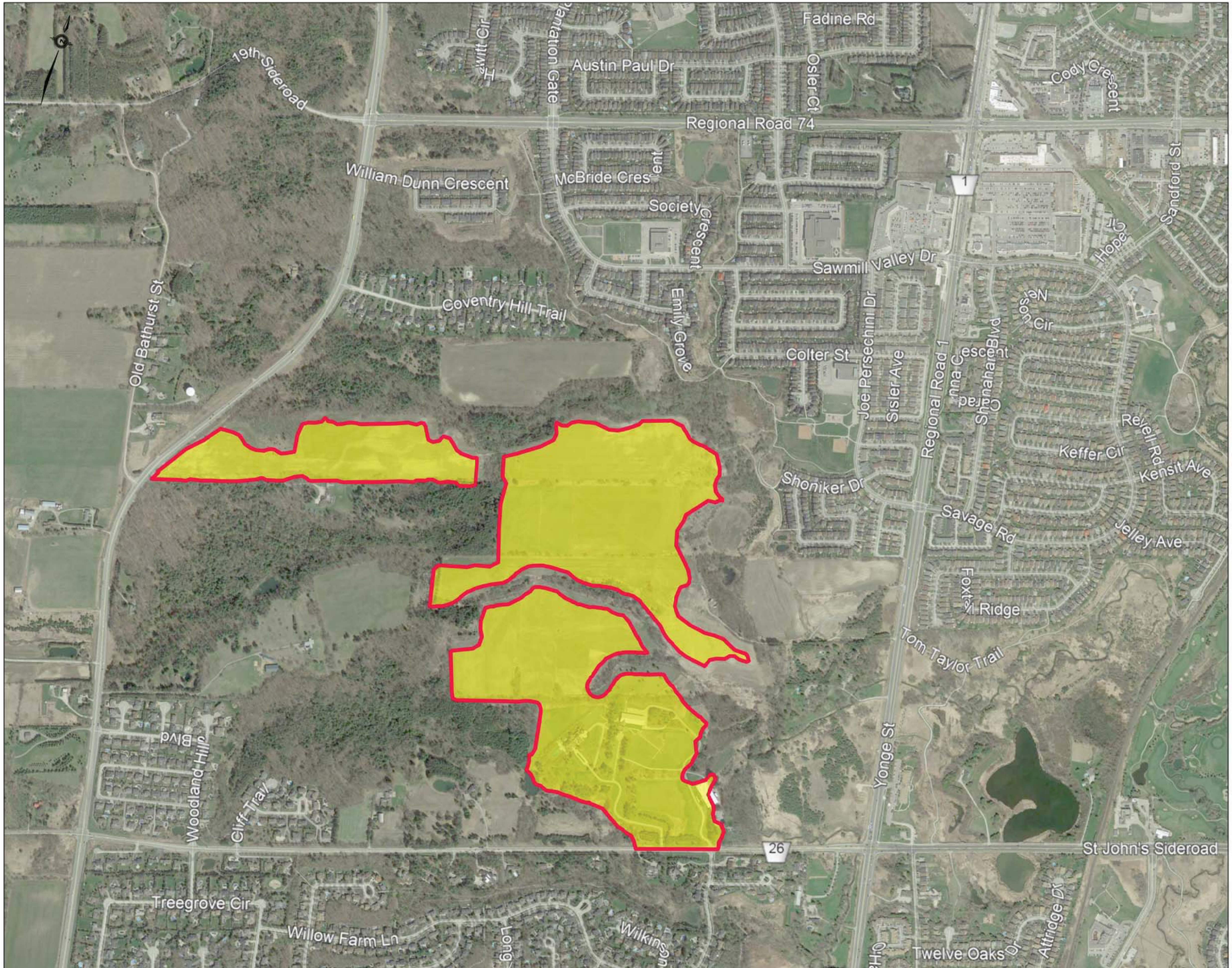

LEGEND

SITE LOCATION

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FIGURE 1.1
LOCATION PLAN

2019-4750	SEPTEMBER 2019	SCALE: N.T.S.

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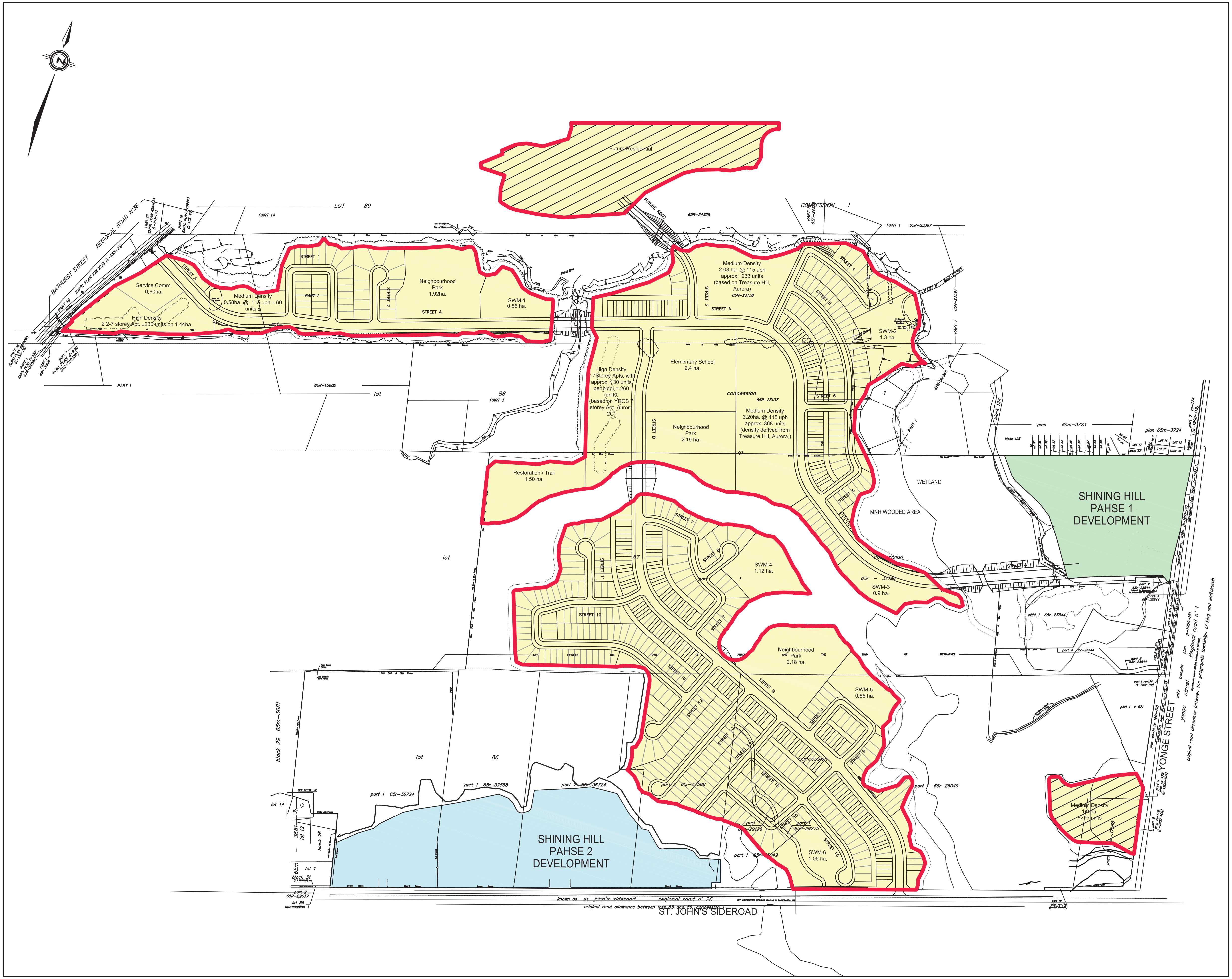
1.3 Proposed Development Plan and Population

The proposed development area is approximately 67ha and consists of single detached houses, townhouses, medium and high density residential spaces, roads, as well as parks and other natural areas. In addition area has been allocated within the development to facilitate the inclusion of 6 SWM Pond facilities to provide stormwater management to the site. The legal description of the subject site is part of Lot 87, and 88, Concessions 65R-23137, 65R-23138 and 65R-37198, as part of the Towns of Aurora and Newmarket, within the Regional Municipality of York. The proposed land use for the subject site is illustrated in **Figure 1.2**.



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LEGEND

SITE LOCATION

FUTURE DEVELOPMENT

SHINING HILL PHASE 1 DEVELOPMENT

SHINING HILL PHASE 2 DEVELOPMENT

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FIGURE 1.2
DEVELOPMENT PLAN

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2 Stormwater Management

The following sections provide details on the SWM plan for the proposed site and is in accordance with applicable provincial guidelines, municipal and conservation authority criteria.

2.1 Existing Drainage Conditions and Infrastructure

The site is located within the East Holland River watershed, covering approximately 67ha, which is under the jurisdiction of the Lake Simcoe Region Conservation Authority (LSRCA). The site area drains predominantly to Armitage Creek, as well as Tannery Creek within the southern site areas near St. John's Sideroad. Ultimately the site drains to the Tannery creek crossing through Yonge Street, east of the site and eventually draining to the East Holland River.

Elevations of the site range approximately from 317m at the furthest northwest corner to 253m to the east. In existing conditions majority of the site is covered in undeveloped agricultural croplands. Furthermore the southern portion of the site is predominantly covered in grasslands, with some local developments, consisting of both private roadway and larger private homes. Existing soil mapping for York County suggests that the area is predominantly underlain by Schomberg Clay.

Due to the large size of the site, several pre-development catchments have been identified as part of the existing property in relation to the proposed post development discharge points. **Figure 2.1** identifies the existing pre-development drainage catchment areas. Based on the catchments considered, the total pre-development area considered for the site is 59.88ha, of the total 66.7ha. A summary of the considered catchments areas and where they discharge is summarized in **Table 2.1** below.

Table 2.1. Pre-Development Catchment Areas

Catchment ID	Area (ha)	Description
101	3.88	Drainage Area South to Aurora 10 (Tannery Creek)
102	3.23	
201	5.42	Drainage Area East to Tannery 35 (Armitage Creek)
202	1.06	
301	13.66	
401	9.18	
402	0.50	Drainage Area North to Tannery 37 (Armitage Creek)
501	10.06	Drainage Area East to Tannery 35 (Armitage Creek)
502	2.82	
503	1.80	
504	1.87	
505	0.54	Drainage Area North to Tannery 37 (Armitage Creek)
601	4.91	Drainage Area North to Tannery 36 (Armitage Creek)
602	3.90	
603	0.39	Drainage Area South to Tannery 37 (Armitage Creek)
604	1.68	
701	1.76	Drainage Area South to Aurora 10 (Tannery Creek)
Total Area to Tannery Creek	66.7	

2.2 Design Criteria

Stormwater Management Design Criteria for the subject site follows Ministry of the Environment and Climate Change (MOECC) Stormwater Management Planning and Design Manual dated 2003 (hereon referred to as the MOECC SWM Manual) for quality, quantity and erosion control. Additional Design Criteria from Town of Aurora, Town of Newmarket and Lake Simcoe Region Conservation Authority (LSRCA) are incorporated into the design of this proposed development as discussed below.

1. Quantity Control – post to pre-peak flow controls for return periods 2 year through 100-year.
2. Volume Control – According to the LSRCA Technical guidelines, "*For new, nonlinear developments that create more than 0.5 hectares of new impervious surface on sites without restrictions, stormwater runoff volumes will be controlled and the post-construction runoff volume shall be captured and retained / treated on site from a 25 mm rainfall event from the total impervious area.*"
3. Quality Control - Enhanced stormwater quality must be provided for the site with 80% TSS removal from 90% of average annual flows(MOECC SWM Manual)
4. Erosion Control - based on the detention of runoff from 25mm rain event and released over 48 hours (LSRCA)
5. Water Balance - predevelopment levels must be maintained as per LSRCA. The site is located within the WHPA (Well Head Protection Area) Q1 and Q2, therefore pre-development infiltration volumes are to be maintained.
6. Phosphorus Loading –As per Town of Aurora and Town of Newmarket Design Criterias the LSRCA requires the development to follow a zero phosphorous policy. Furthermore the Lake Simco Phosphorus Offsetting Policy (LSPOP) is applicable to this site.
7. Pre-development and post-development peak flows for the site were calculated using the following 3 storm types for the 2-year -100 year storm events as follows with the most conservative of the three to be considered:
    - 4Hr Chicago;
    - SCS Type II-12Hr Toronto Bloor Street;
    - SCS Type II-24Hr Toronto Bloor Street;

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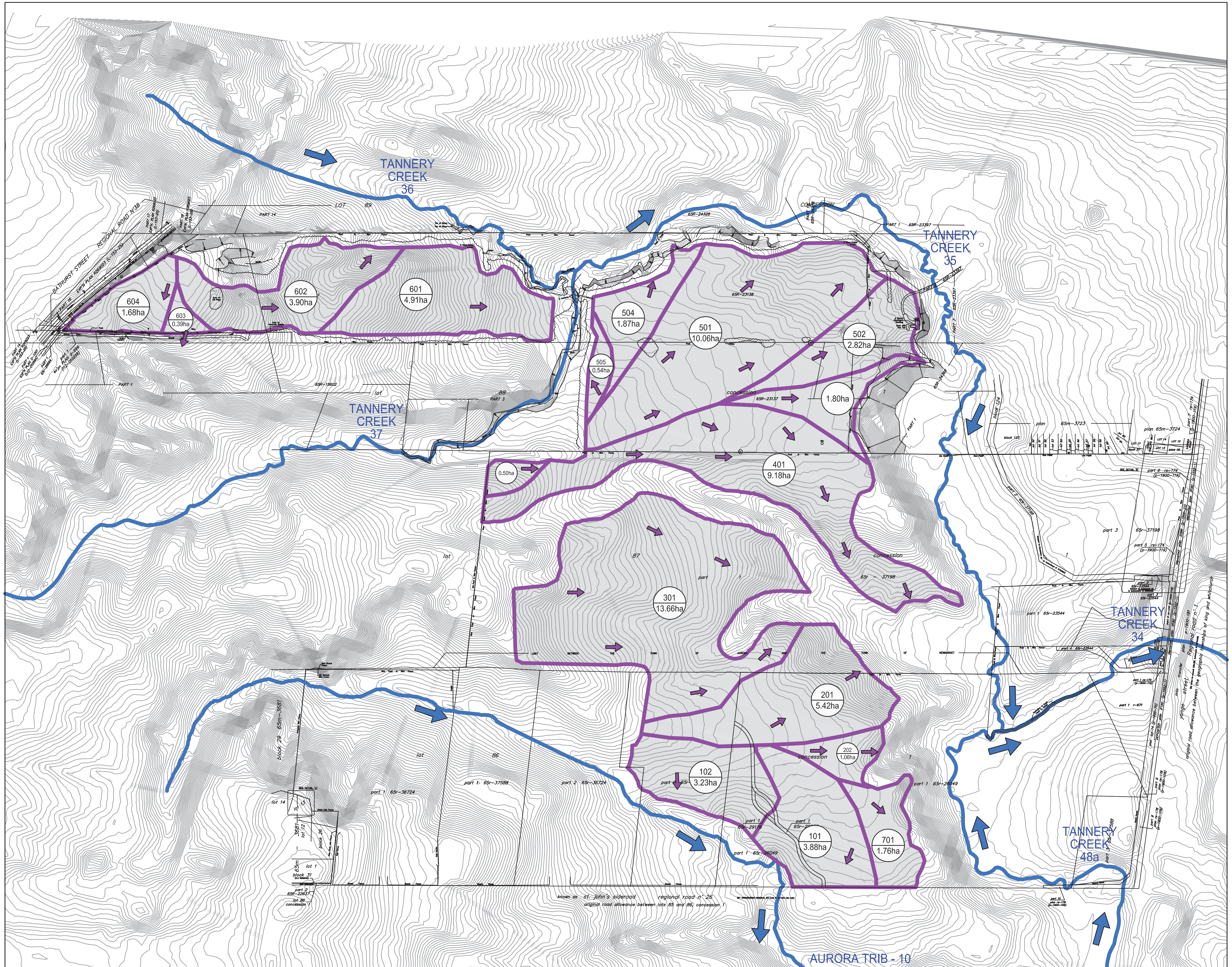

LEGEND

SITE LOCATION

EXISTING DRAINAGE AREAS

502 2.82ha — CATCHMENT ID AREA IN HECTARES

RIVER REACH

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FIGURE 2.1
PRE-DEVELEOPMENT DRAINAGE

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2.3 Proposed Stormwater Management Plan

The site is proposed to consist of a dual drainage scheme, including both a major and minor system. In order to support the development, the stormwater management strategy for the site is to incorporate 6 downstream SWM pond facilities in order to meet the aforementioned criterias. The overall proposed stormwater management drainage scheme, and pond locations are illustrated in **Figure 2.2**.

It is proposed to provide on-site quantity controls for the 2-year through 100-year storm event. In addition, on-site quality controls will be required to provide 'Enhanced' (Level 1) protection. As the site is classified as a major development, a treatment train approach is required to meet both the site quality and volumetric targets. Low impact development measures (LIDs) are proposed in series with the SWM ponds to provide a treatment train in each catchment. The LIDs deemed most feasible for this development include; infiltration/filtration basins in park blocks or SWM pond blocks, centralized separation units (i.e. Oil-grit separators), catchbasins shields if approved by the Town, clean water collector, and exfiltration systems. Each of the SWM pond facilities will be sized to provide 80% TSS removal for their respective drainage areas. The site volumetric retention requirements, will be met by providing infiltration or filtration, as permitted by site soil conditions by the aforementioned treatment train options.

A flood plain analysis was also conducted for the site based on the existing LSRCA model for the East Holland River Watershed. The model should be adjusted to incorporate the 3 added crossings as part of the proposed development. It should be noted that the span of the crossings can be selected to minimize the impact on the existing floodplain and potential wildlife crossings. The outfalls for each pond will be placed such that it is above the 100-year flood line elevation to eliminate the backwater affects from the watercourse.

Catchment 1008, which represents the eastern access road to the site identified on Figure 2.2, is proposed to be left to drain uncontrolled to the Tannery Creek watercourse due to restrictive grading. Local catchbasins are proposed to collect flows in the area and drain to a proposed OGS unit, prior to discharging to the Creek at the location of the proposed culvert.

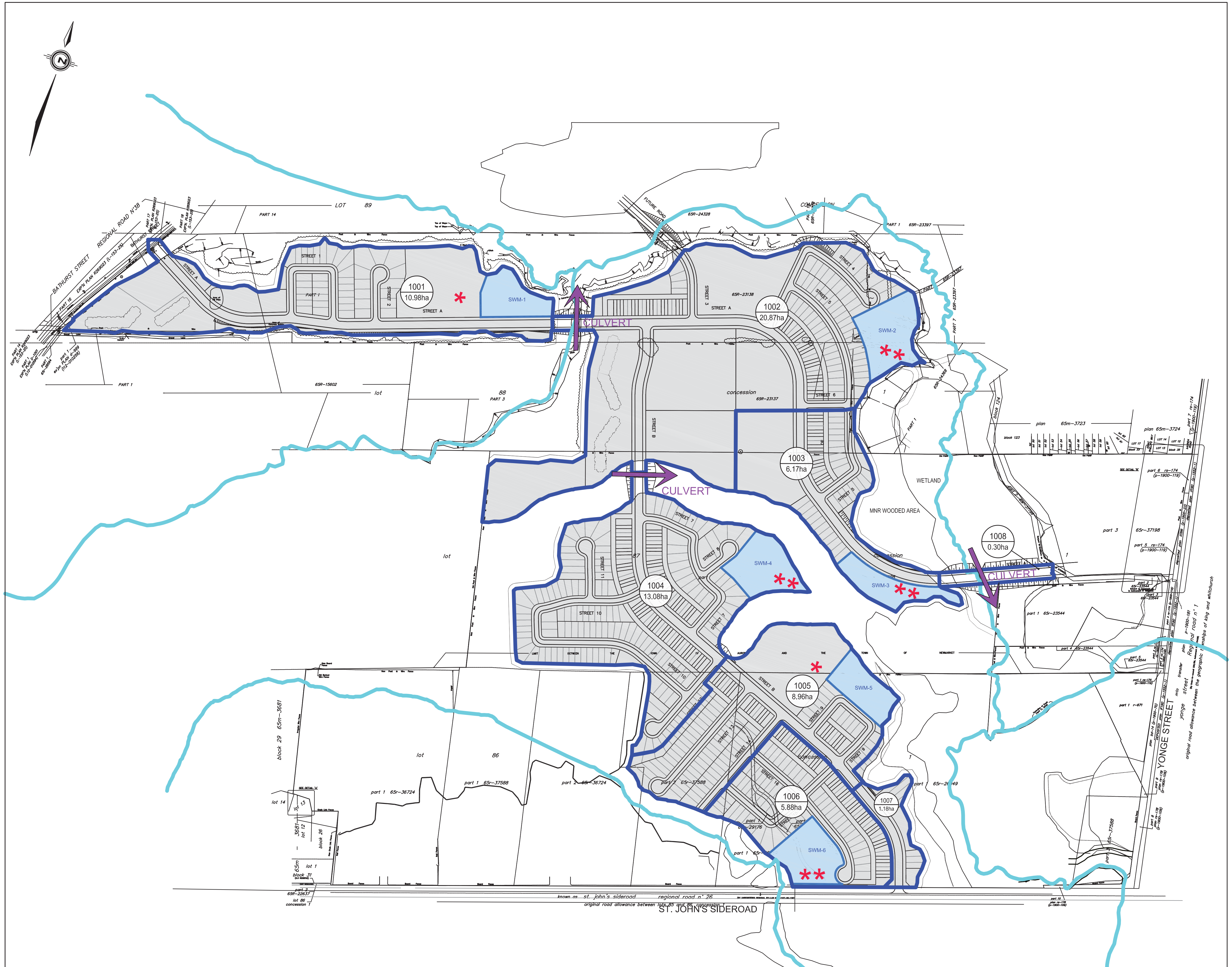
In support of the proposed SWM drainage scheme a post development drainage area was established for each of the six (6) SWM ponds (provided for catchments 1001 through 1006) based on the current Draft Plan and proposed site grading design. Each of these drainage areas have had their imperviousness estimated in consultation with both the Town of Newmarket and Town of Aurora Design criterias. In cases where overlap regarding land usage occurs, the higher imperviousness was used. Each of the proposed drainage areas, and their expected controlled areas are summarized in Table 2-2. Furthermore it should be noted that catchments 1001 and 1002 contain controlled site plans; the implication of this is further described in the following sections.

Table 2-2: Summary of Post Development Drainage Areas

Drainage ID	Area (ha)	Controlled Area (ha)	Controlled TIMP.*	Controlled Site Plan Area (ha)	Draining to
1001	10.98	7.82	0.54	2.05	Pond 1
1002	20.87	16.32	0.62	2.29	Pond 2
1003	6.17	5.56	0.68	-	Pond 3
1004	13.08	12.33	0.64	-	Pond 4
1005	8.96	8.85	0.51	-	Pond 5
1006	5.88	5.59	0.64	-	Pond 6
1007	1.18	0.71	0.67	-	Super Pipe
1008	0.30	-	-	-	Uncontrolled to Tannery Creek

*For catchments with a TIMP of < 0.60 a minimum TIMP of 0.60 was conservatively assumed during modeling.

Lastly the subject development is within the South Georgian Bay Lake Simco Region Source Protection area (February, 2018). As per the MOE Source Protection Atlas, majority of the site area is within the Q1/Q2 wellhead protection areas B, C and D. This means that groundwater from the site can be expected to impact the quality of the nearby drinking water wells within 2 to 25-years. As such the post to pre-development water balance needs to be maintained on-site through infiltration based LID's where necessary.



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LEGEND

SITE LOCATION

PROPOSED DRAINAGE AREAS

PROPOSED SWM PONDS

502
2.82ha
CATCHMENT ID
AREA IN HECTARES

PROPOSED CULVERT

* POTENTIAL CENTRALIZED LID LOCATION

** POTENTIAL LID WITHIN SWM POND

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FIGURE 2.2
POST-DEVELEOPMENT DRAINAGE

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LEGEND

SITE LOCATION

PROPOSED STORM SEWERS

PROPOSED SWM PONDS

PROPOSED OGS

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FIGURE 2.3
STORM SERVICING PLAN

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2.4 Allowable Release Rates

The allowable release rates for the post development were calculated using the pre-development Visual OTTHYMO models for the 2-year to 100-year storm events for the most conservative of the 4hr Chicago, Type II 12 AES, and Type II 24hr AES storms as per the aforementioned Design Criterias.

In order to estimate the allowable release rate for each pond, several pre-development catchments were used to establish rates for each SWM feature. A summary is provided in **Table 2-3** which displays the pre-development model used to establish rates for each of the 6 proposed ponds, and the southern storage pipe system.

Table 2-3: Pre-Development Peak Flows for 2-year to 100-year storms

SWM Feature	Pre-Development Nodes
Pond 1 (1001)	601 + 602
Pond 2 (1002)	501 + 502
Pond 3 (1003)	401
Pond 4 (1004)	301
Pond 5 (1005)	201 + 202
Pond 6 (1006)	101 + 102
Super Pipe (1007)	701

Detailed calculations for input parameters for the pre-development Visual OTTHYMO model are provided in Tables 1 through 5 in **Appendix A**. Time of concentration and site slopes were calculated using the Airport and equivalent slope methods respectively. As discussed, existing York County soil mapping, Soil survey No. 19, dictates that site soils are a Schomberg Clay, which belongs to soil group D. Furthermore the site's existing land type is considered to be predominantly pasture and pervious lawn due to the large grasses areas present on site. As such a CN of 80, and IA of 5mm was selected to model the site's pre-development conditions.

Furthermore, site plans present within catchments 1001 and 1002 have been proposed to be controlled to 180 L/s/ha. Details of these storages are provided in Sections 2.5 and 2.6. Site plans are proposed to have quality provided by the downstream SWM ponds, while volumetric (25mm retention) requirement will need to be provided within the site plans.

Table 2-3 through **Table 2-10** presents the pre-development peak flows based on Visual OTTHYMO modelling. The Visual OTTHYMO model output for predevelopment conditions are also presented in **Appendix A**. The following tables provide the estimated pre-development peak flows, to be used as the allowable release rates for each of the 7 SWM features, run with each of the aforementioned storms.

Table 2-4: SWM Pond 1 (1001) - Pre-Development Peak Flows for 2-year to 100-year storms

Return Period	4Hr Chicago Flow Rate (m^3/s)	12Hr SCSII Toronto Bloor Street Flow Rate (m^3/s)	24HR SCSII Toronto Bloor Street Flow Rate (m^3/s)
2-Year	0.148	0.233	0.270
5-Year	0.271	0.380	0.354
10-Year	0.364	0.505	0.563
25-Year	0.466	0.643	0.711
50-Year	0.628	0.780	0.836
100-Year	0.725	0.856	0.899

Table 2-5: SWM Pond 2 (1002) - Pre-Development Peak Flows for 2-year to 100-year storms

Return Period	4Hr Chicago Flow Rate (m^3/s)	12Hr SCSII Toronto Bloor Street Flow Rate (m^3/s)	24HR SCSII Toronto Bloor Street Flow Rate (m^3/s)
2-Year	0.148	0.246	0.284
5-Year	0.271	0.400	0.372
10-Year	0.364	0.531	0.592
25-Year	0.466	0.675	0.748
50-Year	0.628	0.819	0.886
100-Year	0.725	0.899	0.947

Table 2-6: SWM Pond 3 (1003) - Pre-Development Peak Flows for 2-year to 100-year storms

Return Period	4Hr Chicago Flow Rate (m^3/s)	12Hr SCSII Toronto Bloor Street Flow Rate (m^3/s)	24HR SCSII Toronto Bloor Street Flow Rate (m^3/s)
2-Year	0.116	0.179	0.206
5-Year	0.209	0.292	0.270
10-Year	0.279	0.387	0.431
25-Year	0.355	0.492	0.542
50-Year	0.474	0.596	0.643
100-Year	0.547	0.654	0.687

Table 2-7: SWM Pond 4 (1004) - Pre-Development Peak Flows for 2-year to 100-year storms

Return Period	4Hr Chicago Flow Rate (m^3/s)	12Hr SCSII Toronto Bloor Street Flow Rate (m^3/s)	24HR SCSII Toronto Bloor Street Flow Rate (m^3/s)
2-Year	0.237	0.375	0.434
5-Year	0.437	0.612	0.569
10-Year	0.586	0.813	0.901
25-Year	0.750	1.035	1.141
50-Year	1.011	1.255	1.341
100-Year	1.167	1.377	1.444

Table 2-8: SWM Pond 5 (1005) - Pre-Development Peak Flows for 2-year to 100-year storms

Return Period	4Hr Chicago Flow Rate (m^3/s)	12Hr SCSII Toronto Bloor Street Flow Rate (m^3/s)	24HR SCSII Toronto Bloor Street Flow Rate (m^3/s)
2-Year	0.086	0.135	0.157
5-Year	0.157	0.220	0.205
10-Year	0.211	0.292	0.324
25-Year	0.269	0.372	0.411
50-Year	0.362	0.451	0.484
100-Year	0.418	0.494	0.520

Table 2-9: SWM Pond 6 (1006) - Pre-Development Peak Flows for 2-year to 100-year storms

Return Period	4Hr Chicago Flow Rate (m^3/s)	12Hr SCSII Toronto Bloor Street Flow Rate (m^3/s)	24HR SCSII Toronto Bloor Street Flow Rate (m^3/s)
2-Year	0.122	0.192	0.221
5-Year	0.223	0.312	0.290
10-Year	0.300	0.415	0.462
25-Year	0.384	0.528	0.583
50-Year	0.517	0.641	0.686
100-Year	0.597	0.703	0.738

Table 2-10: Super Pipe (1007) - Pre-Development Peak Flows for 2-year to 100-year storms

Return Period	4Hr Chicago Flow Rate (m^3/s)	12Hr SCSII Toronto Bloor Street Flow Rate (m^3/s)	24HR SCSII Toronto Bloor Street Flow Rate (m^3/s)
2-Year	0.062	0.109	0.120
5-Year	0.120	0.174	0.155
10-Year	0.168	0.229	0.226
25-Year	0.225	0.289	0.305
50-Year	0.302	0.348	0.346
100-Year	0.343	0.381	0.384

2.5 Pond 1 Design

Catchment 1001 for pond 1 includes a large 1.92 ha park area, 0.85ha pond block, as well as single detached homes, and a 0.58ha medium density residential block. Two site plan blocks (0.6ha commercial and 1.44ha High Density residential) have also been proposed which will be able to provide on-site controls for quantity and quality. A 1.11ha uncontrolled area, including predominantly grassed features, and backyard area has been estimated. The following sections will describe how quantity, quality and volumetric requirements will be provided for Pond 1 catchment.

Note that detailed imperviousness calculations for all uncontrolled and controlled areas are provided in **Appendix A**. Imperviousness estimates for both the 18m and 26m right of ways present on-site were conducted based on the catchments which yielded the highest imperviousness. In this case the impervious calculation for 18m ROW's within the Pond 1 area and 26m ROW in Pond 3 area was used.

2.5.1 Erosion Controls

The erosion target release rate for Catchment 1001 was established based on the detention of the run-off from 25mm storm event and releasing it over 48 hours. As per calculations presented in Appendix B, the erosion control volume is estimated to be 1699 m^3 and the target release rate is calculated to be 0.015 m^3/s. The 1.11ha uncontrolled areas are excluded from these calculations since these areas will remain in their predevelopment state after construction or will be grassed areas.

2.5.2 Quantity Control

In order to accommodate the site plan blocks, a release rate of 180 L/s/ha has been accommodated by the pond. Storage estimates for the 100 year storm event for the site plan blocks are provided based on this rate, running all three of the required storms. Based on the results of the analysis the largest required storage was identified while running the 4hr Chicago Storm. **Table 2.11** below summarizes the Site Plan block storage requirements considered.

Table 2.11: Site Plan Block Required Storages

Block	Target Flow Rate (m^3/s/ha)	Area (ha)	Target Rate (m^3/s)	100-year 4hr Chicago Release Rate (m^3/s)	Required Storage (m^3)
Commercial	0.1800	0.60	0.108	0.107	201
High Density Residential		1.44	0.261	0.259	412

Following estimating catchment 1001's input parameters, Visual OTTHYMO (VO) modeling was used to estimate the required storage volume for quantity control during post-development conditions the 2-year to 100-year storm events (discussed previously in Section 2.2 Design Criteria). The methodology behind the conducted modeling is to design based on the storm (4hr Chicago, 12hr SCSII, and 24hr SCSII) which provides the highest required storage volume, while meeting their corresponding pre-development rate.

Based on the proposed site storm servicing plan, the site plan blocks as well as the remaining 7.82ha controlled site area (TIMP = 0.54 and XIMP = 0.47), will have downstream quantity controls managed by the proposed SWM Pond 1 facility. Note that a minimum TIMP of 0.60 has been conservatively used for modelling purposes. Based on the results of VO modeling for each storm event, the 24hr SCSII storm was found to yield the highest required storage volumes. As such the proposed SWM Pond 1 design will be based on the results of the 24hr SCSII as shown in **Table 2-12**. As is shown, an estimated 100 year storage volume of **4248m^3** is required for Pond 1. All VO modeling results for the required 3 storm are provided in **Appendix A** for review.

Table 2-12: Pond 1 - Summary of post development VO results – 24HR SCS

Storm Event	Pre development Release Rate -Target Rate (m^3/s) (24hr SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)Storage Provided (m3)	Storage Required (m3)	Post development Release Rate(m3/s)
Erosion Control	0.015	0.015	-	1,699	0.015
2 Year	0.148	0.066	0.082	2,079	0.087
5 Year	0.271	0.147	0.124	2,588	0.160
10 Year	0.364	0.208	0.156	2,943	0.227
25 Year	0.466	0.235	0.231	3,374	0.269
50 Year	0.628	0.335	0.293	3,933	0.365
100 Year	0.725	0.400	0.325	4,248	0.473

2.5.3 Volume Control

According to the LSRCA Technical guidelines, "*For new, nonlinear developments that create more than 0.5 hectares of new impervious surface on sites without restrictions, stormwater runoff volumes will be controlled and the post-construction runoff volume shall be captured and retained / treated on site from a 25 mm rainfall event from the total impervious area.*"

Volume required to be treated across catchment 1001: 25mm x 10 x 8.93ha x 50% = **1124m^3**

According to the calculations presented above, and in **Appendix B**, approximately 1124m^3 of water volume is required to be infiltrated or filtered across the site area. To meet this requirement filtration or infiltration (as site soils permit) will be provided within the park area or pond block. The provided retention method will be confirmed and sized at the detailed design phase.

2.5.4 Quality Control

Water Quality control will be provided for Catchment 1001 within the Pond 1 permanent pool. The pond will be sized to provide an 'enhanced' level of TSS removal (80% TSS removal). An estimated 9.87ha area is tributary to the pond (Imperviousness of 60%), which includes 2.05ha site plan area at 83% imperviousness. Based on Table 3.2 of the MOE SWM Design manual (March, 2003), a required volume of 1986m^3 is needed to meet this requirement. Detailed calculations are provided in **Appendix A**. To facilitate a treatment train approach to quality controls the following treatment options are considered:

1. Park Block Infiltration / Filtration + OGS Unit + SWM Pond Permanent Pool

2. Catchbasin Shield + Park Block Infiltration / Filtration + SWM Pond Permanent Pool

The final treatment approach will be selected as per future consultation with the Town. Furthermore, design of infiltration/filtration features will be confirmed at the detailed design stage.

2.6 Pond 2 Design

Catchment 1002 for pond 2 includes a 1.98 ha park area, 2.41ha institutional block, 1.29ha pond block, as well as single detached homes, and a 3.41ha medium density residential block. One 2.29ha high density residential site plan blocks has also been proposed, and will be able to provide on-site controls for quantity and quality. An area of 2.25ha will drain uncontrolled from the site, including predominantly grassed features, and backyard, as well as a planned restoration trail (C = 0.3) area has been estimated. The following sections will describe how quantity, quality and volumetric requirements will be provided for the Pond 2 catchment.

Note that detailed imperviousness calculations for all uncontrolled and controlled areas are provided in **Appendix A**. Imperviousness estimates for both the 18m and 26m right of ways present on-site were conducted based on the catchments which yielded the highest imperviousness. In this case the impervious calculation for 18m ROW's within the Pond 1 area and 26m ROW in Pond 3 area was used.

2.6.1 Erosion Controls

The erosion target release rate for Catchment 1002 was established based on the detention of the run-off from 25mm storm event and releasing it over 48 hours. As per calculations presented in Appendix B, the erosion control volume is estimated to be 3233 m^3 and the target release rate is calculated to be 0.028 m^3/s. The 2.25ha uncontrolled areas are excluded from these calculations since these areas will remain in their predevelopment state after construction or will be grassed areas.

2.6.2 Quantity Control

In order to accommodate the site plan blocks, a release rate of 180 L/s/ha has been accommodated by the pond. Storage estimates for the 100 year storm event for the site plan blocks are provided based on this rate, running all three of the required storms. Based on the results of the analysis the largest required storage was identified while running the 4hr Chicago Storm. **Table 2.13** below summarizes the Site Plan block storage requirements considered.

Table 2.13: Site Plan Block Required Storages

Block	Target Flow Rate (m^3/s/ha)	Area (ha)	Target Rate (m^3/s)	100-year 4hr Chicago Release Rate (m^3/s)	Required Storage (m^3)
High Density Residential	0.180	2.29	0.412	0.407	648

Following estimating catchment 1001's input parameters, Visual OTTHYMO (VO) modeling was used to estimate the required storage volume for quantity control during post-development conditions the 2-year to 100-year storm events (discussed previously in Section 2.2 Design Criteria). The methodology behind the conducted modeling is to design based on the storm (4hr Chicago, 12hr SCSII, and 24hr SCSII) which provides the highest required storage volume, while meeting their corresponding pre-development rate.

Based on the proposed site storm servicing plan, the site plan block as well as the remaining 16.32ha controlled site area (TIMP = 0.62 and XIMP = 0.52), will have downstream quantity controls managed by the proposed SWM Pond 1 facility. Based on the results of VO modeling for each storm event, the 24hr SCSII storm was found to yield the highest required storage volumes. As such the proposed SWM Pond 2 design will be based on the results of the 24hr SCSII as shown in **Table 2-14**. As is shown, an estimated 100 year storage volume of **11,317m^3** is required for Pond 1. All VO modeling results for the required 3 storm are provided in **Appendix A** for review.

Table 2-14: Pond 2 - Summary of post development VO results – 24HR SCS

Storm Event	Pre development Release Rate -Target Rate (m^3/s) (24hr SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)Storage Provided (m3)	Storage Required (m3)	Post development Release Rate(m3/s)
Erosion Control	0.028	0.028	-	3,233	0.028
2 Year	0.284	0.118	0.165	5,262	0.192
5 Year	0.372	0.159	0.213	6,126	0.265
10 Year	0.592	0.276	0.316	8,203	0.420
25 Year	0.748	0.333	0.415	9,604	0.583
50 Year	0.886	0.422	0.465	10,852	0.687
100 Year	0.947	0.426	0.521	11,317	0.761

2.6.3 Volume Control

According to the LSRCA Technical guidelines, "*For new, nonlinear developments that create more than 0.5 hectares of new impervious surface on sites without restrictions, stormwater runoff volumes will be controlled and the post-construction runoff volume shall be captured and retained / treated on site from a 25 mm rainfall event from the total impervious area.*"

Volume required to be treated across catchment 1002: 25mm x 10 x 18.57ha x 57% = **2,632m^3**

According to the calculations presented above, and in **Appendix B**, approximately 2632m^3 of water volume is required to be infiltrated or filtered across the site area. To meet this requirement filtration or infiltration (as site soils permit) can be provided within the pond block. The provided retention method will be confirmed and sized at the detailed design phase.

2.6.4 Quality Control

Water Quality control will be provided for Catchment 1002 within the Pond 2 permanent pool. The pond will be sized to provide an 'enhanced' level of TSS removal (80% TSS removal). An estimated 18.61ha area is tributary to the pond (Imperviousness of 64%), which includes 2.29ha site plan area at 79% imperviousness. Based on Table 3.2 of the MOE SWM Design manual (March, 2003), a required volume of 3,929m^3 is needed to meet this requirement. Detailed calculations are provided in **Appendix A**. To facilitate a treatment train approach to quality controls the following treatment options are considered:

1. Clean Water Collector + OGS Unit + SWM Pond Permanent Pool + Infiltration/Filtration Cell in Pond Block

2. Catchbasin Shields + SWM Pond Permanent Pool + Infiltration/Filtration Cell in Pond Block

Note that in the first option, due to the large catchment area, a clean water collector is proposed to reduce the loading on the proposed downstream OGS units. The final treatment approach will be selected as per future consultation with the Town. Furthermore design of infiltration/filtration features will be confirmed at the detailed design stage.

2.7 Pond 3 Design

Catchment 1003 for Pond 3 includes a 0.90ha pond block, as well as single detached homes, and a 1.82ha medium density residential block. An area of 0.61ha will drain uncontrolled, including predominantly grassed features, and backyard area has been estimated. The following sections will describe how quantity, quality and volumetric requirements will be provided for the Pond 3 catchment.

Note that detailed imperviousness calculations for all uncontrolled and controlled areas are provided in **Appendix A**. Imperviousness estimates for both the 18m and 26m right of ways present on-site were conducted based on the catchments which yielded the highest imperviousness. In this case the impervious calculation for 18m ROW's within the Pond 1 area and 26m ROW in Pond 3 area was used.

2.7.1 Erosion Controls

The erosion target release rate for Catchment 1003 was established based on the detention of the run-off from 25mm storm event and releasing it over 48 hours. As per calculations presented in Appendix B, the erosion control volume is estimated to be 940 m^3 and the target release rate is calculated to be 0.008 m^3/s. The 0.61ha uncontrolled areas are excluded from these calculations since these areas will remain in their predevelopment state after construction or will be grassed areas.

2.7.2 Quantity Control

Following estimating catchment 1003's input parameters, Visual OTTHYMO (VO) modeling was used to estimate the required storage volume for quantity control during post-development conditions the 2-year to 100-year storm events (discussed previously in Section 2.2 Design Criteria). The methodology behind the conducted modeling is to design based on the storm (4hr Chicago, 12hr SCSII, and 24hr SCSII) which provides the highest required storage volume, while meeting their corresponding pre-development rate.

Based on the proposed site storm servicing plan 5.56ha controlled site area (TIMP = 0.68 and XIMP = 0.54), will have downstream quantity controls managed by the proposed SWM Pond 3 facility. Based on the results of VO modeling for each storm event, the 24hr SCSII storm was found to yield the highest required storage volumes. As such the proposed SWM Pond 3 design will be based on the results of the 24hr SCSII as shown in **Table 2-15**. As is shown, an estimated

100 year storage volume of **2,303m^3** is required for Pond 3. All VO modeling results for the required 3 storm are provided in **Appendix A** for review.

Table 2-15: Pond 3 - Summary of post development VO results – 24HR SCS

Storm Event	Pre development Release Rate -Target Rate (m^3/s) (24hr SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)Storage Provided (m3)	Storage Required (m3)	Post development Release Rate(m3/s)
Erosion Control	0.008	0.008	-	940	0.008
2 Year	0.116	0.062	0.054	1,088	0.069
5 Year	0.209	0.129	0.080	1,361	0.144
10 Year	0.279	0.164	0.115	1,576	0.186
25 Year	0.355	0.213	0.142	1,805	0.242
50 Year	0.474	0.296	0.178	2,122	0.336
100 Year	0.547	0.351	0.196	2,303	0.398

2.7.3 Volume Control

According to the LSRCA Technical guidelines, "*For new, nonlinear developments that create more than 0.5 hectares of new impervious surface on sites without restrictions, stormwater runoff volumes will be controlled and the post-construction runoff volume shall be captured and retained / treated on site from a 25 mm rainfall event from the total impervious area.*"

Volume required to be treated across catchment 1003: 25mm x 10 x 6.17ha x 64% = **989m^3**

According to the calculations presented above, and in **Appendix B**, approximately 989m^3 of water volume is required to be infiltrated or filtered across the site area. To meet this requirement filtration or infiltration (as site soils permit) will be provided within the pond block. Furthermore an infiltration/filtration bed can be investigated within the pond block to meet this requirement. The provided retention method will be confirmed and sized at the detailed design phase.

2.7.4 Quality Control

Water Quality control will be provided for Catchment 1003 within the Pond 3 permanent pool. The pond will be sized to provide an 'enhanced' level of TSS removal (80% TSS removal). An estimated 5.56ha area is tributary to the pond (Imperviousness of 68%). Based on Table 3.2 of the MOE SWM Design manual (March, 2003), a required volume of 1,219m^3 is needed to meet this requirement. Detailed calculations are provided in **Appendix A**. To facilitate a treatment train approach to quality controls the following treatment options are considered:

1. OGS Unit + SWM Pond Permanent Pool + Infiltration/Filtration Cell in Pond Block

2. Catchbasin Shields + SWM Pond Permanent Pool + Infiltration/Filtration Cell in Pond Block

The final treatment approach will be selected as per future consultation with the Town. Furthermore design of infiltration/filtration features will be confirmed at the detailed design stage.

2.8 Pond 4 Design

Catchment 1004 for Pond 4 includes a 1.12ha pond block, as well as single detached homes. An area of 0.76ha will drain uncontrolled, including predominantly grassed features, and backyard area has been estimated. The following sections will describe how quantity, quality and volumetric requirements will be provided for the Pond 4 catchment.

Note that detailed imperviousness calculations for all uncontrolled and controlled areas are provided in **Appendix A**. Imperviousness estimates for both the 18m and 26m right of ways present on-site were conducted based on the catchments which yielded the highest imperviousness. In this case the impervious calculation for 18m ROW's within the Pond 1 area and 26m ROW in Pond 3 area was used.

2.8.1 Erosion Controls

The erosion target release rate for Catchment 1004 was established based on the detention of the run-off from 25mm storm event and releasing it over 48 hours. As per calculations presented in Appendix B, the erosion control volume is estimated to be 2,117 m^3 and the target release rate is calculated to be 0.018 m^3/s. The 0.76ha uncontrolled areas are excluded from these calculations since these areas will remain in their predevelopment state after construction or will be grassed areas.

2.8.2 Quantity Control

Following estimating catchment 1004's input parameters, Visual OTTHYMO (VO) modeling was used to estimate the required storage volume for quantity control during post-development conditions the 2-year to 100-year storm events (discussed previously in Section 2.2 Design Criteria). The methodology behind the conducted modeling is to design based on the storm (4hr Chicago, 12hr SCSII, and 24hr SCSII) which provides the highest required storage volume, while meeting their corresponding pre-development rate.

Based on the proposed site storm servicing plan 12.33ha controlled site area (TIMP = 0.64 and XIMP = 0.54), will have downstream quantity controls managed by the proposed SWM Pond 4 facility. Based on the results of VO modeling for each storm event, the 24hr SCSII storm was found to yield the highest required storage volumes. As such the proposed SWM Pond 4 design will be based on the results of the 24hr SCSII as shown in **Table 2-16**. As is shown, an estimated 100 year storage volume of **5,320m^3** is required for Pond 4. Based on the preliminary pond design

6,800m^3 of active storage is provided. All VO modeling results for the required 3 storm are provided in **Appendix A** for review.

Table 2-16: Pond 4 - Summary of post development VO results – 24HR SCS

Storm Event	Pre development Release Rate -Target Rate (m^3/s) (24hr SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)Storage Provided (m3)	Storage Required (m3)	Post development Release Rate(m3/s)
Erosion Control	0.018	0.018	-	2,117	0.018
2 Year	0.434	0.357	0.077	2,785	0.375
5 Year	0.569	0.476	0.093	3,183	0.503
10 Year	0.901	0.776	0.125	4,102	0.822
25 Year	1.141	0.971	0.170	4,671	1.020
50 Year	1.341	1.154	0.187	5,107	1.210
100 Year	1.444	1.237	0.207	5,320	1.293

2.8.3 Volume Control

According to the LSRCA Technical guidelines, "*For new, nonlinear developments that create more than 0.5 hectares of new impervious surface on sites without restrictions, stormwater runoff volumes will be controlled and the post-construction runoff volume shall be captured and retained / treated on site from a 25 mm rainfall event from the total impervious area.*"

Volume required to be treated across catchment 1004: 25mm x 10 x 13.08ha x 63% = **2049m^3**

According to the calculations presented above, and in **Appendix B**, approximately 2,049m^3 of water volume is required to be infiltrated or filtered across the site area. To meet this requirement filtration or infiltration (as site soils permit) can be provided within the pond block, likely as a filtration/infiltration bed. The provided retention method will be confirmed and sized at the detailed design phase.

2.8.4 Quality Control

Water Quality control will be provided for Catchment 1004 within the Pond 4 permanent pool. The pond will be sized to provide an 'enhanced' level of TSS removal (80% TSS removal). An estimated 12.33ha area is tributary to the pond (Imperviousness of 64%). Based on Table 3.2 of the MOE SWM Design manual (March, 2003), a required volume of 2,596m^3 is needed to meet this requirement. Detailed calculations are provided in **Appendix A**. To facilitate a treatment train approach to quality controls the following treatment options are considered:

1. Clean Water Collector + OGS Unit + SWM Pond Permanent Pool + Infiltration/Filtration Cell in Pond Block

2. Catchbasin Shields + SWM Pond Permanent Pool + Infiltration/Filtration Cell in Pond Block

Note that in the first option, due to the large catchment area, a clean water collector is proposed to reduce the loading on the proposed downstream OGS units. The final treatment approach will be selected as per future consultation with the Town. Furthermore design of infiltration/filtration features will be confirmed at the detailed design stage.

2.9 Pond 5 Design

Catchment 1005 for Pond 5 includes a 0.86ha pond block, 2.18ha park area as well as single detached homes. An area of 0.11ha will drain uncontrolled, including predominantly grassed features, and backyard area has been estimated. The following sections will describe how quantity, quality and volumetric requirements will be provided for the Pond 5 catchment.

Note that detailed imperviousness calculations for all uncontrolled and controlled areas are provided in **Appendix A**. Imperviousness estimates for both the 18m and 26m right of ways present on-site were conducted based on the catchments which yielded the highest imperviousness. In this case the impervious calculation for 18m ROW's within the Pond 1 area and 26m ROW in Pond 3 area was used.

2.9.1 Erosion Controls

The erosion target release rate for Catchment 1005 was established based on the detention of the run-off from 25mm storm event and releasing it over 48 hours. As per calculations presented in Appendix B, the erosion control volume is estimated to be 1,422 m^3 and the target release rate is calculated to be 0.012 m^3/s. The 0.11ha uncontrolled areas are excluded from these calculations since these areas will remain in their predevelopment state after construction or will be grassed areas.

2.9.2 Quantity Control

Following estimating catchment 1005's input parameters, Visual OTTHYMO (VO) modeling was used to estimate the required storage volume for quantity control during post-development conditions the 2-year to 100-year storm events (discussed previously in Section 2.2 Design Criteria). The methodology behind the conducted modeling is to design based on the storm (4hr Chicago, 12hr SCSII, and 24hr SCSII) which provides the highest required storage volume, while meeting their corresponding pre-development rate.

Based on the proposed site storm servicing plan 8.85ha controlled site area (TIMP = 0.51 and XIMP = 0.45), will have downstream quantity controls managed by the proposed SWM Pond 5 facility. Note that a minimum TIMP of 0.60 has been conservatively used for modelling purposes. Based on the results of VO modeling for each storm event, the 24hr SCSII storm was found to yield the highest required storage volumes. As such the proposed SWM Pond 5 design will be based on the results of the 24hr SCSII as shown in **Table 2-17**. As is shown, an estimated 100 year storage volume of **4,512m^3** is required for Pond 5. All VO modeling results for the required 3 storm are provided in **Appendix A** for review.

Table 2-17: Pond 5 - Summary of post development VO results – 24HR SCS

Storm Event	Pre development Release Rate -Target Rate (m^3/s) (24hr SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)Storage Provided (m3)	Storage Required (m3)	Post development Release Rate(m3/s)
Erosion Control	0.018	0.018	-	2,117	0.018
2 Year	0.434	0.357	0.077	2,785	0.375
5 Year	0.569	0.476	0.093	3,183	0.503
10 Year	0.901	0.776	0.125	4,102	0.822
25 Year	1.141	0.971	0.170	4,671	1.020
50 Year	1.341	1.154	0.187	5,107	1.210
100 Year	1.444	1.237	0.207	5,320	1.293

2.9.3 Volume Control

According to the LSRCA Technical guidelines, "*For new, nonlinear developments that create more than 0.5 hectares of new impervious surface on sites without restrictions, stormwater runoff volumes will be controlled and the post-construction runoff volume shall be captured and retained / treated on site from a 25 mm rainfall event from the total impervious area.*"

Volume required to be treated across catchment 1005: 25mm x 10 x 8.96ha x 50% = **1131m^3**

According to the calculations presented above, and in **Appendix B**, approximately 1,131m^3 of water volume is required to be infiltrated or filtered across the site area. To meet this requirement filtration or infiltration (as site soils permit) will be provided within the park area or other LID's within the pond block. The provided retention method will be confirmed and sized at the detailed design phase.

2.9.4 Quality Control

Water Quality control will be provided for Catchment 1005 within the Pond 5 permanent pool. The pond will be sized to provide an 'enhanced' level of TSS removal (80% TSS removal). An estimated 8.85ha area is tributary to the pond (Imperviousness of 51%). Based on Table 3.2 of the MOE SWM Design manual (March, 2003), a required volume of 1,590m^3 is needed to meet this requirement. Detailed calculations are provided in **Appendix A**. To facilitate a treatment train approach to quality controls the following treatment options are considered:

1. Park Block Infiltration / Filtration + OGS Unit + SWM Pond Permanent Pool

2. Catchbasin Shield + Park Block Infiltration / Filtration + SWM Pond Permanent Pool

The final treatment approach will be selected as per future consultation with the Town. Furthermore design of infiltration/filtration features will be confirmed at the detailed design stage.

2.10 Pond 6 Design

Catchment 1006 for Pond 6 includes a 1.06ha pond block, 2.12ha of single detached homes. An area of 0.29ha will drain uncontrolled, including predominantly grassed features, and backyard area has been estimated. The following sections will describe how quantity, quality and volumetric requirements will be provided for the Pond 6 catchment.

Note that detailed imperviousness calculations for all uncontrolled and controlled areas are provided in **Appendix A**. Imperviousness estimates for both the 18m and 26m right of ways present on-site were conducted based on the catchments which yielded the highest imperviousness. In this case the impervious calculation for 18m ROW's within the Pond 1 area and 26m ROW in Pond 3 area was used.

2.10.1 Erosion Controls

The erosion target release rate for Catchment 1006 was established based on the detention of the run-off from 25mm storm event and releasing it over 48 hours. As per calculations presented in Appendix B, the erosion control volume is estimated to be 944 m^3 and the target release rate is calculated to be 0.008 m^3/s. The 0.29ha uncontrolled areas are excluded from these calculations since these areas will remain in their predevelopment state after construction or will be grassed areas.

2.10.2 Quantity Control

Following estimating catchment 1006's input parameters, Visual OTTHYMO (VO) modeling was used to estimate the required storage volume for quantity control during post-development conditions the 2-year to 100-year storm events (discussed previously in Section 2.2 Design Criteria). The methodology behind the conducted modeling is to design based on the storm (4hr Chicago, 12hr SCSII, and 24hr SCSII) which provides the highest required storage volume, while meeting their corresponding pre-development rate.

Based on the proposed site storm servicing plan 5.59ha controlled site area (TIMP = 0.64 and XIMP = 0.54), will have downstream quantity controls managed by the proposed SWM Pond 6 facility. Based on the results of VO modeling for each storm event, the 24hr SCSII storm was found to yield the highest required storage volumes. As such the proposed SWM Pond 6 design will be based on the results of the 24hr SCSII as shown in **Table 2-18**. As is shown, an estimated 100 year storage volume of **2,250m^3** is required for Pond 5. All VO modeling results for the required 3 storm are provided in **Appendix A** for review.

Table 2-18: Pond 6 - Summary of post development VO results – 24HR SCS

Storm Event	Pre development Release Rate -Target Rate (m^3/s) (24hr SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)Storage Provided (m3)	Storage Required(m3)	Post development Release Rate(m3/s)
Erosion Control	0.008	0.008	-	944	-
2 Year	0.221	0.194	0.027	1,225	0.202
5 Year	0.290	0.257	0.033	1,394	0.270
10 Year	0.462	0.412	0.050	1,775	0.430
25 Year	0.583	0.520	0.063	2,009	0.540
50 Year	0.686	0.617	0.069	2,173	0.641
100 Year	0.738	0.660	0.078	2,250	0.682

2.10.3 Volume Control

According to the LSRCA Technical guidelines, "*For new, nonlinear developments that create more than 0.5 hectares of new impervious surface on sites without restrictions, stormwater runoff volumes will be controlled and the post-construction runoff volume shall be captured and retained / treated on site from a 25 mm rainfall event from the total impervious area.*"

Volume required to be treated across catchment 1006: 25mm x 10 x 5.88ha x 63% = **923m^3**

According to the calculations presented above, and in **Appendix B**, approximately 923m^3 of water volume is required to be infiltrated or filtered across the site area. To meet this requirement filtration or infiltration (as site soils permit) will be provided within the pond block. The provided retention method will be confirmed and sized at the detailed design phase.

2.10.4 Quality Control

Water Quality control will be provided for Catchment 1006 within the Pond 6 permanent pool. The pond will be sized to provide an 'enhanced' level of TSS removal (80% TSS removal). An estimated 5.59ha area is tributary to the pond (Imperviousness of 64%). Based on Table 3.2 of the MOE SWM Design manual (March, 2003), a required volume of 1,182m^3 is needed to meet this requirement. Detailed calculations are provided in **Appendix A**. To facilitate a treatment train approach to quality controls the following treatment options are considered:

1. OGS Unit + SWM Pond Permanent Pool + Infiltration/Filtration Cell in Pond Block

2. Catchbasin Shields + SWM Pond Permanent Pool + Infiltration/Filtration Cell in Pond Block

The final treatment approach will be selected as per future consultation with the Town. Furthermore design of infiltration/filtration features will be confirmed at the detailed design stage.

2.11 Super Pipe Storage Design

Catchment 1007 is a smaller 1.18ha area which could not be brought to drain to Pond 6. In light of this restraint it is proposed to capture and control majority of the runoff into a super pipe structure and discharge to the downstream watercourse. The controlled area includes a 0.15ha of detached lots, and 0.57ha of 26m ROW. An area of 0.46ha will drain uncontrolled, including predominantly grassed features, and backyard area due to grading constraints along the eastern property boundary. The following sections will describe how quantity, quality and volumetric requirements will be provided for catchment 1007.

Note that detailed imperviousness calculations for all uncontrolled and controlled areas are provided in **Appendix A**. Imperviousness estimates for both the 18m and 26m right of ways present on-site were conducted based on the catchments which yielded the highest imperviousness. In this case the impervious calculation for 18m ROW's within the Pond 1 area and 26m ROW in Pond 3 area was used.

2.11.1 Quantity Control

Following estimating catchment 1007's input parameters, Visual OTTHYMO (VO) modeling was used to estimate the required storage volume for quantity control during post-development conditions the 2-year to 100-year storm events (discussed previously in Section 2.2 Design Criteria). The methodology behind the conducted modeling is to design based on the storm (4hr Chicago, 12hr SCSII, and 24hr SCSII) which provides the highest required storage volume, while meeting their corresponding pre-development rate.

As the proposed super pipe structure is for a smaller area, it has been proposed that the flows from the 0.71 (TIMP = 0.67 & XIMP = 0.64) are controlled to the 2 year pre-development rate for all storms up to and including the 100 year event. By using this approach it will allow for a simpler control structure design within the ROW.

Based on the proposed site storm servicing plan 0.71ha controlled site area (TIMP = 0.67 and XIMP = 0.64), will have downstream quantity controls managed by the proposed SWM Pond 6 facility. Based on the results of VO modeling for each storm event, the 4hr Chicago storm was found to yield the highest required storage volumes. As such the proposed SWM Pond 6 design will be based on the results of the 24hr SCSII as shown in **Table 2-19**.

Table 2-19: Super Pipe (1007) - Summary of Post development VO results – 4HR Chicago

Storm Event	Pre Development Release Rate -Target Rate (m^3/s) (24hr SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)Storage Provided (m3)	Storage Provided (m3)	Post Development Release Rate(m3/s)
2 Year	0.062	0.026	0.036	123	0.036
5 Year	0.120	0.026	0.055	173	0.055
10 Year	0.168	0.026	0.080	208	0.080
100 Year	0.225	0.026	0.100	242	0.100
100 Year	0.302	0.026	0.122	284	0.122
100 Year	0.343	0.026	0.140	322	0.140

As is shown, an estimated 100 year storage volume of **322m^3** is required for Catchment 1007 which can be provided via a pipe or culvert structure. The required control structure will be provide via an orifice plate, sizing of which will be confirmed at the detailed design stage. All VO modeling results for the required 3 storm are provided in **Appendix A** for review.

2.11.2 Volume Control

According to the LSRCA Technical guidelines, "*For new, nonlinear developments that create more than 0.5 hectares of new impervious surface on sites without restrictions, stormwater runoff volumes will be controlled and the post-construction runoff volume shall be captured and retained / treated on site from a 25 mm rainfall event from the total impervious area.*"

Volume required to be treated across catchment 1007: 25mm x 10 x 1.18ha x 51% = **151m^3**

According to the calculations presented above, and in **Appendix B**, approximately 151m^3 of water volume is required to be infiltrated or filtered across the site area. To meet this requirement filtration or infiltration (as site soils permit) can be provided using an exfiltration system (perforated clean water collector). The provided retention method will be confirmed and sized at the detailed design phase.

2.11.3 Quality Control

Water Quality control will be provided for Catchment 1007 through a treatment train approach. It is proposed to treat flows initially through the use of catchbasin shields to provide an initial 50% TSS removal. This is to be followed by a downstream OGS unit sized for 80% TSS removal (credited for 50% TSS removal) downstream of the proposed control structure for the super pipe storage structure.

2.12 Water Balance

The subject site is located within the WHPA (Well Head Protection Area) Q1 and Q2, therefore pre-development infiltration volumes are to be maintained. A preliminary water balance was completed for the 67.42ha development area and is provided in **Appendix A** for the development. A bulk site imperviousness of 60% was taken based on the post development imperviousness calculations for the site.

Based on the water balance assessment, a minimum 1.63mm/year of infiltration across the site area will be required to meet the water balance. As this is a smaller target to achieve, the water balance can be met if the volumetric requirement is achieved through the infiltration of 25mm, or even 12.5mm, therefore satisfying both the water balance and volumetric requirements. A detailed water balance assessment will be conducted during the detailed design stage once appropriate site LID's are finalized. Furthermore other mitigation measures, such as downspout disconnection, can be considered to further mitigate the site's expected infiltration deficit.

2.13 Flood Plain Analysis

The LSRCA HEC-RAS model was obtained in order to establish the existing flood lines along Tannery Creek, adjacent to the site. This information was used to ensure pond outlet elevations remain above the flood line elevations. The existing model has been attached in **Appendix B**. Note that refinement to the existing model will be performed at a later stage to include the 3 proposed culverts at the detailed design stage once culvert sizings have been finalized.

2.14 Phosphorus Loading

High phosphorus loading in Lake Simcoe have led to excessive growth of plants and algae in the lake. Since the phosphorus contribution of stormwater is considerably higher in the tributaries and lakes, it needs to be controlled.

Filtration, infiltration galleries and storage chambers can reduce the phosphorus loadings into creeks and lakes. The Ontario Ministry of the Environment's Lake Simco Phosphorus Budget Tool was used in conducting a preliminary assessment of the proposed development's phosphorus budget. Each of the post development catchments was assessed individually and results are summarized in the table below.

Table 2-20: Phosphorus Loading Estimate

Catchment	Area (ha)	Pre-dev Load (kg/yr)	Post Dev. Load (kg/yr)	Post Dev. With Mitigation (kg/yr)	% Increase from Pre Dev.
1001	10.98	3.95	10.27	3.89	-2%
1002	20.87	7.51	21.15	8.01	6.6%
1003	6.17	2.22	6.46	2.44	9.93%
1004	13.08	4.71	15.06	5.63	19.62%
1005	8.96	3.23	8.18	3.18	-2%
1006	5.88	2.12	6.29	2.35	11.12%
1007	1.18	0.42	1.01	0.77	81.87
1008	0.30	0.11	0.40	0.40	267%
Total	67.42	24.27	68.82	26.67	9.89%

Predevelopment phosphorus loading was calculated for each of the catchments based on a cropland value of 0.30kg/ha/yr which reflects the site's predominantly agricultural land use. For post-development conditions, urban residential rate of 1.32kg/ha/yr was used in the post-development calculations. Furthermore a low intensity development rate of 0.13kg/ha/yr was assumed for predominantly grassed areas, while an open water rate of 0.26kg/yr was used to estimate rates for each of the SWM pond blocks. The downstream wet ponds are considered to provide a TP removal rate of 63% for areas tributary to the SWM ponds. The resulting analysis shows approximately a 10% increase in phosphorus loading can be expected annually as a result of the development.

A detailed phosphorus loading estimate will be conducted at the detailed design stage to incorporate any proposed LID's to be used to meet both volumetric and water balance requirements. Any remaining phosphorus loading will be addressed by providing Cash in-lieu, as required by the LSRCA's Phosphorus Offsetting Policy. Detailed MOE Phosphorus tool output is provided for each catchment within **Appendix A**.

3 Sanitary Servicing

3.1 Existing Sanitary Infrastructure

Within the Town of Aurora there is an existing sanitary sewer system located at the intersection of Willow Farm Lane and St. Johns Sideroad servicing the existing residential subdivision south of St. Johns Sideroad**.** The sanitary sewer system eventually joins the existing 975mm diameter sanitary sewer on Yonge Street and continues to convey flow easterly along St. John's Sideroad to the York-Durham sanitary sewer system. Please refer to existing drawings D-5-8628-48 and D-5-8628-49 provided in **Appendix B** for reference.

In addition, a sanitary trunk sewer exists which drains southward along the eastern side of the site. This trunk sewer is referred to as the Southwest Sanitary Trunk Sewer. The sewer size of this system is between 600mmØ and 750mmØ in proximity to the site. This sanitary trunk sewer, which is part of the Town of Newmarket, roughly follows parallel to Armitage Creek, until it crosses over Yonge Street and discharges to the York-Durham sanitary sewer system at MH4. Please refer to the sanitary tributary drawing SW-16, provided in **Appendix C** of this report for reference.

3.2 Design Criteria

The proposed sanitary servicing of the subject site will be designed in accordance with both the Town of Aurora Design Criteria and the Town of Newmarket for wastewater systems. These criteria, where applicable to the proposed development, are summarized below.

<u>Town of Newmarket</u>

- Population densities as per the following unit types:

Single Detached Dwellings	3.38 ppu
Semi-Detached Dwellings	3.04 ppu
Townhouses	2.88 ppu
Apartments	1.95 ppu

- Commercial / Institutional Sewage Flows calculated generally based on floor area:

Office	4 L/day/m^2
Retail	4 L/day/m^2
Restaurant	60 L/day/m^2
Schools	1.6 L/s/ha (based on 220 students or staff per hectare, 140 L/person/ 8hr and peak of 1.5 + 0.3L/s/ha infiltration allowance)

- The Design Flow is equal to the Average Dry Weather Flow multiplied by the Average Peak Sanitary Flow Factor, plus the Infiltration Allowance;

- Anticipated average daily design flow rate of 360 L/capita/day shall be used for determining the capacity of the sanitary sewer;

- An allowance of 0.30L/s/ha should be used in the design for peak extraneous flows for all types of land use; and

- Harmon Peaking Factor to be determined using $M = 1+14/ (4+p^{0.5})$, where p = population in thousands (subject to a minimum and maximum Harmon Peaking factor of 2.0 and 4.0, respectively).

Town of Aurora

- Population densities as per the following land uses:

Single & Semi-Detached Residential	3.8 persons / unit
Townhouses	3.5 persons / unit
Apartments	2.5 persons / unit
Institutional, Parks & Recreational	50 persons / hectare
Commercial	75 persons / hectare

- The Design Flow is equal to the Average Dry Weather Flow multiplied by the Average Peak Sanitary Flow Factor, plus the Infiltration Allowance;

- Anticipated design flow rate of 400 L/capita/day shall be used;

- Except under unusual circumstances, infiltration allowance shall be determined at 0.26L/s/ha for all types of land use; and

- Harmon Peaking Factor to be determined using $M = 1+14/ (4+p^{0.5})$, where p = population in thousands (subject to a minimum and maximum Harmon Peaking factor of 2.0 and 4.0, respectively).

3.3 Proposed Sanitary Servicing

Prior to estimating sanitary flows the proposed site population was estimated using both the Town of Aurora Design Criteria and the Town of Newmarket for wastewater systems. Population estimates were estimated based on the proposed split drainage of the development, as shown in Figure C-1 in **Appendix B**. The estimated population was determined to be 4960 people (approximately 500persons to the Town of Aurora, and 4460 persons to the Town of Newmarket). Please refer to **Appendix B** for the detailed breakdown of the estimated population for the proposed development.

In order to maintain the use of gravity conveyance on-site, the proposed sanitary flows from the site will be split into two systems. The first system, which accounts for approximately 58ha of the site, is proposed to have sanitary flows drain eastwards to the Southwest Sanitary Trunk Sewer. A connection from the site will be made to Ex. MH12A along the trunk, where the existing sewer size is 750mmØ. As the Southwest Sanitary Trunk Sewer is owned by the Town of Newmarket, the Town of Newmarket criteria was consulted when estimating flows from this system. Estimated sanitary demands for the site tributary to the Newmarket Southwest Sanitary Trunk Sewer are provided in **Table 3-1**.

Table 3-1: Sanitary Servicing Flow Summary Table (to Newmarket System)

Residential Average Flow (L/s)	18.396
Residential Peaking Factor	3.29
Total Peak Flow (L/s)	64.635
Inflow and Infiltration (L/s)*	13.378
Total Flow (L/s)	73.99

* Inflow and infiltration based on 0.30 L/s/ha and an infiltration area of 46.99ha.

The second system is proposed to drain to the existing sanitary sewer along St. John's Sideroad in the Town of Aurora. This system will accept sanitary flows from approximately 9.0 ha of the site. The proposed sanitary sewers from this area are proposed to connect to the existing system at proposed MH P27A and existing MH69A. Sanitary flows were estimated from this area based on the Town of Aurora Design Criteria. Estimated sanitary demands for the site tributary to the Aurora sewer along Willow Farm Lane are provided in **Table 3-2**.

Table 3-2: Sanitary Servicing Flow Summary Table (to Aurora System)

Average Flow (L/s)	2.315
Peaking Factor	3.97
Peak Flow (L/s)	9.20
Inflow and Infiltration (L/s)*	2.061
Total Flow (L/s)	11.26

* Inflow and infiltration based on 0.26 L/s/ha and an infiltration area of 7.93ha.

Internally, the site will be serviced according to the proposed sanitary schematic, also shown on **Figure 3.1**. Calculations are provided in **Appendix B**.

3.4 Downstream Sanitary Analysis

To support the proposed split servicing scheme for the site, two separate analyses have been conducted based on the expected sanitary flows to the receiving trunk sewer.

The first system discharges to the Town of Newmarket Sewer. The Southwest Sanitary Trunk Sewer owned by the Town of Newmarket was observed in order to ensure there is available capacity for approximately 58ha of the proposed development site. According to the Southwest Sanitary Trunk Sewer Sanitary Drainage Plan, attached in **Appendix B** the existing MH 12A was designed with a tributary area of 83.5 ha and a population of 6460 people. 58ha from the proposed development with a corresponding population of 4459 people is proposed to drain to the existing MH 12A. Since the proposed tributary area of 58ha from the proposed development and corresponding population of 4459 is less than the designed tributary area of 83.5 ha and population of 6460 people, there will not be any adverse conditions to the Town of Newmarket trunk sewer.

In order to ensure that adequate capacity is available for the second system, discharging to the Town of Aurora Sewers, a sanitary analysis was conducted for the downstream sewers along Willow Farm Lane and Heatherfield Lane, to the Yonge Street Sanitary trunk. Under existing conditions the downstream sanitary sewer services both the Ballymore Development Subdivision to the west of the proposed development, as well as the St. Andrews on the Hill residential subdivision south of the proposed development, as shown in Figure-C1 of **Appendix B**. Furthermore, the incorporation of the proposed Shining Hill Collection Inc. Phase 2 subdivision along St. John's Sideroad was also incorporated into the sewer analysis. Using available sanitary tributary areas from the Town of Aurora, as well as the expected design populations from both Shining Hill Phase 2 and the subject development (Phase 3) the exiting capacity of the pipes along Heatherfield Lane were determined to not exhibit surcharge conditions.

With the addition of the proposed 9.71ha development, it was found that sufficient capacity exists to service the proposed development without surcharge. Therefore, it is expected that the existing sanitary sewer has sufficient capacity to service the site. All related design sheets for existing and proposed conditions are provided in **Appendix B** for review.

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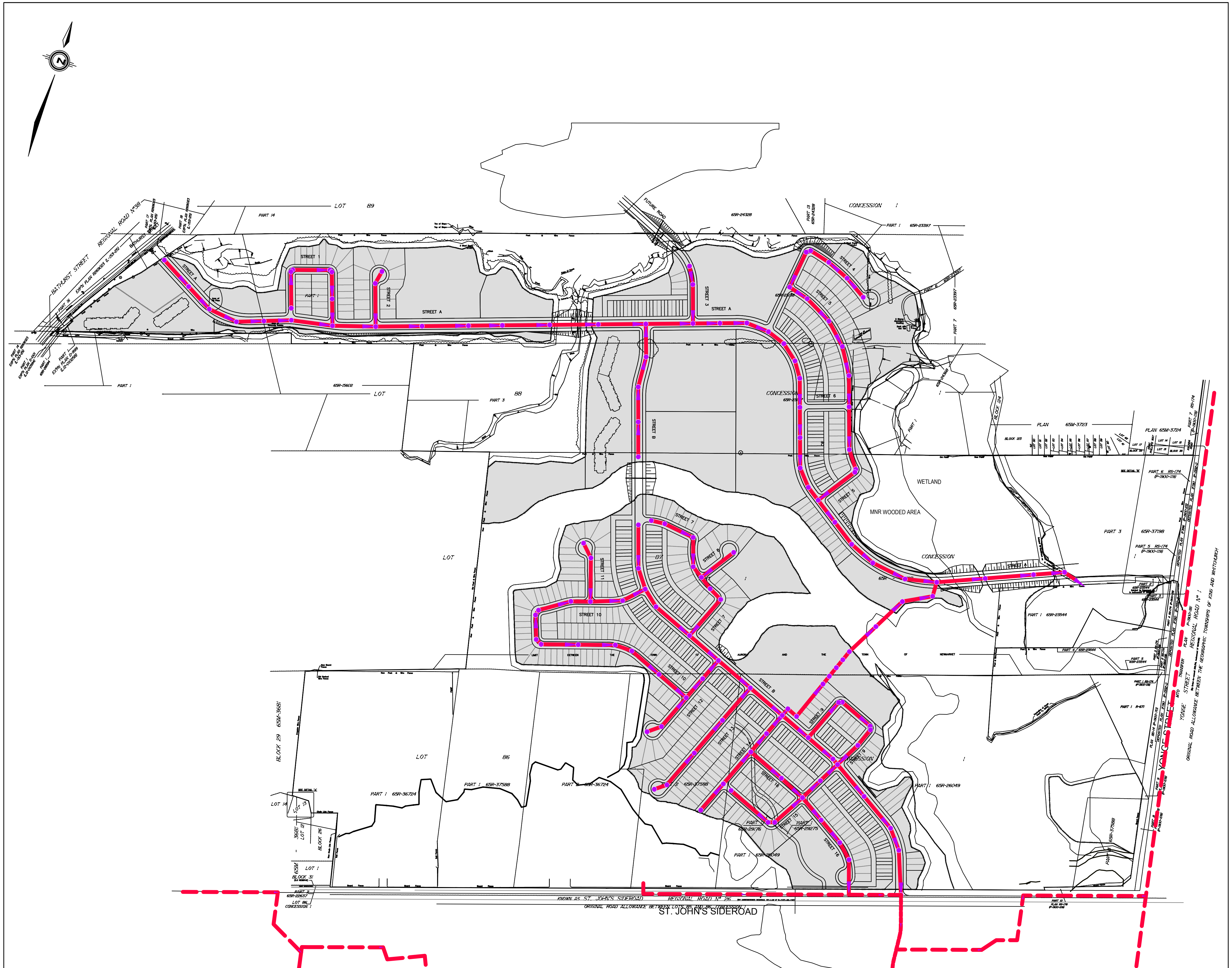

SHINING HILL HOMES (ST. JOHN'S) INC.
DUNIN ESTATES RESIDENTIAL SUBDIVISION

LEGEND

SITE LOCATION

PROPOSED SANITARY SEWERS

EXISTING SANITARY SEWERS

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 3.1
SANITARY SERVICING PLAN

2019-4750	SEPTEMBER 2019	SCALE: N.T.S.

Michael Ventresca

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4 Water Supply

4.1 Existing Water Supply Services

The subject site is located in the Zone 1 (Aurora Central) and Zone 2 (Aurora West) pressure districts for the areas in Aurora and in the Newmarket West pressure district for the areas of the subject site that fall within Newmarket please refer to **Appendix C** for a schematic illustration of the Region of York pressure district map.

There is an existing 200mmØ to the south of the subject site which reduces into a 150mmØ diameter watermain west of the site along St. John's Sideroad (as shown on **Figure 4.1**). There is an existing 600mmØ transmission concrete watermain along Bathurst Street to the northwest of the subject site as well as a transmission watermain along Yonge Street to the East of the subject site.

The Newmarket West Reservoir that feeds the Newmarket West pressure district is located just northwest of the subject site.

4.2 Design Criteria

The proposed water supply scheme will be designed in accordance with the Town of Aurora Design Criteria Manual for Engineering Plan (February 2017) and with the Town of Newmarket Engineering Design Standards and Criteria (September 2018) for the areas located in Aurora and Newmarket respectively.

Aurora

- The system shall be designed to provide sufficient flow and pressure to meet the greater of the Fire Flow plus Maximum Daily Demand, or the Peak Hourly Demand;
- Average Daily Demand of 390 L/capita/day;
- Equivalent population density of;
    - 3.8 persons/unit for single detached and semi-detached households;
    - 3.5 capita/unit for townhouses;
    - 2.5 capita/unit for apartments;
    - 75 capita/ha for commercial; and
    - 50 capita/ha for park and institutional land;
- Demand Peaking Factors shall be;
    - Maximum Daily Demand = 1.8;
    - Maximum Hourly Demand = 5.0; and
    - Minimum Hourly Demand = 0.65.
- Fire flow requirements;
    - 6,000 L/min Residential;

- 10,000 L/min Commercial; and
- 15,000 L/min Institutional.

- Hazen Williams Factors;

Pipe Size	Hazen Williams C-Factor
150mm	100
200-250mm	110
300-600mm	120
>600mm	130

- System Pressure Constraints;
  - Fire Flow: 140kPa;
  - Peak Hour: 275kPa;
  - Min Hour: 700kPa; and
  - Max Day: 350 – 550kPa.

Newmarket

- The system shall be designed to provide sufficient flow and pressure to meet the greater of the Fire Flow plus Maximum Daily Demand, or the Peak Hourly Demand;
- Average Daily Demand of 300 Litres/capita/day;
- Equivalent population density of;
  - 3.38 persons/unit for single detached households;
  - 3.04 semi-detached households;
  - 2.88 capita/unit for townhouses;
  - 1.95 capita/unit for apartments;
  - 2,000 capita/ha floor area for commercial; and
  - 60 capita/ha for park and institutional land;
- Demand Peaking Factors shall be;
  - Maximum Daily Demand = 2.0;
  - Maximum Hourly Demand = 3.0; and
  - Minimum Hourly Demand = 0.70
- Fire flow requirements;
  - 7,000 L/min Singles & Semis;
  - 10,000 L/min Townhouses;
  - 10,000 L/min Commercial;
  - 15,000 L/min Institutional.
- Hazen Williams Factors;

Pipe Size	Hazen Williams C-Factor
150mm	100
200-250mm	110
>300mm	120

- Pressure Constraints;
  - Fire Flow: 140kPa;
  - Peak Hour: 350kPa; and
  - Min Hour: 550kPa.

4.3 Proposed Water Supply

The proposed water supply network will connect to the existing infrastructure in three (3) locations, one (1) to the existing 200mmØ watermain at the intersection of the proposed Street 'B' and St. Johns Sideroad, one (1) to the existing 300mmØ watermain at the proposed extension of Bennington Road (Street 'A') on the east side of the subject site, and one (1) to the existing 600mmØ CPP watermain on the intersection of the proposed Street 'A' and Bathurst street. Internally, the proposed watermain system will generally align with the road network to allow connection for each dwelling. **Figure 4.1** provides a schematic illustration of the water supply network. There are two (2) proposed water meter chambers to be placed at the dividing line between the Town of Aurora and Newmarket, these meters are proposed to measure the domestic water flow between Aurora West/Central and Newmarket West for cost sharing purposes. Please note that these water meter chamber connections will be required to have a bypass for fire flow situations. There is also a pressure reducing valve (PRV) proposed on Street 'B' in the north of the subject site to reduce the pressure from the Newmarket West Reservoir to service the lower eastern and southern areas of the subject site. For more details on the existing and proposed water supply servicing scheme refer to the preliminary engineering drawings in **Appendix C**.

The population used for the water supply calculations and subsequent hydraulic modelling was determined using both the Aurora and Newmarket criteria according to the location of the proposed lots. The design populations used for the determination of the water supply demands are presented in **Table 4-1** below. Anticipated water supply demands are as summarized in **Table 4-2** below. Detailed calculations for the design population and corresponding demands are provided in **Appendix C** for reference.

Table 4-1: **Water Supply Servicing Design Population**

Municipality	Land Use	Design Population
Aurora	Residential	1,196
Aurora	Park/Recreational	109
Newmarket	Residential	4,644
Newmarket	Commercial	45
Newmarket	Institutional	120
Newmarket	Park/Recreational	206
Total	--	6,320

Table 4-2: **Water Supply Servicing Total Flow Summary Table**

Demand Scenario	Demand Flow (L/s)
Average Daily Demand (L/s)	28.53
Maximum Daily Demand (L/s)	55.88
Maximum Hourly Demand (L/s)	97.36
Minimum Hourly Demand (L/s)	19.67

4.4 WaterCAD Modelling and Results

WaterCAD® (Connect Edition Update 1) water supply modelling was prepared in order to analyze the proposed system under various demand scenarios (Average Day, Max Day, Peak Hour, Fire Flow) as per the Towns of Aurora & Newmarket criteria. WaterCAD modelling outputs for the various demand scenarios are included in **Appendix C** for reference.

4.4.1 WaterCAD Simulation Assumptions

WaterCAD Simulation WaterCAD uses the Gradient Algorithm to find a solution for pipe networks. As stated in WaterCAD User's Guide (December 2018): "The gradient algorithm for the solution of pipe networks is formulated upon the full set of system equations that model both heads and flows. Since both continuity and energy are balanced and solved with each iteration, the method is theoretically guaranteed to deliver the same level of accuracy observed and expected in other well-known algorithms such as the Simultaneous Path Adjustment Method (Fowler) and the Linear Theory Method (Wood)."

As previously stated, Hazen – Williams equation is used for friction:

$$V = 0.85\ Cr^{0.63}\ S^{0.54}$$

Where V = velocity in the pipe (m/s)
C = constant (pipe roughness)
r = hydraulic radius of pipe (m)
S = hydraulic gradient (m/m)

Minor losses (local losses) are assumed negligible and ignored.

4.4.2 Model Boundary Conditions

A hydrant flow test has been undertaken by Aquazition at the residual fire hydrant (#WTR-hy-5070-03) and a flow hydrant of (#WTR-hy-5070-09) on July 17th 2017. The static pressure was observed to be 50psi ($35m_{H2O}$). A hydrant flow test has been undertaken by Aquazition at the fire hydrant on 899 Isaac Philips Way (Residual) and the hydrant on 90 Kalinda Road (Flow) on July

19th 2017, the static pressure was observed to be 65psi (46m_{H_2O}). A copy of both of these fire hydrant test results are presented in **Appendix C** for reference. These hydrant tests were used for the connections to St. Johns Sideroad and the connection at the proposed intersection of Street 'B' & Street 'A' / Bennington Road through Shining Hill Phase 1.

The boundary condition taken for the connection to the Bathurst Street transmission main was taken from the Newmarket West Pressure District Boundary. Based on the serviceable range indicated in the Region of York Proposed Water Pressure Districts Figure, attached in **Appendix C**, the serviceable ground elevations of the pressure district range from ~266m – 314masl, therefore it can be assumed that the maximum pressure is not exceeded in the lowest areas and the minimum pressure is provided in the highest areas (i.e. 350kPa (35m_{H_2O}) + 314m = ***349.7m*** & 550kPa (56m_{H_2O}) + 275m = ***331.1m***). These boundary conditions of the operating water levels of the Newmarket West Reservoir shall be confirmed by the Town of Newmarket.

It is noted that the Woodland Hills Subdivision just north of the subject site also lies within the Newmarket West pressure district and the hydraulic modeling was established and approved with an HGL range of 329.7m – 338.9m, providing a basis to confirm the assumptions used for the preliminary design stage of Shining Hill Phase 3.

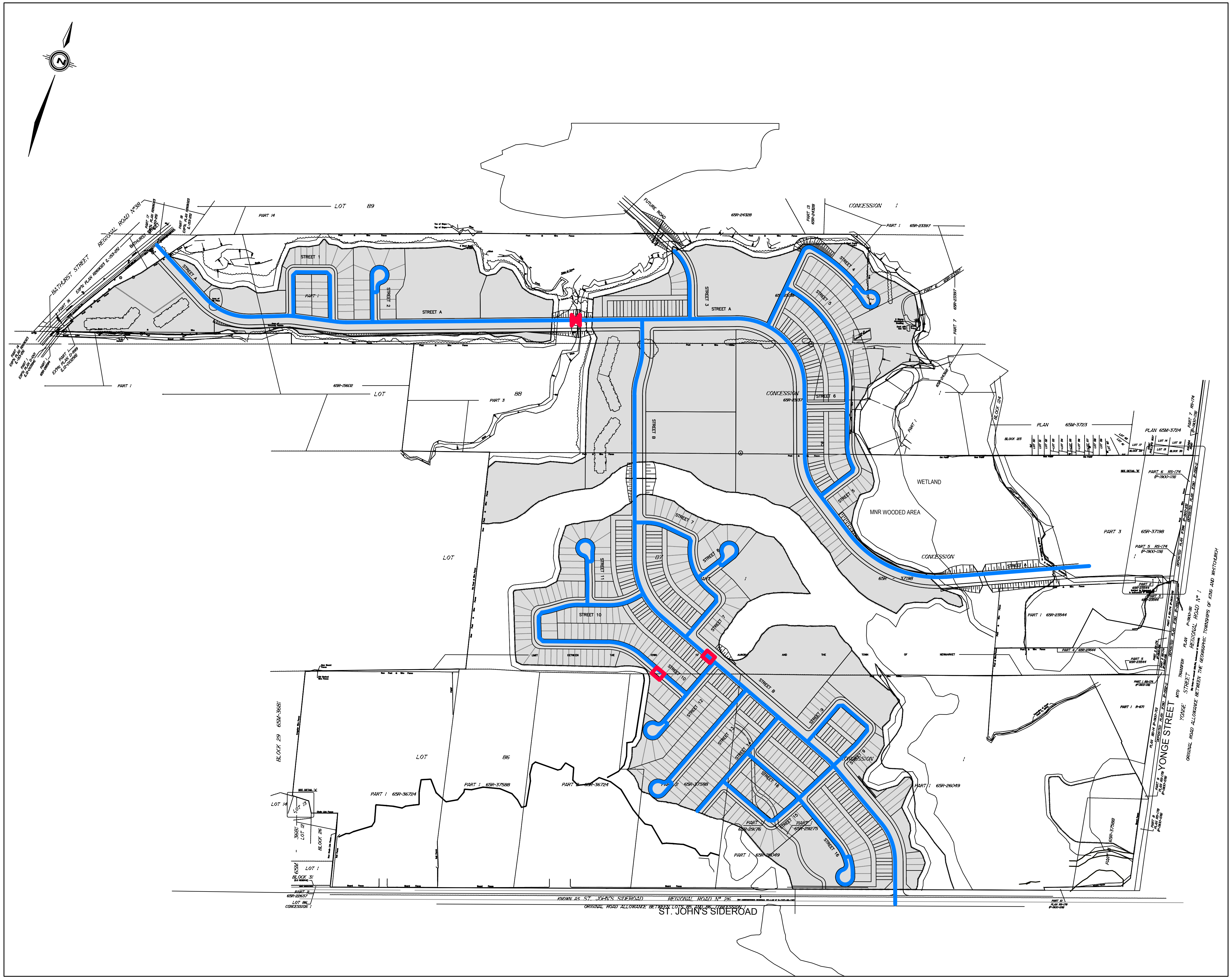
4.4.3 Model Results

The hydraulic WaterCAD model reveals a few areas of non-compliance with the respective Town criteria. It should be noted that the proposed commercial and medium density developments in the northwest of the site neighbouring the Newmarket West Reservoir are under the Newmarket criteria for pressure in either the minimum or maximum HGL condition of the reservoir. Due to the high elevation of this area and the proximity to the reservoir there may be a need for a booster pump for these service connections where the pressure is anticipated to be below the Town criteria. Please note that the operation of the Newmarket West Reservoir must be confirmed by the Town as a difference in operating level from the assumptions will impact the modeling results.

Furthermore, in order to mitigate the southern and eastern locations of the site in Newmarket that slightly exceed the recommended maximum operating pressure in Newmarket of 550kPa, it is proposed to install a pressure reducing valve (PRV) with a maximum boundary condition of an HGL of ~320m. As previously stated however, when further detail are known of the operation of the Newmarket West Reservoir the assumptions can be confirmed and the need for a PRV and its settings can be concluded.

Please find the output results of the WaterCAD model in **Appendix C**.

SHINING HILL HOMES (ST. JOHN'S) INC.
DUNIN ESTATES RESIDENTIAL SUBDIVISION



LEGEND

SITE LOCATION

PROPOSED WATERMAINS

PRESSURE REDUCING VALVE

WATER METER CHAMBER

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 4.1
WATER SUPPLY SERVICING PLAN

2019-4750	SEPTEMBER 2019	SCALE: N.T.S.

Michael Ventresca

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5 Closing Remarks

This report provides a Functional Servicing Plan for stormwater, sanitary, and water servicing. The proposed servicing scheme can be summarized as follows:

Stormwater Management:

- Post to pre-quantity control for the 2-year through 100-year design storms will be provided by proposed SWM ponds, as well as pipe storage.
- Enhanced level quality controls are to be provided by each pond's permanent pool. Treatment train approach is proposed for controlled areas not draining to a pond.
- Volume/Erosion control by providing filtration/infiltration (to be confirmed with detailed soils analyses) of 25 mm from impervious areas.
- Post to pre-development infiltration for water balance is to be managed through use of infiltration based LID's to be confirmed at the detailed design stage. Current estimate suggests a post development deficit will exist with no mitigation.
- Post development phosphorus loading generally was found to increase as a result of the proposed LID SWM mitigation measures. A detailed phosphorus loading to be performed at the detailed design stage to assess impact of proposed LIDs required to meet volumetric and water balance requirements.

Sanitary Servicing

- Sanitary servicing to majority of the site will be provided by a connection to Newmarket's existing Southwest Sanitary Trunk Sewer.
- Sanitary servicing will be provided to the south by the existing 200mm Sanitary Sewer along Willow Farm Lane.

Water Supply Servicing

- Water will be supplied to the site from existing watermains along St. John's Sideroad to the south, Bathurst Street to the west, Bennington Road to the east.

We trust this report meets your satisfaction and look forward to your approval. Should you have any questions, please do not hesitate to contact our office.

Respectfully submitted,

SCHAEFFER & ASSOCIATES LTD

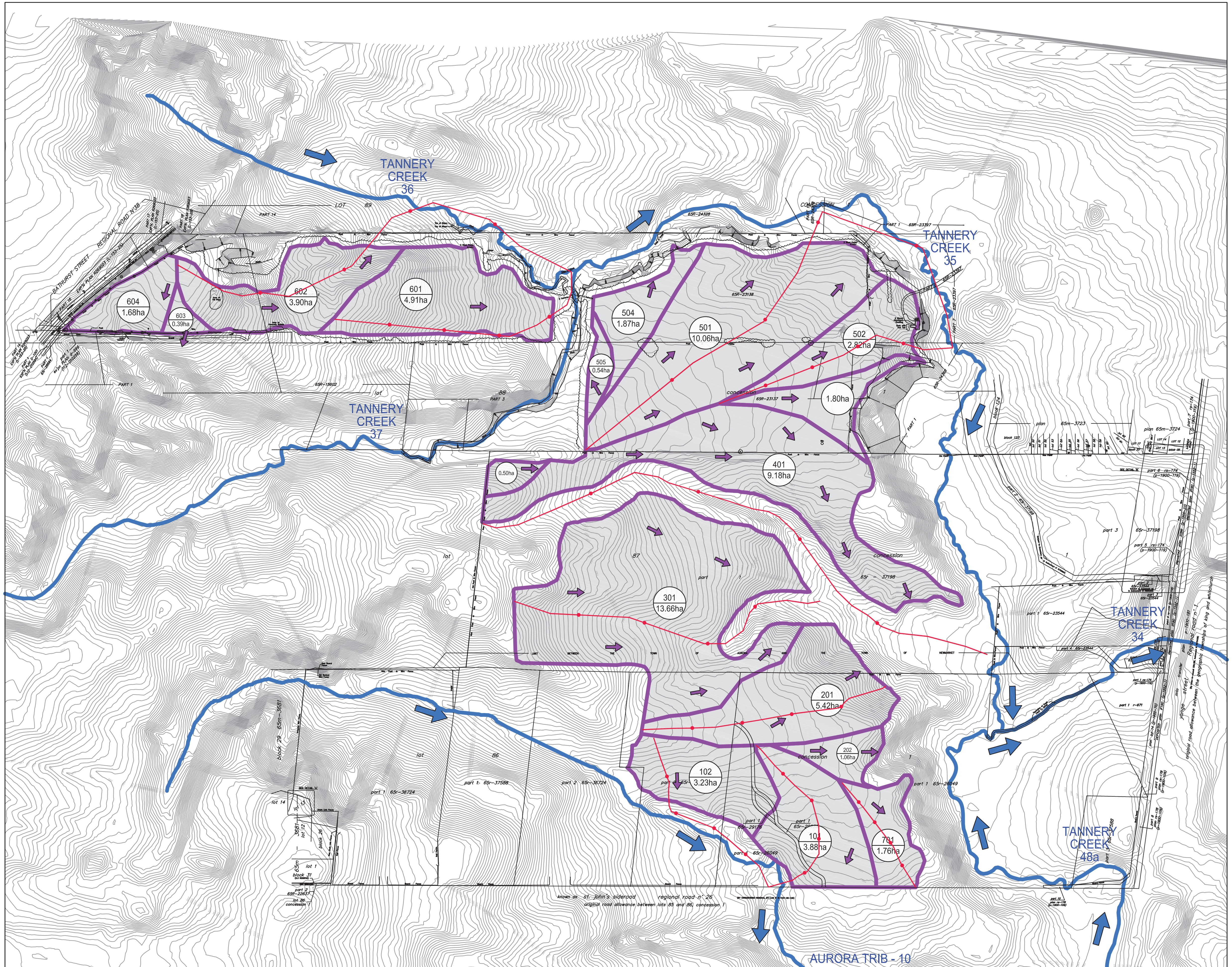
LICENSED PROFESSIONAL ENGINEER
K. SHAHBIKIAN
100090411
Sept. 31/2019
PROVINCE OF ONTARIO

Giancarlo Volpe, M.Eng.
Water Resources Analyst

Koryun Shahbikian, M.Eng, P.Eng., PMP
Associate

Appendix A
Stormwater Management

Appendix A1
Pre-development Calculations



SHINING HILL HOMES (ST. JOHN'S) INC.
DUNIN ESTATES RESIDENTIAL SUBDIVISION

LEGEND

SITE LOCATION

EXISTING DRAINAGE AREAS

502 2.82ha CATCHMENT ID
AREA IN HECTARES

RIVER REACH

TIME OF CONCENTRATION FLOW

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE A-1
TIME OF CONCENTRATION FLOW LENGTHS

2019-4750	SEPTEMBER 2019	SCALE: N.T.S.

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Phil Gotfried

PROJECT NO.: 4750
PROJECT NAME: Shining Hill Phase 3
LOCATION: Aurora / Newmarket
DATE: Sep-19

SCHAEFFERS CONSULTING ENGINEERS

Table 1: Existing Catchment Area Drainage Characteristics

Facility	Catchment	Area	Soil Characteristics	Hydrologic Soil Group	Soil Conservation Science Curve Number (SCS CN)	Initial Abstraction based on SCS CN	Watershed Slope, S_w	Overland Flow Length, L	Runoff Coefficient, C (100-YEAR)	Time of Concentration, t_c (Airport)	Time of Concentration (Upland)	Time to Peak, tp = 0.67tc (Airport)	Time to Peak (Upland)	Time to Peak, tp = 0.67tc (Airport)	Time to Peak, tp = 0.67tc (Upland)
		(ha)	*Series; Symbol*			*(mm)*	*(%)*	*(m)*		minutes	minutes	minutes	minutes	(hrs)	(hrs)
Pond 6	101	3.88 ha	Schomberg Clay Loam	D	80	4.8	**2.5**	364.0	0.30	36.7	8.7	24.6	5.8	**0.41**	0.10
	102	3.23 ha	Schomberg Clay Loam	D	80	4.8	**2.7**	379.0	0.30	36.6	8.4	24.5	5.6	**0.41**	0.09
Pond 5	201	5.42 ha	Schomberg Clay Loam	D	80	9.5	**2.6**	466.0	0.30	41.3	10.8	27.7	7.2	**0.46**	0.12
	202*	1.06 ha	Schomberg Clay Loam	D	80	9.5	**2.6**	466.0	0.30	41.3	10.8	27.7	7.2	**0.46**	0.12
Pond 4	301	13.66 ha	Schomberg Clay Loam	D	80	9.5	**6.1**	619.0	0.30	35.8	10.3	24.0	6.9	**0.40**	0.12
Pond 3	401	9.18 ha	Schomberg Clay Loam	D	80	9.5	**3.2**	1071.0	0.30	58.4	22.3	39.1	14.9	**0.65**	0.25
Pond 2	501	10.06 ha	Schomberg Clay Loam	D	80	9.5	**2.3**	1033.0	0.30	64.0	24.6	42.9	16.5	**0.71**	0.27
	502	2.82 ha	Schomberg Clay Loam	D	80	9.5	**2.5**	465.0	0.30	41.5	11.1	27.8	7.4	**0.46**	0.12
Pond 1	601	4.91 ha	Schomberg Clay Loam	D	80	9.5	**5.8**	510.0	0.30	33.0	8.5	22.1	5.7	**0.37**	0.09
	602	3.90 ha	Schomberg Clay Loam	D	80	9.5	**5.6**	840.0	0.30	42.7	14.0	28.6	9.4	**0.48**	0.16
Super Pipe	701	1.76 ha	Schomberg Clay Loam	D	80	9.5	**2.3**	238.8	0.30	30.5	10.2	20.5	6.8	**0.12**	0.11

***Drainage Area 202 conservatively uses Tp of Area 201.**

Total Site Area (Catchments 101-701)= 59.88 ha

Area Excluded from Pre = 6.79 ha
Total Pre-development Site = 66.67 ha

Notes:

1. Soil information was determined based on York County Soil Mapping, Soil Survey Report No. 19

2. The time of concentration is calculated using the Airport Equation when the runoff coefficient was less than or equal to 0.40 and the Bransby-Williams Equation when the runoff coefficient was more than 0.40. The runoff coefficient for cultivated agricultural land is based on catchment topography and hydrologic soil group; and derived using Design Chart 1.07 of the MTO DRainage Management Manual that the Airport Equation was applicable to all catchments with the with the exception of Catchment 211 which had a runoff coefficient of 0.45. As such, the Bransby-Williams Equation was only applicable to Catchment 211.

3. Roughness coefficients (Manning's n) for sheet flow or overland flow was selected for cultivated land with residue cover of greater than 20% using Table 3-1 (page 3-3) in Chapter 3 of the Technical Release-55 (USDA, 1986).

Airport Equation:

Assumptions: Runoff Coefficient, C, is <u>less than or equal to 0.4</u>

$$t_c = 3.26 * (1.1 - C) * L^{0.5} * S_w^{-0.33}$$

Where:
t_c is the time of concentration (minutes);
C is the runoff coefficient;
L is the watershed length (m); and
S_w is the watershed slope (%).

Source: (MTO, 1997)

Bransby Williams Equations:

Assumptions: Runoff Coefficient, C, is <u>greater than 0.4</u>

$$t_c = 0.057 * L * S_w^{-0.2} * A^{-0.1}$$

Where:
t_c is the time of concentration (minutes);
A is the watershed area (ha);

4. Watershed slope was calculated using the Equivalent Slope Method (Ministry of Transportation).

Pre-development Catchment - Curve Number Calculations

PROJECT NO.: 4750
PROJECT NAME: Shining Hill Phase 3
LOCATION: Aurora / Newmarket
DATE: Sep-19

SCHAEFFERS CONSULTING ENGINEERS

Table 2: Pre-development Curve Numbers

Catchment	Land Type	Area (ha)	Soil Type	Hydrologic Soil Group	Hydrologic Condition	CN (based on Land Type and Soil Type)	Weighted Curve Number
101	Pasture	3.880	Schomberg Clay Loam	D	Good	80.0	80
102	Pasture	3.230	Schomberg Clay Loam	D	Good	80.0	80
201	Pasture	5.420	Schomberg Clay Loam	D	Good	80.0	80
202	Pasture	1.060	Schomberg Clay Loam	D	Good	80.0	80
301	Pasture	13.660	Schomberg Clay Loam	D	Good	80.0	80
401	Pasture	9.180	Schomberg Clay Loam	D	Good	80.0	80
501	Pasture	10.060	Schomberg Clay Loam	D	Good	80.0	80
502	Pasture	2.820	Schomberg Clay Loam	D	Good	80.0	80
601	Pasture	4.910	Schomberg Clay Loam	D	Good	80.0	80
602	Pasture	3.900	Schomberg Clay Loam	D	Good	80.0	80
701	Pasture	1.760	Schomberg Clay Loam	D	Good	80.0	80
					Average CN for the whole subject site		**80**

Reference: Table 2-2a,b,c from Urban Hydrology for Small Watersheds TR-55

Pre-development Catchment - Initial Abstraction Calculations

PROJECT NO.: 4750
PROJECT NAME: Shining Hill Phase 3
LOCATION: Aurora / Newmarket
DATE: Sep-19

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Table 3: Pre-development Initial Abstraction

Catchment	Land Type	Area	Initial Abstraction(mm) - LSRCA Table 14.0	Weighted Initial Abstraction Value (mm)
101	Pervious Lawns	3.88	5	5.00
102	Pervious Lawns	3.23	5	5.00
201	Pervious Lawns	5.42	5	5.00
202	Pervious Lawns	1.06	5	5.00
301	Pervious Lawns	13.66	5	5.00
401	Pervious Lawns	9.18	5	5.00
501	Pervious Lawns	10.06	5	5.00
502	Pervious Lawns	2.82	5	5.00
601	Pervious Lawns	4.91	5	5.00
602	Pervious Lawns	3.90	5	5.00
701	Pervious Lawns	1.76	5	5.00
		Average Ia for the whole subject site		**5.00**

References: Table 14.0 - LSRCA Technical Guidelines for SWM

PROJECT NO.: 4750
PROJECT NAME: Shining Hill Phase 3
LOCATION: Aurora / Newmarket
DATE: Sep-19

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Table 4: Watershed Slope Calculations

Catchment	Number of Divisions of Equal Length	Equal Lengths *(m)*	Upstream Elevation *(mAMSL)*	Downstream Elevation *(mAMSL)*	Slope *(m/m)*	Slope to the power of -0.5 *(m/m)*	Sum of Length *(m)*	Sum of Slope to the power of -0.5	Watershed Slope, Sw *(%)*
101	1	72.8	269.5	267.5	0.027	6.0	364.0	31.5	2.5
	2	72.8	267.5	266	0.021	7.0			
	3	72.8	266	264.5	0.021	7.0			
	4	72.8	264.5	263	0.021	7.0			
	5	72.8	263	259.5	0.048	4.6			
102	1	75.8	272.5	268.5	0.053	4.4	379.0	30.4	2.7
	2	75.8	268.5	264	0.059	4.1			
	3	75.8	264	263	0.013	8.7			
	4	75.8	263	261.5	0.020	7.1			
	5	75.8	261.5	259.5	0.026	6.2			
201	1	93.2	273	271	0.021	6.8	466.0	31.3	2.6
	2	93.2	271	269.5	0.016	7.9			
	3	93.2	269.5	268	0.016	7.9			
	4	93.2	268	265	0.032	5.6			
	5	93.2	265	255.5	0.102	3.1			
301	1	123.8	287	278	0.073	3.7	619.0	20.3	6.1
	2	123.8	278	272	0.048	4.5			
	3	123.8	272	267	0.040	5.0			
	4	123.8	267	260.5	0.053	4.4			
	5	123.8	272	255	0.137	2.7			
401	1	214.2	285	275	0.047	4.6	1071.0	28.1	3.2
	2	214.2	275	265	0.047	4.6			
	3	214.2	265	258	0.033	5.5			
	4	214.2	258	251	0.033	5.5			
	5	214.2	251	247.5	0.016	7.8			
501	1	206.6	277	271.5	0.027	6.1	1033.0	33.2	2.3
	2	206.6	271.5	269	0.012	9.1			
	3	206.6	269	258.5	0.051	4.4			
	4	206.6	258.5	255	0.017	7.7			
	5	206.6	258.5	252.5	0.029	5.9			
502	1	93.0	271	270	0.011	9.6	465.0	31.6	2.5
	2	93.0	270	268.5	0.016	7.9			
	3	93.0	268.5	267	0.016	7.9			
	4	93.0	267	260	0.075	3.6			
	5	93.0	267	252.5	0.156	2.5			
601	1	102.0	299	291.5	0.074	3.7	510.0	20.8	5.8
	2	102.0	291.5	284	0.074	3.7			
	3	102.0	284	277	0.069	3.8			
	4	102.0	277	272	0.049	4.5			
	5	102.0	272	268	0.039	5.0			
602	1	168.0	318	305	0.077	3.6	840.0	21.1	5.6
	2	168.0	305	294.5	0.063	4.0			
	3	168.0	294.5	282.5	0.071	3.7			
	4	168.0	282.5	276.5	0.036	5.3			
	5	168.0	276.5	268	0.051	4.4			
701	1	47.8	267	266	0.021	6.9	238.8	32.9	2.3
	2	47.8	266	265.5	0.010	9.8			
	3	47.8	266	265	0.021	6.9			
	4	47.8	265.5	263.5	0.042	4.9			
	5	47.8	263.5	261	0.052	4.4			

Notes:

1. The watershed slope is calculated using the Equivalent Slope Method using the Ministry of Transportation (MTO, 1997) Drainage Manual guidelines in Chapter 8 (page 27). The Equalivent Slope

Equivalent Slope Method:

$$S_w = 100 * \left[\frac{n}{\Sigma(S_n{}^{-0.5})}\right]^2$$

Where:
S_w is the watershed slope (%);
n is the number of divisions of equal length; and
S_n is the slope of the individual divisions (m/m).

Source: (MTO, 1997)

References:

1. Ministry of Transportation (MTO). 1997. Drainage Management Manual Part 3. Drainage and Hydrology Section. Transportation Engineering Branch. Quality and Standards Division.

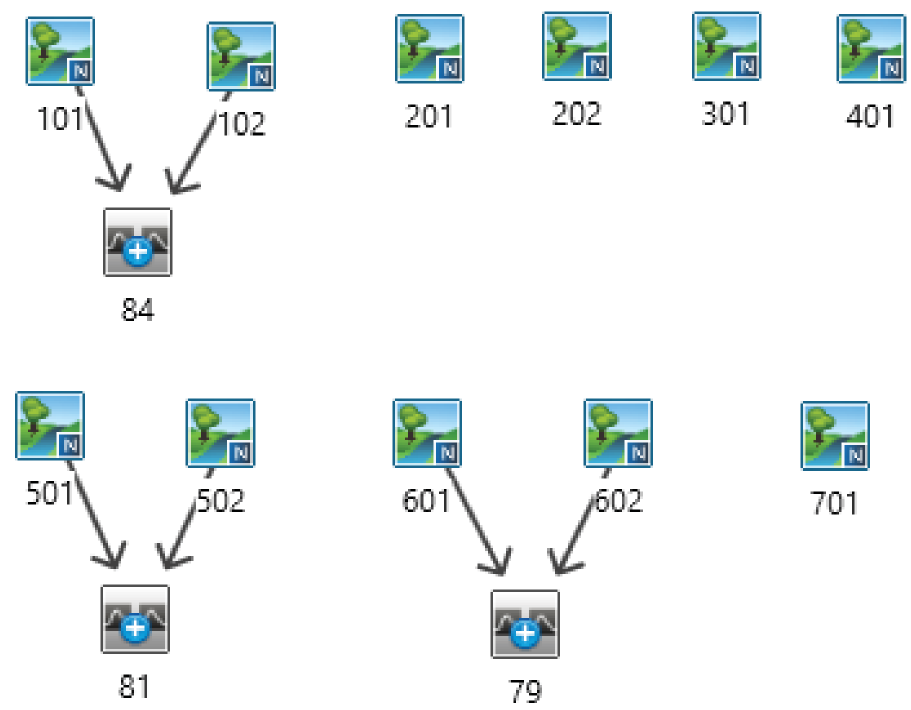
PROJECT NO.: 4750
PROJECT NAME: Shining Hill Phase 3
LOCATION: Aurora / Newmarket
DATE: Sep-19

SCHAEFFERS CONSULTING ENGINEERS

Table 5: Runoff Coefficents

Catchment	Land Type	Area	Soil Type	Runoff Coefficent(based on Land Type and Slope)	Weighted Runoff Coefficient
101	Flat-Cultivated	3.88	Schomberg Clay Loam	0.30	0.30
102	Flat-Cultivated	3.23	Schomberg Clay Loam	0.30	0.30
201	Flat-Cultivated	5.420	Schomberg Clay Loam	0.30	0.30
202	Flat-Cultivated	1.060	Schomberg Clay Loam	0.30	0.30
301	Rolling-Cultivated	13.66	Schomberg Clay Loam	0.30	0.30
401	Flat-Cultivated	9.18	Schomberg Clay Loam	0.30	0.30
501	Flat-Cultivated	10.06	Schomberg Clay Loam	0.30	0.30
502	Flat-Cultivated	2.82	Schomberg Clay Loam	0.30	0.30
601	Rolling-Cultivated	4.91	Schomberg Clay Loam	0.30	0.30
602	Rolling-Cultivated	3.90	Schomberg Clay Loam	0.30	0.30
701	Flat-Cultivated	1.76	Schomberg Clay Loam	0.30	0.30

References:
1. LSRCA Design Manual: Section 22.0 Rural Run-off Coefficients - Design Chart 1.07



FOR VO MODEL RESULTS PLEASE REFER TO THE VO MODEL ATTACHED IN THE CD

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Visual OTTHYMO™ Schematic

PRE-DEVELOPMENT MODEL
(12hr SCSII, 24hr SCSII, & 4 Hr Chicago Storm)

Job #: 4750	**Date: September 2019**

Project: *2019-4750*
Shining Hill Phase 3
Town of Newmarket

SCHAEFFERS CONSULTING ENGINEERS

Pre-deveopment Target Rates

PRE-DEVELOPMENT CATCHMENT PARAMETERS

Catchment	POND 1	POND 2	POND 3	POND 4
Area	8.81	12.88	9.18	13.66

SCS 6HR-BLOOR FLOW RATES

Storm Event	Pre development Release Rate -Target Rate (m3/s)	Pre development Release Rate -Target Rate (m3/s)	Pre development Release Rate -Target Rate (m^3/s)	Pre development Release Rate -Target Rate (m^3/s)
2 Year	0.192	0.202	0.147	0.308
5 Year	0.327	0.344	0.250	0.525
10 Year	0.436	0.458	0.334	0.700
25 Year	0.555	0.584	0.425	0.894
50 Year	0.700	0.736	0.536	1.129
100 Year	0.786	0.825	0.601	1.266

SCS 12HR -BLOOR FLOW RATES

Storm Event	Pre development Release Rate -Target Rate (m3/s)	Pre development Release Rate -Target Rate (m3/s)	Pre development Release Rate -Target Rate (m3/s)	Pre development Release Rate Target Rate (m3/s)
2 Year	0.233	0.246	0.179	0.375
5 Year	0.380	0.400	0.292	0.612
10 Year	0.505	0.531	0.387	0.813
25 Year	0.643	0.675	0.492	1.035
50 Year	0.780	0.819	0.596	1.255
100 Year	0.856	0.899	0.654	1.377

SCS 24HR -BLOOR FLOW RATES

Storm Event	Pre development Release Rate -Target Rate (m3/s)	Pre development Release Rate -Target Rate (m3/s)	Pre development Release Rate -Target Rate (m3/s)	Pre development Release Rate Target Rate (m3/s)
2 Year	0.270	0.284	0.206	0.434
5 Year	0.354	0.372	0.270	0.569
10 Year	0.563	0.592	0.431	0.901
25 Year	0.711	0.748	0.542	1.141
50 Year	0.836	0.886	0.643	1.341
100 Year	0.899	0.947	0.687	1.444

4hr CHICAGO FLOW RATES

Storm Event	Pre development Release Rate -Target Rate (m3/s)	Pre development Release Rate -Target Rate (m3/s)	Pre development Release Rate -Target Rate (m3/s)	Pre development Release Rate -Target Rate (m3/s)
2 Year	0.148	0.148	0.116	0.237
5 Year	0.271	0.271	0.209	0.437
10 Year	0.364	0.364	0.279	0.586
25 Year	0.466	0.466	0.355	0.750
50 Year	0.628	0.628	0.474	1.011
100 Year	0.725	0.725	0.547	1.167

Project: *2019-4750*
Shining Hill Phase 3
Town of Aurora

SCHAEFFERS CONSULTING ENGINEERS

Pre-deveopment Target Rates

PRE-DEVELOPMENT CATCHMENT PARAMETERS

Catchment	POND 5	POND 6	Storage Pipe
Area	6.48	7.110	1.76

SCS 6HR-BLOOR FLOW RATES

Storm Event	Pre development Release Rate Target Rate (m^3/s)	Pre development Release Rate Target Rate (m^3/s)	Pre development Release Rate Target Rate (m^3/s)
2 Year	0.111	0.158	0.092
5 Year	0.188	0.269	0.155
10 Year	0.252	0.359	0.204
25 Year	0.321	0.457	0.258
50 Year	0.406	0.576	0.323
100 Year	0.455	0.645	0.361

SCS 12HR -BLOOR FLOW RATES

Storm Event	Pre development Release Rate Target Rate (m3/s)	Pre development Release Rate Target Rate (m3/s)	Pre development Release Rate Target Rate (m3/s)
2 Year	0.135	0.192	0.109
5 Year	0.220	0.312	0.174
10 Year	0.292	0.415	0.229
25 Year	0.372	0.528	0.289
50 Year	0.451	0.641	0.348
100 Year	0.494	0.703	0.381

SCS 24HR -BLOOR FLOW RATES

Storm Event	Pre development Release Rate Target Rate (m3/s)	Pre development Release Rate Target Rate (m3/s)	Pre development Release Rate Target Rate (m3/s)
2 Year	0.157	0.221	0.120
5 Year	0.205	0.290	0.155
10 Year	0.324	0.462	0.226
25 Year	0.411	0.583	0.305
50 Year	0.484	0.686	0.346
100 Year	0.520	0.738	0.384

4hr CHICAGO FLOW RATES

Storm Event	Pre development Release Rate Target Rate (m3/s)	Pre development Release Rate Target Rate (m3/s)	Pre development Release Rate Target Rate (m3/s)
2 Year	0.086	0.122	0.062
5 Year	0.157	0.223	0.120
10 Year	0.211	0.300	0.168
25 Year	0.269	0.384	0.225
50 Year	0.362	0.517	0.302
100 Year	0.418	0.597	0.343

Appendix A2
Post-development Calculations

Estimating Sheet - TIMP/XIMP for Typical 40ft LOTs

W= Lot Width	40.0	ft.	→	12.2 m
D= Lot Depth	30	m		
bs= minimum Back yard set back	7.5	m		
fs= minimum Front set back	4.5	m		
ss= Minimum side set back	0.9	m		
dw = driveway Width	4.5	m		
Porch area=	2.95	sqm		(min. set back for Porch is4m)

Calculation based on lot Fabric

Total Lot Area	366.00	sqm
Roof Area	187.20	sqm
Porch	2.95	sqm
Drive way	20.25	sqm
Grass Area	155.60	sqm

Total impervious Areas	210.40	sqm
Direct Impervious areas	116.80	sqm

T IMP	57%
XIMP	32%

Suggested Conservation Authority's guideline

T IMP	55%	(Low Density Residential - from LSRCA)
XIMP	45%	(for instance , based on LSRCA, The best available information should be utilized in the design, modelling and calculations)

Minimum TIMP based on Town of Newmarket Criteria

C	0.59	(Low Density Residential)
TIMP	55%	

Minimum TIMP/XIMP used in the model (Full Lot)

C	0.60
TIMP	57%
XIMP	45%

Minimum TIMP/XIMP Draining to back yard

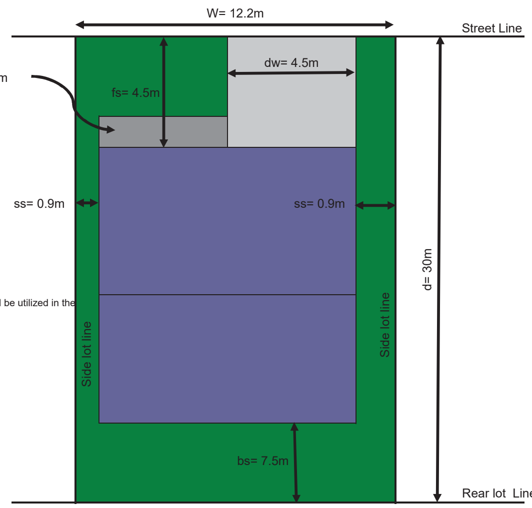
Total Lot Area	214.80	sqm	
Roof Area	93.60	sqm	(Backhalf of Roof)
Porch	0.00	sqm	
Drive way	0.00	sqm	
Grass Area	121.20	sqm	

C	0.52
TIMP	45%
XIMP	45%

Minimum TIMP/XIMP Draining to Front

Total Lot Area	151.20	sqm
Roof Area	93.60	sqm
Porch	2.95	sqm
Drive way	20.25	sqm
Grass Area	34.40	sqm

C	0.74
TIMP	77%
XIMP	46%



Estimating Sheet - TIMP/XIMP for Typical 20ft LOTs (Laneway Townhouse)

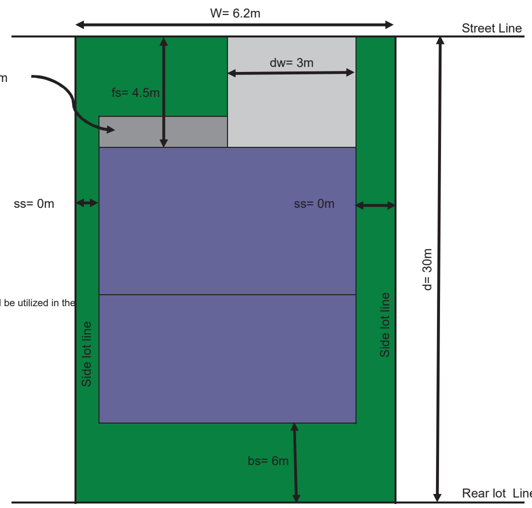
W= Lot Width	20	ft.	→ 6.2 m
D= Lot Depth	30	m	
bs= minimum Back yard set back	6	m	
fs= minimum Front set back	4.5	m	
ss= Minimum side set back	0	m	
dw = driveway Width	3	m	
Porch area=	1.6	sqm	(min. set back for Porch is4m)

Calculation based on lot Fabric

Total Lot Area	186.00	sqm
Roof Area	120.90	sqm
Porch	1.60	sqm
Drive way	13.50	sqm
Grass Area	50.00	sqm

Total impervious Areas	136.00	sqm
Direct Impervious areas	75.55	sqm

T IMP	73%
XIMP	41%



Suggested Conservation Authority's guideline

T IMP	55%	(Low Density Residential - from LSRCA)
XIMP	45%	(for instance , based on LSRCA, The best available information should be utilized in the design, modelling and calculations)

Minimum TIMP based on Town of Newmarket Criteria

C	0.59	(Townhouses)
TIMP	75%	

Minimum TIMP/XIMP used in the model (Full Lot)

C	0.73
TIMP	75%
XIMP	45%

Minimum TIMP/XIMP Draining to back yard

Total Lot Area	97.65	sqm	
Roof Area	60.45	sqm	(Backhalf of Roof)
Porch	0.00	sqm	
Drive way	0.00	sqm	
Grass Area	37.20	sqm	

C	0.63
TIMP	62%
XIMP	45%

Minimum TIMP/XIMP Draining to Front

Total Lot Area	88.35	sqm
Roof Area	60.45	sqm
Porch	1.60	sqm
Drive way	13.50	sqm
Grass Area	12.80	sqm

C	0.80
TIMP	86%
XIMP	51%

18m ROW - Sidewalk One Side **Pond 1**

Calculation based on lot Fabric

Total ROW Width	18.00	m
Total Sidewalk Width	1.50	m
Total Bike Lane Width	0.00	m
Total pavement Width	8.40	m

Number of Driveway W/O Sidewalk	21	
Width of TYP. Driveway	5.50	m
Length of TYP. Driveway	5	m
Total Area of Driveway	577.50	sqm

Number of Driveway With Sidewalk	20	
Width of TYP. Driveway	5.50	m
Length of TYP. Driveway incl. sidewalk	5	m
Sidewalk Width	1.5	m
Total Area of Driveway	385.00	sqm

Total Area of ROW	6623	sqm	From AutoCAD
Total Driveway Area	963	sqm	

Minimum TIMP based on Lot Fabric

C	0.69
TIMP	70%
XIMP	70%

26m ROW - Sidewalk Both Sides **Pond 3**

Calculation based on lot Fabric

Total ROW Width	26.00	m
Total Sidewalk Width	2.80	m
Total Bike Lane Width	0.00	m
Total pavement Width	14.4	m

Number of Driveway W/O Sidewalk	0	
Width of TYP. Driveway	5.50	m
Length of TYP. Driveway	6	m
Total Area of Driveway	0.00	sqm

Number of Driveway With Sidewalk	11	
Width of TYP. Driveway	5.50	m
Length of TYP. Driveway incl. sidewalk	6	m
Sidewalk Width	1.4	m
Total Area of Driveway	278.30	sqm

Total Area of ROW	11565	sqm	From AutoCAD
Total Driveway Area	278	sqm	

Minimum TIMP based on Lot Fabric

C	0.68
TIMP	69%
XIMP	69%

Appendix A2-1
Pond 1 Calculations

Project: 2019-4750

SCHAEFFERS CONSULTING ENGINEERS

Post-development Catchment - SWM Pond 1

Cacthment Total Area=	10.98
Controlled Area=	7.82
Site Plan Controlled Area=	2.05
Uncontrolled Area=	1.11
External Area=	0.00
Development Area=	10.98

Imperviousness

For Controlled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Residential (6m lots)	1.03	0.73	0.75	0.75	0.77	0.45	0.46
Low Density Residential (12m lots)	0.68	0.60	0.57	0.41	0.39	0.45	0.31
Medium Density Residential	0.59	0.73	0.75	0.43	0.44	0.45	0.26
Park	1.92	0.30	0.14	0.58	0.27	0.14	0.27
Road (18m)	0.66	0.69	0.70	0.46	0.46	0.70	0.46
Road (26m)	1.99	0.68	0.69	1.36	1.37	0.69	1.37
Road (26m) - Transition	0.10	0.68	0.69	0.07	0.07	0.69	0.07
SWM Facility (Pond 1)	0.85	0.55	0.50	0.47	0.43	0.50	0.43
Total Area	**7.82**	**0.58**	**0.54**	**4.51**	**4.21**	**0.47**	**3.64**

**IMP bumped to 0.60 (C = 0.62) for modeling purposes to obtain conservative estimate.

For Uncontrolled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Low Density Residential (Backyards)	0.42	0.51	0.45	0.21	0.19	0.45	0.19
Vista (grassed)	0.69	0.30	0.14	0.21	0.10	0.14	0.10
Total Area	**1.11**	**0.38**	**0.26**	**0.42**	**0.29**	**0.26**	**0.29**

For Sites with Internal Controls

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
High Density Residential	1.45	0.75	0.79	1.08	1.14	0.79	1.14
Commericial	0.60	0.85	0.93	0.51	0.56	0.93	0.56
Total Area	**2.05**	**0.78**	**0.83**	**1.60**	**1.70**	**0.83**	**1.70**

25mm Retention Requirement

Total Area	8.93 ha				
A * IMP	4.50				
Total IMP	50%				
25mm Volume	**1124 m3**	(i.e. 8.93ha x 50% x 25mm x 10)			
12.5mm Volume	562 m3	(i.e. 8.93ha x 50% x 12.5mm x 10)			
Site Plan 5mm	**85 m3**	(i.e. 2.05ha x 83% x 5mm x 10)	25mm	424 m3	

Permanent Pool Volume Required (80% TSS Removal)

Table: Water Quality Storage Requirements Based on Receiving Waters

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level					
		0%	35%	55%	70%	85%	100%
Level 1	Wet Pond	53	140	190	225	250	275

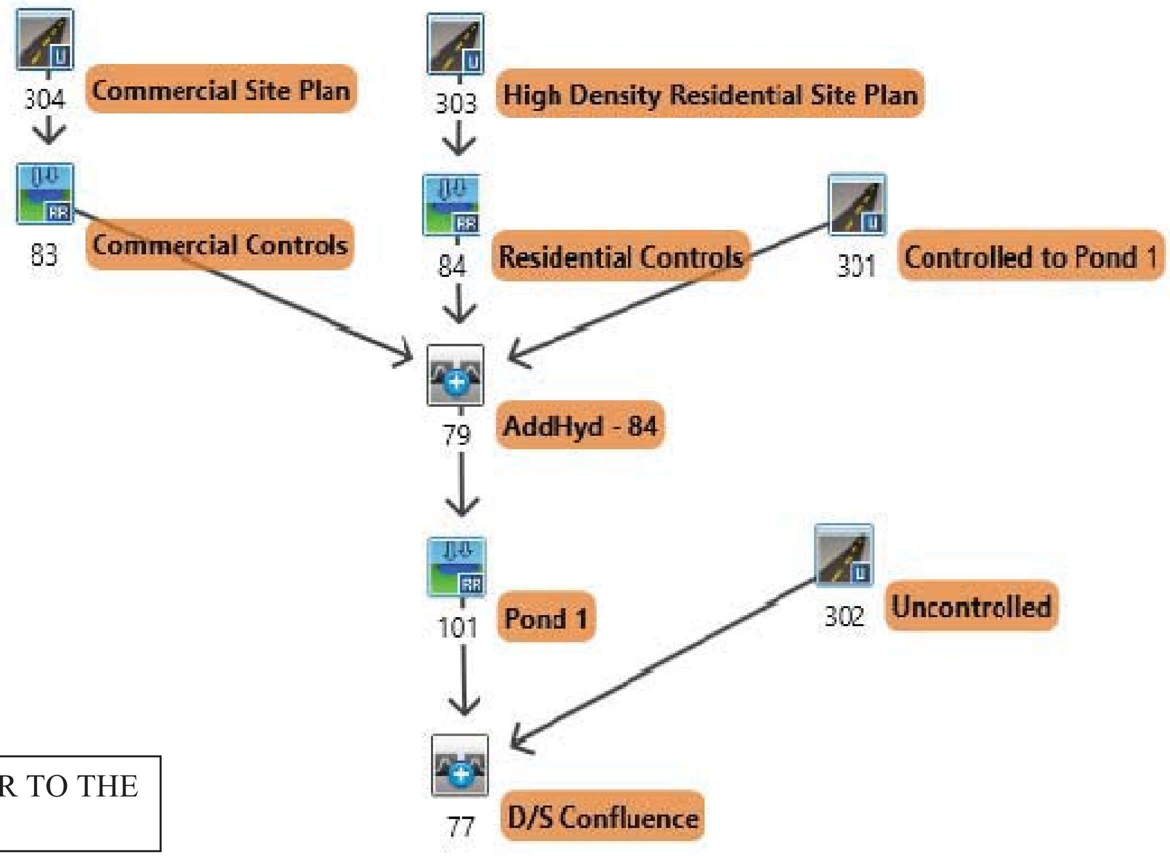
* For wet ponds, all of the storage, except for 40 m^3/ha represents the permanent pool volume.
The 40 m^3/ha represents extended detention storage.

Input:

Estimated Imperviousness =	60%			
Area =	9.87	ha		
Level of Protection:	1			
SWMP Type :	Wet Pond			

Calculation:

Total Storage Volume Required =	201	m^3/ha →	1,986	m^3
Permanent Pool Volume =	161	m^3/ha →	1,591	m^3
Active Storage Volume =	40	m^3/ha →	395	m^3



FOR VO MODEL RESULTS PLEASE REFER TO THE VO MODEL ATTACHED IN THE CD

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Visual OTTHYMO™ Schematic

POST-DEVELOPMENT MODEL – Pond 1
(12hr SCSII, 24hr SCSII, & 4 Hr Chicago Storm)

Job #: 4750	**Date: September 2019**

Project: *2019-4750*
Shining Hill Phase 3
Town of Newmarket
Pond 1

SCHAEFFERS CONSULTING ENGINEERS

Post Development Controlled Area Allowable Release Rate - Theoretical Storages

Target rates based on the Pre Development site area of **8.81** **ha**
Post development Controlled Allowable Release rates calculated by subtracting the uncontrolled release rates from target release rates

SCS 12HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3/s)	Post development Release Rate(m3/s)
Erosion Control	0.015	0.015	-	1,699	0.015
2 Year	0.233	0.146	0.087	2,205	0.146
5 Year	0.380	0.252	0.128	2,799	0.252
10 Year	0.505	0.343	0.162	3,277	0.342
25 Year	0.643	0.445	0.198	3,768	0.444
50 Year	0.780	0.524	0.256	4,258	0.523
100 Year	0.856	0.578	0.278	4,518	0.577

SCS 24HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3/s)	Post development Release Rate(m3/s)
2 Year	0.270	0.180	0.090	2,352	0.197
5 Year	0.354	0.242	0.112	2,709	0.269
10 Year	0.563	0.412	0.151	3,525	0.464
25 Year	0.711	0.488	0.223	4,077	0.562
50 Year	0.836	0.588	0.248	4,536	0.653
100 Year	0.899	0.624	0.275	4,730	0.716

4hr Chicago

Storm Event	Pre development Release Rate -Target Rate (m3/s) (Chicago)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3/s)	Post development Release Rate(m3/s)
2 Year	0.148	0.066	0.082	2,079	0.087
5 Year	0.271	0.147	0.124	2,588	0.160
10 Year	0.364	0.208	0.156	2,943	0.227
25 Year	0.466	0.235	0.231	3,374	0.269
50 Year	0.628	0.335	0.293	3,933	0.365
100 Year	0.725	0.400	0.325	4,248	0.473

Project: 2019-4750

EROSION CONTROL CALCULATIONS
Pond 1

Based on 25mm Storm Event Releasing over 48-Hour Period

Post Dev - BLOOR 24HR SCS(2019-08-12)

Schematic | Hydrograph Results (instance)

Run: 1.4-Hr 25mm Erosion Event   Show All Runs

Run	NHYD	DT [hr]	AREA [ha]	PKFW [m³/s]	TP [hr]	RV [mm]	DWF [m³/s]
1.4-Hr 25mm Erosion Event	106	0.0833	9.8700	0.0137	4.5000	17.2183	0.0000

Input:

Post-Dev. Area =	9.87	ha
R.V =	17.2183	mm
Draw Down Time =	48	hrs

Calculations:

Required Storage =	1,699	m^3
Average Outflow =	0.010	m^3/s
Peak Outflow =	0.015	m^3/s (Estimated at 1.5 times Average Outflow)

Appendix A2-2
Pond 2 Calculations

Project: 2019-4750

SCHAEFFERS CONSULTING ENGINEERS

Post-development Catchment - SWM Pond 2

Cacthment Total Area=	20.87
Pond Controlled Area=	16.32
Site Plan Controlled Area=	2.29
Uncontrolled Area=	2.25
External Area=	0.00
	20.87

Imperviousness

For Controlled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Residential (6m lots)	0.97	0.73	0.75	0.70	0.73	0.45	0.44
Low Density Residential (12m lots)	2.26	0.60	0.57	1.36	1.30	0.45	1.02
Medium Density Residential	3.41	0.73	0.75	2.47	2.56	0.45	1.53
Laneway	0.35	0.90	1.00	0.32	0.35	1.00	0.35
Institutional	2.41	0.70	0.71	1.69	1.72	0.71	1.72
Park	1.98	0.30	0.14	0.59	0.28	0.14	0.28
Road (18m)	1.46	0.69	0.70	1.01	1.02	0.70	1.02
Road (26m)	1.94	0.68	0.69	1.32	1.34	0.69	1.34
Road (26m) - Transition	0.25	0.68	0.69	0.17	0.17	0.69	0.17
SWM Facility (Pond 2)	1.29	0.55	0.50	0.71	0.64	0.50	0.64
Total Area	**16.32**	**0.63**	**0.62**	**10.35**	**10.12**	**0.52**	**8.52**

For Uncontrolled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Low Density Residential (Backyards)	0.29	0.51	0.45	0.15	0.13	0.44	0.13
Vista (grassed)	0.46	0.30	0.14	0.14	0.07	0.14	0.07
Restoration Trail	1.50	0.30	0.14	0.45	0.21	0.14	0.21
Total Area	**2.25**	**0.33**	**0.18**	**0.74**	**0.41**	**0.18**	**0.41**

For Sites With Internal Control

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
High Density Residential Site Plan	2.29	0.75	0.79	1.72	1.80	0.79	1.80
Total Area	**2.29**	**0.75**	**0.79**	**1.72**	**1.80**	**0.79**	**1.80**

25mm Retention Requirement

Total Area	18.57 ha			
A * IMP	10.53			
Total IMP	57%			
25mm Volume	**2632 m3**	(i.e. 18.57ha x 57% x 25mm x 10)		
12.5mm Volume	1316 m3	(i.e. 18.57ha x 57% x 12.5mm x 10)		
Site Plan 5mm	**90 m3**	(i.e. 2.29ha x 79% x 5mm x 10)	25mm	451 m3

Permanent Pool Volume Required (80% TSS Removal)

Table: Water Quality Storage Requirements Based on Receiving Waters

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level					
		0%	35%	55%	70%	85%	100%
Level 1	Wet Pond	53	140	190	225	250	275

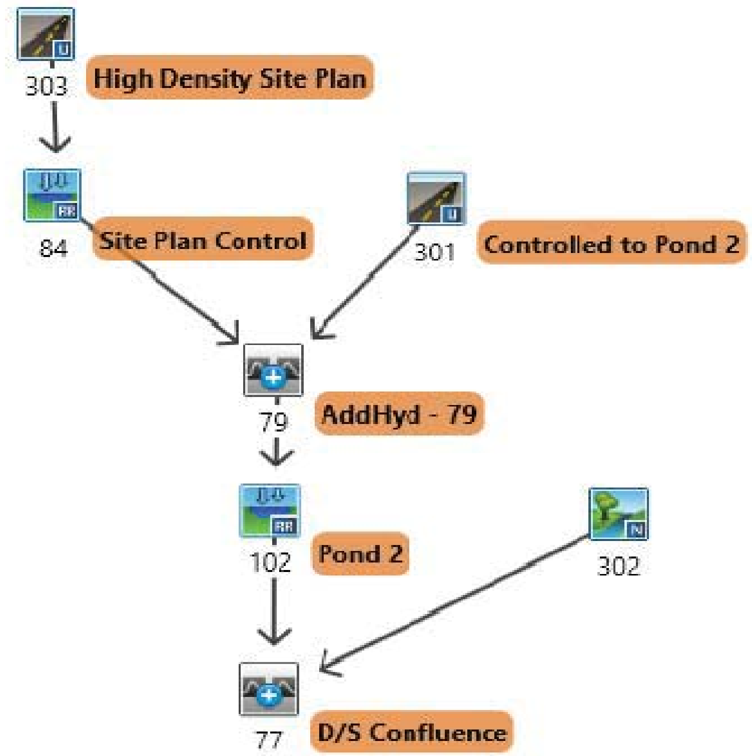
* For wet ponds, all of the storage, except for 40 m^3/ha represents the permanent pool volume.
The 40 m^3/ha represents extended detention storage.

Input:

Estimated Imperviousness =	64%			
Area =	18.61	ha		
Level of Protection:	1			
SWMP Type :	Wet Pond			

Calculation:

Total Storage Volume Required =	211	m^3/ha →	3,929	m^3
Permanent Pool Volume =	171	m^3/ha →	3,184	m^3
Active Storage Volume =	40	m^3/ha →	745	m^3



FOR VO MODEL RESULTS PLEASE REFER TO THE VO MODEL ATTACHED IN THE CD

SCHAEFFERS CONSULTING ENGINEERS

Visual OTTHYMO™ Schematic

POST-DEVELOPMENT MODEL – Pond 2
(12hr SCSII, 24hr SCSII, & 4 Hr Chicago Storm)

Job #: 4750	**Date: September 2019**

Project: ***2019-4750***
Shining Hill Phase 3
Town of Newmarket
Pond 2

SCHAEFFERS CONSULTING ENGINEERS

Post Development Controlled Area Allowable Release Rate - Theoretical Storages

Target rates based on the Pre Development site area of **12.88** **ha**
Post development Controlled Allowable Release rates calculated by subtracting the uncontrolled release rates from target release rates

SCS 12HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3)	Post development Release Rate(m3/s)
Erosion Control	0.028	0.028	-	3,233	0.028
2 Year	0.246	0.097	0.149	4,881	0.171
5 Year	0.400	0.164	0.237	6,408	0.282
10 Year	0.531	0.222	0.309	7,593	0.389
25 Year	0.675	0.287	0.388	8,855	0.506
50 Year	0.819	0.353	0.466	10,068	0.621
100 Year	0.899	0.390	0.508	10,721	0.685

SCS 24HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3)	Post development Release Rate(m3/s)
2 Year	0.284	0.118	0.165	5,262	0.192
5 Year	0.372	0.159	0.213	6,126	0.265
10 Year	0.592	0.276	0.316	8,203	0.420
25 Year	0.748	0.333	0.415	9,604	0.583
50 Year	0.886	0.422	0.465	10,852	0.687
100 Year	0.947	0.426	0.521	11,317	0.761

4hr Chicago

Storm Event	Pre development Release Rate -Target Rate (m3/s) (Chicago)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3)	Post development Release Rate(m3/s)
2 Year	0.148	0.046	0.102	4,404	0.112
5 Year	0.271	0.077	0.194	6,049	0.209
10 Year	0.364	0.094	0.270	7,218	0.288
25 Year	0.466	0.108	0.359	8,454	0.381
50 Year	0.628	0.149	0.479	9,937	0.507
100 Year	0.725	0.184	0.541	10,696	0.574

Project: 2019-4750

EROSION CONTROL CALCULATIONS
Pond 2

Based on 25mm Storm Event Releasing over 48-Hour Period

Post Dev - BLOOR 24HR SCS(2019-08-12)

Schematic | Hydrograph Results (instance)

Run: 1.4-Hr 25mm Erosion Event Show All Runs

Run	NHYD	DT [hr]	AREA [ha]	PKFW [m^3/s]	TP [hr]	RV [mm]	DWF [m^3/s]
1.4-Hr 25mm Erosion Event	105	0.0833	18.6100	0.0259	4.5000	17.3700	0.0000

Input:

Post-Dev. Area =	18.61	ha
R.V =	17.370	mm
Draw Down Time =	48	hrs

Calculations:

Required Storage =	3,233	m^3
Average Outflow =	0.019	m^3/s
Peak Outflow =	0.028	m^3/s (Estimated at 1.5 times Average Outflow)

Appendix A2-3
Pond 3 Calculations

Project: 2019-4750

SCHAEFFERS CONSULTING ENGINEERS

Post-development Catchment - SWM Pond 3

Cacthment Total Area=	6.17
Controlled Area=	5.56
Uncontrolled Area=	0.61
External=	0.00
Development Area=	6.17

Imperviousness

For Controlled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Residential (6m lots)	0.44	0.73	0.75	0.32	0.33	0.45	0.20
Low Density Residential (12m lots)	0.75	0.60	0.57	0.45	0.43	0.45	0.34
Medium Density Residential	1.82	0.73	0.75	1.32	1.36	0.45	0.82
Laneway	0.12	0.90	1.00	0.11	0.12	1.00	0.12
Road (18m)	0.34	0.69	0.70	0.24	0.24	0.70	0.24
Road (26m)	1.16	0.68	0.69	0.79	0.80	0.69	0.80
Road (26m) - Transition	0.03	0.68	0.69	0.02	0.02	0.69	0.02
SWM Facility (Pond 3)	0.90	0.55	0.50	0.49	0.45	0.50	0.45
Total Area	**5.56**	**0.67**	**0.68**	**3.74**	**3.75**	**0.54**	**2.98**

For Uncontrolled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Low Density Residential (Backyards)	0.37	0.51	0.45	0.19	0.17	0.45	0.17
Vista (grassed)	0.24	0.30	0.14	0.07	0.03	0.14	0.03
Total Area	**0.61**	**0.43**	**0.33**	**0.26**	**0.20**	**0.33**	**0.20**

25mm Retention Requirement		
Total Area	6.17 ha	
A * IMP	3.95	
Total IMP	64%	
25mm Volume	**989 m3**	(i.e. 6.17ha x 64% x 25mm x 10)
12.5mm Volume	494 m3	(i.e. 6.17ha x 64% x 12.5mm x 10)

Permanent Pool Volume Required (80% TSS Removal)

Table: Water Quality Storage Requirements Based on Receiving Waters

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level					
		0%	35%	55%	70%	85%	100%
Level 1	Wet Pond	53	140	190	225	250	275

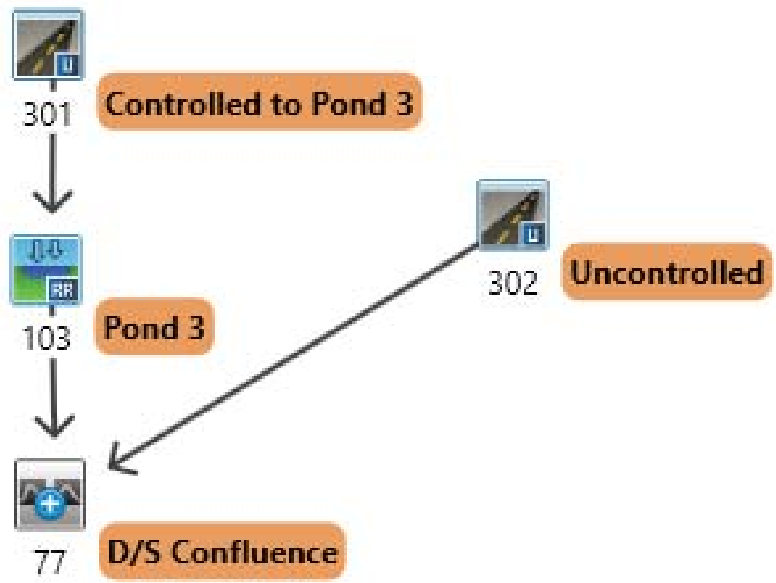
* For wet ponds, all of the storage, except for 40 m^3/ha represents the permanent pool volume.
The 40 m^3/ha represents extended detention storage.

Input:

Estimated Imperviousness =	68%			
Area =	5.56	ha		
Level of Protection:	1			
SWMP Type :	Wet Pond			

Calculation:

Total Storage Volume Required =	219	m^3/ha →	1,219	m^3
Permanent Pool Volume =	179	m^3/ha →	996	m^3
Active Storage Volume =	40	m^3/ha →	222	m^3



FOR VO MODEL RESULTS PLEASE REFER TO THE VO MODEL ATTACHED IN THE CD

SCHAEFFERS CONSULTING ENGINEERS	**Visual OTTHYMO™ Schematic** **POST-DEVELOPMENT MODEL – Pond 3** **(12hr SCSII, 24hr SCSII, & 4 Hr Chicago Storm)**	
	Job #: 4750	**Date: September 2019**

Project: *2019-4750*
Shining Hill Phase 3
Town of Newmarket
Pond 3

SCHAEFFERS CONSULTING ENGINEERS

Post Development Controlled Area Allowable Release Rate - Theoretical Storages

Target rates based on the Pre Development site area of **9.18** **ha**
Post development Controlled Allowable Release rates calculated by subtracting the uncontrolled release rates from target release rates

SCS 12HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3/s)	Post development Release Rate(m3/s)
Erosion Control	0.008	0.008	-	940	0.008
2 Year	0.179	0.126	0.053	1,205	0.139
5 Year	0.292	0.215	0.077	1,515	0.241
10 Year	0.387	0.291	0.096	1,769	0.330
25 Year	0.492	0.366	0.126	2,040	0.405
50 Year	0.596	0.448	0.148	2,322	0.510
100 Year	0.654	0.494	0.160	2,458	0.559

SCS 24HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3/s)	Post development Release Rate(m3/s)
2 Year	0.206	0.151	0.055	1,298	0.169
5 Year	0.270	0.203	0.067	1,493	0.229
10 Year	0.431	0.340	0.091	1,928	0.384
25 Year	0.542	0.413	0.129	2,235	0.471
50 Year	0.643	0.500	0.143	2,452	0.560
100 Year	0.687	0.529	0.158	2,558	0.603

4hr Chicago

Storm Event	Pre development Release Rate -Target Rate (m3/s) (Chicago)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3/s)	Post development Release Rate(m3/s)
2 Year	0.116	0.062	0.054	1,088	0.069
5 Year	0.209	0.129	0.080	1,361	0.144
10 Year	0.279	0.164	0.115	1,576	0.186
25 Year	0.355	0.213	0.142	1,805	0.242
50 Year	0.474	0.296	0.178	2,122	0.336
100 Year	0.547	0.351	0.196	2,303	0.398

Project: 2019-4750

EROSION CONTROL CALCULATIONS
Pond 3

Based on 25mm Storm Event Releasing over 48-Hour Period

Post Dev - BLOOR 24HR SCS(2019-08-12)

Schematic | Hydrograph Results (instance)

Run: 1.4-Hr 25mm Erosion Event   Show All Runs

Run	NHYD	DT [hr]	AREA [ha]	PKFW [m^3/s]	TP [hr]	RV [mm]	DWF [m^3/s]
1.4-Hr 25mm Erosion Event	104	0.0833	5.5600	0.0076	4.3333	16.8995	0.0000

Input:

Post-Dev. Area =	5.56	ha
R.V =	16.8995	mm
Draw Down Time =	48	hrs

Calculations:

Required Storage =	940	m^3
Average Outflow =	0.005	m^3/s
Peak Outflow =	0.008	m^3/s (Estimated at 1.5 times Average Outflow)

Appendix A2-4
Pond 4 Calculations

Project: 2019-4750

SCHAEFFERS CONSULTING ENGINEERS

Post-development Catchment - SWM Pond 4

Cacthment Total Area=	13.08
Controlled Area=	12.33
Uncontrolled Area=	0.76
External Area=	0.00
Development Area=	13.08

Imperviousness

For Controlled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Residential (6m lots)	1.57	0.73	0.75	1.14	1.18	0.45	0.71
Low Density Residential (12m lots)	5.58	0.60	0.57	3.36	3.21	0.45	2.51
Laneway	0.51	0.90	1.00	0.46	0.51	1.00	0.51
Vista (Grass)	0.10	0.30	0.14	0.03	0.01	0.14	0.01
Road (18m)	2.35	0.69	0.70	1.62	1.65	0.70	1.65
Road (26m)	0.97	0.68	0.69	0.66	0.67	0.69	0.67
Road (26m) - Transition	0.11	0.68	0.69	0.08	0.08	0.69	0.08
SWM Facility (Pond 4)	1.12	0.55	0.50	0.62	0.56	0.50	0.56
Total Area	**12.33**	**0.65**	**0.64**	**7.97**	**7.87**	**0.54**	**6.70**

For Uncontrolled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Low Density Residential (Backyards)	0.71	0.51	0.45	0.36	0.32	0.45	0.32
Vista (Grass)	0.05	0.30	0.14	0.01	0.01	0.14	0.01
Total Area	**0.76**	**0.50**	**0.43**	**0.37**	**0.33**	**0.43**	**0.33**

25mm Retention Requirement		
Total Area	13.08 ha	
A * IMP	8.19	
Total IMP	63%	
25mm Volume	**2049 m3**	(i.e. 13.08ha x 63% x 25mm x 10)
12.5mm Volume	1024 m3	(i.e. 13.08ha x 63% x 12.5mm x 10)

Permanent Pool Volume Required (80% TSS Removal)

Table: Water Quality Storage Requirements Based on Receiving Waters

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level					
		0%	35%	55%	70%	85%	100%
Level 1	Wet Pond	53	140	190	225	250	275

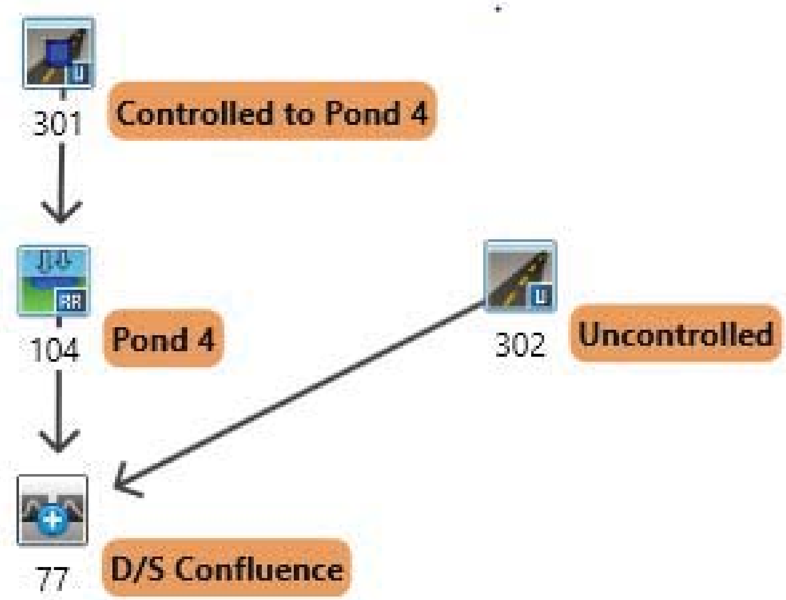
* For wet ponds, all of the storage, except for 40 m^3/ha represents the permanent pool volume.
The 40 m^3/ha represents extended detention storage.

Input:

Estimated Imperviousness =	64%			
Area =	12.33	ha		
Level of Protection:	1			
SWMP Type :	Wet Pond			

Calculation:

Total Storage Volume Required =	211	m^3/ha →	2,596	m^3
Permanent Pool Volume =	171	m^3/ha →	2,103	m^3
Active Storage Volume =	40	m^3/ha →	493	m^3



FOR VO MODEL RESULTS PLEASE REFER TO THE VO MODEL ATTACHED IN THE CD

SCHAEFFERS CONSULTING ENGINEERS	**Visual OTTHYMO™ Schematic** **POST-DEVELOPMENT MODEL – Pond 4** **(12hr SCSII, 24hr SCSII, & 4 Hr Chicago Storm)**	
	Job #: 4750	**Date: September 2019**

Project: ***2019-4750***
Shining Hill Phase 3
Town of Newmarket
Pond 4

SCHAEFFERS CONSULTING ENGINEERS

Post Development Controlled Area Allowable Release Rate - Theoretical Storages

Target rates based on the Pre Development site area of **13.66** **ha**
Post development Controlled Allowable Release rates calculated by subtracting the uncontrolled release rates from target release rates

SCS 12HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3)	Post development Release Rate(m3/s)
Erosion Control	0.018	0.018	-	2,117	0.018
2 Year	0.375	0.300	0.075	2,583	0.315
5 Year	0.612	0.507	0.105	3,220	0.536
10 Year	0.813	0.683	0.130	3,752	0.723
25 Year	1.035	0.869	0.166	4,310	0.912
50 Year	1.255	1.061	0.194	4,819	1.114
100 Year	1.377	1.168	0.209	5,094	1.223

SCS 24HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3)	Post development Release Rate(m3/s)
2 Year	0.434	0.357	0.077	2,785	0.375
5 Year	0.569	0.476	0.093	3,183	0.503
10 Year	0.901	0.776	0.125	4,102	0.822
25 Year	1.141	0.971	0.170	4,671	1.020
50 Year	1.341	1.154	0.187	5,107	1.210
100 Year	1.444	1.237	0.207	5,320	1.293

4hr Chicago

Storm Event	Pre development Release Rate -Target Rate (m3/s) (Chicago)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (Chicago)(m3)	Post development Release Rate(m3/s)
2 Year	0.237	0.154	0.083	2,338	0.163
5 Year	0.437	0.316	0.121	2,883	0.334
10 Year	0.586	0.438	0.148	3,282	0.464
25 Year	0.750	0.550	0.200	3,769	0.584
50 Year	1.011	0.763	0.248	4,422	0.809
100 Year	1.167	0.896	0.271	4,810	0.950

EROSION CONTROL CALCULATIONS
Pond 4

Based on 25mm Storm Event Releasing over 48-Hour Period

Schematic | Hydrograph Results (instance)

Run: 1.4-Hr 25mm Erosion Event | Show All Runs

Run	NHYD	DT [hr]	AREA [ha]	PKFW [m^3/s]	TP [hr]	RV [mm]	DWF [m^3/s]
1.4-Hr 25mm Erosion Event	103	0.0833	12.3300	0.0168	4.4167	17.1690	0.0000

Input:

Post-Dev. Area =	12.33	ha
R.V =	17.1690	mm
Draw Down Time =	48	hrs

Calculations:

Required Storage =	2,117	m^3
Average Outflow =	0.012	m^3/s
Peak Outflow =	0.018	m^3/s (Estimated at 1.5 times Average Outflow)

Appendix A2-5
Pond 5 Calculations

Project: 2019-4750

SCHAEFFERS CONSULTING ENGINEERS

Post-development Catchment - SWM Pond 5

Cacthment Total Area=	8.96
Controlled Area=	8.85
Uncontrolled Area=	0.11
External Area=	0.00
Development Area=	8.96

Imperviousness

For Controlled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Residential (6m lots)	0.54	0.73	0.75	0.39	0.41	0.45	0.24
Low Density Residential (12m lots)	2.58	0.60	0.57	1.55	1.48	0.45	1.16
Low Density Residential (Backyards)	0.29	0.51	0.45	0.15	0.13	0.45	0.13
Laneway	0.17	0.90	1.00	0.15	0.17	1.00	0.17
Vista (Grass)	0.02	0.30	0.14	0.01	0.00	0.14	0.00
Park	2.18	0.30	0.14	0.65	0.31	0.14	0.31
Road (18m)	1.33	0.69	0.70	0.92	0.93	0.70	0.93
Road (26m)	0.89	0.68	0.69	0.61	0.61	0.69	0.61
SWM Facility (Pond 5)	0.86	0.55	0.50	0.47	0.43	0.50	0.43
Total Area	**8.85**	**0.55**	**0.51**	**4.90**	**4.47**	**0.45**	**3.99**

**IMP bumped to 0.60 (C = 0.62) for modeling purposes to obtain conservative estimate.

For Uncontrolled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Low Density Residential (Backyards)	0.11	0.51	0.45	0.05	0.05	0.45	0.05
Total Area	**0.11**	**0.51**	**0.45**	**0.05**	**0.05**	**0.45**	**0.05**

25mm Retention Requirement		
Total Area	8.96 ha	
A * IMP	4.52	
Total IMP	50%	
25mm Volume	**1131 m3**	(i.e. 8.96ha x 50% x 25mm x 10)
12.5mm Volume	565 m3	(i.e. 8.96ha x 50% x 12.5mm x 10)

Permanent Pool Volume Required (80% TSS Removal)

Table: Water Quality Storage Requirements Based on Receiving Waters

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level					
		0%	35%	55%	70%	85%	100%
Level 1	Wet Pond	53	140	190	225	250	275

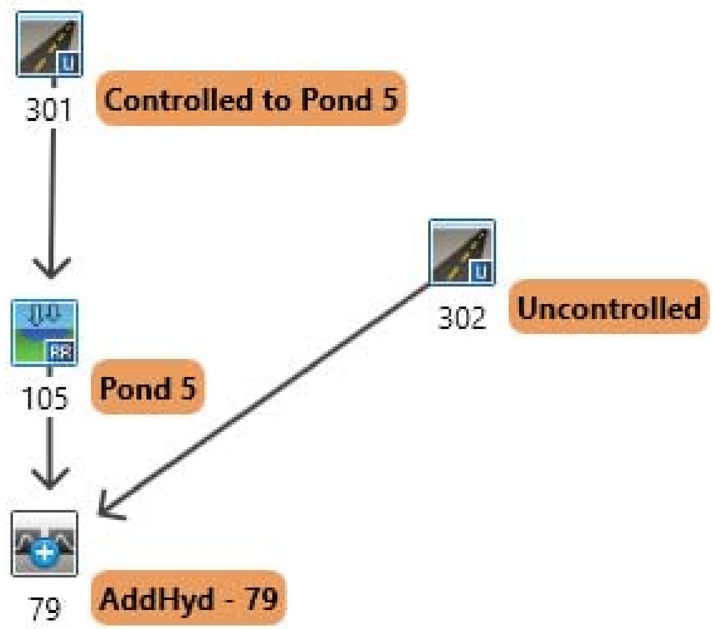
* For wet ponds, all of the storage, except for 40 m^3/ha represents the permanent pool volume.
The 40 m^3/ha represents extended detention storage.

Input:

Estimated Imperviousness =	51%			
Area =	8.85	ha		
Level of Protection:	1			
SWMP Type :	Wet Pond			

Calculation:

Total Storage Volume Required =	180	m^3/ha →	1,590	m^3
Permanent Pool Volume =	140	m^3/ha →	1,236	m^3
Active Storage Volume =	40	m^3/ha →	354	m^3



FOR VO MODEL RESULTS PLEASE REFER TO THE VO MODEL ATTACHED IN THE CD

SCHAEFFERS
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Visual OTTHYMO™ Schematic

POST-DEVELOPMENT MODEL – Pond 5
(12hr SCSII, 24hr SCSII, & 4 Hr Chicago Storm)

Job #: 4750	**Date: September 2019**

Project: *2019-4750*
Shining Hill Phase 3
Town of Aurora
Pond 5

SCHAEFFERS CONSULTING ENGINEERS

Post Development Controlled Area Allowable Release Rate - Theoretical Storages

Target rates based on the Pre Development site area of **6.48** **ha**
Post development Controlled Allowable Release rates calculated by subtracting the uncontrolled release rates from target release rates

SCS 12HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3/s)	Post development Release Rate(m3/s)
Erosion Control	0.012	0.012	-	1,422	
2 Year	0.135	0.124	0.011	1,917	0.125
5 Year	0.220	0.204	0.016	2,513	0.206
10 Year	0.292	0.271	0.021	2,994	0.274
25 Year	0.372	0.347	0.025	3,497	0.350
50 Year	0.451	0.423	0.028	3,844	0.427
100 Year	0.494	0.463	0.031	4,226	0.468

SCS 24HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3/s)	Post development Release Rate(m3/s)
2 Year	0.157	0.145	0.012	2,086	0.146
5 Year	0.205	0.191	0.014	2,444	0.193
10 Year	0.324	0.304	0.020	3,294	0.306
25 Year	0.411	0.386	0.025	3,833	0.389
50 Year	0.484	0.456	0.028	4,299	0.460
100 Year	0.520	0.489	0.031	4,512	0.493

4hr Chicago

Storm Event	Pre development Release Rate -Target Rate (m3/s) (Chicago)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3/s)	Post development Release Rate(m3/s)
2 Year	0.086	0.073	0.013	1,686	0.074
5 Year	0.157	0.139	0.018	2,176	0.140
10 Year	0.211	0.186	0.025	2,535	0.188
25 Year	0.269	0.239	0.030	2,904	0.242
50 Year	0.362	0.326	0.036	3,329	0.330
100 Year	0.418	0.377	0.041	3,752	0.381

Project: 2019-4750

EROSION CONTROL CALCULATIONS
Pond 5

Based on 25mm Storm Event Releasing over 48-Hour Period

Schematic | Hydrograph Results (instance)

Run: 4-Hr 25mm Erosion Event | Show All Runs

Run	NHYD	DT [hr]	AREA [ha]	PKFW [m^3/s]	TP [hr]	RV [mm]	DWF [m^3/s]
4-Hr 25mm Erosion Event	102	0.0833	8.8500	0.0127	4.4167	16.0633	0.0000

Input:

Post-Dev. Area =	8.85	ha
R.V =	16.0633	mm
Draw Down Time =	48	hrs

Calculations:

Required Storage =	1,422	m^3
Average Outflow =	0.008	m^3/s
Peak Outflow =	0.012	m^3/s (Estimated at 1.5 times Average Outflow)

Appendix A2-6
Pond 6 Calculations

Project: 2019-4750

SCHAEFFERS CONSULTING ENGINEERS

Post-development Catchment - SWM Pond 6

Cacthment Total Area=	5.88
Controlled Area=	5.59
Uncontrolled Area=	0.29
External Area=	0.00
Development Area=	5.88

Imperviousness

For Controlled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Residential (6m lots)	1.03	0.73	0.75	0.75	0.77	0.45	0.46
Low Density Residential (12m lots)	2.12	0.60	0.57	1.28	1.22	0.45	0.96
Laneway	0.34	0.90	1.00	0.31	0.34	1.00	0.34
Road (18m)	1.04	0.69	0.70	0.72	0.73	0.70	0.73
SWM Facility (Pond 6)	1.06	0.55	0.50	0.58	0.53	0.50	0.53
Total Area	**5.59**	**0.65**	**0.64**	**3.63**	**3.59**	**0.54**	**3.02**

For Uncontrolled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Low Density Residential (Backyards)	0.20	0.52	0.45	0.10	0.09	0.45	0.09
Vista (Grass)	0.08	0.30	0.14	0.03	0.01	0.14	0.01
Total Area	**0.29**	**0.45**	**0.36**	**0.13**	**0.10**	**0.36**	**0.10**

25mm Retention Requirement

Total Area	5.88 ha	
A * IMP	3.69	
Total IMP	63%	
25mm Volume	**923 m3**	(i.e. 5.88ha x 63% x 25mm x 10)
12.5mm Volume	462 m3	(i.e. 5.88ha x 63% x 12.5mm x 10)

Permanent Pool Volume Required (80% TSS Removal)

Table: Water Quality Storage Requirements Based on Receiving Waters

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level 0%	35%	55%	70%	85%	100%
Level 1	Wet Pond	53	140	190	225	250	275

* For wet ponds, all of the storage, except for 40 m^3/ha represents the permanent pool volume.
The 40 m^3/ha represents extended detention storage.

Input:

Estimated Imperviousness =	64%			
Area =	5.59	ha		
Level of Protection:	1			
SWMP Type :	Wet Pond			

Calculation:

Total Storage Volume Required =	211	m^3/ha →	1,182	m^3
Permanent Pool Volume =	171	m^3/ha →	959	m^3
Active Storage Volume =	40	m^3/ha →	224	m^3

Project: *2019-4750*
Shining Hill Phase 3
Town of Aurora
Pond 6

SCHAEFFERS CONSULTING ENGINEERS

Post Development Controlled Area Allowable Release Rate - Theoretical Storages

Target rates based on the Pre Development site area of **7.13** **ha**
Post development Controlled Allowable Release rates calculated by subtracting the uncontrolled release rates from target release rates

SCS 12HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3/s)	Post development Release Rate(m3/s)
Erosion Control	0.008	0.008	-	944	-
2 Year	0.192	0.166	0.026	1,119	0.174
5 Year	0.312	0.274	0.038	1,402	0.288
10 Year	0.415	0.368	0.047	1,631	0.386
25 Year	0.528	0.467	0.061	1,863	0.485
50 Year	0.641	0.572	0.069	2,014	0.594
100 Year	0.703	0.625	0.078	2,229	0.658

SCS 24HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3/s)	Post development Release Rate(m3/s)
2 Year	0.221	0.194	0.027	1,225	0.202
5 Year	0.290	0.257	0.033	1,394	0.270
10 Year	0.462	0.412	0.050	1,775	0.430
25 Year	0.583	0.520	0.063	2,009	0.540
50 Year	0.686	0.617	0.069	2,173	0.641
100 Year	0.738	0.660	0.078	2,250	0.682

4hr Chicago

Storm Event	Pre development Release Rate -Target Rate (m3/s) (Chicago)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3/s)	Post development Release Rate(m3/s)
2 Year	0.122	0.094	0.028	1,010	0.099
5 Year	0.223	0.182	0.041	1,231	0.191
10 Year	0.300	0.243	0.057	1,401	0.254
25 Year	0.384	0.313	0.071	1,624	0.329
50 Year	0.517	0.432	0.085	1,832	0.453
100 Year	0.597	0.500	0.097	2,048	0.526

Project: 2019-4750

EROSION CONTROL CALCULATIONS
Pond 6

Based on 25mm Storm Event Releasing over 48-Hour Period

Schematic | Hydrograph Results (instance)

Run: 4-Hr 25mm Erosion Event | Show All Runs

Run	NHYD	DT [hr]	AREA [ha]	PKFW [m^3/s]	TP [hr]	RV [mm]	DWF [m^3/s]
4-Hr 25mm Erosion Event	101	0.0833	5.5900	0.0078	4.3333	16.8840	0.0000

Input:

Post-Dev. Area =	5.59	ha
R.V =	16.884	mm
Draw Down Time =	48	hrs

Calculations:

Required Storage =	944	m^3
Average Outflow =	0.005	m^3/s
Peak Outflow =	0.008	m^3/s (Estimated at 1.5 times Average Outflow)

Appendix A2-7
Super Pipe Calculations

Project: 2019-4750

SCHAEFFERS
CONSULTING ENGINEERS

Post-development Catchment - Superpipe

Cacthment Total Area=	1.18
Controlled Area=	0.71
Uncontrolled Area=	0.46
External Area=	0.00
Development Area=	1.18

Imperviousness

For Controlled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Low Density Residential	0.15	0.60	0.57	0.09	0.08	0.45	0.07
Road (26m)	0.57	0.68	0.69	0.39	0.39	0.69	0.39
Total Area	**0.71**	**0.67**	**0.67**	**0.47**	**0.47**	**0.64**	**0.46**

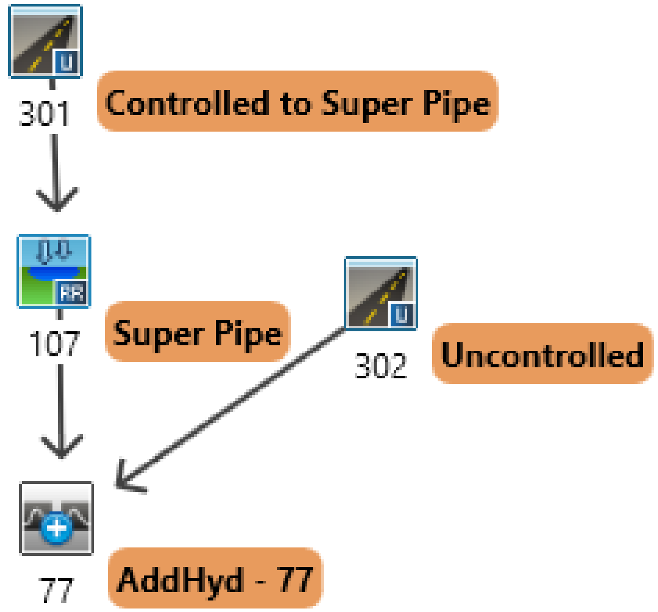
For Uncontrolled Area

Composite Runoff Coefficient

	Area (ha)	Runoff Coeff	Impervious	A*R	A*Imp	Ximp	A*Ximp
Low Density Residential (Backyards)	0.20	0.50	0.45	0.10	0.09	0.45	0.09
Vista (Grass)	0.26	0.30	0.14	0.08	0.04	0.14	0.04
Total Area	**0.46**	**0.39**	**0.28**	**0.18**	**0.13**	**0.28**	**0.13**

25mm Retention Requirement

Total Area	1.18 ha	
A * IMP	0.60	
Total IMP	51%	
25mm Volume	**151 m3**	(i.e. 1.18ha x 51% x 25mm x 10)
12.5mm Volume	76 m3	(i.e. 1.18ha x 51% x 12.5mm x 10)



FOR VO MODEL RESULTS PLEASE REFER TO THE VO MODEL ATTACHED IN THE CD

SCHAEFFERS CONSULTING ENGINEERS	**Visual OTTHYMO™ Schematic** **POST-DEVELOPMENT MODEL – Super Pipe** **(12hr SCSII, 24hr SCSII, & 4 Hr Chicago Storm)**	
	Job #: 4750	**Date: September 2019**

Project: *2019-4750*
Shining Hill Phase 3
Town of Aurora
Super Pipe Storage

SCHAEFFERS CONSULTING ENGINEERS

Post Development Controlled Area Allowable Release Rate - Theoretical Storages

Target rates based on the Pre Development site area of **1.76** **ha**
Post development Controlled Allowable Release rates calculated by subtracting the uncontrolled release rates from target release rates

SCS 12HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3)	Post development Release Rate(m3/s)
2 Year	0.109	0.071	0.038	94	0.062
5 Year	0.174	0.071	0.055	127	0.089
10 Year	0.229	0.071	0.069	154	0.110
25 Year	0.289	0.071	0.092	187	0.142
50 Year	0.348	0.071	0.105	209	0.160
100 Year	0.381	0.071	0.118	235	0.180

SCS 24HR -BLOOR

Storm Event	Pre development Release Rate -Target Rate (m3/s) (SCS)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3)	Post development Release Rate(m3/s)
2 Year	0.120	0.081	0.039	160	0.056
5 Year	0.155	0.081	0.048	183	0.075
10 Year	0.226	0.081	0.065	235	0.110
25 Year	0.305	0.081	0.095	266	0.153
50 Year	0.346	0.081	0.105	288	0.172
100 Year	0.384	0.081	0.118	301	0.189

* Controlled all to 2 year flow

4hr Chicago

Storm Event	Pre development Release Rate -Target Rate (m3/s) (Chicago)	Post Development Controlled Allowable Release Rate(m3/s)	Uncontrolled Area Release Rate(m3/s)	Storage Required (SCS)(m3)	Post development Release Rate(m3/s)
2 Year	0.062	0.026	0.036	123	0.036
5 Year	0.120	0.026	0.055	173	0.055
10 Year	0.168	0.026	0.080	208	0.080
25 Year	0.225	0.026	0.100	242	0.100
50 Year	0.302	0.026	0.122	284	0.122
100 Year	0.343	0.026	0.140	322	0.140

Appendix A3
Water Balance Calculations

TABLE 1: WATER BUDGET - PRE DEVELOPMENT
WATER BALANCE/WATER BUDGET ASSESSMENT

Catchment Designation	Site	Total
	Site	
Area (m^2)	674200	674200
Pervious Area (m^2)	674200	674200
Impervious Area (m^2)	0	0
Infiltration Factors[1]		
Topography Infiltration Factor	0.2	
Soil Infiltration Factor	0.1	
Land Cover Infiltration Factor (Cultivated Land)	0.1	
MOE Infiltration Factor	0.4	
Inputs (mm/year)		
Precipitation[2]	895	895
Total Inputs	895	895
Outputs (mm/year)		
Precipitation Surplus	275	275
Net Surplus	275	275
Downspout Disconnection Retention	0	0
Evapotranspiration	620	620
Roof Evapotranspiration	0	0
Rooftop Runoff Lawn Evaporation	0	0
Total Evapotranspiration[3]	**620**	620
Infiltration	110	110
Rooftop Infiltration	0	0
Total Infiltration	**110**	110
Runoff Pervious Area	165	165
Runoff Impervious Area	0	0
Total Runoff	**165**	165
Total Outputs	**895**	895
Difference (Inputs - Outputs)	0	0
Input (Volumes - m^3/year)		
Precipitation	603409	603409
Total Inputs	**603409**	**603409**
Outputs (Volumes - m^3/year)		
Precipitation Surplus	185405	185405
Net Surplus	185405	185405
Downspout Disconnection Retention	0	0
Evapotranspiration	418004	418004
Roof Evapotranspiration	0	0
Rooftop Runoff Lawn Evaporation	0	0
Total Evapotranspiration	**418004**	**418004**
Infiltration	74162	74162
Rooftop Infiltration	0	0
Total Infiltration	**74162**	**74162**
Runoff Pervious Area	111243	111243
Runoff Impervious Area	0	0
Total Runoff	**111243**	**111243**
Total Outputs	**603409**	**603409**
Difference (Inputs - Outputs)	0	0

1 - MOE Factors derived from MOE SWM Guidelines - 2003 Table 3-1
2 - Annual Precipitation determined from Pearson Airport data from 1983-2012
3 - Annual evapotranispration determined by Thornwaite Method

TABLE 2: WATER BUDGET - POST-DEVELOPMENT WITHOUT MITIGATION
WATER BALANCE/WATER BUDGET ASSESSMENT

Catchment Designation	Site		
	Pervious Area	Impervious Area	Total
Area (m^2)	322176	349024	671200
Pervious Area (m^2)	322176	0	322176
Impervious Area (m^2)	0	349024	349024
Infiltration Factors			
Topography Infiltration Factor	0.1	N/A	
Soil Infiltration Factor	0.2	N/A	
Land Cover Infiltration Factor	0.1	N/A	
MOE Infiltration Factor	0.4	N/A	
Inputs (per unit area)			
Precipitation (mm/year	895	895	895
Total Inputs (m^3/year)	895	895	895
Outputs (per unit area)			
Precipitation Surplus (mm/year)[1]	269	806	548
Net Surplus (mm/year)	269	806	548
Downspout Disconnection Retention[2]	0	0	0
Evapotranpiration (mm/year)	626	0	300
Roof Evapotranspiration (mm/year)[2]	0	90	47
Rooftop Runoff Lawn Evaporation (mm/year)	0	0	0
Total Evapotranspiration (mm/yr)	**626**	**90**	**347**
Infiltration (mm/year)	108	0	52
Rooftop Infiltration (mm/year)[2]	0	0	0
Mitigation Infiltration (mm/year)	0	0	0
Total Infiltration (mm/year)	**108**	**0**	**52**
Runoff Pervious Area (mm/year)	161	0	77
Runoff Impervious Area (mm/year)	0	806	419
Total Runoff (mm/year)	**161**	**806**	496
Total Outputs (mm/year)	**895**	**895**	**895**
Difference (Inputs - Outputs)	0	0	0
Input Volumes			
Precipitation (m^3/year)	288348	312376	600724
Total Inputs (m^3/year)	**288348**	**312376**	**600724**
Outputs (Volumes)			
Precipitation Surplus (m^3/year)	86665	281139	367804
Net Surplus (m^3/year)	86665	281139	367804
Downspout Disconnection Retention[2] (m^3/year)	0	0	0
Evapotranpiration (m^3/year)	201682	0	201682
Roof Evapotranspiration (m^3/year)	0	31238	31238
Rooftop Runoff Lawn Evaporation (m^3/year)	0	0	0
Total Evapotranspiration (m^3/year)	**201682**	**31238**	**232920**
Infiltration (m^3/year)	34666	0	34666
Rooftop Infiltration (m^3/year)	0	0	0
Total Infiltration (m^3/year)	**34666**	**0**	**34666**
Runoff Pervious Area (m^3/year)	51999	0	51999
Runoff Impervious Area (m^3/year)	0	281139	281139
Total Runoff (m^3/year)	**51999**	**281139**	**333138**
Total Outputs (m^3/year)	**288348**	**312376**	**600724**
Difference (Inputs - Outputs)	0	0	0

1 - Assumes 10% Evaporation from Impervious Surfaces

Water Balance Mitigation Calculations

Pre Development Infiltration =	**74,162 m^3/y**
Post Development Infiltration =	**34,821 m^3/y**
Post to Pre Deficit =	**39,341 m^3/y**

The pre versus post development water balance analysis reveals that a annual infiltration deficit of **39,341 m^3/y** is expected as a result of the proposed development.

By taking this annual deficit across the entire site area of **67.120 ha**, the expected equivalent annual rainfall depth is **58.61 mm** across the site area.

As the resulting deficit is **less than 5mm**, approximately 1.63mm.

Appendix A4
Total Phosphorus Calculations

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: Shining Hill Estates Collection Inc. Phase 3 Catchment 1001
Subwatershed: East Holland

Total Pre-Development Area (ha):	**10.98**	Total Pre-Development Phosphorus Load (kg/yr):	**3.95**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	10.98	0.36	3.95

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Comm/Industrial	0.6	1.82	Wet Detention Ponds	63%	0.40
			Commercial Block to Pond		
High Intensity - Residential	6.49	1.32	Wet Detention Ponds	63%	3.17
			Residential & Road to Pond		
Low Intensity Development	1.11	0.13	NONE	0%	0.14
			Uncontrolled Grass/Backyard		
Low Intensity Development	1.93	0.13	Wet Detention Ponds	63%	0.09
			Parkland to Pond		
Open Water	0.85	0.26	Wet Detention Ponds	63%	0.08
			SWM Pond Block		

Post-Development Area Altered: **10.98**
Total Pre-Development Area: **10.98**
Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**3.95**
Post-Development:	**10.27**
Change (Pre - Post):	**-6.32**
	160% Net Increase in Load
Post-Development (with BMPs):	**3.89**
Change (Pre - Post):	**0.06**
	2% Net Reduction in Load

DEVELOPMENT: **Shining Hill Estates Collection Inc. Phase 3 Catchment 1001**
Subwatershed: **East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	P Load (kg/yr)
Pre-Development:	**3.95**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**3.89**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**0.06**
Conclusion:	**2% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: **Shining Hill Estates Inc. Phase 3 - Catchment 1008**
Subwatershed: **East Holland**

Total Pre-Development Area (ha):	**0.3000**	Total Pre-Development Phosphorus Load (kg/yr):	**0.11**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	0.3	0.36	0.11

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	0.3	1.32	NONE	0%	0.40

Uncontrolled Road

Post-Development Area Altered:	**0.30**
Total Pre-Development Area:	**0.30**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**0.11**
Post-Development:	**0.40**
Change (Pre - Post):	**-0.29**
	267% Net Increase in Load
Post-Development (with BMPs):	**0.40**
Change (Pre - Post):	**-0.29**
	266.67% Net Increase in Load

DEVELOPMENT: Shining Hill Estates Inc. Phase 3 - Catchment 1008
Subwatershed: East Holland

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**0.11**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**0.40**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**-0.29**
Conclusion:	**267% Increase in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Not approve development as site specific appropriate

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: Shining Hill Estates Inc. Phase 3 - Catchment 1007
Subwatershed: East Holland

Total Pre-Development Area (ha):	**1.18**	Total Pre-Development Phosphorus Load (kg/yr):	**0.42**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	1.18	0.36	0.42

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	0.72	1.32	Underground Storage	25%	0.71
			Residential and Road areas to pipe storage		
Low Intensity Development	0.46	0.13	NONE	0%	0.06
			Uncontrolled grassland and Backyards		

Post-Development Area Altered:	**1.18**
Total Pre-Development Area:	**1.18**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**0.42**
Post-Development:	**1.01**
Change (Pre - Post):	**-0.59**
138% Net Increase in Load	
Post-Development (with BMPs):	**0.77**
Change (Pre - Post):	**-0.35**
81.87% Net Increase in Load	

DEVELOPMENT:	**Shining Hill Estates Inc. Phase 3 - Catchment 1007**
Subwatershed:	**East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**0.42**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**0.77**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**-0.35**
Conclusion:	**82% Increase in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Not approve development as site specific appropriate

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Ontario

MINISTRY OF THE ENVIRONMENT

Project DEVELOPMENT Summary

DEVELOPMENT: Shining Hill Estates Inc. Phase 3 - Catchment 1006
Subwatershed: East Holland

Total Pre-Development Area (ha):	**5.8800**	Total Pre-Development Phosphorus Load (kg/yr):	**2.12**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	5.88	0.36	2.12

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	4.53	1.32	Wet Detention Ponds	63%	2.21
			Residential and Road Area to Pond		
Low Intensity Development	0.29	0.13	NONE	0%	0.04
			Uncontrolled Grassland and Backyard		
Open Water	1.06	0.26	Wet Detention Ponds	63%	0.10
			Pond Block		

Post-Development Area Altered:	**5.88**
Total Pre-Development Area:	**5.88**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**2.12**
Post-Development:	**6.29**
Change (Pre - Post):	**-4.18**
	197% Net Increase in Load
Post-Development (with BMPs):	**2.35**
Change (Pre - Post):	**-0.24**
	11.12% Net Increase in Load

DEVELOPMENT: **Shining Hill Estates Inc. Phase 3 - Catchment 1006**
Subwatershed: **East Holland**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	P Load (kg/yr)
Pre-Development:	**2.12**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**2.35**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**-0.24**
Conclusion:	**11% Increase in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Not approve development as site specific appropriate

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: Shining Hill Estates Inc. Phase 3 - Catchment 1005
Subwatershed: East Holland

Total Pre-Development Area (ha):	**8.9600**	Total Pre-Development Phosphorus Load (kg/yr):	**3.23**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	8.96	0.36	3.23

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	5.8	1.32	Wet Detention Ponds	63%	2.83
			Controlled Residential Area to Pond		
Low Intensity Development	0.11	0.13	NONE	0%	0.01
			Uncontrolled Backyard Area		
Low Intensity Development	2.19	0.13	Wet Detention Ponds	63%	0.11
			Park and grassed area to Pond		
Open Water	0.86	0.26	NONE	0%	0.22
			Pond Block		

Post-Development Area Altered:	**8.96**
Total Pre-Development Area:	**8.96**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**3.23**
Post-Development:	**8.18**
Change (Pre - Post):	**-4.95**
	154% Net Increase in Load
Post-Development (with BMPs):	**3.18**
Change (Pre - Post):	**0.05**
	2% Net Reduction in Load

DEVELOPMENT: Shining Hill Estates Inc. Phase 3 - Catchment 1005
Subwatershed: East Holland

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	P Load (kg/yr)
Pre-Development:	**3.23**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**3.18**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**0.05**
Conclusion:	**2% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version:	**V 2.0 Release Update**
Update Date:	**30-Mar-12**

Project DEVELOPMENT Summary

DEVELOPMENT: Shining Hill Estates Inc. Phase 3 - Catchment 1004

Subwatershed: East Holland

Total Pre-Development Area (ha):	**13.08**	Total Pre-Development Phosphorus Load (kg/yr):	**4.71**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	13.08	0.36	4.71

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	11.1	1.32	Wet Detention Ponds	63%	5.42
			Residential and Road to Pond		
Low Intensity Development	0.76	0.13	NONE	0%	0.10
			Uncontrolled Grassland and Backyards		
Low Intensity Development	0.1	0.13	Wet Detention Ponds	63%	0.00
			Grassed Area to Pond		
Open Water	1.12	0.26	Wet Detention Ponds	63%	0.11
			Pond Block		

Post-Development Area Altered:	**13.08**
Total Pre-Development Area:	**13.08**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**4.71**
Post-Development:	**15.06**
Change (Pre - Post):	**-10.35**
	220% Net Increase in Load
Post-Development (with BMPs):	**5.63**
Change (Pre - Post):	**-0.92**
	19.62% Net Increase in Load

DEVELOPMENT: Shining Hill Estates Inc. Phase 3 - Catchment 1004
Subwatershed: East Holland

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	P Load (kg/yr)
Pre-Development:	**4.71**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**5.63**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**-0.92**
Conclusion:	**20% Increase in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Not approve development as site specific appropriate

Database Version:	V 2.0 Release Update
Update Date:	30-Mar-12

Ontario

MINISTRY OF THE ENVIRONMENT

Project DEVELOPMENT Summary

DEVELOPMENT: Shining Hill Estates Inc. Phase 3 - Catchment 1003

Subwatershed: East Holland

Total Pre-Development Area (ha):	6.1700	Total Pre-Development Phosphorus Load (kg/yr):	2.22

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	6.17	0.36	2.22

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	4.66	1.32	Wet Detention Ponds	63%	2.28
			Roads and Residential areas to Pond		
Low Intensity Development	0.61	0.13	NONE	0%	0.08
			Uncontrolled Backyard and grassed lands		
Open Water	0.9	0.26	Wet Detention Ponds	63%	0.09
			Pond Block		

Post-Development Area Altered:	**6.17**
Total Pre-Development Area:	**6.17**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**2.22**
Post-Development:	**6.46**
Change (Pre - Post):	**-4.24**
	191% Net Increase in Load
Post-Development (with BMPs):	**2.44**
Change (Pre - Post):	**-0.22**
	9.93% Net Increase in Load

DEVELOPMENT: Shining Hill Estates Inc. Phase 3 - Catchment 1003
Subwatershed: East Holland

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**2.22**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**2.44**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**-0.22**
Conclusion:	**10% Increase in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Not approve development as site specific appropriate

Ontario

MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: Shining Hill Estates Inc. Phase 3 - Catchment 1002
Subwatershed: East Holland

Total Pre-Development Area (ha):	20.870	Total Pre-Development Phosphorus Load (kg/yr):	7.51

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	20.87	0.36	7.51

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	15.35	1.32	Wet Detention Ponds	63%	7.50
			Residential, School and Roads to Pond		
Low Intensity Development	1.98	0.13	Wet Detention Ponds	63%	0.10
			Controlled Parkland to Pond		
Low Intensity Development	2.25	0.13	NONE	0%	0.29
			Uncontrolled Vegetated Trail, backyards and grasslands		
Open Water	1.29	0.26	Wet Detention Ponds	63%	0.12
			SWM Pond Block		

Post-Development Area Altered: **20.87**
Total Pre-Development Area: **20.87**
Unaffected Area: **0**

	P Load (kg/yr)
Pre-Development:	**7.51**
Post-Development:	**21.15**
Change (Pre - Post):	**-13.63**
	181% Net Increase in Load
Post-Development (with BMPs):	**8.01**
Change (Pre - Post):	**-0.50**
	6.6% Net Increase in Load

DEVELOPMENT: Shining Hill Estates Inc. Phase 3 - Catchment 1002
Subwatershed: East Holland

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	P Load (kg/yr)
Pre-Development:	**7.51**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**8.01**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**-0.50**
Conclusion:	**7% Increase in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Not approve development as site specific appropriate

Appendix A5
Flood Plain & VO Model CD

Appendix B

Sanitary Servicing

Population / Infiltration Area Calculation - System 1

Project: Shining Hill Phase 3

Project No: 4750

Municipality: Town of Aurora / Newmarket

Infiltration Areas to Eastern Sewers

Sanitary Tributary	Total Area	Pervious Area	Net Area to Sewer
Pond 1	10.88	0.85	**10.02**
Pond 2 & 3	26.78	5.68	**21.10**
Pond 4 & 5	20.03	4.16	**15.87**
Total to East	57.68	-	**46.99**

Residential Population from Pond 1 Area

Site/Unit Type	Units/Area	Pop. Density (Person/unit)	Pop. Density (Person/ha)	Population	
Commercial	0.6		75.0	45	
Single / Semi	41	3.38		139	
Townhouse	60	2.88		173	
Apartments	230	1.95		449	
Institutional (School)	0		0.0	0	**
Parks	1.92		0.0	0	**
Total				806	

Population From Pond 2 & 3 Area

Site/Unit Type	Units/Area	Pop. Density (Person/unit)	Pop. Density (Person/100m^2)	Population	
Commercial	0		75.0	0	
Single / Semi	89	3.38		301	
Townhouse	665	2.88		1916	
Apartments	260	1.95		507	
Institutional (School)	2.40		0.0	0	**
Parks	2.19		0.0	0	**
Total				2724	

Population From Pond 4 & 5 Area

Site/Unit Type	Units/Area	Pop. Density (Person/unit)	Pop. Density (Person/100m^2)	Population	
Commercial	0		75.0	0	
Single / Semi	200	3.38		676	
Townhouse	88	2.88		254	
Apartments	0	1.95		0	
Institutional (School)	0		0.0	0	**
Parks	2.18		0.0	0	**
Total				930	

Note: (1) - Populations Densities based on Town of New Market Design Criteria for Sewers and Watermains
(2) - Population rounded up for each site/unit type before being carried forward for additional calculations

Sanitary Flow Generation at the Sewer - System 1 (Newmarket)

Project: Shining Hill Phase 3
Project No: 4750
Municipality: Town of Aurora / Newmarket

Infiltration Rate:	All types*	0.3	L/s/ha
Generation Rate:	Residential*	360	litres/capita/day
School Generatin Rate:		1.6	litres/s/ha
Total Site Infiltration Area:		46.99	ha

(Based on 220 students or staff per hectare, 140 L/person/ 8hr and peak of 1.5 + 0.3L/s/ha infiltration allowance)

Estimated Site Discharge

Site Discharge	Units	Population	Average Demand (L/S)	Harmon's Peaking Factor	Peak Flow (L/s)	Infiltration (L/s)	Total Peak Flow (L/s)
Residential	1633	4415	18.396	3.29	60.608	13.198	**73.81**

Site Discharge	Floor Area (ha)	Population	Average Demand (L/S)	Harmon's Peaking Factor	Peak Flow (L/s)	Infiltration (L/s)	Total Peak Flow (L/s)
Schools	2.40	-	-	-	3.840	Included	**3.84**

Site Discharge	Floor Area (ha)	Population	Average Demand (L/S)		Peak Flow (L/s)	Infiltration (L/s)	Total Peak Flow (L/s)
Commercial	0.60	45	0.188	4.00	0.19	0.180	**0.19**

Total Flow =	**73.99**

*As per the Town of Newmarket Engineering Design Standards & Criteria

Population / Infiltration Area Calculation - System 2

Project: Shining Hill Phase 3

Project No: 4750

Municipality: Town of Aurora / Newmarket

Infiltration Areas to St. John Sideroad

Sanitary Tributary	Total Area	Pervious Area	Net Area to Sewer
To Ex. 69A	4.35	0	**4.35**
To P27A	4.64	1.06	**3.58**
Total to South	8.99		**7.93**

Residential Population to Ex. 69A

Site/Unit Type	Units/Area	Pop. Density (Person/unit)	Pop. Density (Person/ha)	Population
Commercial	0		75.0	0
Single / Semi	25	3.8		95
Townhouse	56	3.5		196
Apartments	0	2.5		0
Institutional	0		50.0	0
Parks	0		50.0	0
Total				291

Residential Population to P27A

Site/Unit Type	Units/Area	Pop. Density (Person/unit)	Pop. Density (Person/100m^2)	Population
Commercial	0		75.0	0
Single / Semi	55	3.8		209
Townhouse	0	3.5		0
Apartments	0	2.5		0
Institutional	0		50.0	0
Parks	0		50.0	0
Total				209

Note: (1) - Populations Densities based on Town of Aurora Design Criteria for Sewers and Watermains

(2) - Population rounded up for each site/unit type before being carried forward for additional calculations

Sanitary Flow Generation at the Sewer - System 2 (Aurora)

Project: Shining Hill Phase 3

Project No: 4750

Municipality: Town of Aurora / Newmarket

Infiltration Rate:	All types*	0.26	L/s/ha
Generation Rate:	Residential*	400	litres/capita/day
Total Site Infiltration Area		7.93	ha

Estimated Site Discharge

Site Discharge	Units	Population	Average Demand (L/S)	Harmon's Peaking Factor	Peak Flow (L/s)	Infiltration (L/s)	Total Peak Flow (L/s)
Residential	136	500	2.315	3.97	9.200	2.061	**11.26**

*As per the town of Aurora Design Criteria Manual for Engineering Plans

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TOWN OF AURORA

SANITARY SEWER DESIGN SHEET

SHINING HILL COLLECTION INC. (PHASE 2)
RESIDENTIAL SUBDIVISION
Proposed Condition - St. John's Sideroad to Yonge Street

REGISTERED PROFESSIONAL ENGINEER
H. O. TOZCU
May 31, 2019
PROVINCE OF ONTARIO

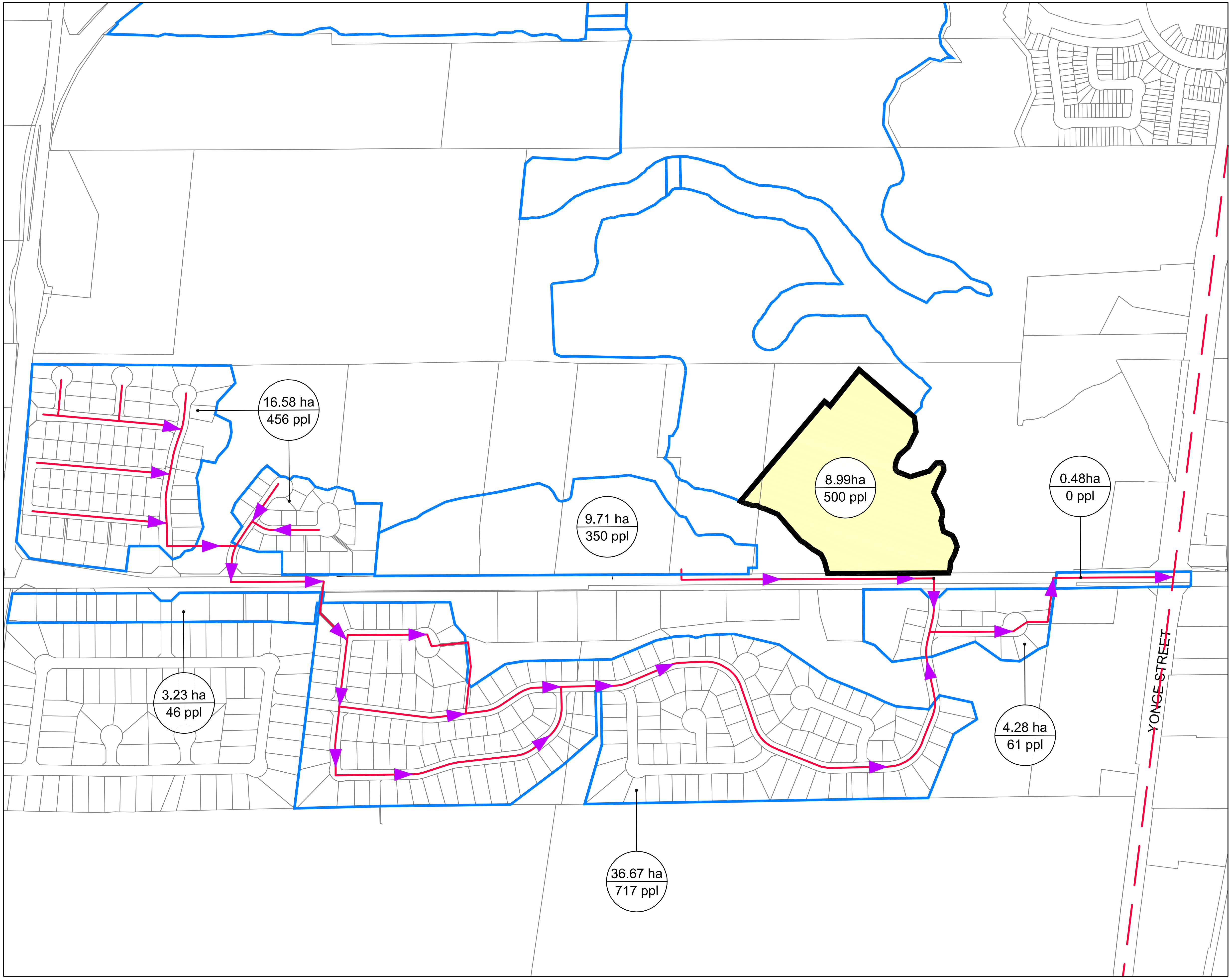
Design By: G.V.
Checked By: K.S.
Date: September 17, 2019
Project No.: 2016-4473

Population Density = 3.8 ppu or 95 ppha
M = 1 + 14 / (4 + SqRt P), P=population in 1000's
Q = 400 L/cap/day (average)
Infiltration = 0.26 L/sec/ha

Location / Street	From MH.	To MH.	Area ha	Accum. Area ha	No. of Units	Density PPU	Pop.	Accum. Pop.	'M'	Res. Flow l/sec	Infilt. Flow l/sec	Ind./Comm.	Total Flow l/sec	Pipe Length m	Dia. mm	Slope %	Cap. l/sec	Vel. m/sec	Actual Vel. m/sec	Remarks	Capacity	DWG Reference
Proposed Shining Hill Phase 2	27A	EX. 69A	9.71	9.71	92	3.8	350	350	4.00	6.47	2.52		9.00	68.9	200	0.50	23.19	0.74	0.69		39%	Proposed Development
to St. John Sideroad				**9.71**				**350**														
North External to Willow Farm Lane	EX. 69A	EX.68A	12.00	21.71	-	3.8	750	1100	3.77	19.21	5.64		24.85	46.8	200	2.04	46.85	1.49	1.51		53%	DWG No. B-8628-F - St. Andrew on the Hill
	EX.68A	EX.64A	1.95	23.66	-	3.8	19	1119	3.77	19.51	6.15		25.67	48.2	200	4.95	72.97	2.32	2.10		35%	
				23.66				**1119**														
Ex. St. Andrews on the Hill Subdivision			56.48	**56.48**			1173	**1173**														
and Ballymore Development																						
South External to Willow Farm Lane	EX. 63A	EX.64A	0.54	57.02	-	3.8	12	1185	3.75	20.58	14.83		35.41	68.9	250	0.40	37.61	0.77	0.85		94%	DWG No. 3 - Ballymore Development
				57.02				**1185**														DWG No. B-8628-D,E, & F - St. Andrew on the Hill
Heatherfield Lane	EX.64A	EX.65A	0.11	80.79	**0**	3.8	0	2304	3.54	37.72	21.01		58.73	76.3	300	0.40	61.16	0.87	0.93		96%	DWG No. B-8628-F & 41
	EX.65A	EX.66A	0.64	81.43	**4**	3.8	15	2319	3.53	37.95	21.17		59.12	73.5	300	0.40	61.16	0.87	0.92		97%	
	EX.66A	EX.67A	1.04	82.47	**4**	3.8	15	2334	3.53	38.17	21.44		59.61	29.6	300	0.48	67.00	0.95	1.09		89%	
Easement	EX.67A	EX.74A	0.00	82.47	**0**	3.8	0	2334	3.53	38.17	21.44		59.61	29.6	300	0.47	66.29	0.94	1.08		90%	DWG No. B-8628-42
Easement	EX.74A	EX.73A	0.00	82.47	0	3.8	0	2334	3.53	38.17	21.44		59.61	55.2	300	1.00	96.70	1.37	1.44		62%	
Easement	EX.73A	EX.72A	0.00	82.47	0	3.8	0	2334	3.53	38.17	21.44		59.61	27.1	300	2.00	136.86	1.94	1.86		44%	
				82.47				**2334**														
St. John Sideroad	EX.72A	EX.71A	0.20	82.67	0	3.8	0	2334	3.53	38.17	21.49		59.67	102.7	300	0.42	62.67	0.89	0.97		95%	DWG No. B-8628-47
	EX.71A	EX.70A	0.20	82.87	0	3.8	0	2334	3.53	38.17	21.55		59.72	89.9	300	0.46	65.59	0.93	1.06		91%	
	EX.70A	EX.70C	0.00	82.87	0	3.8	0	2334	3.53	38.17	21.55		59.72	7.0	300	0.46	65.59	0.93	1.06		91%	
	EX.70C	EX.70B	0.08	82.95	0	3.8	0	2334	3.53	38.17	21.57		59.74	43.0	300	0.46	65.59	0.93	1.06		91%	

Harrison Demone

W:\4700's\4750 - Shining Hill Phase 3\Drawings\Sanitary\2019-09-16-4750-Sanitary Analysis.dwg



SHINING HILL ESTATES COLLECTION INC.
BASIL DEVELOPMENTS
C/O CONDOR PROPERTIES

LEGEND

SUBJECT AREA

PROPOSED SANITARY SEWER

PROPOSED SANITARY DRAINAGE AREA

12.00 ha — AREA IN HECTARES
750 ppl — POPULATION

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE C-1
SANITARY SEWER
ANALYSIS

2019-4750	SEPTEMBER 2019	SCALE: N.T.S.

SCHAEFFERS Consulting Engineers
SCHAEFFER & ASSOCIATES LTD.
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
design@schaeffers.com

TOWN OF AURORA

SANITARY SEWER DESIGN SHEET

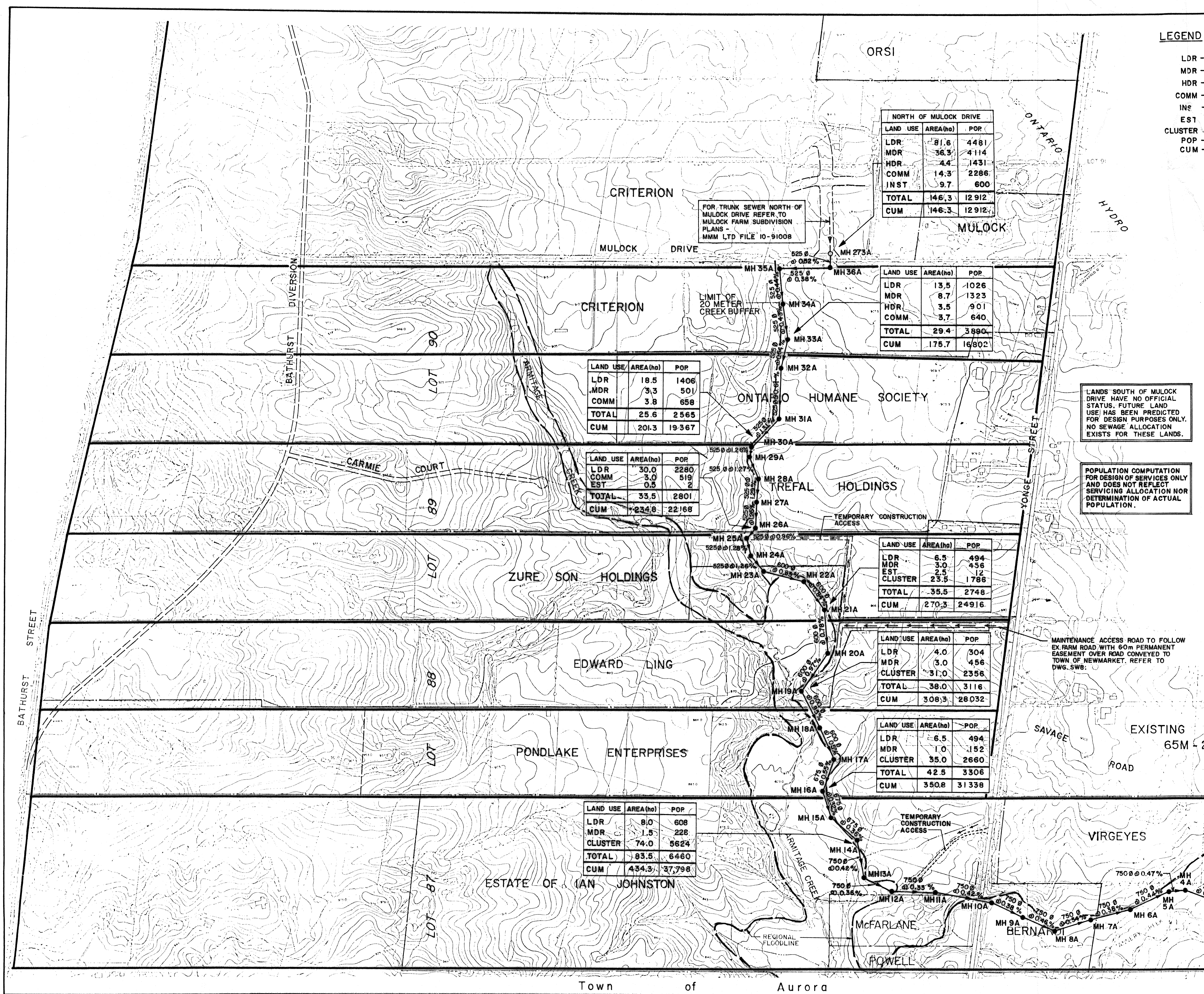
SHINING HILL COLLECTION INC. (PHASE 2 & 3)
RESIDENTIAL SUBDIVISION
Proposed Condition - St. John's Sideroad to Yonge Street

REGISTERED PROFESSIONAL ENGINEER
H. O. TOZCU
May 31, 2019
PROVINCE OF ONTARIO

Design By: G.V.
Checked By: K.S.
Date: September 17, 2019
Project No.: 2016-4473

Population Density = 3.8 ppu or 95 ppha
M = 1 + 14 / (4 + SqRt P), P=population in 1000's
Q = 400 L/cap/day (average)
Infiltration = 0.26 L/sec/ha

Location / Street	From MH.	To MH.	Area ha	Accum. Area ha	No. of Units	Density PPU	Pop.	Accum. Pop.	'M'	Res. Flow l/sec	Infilt. Flow l/sec	Ind./ Comm.	Total Flow l/sec	Pipe Length m	Dia. mm	Slope %	Cap. l/sec	Vel. m/sec	Actual Vel. m/sec	Remarks	Capacity	DWG Reference
Proposed Shining Hill Phase 2	27A	EX. 69A	9.71	9.71	92	3.8	350	350	4.00	6.47	2.52		9.00	68.9	200	0.50	23.19	0.74	0.69		39%	Proposed Development
to St. John Sideroad				**9.71**				**350**														
Proposed Shining Hill Phase 3	-	EX. 69A	8.99	8.99	92	3.8	500	500	3.97	9.20	2.34		11.54	68.9	200	0.50	23.19	0.74	0.73		50%	Proposed Development
to St. John Sideroad				**8.99**				**500**														
External to Willow Farm Lane	EX. 69A	EX.68A	12.00	30.70	-	3.8	750	1600	3.66	27.10	7.98		35.08	46.8	200	2.04	46.85	1.49	1.65		75%	DWG No. B-8628-F - St. Andrew on the Hill
	EX.68A	EX.64A	1.95	32.65	-	3.8	19	1619	3.66	27.39	8.49		35.88	48.2	200	4.95	72.97	2.32	2.30		49%	
				32.65				**1619**														
Ex. St. Andrews on the Hill Subdivision			56.48	**56.48**			1173	**1173**														
and Ballymore Development																						
South External to Willow Farm Lane	EX. 63A	EX.64A	0.54	57.02	-	3.8	12	1185	3.75	20.58	14.83		35.41	68.9	250	0.40	37.61	0.77	0.85		94%	DWG No. 3 - Ballymore Development
				57.02				**1185**														DWG No. B-8628-D,E, & F - St. Andrew on the Hill
Heatherfield Lane	EX.64A	EX.65A	0.11	89.78	**0**	3.8	0	2804	3.47	45.00	23.34		68.35	76.3	300	0.40	61.16	0.87	-1.41	SURCHARGE	112%	DWG No. B-8628-F & 41
	EX.65A	EX.66A	0.64	90.42	**4**	3.8	15	2819	3.47	45.22	23.51		68.73	73.5	300	0.40	61.16	0.87	-1.69	SURCHARGE	112%	
	EX.66A	EX.67A	1.04	91.46	**4**	3.8	15	2834	3.46	45.44	23.78		69.22	29.6	300	0.48	67.00	0.95	0.61	SURCHARGE	103%	
Easement	EX.67A	EX.74A	0.00	91.46	**0**	3.8	0	2834	3.46	45.44	23.78		69.22	29.6	300	0.47	66.29	0.94	0.47	SURCHARGE	104%	DWG No. B-8628-42
Easement	EX.74A	EX.73A	0.00	91.46	0	3.8	0	2834	3.46	45.44	23.78		69.22	55.2	300	1.00	96.70	1.37	1.50		72%	
Easement	EX.73A	EX.72A	0.00	91.46	0	3.8	0	2834	3.46	45.44	23.78		69.22	27.1	300	2.00	136.86	1.94	1.93		51%	
				91.46				**2834**														
St. John Sideroad	EX.72A	EX.71A	0.20	91.66	0	3.8	0	2834	3.46	45.44	23.83		69.27	102.7	300	0.42	62.67	0.89	-0.95	SURCHARGE	111%	DWG No. B-8628-47
	EX.71A	EX.70A	0.20	91.86	0	3.8	0	2834	3.46	45.44	23.88		69.32	89.9	300	0.46	65.59	0.93	0.27	SURCHARGE	106%	
	EX.70A	EX.70C	0.00	91.86	0	3.8	0	2834	3.46	45.44	23.88		69.32	7.0	300	0.46	65.59	0.93	0.27	SURCHARGE	106%	
	EX.70C	EX.70B	0.08	91.94	0	3.8	0	2834	3.46	45.44	23.90		69.34	43.0	300	0.46	65.59	0.93	0.26	SURCHARGE	106%	



LEGEND

LDR - LOW DENSITY RESIDENTIAL
MDR - MEDIUM DENSITY RESIDENTIAL
HDR - HIGH DENSITY RESIDENTIAL
COMM - COMMERCIAL
INS - INSTITUTIONAL
EST - ESTATE RESIDENTIAL
CLUSTER - CLUSTER HOUSING
POP - EQUIVALENT POPULATION
CUM - CUMULATIVE TOTALS

NORTH OF MULOCK DRIVE

LAND USE	AREA(ha)	POP.
LDR	81.6	4481
MDR	36.3	4114
HDR	4.4	1431
COMM	14.3	2286
INST	9.7	600
TOTAL	146.3	12912
CUM	146.3	12912

LAND USE	AREA(ha)	POP.
LDR	13.5	1026
MDR	8.7	1323
HDR	3.5	901
COMM	3.7	640
TOTAL	29.4	3890
CUM	175.7	16802

LAND USE	AREA(ha)	POP.
LDR	18.5	1406
MDR	3.3	501
COMM	3.8	658
TOTAL	25.6	2565
CUM	201.3	19367

LAND USE	AREA(ha)	POP.
LDR	30.0	2280
COMM	3.0	519
EST	0.5	2
TOTAL	33.5	2801
CUM	234.8	22168

LAND USE	AREA(ha)	POP.
LDR	6.5	494
MDR	3.0	456
EST	2.5	12
CLUSTER	23.5	1786
TOTAL	35.5	2748
CUM	270.3	24916

LAND USE	AREA(ha)	POP.
LDR	4.0	304
MDR	3.0	456
CLUSTER	31.0	2356
TOTAL	38.0	3116
CUM	308.3	28032

LAND USE	AREA(ha)	POP.
LDR	6.5	494
MDR	1.0	152
CLUSTER	35.0	2660
TOTAL	42.5	3306
CUM	350.8	31338

LAND USE	AREA(ha)	POP.
LDR	8.0	608
MDR	1.5	228
CLUSTER	74.0	5624
TOTAL	83.5	6460
CUM	434.3	37798

LANDS SOUTH OF MULOCK DRIVE HAVE NO OFFICIAL STATUS. FUTURE LAND USE HAS BEEN PREDICTED FOR DESIGN PURPOSES ONLY. NO SEWAGE ALLOCATION EXISTS FOR THESE LANDS.

POPULATION COMPUTATION FOR DESIGN OF SERVICES ONLY AND DOES NOT REFLECT SERVICING ALLOCATION NOR DETERMINATION OF ACTUAL POPULATION.

No.	REVISIONS TO DRAWING	BY	DATE	APP'H.
	AS CONSTRUCTED UNDERGROUND ONLY	P.M.W.	07-02-96	
	ISSUED FOR CONSTRUCTION	J.S.	08-02-95	
⚠	LOCATION OF MH 30A REVISED	J.S.	09-01-95	
	ISSUED FOR TENDER	J.S.	25-11-94	
	ISSUED FOR APPROVAL NOT FOR CONSTRUCTION	A.S.	13-12-93	

ALL PREVIOUS ISSUES OF THIS DRAWING ARE SUPERSEDED

CLIENT
CRITERION DEVELOPMENT CORPORATION

MUNICIPALITY
TOWN OF NEWMARKET

PROJECT TITLE
SOUTHWEST SANITARY TRUNK SEWER

SHEET TITLE
SANITARY DRAINAGE PLAN

Marshall Macklin Monaghan Limited
Thornhill
Consulting Engineers – Surveyors – Planners

REGISTERED PROFESSIONAL ENGINEER
A. SLYWYNSKYJ
PROVINCE OF ONTARIO

APPROVED

TOWN ENGINEER

DATE

DESIGNED	DRAWN	CHECKED
J.S./A.S.	R.M.M.	A.S.

SCALE 1:4000 — DATE AUGUST 1993

PROJECT NUMBER 10-91008 — DWG. NUMBER SW 16

Appendix C
Water Supply Servicing

TOWN OF NEWMARKET

WATER AND WASTEWATER MASTER PLAN

MASTER PLAN REPORT

MARCH 2017

WATER AND WASTEWATER MASTER PLAN

MASTER PLAN REPORT

Town of Newmarket

WSP Project No.: 151-04561-00
Date: March 2017

–
WSP Canada Inc.
100 Commerce Valley Drive West
Thornhill, ON L3T 0A1
Phone: 905-882-1100
Fax: 905-882-0055
www.wspgroup.com

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TABLES

FIGURES

APPENDICES

- **Step 4: Evaluate the Alternatives** - Each of the alternatives was assigned a colour rating for each of the four evaluation criteria using the methodology established in Step 2. The evaluation was based on a qualitative assessment of the individual impacts documented in the table created during Step 3. The colour green rating indicates that the alternative had a low impact (most preferred) with respect to that particular criterion. A yellow colour indicates a moderate impact (less preferred). An orange/red colour indicates that the alternative had a high impact (least preferred) with respect to that particular criterion.
- **Step 5: Determine the Preferred Alternative** - The servicing alternative with the least overall impact was recommended for implementation.

4.2 EVALUATION CRITERIA

The evaluation of each alternative will take into consideration any impacts to the natural environment, social and cultural environments, as well as technical and operational suitability and overall cost.

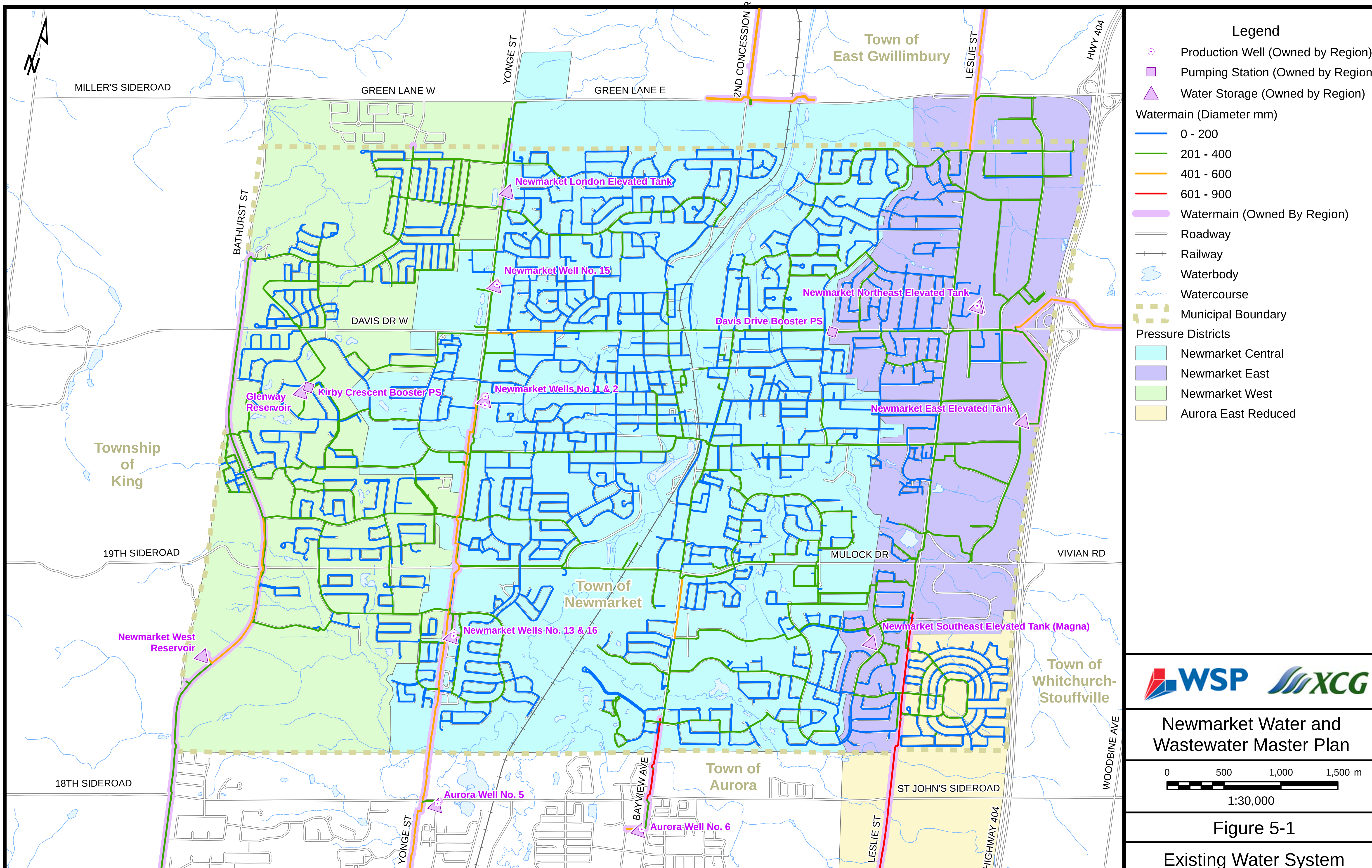
Table 4-1 Evaluation Criteria

CRITERIA	KEY CONSIDERATIONS
Natural Environment Considerations	Natural Features (including Woodlands, hedgerows or wetlands)
	Watercourses and Aquatics
	Natural Heritage Areas
	Areas of Natural and Scientific Interest (ANSI), Environmentally Sensitive Areas (ESA), provincially or locally significant wetlands
	Designated Natural Areas
Social and Cultural Environment Considerations	Archaeological and Cultural Features (including known archaeological sites, cultural areas or the potential for archaeological impacts)
	Designated Heritage Features
	Wells or Wellhead Protection Areas
	Consistency with Land Use Designations, Approved Development Plans and Proposed Land Use Changes
	Community Impacts During Construction (e.g. road access, visibility, noise)
Technical and Operational Suitability	Constructability (the potential for encountering difficulties during construction (e.g. geotechnical conditions, utility crossings, traffic impacts))
	Maintaining or Enhancing Drinking Water Quality
	Security and Performance of System
	Infrastructure Phasing
	Feasibility of Connection to Existing Infrastructure & Feasibility of Modifications Required to Existing Infrastructure
Economic Considerations	Total Capital Costs
	Operations and Maintenance Costs

5 WATER SERVICING

5.1 EXISTING CONDITIONS

The existing water distribution system in the Town of Newmarket is illustrated in Figure 5-1 and described in the subsections below.



WSP XCG

Newmarket Water and Wastewater Master Plan

Figure 5-1

Existing Water System

5.2 WATER SYSTEM DESIGN CRITERIA

5.2.1 EXISTING AND FUTURE WATER DEMAND RATES

The criteria used to calculate the projected water demands for the Town of Newmarket are documented in Table 5-1. The criteria in the Town's Engineering Design Standards (Town of Newmarket, February 2015) were considered; however, the average day flow and peaking factors used in the Town's Master Plan were derived from historical data for the Town's existing water distribution system and were found to be aligned with, the criteria used for the base year in York Region's current Water and Wastewater Master Plan. The historical data includes the Town's average day flows between 2012 and 2014, and the ten max day and associated peak hour flows for each year between 2012 and 2014. The historical data including the water design criteria calculations is included in Appendix A.

Table 5-1 Water Design Criteria

	YORK REGION'S WATER AND WASTEWATER MASTER PLAN (2009)	2015 NEWMARKET ENGINEERING DESIGN STANDARDS	NEWMARKET WATER AND WASTEWATER MASTER PLAN
Average Day (L/cap/day)	220	300	220
Maximum Day Factor	1.7	2.0	1.7
Peak Hour Factor	2.5	3.0	2.5

In addition, the ultimate conditions scenario (to 2041) for the water distribution system was evaluated based on the required fire flow criteria, as shown below in Table 5-2. The Town's fire flow criteria for the various development types has generally increased over time and as such, the Town's watermains have been sized according to the criteria at the time of installation. The Town's fire flow criteria was modified in consultation with the Town to better reflect the fire flows required for the types of developments found within the Town of Newmarket.

Table 5-2 Required Fire Flow Criteria

DEVELOPMENT TYPE	2015 NEWMARKET ENGINEERING DESIGN STANDARDS	NEWMARKET WATER AND WASTEWATER MASTER PLAN FIRE FLOW CRITERIA
Detached and Semi-Detached Dwellings	7,000 L/min (117 L/s)	5,400 L/min (90 L/s)
Townhouses	10,000 L/min (167 L/s)	10,000 L/min (167 L/s)
Apartments	15,000 L/min (250 L/s)	15,000 L/min (250 L/s)
Industrial/Commercial	15,900 L/min (265 L/s)	N/A
Industrial	N/A	15,900 L/min (265 L/s)
Commercial/Institutional	N/A	10,000 L/min (167 L/s)

5.3 WATER SERVICING ALTERNATIVES

MODELING OF EXISTING SYSTEM

The Town's water model was updated prior to conducting an analysis of the water distribution network for the Master Plan. The Town's model was based on 2006 census information and had been updated with developments that had come online to the 2010 timeframe. During the development of the Master Plan, the base model was updated to reflect the existing (2014) water distribution network using GIS files for the Town's water infrastructure. Furthermore, the Region's boundary conditions and planned upgrades and associated demands in Holland Landing and Aurora were added to the model. After the required updates to the Town's model were completed, an analysis of the water distribution network to support existing conditions and the projected demands to the year 2041 was conducted.

Discussion on model development and validation is contained in Technical Memorandum No. 1 in Appendix B.

5.4 WATER SUPPLY, TREATMENT AND STORAGE

The Regional Municipality of York is responsible for providing water supply, treatment, storage as well as transmission to the Town of Newmarket's local water distribution system. The existing and future water supply, treatment and storage infrastructure is planned for through the Region's Water and Wastewater Master Plan. Since the Town is responsible for the distribution of water to residents and businesses, the Master Plan will focus on planning for the Town's local water distribution system to support existing conditions and future growth to 2041. Alternatives related to water supply, treatment and storage will not be developed as part of the Town's Master Plan.

5.4.1 WATER DISTRIBUTION

As identified through the modeling exercise, Table 5-3 lists the deficiencies in the existing water distribution system and the proposed improvements. The list of deficiencies is limited to the water modeling results which do not indicate all operational issues and do not take into consideration the age and condition of existing infrastructure or fire hydrant location/coverage.

Table 5-3 Existing and Future Water System Deficiencies

ITEM	STREET NAME	EXTENT	DEFICIENCY	DETAIL OF DEFICIENCY	PROPOSED IMPROVEMENT
W1	Bristol Road	Main Street North to Stiver Drive	Fire flow less than current standard	Modeled fire flow less than 116 L/s	Increase diameter to 300 mm
W2	Main Street North	From Regional Main to Bristol	Inconsistent watermain velocity/size	Existing 200 mm watermain inconsistent with connecting 300 mm watermain proposed on Bristol Road	Increase diameter to 300 mm
W3	George Street	Kingston Road to Davis Drive	Fire flow less than current standard	Modeled fire flow less than 265 L/s	Increase diameter to 200 mm
W4	Willow Lane	From existing 250 mm WM to Longford Drive	Inconsistent watermain velocity/size	Existing 150 mm watermain inconsistent with connecting 250 mm watermain	Increase diameter to 250 mm
W5	Huron Heights Drive	Davis Drive to existing 200 mm WM	Fire flow less than current standard	Modeled fire flow less than 265 L/s	Increase diameter to 200 mm
W6	Willstead Drive	Queen Street to Davis Drive	Fire flow less than current standard	Modeled fire flow less than 116 L/s	Increase diameter to 200 mm
W7	Queen Street	Millard Avenue to Parkside	Fire flow less than current standard	Modeled fire flow less than 167 L/s	Increase diameter to 200 mm
W8	Parkside Drive	Queen Street to existing 200 mm WM	Fire flow less than current standard	Modeled fire flow less than 265 L/s	Increase diameter to 200 mm
W9	Calgain Road	Lorne Avenue to End	Fire flow less than current standard	Modeled fire flow less than 250 L/s	Increase diameter to 200 mm
W10	Lorne Avenue	Davis Drive to Calgain Road	Fire flow less than current standard	Modeled fire flow less than 250 L/s	Increase diameter to 200 mm
W11	Charles Street	Davis Drive to Queen Street	Fire flow less than current standard	Modeled fire flow less than 265 L/s	Increase diameter to 200 mm
W12	Glenway Circle	Eagle St. to existing 200 mm WM on Glenway Circle	Fire flow less than current standard	Modeled fire flow less than 116 L/s	Increase diameter to 200 mm

ITEM	STREET NAME	EXTENT	DEFICIENCY	DETAIL OF DEFICIENCY	PROPOSED IMPROVEMENT
W13	Millard Avenue	Yonge Street to Queen Street	Fire flow less than current standard (on Queen Street)	Modeled fire flow less than 167 L/s	Increase diameter to 200 mm

The modeling exercise determined that the majority of the deficiencies in the Town's water distribution system are due to fire flows that are less than the current standard listed in Table 5-2. The results of recent hydrant tests conducted throughout the Town's system were used to validate the results of the model.

5.4.1.1 WATER DISTRIBUTION ALTERNATIVES

Since most of the Town's future growth to 2041 will be due to redevelopment and intensification (within the Urban Centres Secondary Planning Area, in particular) as opposed to new development, the water system solutions proposed in the Master Plan become somewhat simplified. That is, the Master Plan becomes an exercise in determining how to plan the Town's existing water servicing network to supply the higher demands associated with future intensification. As a result, the water system upgrades developed in the Master Plan involve the upsizing of existing watermains to provide adequate service pressures and meet fire flow requirements.

Water servicing alternatives considered for the Town of Newmarket's local water distribution system included the following:

- Do Nothing (required for evaluation per the Class EA process)
- Upgrade and Expand Existing Water System Network

5.4.1.2 EVALUATION OF WATER DISTRIBUTION ALTERNATIVES

Upon further consideration of the water distribution alternatives, it was clear that the "Do Nothing" alternative could be eliminated through a screening process, instead of using the evaluation approach as described in Section 4. The screening process allows for the elimination of a certain alternative based on the alternative's adverse impact on one of the evaluation criterions or the Master Plan's Opportunity Statement. The "Do Nothing" alternative represents a scenario where no improvements or expansions would be undertaken. It may be preferred for some of the evaluation criteria, but it does not satisfy the Master Plan's core objective to support future growth to 2041. Future planning policies and opportunities to provide water and wastewater servicing for existing and future development would not be adhered to in selecting this alternative. This alternative is therefore not a viable solution since it does not fulfill the projects' Opportunity Statement.

York Region is responsible for providing water treatment, storage and transmission to the Town's water distribution system. Since the Town is responsible for the distribution of water to residents and businesses, the recommended alternative is to improve the ability of the water distribution system to provide adequate service pressures and fire flow.

5.5 FUTURE WATER INFRASTRUCTURE REQUIREMENTS

The following subsections include a description of the future water infrastructure requirements for servicing the Town of Newmarket, as well as the associated capital costs and proposed infrastructure phasing to 2041.

5.5.1 RECOMMENDED WATER SERVICING NETWORK

The recommended upgrades were determined through a water modeling exercise and will be required to support existing and future development to 2041 in the Town of Newmarket. Watermain upgrades to the year 2041 are presented in Table 5-4 and illustrated in Figure 5-2.

Table 5-4 Recommended Watermain Upgrades to Service to 2041

ITEM	STREET NAME	EXTENT	LENGTH (M)	CURRENT DIAMETER (MM)	PROPOSED DIAMETER (MM)
W1	Bristol Road	Main Street North to Stiver Drive	1,680	200	300
W2	Main Street North	From Regional Main to Bristol	15	200	300
W3	George Street	Kingston Road to Davis Drive	657	150	200
W4	Willow Lane	From existing 250 mm WM to Longford Drive	120	150	250
W5	Huron Heights Drive	Davis Drive to existing 200 mm WM	185	150	200
W6	Willstead Drive	Queen Street to Davis Drive	481	150	200
W7	Queen Street	Millard Avenue to Parkside	390	150	200
W8	Parkside Drive	Queen Street to existing 200 mm WM	130	150	200
W9	Calgain Road	Lorne Avenue to End	95	150	200
W10	Lorne Avenue	Davis Drive to Calgain Road	135	150	200
W11	Charles Street	Davis Drive to Queen Street	330	150	200
W12	Glenway Circle	Eagle St. to existing 200 mm WM on Glenway Circle	540	150	200
W13	Millard Avenue	Yonge Street to Queen Street	400	150	200

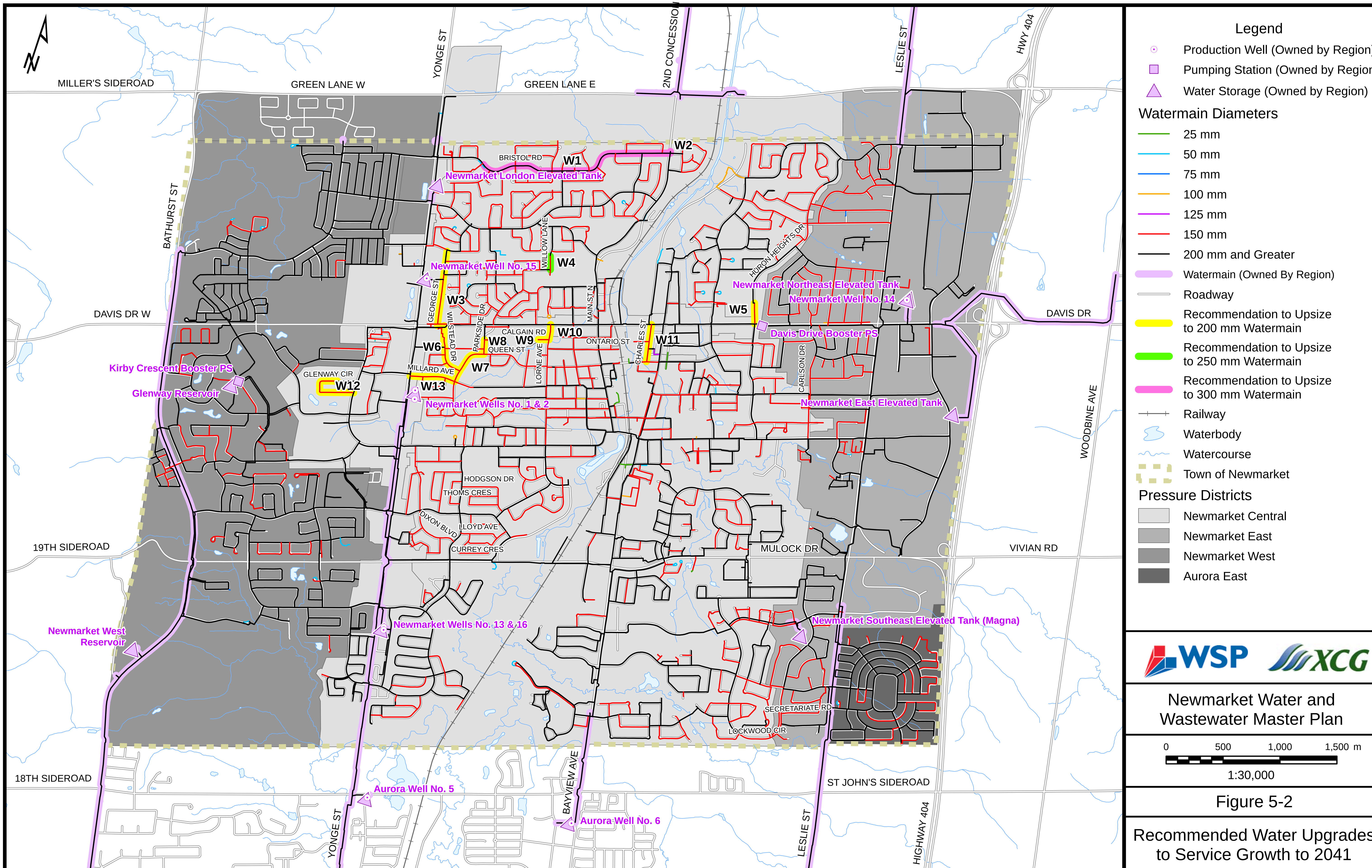
5.5.2 COST OF RECOMMENDED WATER INFRASTRUCTURE

The capital investments required to address the water system deficiencies identified in Table 5-3 are provided below in Table 5-5. These Class D cost estimates were developed using WSP's Watermain Unit Cost Table (2016), as shown in Appendix C, and include pipe material costs, excavation, road restoration within the trench width for the watermain and engineering (10%) and contingency (25%). The unit costs for the watermains are based on the Town's costs for recent linear infrastructure works undertaken within the Town of Newmarket. The unit costs assumed that areas in which pipes are being replaced are dense urban, meaning the watermains were replaced within a road. Class D cost estimates, including those provided in Table 5-5, are determined using unit costs based upon a comprehensive list of project requirements, and are only an indication of the total final project cost.

Table 5-5 Recommended Watermain System Upgrades Cost to Service to 2041

ITEM	STREET NAME	INFRASTRUCTURE UPGRADES REQUIRED	PIPE LENGTH (M)	TOTAL COST (2016$)
W1	Bristol Road	Increase diameter from 200 mm to 300 mm	1,680	$1,340,000
W2	Main Street North	Increase diameter from 200 mm to 300 mm	15	$20,000
W3	George Street	Increase diameter from 150 mm to 200 mm	657	$430,000
W4	Willow Lane	Increase diameter from 150 mm to 250 mm	120	$90,000
W5	Huron Heights Drive	Increase diameter from 150 mm to 200 mm	185	$120,000
W6	Willstead Drive	Increase diameter from 150 mm to 200 mm	481	$310,000
W7	Queen Street	Increase diameter from 150 mm to 200 mm	390	$260,000
W8	Parkside Drive	Increase diameter from 150 mm to 200 mm	130	$90,000
W9	Calgain Road	Increase diameter from 150 mm to 200 mm	95	$60,000
W10	Lorne Avenue	Increase diameter from 150 mm to 200 mm	135	$90,000

ITEM	STREET NAME	INFRASTRUCTURE UPGRADES REQUIRED	PIPE LENGTH (M)	TOTAL COST (2016$)
W11	Charles Street	Increase diameter from 150 mm to 200 mm	330	$220,000
W12	Glenway Circle	Increase diameter from 150 mm to 200 mm	540	$350,000
W13	Millard Avenue	Increase diameter from 150 mm to 200 mm	400	$260,000
Capital Cost to Service Town of Newmarket				**$3,640,000**



WSP XCG

Newmarket Water and Wastewater Master Plan

Figure 5-2

Recommended Water Upgrades to Service Growth to 2041

5.5.3 WATER INFRASTRUCTURE PHASING

The infrastructure upgrades discussed above, as determined by water modeling exercises, should be implemented as the need arises. As previously noted, the recommended water infrastructure upgrades were based on the water modeling results which do not indicate all operational issues and do not take into consideration the age and condition of existing infrastructure or fire hydrant location/coverage.

Estimated project construction timelines and the Class EA Schedule for each recommended water servicing project are provided in Table 5-6. The timelines are based on factors such as location, and the timing of other Town-planned infrastructure works within the same roadways. To better refine the project timelines, it is recommended that the Town:

- review these timelines and adjust as needed based on the actual rate of development progress;
- replace watermains if roadwork or sewer replacement is planned in the same street to minimize repeated disturbance and reduce costs; and
- model the system based on projected water demands to each pressure zone for a given horizon year.

Table 5-6 Estimated Water Infrastructure Construction Phasing Timelines

ITEM	STREET NAME	EXTENT	CLASS EA SCHEDULE	ESTIMATED CONSTRUCTION YEAR INTERVAL
W1	Bristol Road	Main Street North to Stiver Drive	A+	2037-2041
W2	Main Street North	From Regional Main to Bristol	A+	2017-2021
W3	George Street	Kingston Road to Davis Drive	A+	2022-2026
W4	Willow Lane	From existing 250 mm WM to Longford Drive	A+	2022-2026
W5	Huron Heights Drive	Davis Drive to existing 200 mm WM	A+	2017-2021
W6	Willstead Drive	Queen Street to Davis Drive	A+	2017-2021
W7	Queen Street	Millard Avenue to Parkside	A+	2017-2021
W8	Parkside Drive	Queen Street to existing 200 mm WM	A+	2027-2031
W9	Calgain Road	Lorne Avenue to End	A+	2017-2021
W10	Lorne Avenue	Davis Drive to Calgain Road	A+	2017-2021
W11	Charles Street	Davis Drive to Queen Street	A+	2017-2021
W12	Glenway Circle	Eagle St. to existing 200 mm WM on Glenway Circle	A+	2017-2021
W13	Millard Avenue	Yonge Street to Queen Street	A+	2022-2026

The study uses Master Plan Approach #1 whereby Phases 1 and 2 of the Class EA process are completed and all Schedule A and A+ projects may proceed to be implemented without further study. All of the recommended water servicing projects identified in the Master Plan have been categorized as Schedule A+, and therefore do not require further study.

The capital costs to service the Town of Newmarket to support existing and future growth to 2041 are summarized by time interval in Table 5-7.

Table 5-7 Estimated Water System Capital Costs by Timeframe

YEAR INTERVAL	ITEMS	TOTAL ESTIMATED COST (2014$)
2017-2021	W2, W5, W6, W7, W9, W10, W11, W12	$1,430,000
2022-2026	W3, W4, W13	$780,000
2027-2031	W8	$90,000
2032-2036	N/A	N/A
2037-2041	W1	$1,340,000
Total		**$3,640,000**

6 WASTEWATER SERVICING

6.1 EXISTING CONDITIONS

The existing wastewater collection system in the Town of Newmarket is illustrated in Figure 6-1 and described in the subsections below.

6.1.1 WASTEWATER TREATMENT AND PUMPING STATIONS

The wastewater collection system that services the Town of Newmarket consists of local sanitary sewers, local pumping stations, and sub-trunk sewers owned by the Town of Newmarket, and trunk sewers, pumping stations and the York Durham Sewerage System (YDSS) which are owned by York Region. Ultimately, wastewater generated in Newmarket receives treatment at the Duffin Creek Water Pollution Control Plant which is co-owned by the Regions of Durham and York. This Master Plan addresses the wastewater system improvements and/or expansion related only to the Town's local and sub-trunk wastewater system. Details on expansion and system improvements within the Regional System can be found in the Region's Water and Wastewater Master Plan.

6.1.2 WASTEWATER CONVEYANCE NETWORK

The Town's existing wastewater system is illustrated in Figure 6-1. Figure 6-2 shows the drainage areas associated with each of the Town's sanitary sub-trunks. Key elements of the Town's wastewater conveyance network include:

- The Town owns and operates local wastewater sewers, sub-trunk sewers, and six local sanitary pumping stations. The Town's local sanitary pumping stations include the Bayview Avenue Sanitary Pumping Station (SPS), St. Andrew's SPS, Woodmount SPS, Woodspring SPS, Northwest SPS and Senior's SPS. Details for four of these stations (Bayview Avenue SPS, St. Andrew's SPS, Woodmount SPS and Woodspring SPS) were obtained from the Town.

- The Bayview Avenue Sub-trunk sewer services the southeastern part of the Town, south of Stonehaven Avenue and east of Bayview Avenue, and discharges into the Town's Bayview SPS. The St. Andrews SPS is located upstream of the Bayview SPS. The Bayview SPS forcemain discharges into the YDSS Trunk Sewer north of Newmarket's southern boundary.

- The Bogart Creek Sub-trunk sewer services the southeastern part of the Town located south of Gorham Street, north of Stonehaven Avenue and east of Bayview Avenue. The Bogart Creek Sub-trunk discharges into the Regional Bogart Creek SPS.

Appendix A

WATER & WASTEWATER DESIGN CRITERIA

Town of Newmarket Water and Wastemater Master Plan

Water Unit Rates

Recommended Rates

	York Region MP	2015 Newmarket Engineering Design Standards	Recommended Rates (Base Year)
Maximum Day Factor	1.7	2.0	1.7
Average Day (L/cap/day)	220	300	220
Peak Hour Factor	2.5	3.0	2.5

Notes:
1. Recommended Average Day Rate was selected based on York Region's W&WW Master Plan.
2. Recommended Maximum Day Factor was selected based on York Region's W&WW Master Plan.
3. Recommended Peak Hour Factor was selected based on York Region's W&WW Master Plan (1.7 x 1.45 = 2.5)

Average Day Rate Calculations [1]

	Population			York SCADA Data		
Year	**Residential**	**Employment**	**Total [2]**	**Total Consumption (m3/day)**	**Avg Day (L/cap/day) - Based on dividing by Residential Population Only**	**Avg Day (L/cap/day) - Based on dividing by Residential and Employment Population**
2012	85,453	43,292	128,745	26,766	313	208
2013	86,819	43,750	130,569	26,477	305	203
2014	89,015	44,692	133,707	25,231	283	189

Maximum Day and Peak Hour Factor Calculations [1]

Average Day for 2012 [3] (m3/day)	**26,771**

	2012					
	Max Day	**Max Flow (m3/day)**	**Max Day Factor [4]**	**Peak Hour Time**	**Peak Hour Flow (m3/day)**	**Peak Hour Factor**
1	June 29th, 2012	31,255	1.17	10:00	55,296	2.07
2	June 30th, 2012	30,767	1.15	10:00	52,538	1.96
3	June 20th, 2012	30,370	1.13	8:00	66,938	2.50
4	June 19th, 2012	30,281	1.13	11:00	53,813	2.01
5	June 27th, 2012	30,269	1.13	10:00	59,753	2.23
6	August 28th, 2012	30,090	1.12	10:00	45,662	1.71
7	December 14th, 2012	29,305	1.09	2:00	56,707	2.12
8	June 22nd, 2012	29,166	1.09	13:00	54,137	2.02
9	July 17th, 2012	28,921	1.08	17:00	61,243	2.29
10	July 5th, 2012	28,736	1.07	23:00	55,886	2.09
	Average	29,916	1.12		56,197	2.10

Average Day for 2013 [3] (m3/day)	**26,486**

	2013					
	Max Day	**Max Flow (m3/day)**	**Max Day Factor [4]**	**Peak Hour Time**	**Peak Hour Flow (m3/day)**	**Peak Hour Factor**
1	July 17th, 2013	39,126	1.48	20:00	60,602	2.29
2	August 12th, 2013	38,676	1.46	14:00	60,098	2.27
3	July 19th, 2013	38,182	1.44	7:00	57,676	2.18
4	August 22nd, 2013	37,691	1.42	20:00	57,383	2.17
5	July 22nd, 2013	37,356	1.41	17:00	56,410	2.13
6	August 19th, 2013	37,320	1.41	20:00	60,486	2.28
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10	August 9th, 2013	36,270	1.37	8:00	56,482	2.13
	Average	37,569	1.42		58,045	2.19

Average Day for 2014 [3] (m3/day)	**25,235**

2014

	Max Day	Max Flow (m3/day)	Max Day Factor [4]	Peak Hour Time	Peak Hour Flow (m3/day)	Peak Hour Factor
1	August 6th, 2014	38,667	1.53	18:00	60,926	2.41
2	June 10th, 2014	37,279	1.48	19:00	55,944	2.22
3	August 27th, 2014	37,149	1.47	11:00	66,968	2.65
4	August 28th, 2014	36,743	1.46	10:00	61,754	2.45
5	July 22nd, 2014	35,573	1.41	12:00	59,342	2.35
6	May 25th, 2014	35,567	1.41	19:00	61,114	2.42
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8	June 24th, 2014	35,308	1.40	7:00	62,909	2.49
9	July 21st, 2014	35,116	1.39	8:00	53,095	2.10
10	July 23rd, 2014	34,146	1.35	1:00	65,730	2.60
	Average	36,086	1.43		60,485	2.40

Note:

[1]SCADA data provide by the York Region was used to calculate average day per capita flows as well as Maximum Day and Peak Hour factors. Data provided by the Region included totalized flows per day and instantaneous flows at all well sources, major valves and for 15 minute intervals were provided.

[2] Total Flows were calculated by adding the flows coming in from Aurora, net flow from Queensville, the flows from the Newmarket Wells were added and the East Gwillimbury flows were deducted and then the final value was divided by the number of days in each year

[3] Average Day Flows were calculated by adding the total flows coming in from Aurora, net flow from Queensville and the flows from the Newmarket Wells were added (East Gwillimbury flows were not deducted) and then the final value was divided by the number of days in each year. East Gwillimbury (EG) flows were not deducted in the Average Day Flows as there were inconsistencies between the 2012, 2013 and 2014 flows into EG. Since residential and ICI consumption in the section of EG supplied by the water feeds in question is assumed to be similar to the consumption in Newmarket (i.e. the area is assumed to have the same kind of Maximum Day and Peak Hour factors) this approach was used to determine Max Day and Peak Hour Factors.

[4] Max Day Factors and Peak Hour Factors were calculated by dividing the Max Day Flows and Peak Hour Flows by the Average Day Flows (as calculate per item 3 in the notes).

Appendix B

MASTER PLAN TECHNICAL MEMORANDA

Technical Memorandum No. 1 – Water Existing Conditions

Technical Memorandum No. 2 – Wastewater Existing Conditions

TOWN OF NEWMARKET

WATER SYSTEM EXISTING CONDITIONS MODEL UPDATE

WATER SYSTEM EXISTING CONDITIONS MODEL UPDATE

Town of Newmarket

TECHNICAL MEMORANDUM

Project nº: 151-04561-00
Date: January 2017

WSP Canada Inc.
100 Commerce Valley Drive West
Thornhill, ON L3T 0A1

Phone: +1 905-882-1100
www.wspgroup.com

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APPENDICES

1 INTRODUCTION

1.1 PROJECT BACKGROUND

The Town of Newmarket has retained WSP to undertake a Water and Wastewater Master Plan (henceforth referred to as the Master Plan). The purpose of the Master Plan is to identify the required improvements to the Town's water distribution system and wastewater collection system to support the proposed growth within the Town, including the Urban Centres Secondary Plan area. A hydraulic modelling exercise has been completed as part of the Master Plan to examine the Town's water distribution system in order to determine potential existing and future system deficiencies, as well as identify opportunities for operational improvements. The following report provides the details regarding the updates made to the Town's water model.

The Town of Newmarket is expected to grow significantly to 2041. The majority of this growth will occur through the redevelopment of the Davis Drive and Yonge Street corridors, which comprises of the Urban Centres area. The Town of Newmarket's Urban Centres Secondary Plan calls for a well-integrated, sustainable, mixed use area, accommodating a broad range of land uses. Increased density will be achieved through intensification of the area. Due to the anticipated population growth the town may need to expand on its existing water infrastructure.

The supply and treatment of water to the Town of Newmarket and the storage of water within Newmarket and surrounding municipalities is within the Region of York's jurisdiction. The Town of Newmarket is currently supplied by both groundwater from various wells in Newmarket and East Gwillimbury, as well as surface water from Peel Region through supplies on Bathurst Street, Yonge Street, Bayview Avenue and Leslie Street from Aurora. The Town of Newmarket is responsible for the distribution of water within the Town's boundaries from the Regional storage facilities and water supplies. The Town of Newmarket Distribution System is comprised of four pressure districts (West, Central, East and Aurora East Reduced Pressure Districts).

The Urban Centre Secondary Plan is serviced by both the West Pressure District (WPD) and Central Pressure District (CPD); however most of the water supply is from the Region's Sharon and Queensville wells and from the Leslie Street watermain via the East Pressure District (EPD). For this reason, it was necessary to determine the impact that the proposed growth will have on all pressure districts.

1.2 PROJECT SCOPE

The intent of this project is to provide the Town of Newmarket with recommendations for the water distribution system based on modeling undertaken by WSP. The Town of Newmarket had a working water model in H2ONet that was last updated in 2012. The modeling approach to be undertaken included updating the existing system model to include any changes made to the system since the 2012 update and loading the model with future development and population scenarios. 2011 census data was used to confirm water demands and update the model as required.

This Master Plan will include the evaluation of existing Town wide infrastructure, the identification of deficiencies and the development of short-term and long-term implementation plans for improvements for a financially sustainable program. WSP worked with the Region of York to ensure that this study is in tandem with the Region of York's 2015 Water and Wastewater Master Plan Update.

With an updated existing condition model, Town's development and planning information would be used to prepare a future growth condition scenario for, the 2041 horizon year. Using this model, distribution system shortfalls were determined and alternative solutions were confirmed.

2 REVIEW OF MODELS AND UPDATES

2.1 MODELING APPROACH

The Town of Newmarket provided a copy of the 2012 H2ONet water model of the Town's system in April 2015. As H2ONet is an Autocad based version of the hydraulic software created by Innovyze. With approval from the Town, it was decided to import the model into the GIS version of the software, InfoWater. The existing model would be reviewed and edits made as required to create an up-to-date model for the modelling exercises to be undertaken as part of the Master Plan.

2.2 REVIEW OF NEWMARKET MODELS

The water model was first imported into InfoWater before the data and scenarios could be reviewed. The model database was compared to the GIS information provided by the Town and the existing Regional information for the Regional facilities.

The information generally was correct for the pumping stations, wells and storage but most of the watermains had lost the data related to curves and bends in the pipes. At this point, Town staff were contacted to discuss the options to update the model. The bends could be recreated for each pipe or the entire model reconstructed from the Town's GIS information.

2.3 STAFF CONSULTATION

The Town was consulted via meetings and conference calls to provide input on the model creation, fire flows, unit rates and proposed upgrades. The Town decided that the reconstructing the model from the GIS was appropriate. This option would integrate the model with the Town's GIS information to allow a transfer of data between the two databases.

Historical water usage for the years 2012, 2013 and 2014 were used to calculate a water rate per person. The calculated values were discussed, compared to the Regional Master Plan rates, Town of Newmarket's engineering standards and the rates generated by the Wastewater team. It was decided that an average day rate of 220 L/cap/day would be used for both the residential and ICI development. Peaking factors were based on historical data and Regional Master Plan information. A summary of the data used to calculate the average day is included in Appendix A.

Fire flows were reviewed against the Town of Newmarket's engineering standards, the Fire Underwriters' Survey, other similar sized community standards and the Region's criteria. Fire flows were agreed to be the following:

- → 7,000 L/min for single family dwellings
- → 10,000 L/min for townhomes
- → 15,000 L/min for apartments
- → 15,900 L/min for commercial and industrial lands

2.4 DATA COLLECTION

As noted in Section 2.3, the Town provided background information on the existing infrastructure, historic flows, hydrant test pressure data and system operation. Information was also provided by the Region as the Region oversees the water supply to the municipalities and operates the wells, pumping stations, valves and storage facilities.

The data was provided by the Town was used to re-create the model, assess the per capita water usage, pressure district boundaries and confirm the model pressures. The Regional data was used to set the flows from the neighbouring municipalities and update operational settings for valves, pumping stations and storage.

2.5 WSP MODEL UPDATES

The GIS information for watermains was provided by both the Town and the Region. The Town information was used to recreate the pipes and nodes within the Town boundaries. Regional information was used to confirm the Town's data and provide the external supply watermains, pumping stations and storage as required. The information was adjusted to suit the needs of the model i.e. piping around pumping stations and wells are not clear without moving pipes to avoid overlap, etc. Any anomalies were noted and sent to the Town to confirm before proceeding.

The revised GIS information was imported into the InfoWater software. Connectivity was checked and zone boundaries set. Node elevations were extracted from the contour GIS shapefile and checked for inconsistencies.

The nodes to have demands allocated to them were identified. Demands are not placed on nodes within pumping stations or other points where supply is not directly required i.e. next to a park or on either side of a pressure reducing valve. With the demand nodes selected, Thiesson polygons were created around these nodes using the pressure district boundaries as the outer limit. The polygons were then used along with the population data, approved usage criteria to calculate the demands for each demand node. The demand data was then imported back into the model, the scenarios run, zone demands checked to confirm no zone errors and demands adjusted to suit if required.

Data for the pumping stations, storage and system operation, both internal and external to the Town, was input and checked. A pressure reducing valve was added to the Leslie Street Regional watermain to create the Aurora East Reduced Zone for the residential area east of Leslie Street.

With all data input and checked, the model was run and the pressures confirmed against the hydrant testing information. Adjustments were done as required before loading up the fire demands. Scenarios were created for each type of fire flow demand. The nodes were assigned the highest fire flow of the nearby developments.

3 HYDRAULIC MODELING RESULTS

3.1 MODEL RESULTS

With the model updated and checked against the existing pressure data, the system could be checked for any areas that required upgrades. Fire flows tend to be the demand that dictates the watermain size. Generally speaking the system pressures are adequate in the existing system. Fire flows could be met except near the London Elevated Tank. This is partly due to the existing system operation to maintain water quality in the system.

The Newmarket system has water quality issues. To assist with the turnover of water, the Region operates the London Tower using only the lower portion of the available storage. The water quality is being examined by others.

3.2 PROPOSED SOLUTIONS - EXISTING CONDITIONS SCENARIO

The Newmarket existing system is relatively robust and the Region provides adequate supply to the system. There are a few upgrades required to meet the fire flows under existing conditions as documented in Table 3-1.

Table 3-1 Existing Upgrades

PROJECT LABEL	STREET NAME	EXTENT	EXISTING SIZE (MM)	PROPOSED SIZE (MM)
W4	Willow Lane	From existing 250 mm to Longford Drive	150	250
W9	Calgain Road	Lorne Avenue to end of street	150	200
W10	Lorne Avenue	Davis Drive to Calgain Road	150	200

3.3 PROPOSED SOLUTIONS - FUTURE CONDITIONS SCENARIO

With a robust existing system supplying Newmarket and adequate supply from the Region, the additional demand doesn't overly stress the existing system. There are a few upgrades required to meet the future fire flows as documented in Table 3-2.

Table 3-2 Future Upgrades

PROJECT LABEL	STREET NAME	EXTENT	EXISTING SIZE (MM)	PROPOSED SIZE (MM)
W1	Bristol Road	Main Street North to Stiver Drive	200	300
W2	Main Street N	From Regional Main to Bristol	200	300
W3	George Street	Kingston Road to Davis Drive	150	200
W5	Huron Heights Drive	Davis Drive to existing 200 mm WM	150	200
W6	Willstead Drive	Queen Street to Davis Drive	150	200
W7	Queen Street	Millard Avenue to Parkside	150	200
W8	Parkside Drive	Queen Street to existing 200 mm WM	150	200
W11	Charles Street	Davis Drive to Queen Street	150	200
W12	Glenway Circle	Eagle St. to existing 200 mm WM on Glenway Circle	150	200
W13	Millard Avenue	Yonge Street to Queen Street	150	200

4 CONCLUSIONS

The Newmarket existing system is adequate to supply the existing community. The Region provides ample supply to the system to meet the needs of the system. Three upgrades are required to meet the fire flow demands.

5 RECOMMENDATIONS

- Newmarket and York should continue to maintain the current working relationship that is providing adequate water supply to the community.
- The water quality issues should be addressed by the report by others.
- The three upgrades should be completed to address the existing fire flow shortfall
- There are ten upgrades required to meet future fire flow demands.

APPENDIX A

Water Design Criteria

Town of Newmarket Water and Wastemater Master Plan

Water Unit Rates

Recommended Rates

	York Region MP	2015 Newmarket Engineering Design Standards	Recommended Rates (Base Year)
Maximum Day Factor	1.7	2.0	1.7
Average Day (L/cap/day)	220	300	220
Peak Hour Factor	2.5	3.0	2.5

Notes:
1. Recommended Average Day Rate was selected based on York Region's W&WW Master Plan.
2. Recommended Maximum Day Factor was selected based on York Region's W&WW Master Plan.
3. Recommended Peak Hour Factor was selected based on York Region's W&WW Master Plan (1.7 x 1.45 = 2.5)

Average Day Rate Calculations [1]

	Population			York SCADA Data		
Year	**Residential**	**Employment**	**Total [2]**	**Total Consumption (m3/day)**	**Avg Day (L/cap/day) - Based on dividing by Residential Population Only**	**Avg Day (L/cap/day) - Based on dividing by Residential and Employment Population**
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Maximum Day and Peak Hour Factor Calculations [1]

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	Max Day	**Max Flow (m3/day)**	**Max Day Factor [4]**	**Peak Hour Time**	**Peak Hour Flow (m3/day)**	**Peak Hour Factor**
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	Max Day	Max Flow (m3/day)	Max Day Factor [4]	Peak Hour Time	Peak Hour Flow (m3/day)	Peak Hour Factor
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Note:

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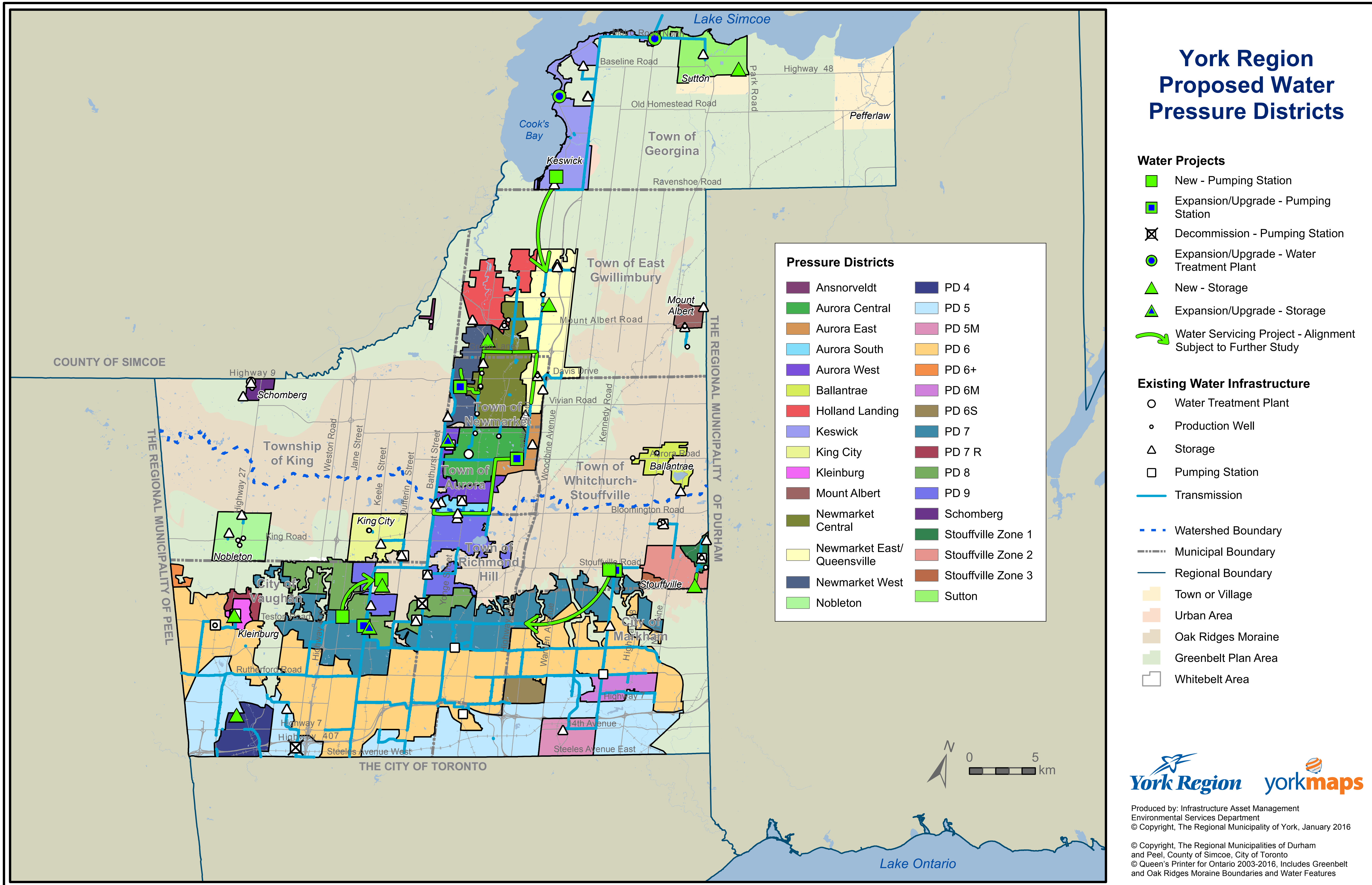
[4] Max Day Factors and Peak Hour Factors were calculated by dividing the Max Day Flows and Peak Hour Flows by the Average Day Flows (as calculate per item 3 in the notes).

Volume 2 – Appendix 2C

Water and Wastewater Service Maps

- **Water and Wastewater Service Maps**

Appendix 2C provides two maps showing the proposed location and naming of the water system pressure districts and the wastewater system service areas (areas tributary to a wastewater facility).



York Region Proposed Water Pressure Districts
Water Projects
New - Pumping Station
Expansion/Upgrade - Pumping Station
Decommission - Pumping Station
Expansion/Upgrade - Water Treatment Plant
New - Storage
Expansion/Upgrade - Storage
Water Servicing Project - Alignment Subject to Further Study
Existing Water Infrastructure
Water Treatment Plant
Production Well
Storage
Pumping Station
Transmission
Watershed Boundary
Municipal Boundary
Regional Boundary
Town or Village
Urban Area
Oak Ridges Moraine
Greenbelt Plan Area
Whitebelt Area
Pressure Districts
Ansnorveldt
Aurora Central
Aurora East
Aurora South
Aurora West
Ballantrae
Holland Landing
Keswick
King City
Kleinburg
Mount Albert
Newmarket Central
Newmarket East/ Queensville
Newmarket West
Nobleton
PD 4
PD 5
PD 5M
PD 6
PD 6+
PD 6M
PD 6S
PD 7
PD 7 R
PD 8
PD 9
Schomberg
Stouffville Zone 1
Stouffville Zone 2
Stouffville Zone 3
Sutton
Lake Simcoe
Cook's Bay
Keswick
Sutton
Pefferlaw
Town of Georgina
Baseline Road
Old Homestead Road
Ravenshoe Road
Highway 48
Park Road
Town of East Gwillimbury
Mount Albert
Mount Albert Road
Davis Drive
Vivian Road
Town of Newmarket
Town of Aurora
Town of Whitchurch-Stouffville
Ballantrae
Aurora Road
Bloomington Road
Stouffville Road
Stouffville
COUNTY OF SIMCOE
Highway 9
Schomberg
Township of King
King City
King Road
Nobleton
Highway 27
Weston Road
Jane Street
Keele Street
Dufferin Street
Bathurst Street
Yonge Street
Woodbine Avenue
Kennedy Road
Town of Richmond Hill
City of Vaughan
Kleinburg
Teston Road
Rutherford Road
Highway 7
Highway 407
Steeles Avenue West
Steeles Avenue East
14th Avenue
City of Markham
THE REGIONAL MUNICIPALITY OF PEEL
THE REGIONAL MUNICIPALITY OF DURHAM
THE CITY OF TORONTO
Lake Ontario
N
0 5 km
York Region
yorkmaps
Produced by: Infrastructure Asset Management
Environmental Services Department
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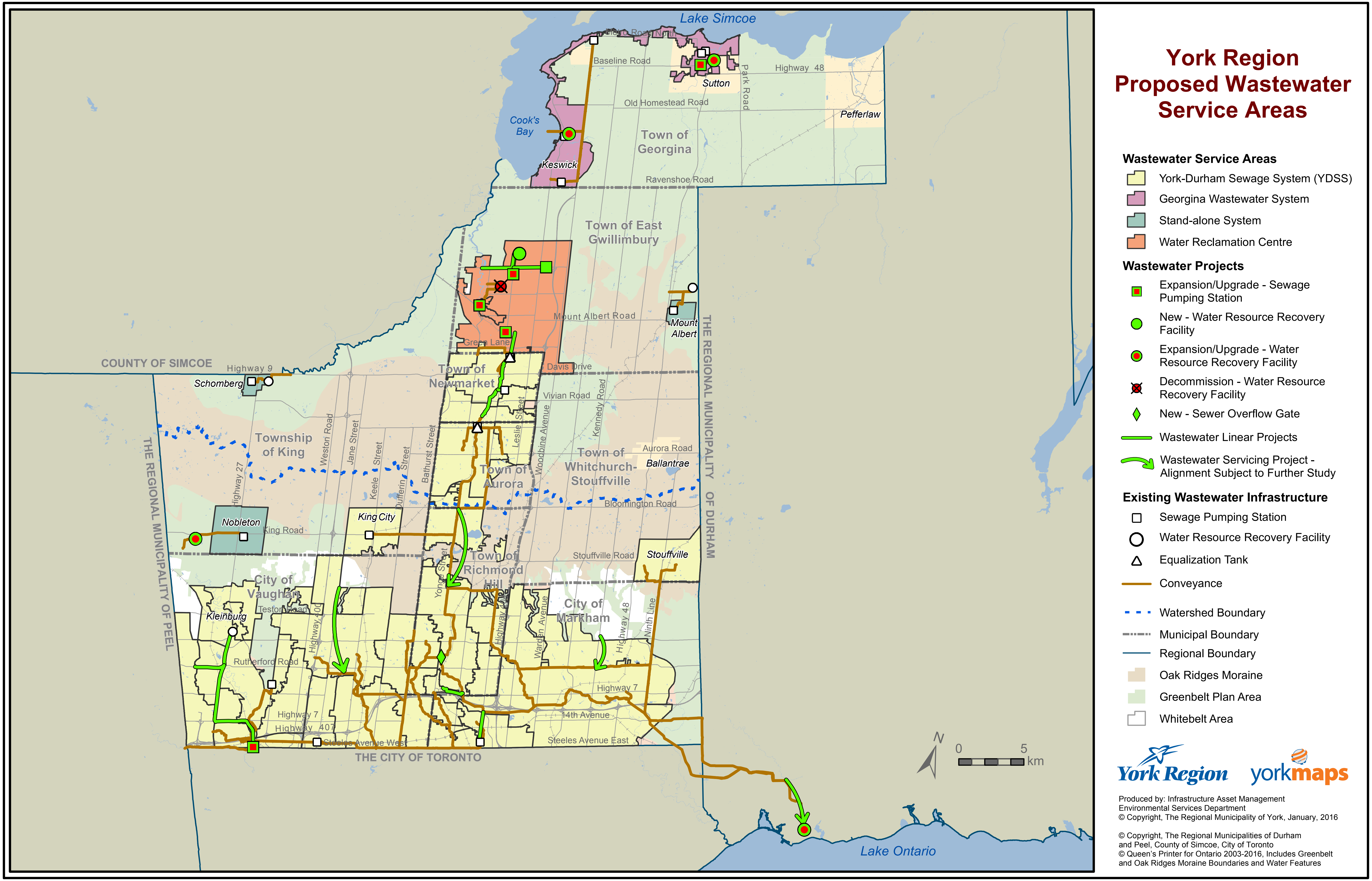
York Region
Proposed Wastewater
Service Areas
Wastewater Service Areas
York-Durham Sewage System (YDSS)
Georgina Wastewater System
Stand-alone System
Water Reclamation Centre
Wastewater Projects
Expansion/Upgrade - Sewage Pumping Station
New - Water Resource Recovery Facility
Expansion/Upgrade - Water Resource Recovery Facility
Decommission - Water Resource Recovery Facility
New - Sewer Overflow Gate
Wastewater Linear Projects
Wastewater Servicing Project - Alignment Subject to Further Study
Existing Wastewater Infrastructure
Sewage Pumping Station
Water Resource Recovery Facility
Equalization Tank
Conveyance
Watershed Boundary
Municipal Boundary
Regional Boundary
Oak Ridges Moraine
Greenbelt Plan Area
Whitebelt Area
Lake Simcoe
Cook's Bay
Keswick
Sutton
Pefferlaw
Town of Georgina
Baseline Road
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AQUAZITION

5-200 Connie Cres. Concord ON L4K 1M1 Phone 416-883-9777 Fax 905-303-6977

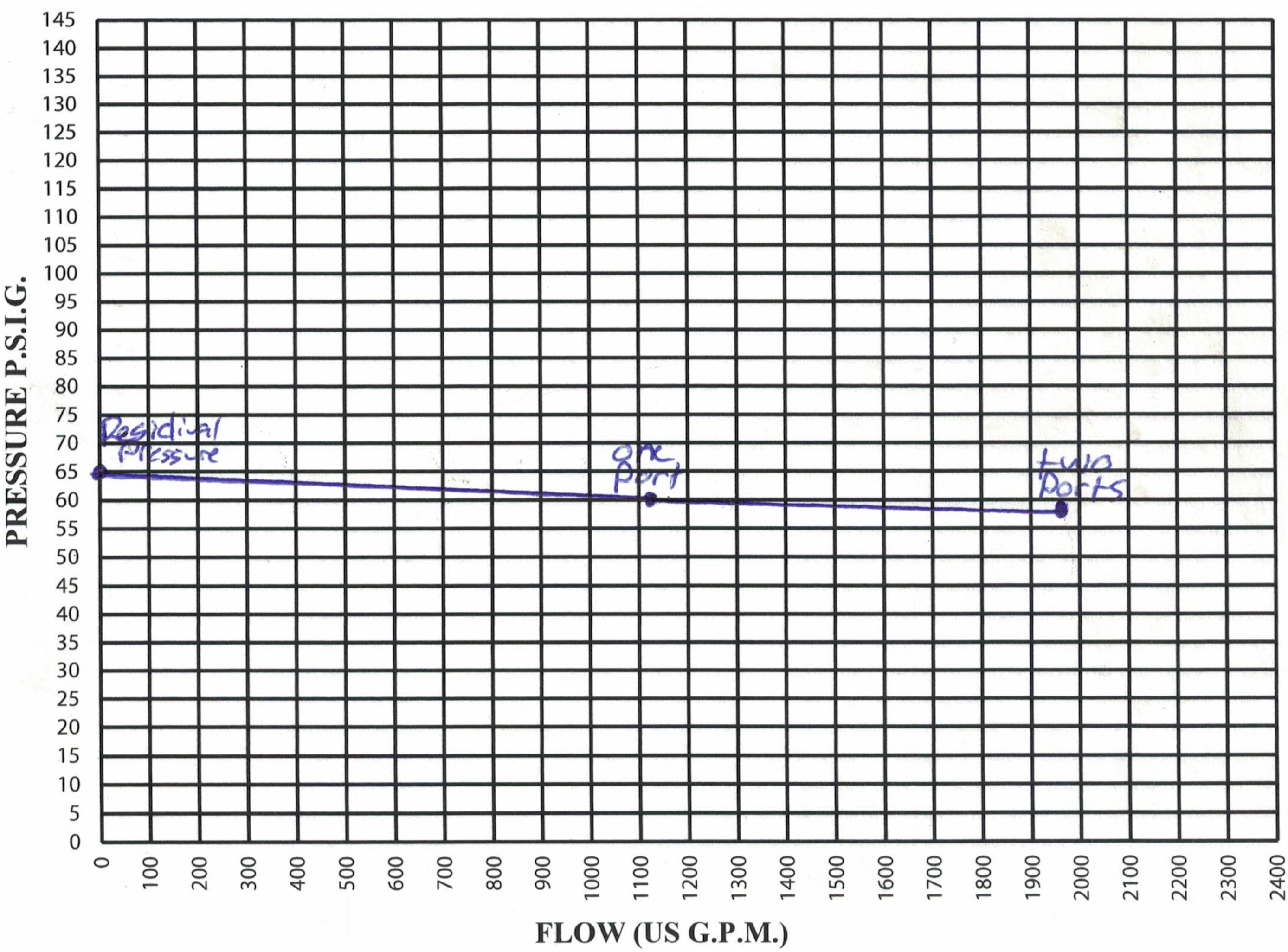
FLOW TEST REPORT

LOCATION OF RESIDUAL HYDRANT 899 Issic PhilPS way

LOCATION OF FLOW HYDRANT 90 Kalinda Road

TIME OF TEST 2:30 WATERMAIN SIZE 200mm STATIC PRESSURE 65psi

NUMBER OF OUTLETS	PITOT PRESSURE	FLOW (US G.P.M.)	RESIDUAL PRESSURE
One 2 ½" hydrant port	45 Psi	1123	60psi
Two 2 ½" hydrant port	35 Psi	1981	58psi



PROJECT LOCATION 90 Kalinda Road DATE 07-19-17

COMPANY NAME Schaeffers Consulting (PRINT NAME) AQUAZITION EMPLOYEE Nick Guriel (PRINT NAME)

AQUAZITION

5-200 Connie Cres. Concord ON L4K 1M1 Phone 416-883-9777 Fax 905-303-6977

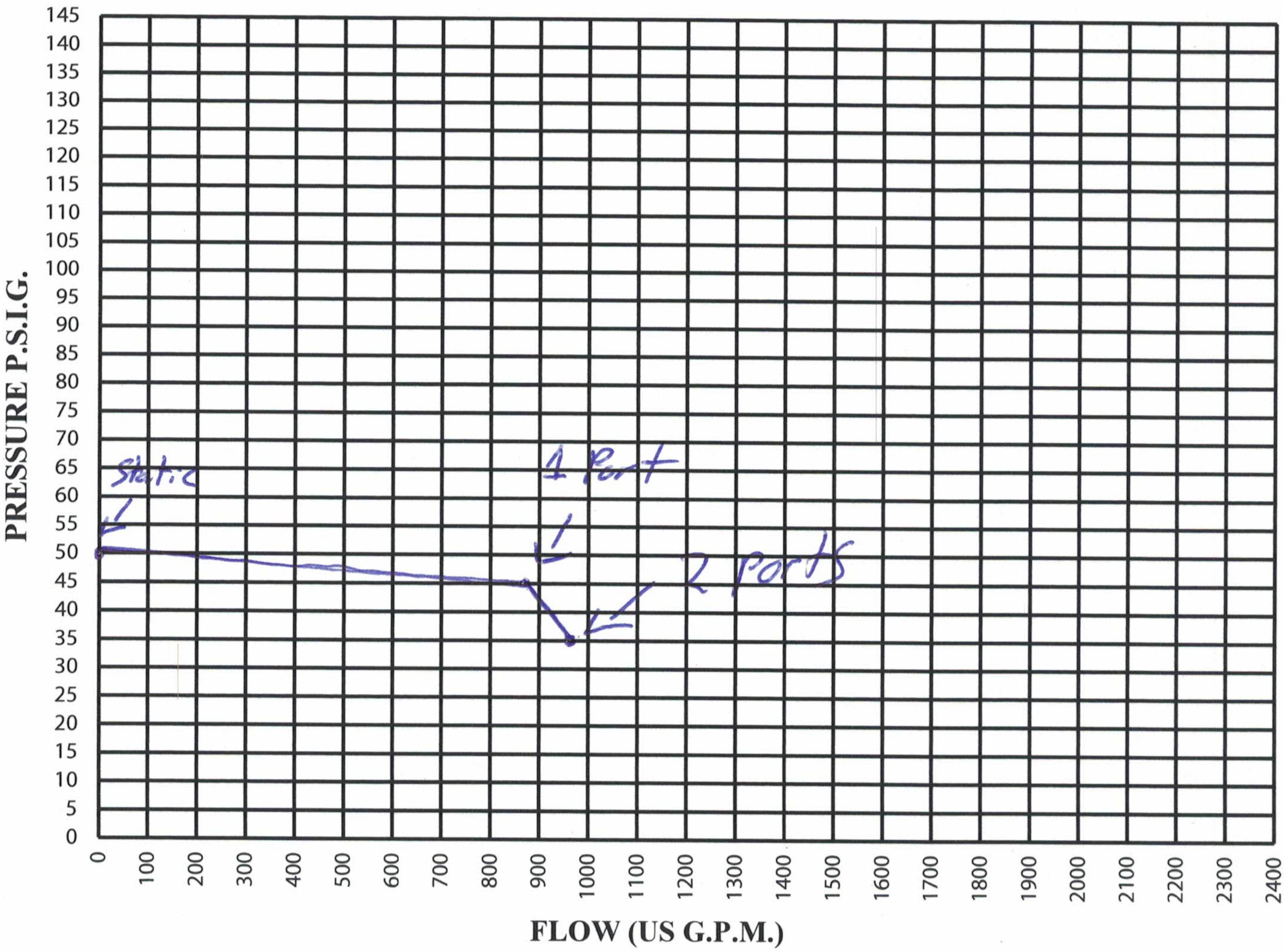
FLOW TEST REPORT

LOCATION OF RESIDUAL HYDRANT hydrant# WtR hy-5070-03

LOCATION OF FLOW HYDRANT hydrant# wtr-hy 5070-09

TIME OF TEST 11:30 WATERMAIN SIZE 200 STATIC PRESSURE 50

NUMBER OF OUTLETS	PITOT PRESSURE	FLOW (US G.P.M.)	RESIDUAL PRESSURE
One 2 ½" hydrant port	28	886	45
Two 2 ½" hydrant port	8	947	35



PROJECT LOCATION 457 St John's sideroad DATE 07-17-17

COMPANY NAME Schaeffers AQUAZITION EMPLOYEE Karl Biso

(PRINT NAME) (PRINT NAME)

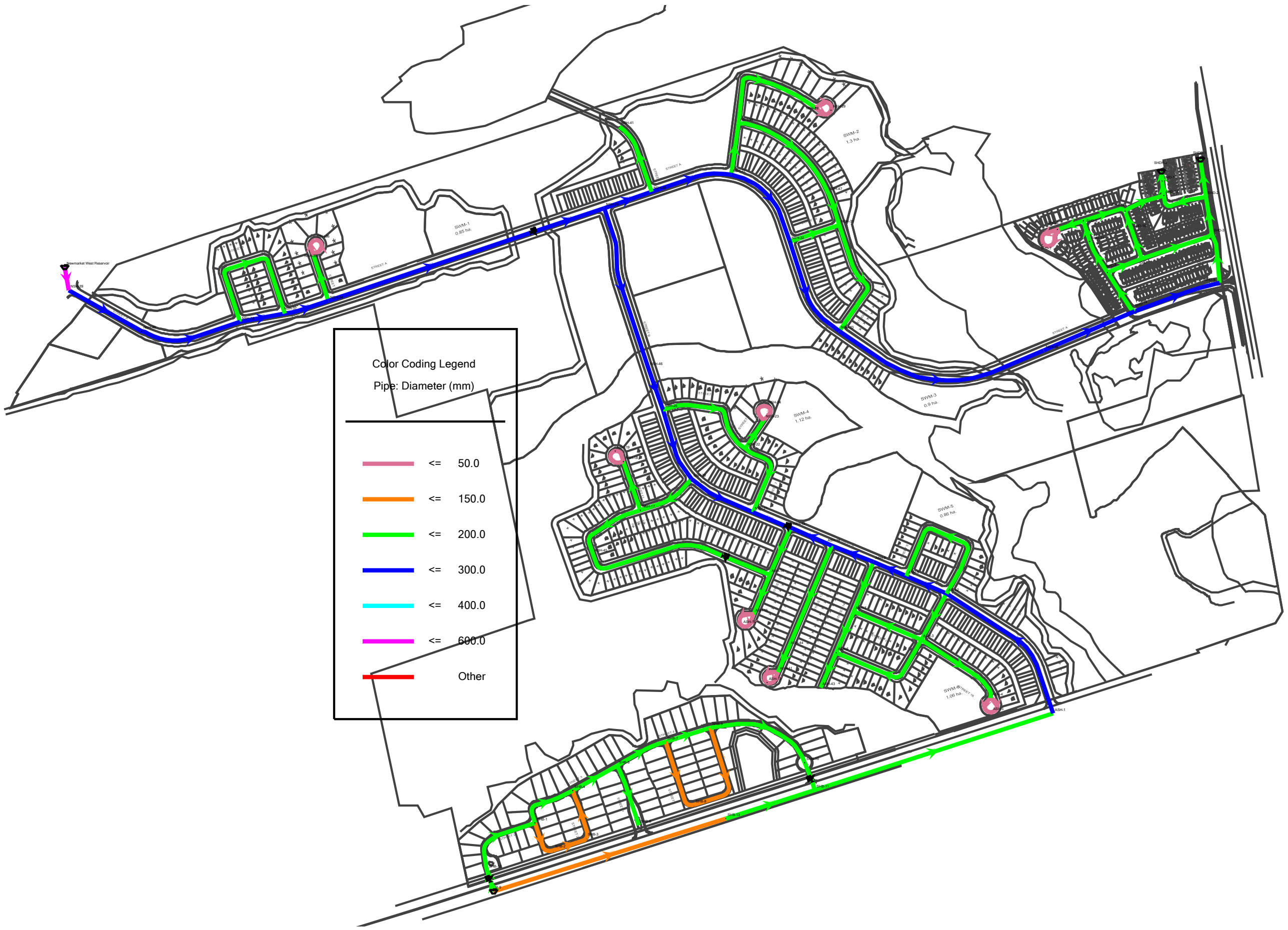
Water Supply Demand (Shining Hill Master Plan [All 3 Phases])
Town of Aurora and Town of Newmarket - Aurora Zone 1 (Aurora Central), Zone 2 (Aurora West) and Newmarket Central, Newmarket West

Node	Municipality	Elevation m	Single Detached Units	Townhouse Units	Apartment Units	No. of People Res.	Comm. Area (ha)	Instit. Area (ha)	Park Area (ha)	No. of People Non-Res.	Average Day (L/s)	Max. Day (L/s)	Peak Hour (L/s)	Min. Hour (L/s)
SHD- 1	Newmarket	261.49	0	21	0	74	0	0	0	0	0.33	0.67	1.00	0.23
SHD- 2	Newmarket	259.60	0	11	0	39	0	0	0	0	0.18	0.35	0.53	0.12
SHD- 3	Newmarket	258.20	0	15	0	53	0	0	0	0	0.24	0.48	0.72	0.17
SHD- 4	Newmarket	257.51	0	28	0	98	0	0	0	0	0.44	0.88	1.33	0.31
SHD- 5	Newmarket	258.25	8	23	0	111	0	0	0	0	0.50	1.00	1.50	0.35
SHD- 6	Newmarket	257.58	6	5	0	41	0	0	0	0	0.19	0.37	0.56	0.13
SHD- 7	Newmarket	257.13	2	5	0	26	0	0	0	0	0.12	0.23	0.35	0.08
SHD- 8	Newmarket	257.65	7	16	0	83	0	0	0	0	0.37	0.75	1.12	0.26
SHD- 9	Newmarket	253.65	0	25	0	88	0	0	0	0	0.40	0.79	1.19	0.28
SHD- 10	Newmarket	257.60	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
SHD- 11	Newmarket	257.90	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
SHD- 12	Newmarket	258.25	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
SHD- 13	Newmarket	261.30	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
SHD- 14	Newmarket	258.01	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
SHB- 1	Aurora	299.45	10	0	0	38	0	0	0	0	0.17	0.31	0.86	0.11
SHB- 2	Aurora	298.90	2	0	0	8	0	0	0	0	0.04	0.07	0.18	0.02
SHB- 3	Aurora	295.45	5	0	0	19	0	0	0	0	0.09	0.15	0.43	0.06
SHB- 4	Aurora	292.76	8	0	0	31	0	0	0	0	0.14	0.25	0.70	0.09
SHB- 5	Aurora	287.00	7	0	0	27	0	0	0	0	0.12	0.22	0.61	0.08
SHB- 6	Aurora	289.05	8	0	0	31	0	0	0	0	0.14	0.25	0.70	0.09
SHB- 7	Aurora	281.17	9	0	0	35	0	0	0	0	0.16	0.28	0.79	0.10
SHB- 8	Aurora	281.36	8	0	0	31	0	0	0	0	0.14	0.25	0.70	0.09
SHB- 9	Aurora	276.09	12	0	0	46	0	0	0	0	0.21	0.37	1.04	0.13
SHB- 10	Aurora	269.12	7	0	0	27	0	0	0	0	0.12	0.22	0.61	0.08
SHB- 11	Aurora	269.50	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
SHB- 12	Aurora	307.17	11	0	0	42	0	0	0	0	0.19	0.34	0.95	0.12
SHB- 13	Aurora	280.60	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
ASH- 1	Aurora	261.86	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
ASH- 2	Aurora	267.07	18	35	0	191	0	0	0	0	0.86	1.55	4.31	0.56
ASH- 3	Aurora	267.23	25	0	0	95	0	0	0	0	0.43	0.77	2.14	0.28
ASH- 4	Aurora	264.55	7	0	0	27	0	0	0	0	0.12	0.22	0.61	0.08
ASH- 5	Aurora	264.88	3	0	0	12	0	0	0	0	0.05	0.10	0.27	0.04
ASH- 6	Aurora	268.55	14	0	0	54	0	0	0	0	0.24	0.44	1.22	0.16
ASH- 7	Aurora	268.14	17	0	0	65	0	0	0	0	0.29	0.53	1.47	0.19
ASH- 8	Aurora	267.60	0	7	0	25	0	0	0	0	0.11	0.20	0.56	0.07
ASH- 9	Aurora	267.57	10	18	0	101	0	0	0	0	0.46	0.82	2.28	0.30
ASH- 10	Aurora	268.54	10	8	0	66	0	0	2.18	109	0.79	1.42	3.95	0.51
ASH- 11	Aurora	268.32	4	0	0	16	0	0	0	0	0.07	0.13	0.36	0.05
ASH- 12	Aurora	268.19	3	0	0	12	0	0	0	0	0.05	0.10	0.27	0.04
ASH- 13	Aurora	268.99	0	8	0	28	0	0	0	0	0.13	0.23	0.63	0.08
ASH- 14	Aurora	270.02	36	0	0	137	0	0	0	0	0.62	1.11	3.09	0.40

Water Supply Demand (Shining Hill Master Plan [All 3 Phases])
Town of Aurora and Town of Newmarket - Aurora Zone 1 (Aurora Central), Zone 2 (Aurora West) and Newmarket Central, Newmarket West

Node	Municipality	Elevation m	Single Detached Units	Townhouse Units	Apartment Units	No. of People Res.	Comm. Area (ha)	Instit. Area (ha)	Park Area (ha)	No. of People Non-Res.	Average Day (L/s)	Max. Day (L/s)	Peak Hour (L/s)	Min. Hour (L/s)
ASH- 15	Aurora	271.62	8	0	0	31	0	0	0	0	0.14	0.25	0.70	0.09
ASH- 16	Aurora	272.84	2	0	0	8	0	0	0	0	0.04	0.07	0.18	0.02
NSH- 17	Newmarket	276.85	16	0	0	61	0	0	0	0	0.28	0.55	0.83	0.19
NSH- 18	Newmarket	279.12	19	0	0	73	0	0	0	0	0.33	0.66	0.99	0.23
NSH- 19	Newmarket	280.89	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
NSH- 20	Newmarket	273.89	0	28	0	98	0	0	0	0	0.44	0.88	1.33	0.31
ASH- 21	Aurora	269.39	3	23	0	92	0	0	0	0	0.42	0.75	2.08	0.27
NSH- 22	Newmarket	270.30	17	0	0	65	0	0	0	0	0.29	0.59	0.88	0.21
NSH- 23	Newmarket	269.36	4	0	0	16	0	0	0	0	0.07	0.14	0.22	0.05
NSH- 24	Newmarket	269.57	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
NSH- 25	Newmarket	274.94	0	17	0	60	0	0	0	0	0.27	0.54	0.81	0.19
NSH- 26	Newmarket	272.64	0	16	260	706	0	2.40	2.19	230	4.23	8.45	12.68	2.96
NSH- 27	Newmarket	269.84	0	8	0	28	0	0	0	0	0.13	0.25	0.38	0.09
NSH- 28	Newmarket	264.45	15	0	0	57	0	0	0	0	0.26	0.51	0.77	0.18
NSH- 29	Newmarket	264.00	4	0	0	16	0	0	0	0	0.07	0.14	0.22	0.05
NSH- 30	Newmarket	267.13	18	233	0	884	0	0	0	0	3.99	7.98	11.97	2.79
NSH- 31	Newmarket	267.32	7	0	0	27	0	0	0	0	0.12	0.24	0.37	0.09
NSH- 32	Newmarket	268.71	0	348	0	1218	0	0	0	0	5.50	11.00	16.49	3.85
NSH- 33	Newmarket	263.59	24	0	0	92	0	0	0	0	0.42	0.83	1.25	0.29
NSH- 34	Newmarket	291.88	6	0	0	23	0	0	1.92	96	0.54	1.07	1.61	0.38
NSH- 35	Newmarket	294.08	3	0	0	12	0	0	0	0	0.05	0.11	0.16	0.04
NSH- 36	Newmarket	295.08	4	0	0	16	0	0	0	0	0.07	0.14	0.22	0.05
NSH- 37	Newmarket	297.34	18	0	0	69	0	0	0	0	0.31	0.62	0.93	0.22
NSH- 38	Newmarket	302.85	10	0	0	38	0	0	0	0	0.17	0.34	0.51	0.12
NSH- 39	Newmarket	313.15	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
NSH- 40	Newmarket	271.56	0	5	0	18	0	0	0	0	0.08	0.16	0.24	0.06
NSH- 41	Newmarket	270.01	4	0	0	16	0	0	0	0	0.07	0.14	0.22	0.05
ASH- 43	Aurora	267.03	11	0	0	42	0	0	0	0	0.19	0.34	0.95	0.12
ASH- 44	Aurora	269.13	20	0	0	76	0	0	0	0	0.34	0.62	1.72	0.22
ASH- 45	Aurora	283.69	31	0	0	118	0	0	0	0	0.53	0.96	2.66	0.35
NSH- 46	Newmarket	275.29	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
NSH- 47	Newmarket	267.84	19	0	0	73	0	0	0	0	0.33	0.66	0.99	0.23
NSH- 48	Newmarket	252.91	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00
NSH- 49	Newmarket	314.03	0	115	230	978	0.60	0	0	45	4.62	9.24	13.85	3.23
Total Shining Hill Phase 3	--	--	410	869	490	5840	0.60	2.40	6.29	480	28.53	55.88	97.36	19.67
Total Shining Hill (All Phases)	--	--	520	1018	490	6788	0.60	2.40	6.29	480	32.81	64.13	113.23	22.59

Scenario: Min HGL - Max Day + Fire



FlexTable: Junction Table

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
285	NSH-49	314.03	3.55	336.91	223.9
259	NSH-39	313.15	0.00	338.88	251.9
150	SHB-12	307.17	0.19	333.02	253.0
256	NSH-38	302.85	0.13	334.60	310.7
125	SHB-1	299.45	0.17	333.02	328.5
126	SHB-2	298.90	0.04	333.02	333.9
273	NSH-45	283.69	0.53	318.32	338.9
254	NSH-37	297.34	0.24	333.82	357.1
208	NSH-19	280.89	0.00	318.32	366.3
128	SHB-3	295.45	0.09	333.02	367.6
251	NSH-36	295.08	0.06	332.81	369.2
249	NSH-35	294.08	0.04	332.81	379.0
206	NSH-18	279.12	0.25	318.32	383.7
69	SHD-1	261.49	0.26	301.49	391.5
130	SHB-4	292.76	0.14	333.02	394.0
247	NSH-34	291.88	0.41	332.81	400.5
105	SHD-13	261.30	0.00	302.59	404.1
204	NSH-17	276.85	0.21	318.32	405.9
276	NSH-46	275.29	0.00	318.32	421.2
223	NSH-25	274.94	0.21	318.32	424.6
67	SHD-2	259.60	0.14	303.01	424.8
134	SHB-6	289.05	0.14	333.01	430.3
211	NSH-20	273.89	0.34	318.32	434.9
240	NSH-32	268.71	4.23	314.30	446.1
226	NSH-26	272.64	3.25	318.33	447.1
261	NSH-40	271.56	0.06	317.30	447.6
228	NSH-27	269.84	0.10	315.61	447.9
102	SHD-12	258.25	0.00	304.18	449.5
132	SHB-5	287.00	0.12	333.01	450.3
78	SHD-5	258.25	0.39	304.62	453.8
71	SHD-3	258.20	0.18	304.72	455.3
279	NSH-47	267.84	0.25	314.47	456.4
96	SHD-10	257.60	0.00	304.39	457.9
93	SHD-11	257.90	0.00	304.84	459.4
238	NSH-31	267.32	0.09	314.26	459.4
84	SHD-6	257.58	0.14	304.62	460.4
80	SHD-4	257.51	0.34	304.73	462.1
264	NSH-41	270.01	0.06	317.30	462.8
86	SHD-7	257.13	0.09	304.62	464.7
75	SHD-8	257.65	0.29	305.22	465.5
216	NSH-22	270.30	0.23	318.32	470.0
235	NSH-30	267.13	3.07	315.19	470.4
220	NSH-24	269.57	0.00	318.32	477.1
213	NSH-21	269.39	0.42	318.32	478.9
218	NSH-23	269.36	0.06	318.32	479.2
109	SHD-14	258.01	0.00	307.25	481.9
243	NSH-33	263.59	0.32	313.09	484.4
230	NSH-28	264.45	0.20	315.19	496.6
232	NSH-29	264.00	0.06	315.19	501.0

FlexTable: Junction Table

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
138	SHB-8	281.36	0.14	333.01	505.5
136	SHB-7	281.17	0.16	333.01	507.4
162	SHB-13	280.60	0.00	332.53	508.3
73	SHD-9	253.65	0.31	306.80	520.2
282	NSH-48	252.91	0.00	309.05	549.4
140	SHB-9	276.09	0.21	333.01	557.1
201	ASH-16	272.84	0.04	332.20	580.9
199	ASH-15	271.62	0.14	332.20	592.9
197	ASH-14	270.02	0.62	332.20	608.5
144	SHB-11	269.50	0.00	332.49	616.5
270	ASH-44	269.13	0.34	332.20	617.2
195	ASH-13	268.99	0.13	332.20	618.6
177	ASH-6	268.55	0.24	332.20	622.9
188	ASH-10	268.54	0.79	332.20	623.0
190	ASH-11	268.32	0.07	332.20	625.2
142	SHB-10	269.12	0.12	333.01	625.3
192	ASH-12	268.19	0.05	332.20	626.4
179	ASH-7	268.14	0.29	332.20	626.9
182	ASH-8	267.60	0.11	332.20	632.2
184	ASH-9	267.57	0.46	332.20	632.5
170	ASH-3	267.23	0.43	332.20	635.8
168	ASH-2	267.07	0.86	332.20	637.4
268	ASH-43	267.03	0.19	332.20	637.8
174	ASH-5	264.88	0.05	332.20	658.8
172	ASH-4	264.55	0.12	332.20	662.1
166	ASH-1	261.86	0.00	332.21	688.5

FlexTable: Pipe Table

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
P-15	65.24	SHDR-1	SHD-2	200.0	PVC
P-17	65.29	SHD-2	SHD-3	200.0	PVC
P-18	85.72	SHD-3	SHD-9	200.0	PVC
P-22	63.55	SHD-8	SHD-4	200.0	PVC
P-23	128.63	SHD-4	SHD-3	200.0	PVC
P-25	47.20	SHD-5	SHD-6	200.0	PVC
P-26	47.99	SHD-6	SHD-7	50.0	Copper
P-27	41.94	SHD-7	SHD-6	50.0	Copper
P-28	16.38	SHDR-2	SHD-1	200.0	PVC
P-29	61.95	SHD-8	SHD-11	200.0	PVC
P-30	37.29	SHD-11	SHD-5	200.0	PVC
P-32	53.47	SHD-10	SHD-4	200.0	PVC
P-33	76.50	SHD-5	SHD-12	200.0	PVC
P-34	33.34	SHD-12	SHD-10	200.0	PVC
P-35	87.58	SHD-2	SHD-13	200.0	PVC
P-36	25.40	SHD-13	SHD-1	200.0	PVC
P-37	72.78	SHD-12	SHD-13	200.0	PVC
P-38	154.67	SHD-9	SHD-14	300.0	PVC
P-39	82.15	SHD-14	SHD-8	200.0	PVC
P-42	64.24	SHB-1	SHB-2	150.0	PVC
P-43	60.86	SHB-2	SHB-3	150.0	PVC
P-44	87.29	SHB-3	SHB-4	150.0	PVC
P-45	87.63	SHB-4	SHB-5	200.0	PVC
P-46	109.24	SHB-5	SHB-6	200.0	PVC
P-47	93.67	SHB-5	SHB-7	200.0	PVC
P-48	125.62	SHB-7	SHB-8	150.0	PVC
P-49	179.50	SHB-8	SHB-9	150.0	PVC
P-50	190.52	SHB-9	SHB-10	200.0	PVC
P-52	81.10	SHB-9	SHB-7	200.0	PVC
P-53	103.66	SHB-1	SHB-4	200.0	PVC
P-54	138.85	SHB-1	SHB-12	200.0	PVC
P-55(1)	17.87	SHB-12	PRV-1	200.0	PVC
P-55(2)	20.83	PRV-1	R-9	200.0	PVC
P-51(1)	31.94	SHB-10	PRV-2	200.0	PVC
P-51(2)	18.61	PRV-2	SHB-11	200.0	PVC
P-41(2)(1)(1)	161.01	SHB-11	SHB-13	200.0	PVC
P-41(2)(1)(2)	419.84	SHB-13	R-9	150.0	PVC
P-56	432.12	SHB-11	ASH-1	152.4	Ductile Iron
P-57	290.02	ASH-1	ASH-2	300.0	PVC
P-58	90.80	ASH-2	ASH-3	200.0	PVC
P-59	161.27	ASH-3	ASH-4	200.0	PVC
P-60	35.42	ASH-4	ASH-5	50.0	PVC
P-61	35.69	ASH-5	ASH-4	50.0	PVC
P-62	191.63	ASH-3	ASH-6	200.0	PVC
P-63	77.52	ASH-6	ASH-7	200.0	PVC
P-64	126.30	ASH-7	ASH-3	200.0	PVC
P-65	92.10	ASH-7	ASH-8	200.0	PVC
P-66	62.23	ASH-8	ASH-9	300.0	PVC
P-67	256.68	ASH-9	ASH-2	200.0	PVC

FlexTable: Pipe Table

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
P-68	75.24	ASH-2	ASH-9	300.0	PVC
P-69	77.14	ASH-8	ASH-10	300.0	PVC
P-71	38.60	ASH-11	ASH-12	50.0	PVC
P-72	30.24	ASH-12	ASH-11	50.0	PVC
P-74	89.14	ASH-13	ASH-14	200.0	PVC
P-75	73.75	ASH-14	ASH-15	200.0	PVC
P-76	39.78	ASH-15	ASH-16	50.0	PVC
P-77	34.63	ASH-16	ASH-15	50.0	PVC
P-79	88.98	NSH-17	NSH-18	200.0	PVC
P-80	26.04	NSH-18	NSH-19	50.0	PVC
P-81	41.98	NSH-19	NSH-18	50.0	PVC
P-82	106.05	NSH-17	NSH-20	200.0	PVC
P-83	121.54	NSH-20	NSH-21	300.0	PVC
P-85	140.98	NSH-21	NSH-22	200.0	PVC
P-86	58.66	NSH-22	NSH-23	200.0	PVC
P-87	38.89	NSH-23	NSH-24	50.0	PVC
P-88	30.71	NSH-24	NSH-23	50.0	PVC
P-89	184.60	NSH-22	NSH-25	200.0	PVC
P-90	130.80	NSH-25	NSH-20	300.0	PVC
P-94	33.55	NSH-28	NSH-29	50.0	PVC
P-95	39.75	NSH-29	NSH-28	50.0	Copper
P-93(1)	89.11	NSH-27	NSH-30	200.0	PVC
P-93(2)	214.13	NSH-30	NSH-28	200.0	PVC
P-97	90.13	NSH-31	NSH-32	200.0	PVC
P-98	163.52	NSH-32	NSH-27	300.0	PVC
P-99	182.26	NSH-32	NSH-33	300.0	PVC
P-100	210.66	NSH-33	NSH-31	200.0	PVC
P-103	86.27	NSH-34	NSH-35	200.0	PVC
P-104	39.72	NSH-35	NSH-36	50.0	PVC
P-105	27.00	NSH-36	NSH-35	50.0	PVC
P-106	78.53	NSH-34	NSH-37	300.0	PVC
P-107	267.07	NSH-37	NSH-38	200.0	PVC
P-108	78.71	NSH-38	NSH-37	300.0	PVC
P-92(1)	86.55	NSH-26	NSH-40	300.0	PVC
P-92(2)	141.71	NSH-40	NSH-27	300.0	PVC
P-110	127.87	NSH-40	NSH-41	200.0	PVC
P-111	65.80	ASH-6	ASH-43	152.4	Ductile Iron
P-70(1)	189.33	ASH-10	ASH-44	200.0	PVC
P-70(2)	47.58	ASH-44	ASH-11	200.0	PVC
P-78(2)	130.62	NSH-45	NSH-17	200.0	PVC
P-91(1)	76.82	NSH-25	NSH-46	300.0	PVC
P-91(2)	286.71	NSH-46	NSH-26	300.0	PVC
P-96(1)	203.91	NSH-30	NSH-47	200.0	PVC
P-96(2)	59.88	NSH-47	NSH-31	200.0	PVC
P-101(2)	170.77	NSH-48	SHD-14	300.0	PVC
P-109(1)	177.52	NSH-38	NSH-49	300.0	PVC
P-109(2)	144.16	NSH-49	NSH-39	300.0	PVC
P-112	40.37	Newmarket West Reservoir	NSH-39	600.0	PVC

FlexTable: Pipe Table

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
P-78(1)(1)	85.14	ASH-14	PRV-3	200.0	PVC
P-78(1)(2)	250.82	PRV-3	NSH-45	200.0	PVC
P-84(1)	62.10	NSH-21	PRV-5	300.0	PVC
P-84(2)	8.26	PRV-5	ASH-13	300.0	PVC
P-113	77.17	ASH-10	ASH-13	300.0	PVC
P-114	384.76	NSH-33	NSH-48	300.0	PVC
P-102(1)	131.13	NSH-26	PRV-7	300.0	PVC
P-102(2)	371.01	PRV-7	NSH-34	300.0	PVC

Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss (m)
110.0	-37.15	1.18	0.66
110.0	-62.23	1.98	1.71
110.0	-59.73	1.90	2.08
110.0	31.98	1.02	0.49
110.0	2.68	0.09	0.01
110.0	0.23	0.01	0.00
100.0	0.04	0.02	0.00
100.0	-0.05	0.02	0.00
110.0	-81.11	2.58	0.70
110.0	28.09	0.89	0.37
110.0	28.09	0.89	0.22
110.0	-28.96	0.92	0.34
110.0	27.47	0.87	0.44
110.0	-28.96	0.92	0.21
110.0	24.94	0.79	0.42
110.0	81.37	2.59	1.09
110.0	56.43	1.80	1.59
120.0	-60.04	0.85	0.45
110.0	60.36	1.92	2.04
100.0	0.31	0.02	0.00
100.0	0.27	0.02	0.00
100.0	0.18	0.01	0.00
110.0	0.89	0.03	0.00
110.0	0.14	0.00	0.00
110.0	0.63	0.02	0.00
100.0	0.12	0.01	0.00
100.0	-0.02	0.00	0.00
110.0	0.12	0.00	0.00
110.0	-0.35	0.01	0.00
110.0	0.85	0.03	0.00
110.0	-1.33	0.04	0.00
110.0	-1.52	0.05	0.00
110.0	-1.52	0.05	0.00
110.0	0.00	0.00	0.00
110.0	0.00	0.00	0.00
110.0	-4.93	0.16	0.04
100.0	-4.93	0.28	0.49
130.0	4.93	0.27	0.29
120.0	4.93	0.07	0.01

FlexTable: Pipe Table

Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss (m)
110.0	1.03	0.03	0.00
110.0	0.17	0.01	0.00
100.0	0.03	0.01	0.00
100.0	-0.02	0.01	0.00
110.0	0.22	0.01	0.00
110.0	-0.21	0.01	0.00
110.0	-0.21	0.01	0.00
110.0	-0.29	0.01	0.00
120.0	-2.58	0.04	0.00
110.0	-0.43	0.01	0.00
120.0	2.61	0.04	0.00
120.0	2.18	0.03	0.00
100.0	0.02	0.01	0.00
100.0	-0.03	0.01	0.00
110.0	0.80	0.03	0.00
110.0	0.18	0.01	0.00
100.0	0.02	0.01	0.00
100.0	-0.02	0.01	0.00
110.0	0.25	0.01	0.00
100.0	0.00	0.00	0.00
100.0	0.00	0.00	0.00
110.0	-0.99	0.03	0.00
120.0	0.29	0.00	0.00
110.0	-0.13	0.00	0.00
110.0	0.06	0.00	0.00
100.0	0.00	0.00	0.00
100.0	0.00	0.00	0.00
110.0	-0.42	0.01	0.00
120.0	1.62	0.02	0.00
100.0	0.03	0.02	0.00
100.0	-0.03	0.01	0.00
110.0	24.47	0.78	0.41
110.0	0.26	0.01	0.00
110.0	-6.16	0.20	0.03
120.0	-104.15	1.47	1.31
120.0	93.76	1.33	1.21
110.0	-26.96	0.86	1.17
110.0	0.10	0.00	0.00
100.0	0.03	0.01	0.00
100.0	-0.03	0.02	0.00
120.0	-134.85	1.91	1.02
110.0	-18.95	0.60	0.77
120.0	116.14	1.64	0.77
120.0	128.84	1.82	1.03
120.0	128.72	1.82	1.69
110.0	0.06	0.00	0.00
130.0	0.19	0.01	0.00
110.0	0.46	0.01	0.00
110.0	0.12	0.00	0.00

FlexTable: Pipe Table

Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss (m)
110.0	-0.53	0.02	0.00
120.0	-2.25	0.03	0.00
120.0	-2.25	0.03	0.00
110.0	21.14	0.67	0.72
110.0	20.89	0.67	0.21
120.0	120.40	1.70	1.80
120.0	-135.22	1.91	2.31
120.0	-138.77	1.96	1.97
130.0	138.77	0.49	0.02
110.0	0.00	0.00	0.00
110.0	0.00	0.00	0.00
120.0	0.00	0.00	0.00
120.0	0.00	0.00	0.00
120.0	0.93	0.01	0.00
120.0	120.40	1.70	4.04
120.0	-134.34	1.90	1.69
120.0	-134.34	1.90	4.78

FlexTable: Junction Table

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
285	NSH-49	314.03	2.49	337.04	225.2
259	NSH-39	313.15	0.00	338.88	251.9
150	SHB-12	307.17	0.12	333.02	253.0
256	NSH-38	302.85	0.09	334.84	313.1
125	SHB-1	299.45	0.11	333.02	328.5
126	SHB-2	298.90	0.02	333.02	333.9
273	NSH-45	283.69	0.35	318.40	339.7
254	NSH-37	297.34	0.17	334.11	359.8
208	NSH-19	280.89	0.00	318.41	367.2
128	SHB-3	295.45	0.06	333.02	367.7
251	NSH-36	295.08	0.04	333.14	372.5
249	NSH-35	294.08	0.03	333.14	382.3
206	NSH-18	279.12	0.18	318.41	384.5
69	SHD-1	261.49	0.18	301.50	391.6
130	SHB-4	292.76	0.09	333.02	394.0
247	NSH-34	291.88	0.29	333.14	403.8
105	SHD-13	261.30	0.00	302.61	404.3
204	NSH-17	276.85	0.15	318.41	406.7
276	NSH-46	275.29	0.00	318.41	422.0
67	SHD-2	259.60	0.09	303.03	425.1
223	NSH-25	274.94	0.15	318.41	425.4
134	SHB-6	289.05	0.09	333.02	430.3
211	NSH-20	273.89	0.24	318.41	435.7
240	NSH-32	268.71	2.96	314.46	447.8
226	NSH-26	272.64	2.28	318.41	447.9
261	NSH-40	271.56	0.04	317.40	448.7
228	NSH-27	269.84	0.07	315.76	449.4
102	SHD-12	258.25	0.00	304.23	450.0
132	SHB-5	287.00	0.08	333.02	450.4
78	SHD-5	258.25	0.27	304.68	454.4
71	SHD-3	258.20	0.13	304.78	455.9
279	NSH-47	267.84	0.18	314.64	458.1
96	SHD-10	257.60	0.00	304.45	458.5
93	SHD-11	257.90	0.00	304.91	460.1
84	SHD-6	257.58	0.10	304.68	461.0
238	NSH-31	267.32	0.07	314.43	461.1
80	SHD-4	257.51	0.24	304.79	462.7
264	NSH-41	270.01	0.04	317.40	463.8
86	SHD-7	257.13	0.06	304.68	465.4
75	SHD-8	257.65	0.20	305.28	466.2
216	NSH-22	270.30	0.16	318.41	470.8
235	NSH-30	267.13	2.15	315.37	472.1
220	NSH-24	269.57	0.00	318.41	477.9
213	NSH-21	269.39	0.27	318.41	479.7
218	NSH-23	269.36	0.04	318.41	480.0
109	SHD-14	258.01	0.00	307.34	482.8
243	NSH-33	263.59	0.22	313.25	486.0
230	NSH-28	264.45	0.14	315.37	498.4
232	NSH-29	264.00	0.04	315.37	502.8

FlexTable: Junction Table

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
138	SHB-8	281.36	0.09	333.02	505.6
136	SHB-7	281.17	0.10	333.02	507.4
162	SHB-13	280.60	0.00	332.80	510.9
73	SHD-9	253.65	0.21	306.89	521.1
282	NSH-48	252.91	0.00	309.16	550.5
140	SHB-9	276.09	0.13	333.02	557.1
201	ASH-16	272.84	0.02	332.65	585.3
199	ASH-15	271.62	0.09	332.65	597.3
197	ASH-14	270.02	0.40	332.65	612.9
144	SHB-11	269.50	0.00	332.78	619.3
270	ASH-44	269.13	0.22	332.65	621.7
195	ASH-13	268.99	0.08	332.65	623.0
142	SHB-10	269.12	0.08	333.02	625.4
177	ASH-6	268.55	0.16	332.65	627.3
188	ASH-10	268.54	0.51	332.65	627.4
190	ASH-11	268.32	0.05	332.65	629.6
192	ASH-12	268.19	0.04	332.65	630.8
179	ASH-7	268.14	0.19	332.65	631.3
182	ASH-8	267.60	0.07	332.65	636.6
184	ASH-9	267.57	0.30	332.65	636.9
170	ASH-3	267.23	0.28	332.65	640.3
168	ASH-2	267.07	0.56	332.65	641.8
268	ASH-43	267.03	0.12	332.65	642.2
174	ASH-5	264.88	0.04	332.65	663.2
172	ASH-4	264.55	0.08	332.65	666.5
166	ASH-1	261.86	0.00	332.65	692.8

FlexTable: Pipe Table

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
P-15	65.24	SHDR-1	SHD-2	200.0	PVC
P-17	65.29	SHD-2	SHD-3	200.0	PVC
P-18	85.72	SHD-3	SHD-9	200.0	PVC
P-22	63.55	SHD-8	SHD-4	200.0	PVC
P-23	128.63	SHD-4	SHD-3	200.0	PVC
P-25	47.20	SHD-5	SHD-6	200.0	PVC
P-26	47.99	SHD-6	SHD-7	50.0	Copper
P-27	41.94	SHD-7	SHD-6	50.0	Copper
P-28	16.38	SHDR-2	SHD-1	200.0	PVC
P-29	61.95	SHD-8	SHD-11	200.0	PVC
P-30	37.29	SHD-11	SHD-5	200.0	PVC
P-32	53.47	SHD-10	SHD-4	200.0	PVC
P-33	76.50	SHD-5	SHD-12	200.0	PVC
P-34	33.34	SHD-12	SHD-10	200.0	PVC
P-35	87.58	SHD-2	SHD-13	200.0	PVC
P-36	25.40	SHD-13	SHD-1	200.0	PVC
P-37	72.78	SHD-12	SHD-13	200.0	PVC
P-38	154.67	SHD-9	SHD-14	300.0	PVC
P-39	82.15	SHD-14	SHD-8	200.0	PVC
P-42	64.24	SHB-1	SHB-2	150.0	PVC
P-43	60.86	SHB-2	SHB-3	150.0	PVC
P-44	87.29	SHB-3	SHB-4	150.0	PVC
P-45	87.63	SHB-4	SHB-5	200.0	PVC
P-46	109.24	SHB-5	SHB-6	200.0	PVC
P-47	93.67	SHB-5	SHB-7	200.0	PVC
P-48	125.62	SHB-7	SHB-8	150.0	PVC
P-49	179.50	SHB-8	SHB-9	150.0	PVC
P-50	190.52	SHB-9	SHB-10	200.0	PVC
P-52	81.10	SHB-9	SHB-7	200.0	PVC
P-53	103.66	SHB-1	SHB-4	200.0	PVC
P-54	138.85	SHB-1	SHB-12	200.0	PVC
P-55(1)	17.87	SHB-12	PRV-1	200.0	PVC
P-55(2)	20.83	PRV-1	R-9	200.0	PVC
P-51(1)	31.94	SHB-10	PRV-2	200.0	PVC
P-51(2)	18.61	PRV-2	SHB-11	200.0	PVC
P-41(2)(1)(1)	161.01	SHB-11	SHB-13	200.0	PVC
P-41(2)(1)(2)	419.84	SHB-13	R-9	150.0	PVC
P-56	432.12	SHB-11	ASH-1	152.4	Ductile Iron
P-57	290.02	ASH-1	ASH-2	300.0	PVC
P-58	90.80	ASH-2	ASH-3	200.0	PVC
P-59	161.27	ASH-3	ASH-4	200.0	PVC
P-60	35.42	ASH-4	ASH-5	50.0	PVC
P-61	35.69	ASH-5	ASH-4	50.0	PVC
P-62	191.63	ASH-3	ASH-6	200.0	PVC
P-63	77.52	ASH-6	ASH-7	200.0	PVC
P-64	126.30	ASH-7	ASH-3	200.0	PVC
P-65	92.10	ASH-7	ASH-8	200.0	PVC
P-66	62.23	ASH-8	ASH-9	300.0	PVC
P-67	256.68	ASH-9	ASH-2	200.0	PVC

FlexTable: Pipe Table

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
P-68	75.24	ASH-2	ASH-9	300.0	PVC
P-69	77.14	ASH-8	ASH-10	300.0	PVC
P-71	38.60	ASH-11	ASH-12	50.0	PVC
P-72	30.24	ASH-12	ASH-11	50.0	PVC
P-74	89.14	ASH-13	ASH-14	200.0	PVC
P-75	73.75	ASH-14	ASH-15	200.0	PVC
P-76	39.78	ASH-15	ASH-16	50.0	PVC
P-77	34.63	ASH-16	ASH-15	50.0	PVC
P-79	88.98	NSH-17	NSH-18	200.0	PVC
P-80	26.04	NSH-18	NSH-19	50.0	PVC
P-81	41.98	NSH-19	NSH-18	50.0	PVC
P-82	106.05	NSH-17	NSH-20	200.0	PVC
P-83	121.54	NSH-20	NSH-21	300.0	PVC
P-85	140.98	NSH-21	NSH-22	200.0	PVC
P-86	58.66	NSH-22	NSH-23	200.0	PVC
P-87	38.89	NSH-23	NSH-24	50.0	PVC
P-88	30.71	NSH-24	NSH-23	50.0	PVC
P-89	184.60	NSH-22	NSH-25	200.0	PVC
P-90	130.80	NSH-25	NSH-20	300.0	PVC
P-94	33.55	NSH-28	NSH-29	50.0	PVC
P-95	39.75	NSH-29	NSH-28	50.0	Copper
P-93(1)	89.11	NSH-27	NSH-30	200.0	PVC
P-93(2)	214.13	NSH-30	NSH-28	200.0	PVC
P-97	90.13	NSH-31	NSH-32	200.0	PVC
P-98	163.52	NSH-32	NSH-27	300.0	PVC
P-99	182.26	NSH-32	NSH-33	300.0	PVC
P-100	210.66	NSH-33	NSH-31	200.0	PVC
P-103	86.27	NSH-34	NSH-35	200.0	PVC
P-104	39.72	NSH-35	NSH-36	50.0	PVC
P-105	27.00	NSH-36	NSH-35	50.0	PVC
P-106	78.53	NSH-34	NSH-37	300.0	PVC
P-107	267.07	NSH-37	NSH-38	200.0	PVC
P-108	78.71	NSH-38	NSH-37	300.0	PVC
P-92(1)	86.55	NSH-26	NSH-40	300.0	PVC
P-92(2)	141.71	NSH-40	NSH-27	300.0	PVC
P-110	127.87	NSH-40	NSH-41	200.0	PVC
P-111	65.80	ASH-6	ASH-43	152.4	Ductile Iron
P-70(1)	189.33	ASH-10	ASH-44	200.0	PVC
P-70(2)	47.58	ASH-44	ASH-11	200.0	PVC
P-78(2)	130.62	NSH-45	NSH-17	200.0	PVC
P-91(1)	76.82	NSH-25	NSH-46	300.0	PVC
P-91(2)	286.71	NSH-46	NSH-26	300.0	PVC
P-96(1)	203.91	NSH-30	NSH-47	200.0	PVC
P-96(2)	59.88	NSH-47	NSH-31	200.0	PVC
P-101(2)	170.77	NSH-48	SHD-14	300.0	PVC
P-109(1)	177.52	NSH-38	NSH-49	300.0	PVC
P-109(2)	144.16	NSH-49	NSH-39	300.0	PVC
P-112	40.37	Newmarket West Reservoir	NSH-39	600.0	PVC

FlexTable: Pipe Table

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
P-78(1)(1)	85.14	ASH-14	PRV-3	200.0	PVC
P-78(1)(2)	250.82	PRV-3	NSH-45	200.0	PVC
P-84(1)	62.10	NSH-21	PRV-5	300.0	PVC
P-84(2)	8.26	PRV-5	ASH-13	300.0	PVC
P-113	77.17	ASH-10	ASH-13	300.0	PVC
P-114	384.76	NSH-33	NSH-48	300.0	PVC
P-102(1)	131.13	NSH-26	PRV-7	300.0	PVC
P-102(2)	371.01	PRV-7	NSH-34	300.0	PVC

Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss (m)
110.0	-37.89	1.21	0.68
110.0	-62.92	2.00	1.75
110.0	-60.17	1.92	2.11
110.0	32.29	1.03	0.49
110.0	2.88	0.09	0.01
110.0	0.16	0.01	0.00
100.0	0.03	0.01	0.00
100.0	-0.03	0.02	0.00
110.0	-81.75	2.60	0.71
110.0	28.25	0.90	0.38
110.0	28.25	0.90	0.23
110.0	-29.17	0.93	0.34
110.0	27.82	0.89	0.45
110.0	-29.17	0.93	0.21
110.0	24.94	0.79	0.42
110.0	81.93	2.61	1.11
110.0	56.99	1.81	1.62
120.0	-60.38	0.85	0.45
110.0	60.74	1.93	2.06
100.0	0.19	0.01	0.00
100.0	0.17	0.01	0.00
100.0	0.11	0.01	0.00
110.0	0.57	0.02	0.00
110.0	0.09	0.00	0.00
110.0	0.40	0.01	0.00
100.0	0.08	0.00	0.00
100.0	-0.01	0.00	0.00
110.0	0.08	0.00	0.00
110.0	-0.22	0.01	0.00
110.0	0.55	0.02	0.00
110.0	-0.85	0.03	0.00
110.0	-0.97	0.03	0.00
110.0	-0.97	0.03	0.00
110.0	0.00	0.00	0.00
110.0	0.00	0.00	0.00
110.0	-3.21	0.10	0.02
100.0	-3.21	0.18	0.22
130.0	3.21	0.18	0.13
120.0	3.21	0.05	0.00

FlexTable: Pipe Table

Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss (m)
110.0	0.68	0.02	0.00
110.0	0.12	0.00	0.00
100.0	0.02	0.01	0.00
100.0	-0.02	0.01	0.00
110.0	0.14	0.00	0.00
110.0	-0.14	0.00	0.00
110.0	-0.14	0.00	0.00
110.0	-0.19	0.01	0.00
120.0	-1.67	0.02	0.00
110.0	-0.32	0.01	0.00
120.0	1.66	0.02	0.00
120.0	1.41	0.02	0.00
100.0	0.02	0.01	0.00
100.0	-0.02	0.01	0.00
110.0	0.51	0.02	0.00
110.0	0.11	0.00	0.00
100.0	0.01	0.00	0.00
100.0	-0.01	0.01	0.00
110.0	0.18	0.01	0.00
100.0	0.00	0.00	0.00
100.0	0.00	0.00	0.00
110.0	-0.68	0.02	0.00
120.0	0.18	0.00	0.00
110.0	-0.09	0.00	0.00
110.0	0.04	0.00	0.00
100.0	0.00	0.00	0.00
100.0	0.00	0.00	0.00
110.0	-0.29	0.01	0.00
120.0	1.10	0.02	0.00
100.0	0.02	0.01	0.00
100.0	-0.02	0.01	0.00
110.0	23.56	0.75	0.39
110.0	0.18	0.01	0.00
110.0	-6.12	0.19	0.03
120.0	-103.32	1.46	1.29
120.0	94.24	1.33	1.22
110.0	-27.10	0.86	1.18
110.0	0.07	0.00	0.00
100.0	0.02	0.01	0.00
100.0	-0.02	0.01	0.00
120.0	-131.21	1.86	0.97
110.0	-18.43	0.59	0.74
120.0	112.95	1.60	0.74
120.0	127.03	1.80	1.00
120.0	126.95	1.80	1.64
110.0	0.04	0.00	0.00
130.0	0.12	0.01	0.00
110.0	0.31	0.01	0.00
110.0	0.09	0.00	0.00

FlexTable: Pipe Table

Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss (m)
110.0	-0.35	0.01	0.00
120.0	-1.54	0.02	0.00
120.0	-1.54	0.02	0.00
110.0	21.23	0.68	0.73
110.0	21.05	0.67	0.21
120.0	121.12	1.71	1.81
120.0	-131.47	1.86	2.20
120.0	-133.96	1.90	1.85
130.0	133.96	0.47	0.02
110.0	0.00	0.00	0.00
110.0	0.00	0.00	0.00
120.0	0.00	0.00	0.00
120.0	0.00	0.00	0.00
120.0	0.59	0.01	0.00
120.0	121.12	1.71	4.09
120.0	-130.85	1.85	1.61
120.0	-130.85	1.85	4.55

Fire Flow Node FlexTable: Fire Flow Report

Label	Satisfies Fire Flow Constraints?	Fire Flow (Needed) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Residual Lower Limit) (kPa)
NSH-49	True	166.00	173.10	174.10	0.0
NSH-45	True	100.00	100.96	101.96	0.0
NSH-18	True	100.00	100.51	101.51	0.0
NSH-35	True	100.00	100.08	101.08	0.0
NSH-38	True	100.00	100.26	101.26	0.0
NSH-39	True	100.00	100.00	101.00	0.0
SHB-6	True	100.00	100.25	101.25	0.0
SHB-8	True	100.00	100.25	101.25	0.0
ASH-11	True	100.00	100.13	101.13	0.0
NSH-37	True	100.00	100.48	101.48	0.0
SHB-1	True	100.00	100.31	101.31	0.0
NSH-28	True	100.00	100.40	101.40	0.0
SHB-12	True	100.00	100.34	101.34	0.0
ASH-44	True	100.00	100.62	101.62	0.0
NSH-26	True	250.00	256.50	257.50	0.0
NSH-34	True	100.00	100.83	101.83	0.0
NSH-17	True	100.00	100.42	101.42	0.0
ASH-15	True	100.00	100.25	101.25	0.0
SHB-4	True	100.00	100.25	101.25	0.0
ASH-4	True	100.00	100.22	101.22	0.0
NSH-41	True	100.00	100.11	101.11	0.0
SHB-11	True	100.00	100.00	101.00	0.0
NSH-36	True	0.50	0.61	1.11	0.0
ASH-43	True	100.00	100.34	101.34	0.0
SHB-5	True	100.00	100.22	101.22	0.0
NSH-23	True	100.00	100.11	101.11	0.0
NSH-46	True	100.00	100.00	101.00	0.0
NSH-25	True	100.00	100.42	101.42	0.0
NSH-20	True	100.00	100.68	101.68	0.0
ASH-14	True	100.00	101.11	102.11	0.0
ASH-6	True	100.00	100.44	101.44	0.0
NSH-47	True	100.00	100.51	101.51	0.0
NSH-22	True	100.00	100.45	101.45	0.0
NSH-30	True	100.00	106.14	107.14	0.0
NSH-32	True	100.00	108.46	109.46	0.0
SHB-7	True	100.00	100.28	101.28	0.0
NSH-27	True	100.00	100.19	101.19	0.0
NSH-31	True	100.00	100.19	101.19	0.0
SHB-2	True	0.50	0.57	1.07	0.0
NSH-40	True	100.00	100.13	101.13	0.0
ASH-7	True	100.00	100.53	101.53	0.0
ASH-3	True	100.00	100.77	101.77	0.0
SHD-6	True	100.00	100.28	101.28	0.0
NSH-21	True	100.00	100.75	101.75	0.0
SHD-1	True	100.00	100.51	101.51	0.0
ASH-13	True	100.00	100.23	101.23	0.0
SHD-13	True	100.00	100.00	101.00	0.0

Fire Flow Node FlexTable: Fire Flow Report

Label	Satisfies Fire Flow Constraints?	Fire Flow (Needed) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Residual Lower Limit) (kPa)
ASH-10	True	100.00	101.42	102.42	0.0
NSH-19	True	0.50	0.50	1.00	0.0
ASH-9	True	100.00	100.82	101.82	0.0
ASH-8	True	100.00	100.20	101.20	0.0
ASH-2	True	100.00	101.55	102.55	0.0
SHB-3	True	0.50	0.65	1.15	0.0
NSH-33	True	100.00	100.64	101.64	0.0
SHB-9	True	100.00	100.37	101.37	0.0
SHD-5	True	100.00	100.77	101.77	0.0
SHD-2	True	100.00	100.27	101.27	0.0
SHD-11	True	100.00	100.00	101.00	0.0
SHD-12	True	100.00	100.00	101.00	0.0
SHD-10	True	100.00	100.00	101.00	0.0
SHD-3	True	100.00	100.37	101.37	0.0
SHD-4	True	100.00	100.68	101.68	0.0
SHD-8	True	100.00	100.58	101.58	0.0
SHB-13	True	0.50	0.50	1.00	0.0
SHD-14	True	100.00	100.00	101.00	0.0
ASH-1	True	100.00	100.00	101.00	0.0
SHD-7	True	0.50	0.68	1.18	0.0
SHB-10	True	100.00	100.22	101.22	0.0
ASH-16	True	0.50	0.57	1.07	0.0
SHD-9	True	100.00	100.61	101.61	0.0
NSH-48	True	100.00	100.00	101.00	0.0
NSH-24	True	0.50	0.50	1.00	0.0
NSH-29	True	0.50	0.61	1.11	0.0
ASH-12	True	0.50	0.60	1.10	0.0
ASH-5	True	0.50	0.60	1.10	0.0

Pressure (Calculated Residual @ Total Flow Needed) (kPa)	Pressure (Calculated Residual) (kPa)
87.1	86.7
159.5	157.1
167.5	164.5
167.7	165.9
170.3	169.6
175.2	175.2
202.9	200.1
208.0	204.2
210.1	205.9
208.5	207.8
213.9	211.8
222.6	218.9
227.9	227.4
231.7	228.0
241.4	241.1

Fire Flow Node FlexTable: Fire Flow Report

Pressure (Calculated Residual @ Total Flow Needed) (kPa)	Pressure (Calculated Residual) (kPa)
242.7	241.9
245.2	243.2
253.3	250.4
255.3	254.0
272.9	269.1
272.6	270.2
273.9	270.3
286.3	285.0
291.4	288.4
290.7	289.2
293.3	290.8
303.0	301.8
303.4	302.1
309.8	308.4
314.7	312.8
317.4	315.1
319.7	318.5
320.4	318.6
329.9	328.6
330.4	329.6
332.0	330.5
332.8	331.9
334.5	333.5
333.7	333.7
336.6	335.7
338.1	336.1
346.9	344.9
351.4	350.4
352.1	350.7
351.7	351.7
354.4	352.9
354.0	354.0
356.3	354.8
358.1	356.8
362.0	360.4
363.2	361.6
366.1	364.5
367.5	367.4
371.2	370.5
375.1	373.6
374.3	373.8
375.1	375.0
378.6	378.1
383.6	383.4
387.2	386.9
389.7	389.6

Fire Flow Node FlexTable: Fire Flow Report

Pressure (Calculated Residual @ Total Flow Needed) (kPa)	Pressure (Calculated Residual) (kPa)
391.1	390.9
391.8	391.6
397.3	396.1
398.2	397.9
410.1	408.3
430.2	428.6
436.0	434.8
437.0	435.4
436.1	435.9
454.0	453.5
468.9	467.5
482.5	480.8
482.9	481.3
515.8	514.2

FlexTable: Junction Table

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
285	NSH-49	314.03	7.10	328.85	145.1
259	NSH-39	313.15	0.00	331.08	175.5
256	NSH-38	302.85	0.26	326.34	229.9
150	SHB-12	307.17	0.34	333.02	253.0
254	NSH-37	297.34	0.48	325.51	275.7
251	NSH-36	295.08	0.11	324.41	287.0
249	NSH-35	294.08	0.08	324.41	296.8
247	NSH-34	291.88	0.83	324.41	318.4
125	SHB-1	299.45	0.31	333.01	328.4
273	NSH-45	283.69	0.96	317.57	331.6
126	SHB-2	298.90	0.07	333.01	333.8
69	SHD-1	261.49	0.51	298.08	358.1
208	NSH-19	280.89	0.00	317.57	359.0
128	SHB-3	295.45	0.15	333.01	367.6
105	SHD-13	261.30	0.00	299.03	369.2
206	NSH-18	279.12	0.51	317.57	376.3
67	SHD-2	259.60	0.27	299.24	387.9
130	SHB-4	292.76	0.25	333.01	393.9
204	NSH-17	276.85	0.42	317.57	398.5
162	SHB-13	280.60	0.00	321.33	398.6
276	NSH-46	275.29	0.00	317.54	413.5
102	SHD-12	258.25	0.00	300.72	415.7
223	NSH-25	274.94	0.42	317.55	417.0
78	SHD-5	258.25	0.77	301.20	420.3
71	SHD-3	258.20	0.37	301.28	421.6
96	SHD-10	257.60	0.00	300.95	424.2
93	SHD-11	257.90	0.00	301.45	426.2
84	SHD-6	257.58	0.28	301.20	426.9
240	NSH-32	268.71	8.46	312.37	427.3
211	NSH-20	273.89	0.68	317.57	427.5
80	SHD-4	257.51	0.68	301.30	428.6
134	SHB-6	289.05	0.25	333.00	430.2
86	SHD-7	257.13	0.18	301.19	431.2
228	NSH-27	269.84	0.19	314.01	432.2
75	SHD-8	257.65	0.58	301.87	432.7
261	NSH-40	271.56	0.13	316.16	436.5
279	NSH-47	267.84	0.51	312.57	437.8
201	ASH-16	272.84	0.07	317.59	438.0
226	NSH-26	272.64	6.50	317.48	438.8
238	NSH-31	267.32	0.19	312.33	440.5
199	ASH-15	271.62	0.25	317.59	449.9
132	SHB-5	287.00	0.22	333.00	450.2
264	NSH-41	270.01	0.11	316.16	451.7
109	SHD-14	258.01	0.00	304.21	452.1
235	NSH-30	267.13	6.14	313.41	453.0
216	NSH-22	270.30	0.45	317.57	462.6
243	NSH-33	263.59	0.64	310.97	463.7
197	ASH-14	270.02	1.11	317.59	465.6
220	NSH-24	269.57	0.00	317.57	469.8

FlexTable: Junction Table

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
213	NSH-21	269.39	0.75	317.59	471.7
218	NSH-23	269.36	0.11	317.57	471.8
270	ASH-44	269.13	0.62	317.63	474.7
195	ASH-13	268.99	0.23	317.61	475.8
230	NSH-28	264.45	0.40	313.41	479.2
188	ASH-10	268.54	1.42	317.64	480.5
177	ASH-6	268.55	0.44	317.68	480.9
190	ASH-11	268.32	0.13	317.63	482.6
232	NSH-29	264.00	0.11	313.41	483.6
192	ASH-12	268.19	0.10	317.63	483.9
179	ASH-7	268.14	0.53	317.68	484.9
73	SHD-9	253.65	0.61	303.69	489.7
182	ASH-8	267.60	0.20	317.67	490.1
184	ASH-9	267.57	0.82	317.70	490.6
170	ASH-3	267.23	0.77	317.69	493.9
168	ASH-2	267.07	1.55	317.72	495.7
268	ASH-43	267.03	0.34	317.68	495.7
144	SHB-11	269.50	0.00	320.40	498.1
138	SHB-8	281.36	0.25	333.00	505.4
136	SHB-7	281.17	0.28	333.00	507.3
174	ASH-5	264.88	0.10	317.69	516.8
172	ASH-4	264.55	0.22	317.69	520.1
282	NSH-48	252.91	0.00	306.29	522.4
166	ASH-1	261.86	0.00	317.91	548.6
140	SHB-9	276.09	0.37	333.00	557.0
142	SHB-10	269.12	0.22	333.00	625.2

FlexTable: Pipe Table

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
P-15	65.24	SHDR-1	SHD-2	200.0	PVC
P-17	65.29	SHD-2	SHD-3	200.0	PVC
P-18	85.72	SHD-3	SHD-9	200.0	PVC
P-22	63.55	SHD-8	SHD-4	200.0	PVC
P-23	128.63	SHD-4	SHD-3	200.0	PVC
P-25	47.20	SHD-5	SHD-6	200.0	PVC
P-26	47.99	SHD-6	SHD-7	50.0	Copper
P-27	41.94	SHD-7	SHD-6	50.0	Copper
P-28	16.38	SHDR-2	SHD-1	200.0	PVC
P-29	61.95	SHD-8	SHD-11	200.0	PVC
P-30	37.29	SHD-11	SHD-5	200.0	PVC
P-32	53.47	SHD-10	SHD-4	200.0	PVC
P-33	76.50	SHD-5	SHD-12	200.0	PVC
P-34	33.34	SHD-12	SHD-10	200.0	PVC
P-35	87.58	SHD-2	SHD-13	200.0	PVC
P-36	25.40	SHD-13	SHD-1	200.0	PVC
P-37	72.78	SHD-12	SHD-13	200.0	PVC
P-38	154.67	SHD-9	SHD-14	300.0	PVC
P-39	82.15	SHD-14	SHD-8	200.0	PVC
P-42	64.24	SHB-1	SHB-2	150.0	PVC
P-43	60.86	SHB-2	SHB-3	150.0	PVC
P-44	87.29	SHB-3	SHB-4	150.0	PVC
P-45	87.63	SHB-4	SHB-5	200.0	PVC
P-46	109.24	SHB-5	SHB-6	200.0	PVC
P-47	93.67	SHB-5	SHB-7	200.0	PVC
P-48	125.62	SHB-7	SHB-8	150.0	PVC
P-49	179.50	SHB-8	SHB-9	150.0	PVC
P-50	190.52	SHB-9	SHB-10	200.0	PVC
P-52	81.10	SHB-9	SHB-7	200.0	PVC
P-53	103.66	SHB-1	SHB-4	200.0	PVC
P-54	138.85	SHB-1	SHB-12	200.0	PVC
P-55(1)	17.87	SHB-12	PRV-1	200.0	PVC
P-55(2)	20.83	PRV-1	R-9	200.0	PVC
P-51(1)	31.94	SHB-10	PRV-2	200.0	PVC
P-51(2)	18.61	PRV-2	SHB-11	200.0	PVC
P-41(2)(1)(1)	161.01	SHB-11	SHB-13	200.0	PVC
P-41(2)(1)(2)	419.84	SHB-13	R-9	150.0	PVC
P-56	432.12	SHB-11	ASH-1	200.0	PVC
P-57	290.02	ASH-1	ASH-2	300.0	PVC
P-58	90.80	ASH-2	ASH-3	200.0	PVC
P-59	161.27	ASH-3	ASH-4	200.0	PVC
P-60	35.42	ASH-4	ASH-5	50.0	PVC
P-61	35.69	ASH-5	ASH-4	50.0	PVC
P-62	191.63	ASH-3	ASH-6	200.0	PVC
P-63	77.52	ASH-6	ASH-7	200.0	PVC
P-64	126.30	ASH-7	ASH-3	200.0	PVC
P-65	92.10	ASH-7	ASH-8	200.0	PVC
P-66	62.23	ASH-8	ASH-9	300.0	PVC
P-67	256.68	ASH-9	ASH-2	200.0	PVC

FlexTable: Pipe Table

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
P-68	75.24	ASH-2	ASH-9	300.0	PVC
P-69	77.14	ASH-8	ASH-10	300.0	PVC
P-71	38.60	ASH-11	ASH-12	50.0	PVC
P-72	30.24	ASH-12	ASH-11	50.0	PVC
P-74	89.14	ASH-13	ASH-14	200.0	PVC
P-75	73.75	ASH-14	ASH-15	200.0	PVC
P-76	39.78	ASH-15	ASH-16	50.0	PVC
P-77	34.63	ASH-16	ASH-15	50.0	PVC
P-79	88.98	NSH-17	NSH-18	200.0	PVC
P-80	26.04	NSH-18	NSH-19	50.0	PVC
P-81	41.98	NSH-19	NSH-18	50.0	PVC
P-82	106.05	NSH-17	NSH-20	200.0	PVC
P-83	121.54	NSH-20	NSH-21	300.0	PVC
P-85	140.98	NSH-21	NSH-22	200.0	PVC
P-86	58.66	NSH-22	NSH-23	200.0	PVC
P-87	38.89	NSH-23	NSH-24	50.0	PVC
P-88	30.71	NSH-24	NSH-23	50.0	PVC
P-89	184.60	NSH-22	NSH-25	200.0	PVC
P-90	130.80	NSH-25	NSH-20	300.0	PVC
P-94	33.55	NSH-28	NSH-29	50.0	PVC
P-95	39.75	NSH-29	NSH-28	50.0	PVC
P-93(1)	89.11	NSH-27	NSH-30	200.0	PVC
P-93(2)	214.13	NSH-30	NSH-28	200.0	PVC
P-97	90.13	NSH-31	NSH-32	200.0	PVC
P-98	163.52	NSH-32	NSH-27	300.0	PVC
P-99	182.26	NSH-32	NSH-33	300.0	PVC
P-100	210.66	NSH-33	NSH-31	200.0	PVC
P-103	86.27	NSH-34	NSH-35	200.0	PVC
P-104	39.72	NSH-35	NSH-36	50.0	PVC
P-105	27.00	NSH-36	NSH-35	50.0	PVC
P-106	78.53	NSH-34	NSH-37	300.0	PVC
P-107	267.07	NSH-37	NSH-38	200.0	PVC
P-108	78.71	NSH-38	NSH-37	300.0	PVC
P-92(1)	86.55	NSH-26	NSH-40	300.0	PVC
P-92(2)	141.71	NSH-40	NSH-27	300.0	PVC
P-110	127.87	NSH-40	NSH-41	200.0	PVC
P-111	65.80	ASH-6	ASH-43	200.0	PVC
P-70(1)	189.33	ASH-10	ASH-44	200.0	PVC
P-70(2)	47.58	ASH-44	ASH-11	200.0	PVC
P-78(2)	130.62	NSH-45	NSH-17	200.0	PVC
P-91(1)	76.82	NSH-25	NSH-46	300.0	PVC
P-91(2)	286.71	NSH-46	NSH-26	300.0	PVC
P-96(1)	203.91	NSH-30	NSH-47	200.0	PVC
P-96(2)	59.88	NSH-47	NSH-31	200.0	PVC
P-101(2)	170.77	NSH-48	SHD-14	300.0	PVC
P-109(1)	177.52	NSH-38	NSH-49	300.0	PVC
P-109(2)	144.16	NSH-49	NSH-39	300.0	PVC
P-112	40.37	Newmarket West Reservoir	NSH-39	600.0	Concrete

FlexTable: Pipe Table

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
P-78(1)(1)	85.14	ASH-14	PRV-3	200.0	PVC
P-78(1)(2)	250.82	PRV-3	NSH-45	200.0	PVC
P-84(1)	62.10	NSH-21	PRV-5	300.0	PVC
P-84(2)	8.26	PRV-5	ASH-13	300.0	PVC
P-113	77.17	ASH-10	ASH-13	300.0	PVC
P-114	384.76	NSH-33	NSH-48	300.0	PVC
P-102(1)	131.13	NSH-26	PRV-7	300.0	PVC
P-102(2)	371.01	PRV-7	NSH-34	300.0	PVC

Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss (m)
110.0	-51.10	1.63	1.19
110.0	-68.46	2.18	2.04
110.0	-64.59	2.06	2.41
110.0	34.67	1.10	0.56
110.0	4.24	0.14	0.02
110.0	0.46	0.01	0.00
100.0	0.09	0.04	0.01
100.0	-0.09	0.05	0.01
110.0	-74.96	2.39	0.61
110.0	29.86	0.95	0.42
110.0	29.86	0.95	0.25
110.0	-29.75	0.95	0.36
110.0	28.63	0.91	0.48
110.0	-29.75	0.95	0.22
110.0	17.09	0.54	0.21
110.0	75.47	2.40	0.95
110.0	58.38	1.86	1.70
120.0	-65.20	0.92	0.52
110.0	65.11	2.07	2.34
100.0	0.54	0.03	0.00
100.0	0.47	0.03	0.00
100.0	0.32	0.02	0.00
110.0	1.59	0.05	0.00
110.0	0.25	0.01	0.00
110.0	1.12	0.04	0.00
100.0	0.22	0.01	0.00
100.0	-0.03	0.00	0.00
110.0	0.22	0.01	0.00
110.0	-0.62	0.02	0.00
110.0	1.52	0.05	0.00
110.0	-2.37	0.08	0.01
110.0	-2.71	0.09	0.00
110.0	-2.71	0.09	0.00
110.0	0.00	0.00	0.00
110.0	0.00	0.00	0.00
110.0	-27.43	0.87	0.93
100.0	-27.43	1.55	11.69
110.0	27.43	0.87	2.48
120.0	27.43	0.39	0.20

FlexTable: Pipe Table

Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss (m)
110.0	5.51	0.18	0.03
110.0	0.32	0.01	0.00
100.0	0.05	0.03	0.00
100.0	-0.05	0.03	0.00
110.0	1.88	0.06	0.01
110.0	1.10	0.03	0.00
110.0	-2.54	0.08	0.01
110.0	3.11	0.10	0.01
120.0	-19.56	0.28	0.02
110.0	-2.85	0.09	0.02
120.0	17.52	0.25	0.02
120.0	22.46	0.32	0.04
100.0	0.05	0.02	0.00
100.0	-0.05	0.03	0.00
110.0	3.74	0.12	0.01
110.0	0.32	0.01	0.00
100.0	0.03	0.02	0.00
100.0	-0.04	0.02	0.00
110.0	0.51	0.02	0.00
100.0	0.00	0.00	0.00
100.0	0.00	0.00	0.00
110.0	0.42	0.01	0.00
120.0	-11.92	0.17	0.02
110.0	3.55	0.11	0.02
110.0	0.11	0.00	0.00
100.0	0.00	0.00	0.00
100.0	0.00	0.00	0.00
110.0	2.99	0.10	0.02
120.0	-11.66	0.16	0.02
100.0	0.06	0.03	0.00
100.0	-0.05	0.03	0.00
110.0	29.63	0.94	0.59
110.0	0.51	0.02	0.00
110.0	-6.94	0.22	0.04
120.0	-117.13	1.66	1.63
120.0	101.73	1.44	1.40
110.0	-29.22	0.93	1.36
110.0	0.19	0.01	0.00
100.0	0.05	0.03	0.00
100.0	-0.06	0.03	0.00
120.0	-140.48	1.99	1.10
110.0	-19.77	0.63	0.84
120.0	121.19	1.71	0.84
120.0	147.19	2.08	1.32
120.0	146.95	2.08	2.15
110.0	0.11	0.00	0.00
110.0	0.34	0.01	0.00
110.0	0.85	0.03	0.00
110.0	0.23	0.01	0.00

FlexTable: Pipe Table

Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss (m)
110.0	1.35	0.04	0.00
120.0	14.23	0.20	0.02
120.0	14.23	0.20	0.06
110.0	22.98	0.73	0.84
110.0	22.47	0.72	0.24
120.0	130.31	1.84	2.08
120.0	-141.22	2.00	2.51
120.0	-148.32	2.10	2.23
130.0	148.32	0.52	0.02
110.0	2.31	0.07	0.01
110.0	2.31	0.07	0.01
120.0	-16.22	0.23	0.02
120.0	-16.22	0.23	0.00
120.0	20.19	0.29	0.03
120.0	130.31	1.84	4.68
120.0	-139.46	1.97	1.81
120.0	-139.46	1.97	5.12

FlexTable: Junction Table

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
285	NSH-49	314.03	10.66	328.16	138.2
259	NSH-39	313.15	0.00	331.08	175.4
256	NSH-38	302.85	0.40	324.96	216.4
150	SHB-12	307.17	0.95	333.00	252.8
254	NSH-37	297.34	0.72	323.90	259.9
251	NSH-36	295.08	0.17	322.50	268.3
249	NSH-35	294.08	0.13	322.50	278.2
273	NSH-45	283.69	2.66	313.68	293.5
247	NSH-34	291.88	1.24	322.50	299.7
208	NSH-19	280.89	0.00	313.69	321.0
125	SHB-1	299.45	0.86	332.94	327.8
126	SHB-2	298.90	0.18	332.93	333.1
206	NSH-18	279.12	0.76	313.69	338.4
69	SHD-1	261.49	0.77	297.95	356.8
204	NSH-17	276.85	0.64	313.69	360.6
105	SHD-13	261.30	0.00	298.70	366.0
128	SHB-3	295.45	0.43	332.93	366.8
276	NSH-46	275.29	0.00	313.72	376.1
223	NSH-25	274.94	0.63	313.72	379.5
67	SHD-2	259.60	0.41	298.89	384.5
211	NSH-20	273.89	1.02	313.71	389.7
130	SHB-4	292.76	0.70	332.92	393.1
240	NSH-32	268.71	12.69	309.16	395.9
228	NSH-27	269.84	0.29	310.59	398.8
261	NSH-40	271.56	0.19	312.54	401.1
226	NSH-26	272.64	9.75	313.75	402.3
279	NSH-47	267.84	0.76	309.31	405.8
102	SHD-12	258.25	0.00	299.99	408.5
238	NSH-31	267.32	0.28	309.12	409.1
78	SHD-5	258.25	1.16	300.35	412.0
71	SHD-3	258.20	0.55	300.43	413.3
264	NSH-41	270.01	0.17	312.54	416.3
96	SHD-10	257.60	0.00	300.17	416.6
93	SHD-11	257.90	0.00	300.55	417.4
84	SHD-6	257.58	0.43	300.35	418.6
162	SHB-13	280.60	0.00	323.38	418.7
235	NSH-30	267.13	9.21	309.97	419.3
80	SHD-4	257.51	1.02	300.45	420.2
86	SHD-7	257.13	0.27	300.34	422.9
75	SHD-8	257.65	0.86	300.88	423.1
216	NSH-22	270.30	0.68	313.71	424.9
134	SHB-6	289.05	0.70	332.91	429.2
220	NSH-24	269.57	0.00	313.71	432.0
213	NSH-21	269.39	2.08	313.71	433.8
218	NSH-23	269.36	0.17	313.71	434.1
243	NSH-33	263.59	0.96	308.05	435.1
109	SHD-14	258.01	0.00	302.72	437.6
230	NSH-28	264.45	0.59	309.97	445.5
132	SHB-5	287.00	0.61	332.91	449.3

FlexTable: Junction Table

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
232	NSH-29	264.00	0.17	309.97	449.9
201	ASH-16	272.84	0.18	320.35	465.0
73	SHD-9	253.65	0.92	302.31	476.2
199	ASH-15	271.62	0.70	320.36	477.0
197	ASH-14	270.02	3.09	320.36	492.7
270	ASH-44	269.13	1.72	320.36	501.4
195	ASH-13	268.99	0.63	320.37	502.9
282	NSH-48	252.91	0.00	304.36	503.5
138	SHB-8	281.36	0.70	332.89	504.3
136	SHB-7	281.17	0.79	332.90	506.2
177	ASH-6	268.55	1.22	320.38	507.3
188	ASH-10	268.54	3.95	320.38	507.3
190	ASH-11	268.32	0.36	320.36	509.4
192	ASH-12	268.19	0.27	320.35	510.5
179	ASH-7	268.14	1.47	320.38	511.3
182	ASH-8	267.60	0.56	320.39	516.6
184	ASH-9	267.57	2.28	320.40	517.0
144	SHB-11	269.50	0.00	322.62	519.9
170	ASH-3	267.23	2.14	320.39	520.2
168	ASH-2	267.07	4.31	320.41	522.0
268	ASH-43	267.03	0.95	320.38	522.1
174	ASH-5	264.88	0.27	320.37	543.1
172	ASH-4	264.55	0.61	320.38	546.4
140	SHB-9	276.09	1.04	332.89	555.9
166	ASH-1	261.86	0.00	320.57	574.6
142	SHB-10	269.12	0.61	332.89	624.1

FlexTable: Pipe Table

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
P-15	65.24	SHDR-1	SHD-2	200.0	PVC
P-17	65.29	SHD-2	SHD-3	200.0	PVC
P-18	85.72	SHD-3	SHD-9	200.0	PVC
P-22	63.55	SHD-8	SHD-4	200.0	PVC
P-23	128.63	SHD-4	SHD-3	200.0	PVC
P-25	47.20	SHD-5	SHD-6	200.0	PVC
P-26	47.99	SHD-6	SHD-7	50.0	Copper
P-27	41.94	SHD-7	SHD-6	50.0	Copper
P-28	16.38	SHDR-2	SHD-1	200.0	PVC
P-29	61.95	SHD-8	SHD-11	200.0	PVC
P-30	37.29	SHD-11	SHD-5	200.0	PVC
P-32	53.47	SHD-10	SHD-4	200.0	PVC
P-33	76.50	SHD-5	SHD-12	200.0	PVC
P-34	33.34	SHD-12	SHD-10	200.0	PVC
P-35	87.58	SHD-2	SHD-13	200.0	PVC
P-36	25.40	SHD-13	SHD-1	200.0	PVC
P-37	72.78	SHD-12	SHD-13	200.0	PVC
P-38	154.67	SHD-9	SHD-14	300.0	PVC
P-39	82.15	SHD-14	SHD-8	200.0	PVC
P-42	64.24	SHB-1	SHB-2	150.0	PVC
P-43	60.86	SHB-2	SHB-3	150.0	PVC
P-44	87.29	SHB-3	SHB-4	150.0	PVC
P-45	87.63	SHB-4	SHB-5	200.0	PVC
P-46	109.24	SHB-5	SHB-6	200.0	PVC
P-47	93.67	SHB-5	SHB-7	200.0	PVC
P-48	125.62	SHB-7	SHB-8	150.0	PVC
P-49	179.50	SHB-8	SHB-9	150.0	PVC
P-50	190.52	SHB-9	SHB-10	200.0	PVC
P-52	81.10	SHB-9	SHB-7	200.0	PVC
P-53	103.66	SHB-1	SHB-4	200.0	PVC
P-54	138.85	SHB-1	SHB-12	200.0	PVC
P-55(1)	17.87	SHB-12	PRV-1	200.0	PVC
P-55(2)	20.83	PRV-1	R-9	200.0	PVC
P-51(1)	31.94	SHB-10	PRV-2	200.0	PVC
P-51(2)	18.61	PRV-2	SHB-11	200.0	PVC
P-41(2)(1)(1)	161.01	SHB-11	SHB-13	200.0	PVC
P-41(2)(1)(2)	419.84	SHB-13	R-9	150.0	PVC
P-56	432.12	SHB-11	ASH-1	200.0	PVC
P-57	290.02	ASH-1	ASH-2	300.0	PVC
P-58	90.80	ASH-2	ASH-3	200.0	PVC
P-59	161.27	ASH-3	ASH-4	200.0	PVC
P-60	35.42	ASH-4	ASH-5	50.0	PVC
P-61	35.69	ASH-5	ASH-4	50.0	PVC
P-62	191.63	ASH-3	ASH-6	200.0	PVC
P-63	77.52	ASH-6	ASH-7	200.0	PVC
P-64	126.30	ASH-7	ASH-3	200.0	PVC
P-65	92.10	ASH-7	ASH-8	200.0	PVC
P-66	62.23	ASH-8	ASH-9	300.0	PVC
P-67	256.68	ASH-9	ASH-2	200.0	PVC

FlexTable: Pipe Table

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
P-68	75.24	ASH-2	ASH-9	300.0	PVC
P-69	77.14	ASH-8	ASH-10	300.0	PVC
P-71	38.60	ASH-11	ASH-12	50.0	PVC
P-72	30.24	ASH-12	ASH-11	50.0	PVC
P-74	89.14	ASH-13	ASH-14	200.0	PVC
P-75	73.75	ASH-14	ASH-15	200.0	PVC
P-76	39.78	ASH-15	ASH-16	50.0	PVC
P-77	34.63	ASH-16	ASH-15	50.0	PVC
P-79	88.98	NSH-17	NSH-18	200.0	PVC
P-80	26.04	NSH-18	NSH-19	50.0	PVC
P-81	41.98	NSH-19	NSH-18	50.0	PVC
P-82	106.05	NSH-17	NSH-20	200.0	PVC
P-83	121.54	NSH-20	NSH-21	300.0	PVC
P-85	140.98	NSH-21	NSH-22	200.0	PVC
P-86	58.66	NSH-22	NSH-23	200.0	PVC
P-87	38.89	NSH-23	NSH-24	50.0	PVC
P-88	30.71	NSH-24	NSH-23	50.0	PVC
P-89	184.60	NSH-22	NSH-25	200.0	PVC
P-90	130.80	NSH-25	NSH-20	300.0	PVC
P-94	33.55	NSH-28	NSH-29	50.0	PVC
P-95	39.75	NSH-29	NSH-28	50.0	PVC
P-93(1)	89.11	NSH-27	NSH-30	200.0	PVC
P-93(2)	214.13	NSH-30	NSH-28	200.0	PVC
P-97	90.13	NSH-31	NSH-32	200.0	PVC
P-98	163.52	NSH-32	NSH-27	300.0	PVC
P-99	182.26	NSH-32	NSH-33	300.0	PVC
P-100	210.66	NSH-33	NSH-31	200.0	PVC
P-103	86.27	NSH-34	NSH-35	200.0	PVC
P-104	39.72	NSH-35	NSH-36	50.0	PVC
P-105	27.00	NSH-36	NSH-35	50.0	PVC
P-106	78.53	NSH-34	NSH-37	300.0	PVC
P-107	267.07	NSH-37	NSH-38	200.0	PVC
P-108	78.71	NSH-38	NSH-37	300.0	PVC
P-92(1)	86.55	NSH-26	NSH-40	300.0	PVC
P-92(2)	141.71	NSH-40	NSH-27	300.0	PVC
P-110	127.87	NSH-40	NSH-41	200.0	PVC
P-111	65.80	ASH-6	ASH-43	200.0	PVC
P-70(1)	189.33	ASH-10	ASH-44	200.0	PVC
P-70(2)	47.58	ASH-44	ASH-11	200.0	PVC
P-78(2)	130.62	NSH-45	NSH-17	200.0	PVC
P-91(1)	76.82	NSH-25	NSH-46	300.0	PVC
P-91(2)	286.71	NSH-46	NSH-26	300.0	PVC
P-96(1)	203.91	NSH-30	NSH-47	200.0	PVC
P-96(2)	59.88	NSH-47	NSH-31	200.0	PVC
P-101(2)	170.77	NSH-48	SHD-14	300.0	PVC
P-109(1)	177.52	NSH-38	NSH-49	300.0	PVC
P-109(2)	144.16	NSH-49	NSH-39	300.0	PVC
P-112	40.37	Newmarket West Reservoir	NSH-39	600.0	Concrete

FlexTable: Pipe Table

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material
P-78(1)(1)	85.14	ASH-14	PRV-3	200.0	PVC
P-78(1)(2)	250.82	PRV-3	NSH-45	200.0	PVC
P-84(1)	62.10	NSH-21	PRV-5	300.0	PVC
P-84(2)	8.26	PRV-5	ASH-13	300.0	PVC
P-113	77.17	ASH-10	ASH-13	300.0	PVC
P-114	384.76	NSH-33	NSH-48	300.0	PVC
P-102(1)	131.13	NSH-26	PRV-7	300.0	PVC
P-102(2)	371.01	PRV-7	NSH-34	300.0	PVC

Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss (m)
110.0	-42.36	1.35	0.84
110.0	-58.89	1.87	1.55
110.0	-56.43	1.80	1.87
110.0	30.03	0.96	0.43
110.0	3.01	0.10	0.01
110.0	0.70	0.02	0.00
100.0	0.13	0.07	0.01
100.0	-0.14	0.07	0.01
110.0	-65.80	2.09	0.48
110.0	26.32	0.84	0.33
110.0	26.32	0.84	0.20
110.0	-26.00	0.83	0.28
110.0	24.46	0.78	0.36
110.0	-26.00	0.83	0.17
110.0	16.12	0.51	0.19
110.0	66.57	2.12	0.75
110.0	50.46	1.61	1.29
120.0	-57.35	0.81	0.41
110.0	57.20	1.82	1.84
100.0	1.51	0.09	0.01
100.0	1.33	0.08	0.01
100.0	0.90	0.05	0.00
110.0	4.45	0.14	0.02
110.0	0.70	0.02	0.00
110.0	3.14	0.10	0.01
100.0	0.60	0.03	0.00
100.0	-0.10	0.01	0.00
110.0	0.61	0.02	0.00
110.0	-1.75	0.06	0.00
110.0	4.25	0.14	0.02
110.0	-6.62	0.21	0.06
110.0	-7.57	0.24	0.01
110.0	-7.57	0.24	0.01
110.0	0.00	0.00	0.00
110.0	0.00	0.00	0.00
110.0	-24.71	0.79	0.76
100.0	-24.71	1.40	9.64
110.0	24.71	0.79	2.05
120.0	24.71	0.35	0.16

FlexTable: Pipe Table

Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss (m)
110.0	5.20	0.17	0.02
110.0	0.88	0.03	0.00
100.0	0.14	0.07	0.01
100.0	-0.13	0.07	0.01
110.0	1.11	0.04	0.00
110.0	-1.06	0.03	0.00
110.0	-1.07	0.03	0.00
110.0	-1.46	0.05	0.00
120.0	-12.92	0.18	0.01
110.0	-2.13	0.07	0.01
120.0	13.07	0.18	0.01
120.0	10.90	0.15	0.01
100.0	0.13	0.06	0.01
100.0	-0.14	0.07	0.01
110.0	3.97	0.13	0.01
110.0	0.88	0.03	0.00
100.0	0.09	0.04	0.01
100.0	-0.09	0.05	0.01
110.0	0.76	0.02	0.00
100.0	0.00	0.00	0.00
100.0	0.00	0.00	0.00
110.0	-4.06	0.13	0.02
120.0	1.35	0.02	0.00
110.0	-0.73	0.02	0.00
110.0	0.17	0.01	0.00
100.0	0.00	0.00	0.00
100.0	0.00	0.00	0.00
110.0	-1.58	0.05	0.01
120.0	6.43	0.09	0.01
100.0	0.09	0.05	0.00
100.0	-0.08	0.04	0.00
110.0	30.23	0.96	0.61
110.0	0.76	0.02	0.00
110.0	-6.52	0.21	0.04
120.0	-108.99	1.54	1.43
120.0	89.78	1.27	1.11
110.0	-25.74	0.82	1.08
110.0	0.30	0.01	0.00
100.0	0.08	0.04	0.00
100.0	-0.09	0.05	0.00
120.0	-159.80	2.26	1.39
110.0	-22.51	0.72	1.07
120.0	138.00	1.95	1.07
120.0	139.87	1.98	1.20
120.0	139.51	1.97	1.96
110.0	0.17	0.01	0.00
110.0	0.95	0.03	0.00
110.0	2.35	0.07	0.01
110.0	0.63	0.02	0.00

FlexTable: Pipe Table

Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss (m)
110.0	-2.66	0.08	0.01
120.0	-8.64	0.12	0.01
120.0	-8.64	0.12	0.02
110.0	20.26	0.64	0.67
110.0	19.50	0.62	0.18
120.0	114.56	1.62	1.64
120.0	-160.92	2.28	3.19
120.0	-171.58	2.43	2.92
130.0	171.58	0.61	0.02
110.0	0.00	0.00	0.00
110.0	0.00	0.00	0.00
120.0	0.00	0.00	0.00
120.0	0.00	0.00	0.00
120.0	4.60	0.07	0.00
120.0	114.56	1.62	3.69
120.0	-158.26	2.24	2.29
120.0	-158.26	2.24	6.47

Appendix D

DRAWINGS
REFER TO SUBMISSON PACKAGE